BOOK OF ABSTRACTS

10th International Congress of Food Technologists, Biotechnologists and Nutritionists

Smart Food for a Healthy Planet and Human Prosperity

Published by:

Croatian Society of Food Technologists, Biotechnologists and Nutritionists, Zagreb, Croatia

ISSN 2975-4313

The official language of the Congress is English.

The information provided in the Book of Abstracts is based on abstracts submitted by Congress participants. The accuracy, spelling and presentation of the submitted abstract are the sole responsibility of the authors. Statements and opinions given in the Book of Abstracts are those of the contributors.

Organized by:

CROFoST - Croatian Society of Food Technologists, Biotechnologists and Nutritionists, Zagreb, Croatia

Co-organized by:

PBF - University of Zagreb, Faculty of Food Technology and Biotechnology, Zagreb, Croatia

EHEDG - European Hygienic Engineering & Design Group

EFFoST - The European Federation of Food Science and Technology

CONGRESS COMMITTEES

Organizing Committee

President of the Congress and Organizing Committee Chair
Sanja Vidaček Filipec

Bojana Voučko – Congress Secretary
Mario Ščetar – President CROFoST
Sandra Balbino
Irena Budić-Leto
Verica Dragović-Uzelac
Saša Drakula
Jadranka Frece
Jasenka Gajdoš Kljusurić
Mirjana Hruškar
Tibor Janči
Monika Kovačević
Ana Kovačić
Marina Krpan
Andreja Leboš Pavunc
Nives Marušić Radovčić
Helga Medić
Marko Obranović
Kristina Radoš
Maja Repajić
Anet Režek Jambrak
Ivana Rumora Samarin

Scientific Programme Committee

President of the Scientific Programme Committee and Scientific Committee Chair:
Draženka Komes (CRO)

Lidija Barišić (CRO)
Irena Barukčić (CRO)
Danijela Bursać Kovačević (CRO)
Mirjana Čurlin (CRO)
Frederic Debeaufort (FR)
Ksenija Durgo (CRO)
Jelena Đugum (CRO)
Stela Jokić (CRO)
Agnieszka Kita (PL)
Blaženka Kos (CRO)
Karin Kovačević Ganić (CRO)
Mia Kurek (CRO)
Ksenija Marković (CRO)
Song Miao (IR)
Jasna Novak (CRO)
Dubravka Novotni (CRO)
Ines Panjkota Krbavčić (CRO)
Rada Pjanović (SRB)
Jelka Pleadin (CRO)
Nataša Poklar Ulrih (SI)
Ivana Radojčić Redovniković (CRO)
Tonči Rezić (CRO)
Danijela Šeremet (CRO)
Drago Šubarić (CRO)
Aleksandra Vojvodić Cebin (CRO)
Tomislava Vukušić Pavičić (CRO)
Darija Vranešić Bender (CRO)

Honorary Committee

Mara Banović
Irena Colić Barić
Duška Ćurić
Kata Galić
Branka Levaj
Vladimir Mrša
Jagoda Šušković
Nada Vahčić

Organized under the auspices of:

Ministry of Science and Education

REPUBLIC OF CROATIA
Ministry of Science and Education

Ministry of Agriculture

MINISTRY OF AGRICULTURE

University of Zagreb

Croatian Academy of Engineering

Croatian Chamber of Economy

H G K
1 8 5 2
CROATIAN
CHAMBER OF
ECONOMY

City of Zagreb

10th International CONGRESS of Food Technologists, Biotechnologists and Nutritionists

Innovation

Nutrition, Health and Consumer Safety

Sustainability

Industry 4.0

PROGRAM

Smart Food for a **Healthy Planet** and **Human Prosperity**

Wednesday, **November 30th 2022** – Friday, **December 2nd 2022**

Hotel Academia
Ivana Tkalčića 88
Zagreb, Croatia

Pre-conference day: Tuesday, 29th November

19:00	Welcome drink

Day 1: Wednesday, 30th November — Main Hall

08:30-09:15	**Registration**	
09:15-10:30	**Opening cermony**	
10:30-11:00	**Plenary Lecture: Branka Levaj**	**Past, Present and Future Challenges for the Food Industry: Fruit and Vegetable Products**
11:00-11:30	**Coffee and posters (Innovation)**	
11:30-13:30	**Oral Presentations-Innovation** **Chairpersons: Stela Jokić and Verica Dragović-Uzelac**	
11:30-11:50	Invited Speaker **F. Erdoğdu**	**Future of Food Engineering and Emerging Computational Processing – Manufacturing**
11:50-12:10	Invited Speaker **S. Miao**	**Designing micro-gel structure for the delivery of functionality of food**
12:10-12:25	Ž. Kurtanjek	AI causal analysis of food quality
12:25-12:40	M. Kurek, A. Onopiuk and A. Szpicer	Encapsulation of anthocyanins from chokeberry (Aronia melanocarpa) with different types of plazmolyzed yeast cells
12:40-12:55	M. Asaduzzaman and R. Gebhardt	Modulating the swelling behavior of casein microparticles (CMPs) for delivering bioactive compounds
12:55-13:10	M. Dujmović, N. Opačić, S. Radman, S. Fabek Uher, M. Petek, L. Čoga, A. Galić, N. Dobričević, N. Toth, B. Benko, S. Voća and J. Šic Žlabur	Nutrient solution management –innovative agricultural practice for higher nutrient quality of stinging nettle
13:10-13:25	I. Rodrigues, G. Botelho and F. Gomes	Case study: Innovation with strawberry tree fruits (Arbutus unedoL.) for agri-food industry
13:30-14:30	**Lunch and posters (Innovation)**	
14:30-16:20	**Oral Presentations - Sustainability and Industry 4.0** **Chairpersons: Song Miao and Agnieszka Kita**	
14:30-14:50	Invited Speaker **F. Debeaufort**	**Recovery/valorization of agri-food waste and by-products for sustainable food packagingmaterials: the future or a utopia?**
14:50-15:10	Invited Speaker **N. Bolf**	**Process analytical technology for continuous process monitoring and control in chemical, biochemical and food industry**
15:10-15:25	J. Lisičar Vukušić, T. Millenautzki, L. Reichert, A. Mokhlis Saaid, L. Müller, L. Clavijo, J. Hof, M. Mösche and S. Barbe	Turning winery waste into valuable substrate for baker´s yeast production: A circular economy approach
15:25-15:40	I. G. Osojnik Črnivec, M. Skrt, D. Šeremet, D. Komes and N. Poklar Ulrih	Extraction and stabilisation of quercetin from yellow onion skin
15:40-15:55	M. Prelac, N. Major, M. Repajić, D. Anđelini, D. Cvitan, Z. Užila, S. Goreta Ban, T. K. Kovačević, D. Ban and I. Palčić	A study on ultrasound and microwave assisted water-based extraction of polyphenolic compounds from olive leaves
15:55-16:05	L. Klasić-Stanković, sponsored lecture by HIPP	
16:05-16:50	**Afternoon snack and posters (Sustainability and Industry 4.0)**	

Day 1: Wednesday, 30th November — Hall II

14:30-16:40	**Erasmus + project - European Qualifications & Competences for the Vegan Food Industry (EQVEGAN)**	EQVEGAN puratos Food Innovation for Good
14:30-14:35	Jasenka Gajdoš Kljusurić	Opening
14:35-15:00	Rui Costa (project leader, Secretary General ISEKI)	Vegan food processing – educational needs and project outline
15:00-15:10	Zbigniew Krejpcio	Plant based processing
15:10-15:20	Anet Režek Jambrak	Green skills
15:20-15:30	Susana Gonçalves	Soft skills
15:30-15:40	Jarmo Alarinta Heikki	Digitalization & Automation
15:40-16:00	Luis Mayor	Food skills portal
16:00-16:30	Jasenka Gajdoš Kljusurić	Discussion / closing
16:30-16:40	T. Willems, sponsored lecture by Puratos Konding	

SOCIAL PROGRAM

Barentz. Always a better solution.

18:00-19:30	Advent city tour
20:00	Student party

POSTERS: Day 1: Wednesday, 30th November
INNOVATION

A. Bebek Markovinović, P. Bičanić, P. Putnik, B. Duralija and D. Bursać Kovačević	Effect of high-power ultrasound (HPU) on stability of bioactive compounds in strawberry juices
A. Bebek Markovinović, F. Valjak, A. Žigolić, P. Putnik and D. Bursać Kovačević	Application of additive technology in a production of functional strawberry-based product
V. Milanović, F. Cardinali, A. Boban, J. Gajdoš Kljusurić, A. Mucalo, A. Osimani, L. Aquilanti, C. Garofalo and I. Budić-Leto	Oenological characterization of non-Saccharomyces yeasts isolated from Croatian white grape variety Maraština
M. Dent, T. Vujović, A. Miljanović, I. Jerković, Z. Marijanović, D. Grbin and T. Rezić	The impact of enzymatic and ultrasonic pretreatment on the yield and volatile profil of bay laurel and sage essential oil
M. Dent and K. Blažević	The influence of ultrasonic pretreatment prior hydrodistillation of basil on the yield of essential oil
M. Kurek, P. Poldan, M. Ščetar, E. Descours, D. Gabrić and K. Galić	Development and characterization of biobased films from chitosan and gelatine with gallic acid applied as pouches for olive oil storage
M. Ščetar, I. Lenard, M. Kurek, D. Molnar and K. Galić	Characterisation of chitosan films with Vitamin C
A. Pitois, A. Julou, M. Kurek, N. Viallet, E. Descours	Characterization of oil stored in novel bio-based films
K. Galić, M. Kurek and M. Ščetar	Open courseware on responsible food packaging -FitNESS 2.0 project
M. Repajić, I. Elez Garofulić, P. Pufek, E. Cegledi, B. Levaj and V. Dragović-Uzelac	Application of pressurized liquid extraction for the isolation of phenols from sea buckthorn leaves
A. Mandura Jarić, L. Miletić, S. Kuzmić, A. Sander, D. Šeremet, A. Vojvodić Cebin and D. Komes	Electrospun nanofibers as an emerging delivery system for phenylethanoid glycosides: preparation and in vitro evaluation
E. Cegledi, M. Repajić, N. Marčac, I. Elez Garofulić, K. Cegledi, E. Dobroslavić and V. Dragović-Uzelac	Influence of temperature and carrier ratio on fennel essential oil powder obtained by spray drying
S. Šafranko, Š. Mandić and S. Jokić	The preparation of N-doped carbon quantum dots from citric acid and Citrus clementina peel –The application in iron(III) detection in herbs and spices
B. Voučko, N. Čukelj, K. Radoš, T. Vukušić Pavičić, V. Stulić, F. Dujmić, D. Ćurić and D. Novotni	Influence of thermal and non-thermal pre-treatment of dough on the quality of 3D printed gluten free cereal snacks
K. Tušek and M. Benković	Effect of mixture composition on physical properties of honey based cocoa powder
K. Radoš, M. Benković, N. Čukelj Mustač, B. Voučko, M. Tujmer, D. Ćurić and D. Novotni	Potential of Psyllium as an ingredient in 3D-printed gluten-free snacks evaluated by rheology, NIR and physical properties
D. Cvitković, S. Balbino, J. Mrvčić and V. Dragović-Uzelac	Electrostatic extrusion for co-encapsulation of hydrophilic and lipophilic myrtle extracts (Myrtus communis L.)
B. Balanč, J. Halagic, J. Skrobonja, A. Milivojevic, D. Šeremet, D. Komes and R. Pjanovic	Encapsulation of Ground Ivy (Glechoma hederacea L.) extract, obtained by natural deep eutectic solvents extraction, in liposomes
Z. Pelaić, Z. Čošić, M. Repajić, F. Dujmić and B. Levaj	The effect of UV-C irradiation and high hydrostatic pressure on the quality of fresh-cut potatoes
M. Obranović, C. Louis- Gavet, J. Bryś, R. Brzezińska, A. Górska, E. Ostrowska-Ligęza, M. Wirkowska-Wojdyła, A. Bryś	Properties of interesterified mixtures of hemp and coconut oil
M. Obranović, C. Louis- Gavet, A. Górska, D. Mańko-Jurkowska, R. Brzezińska, J. Bryś	The use of regiospecific lipase to obtain structured lipids from mixtures of coconut oil and hemp

POSTERS: Day 1: Wednesday, 30th November
SUSTAINABILITY AND INDUSTRY 4.0

M. Panić, A. Damjanović, M. Bagović, M. Radović, M. Cvjetko Bubalo, K. Radošević and I. Radojčić Redovniković	Application of natural deep eutectic solvents for food waste valorisation
E. Dobroslavić, I. Elez Garofulić, Z. Zorić, A. Dobrinčić and V. Dragović-Uzelac	Polyphenolic profile of bay leaves (Laurus nobilis L.) collected in two coastal regions of Croatia
M. Tranfić Bakić, Sandra Pedisić, Z. Zorić, V. Dragović-Uzelac and A. Ninčević Grassino	Influence of experimental conditions on the yield of phenols and flavonoids obtained from tomato peel waste by microwave-assisted extraction
A. Ninčević Grassino and S. Djaković	Fourier transform infrared spectroscopy for characterization of pectin biofilms enriched with mandarin peel extracts
I. Sabljak, D. Vlahović, A. Režek Jambrak and A. Samardžija	The use of nonthermal techniques for the extraction of fibers and bioactive compounds from red beetroot peel
J. Lisičar Vukušić, R. Engstler, S. Johann Bohr and S. Barbe	Intelligent water treatment technologies for water preservation: case study presentation
K. Ambrozić, V. Velikanović, D. Grgas, T. Štefanac and T. Landeka Dragičević	Efficiency of waste water treatment of Slavonski Brod agglomeration
D. Grgas, M. Ugrina, A. Brozinčević, A. Špehar Ćosić, T. Štefanac, K. Ambrozić and T. Landeka Dragičević	Denitrification of synthetic wastewater containing high nitrate concentration
J. Dukić, M. Margarida Cortês Vieira, M. Dulce Antunes, M. Halil Öztop, N. Grgić, I. Marinčić, A. Režek Jambrak	Effect of ultrasound processing on physicochemical parameters of tomato-based products: addition of RuBisCO and olive powder
J. Dukić, M. M. Cortês Vieira, M. Dulce Antunes, M. Halil Öztop, N. Grgić, I. Marinčić, A. Režek Jambrak	Effect of ultrasound processing on microbiological safety of designed tomato-based product
T. Javornik, B. Lazarević and K. Carović-Stanko	Screening bean genotypes for drought resistance using high-throughput phenotyping
V. Biondić Fučkar, A. Grudenić, A. Božić, I. Djekić and A. Režek Jambrak	Health safety and nutritional value of coffee silverskin with impact of emerging techniques in the processing
M. Čagalj and V. Šimat	Effect of seasonal growth and extraction method on antioxidant activity of Colpomenia sinuosa extracts
D. Skroza, I. Generalić Mekinić, Ž. Skračić, A. Tadić, A. Nadilo, M. Čagalj and V. Šimat	Phenolic profile and biological potential of vinification byproducts
D. Skroza, M. Čagalj, I. Krivić, R. Frleta and V. Šimat	Antimicrobial activity of by-product extracts in combination with pure compounds
A. Dobrinčić, E. Dobroslavić, I. Piasecka, E. Cegledi, Z. Zorić, S. Pedisić and V. Dragović Uzelac	Polyphenol profiles and antioxidant capacity of different berry fruit pomace and seeds
A. M. Gotal Skoko, T. Kovač, G. Fruk, A. Jozinović, D. Šubarić, K. Aladić, J. Babić and A. Lončarić	Polyphenol oxidase from Croatian traditional apple varieties and its role in anthocyanins degradation during storage
N.Ž. Šekuljica, J. R. Mijalković, N. Pavlović, S.M. Jakovetić Tanasković, I.V. Gazikalović, N.D. Luković and Z.D. Knežević-Jugović	Solid state cultivation of Penicillium sp. To produce xylanase for the extraction of xylooligosaccharides from soybean huls
B. Voučko, N. Čukelj Mustač, C. Pereira, Lj. Nanjara, T. Grgić, D. Ćurić and D. Novotni	Fermentation performance of carob flour, proso millet and bran for gluten-free flat bread production
P. Lenoble, J. Rousseau, F. Debeaufort and N. Benbettaieb	Processing of biodegradable PHBV and chitosan films as a multilayer structure for food packaging applications

Day 2: Thursday, 1st December — Main Hall

8:30-9:00	Registration	
9:00-10:10	**Oral Presentations - Sustainability and Industry 4.0** Chairpersons: Rada Pjanović and Danijela Bursać Kovačević	
9:00-9:20	Invited Speaker **N. Štefanić**	**Development of Smart food Factory**
9:20-9:40	Invited Speaker **J. Ranilović**	**Closing the loop and decreasing vegetable by-products in food industry production**
9:40-9:55	D. Dite Hunjek and B. Levaj	Production processes and parameters affecting the oil content in potato chips
9:55-10:10	Ž. Kurtanjek	Artificial intelligence and causal analysis in food technology
10:10-10:40	**Coffee and posters (Sustainability + Industry 4.0)**	
10:40-12:00	**Oral Presentations- Safety** Chairpersons: Jelka Pleadin and Ksenija Marković	
10:40-11:00	Invited Speaker **G. Wirtanen**	**Controlling bacterial spoilage in both vegan and meat based products**
11:00-11:20	Invited Speaker **T. Bogdanović**	**Nano/Micro-plastics as emerging food contaminants: A challenge for food safety**
11:20-11:35	L. Munyendo, D. Njoroge, Y. Zhang and B. Hitzmann	Coffee fraud detection using near infrared spectroscopy combined with artificial neural network
11:35-11:50	M. N. Tosun, G. T. Yalçın, G. Korkmazer, M. Zorba, C. Caner, N. N. Zorba	The effect of washing with antimicrobial solutions on C. difficile Enterobacterales and TAMB load in spinach.
11:50-12:00	I. Martić, sponsored lecture by TIM ZIP	
12:00-13:05	**Oral Presentations - Nutrition, health and consumer** Chairpersons: Ivana Rumora Samarin and Anet Režek Jambrak	
12:00-12:20	Invited speaker **Rui Costa**	**Ethical issues in food chain**
12:20-12:35	N. Major, J. Perković, I. Palčić, I. Bažon, I. Horvat, D. Ban and S. Goreta Ban	The phytochemical diversity of shallots in Croatia
12:35-12:50	A. Bolha, J. Bertoncelj, S. Filip, N. Vahčić and M. Korošec	Quantitative descriptive analysis of reduced fat butter biscuits by trained panels from Ljubljana and Zagreb: a comparison of panel data and feasibility study
12:50-13:05	G. Botelho, M. Lima, I. Rodrigues, J. Lameiras and R. Costa	An outlook about alternatives to meat and dairy products in food industry
13:05-14:00	**Lunch and posters (Safety)**	
14:00-15:10	**Oral Presentations - Nutrition, health and consumer**	
14:00-14:15	V. Gunjević, D. Zurak, M. Košević, Z. Kralik, D. Grbeša and K. Kljak	Distribution of carotenoids in endosperm lipid fractions of maize kernel
14:15-14:30	D. Zurak, V. Gunjević, D. Bedeković, M. Duvnjak, D. Grbeša, Z. Janječić, G. Kiš, V. Pirgozliev and K. Kljak	Carotenoid content in egg yolk increases with the amount of digestible carotenoids in hen diets differentiated in maize hybrid
14:30-14:45	D. Al Yassine, N. El Massri, G. Demircan, G. Bulut, D. Akin and Z. Tacer-Caba	From traditional culinary plants to potential cytotoxic agents against the brain cancer: Melocan (Smilax excelsa L.) and Galdirik (Trachystemon Orientalis)
14:45-15:00	N. Marušić Radovčić, I. Poljanec, K. Majcen, S. Petričević and H. Medić	Influence of processing time on physicochemical parameters, sensory properties, and volatile compounds of smoked dry-cured ham "Dalmatinski pršut"
15:00-15:10	I. Jerman, sponsored lecture by ACO	
15:10-16:00	**Afternoon snack and posters (Nutrition-Part 1)**	

Day 2: Thursday, 1st December — Hall II

14:30-17:10	**Satellite symposium Biotechnology in Croatia „Vera Johanides"**	ENNA FRUIT
14:30-14:50	Opening ceremony: Prof. Vladimir Mrša, Secretary-General of the Academy; Prof. Vesna Zechner Krpan, President of the Croatian Society of Biotechnology; Prof. Emer. Zlatko Kniewald, Co-Founder and Past-President of the Croatian Academy of Engineering and Croatian Society of Biotechnology: "My memories and facts – Prof. emer. Vera Johanides"	
14:50-15:10	Invited speaker **B. Šantek**	**Biotechnology in Croatia**
15:10-15:30	Invited speaker **Ž. Kurtanjek**	**Mathematical modelling at Faculty of Food Technology and Biotechnology: From regression to artificial intelligence**
15:30-15:50	Invited speaker **A. Vrdoljak**	**Expert Vaccines Development Scientist: Modern vaccines: State of the art and future trends**
15:50-16:10	Invited speaker **N. Velić**	**How biotechnology met circular economy at the Faculty of Food Technology in Osijek**
16:10-16:25	N. Čuljak, B. Bellich, P. Cescutti, K. Butorac, J. Novak, M. Banić, A. Leboš Pavunc, J. Šušković and B. Kos	Structural and functional characterization of exopolysaccharides produced by Limosilactobacillus fermentum MC1 isolated from mother's milk
16:25-16:40	N. Šupljika, A. Novačić and I. Stuparević	Involvement of the RNA exosome in the maintenance of cell wall stability in the yeast Saccharomyces cerevisiae
16:40-16:55	A. Jurinjak Tušek, A. Šalić, D. Valinger and B. Zelić	Versatile microfluidic systems applications: From biotransformation to extraction
16:55-17:10	M. Logarušić, T. Ursić, I. Slivac and V. Gaurina Srček	Plant-derived protein hydrolysates and its use in animal cell technology

SOCIAL PROGRAM

PODRAVKA

20:00	Congress dinner sponsored by Podravka

POSTERS: Day 2: Thursday, 1st December
SAFETY

C. Müller, J. Alarinta, B. Frahm and G. Wirtanen	Microbial spoilage in vegan foods
A. Maslać, M. Krpan, T. Janči, A. Rocha and S. Vidaček Filipec	Knowledge, attitudes, and practices of hand washing in a supermarket chain in Croatia
J. Pleadin, T. Lešić, I. Kos, B. Hengl, A. Vulić, M. Zadravec, N. Kudumija and N. Vahčić	The impact of dry-cured meat products' production technology on their contamination with mycotoxins
J. Mrvčić, V. Kovač, K. Hanousek Čiča and D. Stanzer	Antimicrobial and antioxidative evaluation of ferrocene-containing resveratrol and curcumin derivatives
J. Mrvčić, M. Kovačević, K. Hanousek Čiča, D. Stanzer and L. Barišić	Biological potential of ferrocene-contining peptides
M. Dodevska, N. Ivanović, J. Kukić Marković and B. Đorđević	Quality characteristics of oils from selected edible seeds
V. Šimat, M. Čagalj, R. Frleta, I. Šimat, S. Smole Možina and D. Skroza	Effect of natural extracts and pure compounds on the fish burgers' quality parameters
T. Szablewski, R. Cegielska-Radziejewska, Ł. Tomczyk, K. Stuper-Szablewska, M. Ligaj and J. Kobus -Cisowska	Assessment of the antimicrobial effectiveness of cold plasma against the microflora of the shell of consumer eggs
M. Milić, T. Janči, J. Gajdoš Kljusurić and S. Vidaček Filipec	Dynamics of freshness loss and histamine formation in sardines (Sardina pilchardus) stored at different temperatures
G. T. Yalçin, M. N. Tosun, N. N. Zorba	Determination of the inhibitory effects of lactic acid bacteria on Clostridioides difficile in-vitro

POSTERS: Day 2: Thursday, 1st December
NUTRITION PART 1

L. Hoxha	Knowing the Albanian "hurma" (Diospyros kaki Thunb.) fruit and its drying behavior based on quality characteristics and bioactive compounds
M. Oraščanin, M. Bektašević, E. Šertović, Z. Sarić and V. Alibabić	Physico-chemical parameters and antioxidant activity of different types of honey from northwestern Bosnia and Herzegovina
J. M. Kurek, J. Mikołajczyk-Stecyna and Z. Krejpcio	Steviol glycosides attenuate lipid metabolism abnormalities by affecting gene expression in type 2 diabetic rats
J. M. Kurek and Z. Krejpcio	Effects of supplementary steviol glycosides on tissular trace elements levels in type 2 diabetic rats
G. Secci, F. Boncinelli, I. Tucciarone and G. Parisi	Are Italian parents willing to accept that their children eat insect-based products? A preliminary study
A. Merdzhanova, V. Panayotova, N. Petkova, D.A. Dobreva and K. Peycheva	Nutritional and functional potential of Black Sea shellfish (Mytilus galloprovincialis, Chamelea gallina and Donax trunculus)
M. Jukić Špika, M. Veršić Bratinčević, A. Bego, M. Mandušić, J. Rošin, T. Ninčević Runjić, M. Popović, M. žanetić and E. Vitanović	Phenolic compounds in buds and flowers of "Oblica" and "Lastovka" olive cultivars
G. Kenđel Jovanović and V. Đurica	The association of nutrition knowledge and diet quality of young Croatian elite swimmers

POSTERS: Day 2: Thursday, 1st December
NUTRITION PART 1

G. Kenđel Jovanović, T. Čulina, L. Velčić, P. Menescardi, C. Campi, S. Marini, G. Mussoni, Y. Dochevska, Y. Zdravkov, S. Djobova, E. Chrysostalis, P. Kaklatzis, M. Ioannis Nomikos, A. Begovikj, D. Todorova, M. Sambolec, V. Krstevski, A. Pawlowski, D. Luks, J. Radmski and M. Pietrzok	European Project Sports Community Against Eating Disorders
A. Vulić, T. Lešić, N. Kudumija, S. Zrnčić, D. Oraić and J. Pleadin	Vitamin A and vitamin E content in sea bass and sea bream farmed in the Adriatic Sea and its seasonal variability
N. Kudumija, T. Lešić, A. Vulić and J. Pleadin	Mineral content of dry-fermented sausages produced in Croatian households
S. Pavičić Žeželj, G. Kenđel Jovanović and M. Posedel	Changes in the nutritional status, physical activity habits, and diet of children in elementary school during the Covid-19 epidemic
K. Kraljić, M. Žanetić, M. Jukić Špika, K. Filipan, N. Butula, I. Stuparević, O. Koprivnjak and D. Škevin	Influence of cultivar and ripening stage of Croatian olives on endogenous enzyme activity
P. Čulina, I. Elez Garofulić, M. Repajić, Z. Zorić, V. Dragović-Uzelac and S. Pedisić	Influence of spray drying conditions on encapsulation of sea buckthorn oil (Eleagnus Rhamnoides (L.) A. Nelson)
M. Atanassova, J. K. Stangeland, T. H. Dahl, D. Kvam, L. A. Giske and W. Emblem Larsen	Are herring milt protein concentrates ingredients of future foods?
M. Oraščanin, M. Bektašević, E. Šertović, I. Flanjak and M. Cvijetić Stokanović	Physicochemical characterisation of royal jelly from northwestern Bosnia and Herzegovina
K. Kragić, A. Sulimanec Grgec, J. Vlahov, B. Jerak, A. Sekovanić, J. Jurasović, I. Panjkota Krbavčić, N. Vahčić and I. Rumora Samarin	Chemical characterization and antioxidant potential of the Rowan berry fruits (Sorbus aucuparia L.) from various natural habitats in Croatia
E. K. Farhat, A. Piekara, I. Banjari, M. Krzywonos and K. Rybczyńska	The analysis of prenatal supplements on the Croatian and Polish market
M. Burzyńska and D. Piasecka-Kwiatkowska	Pollen profiles of Polish spring nectar honeys from different apiary
K. Filipan, K. Kraljić, I. Hojka, M. Ivanov, Z. Herceg, S. Balbino, M. Obranović and D. Škevin	Optimization of the DSC method for determining the oxidative stability of virgin olive oil
N. Ćorić, A. Jurić and A. Karlović	The impact of the COVID-19 pandemic outbreak on eating and lifestyle habits of adolescents in Bosnia and Herzegovina: A Cross-Sectional Study

Day 3: Friday, 2nd December — Main Hall

8:30-9:00	**Registration**	
9:00-12:45	**Oral Presentations - Nutrition, Health, Consumer** **Chairpersons: Ines Panjkota Krbavčić and Nataša Poklar Ulrih**	
9:00-9:20	Invited Speaker **Ž. Krznarić**	**Diet or δίαιτα? Nutrition science today.**
9:20-9:35	R. Vrkić, J. Šic Žlabur, M. Dujmović and B. Benko	Specialized metabolites content of broccoli microgreens grown under the different LED wavelengths
9:35-9:50	E. Karahmet Farhat, I. Banjari and E. Karahmet Sher	The analysis of dietary habits in acne patients
9:50-10:05	H.Lukša, D. Vuković and A. Hunjet	Influence of vegan product factors on purchase
10:05-10:20	T. Junkkari, L. Arjanne, M. Paakki, M. Kantola, H. Luomala and A. Hopia	A successful reformulation of lacto-vegetarian product
10:20-10:35	W. Fernandes, F. R. Pinto, S. Barroso and M. M. Gil	Innovative, Sustainable and Healthy Blue Food and Consumer Engagement
10:35-10:50	K. Novina Brkić, sponsored lecture by Nestle	
10:50-11:30	**Coffee and Posters - Nutrition Part 1**	
11:30-11:45	T. K. Kovačević, N. Išić, J. Perković, I. Bažon, D. Ban, M. Sivec, S. Goreta Ban and N. Major	The effect of elevation on the phytochemical profile in Allium ursinum L.
11:45-12:00	T. Laitila, J. Kumpulainen, M. Ojala, L. Haapala, J. Alarinta and G. Wirtanen	The process of making plant-based milk alternative
12:00-12:15	A. Gomes-Bispo, R. Gomes, I. Mendes, P. Duarte, C. Coelho, C. Cardoso, C. Afonso and N. M. Bandarra	Production of neuroactive extracts for prevention/delay of Alzheimer disease: an opportunity for a sustainable use of undervalued fish species
12:15-12:30	T. Jović, I. Elez Garofulić, P. Čulina, Z. Čošić, Z. Pelaić, V. Dragović-Uzelac and Z. Zorić	Physical properties and total phenol content of encapsulated Pistacia lentiscus leaf extract
12:30-12:45	D. Delač Salopek, I. Horvat, S. Radeka, T. Plavša, A. Hranilović, S. Carlin, U. Vrhovšek and I. Lukić	Qualitative abundance of volatile esters in Malvazija istarska white wine as revealed by comprehensive two-dimensional gas chromatography: effect of non-Saccharomyces yeasts
12:45-14:00	**Lunch and posters - Nutrition Part 2**	
14:00-15:40	**Smart Cro** **Chairpersons: Danijela Šeremet and Marko Obranović**	
14:00-14:20	Invited Speaker **Nataša Šijaković Vujičić**	**Self-healing Organogelators of Edible Oil as Solid Fat Alternatives**
14.20-14:35	I. Radojčić Redovniković	NADES DESIGN: from academy to entrepreneurship
14.35-14:50	E. Melvan	From science to startup
14:50-15:00	P. Golubić	Physical properties of three-dimensional printed snack product enriched with pre-processed wheat bran
15:00-15:10	K. Varga	Development of snack product recipes for patients with irritable bowel syndrome and non-celiac gluten sensitivity
15:10-15:20	M. Novak	Instrumental evaluation of biscuit texture properties during storage
15:20-15:30	M. Antolić, D. Brdar	Pumpkina - Ecotrophelia 2022
15:30-15:40	A. Dominko, sponsored lecture by Ivan Bulić Foundation	

15:40-16:20	Round table by EHEDG	
15:40-15:45	H. Medić, Co-Chair EHEDG Cro	Introduction to EHEDG roundtable
15:45-16:00	T. Janči	Hygienic design of open equipment for food processing
16:00-16:10	A. Perković, Lead auditor at CB	Hygienic design of equipment for food industry from the perspective of a 3rd party audit
16:10-16:20	I. Jerman, sponsored lecture by ACO	HygieneFirst - our committment to ultimate hygienic performance
16:20-16:40	Closing ceremony	
16:40-17:30	**Farewell drink and posters - Nutririon Part 2**	

POSTERS: Day 3: Friday, 2nd December
NUTRITION PART 2

A. Boban, U. Vrhovsek, S. Carlin, A. Mucalo and I. Budić-Leto	A targeted and untargeted approach to volatile metabolite characterization of „Maraština“ wines produced by spontaneous fermentation
A. Lopes, P. Fernandes, R. Brazão and M. Graça Dias	PortFIR: An integrated approach for promoting multisectoral cooperation – contributing to Sustainable Development Goals achievement
L. Penava, A. Leboš Pavuc, M. Banić, K. Butorac, J. Novak, M. Ceilinger, N. Čuljak, J. Miličević, D. Čukelj, J. Šušković and B. Kos	Probiotic activity of Lacticaseibacillus casei 431® in food for special medical purposes
V. Škoro Rendulić, N. Zovko, M. Hruškar, M. Krpan and V. Košec	Relationship of gestational diabetes with anthropometric parameters of pregnant women and dietary habits with emphasis on vitamin D
P. Fernandes, A. Lopes, R. Brazão and M. Graça Dias	Monitoring salt content in selected foods in Portuguese market
M. Lučan Čolić and M. Antunović	Current trends in buttermilk utilization: A quick overview
K. Radolović, J. Pleadin, N. Kudumija, N. Vahčić and M. Bituh	Our take on sodium intake among Croatian children with celiac disease: sodium content of their gluten-free diets and the contribution of commercial products
D. Šoronja-Simović, B. Pajin, J. Petrović, I. Lončarević, Z. Šereš and N. Maravić	Improvement of cookies nutritional characteristics by the addition of soybean husk
I. Herak, N. Uršulin-Trstenjak, D. Biškup and T. Meštrović, I. Dodlek Šarkanj	The influence of social factors on the quality of life of celiac disease patients
A. Ilić, I. Rumbak, D. Dizdarić, M. Matek Sarić, I. Colić Barić and R. de Pinho Ferreira Guiné	Motivations associated with food choices among adults in the City of Zagreb
T. Knezović, A. Ilić, I. Rumbak, R. Brečić, I. Colić Barić and M. Bituh	The quality of breakfast eaten at home vs. school in primary school children
J. Zonjić, M. Vurdelja, I. Panjkota Krbavčić, M. Krpan and Z. Šatalić	Nutritional status of vitamin D in elite Croatian athletes
D. Klisović, A. Novoselić, M. Lukić, K. Kraljić and K. Brkić Bubola	Changes in quality and composition of phenolic and volatile compounds in selected Croatian monovarietal extra virgin olive oils after heating
M. Veljković, M. Simović, A. Petrov Ivanković, A. Vukoičić, K. Banjanac and D. Bezbradica	In situ transformation of sucrose in maple syrup in order to produce fructo-oligosaccharide enriched product

POSTERS: Day 3: Friday, 2nd December
NUTRITION PART 2

F. Orbanić, S. Rossi, E. Bestulić, K. Kovačević Ganić, N. Ćurko, M. Tomašević, T. Plavša, A. Jeromel and S. Radeka	Impact of pre-fermentative mash cooling, heating, saignée technique and prolonged macerations on antioxidant capacity and total phenolic content in Teran red wine
A. Petrov Ivanković, M. Veljković , A. Vukoičić, A. Milivojević, M. Ćorović , R. Pjanović and D. Bezbradica	Enzyme-assisted extraction of various bioactive components from blackcurrant (Ribes nigrum)
E. Bestulić, S. Rossi, F. Orbanić, I. Horvat, I. Lukić, T. Plavša, A. Jeromel and S. Radeka	Impact of mash maceration duration and temperature on non-flavonoid phenolics in Malvazija istarska wines
A. Vukomanović, M. Jagodić, I. Vrdoljak, K. Šanko, I. Rumora Samarin, Z. Šatalić and I. Panjkota Krbavčić	Chemical composition of meat-based meals for tube feeding
A. Vukomanović, M. Horvatović, I. Rumora Samarin, Z. Šatalić and I. Panjkota Krbavčić	Pregnant women with gestational diabetes mellitus have inadequate dietary fiber intake
P. Petek, P. Škrtić, K. Marković, M. Hruškar, M. Krpan and N. Vahčić	Protein and proline content of honeydew and nectar honey of different botanical origin from Croatia
I. Jurčević, B. Šarkanj and D. Šamec	The influence of 3',8'' dimerization on the antioxidant and antifungal activity of flavonoids: the example of apigenin and amentoflavone
N. Pavlović, J.R. Mijalković, N.Ž. Šekuljica, P.M. Petrović, V.B. Đorđević, B.M. Bugarski and Z.D. Knežević-Jugović	Cold gelation of leaf protein concentrate for nanoencapsulation of vitamins
L. Hoxha, M. Kullaj, A. Ismailaj, S. Ndoj and Ç. Kadakal	Investigating the addition of red beetroot (Beta vulgaris L.) in the improvement of nutritional and sensory properties of tomato paste
N. Lugonja, V. Marinković, S. Miletić, J. Avdalović, S. Spasić, M. M. Vrvić	The effects of thermal processes on the quality of preterm human milk

ORGANIZED BY

Croatian Society of Food technologists, Biotechnologists and Nutricionists (CROFoST)

CO-ORGANIZED/ SUPPORTED BY

faculty of food technology and biotechnology, University of Zagreb

EFFoST

EHEDG European Hygienic Engineering & Design Group

GENERAL SPONSOR

30 years with you — 1992. - 2022. timzip nutrition-technologies-development

CONFERENCE PARTNER

ACO, Nestlé, HiPP, puratos Food Innovation for Good, PODRAVKA

SPONSORS

Selvita, data-bak, IREKS, SCIEX, PEKAR, DUBRAVICA, Endress+Hauser, STANIĆ, AlphaChrom, BIOVIT, Ru-Ve tvoj lab partner, ENNA FRUIT, Barentz, HGK Croatian Chamber of Economy, METTLER TOLEDO, Galić

SPECIAL THANKS

PROBION

PREFACE

The jubilee 10th International Congress of Food Technologists, Biotechnologists and Nutritionists, named Smart Food for a Healthy Planet and Human Prosperity, takes place from 30 November to 2 December 2022 in Zagreb, Croatia. Congress is organized by Croatian Society of Food Technologists, Biotechnologists and Nutritionists and University of Zagreb, Faculty of Food Technology and Biotechnology and co-sponsored by eminent institutions: EFFoST - European Federation of Food Science and Technology and European Hygienic Engineering & Design Group.

The Congress is dedicated to challenges and opportunities in the field of food technology, biotechnology and nutrition, emphasizing different approaches in order to efficiently establish the link between science and industry, young researchers and their more experienced colleagues. The multidisciplinary approach brings together scientists and experts to discuss and highlight the latest sustainability trends in food industry, the relationship of diet and health, consumers trends, new challenges in food safety as well as in bioprocess engineering and molecular biotechnology.

The themes covered by the Congress include: Innovation; Safety; Sustainability; Industry 4.0; Nutrition, Health and Consumer. Parallel sessions are Biotechnology in Croatia "Vera Johanides" and round table on European Qualifications & Competences for the Vegan Food Industry "EQ Vegan".

Thank you for joining us!

Editors

Table of contents

1. Past, present and future challenges for the food industry: Fruit and vegetable products, *Branka Levaj* **1**

2. INNOVATION **2**

2.1 Future of food engineering and emerging computational processing – Manufacturing, *Ferruh Erdoğdu* **3**

2.2 Designing emulsion-gel structures for the delivery of functionality at food application, *Song Miao* **4**

2.3 Modulating the swelling behavior of casein microparticles (CMPs) for delivering bioactive compounds, *Mohammad Asaduzzaman* and Ronald Gebhardt* **5**

2.4 Encapsulation of Ground Ivy (*Glechoma hederacea* L.) extract, obtained by natural deep eutectic solvents extraction, in liposomes, *Bojana Balanč, Jelena Halagi, Jovan Skrobonja, Ana Milivojevic, Danijela Šeremet, Draženka Komes, Rada Pjanovic* **7**

2.5 Effect of high-power ultrasound (HPU) on stability of bioactive compounds in strawberry juices, *Anica Bebek Markovinović, Paula Bičanić, Predrag Putnik, Boris Duralija, Danijela Bursać Kovačević* **9**

2.6 Application of additive technology in a production of functional strawberry-based product, *Anica Bebek Markovinović, Filip Valjak, Adrijana Žigolić, Predrag Putnik, Danijela Bursać Kovačević* **10**

2.7 Influence of temperature and carrier ratio on fennel essential oil powder obtained by spray drying, *Ena Cegledi, Maja Repajić, Nina Marčac, Ivona Elez Garofulić, Karla Cegledi, Erika Dobroslavić, Verica Dragović-Uzelac* **11**

2.8 Electrostatic extrusion for co-encapsulation of hydrophilic and lipophilic myrtle extracts, *Daniela Cvitković, Sandra Balbino, Jasna Mrvčić, Verica Dragović-Uzelac* **13**

2.9 The influence of ultrasonic pretreatment prior hydrodistillation of basil on the yield of essential oil, *Maja Dent and Kristina Blažević* **15**

2.10 The impact of enzymatic and ultrasonic pretreatment on the yield and volatile profil of bay laurel and sage essential oil, *Maja Dent, Tamara Vujović, Anđela Miljanović, Igor Jerković, Zvonimir Marijanović, Dorotea Grbin, Tonči Rezić* **16**

2.11 Nutrient solution management – innovative agricultural practice for higher nutrient quality of stinging nettle, *Mia Dujmović, Nevena Opačić, Sanja Radman, Sanja Fabek Uher, Marko Petek, Lepomir Čoga, Ante Galić, Nadica Dobričević, Nina Toth, Božidar Benko, Sandra Voća, Jana Šic Žlabur* **18**

2.12 Open courseware on responsible food packaging - FitNESS 2.0 project, *Kata Galić, Mia Kurek, Mario Ščetar* **20**

2.13 Encapsulation of anthocyanins from chokeberry (*Aronia melanocarpa*) with different types of plazmolyzed yeast cells, *Marcin A. Kurek, Anna Onopiuk, Arkadiusz Szpicer* **22**

2.14 AI causal analysis of food quality, *Želimir Kurtanjek* **23**

2.15 Development and characterization of biobased films from chitosan and gelatine with gallic acid applied as pouches for olive oil storage, *Mia Kurek, Petra Poldan, Mario Ščetar, Emilie Descours, Domagoj Gabrić, Kata Galić* **24**

2.16 Electrospun nanofibers as an emerging delivery system for phenylethanoid glycosides: preparation and in vitro evaluation, *Ana Mandura Jarić, Laura Miletić, Sunčica Kuzmić, Aleksandra Sander, Danijela Šeremet, Aleksandra Vojvodić Cebin, Draženka Komes* **25**

2.17 Oenological characterization of non-*Saccharomyces* yeasts isolated from Croatian white grape variety Maraština, *Vesna Milanović, Federica Cardinali, Ana Boban, Jasenka Gajdoš Kljusurić, Ana Mucalo, Andrea Osimani, Lucia Aquilanti, Cristiana Garofalo, Irena Budić-Leto* **27**

2.18 Properties of interesterified mixtures of hemp and coconut oil, *Marko Obranović, Chloé Louis-Gavet, Joanna Bry, Rita Brzezińsk, Agata Górska, Ewa Ostrowska-Ligęza, Magdalena Wirkowska-Wojdyła, Andrzej Bryś* **29**

2.19 The use of regiospecific lipase to obtain structured lipids from mixtures of coconut oil and hemp, *Marko Obranović, Chloé Louis- Gavet, Agnieszka Górska, Diana Mańko-Jurkowska, Rita Brzezińska, Joanna Brys* **31**

2.20 The effect of UV-C irradiation and high hydrostatic pressure on the quality of fresh-cut potatoes, *Zdenka Pelaić, Zrinka Čošić, Maja Repajić, Filip Dujmić, Branka Levaj* **33**

2.21 Characterization of oil stored in novel bio-based films, *Arsène Pitois, Anaïs Julou, Mia Kurek, Nadine Vallet, Emilie Descours*..... **35**

2.22 Potential of psyllium as an ingredient in 3D-printed gluten-free snacks evaluated by rheology, NIR and physical properties, *Kristina Radoš, Maja Benković, Nikolina Čukelj Mustač, Bojana Voučko, Mislav Tujmer, Duška Ćurić, Dubravka Novotni*..... **37**

2.23 Application of pressurized liquid extraction for the isolation of phenols from sea buckthorn leaves, *Maja Repajić, Ivona Elez Garofulić, Paula Pufek, Ena Cegledi, Branka Levaj, Verica Dragović-Uzelac* **39**

2.24 Case study: Innovation with strawberry tree fruits (*Arbutus unedo* L.) for agri-food industry, *Ivo Rodrigues, Goreti Botelho, Filomena Gomes* **41**

2.25 The preparation of N-doped carbon quantum dots from citric acid and *Citrus clementina* peel – The application in iron(III) detection in herbs and spices, *Silvija Šafranko, Šimun Mandić, Stela Jokić* **42**

2.26 Characterisation of chitosan films with Vitamin C, *Mario Ščetar, Ivan Lenard, Mia Kurek, Dunja Molnar, Kata Galić* **44**

2.27 Effect of mixture composition on physical properties of honey based cocoa powder, *Kristina Tušek and Maja Benković* **46**

2.28 Influence of thermal and non-thermal pre-treatment of dough on the quality of 3D printed gluten free cereal snacks, *Bojana Voučko, Nikolina Čukelj, Kristina Radoš, Tomislava Vukušić Pavičić, Višnja Stulić*, Filip Dujmić, Duška Ćurić, Dubravka Novotni* **48**

3. NUTRITION, HEALTH AND CONSUMER **50**

3.1 Ethical issues in food chain, *Rui Costa* **51**

3.2 Diet or δίαιτα ? Nutrition science today, *Željko Krznarić* **53**

3.3 Are herring milt protein concentrates ingredients of future foods?, *Miroslava Atanassova, Janne Kristin Stangeland, Thomas Hagby Dahl, Daniel Kvam, Lars André Langøyli Giske, Wenche Emblem Larsen* **55**

3.4 Impact of mash maceration duration and temperature on non-flavonoid phenolics in Malvazija istarska wines, *Ena Bestulić, Sara Rossi, Fumica Orbanić, Ivana Horvat, Igor Lukić, Tomislav Plavša, Ana Jeromel, Sanja Radeka* **57**

3.5 A targeted and untargeted approach to volatile metabolite characterization of „Maraština" wines produced by spontaneous fermentation, *Ana Boban, Urska Vrhovsek, Silvia Carlin, Ana Mucalo, Irena Budić-Leto* **59**

3.6 Quantitative descriptive analysis of reduced fat butter biscuits by trained panels from Ljubljana and Zagreb: a comparison of panel data and feasibility study, *Anja Bolha, Jasna Bertoncelj, Sebastjan Filip, Nada Vahčić, Mojca Korošec* **61**

3.7 An outlook about alternatives to meat and dairy products in food industry, *Goreti Botelho, Miguel Lima, Ivo Rodrigues, Jorge Lameiras, Rui Costa* **63**

3.8 Pollen profiles of Polish spring nectar honeys from different apiary, *Marta Burzyńska and Dorota Piasecka-Kwiatkowska* **65**

3.9 Influence of spray drying conditions on encapsulation of sea buckthorn oil (*Eleagnus Rhamnoides* (L.) A. Nelson), *Patricija Čulina, Ivona Elez Garofulić, Maja Repajić, Zoran Zorić, Verica Dragović-Uzelac, Sandra Pedisić* **67**

3.10 The impact of the COVID-19 pandemic outbreak on eating and lifestyle habits of adolescents in Bosnia and Herzegovina: A Cross-Sectional Study, *Nevena Ćorić, Anita Jurić, Andrea Karlovi* .. **69**

3.11 Qualitative abundance of volatile esters in Malvazija istarska white wine as revealed by comprehensive two-dimensional gas chromatography: effect of non-Saccharomyces yeasts, *Doris Delač Salopek, Ivana Horvat, Sanja Radeka, Tomislav Plavša, Ana Hranilović, Silvia Carlin, Urska Vrhovšek, Igor Lukić* **71**

3.12 The analysis of dietary habits in acne patients, *Esma Karahmet Farhat, Ines Banjari, Emina Karahmet Sher*..... **73**

3.13 Optimization of the DSC method for determining the oxidative stability of virgin olive oil, *Katarina Filipan, Klara Kraljić, Ivana Hojka, Mia Ivanov, Zoran Herceg, Sandra Balbino, Marko Obranović, Dubravka Škevin* **75**

3.14 The analysis of prenatal supplements on the Croatian and Polish market, *Esma Karahmet Farhat, Agnieszka Piekara, Ines Banjari, Małgorzata Krzywonos, Karolina Rybczyńska* **77**

3.15 Innovative, sustainable and healthy blue food and consumer engagement, *Wilson Fernandes, Filipa R. Pinto, Sónia Barroso, Maria M. Gil* **79**

3.16 Monitoring salt content in selected foods in Portuguese market, *Paulo Fernandes, Andreia Lopes, Roberto Brazão, Maria Graça Dias* **81**

3.17 Production of neuroactive extracts for prevention/delay of Alzheimer disease: an opportunity for a sustainable use of undervalued fish species, *Ana Gomes-Bispo, Romina Gomes, Inês Mendes, Paula Duarte, Cláudia Coelho, Carlos Cardoso, Cláudia Afonso, Narcisa M. Bandarra* **83**

3.18 Distribution of carotenoids in endosperm lipid fractions of maize kernel, *Veronika Gunjević, Dora Zurak, Manuela Košević, Zlata Kralik, Darko Grbeša, Kristina Kljak* **85**

3.19 The influence of social factors on the quality of life of celiac disease patients, *Ivana Herak, Natalija Uršulin-Trstenjak, Dijana Biškup, Tomislav Meštrović, Ivana Dodlek Šarkan* **87**

3.20 Knowing the Albanian "hurma" (Diospyros kaki Thunb.) fruit and its drying behavior based on quality characteristics and bioactive compounds, *Luziana Hoxha* **89**

3.21 Investigating the addition of red beetroot (*Beta vulgaris* L.) in the improvement of nutritional and sensory properties of tomato paste, Luziana Hoxha, Migena Kullaj, Adi Ismailaj, Silvana Ndoj, Çetin Kadakal **90**

3.22 Motivations associated with food choices among adults in the City of Zagreb, *Ana Ilić, Ivana Rumbak, Dina Dizdarić, Marijana Matek Sarić, Irena Colić Barić, Raquel de Pinho Ferreira Guiné* . **92**

3.23 Physical properties and total phenol content of encapsulated *Pistacia lentiscus* leaf extract, *Tanja Jović, Ivona Elez Garofulić, Patricija Čulina, Zrinka Čošić, Zdenka Pelaić, Verica Dragović-Uzelac, Zoran Zorić* **94**

3.24 Phenolic compounds in buds and flowers of 'Oblica' and 'Lastovka' olive cultivars, *Maja Jukić Špika, Maja Veršić Bratinčević, Ana Bego, Marija Mandušić, Jakša Rošin, Tonka Ninčević Runjić, Marijana Popović, Mirella žanetić, Elda Vitanović*..... **96**

3.25 A successful reformulation of lacto-vegetarian product, *Terhi Junkkari, Leena Arjanne, Maija Paakki, Maija Kantola, Harri Luomala, Anu Hopia* **98**

3.26 The influence of 3',8" dimerization on the antioxidant and antifungal activity of flavonoids: the example of apigenin and amentoflavone, *Iva Jurčević, Bojan Šarkanj, Dunja Šamec*..... **100**

3.27 The quality of breakfast eaten at home vs. school in primary school children, *Tea Knezović, Ana Ilić, Ivana Rumbak, Ružica Brečić, Irena Colić Barić, Martina Bituh* **101**

3.28 The association of nutrition knowledge and diet quality of young Croatian elite swimmers, *Gordana Kenđel Jovanović, Vanja Đurica* **103**

3.29 European Project Sports Community Against Eating Disorders, *Gordana Kenđel Jovanović, Tatjana Čulina, Lina Velčić, Paolo Menescardi, Chiara Campi, Sara Marini, Giulia Mussoni, Yoanna Dochevska, Yvaylo Zdravkov, Stefka Djobova, Emmanouil Chrysostalis, Pavlos Kaklatzis, Marios Ioannis Nomikos, Begovikj Aamir, Todorova Dragana5, Sambolec Martina, Krstevski Viktor, Pawlowski Andrzej, Luks Dariusz, Radmski Jakub, Pietrzok Michal* **105**

3.30 Changes in quality and composition of phenolic and volatile compounds in selected Croatian monovarietal extra virgin olive oils after heating *Dora Klisović, Anja Novoselić, Marina Lukić, Klara Kraljić, Karolina Brkić Bubola* **107**

3.31 The effect of elevation on the phytochemical profile in *Allium ursinum L.,* *Tvrtko Karlo Kovačević, Nina Išić, Josipa Perković, Iva Bažon, Dean Ban, Marta Sivec, Smiljana Goreta Ban, Nikola Major*..... **109**

3.32 Chemical characterization and antioxidant potential of the Rowan berry fruits (*Sorbus aucuparia* L.) from various natural habitats in Croatia, *Karla Kragić, Antonija Sulimanec Sulimanec Grgec, Josipa Vlahov, Božica Jerak, Ankica Sekovanić, Jasna Jurasović, Ines Panjkota Krbavčić, Nada Vahčić, Ivana Rumora Samarin* **111**

3.33 Influence of cultivar and ripening stage of Croatian olives on endogenous enzyme activity, *Klara Kraljić, Mirella Žanetić, Maja Jukić Špika, Katarina Filipan, Nika Butula, Igor Stuparević, Olivera Koprivnjak, Dubravka Škevin* **113**

3.34 Mineral content of dry-fermented sausages produced in Croatian households, *Nina Kudumija, Tina Lešić, Ana Vulić, Jelka Pleadin* **115**

3.35 Steviol glycosides attenuate lipid metabolism abnormalities by affecting gene expression in type 2 diabetic rats, *Jakub Michał Kurek, Joanna Mikołajczyk-Stecyna, Zbigniew Krejpcio* **117**

3.36 Effects of supplementary steviol glycosides on tissular trace elements levels in type 2 diabetic rats, *Jakub Michał Kurek and Zbigniew Krejpcio* **118**

3.37 The process of making plant-based milk alternative ,*Tiina Laitila, Juuso Kumpulainen, Markus Ojala, Lotta Haapala, Jarmo Alarinta, Gun Wirtanen* **120**

3.38 PortFIR: An integrated approach for promoting multisectoral cooperation – contributing to Sustainable Development Goals achievement, *Andreia Lopes, Paulo Fernandes, Roberto Brazão, Maria Graça Dias* **121**

3.39 Current trends in buttermilk utilization: A quick overview, *Mirela Lučan Čolić, Martina Antunović* **123**

3.40 The effects of thermal processes on the quality of preterm human milk *Nikoleta Lugonja, Vesna Marinković, Srdjan Miletić, Jelena Avdalović, Snežana Spasić, Miroslav M. Vrvić*..... **124**

3.41 Influence of vegan product factors on purchase, *Helena Lukša, Dijana Vuković, Anica Hunjet* **125**

3.42 The phytochemical diversity of shallots in Croatia, *Nikola Major, Josipa Perković, Igor Palčić, Iva Bažon, Ivana Horvat, Dean Ban, Smiljana Goreta Ban* **126**

3.43 Influence of processing time on physicochemical parameters, sensory properties, and volatile compounds of smoked dry-cured ham "Dalmatinski pršut", *Nives Marušić Radovčić, Ivna Poljanec, Krešimir Majcen, Sandra Petričević, Helga Medić* **127**

3.44 Our take on sodium intake among Croatian children with celiac disease: sodium content of their gluten-free diets and the contribution of commercial products, *Katja Radolović, Jelka Pleadin, Nina Kudumija, Nada Vahčić, Martina Bituh* **129**

3.45 Nutritional and functional potential of Black Sea shellfish (*Mytilus galloprovincialis, Chamelea gallina and Donax trunculus*), *Albena Merdzhanova, Veselina Panayotova, Nadezhda Petkova, Diana A. Dobreva, Katya Peycheva* **130**

3.46 Physico-chemical parameters and antioxidant activity of different types of honey from Northwestern Bosnia and Herzegovina, *Melisa Oraščanin, Mejra Bektašević, Edina Šertović, Zlatan Sarić, Vildana Alibabić* **132**

3.47 Physicochemical characterisation of royal jelly from northwestern Bosnia and Herzegovina, *Melisa Oraščanin, Mejra Bektašević, Edina Šertović, Ivana Flanjak, Milica Cvijetić Stokanović* **134**

3.48 Impact of pre-fermentative mash cooling, heating, saignée technique and prolonged macerations on antioxidant capacity and total phenolic content in Teran red wine, *Fumica Orbanic, Sara Rossi, Ena Bestulić, Karin Kovačević Ganić, Natka Ćurko, Marina Tomašević, Tomislav Plavša, Ana Jeromel, Sanja Radeka*..... **136**

3.49 Changes in the nutritional status, physical activity habits, and diet of children in elementary school during the Covid-19 epidemic, *Sandra Pavičić Žeželj, Gordana Kenđel Jovanović, Matea Posedel* **138**

3.50 Cold gelation of leaf protein concentrate for nanoencapsulation of vitamins, *Neda V. Pavlović, Jelena R. Mijalković, Nataša Ž. Šekuljica, Predrag M. Petrović, Verica B. Đorđević, Branko M. Bugarski, Zorica D. Knežević-Jugović*..... **140**

3.51 Protein and proline content of honeydew and nectar honey of different botanical origin from Croatia, *Petra Petek, Petra Škrtić, Ksenija Marković, Mirjana Hruškar, Marina Krpan, Nada Vahčić* **142**

3.52 Probiotic activity of Lacticaseibacillus casei 431® in food for special medical purposes, *Lenkica Penava, Andreja Leboš Pavuc, Martina Banić, Katarina Butorac, Jasna Novak, Marijana Ceilinger, Nina Čuljak, Jelena Miličević, Danijela Čukelj, Jagoda Šušković, Blaženka Kos* **143**

3.53 Enzyme-assisted extraction of various bioactive components from blackcurrant (*Ribes nigrum*), *Anja Petrov Ivanković, Milica Veljković, Ana Vukoičić, Ana Milivojević, Marija Ćorović , Rada Pjanović, Dejan Bezbradica* **145**

3.54 Are Italian parents willing to accept that their children eat insect-based products? A preliminary study, *Giulia Secci, Fabio Boncinelli, Isabella Tucciarone, Giuliana Parisi* **147**

3.55 Relationship of gestational diabetes with anthropometric parameters of pregnant women and dietary habits with emphasis on vitamin D, *Vedrana Škoro Rendulić, Nikolina Zovko, Mirjana Hruškar, Marina Krpan, Vesna Košec*..... **149**

3.56 Improvement of cookies nutritional characteristics by the addition of soybean husk, *Dragana Šoronja-Simović, Biljana Pajin, Jovana Petrović, Ivana Lončarević, Zita Šereš, Nikola Maravić* **151**

3.57 In situ transformation of sucrose in maple syrup in order to produce fructo-oligosaccharide enriched product, *Milica Veljković, Milica Simović, Anja Petrov Ivanković, Ana Vukoičić, Katarina Banjanac, Dejan Bezbradica*.... **152**

3.58 Specialized metabolites content of broccoli microgreens grown under the different LED wavelengths, *Roberta Vrkić, Jana Šic Žlabur, Mia Dujmović, Božidar Benko* **154**

3.59 Chemical composition of meat-based meals for tube feeding, *Anja Vukomanović, Matija Jagodić, Ivica Vrdoljak, Katarina Šanko, Nada Vahčić, Ivana Rumora Samarin, Zvonimir Šatalić, Ines Panjkota Krbavčić*.... **156**

3.60 Pregnant women with gestational diabetes mellitus have inadequate dietary fiber intake, *Anja Vukomanović, Matea Horvatović, Ivana Rumora Samarin, Zvonimir Šatalić, Ines Panjkota Krbavčić* **158**

3.61 Vitamin A and vitamin E content in sea bass and sea bream farmed in the Adriatic Sea and its seasonal variability, *Ana Vulić, Tina Lešić, Nina Kudumija, Snježana Zrnčić, Dražen Oraić, Jelka Pleadin* **160**

3.62 From traditional culinary plants to potential cytotoxic agents against the brain cancer: Melocan (Smilax excelsa L.) and Galdirik (Trachystemon Orientalis), *Diaa Al Yassine, Nourtane El Massri, Günnur Demircan, Gulay Bulut, Demet Akin, Zeynep Tacer-Caba* **162**

3.63 Nutritional status of vitamin D in elite Croatian athletes, *Jadran Zonjić, Mimi Vurdelja, Ines Panjkota Krbavčić, Marina Krpan, Zvonimir Šatalić*.... **164**

3.64 Carotenoid content in egg yolk increases with the amount of digestible carotenoids in hen diets differentiated in maize hybrid, *Dora Zurak, Veronika Gunjević, Dalibor Bedeković, Marija Duvnjak, Darko Grbeša, Zlatko Janječić, Goran Kiš, Vasil Pirgozliev, Kristina Kljak* **165**

4 SAFETY **167**

4.1 Nano/Micro-plastics as emerging food contaminants: a challenge for food safety, *Tanja Bogdanović, Jelka Pleadin, Federica Di Giacinto, Sandra Petričević, Eddy Listeš* **168**

4.2 Controlling bacterial spoilage in both vegan and meat based products, *Gun Wirtanen* **170**

4.3 Quality characteristics of oils from selected edible seeds, *Margarita Dodevska, Nevena Ivanović, Jelena Kukić Marković, Brižita Đorđević* **172**

4.4 Knowledge, attitudes, and practices of hand washing in a supermarket chain in Croatia, *Ana Maslać, Marina Krpan, Tibor Janči, Ada Rocha, Sanja Vidaček Filipec* **173**

4.5 Dynamics of freshness loss and histamine formation in sardines (*Sardina pilchardus*) stored at different temperatures, *Marko Milić, Tibor Janči, Jasenka Gajdoš Kljusurić, Sanja Vidaček Filipec* **175**

4.6 Antimicrobial and antioxidative evaluation of ferrocene-containing resveratrol and curcumin derivatives, *Jasna Mrvčić, Veronika Kovač, Karla Hanousek Čiča, Damir Stanzer* **177**

4.7 Biological potential of ferrocene-containing peptides, *Jasna Mrvčić, Monika Kovačević, Karla Hanousek Čiča, Damir Stanzer, Lidija Barišić* **179**

4.8 Coffee fraud detection using near infrared spectroscopy combined with artificial neural network, *Leah Munyendo, Daniel Njoroge, Yanyan Zhang, Bernd Hitzmann* **180**

4.9 Microbial spoilage in vegan foods, *Carolin Müller, Jarmo Alarinta, Björn Frahm, Gun Wirtanen* **181**

4.10 The impact of dry-cured meat products' production technology on their contamination with mycotoxins, *Jelka Pleadin, Tina Lešić, Ivica Kos, Brigita Hengl, Ana Vulić, Manuela Zadravec, Nina Kudumija, Nada Vahčić* **182**

4.11 Assessment of the antimicrobial effectiveness of cold plasma against the microflora of the shell of consumer eggs, *Tomasz Szablewski, Renata Cegielska-Radziejewska, Łukasz Tomczyk, Kinga Stuper-Szablewska, Marta Ligaj, Joanna Kobus-Cisowska* **184**

4.12 Effect of natural extracts and pure compounds on the fish burgers' quality parameters, *Vida Šimat, Martina Čagalj, Roberta Frleta, Ivan Šimat, Sonja Smole Možina, Danijela Skroza* **186**

4.13 The effect of washing with antimicrobial solutions on *C. diffcile Enterobacterales* and TAMB load in spinach, *Melike Nur Tosun, Gizem Taylan Yalcın, Gizem Korkmazer, Murat Zorba Cengiz Caner, Nükhet N. Zorba* **188**

4.14 Determination of the inhibitory effects of lactic acid bacteria on *Clostridioides difficile* in-vitro, *Gizem Taylan Yalçin, Melike Nur Tosun, Nükhet Nilüfer Demirel Zorba* **190**

5. SUSTAINABILITY **192**

5.1 Process analytical technology for continuous process monitoring and control in chemical, biochemical and food industry, *Nenad Bolf* **193**

5.2 Efficiency of waste water treatment of Slavonski Brod agglomeration, *Korana Ambrozić, Valentina Velikanović, Dijana Grgas, Tea Štefanac, Tibela Landeka Dragičević* **194**

5.3 Health safety and nutritional value of coffee silverskin with impact of emerging techniques in the processing, *Vedran Biondić Fučkar, Anamarija Grudenić, Angela Božić, Ilija Djekić, Anet Režek Jambrak* **195**

5.4 Effect of seasonal growth and extraction method on antioxidant activity of *Colpomenia sinuosa* extracts, *Martina Čagalj, Vida Šimat* **197**

5.5 Polyphenol profiles and antioxidant capacity of different berry fruit pomace and seeds, *Ana Dobrinčić, Erika Dobroslavić, Iga Piasecka, Ena Cegledi, Zoran Zorić, Sandra Pedisić, Verica Dragović Uzelac* **199**

5.6 Polyphenolic profile of bay leaves (*Laurus nobilis* L.) collected in two coastal regions of Croatia, *Erika Dobroslavić, Ivona Elez Garofulić, Zoran Zorić, Ana Dobrinčić, Verica Dragović-Uzelac* **201**
5.7 Effect of ultrasound processing on microbiological safety of designed tomato-based products, *Josipa Dukić, Maria Margarida Cortês Vieira, Maria Dulce Antunes, Mecit Halil Öztop, Nikolina Grgić, Ivona Marinčić, Anet Režek Jambrak* **203**
5.8 Effect of ultrasound processing on physicochemical parameters of tomato-based products: addition of RuBisCO and olive powder, *Josipa Dukić, Maria Margarida Cortês Vieira, Maria Dulce Antunes, Mecit Halil Öztop, Nikolina Grgić, Ivona Marinčić, Anet Režek Jambrak* **205**
5.9 Polyphenol oxidase from Croatian traditional apple varieties and its role in anthocyanins degradation during storage, *Ana-Marija Gotal Skoko,Tihomir.Kovač, Goran Fruk, Antun Jozinović, Drago Šubarić, Krunoslav Aladić, Jurislav Babić, Ante Lončarić* **207**
5.10 Denitrification of synthetic wastewater containing high nitrate concentration, *Dijana Grgas, Marina Ugrina, Andrijana Brozinčević, Ana Špehar Ćosić, Tea Štefanac, Korana Ambrozi, Tibela Landeka Dragičević* **209**
5.11 Screening bean genotypes for drought resistance using high-throughput phenotyping, *Tomislav Javornik, Boris Lazarević, Klaudija Carović-Stanko* **211**
5.12 Processing of biodegradable PHBV and chitosan films as a multilayer structure for food packaging applications, *Pierre Lenoble, Jérôme Rousseau, Frédéric Debeaufort, Nasreddine Benbettaieb* **213**
5.13 Intelligent water treatment technologies for water preservation: case study presentation, *Josipa Lisičar Vukušić, Roxanne Engstler, Sven Johann Bohr, Stéphan Barbe* **215**
5.14 Turning winery waste into valuable substrate for baker´s yeast production: A circular economy approach, *Josipa Lisičar Vukušić, Thomas Millenautzki, Leon Reichert, Abdechafik Mokhlis Saaid, Lothar Müller, Leonardo Clavijo, Jendrik Hof, Marek Mösche, Stéphan Barbe* **216**
5.15 Fourier transform infrared spectroscopy for characterization of pectin biofilms enriched with mandarin peel extracts, *Antonela Ninčević Grassino and Senka Djaković* **216**
5.16Extraction and stabilisation of quercetin from yellow onion skin, *Ilja Gasan Osojnik Črnivec, Mihaela Skrt, Danijela Šeremet, Draženka Komes, Nataša Poklar Ulrih* **218**
5.17 A study on ultrasound and microwave assisted water-based extraction of polyphenolic compounds from olive leaves, *Melissa Prelac, Nikola Major, Maja Repajić, Dominik Anđelini, Danko Cvitan, Zoran Užila, Smiljana Goreta Ban, Tvrtko Karlo Kovačević, Dean Ban, Igor Palčić* **220**
5.18 The use of nonthermal techniques for the extraction of fibers and bioactive compounds from red beetroot peel, *Iva Sabljak, Dora Vlahović, Anet Režek Jambrak, Aleksandra Samardžija* **222**

5.19 Antimicrobial activity of by-product extracts in combination with pure compounds, *Danijela Skroza, Martina Čagalj, Ivona Krivić, Roberta Frleta, Vida Šimat* **224**
5.20 Phenolic profile and biological potential of vinification byproducts, *Danijela Skroza, Ivana Generalić Mekinić, Živko Skračić, Andrea Tadić, Antonia Nadilo, Martina Čagalj, Vida Šimat* **226**
5.21 Solid-state cultivation of *Penicillium* sp. to produce xylanase for the extraction of xylooligosaccharides from soybean hulls, *Nataša Ž. Šekuljica, Jelena R. Mijalković, Neda V. Pavlović, Sonja M. Jakovetić Tanasković, Ivana V. Gazikalović, Nevena D. Luković, Zorica D. Knežević-Jugović* **228**
5.22 Influence of experimental conditions on the yield of phenols and flavonoids obtained from tomato peel waste by microwave-assisted extraction, *Marina Tranfić Bakić, Sandra Pedisić, Zoran Zorić, Verica Dragović-Uzelac, Antonela Ninčević Grassino* **230**
5.23 Fermentation performance of carob flour, proso millet flour and bran for gluten-free flat bread production, *Bojana Voučko, Nikolina Čukelj Mustač, Cleo Pereira, Ljiljana Nanjara, Tomislava Grgić, Duška Ćurić, Dubravka Novotni* **232**

6. INDUSTRY 4.0 ..... **234**

6.1 Closing the loop and decreasing vegetable by-products in food industry production, *Jasmina Ranilović and Tanja Cvetković* **235**

6.2 Development of Smart food Factory, *Nedeljko Štefanić* **236**

6.3 Production processes and parameters affecting the oil content in potato chips, *Draženka Dite Hunje, Branka Levaj* **237**

6.4 Artificial intelligence and causal analysis in food technology *Zelimir Kurtanjek* **238**

6.5 Application of natural deep eutectic solvents for food waste valorisation, *Manuela Panić, Anja Damjanović, Martina Bagović, Mia Radović, Marina Cvjetko Bubalo, Kristina Radošević, Ivana Radojčić Redovniković* **239**

7.SmartCro **240**

7.1 Self-healing Organogelators of Edible Oil as Solid Fat Alternatives, *Nataša Šijaković Vujičić* **241**

8. SATELLITE SYMPOSIUM "VERA JOHANIDES" **243**

8.1 Biotechnology in Croatia, *Nenad Marđetko, Mario Novak, Antonija Trontel, Mario Pavlečić, Božidar Šantek* **244**

8.2 Mathematical modelling at Faculty of Food Technology and Biotechnology: From regression to artificial intelligence, *Želimir Kurtanjek* **246**

8.3 Modern vaccines: State of the art and future trends *Antun Vrdoljak* **247**

8.4 How biotechnology met circular economy at the Faculty of Food Technology Osijek, *Natalija Velić, Mirna Tišma, Vinko Krstanović, Ivica Strelec, Tihana Marček, Tihomir Kovač* **248**

8.5 Structural and functional characterization of exopolysaccharides produced by Limosilactobacillus fermentum MC1 isolated from mother's milk, *Nina Čuljak, Barbara Bellich, Paola Cescutti, Katarina Butorac, Jasna Novak, Martina Banić, Andreja Leboš Pavunc, Krešo, Bendelja, Ksenija Durgo, Jagoda Šušković, Blaženka Kos* **250**

8.6 Involvement of the RNA exosome in the maintenance of cell wall stability in the yeast Saccharomyces cerevisiae, *Nada Šupljika, Ana Novačić, Igor Stuparević* **252**

8.7 Versatile microfluidic systems applications: From biotransformation to extraction, *Ana Jurinjak Tušek, Anita Šalić, Davor Valinger, Bruno Zelić* **253**

8.8 Plant-derived protein hydrolysates and its use in animal cell technology, *Marijan Logarušić, Tino Ursić Igor Slivac, Višnja Gaurina Srček* **255**

Past, present and future challenges for the food industry: Fruit and vegetable products

Branka Levaj
Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Plenary lecture, presenting author Branka Levaj; blevaj@pbf.hr

In recent years, the pace of people's lives has accelerated and lifestyles have changed. In addition, consumers are increasingly aware of the importance of food for their health. All of this is having an impact on the food market and, as a result, on the food industry. Some trends have been around for more than a decade, such as plant-based diets, convenience, on-the-go, wellness, etc. Such macro trends have been market drivers and are likely to continue to be. When it comes to fruit and vegetable products, fresh cut is inevitably mentioned as it overlaps with the above trends, i.e. convenience, freshness and nutritional value. At the same time, production of FC fruits and vegetables is challenging because fruits and vegetables spoil quickly compared to uncut fruits and vegetables because processing mechanically injures tissues, which alters physiology, accelerates microbial growth, and shortens produce shelf life. To prevent microbiological spoilage, several methods and techniques are being investigated, including non-ionizing UV-C irradiation at an optimal wavelength of 254 nm. UV-C is a promising technology that is already widely used. It is of interest not only because of its antimicrobial effect, but also because nutritionally and biologically valuable components of foods are better preserved than, for example, with thermal pasteurization. Biologically active compounds are also the focus of interest as valuable components of the increasing amounts of waste from the food industry and as desirable components of a growing number of different groups of functional foods. All of these topics will be covered in more detail in the lecture.

INNOVATION

Future of food engineering and emerging computational processing – Manufacturing

Ferruh Erdoğdu
Department of Food Engineering, Ankara University, Golbasi-Ankara, Türkiye

Invited lecture, presenting author Ferruh Erdoğdu; ferruherdogdu@ankara.edu.tr

A significant concern of the food industry has been the sustainable processing for quality, safety and efficiency. Sustainability is based on applying non-polluting and economically efficient processes and conserving energy besides the quality and safety, and one trend now is the use of novel approaches to replace or combine them with the conventional techniques. In the meantime, food industry still lacks in innovative designs to satisfy these. Hence, efficient - sustainable processing and reduced energy with improved quality and safety are the challenges to satisfy. While process design and optimization are the required background for industrial process sustainability, improved food safety and quality assurance through sustainable processes further need virtualization (mathematical modelling-based simulation) approaches possibly supported with artificial intelligence and machine learning applications (besides the use of IoT and big data) for efficiency. These are the key components of designing sustainable processes. With the introduction of Industry 4.0, combining the virtualization with digitalization, IoT and cloud for improved smarter processes, computational approaches will be more significant, and they already have a seat in the future processing and manufacturing.

Designing emulsion-gel structures for the delivery of functionality at food application

Song Miao
Teagasc Food Research Centre Moorepark, Fermoy Co. Cork, Ireland

Invited lecture, presenting author Song Miao; song.miao@teagasc.ie

Emulsion gels are defined as emulsions with gel-like network structures and solid-like mechanical properties produced by gelling the continuous phase of emulsions (i.e., gels filled with emulsion droplets) or by aggregating the emulsion droplets (i.e., gel-like emulsions). Emulsion gels are classified into bulk emulsion gels, emulsion gel beads/particles, gel-like emulsions, and disrupted emulsion gels according to their morphological properties. Different morphological properties of emulsion gels also determine their various applications in the food industry, such as fat replacers for bulk emulsion gels, encapsulation materials and structuring agents for emulsion gel particles, and delivery systems and thickening agents for gel-like emulsions. Alginate gels filled with emulsion droplets (i.e., alginate-based emulsion gels) have received increased interest in recent years, and soy protein isolate (SPI), used as an emulsifier, has been widely investigated in the food industry. This study investigated three kinds of alginate-based emulsion gels containing SPI-coated droplets, according to their morphological properties (i.e., the diameter/length of gels): bulk emulsion gels (> 1 cm), emulsion macro-gel beads (1-10 mm) and emulsion micro-gel particles (0.2 - 1,000 µm). Effects of different alginate-based emulsion gels preparation process and conditions, present of SPI and the external/internal O/W/O emulsion-gelation methods on the morphological, structural and mechanical properties, and subsequent stability and applications such as release profile during in-vitro digestion were investigated and demonstrated. This study indicated, depending on preparation methods, process conditions and the polymer and emulsifiers used, emulsion gel properties (e.g., morphology, micro-structure and mechanical properties) and potential applications (e.g., encapsulation materials and structuring agents) can be controlled or designed.

Modulating the swelling behavior of casein microparticles (CMPs) for delivering bioactive compounds

Mohammad Asaduzzaman and Ronald Gebhardt*
Soft Matter Process Engineering (AVT.SMP), Aachener Verfahrenstechnik, RWTH Aachen University, Aachen, Germany

Oral presentation, presenting author Mohammad Asaduzzaman;
mohammad.asaduzzaman@avt.rwth-aachen.de

The aim of the study was to investigate the influence of pH on the stability and swelling behavior of casein microparticles (CMPs) and enhancing those properties at a particular pH of interest. We applied a gentle method of microparticles production based on depletion flocculation reaction in a casein-pectin system (Zhuang et al., 2015). Stable microparticles were formed by film drying followed by enzymatic hydrolysis of pectin. Sodium citrate was also added as a chelating agent during the preparation of CMPs. The structure of the microparticles was observed under the microscope, stability e.g. resistance against sodium dodecyl sulfate, SDS was measured at 600 nm using a UV-VIS spectrometer and the swelling process of single particles was followed in a microfluidic sieve cell under an inverted microscope (Schulte et al., 2020).

The microparticle produced were spherical shapes with a diameter range of 1-20 µM and curcumin was used to encapsulate into CMPs. It is important to know the characteristic properties and stability of the produced CMPs. The result from the stability experiment indicated that the CMPs were mainly formed by hydrophobic interactions, as they decomposed entirely upon the addition of SDS. The particle area observed under the microscope swelled about 1.8 fold at pH 8 after two hours while it took only a few minutes at pH 11 for such an increase in the particle area. The addition of citrate influences the swelling process of CMPs at pH 8. A higher degree of swelling was achieved with an increasing concentration of citrate (Asaduzzaman et al., 2022). However, no swelling was observed at pH 3, similar to human stomach pH. Due to the characteristic pH-dependent swelling

behaviour, CMPs can be used in the future for microencapsulating bioactive compounds to protect from harsh acidic conditions but a controlled release in an alkaline environment.

Encapsulation of Ground Ivy (*Glechoma hederacea* L.) extract, obtained by natural deep eutectic solvents extraction, in liposomes

*Bojana Balanč[1], Jelena Halagić[2], Jovan Skrobonja[2], Ana Milivojevic[2], Danijela Šeremet[3], Draženka Komes[3], Rada Pjanovic[2]**

[1] Innovation Centre, Faculty of Technology and Metallurgy, University of Belgrade, Serbia

[2] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

[3] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Rada Pjanovic; rada@tmf.bg.ac.rs

Ground Ivy (*Glechoma hederacea* L.) has been used in traditional medicine for centuries. Its medicinal properties were known even by Galen, who recommended this plant to those suffering from eye diseases. In American folk medicine, freshly squeezed juice of the Ground Ivy is used against headaches, neuralgia and dizziness. It contains flavonoids (quercetin, apigenin and luteolin), tannins, sesquiterpenes, bitter substances, a little essential oil, saponin and resin. With the fast development of ionic liquid analogues, named 'natural deep eutectic solvents' (NDESs), and their application in a wide range of chemical and biochemical processes in the past decade, the extraction of bioactive compounds has attracted significant interest. Numerous studies have explored the extraction of bioactive compounds using NDESs from diverse groups of natural sources. Compared with conventional organic solvents, NDESs are eco-friendly, biodegradable and non-toxic organic compounds which are also a low cost, being easy to produce in the laboratory. The aim of this work was to find right natural deep eutectic solvent to extract the maximal amount of actives from Ground Ivy. For those purposes several different NDESs was used. Extraction was carried at room temperature for 1 hour. Concentrations of rosmarinic and caffeic acid in the obtained extracts were determined using a high performance liquid chromatography. The results showed that best solvent for Ground Ivy was mixture of betaine and citric acid in molar ratio 1:1. Extracts were encapsulated in liposomes prepared using proliposome methods. Encapsulation should

preserve active compounds from the external factors such as oxidation, hydrolyzes, temperature degradation etc. The release of polyphenols from liposomes was studied using standard Franz diffusion cell.

Effect of high-power ultrasound (HPU) on stability of bioactive compounds in strawberry juices

Anica Bebek Markovinović[1], Paula Bičanić[1], Predrag Putnik[2], Boris Duralija[3], Danijela Bursać Kovačević[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
[2] University North, Koprivnica, Croatia
[3] Faculty of Agriculture, University of Zagreb, Croatia

Poster presentation, presenting author Anica Bebek Markovinović;
abebekmarkovinovic@pbf.hr

The effect of high-power ultrasound (HPU) on the content of total phenolic compounds (TPC), anthocyanins (ANT), hydroxycinnamic acids (HCA), flavonols (FL), and condensed tannins (CT) in strawberry juices (*Fragaria* x *Ananassa* Duch.) of the cultivar 'Albion' (at 75% ripeness, J1; and 100% ripeness, J2; stored at 4 °C for 7 days) was evaluated. HPU treatment parameters were: (i) amplitude (25, 50, 75, and 100%), (ii) pulse (50 and 100%), and (iii) treatment duration (5 and 10 min). Juices from riper strawberries had higher levels of ANT, HCA, FL and CT, while TPC was higher in juices from less ripe samples. Storage decreased TPC and ANT, while HCA and FL increased, and the content of CT remained unchanged during storage. The increase in amplitude negatively affected most phenolic compound contents (ANT, HCA, and CT), with the exception of FL. The TPC content decreased with increasing amplitude up to 75% of the initial value, after which it began to increase. Increasing the pulse and treatment time resulted in a decrease of the most phenolic compounds (ANT, FL, and CT), except for HCA, for which pulse and treatment time had no statistically significant effects. An increase in pulse led to an increase in TPC content, whereas treatment time had no statistical significance. In conclusion, strawberry juices from both ripening stages are suitable for HPU treatment, but optimization of HPU parameters is required to preserve studied phenolic compounds.

Application of additive technology in a production of functional strawberry-based product

*Anica Bebek Markovinović[1], Filip Valjak[2], Adrijana Žigolić[1], Predrag Putnik[2], Danijela Bursać Kovačević[1]**

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia

[3] University North, Koprivnica, Croatia

Poster presentation, presenting author Danijela Bursać Kovačević; dbursac@pbf.hr

Nowadays, consumers are increasingly demanding nutritious foods that have a positive impact on their health. Strawberry represents a valuable biological potential for humans due to its rich composition of phenolic compounds. The application of additive technologies also known as 3D-printing (3DP), enables the production of three-dimensional, personalized, functional products using layer-by-layer technology. Accordingly, the aim of this work was to design a new functional strawberry-product using 3DP. To this end, two sets of different printing parameters (i.e., printing speed, ingredient flow speed, first-layer-nozzle height and line thickness) were evaluated on the printability of a strawberry-based formulation. The formulation was developed by separately adding different proportions (10, 15, 20%) of wheat and corn starch. The contents of total phenolic compounds, monomeric anthocyanins and antioxidant capacity were investigated in all samples. The results showed that different starch proportions and starch types affected the content of the studied bioactive compounds and antioxidant activity. Both starches were suitable carrier materials and can be used for the production of 3DP products. However, optimization of all parameters (starch types and ratios program parameters: printing speed, ingredient flow speed, height of first-layer-nozzle and line thickness) is required to obtain a product with desired and functional properties.

Influence of temperature and carrier ratio on fennel essential oil powder obtained by spray drying

Ena Cegledi, Maja Repajić, Nina Marčac, Ivona Elez Garofulić, Karla Cegledi, Erika Dobroslavić, Verica Dragović-Uzelac*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Ena Cegledi; ecegledi@pbf.hr

Essential oils are volatile mixtures of compounds with characteristic flavor obtained from plant material. One of the plants rich in essential oil is fennel (Foeniculum vulgare Mill.). It is a perennial plant with a pleasant and aromatic odor, whose seeds are rich in essential oil (5-6%). Since the essential oil of fennel seeds has antimicrobial and antioxidant properties, nowadays there is a growing interest in its use in the food and pharmaceutical industries. However, its high volatility and susceptibility to oxidation in the presence of moisture, light and oxygen limit its use. Thus, encapsulation represents a suitable method to prolong the stability of essential oils and preserve their functional properties. One of the most commonly used encapsulation methods is spray drying, in which the suspension is dried in a stream of hot air with the addition of a suitable carrier to form stable powder in which flavor and aroma are preserved. Therefore, the aim of this research was to investigate the impact of temperature (120, 160 and 200 °C) and ratio of maltodextrin and β-cyclodextrin carriers (1:1, 3:1 and 1:3) on process yield, oil retention and encapsulation efficiency, and to determine the optimal conditions for producing powders with the best properties. The spray drying yield of fennel essential oil powder ranged from 60.89- 74.51%, oil retention ranged from 27.40-57.66%, and encapsulation efficiency ranged from 18.99- 42.96%. An increase in temperature increased the values of all three observed parameters, and an increase in maltodextrin content led to an increase in oil retention and encapsulation efficiency. However, the yield was highest at a higher β-cyclodextrin content. The optimal conditions for the production of powders with the best properties were a drying temperature of 200°C and a ratio of

maltodextrin and β-cyclodextrin of 3:1. The application of the spray drying process for fennel essential oil encapsulation proved to be effective in producing powders with desirable properties.

Electrostatic extrusion for co-encapsulation of hydrophilic and lipophilic myrtle extracts (*Myrtus communis* L.)

Daniela Cvitković, Sandra Balbino, Jasna Mrvčić, Verica Dragović-Uzelac*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Sandra Balbino; snedjer@pbf.hr

Since numerous studies have shown the beneficial effects of extracts from Mediterranean herbs on human health, scientific research has focused on the use of various extraction methods to isolate and convert such compounds into stable forms that can be successfully incorporated into functional products and dietary supplements. Myrtle (*Myrtus communis* L.) is one of the best-known aromatic shrubs of the Mediterranean region, long known for its therapeutic effects on various organ systems. Phenolic compounds, flavonols (myrizetin), flavan-3-ols and phenolic acids (hydroxybenzoic acid) are the main hydrophilic bioactive molecules of myrtle leaves. The main lipophilic compounds are the volatile constituents of the essential oil, i.e. terpenoids 1,8-cineole, myrtenyl acetate and α-pinene, while the lipid fraction of the berry is rich in unsaturated fatty acids. Since these compounds are sensitive to a number of external factors such as pH, light, oxygen, high/low temperatures and are often unstable, they need to be protected and stabilized by encapsulation. Moreover, given the potential synergistic effect of molecules of different polarity and bioactive properties isolated from different plants or plant parts by different extraction procedures, encapsulation offers the possibility of co-stabilization of these compounds. Therefore, the aim of this study was to investigate the potential of electrostatic extrusion to obtain capsules of mixtures containing a hydroalcoholic (70% ethanol) extract of myrtle leaves, myrtle essential oil, and supercritical CO_2 from myrtle berries in a 3:1:1 (w/w/w) ratio. A Box-Behnken experimental design was used to determine the effects of process conditions on the co-encapsulation efficiency of 1% sodium alginate as a carrier for total phenolic compounds, volatiles, and lipid fraction

retention. The relationship between the independent factors, encapsulation temperature (28-48 °C), content of Tween 80 (0.5-1.5%) used as emulsifier, and $CaCl_2$ concentration in the recipient solution (3-9%) was modeled using response surface methodology. Selected models showed a significant influence of emulsifier content, with the highest retention of the targeted bioactive molecular groups obtained at higher emulsifier and lower $CaCl_2$ contents. Electrostatic extrusion was successfully implemented for co-encapsulation of hydrophilic and lipophilic extracts from myrtle leaves and berries.

The influence of ultrasonic pretreatment prior hydrodistillation of basil on the yield of essential oil

Maja Dent and Kristina Blažević*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Maja Dent; maja.dent@pbf.unizg.hr

The influence of ultrasonic pretreatments prior hydrodistillation of basil (*Ocimum basilicum* L.) was investigated to increasing essential oils yield. The hydrodistillation was preceded by ultrasonic pretreatment (ultrasonic output power of 200 W, a probe diameter of 14 mm) for 5, 10, 20, 30 and 40 minutes of extraction time. In order to determine the impact of pretreatments prior hydro distillation on the yields of basil essential oil, yields were compared to no pretreatment control. Ultrasonic pretreatments did not increase the yield of basil essential oil compared to the no pretreatment control, while with a longer time of ultrasonic pretreatment there was no increase in the yield of basil essential oil. After ultrasonic pretreatment of basil, enzymatic pretreatment with the addition of cell-degrading enzymes xylanase-pectinase-cellulase (1:1:1) was performed at 40 ˚C for 4 h. However, enzymatic pretreatment did not increase oil yield compared to ultrasonic pretreatment and no pretreatment control. However, the results showed that despite ultrasonic and enzymatic pretreatments prior hydro distillation of basil, the yields of essential oils did not significantly increase. In the production of essential oils, hydrolate is formed as a by-product, which has a strong antioxidant capacity determined by the FRAP method. In conclusion, the results of this study showed that ultrasonic and enzymatic pretreatment prior hydrodistillation did not increase the yield of basil essential oils.

The impact of enzymatic and ultrasonic pretreatment on the yield and volatile profil of bay laurel and sage essential oil

Maja Dent[1], Tamara Vujović[2], Anđela Miljanović[1], Igor Jerković[3], Zvonimir Marijanović[3], Dorotea Grbin[1], Tonči Rezić[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Ruđer Bošković Institute, Zagreb, Croatia,

[3] Faculty of Chemistry and Technology, University of Split, Croatia

Poster presentation, presenting author Maja Dent; maja.dent@pbf.unizg.hr

To enhance the essential oils yields for hydrodistillation of bay laurel and sage, the impact of ultrasonic and enzymatic pretreatment (under optimized xylanase activity) was investigated. Response surface methodology (RSM) was used to optimize the reaction conditions of pH, temperature, and reaction time to obtain maximum xylanase activity. The impact of optimized conditions during enzymatic pretreatment induced variations in the essential oil yields. After the pretreatments, bay laurel and sage essential oils were isolated using Clavenger type apparatus and their yields were measured and compared with the essential oils obtained from non-treated plant materials (no pretreatment control). In order to determine the impact of pretreatments on the chemical composition, isolated essential oils were analyzed by gas chromatography and mass spectrometry (GC-MS), and afterward, the correlations were tested using Spearman's test. The main constitutes of the sage essential oils are oxygenated monoterpens (α- and β-thujone, 1,8-cineole and camphor). 1,8-cineole is the major component of bay laurel essential oils, followed by α-terpinyl acetate, and several monoterpene hydrocarbons and phenylpropane derivates with dominant components eugenol and methyleugenol. Several chemical compounds (mostly oxygenated monoterpenes) of bay laurel and sage essential oils were detected in greater quantity after the ultrasonic and enzymatic pretreatments in comparison to untreated plant material.

However, the results showed that despite optimization, the activity of xylanase did not significantly affect the quantity and quality of bay laurel and sage essential oils. The main advantage of ultrasonic extraction is shortening of the pretreatment time and only 10 minutes of ultrasonic pretreatment before the enzymatic pretreatment caused 50 % enhancement of sage and 40 % of bay laurel essential oil yields. Due to their chemical composition (oxygenated monoterpenes, monoterpene and sesquiterpene hydrocarbons), the essential oils obtained by the ultrasonic and enzymatic pretreatment prior hydrodistillation possess potential in the food industry applications.

Nutrient solution management – innovative agricultural practice for higher nutrient quality of stinging nettle

Mia Dujmović, Nevena Opačić, Sanja Radman, Sanja Fabek Uher, Marko Petek, Lepomir Čoga, Ante Galić, Nadica Dobričević, Nina Toth, Božidar Benko, Sandra Voća, Jana Šic Žlabur*

Faculty of Agriculture, University of Zagreb, Croatia

Oral presentation, presenting author Mia Dujmović; mdujmovic@agr.hr

Innovative agricultural practices are increasingly focused on conserving resources, reducing negative environmental impacts, and producing food with high nutritional quality and high content of health-promoting phytonutrients. Proper selection of cultivating factors, especially balanced nutrition, can significantly increase nutritional value and result in foods with significant biological and functional properties. The innovative techniques for cultivation of plant species, such as floating hydroponic systems, can also ensure a uniform chemical composition and high specialized metabolites (SM) content through nutrient solution management. Although it has been neglected in human diet, stinging nettle has a rich chemical composition (vitamins, minerals, pigments, phenols and other SM) and can be consumed as a green leafy vegetable. The aim of this study was to determine the influence of different corrections (B1, B2 and B3) of the nutrient solution (NS) during three harvest periods on the SM content and antioxidant capacity of nettle leaves. The B1 and B2 treatments were initially filled with NS prepared independently of the water's chemical composition and B3 was filled with NS adjusted according to the chemical analysis of the water. After each harvest, the corrections of NS were made as follows: B1 was filled with water, B2 with NS, and B3 with nutrients according to the chemical analysis of NS. Of the nutritional and functional properties, total phenolics (TP), ascorbic acid (AsA), pigment content and antioxidant capacity were analyzed. The highest TP (377.04 mg GAE/100 g), total flavonoid (279.54 mg CTH/100 g), AsA (112.37 mg/100 g) and pigment content, as well as the highest

antioxidant capacity (3546.91 µmol TE/L) were recorded in the third harvest, B2 treatment. The results show a significant positive influence of multiple harvesting and NS treatment on the SM content of nettle, confirming this type of hydroponic cultivation as an innovative technique for the production of novel food with high nutritional value.

Open courseware on responsible food packaging - FitNESS 2.0 project

Kata Galić, Mia Kurek, Mario Ščetar*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Kata Galić; kata.galic@pbf.unizg.hr

Food packaging is essential for protecting food, keeping it safe and thus preventing substantial food losses. It can help to enable the preservation, transportation, distribution, and preparation of food. However, food packaging today is strongly associated with both environmental risks and health risks for consumers. To help packaging professionals address this challenge, the FitNESS platform, https://fitness.agroparistech.fr was created to provide training courses of different levels on the design of responsible food packaging. The current open-source FitNESS platform is one of the largest e-learning platform on food packaging globally (3 months' worth of lectures are online). It is accessible without needing an account, and anyone can duplicate it. The ambition of the new project (FitNESS 2.0, from 01/11/2021 to 31/10/2024) www.fitness-foodpackaging.com, is to reach a broader audience in the food packaging value chain, from the chemical industry to recyclers, and to offer certified courses validated by online tests. FitNESS 2.0 will contribute to accelerating the digital transformation of education and training systems by bridging education, research, and innovation, as well as by creating a global community within the field and offering new training paths for current and future professionals. In addition to expanding the current set of courses, FitNESS 2.0 is committed to implementing the possibility of multilingual courses and the innovative approach of personalised learning (using an artificial intelligence-based assistant and guided curriculum). FitNESS 2.0 project has as main target food and packaging engineers, recycling and processing professionals, and circular economists.

Acknowledgments:FitNESS 2.0 is funded by ERASMUS+ as a Cooperation Partnership – 2021-1-FR01-KA220-HED-000023509. This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Encapsulation of anthocyanins from chokeberry (*Aronia melanocarpa*) with different types of plazmolyzed yeast cells

Marcin A. Kurek, Anna Onopiuk, Arkadiusz Szpicer*

Institute of Human Nutrition Sciences, Warsaw University of Life Sciences, Poland

Oral presentation, presenting author Marcin A. Kurek; marcin.kurek@sggw.edu.pl

Microencapsulation of anthocyanins using different carriers are known in the literature, while microencapsulation with yeast has not been widely encountered. The aim of this study was to investigate how the type of yeast can affect the ability to microencapsulate anthocyanins. In this study, the possibility of microencapsulation of anthocyanins from black chokeberry was investigated using yeast such as Saccharomyces cerevisiae without plasmolysis (CON), Saccharomyces cerevisiae after plasmolysis (SCB), Saccharomyces pastorianus (SPA), Saccharomyces cerevisiae for top fermentation (SCA) and Saccharomyces bayanus (SBA). The yeast was plasmolyzed (apart from CON) for 24 h in saline, while it was then lyophilized and mixed with an anthocyanin solution (500 mg/L). It was shown that the water content of the CON microcapsules was significantly higher than that of those that were plasmolyzed. This was reflected in the water activity, as the CON and SCB samples had aw values between 0.055 and 0.64, while the rest of the samples took values above 0.115. The CON samples were the brightest, while the b* parameter was the most variable parameter for all samples. In terms of retention, a reference to the ability of yeast to encapsulate, SCA and SPA had the highest values, followed by 52.87 ± 0.22 and 53.88 ± 0.81%. During the sorption, i.e., SCA and SPA samples absorbed anthocyanins the fastest at a rate of more than 70 mg/g min. Thermal analysis only revealed a phase transition around 149°C for the SBA sample, suggesting its different structure during the microcapsule formation.

AI causal analysis of food quality

Želimir Kurtanjek

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral Presentation, presenting author Želimir Kurtanjek; zelimir.kurtanjek@gmail.com

Considered are applications of “big data”, artificial intelligence tools (AI) and structural causality modelling (SCM) for evaluation of key aspects of food science and technology. The focus is to predict a causal relationship between food chemical analytics and physicochemical data related to a human perception of food quality. As example, applied are deep learning, random forest and causal Bayes networks for analytics of meat, bread and wine. The considered data generation processes are NIR and FTIR spectra, biochemical analytics, rheology measurements, physico-chemical data, associated with technological and human expert quality classifications. Due to high biological variability of food stuffs and their interrelations, predictions of quality metrics are subject to intricate confounding. The focus is on causal analysis based on Bayes networks to extract key pattern functional relations in presence of large data entropy. Based on the BN model structure applied is d-separation criteria to block noncausal confounding (interference). The causal relations are extracted as partial dependences plots predicted by the adjustment covariate sets and Bayes neural networks. The results are discussed in view of available open source software tools in the industrial environment.

Development and characterization of biobased films from chitosan and gelatine with gallic acid applied as pouches for olive oil storage

Mia Kurek[1], Petra Poldan[1], Mario Ščetar[1], Emilie Descours[2], Domagoj Gabrić[1], Kata Galić[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] ISIPCA Institut International de Parfums, Cosmétiques et Arômes alimentaires, Versailles, France

Poster presentation, presenting author Mia Kurek; mkurek@pbf.hr

Due to the great commercial interest in reducing the use of single-use plastics, as well as needs for high-quality food with extended shelf-life, made a great opening for innovations in food packaging industry. Taking into account the sustainable concept, it is important to be aware of properties of used raw materials and their performance when used in contact with food product. Therefore, knowledge on structural, morphological, barrier properties of novel materials is on the top of the scientific interest before application to food. In addition, available scientific studies still rarely use novel produced combinations of biomaterials for real food product packaging. In this research, novel type of biobased films with edible properties based on chitosan and gelatine were produced. Firstly, material characterisation was done aiming to determine physico-chemical, barrier and antioxidant properties together with its biodegradability in soil. In a second stage, films were used for creation of pouches aimed for olive oil packaging. Gallic acid was used as antioxidant. The addition of gallic acid resulted in the significant increase in total phenolic content and changes in optical and water related properties, like hydrophilicity, water vapour permeability etc. However, the addition of gallic acid has significantly impacted the gas barrier properties (O_2 and CO_2) and increased the degradation time in the commercial soil.

Electrospun nanofibers as an emerging delivery system for phenylethanoid glycosides: preparation and in vitro evaluation

Ana Mandura Jarić[1], Laura Miletić[1], Sunčica Kuzmić[2], Aleksandra Sander[3], Danijela Šeremet[1], Aleksandra Vojvodić Cebin[1], Draženka Komes[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Forensic Science Centre "Ivan Vučetić" Zagreb, University of Zagreb, Croatia

[3] Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia

Poster presentation, presenting author Ana Mandura Jarić; amandura@pbf.hr

Today, the global market is strongly influenced by environmental awareness and a health-promoting lifestyle, underlined by innovative food concepts that offer both nutritional and bioactive value with the aim of preventing various health diseases. With Millennials being the biggest proponents of consuming herbal preparations and phytochemicals, i.e. dietary fibers, vitamins and polyphenols, the functional foods niche has never been more attractive. Polyphenols, as the most studied group of bioactive compounds, possess remarkable biological potential, e.g. free radical scavenging, antimutagenic, anti-inflammatory, antimicrobial etc. Susceptibility to degradation, unpleasant sensory profile, relatively low bioavailability, and bioaccessibility are significant drawbacks related to the technological and biological aspects of polyphenols, but various encapsulation techniques serve as effective solutions for maintaining functionality, improving their stability, and prolonged release. Electrospinning technology represents an innovative technique for enclosing active agents within carbohydrate or/and protein (bio)polymer under a high- voltage electric field to produce nanofibers with advanced structural properties. For the production of polyphenol-loaded nanofibers, the defined concentration of pullulan (PUL) and polyethylene oxide (PEO) solutions in concentrated water extract (100 °C, 30 min, 1g:100 mL) of plant species Mountain

Germander (*Teucrium montanum* L.; collected from Varivode, Šibensko- kninska županija) were prepared. Conductivity, viscosity and surface tension of PUL and PEO solutions with plant extract were measured and compared with aqueous PUL and PEO solutions. Encapsulation efficiency was monitored by measuring total phenolic content (TPC) and DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay, while the predominant phenolic compounds- echinacoside and verbascoside were analyzed using HPLC-DAD. Morphological characterization of obtained nanofibers was studied by scanning electron microscope (SEM). According to the results, nanofibrous mats with 15% PUL (w/w) were evaluated to have the highest encapsulation efficiency (echinacoside: 92,92%, verbascoside: 49,21%), homogeneous and bead- free surface morphology with promising prolonged release of the targeted bioactive compounds. These results could serve as a basis for further optimization of solutions for the preparation of nanomaterials, enriched with functional agents.

Acknowledgment: This research was acquired as part of the project named: “Formulating encapsulated systems of bioactive ingredients from traditional plants: Mountain Germander and Ground Ivy for the development of innovative functional food products" (IP-2019-04-5879 / FUNCBIOCAP), funded by the Croatian Science Foundation.

Oenological characterization of non-*Saccharomyces* yeasts isolated from Croatian white grape variety Maraština

Vesna Milanović[1], Federica Cardinali[1], Ana Boban[2], Jasenka Gajdoš Kljusurić[3], Ana Mucalo[2], Andrea Osimani[1], Lucia Aquilanti[1], Cristiana Garofalo[1], Irena Budić-Leto[2]**

[1] Polytechnic University of Marche, Department of Agricultural Sciences, Food and Environment,
Ancona, Italy

[2] Institute for Adriatic Crops and Karst Reclamation, Split, Croatia

[3] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Vesna Milanović and Irena Budić-Leto; irena@krs.hr

Wine is the result of alcoholic fermentation carried out principally by Saccharomyces cerevisiae strains which transform sugars present in grape must into ethanol, CO_2 and other compounds. Differently from *S. cerevisiae* which is scarcely present on harvested grapes, non-Saccharomyces yeasts are highly abundant which gives them the opportunity to begin fermentation. Since use of commercial yeasts may negatively affect the aromatic complexity of wine, new trends in winemaking have emphasised the concept of microbiological terroir thus stimulating the use of indigenous starters from different regions, including non-Saccharomyces yeasts aimed to increase organoleptic complexity of wines. This study focused on the oenological characterization of non-*Saccharomyces* yeasts isolated from 11 Maraština vineyards located within the Croatian coastal winegrowing region of Dalmatia aimed to discover new candidate strains for development as starter cultures. Among the 257 isolates, 27 different species from 16 genera were identified by sequencing the ITS1-5.8S-ITS2 region. The species from *Aureobasidium* genus (*Aureobasidium pullulans, Aureobasidium melanogenum*, and *Aureobasidium namibiae*) largely prevailed, follow*ed by Metschnikowia chrysoperlae, Hanseniaspora uvarum and* Lachancea thermotolerans strains. All isolates were evaluated for their ethanol and SO_2 resistance, ability to grow on different temperatures, H_2S

and acetic acid production, as well as hydroxycinnamic acid decarboxylase (HCDC) activity. Furthermore, the 75 best performing strains were screened for the activity of 19 enzymes using API-ZYM test system with the emphasis on the enzymes related to wine aroma such as esterase, esterase lipase, lipase, leucine acrylamidase, valine acrylamidase, cystine acrylamidase, and β-glucosidase. Various strains from *Lachancea, Hanseniaspora, Metschnikowia, Pichia, Hyphopichia* and *Starmerella* genera showed high SO_2 (up to 250 mg/L) and ethanol (up to 12%) tolerance, low acetic acid and medium-low H_2S production. The HCDC activity was detected in several *Metschnikowia* and *Aureobasidium* isolates. Most of the isolates demonstrated high leucine and valine acrylamidase activity whereas several *Hanseniaspora uvarum*, *Lachancea thermotolerans* and *Metschnikowia chrysoperlae* strains were characterized by high β-glucosidase activity thus allowing the selection of the most promising strains for further development as starter cultures to produce aromatically distinct wines.

Properties of interesterified mixtures of hemp and coconut oil

Marko Obranović[1], Chloé Louis-Gavet[2], Joanna Bryś[3], Rita Brzezińsk [3], Agata Górska[3], Ewa Ostrowska-Ligęza[3], Magdalena Wirkowska-Wojdyła[3], Andrzej Bryś[4]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] CPE-Lyon (École supérieure de chimie, physique, électronique de Lyon), Villeurbanne, France

[3] Institute of Food Science, Warsaw University of Life Sciences, Poland

[4] Institute of Mechanical Engineering and Energetics, Warsaw University of Life Sciences, Poland

Poster presentation, presenting author Marko Obranović; mobran@pbf.hr

Hemp seed oil, obtained from the seeds of *Cannabis sativa*, is known for its nutritional, health-promoting and bioactivity properties. Compared to other vegetable oils, it is a particularly rich source of both n-3 and n-6 essential fatty acids. Coconut oil is a vegetable oil obtained by pressing and heating copra, i.e., the hard flesh of coconut palm nuts (*Cocos nucifera*). Coconut oil is composed mainly of saturated fatty acids, which are characterized by high lauric acid with content ranged approximately 50%. Interesterification process is commonly applied method of producing structured lipids. This process influences on the structure and composition of triacylglycerols, but does not change the natural structure of their fatty acids. The main goal of this study was an attempt of enriching coconut fat with low-melting triacylglycerols by conducting interesterification process of this fat with hemp seed oil. The mixtures of coconut oil and hemp oil at different weight ratio: 1:3, 1:1 or 3:1 were mixed with 1% (w/w) sodium methoxide and then interesterified for 60 min or 120 min at 60°C. The determination of fatty acid composition of obtained interesterified product was carried out by gas chromatographic analysis of fatty acid methyl esters. The positional distribution of fatty acids in the sn-2 and sn-1,3 positions of triacylglycerols was based on the ability of the pancreatic lipase to selectively hydrolyze ester bonds in the sn-1,3 positions. The acid values and peroxide values

were determined by using titration methods. Oxidative stability of interesterified product and their oxidative induction time were determined with the use of the differential scanning calorimeter equipped with a high-pressure cell (PDSC). The results of this work indicated that due to interesterification of coconut oil and hemp seed oil blends, new fats that have not their natural equivalents can be produced. On one hand mixtures esterified for 2 hours were characterized by a high peroxide value but on the other hand by a low free fatty acid content. The mixture containing 50% hemp seed oil and 50% coconut oil undergone 2-hour transesterification was characterized by the longest oxidation induction time and the best hydrolytic stability.

The use of regiospecific lipase to obtain structured lipids from mixtures of coconut oil and hemp

Marko Obranović[1], Chloé Louis- Gavet[2], Agnieszka Górska[3], Diana Mańko-Jurkowska[3], Rita Brzezińska[3] Joanna Bryś[4]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] CPE-Lyon (École supérieure de chimie, physique, électronique de Lyon), Villeurbanne, France

[3] Institute of Food Science, Warsaw University of Life Sciences,Poland

[4] Institute of Mechanical Engineering and Energetics, Warsaw University of Life Sciences, Poland

Poster presentation, presenting author Marko Obranović; mobran@pbf.hr

Interesterification is one of the most important processes for modifying the physicochemical characteristics of oils and fats. During this process, fatty acids are exchanged within and among triacylglycerols until a thermodynamic equilibrium is reached. The interesterification of lipids catalyzed by lipases is an alternative to the chemical interesterification. Lipases are widely used for the chemical redesign of fat for improving physical, chemical, and/or nutritional properties. Hemp seed oil contains high concentration of polyunsaturated fatty acid (PUFA, 70-90%) and is a good dietary source of essential fatty acids, linoleic and linolenic acids. Linoleic acid (50-70%) is the major fatty acid in the seed oil. Hemp seed oil is considered healthy because of its desirable omega-6: omega-3 fatty acid ratio. Coconut oil is predominantly composed of saturated fatty acids (about 94%). This gives it a firm texture at cold or room temperatures. The predominant type is lauric acid (47%), with myristic and palmitic acids present in smaller amounts. The aim of this study was to characterize and study fatty acid profile and the oxidative stability of structured lipids synthesized by enzymatic interesterification of a blend of hemp seed oil with coconut oil using differential scanning calorimeter (DSC Q20 TA) coupled with a high-pressure cell. Enzymatic interesterification was

catalyzed by the commercial preparation Lipozyme RM IM, which contains immobilized lipase from Rhizomucor miehei. The blends of hemp and coconut oils (25/75%, 50/50% and 75/25%) were interesterified for 2 and 6 h, at a temperature of 60°C. The determination of fatty acid composition was carried out by gas chromatographic (GC) analysis of fatty acid methyl esters. Acid and peroxide values were determined by titration of fat samples. The oxidative induction time was obtained from the pressure differential scanning calorimetry curves. The fatty acid profile remained unchanged, but fats after modification with more hemp oil contain more essential fatty acid. There is a slight decrease of the oxidative stability of the most blends after enzymatic modifications which is indicated of shorter induction time of oxidation. The acid value increases after interesterification. It can be also observed the higher acid value after the longer reaction time. The peroxide value is higher in the blends which contain more hemp oil than coconut oil.

The effect of UV-C irradiation and high hydrostatic pressure on the quality of fresh-cut potatoes

Zdenka Pelaić, Zrinka Čošić, Maja Repajić, Filip Dujmić, Branka Levaj*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Zdenka Pelaić; zpelaic@pbf.hr

Fresh-cut potatoes (Solanum tuberosum L.) (FCP) are subject to microbiological spoilage and various physico-chemical changes that impair their quality and shorten their shelf-life. As UV-C and high hydrostatic pressure (HHP) have a proven antimicrobial effect, the aim of this research was to investigate their effect on microbial stability, sensory and physicochemical properties of FCP during 15 days of storage in a vacuum package at 6 °C. Samples were previously immersed in sodium ascorbate solution, dried, vacuum packed (PA/PE) and treated with UV-C irradiation for 5 minutes or HHP at 400 MPa for 3 minutes. Samples were analyzed for total aerobic mesophilic bacteria (AMB), sensory properties and CIELab color during storage (on 0, 8th and 15th day). Chlorogenic acid and acrylamide levels were determined by UPLC MS2 and reducing sugar levels by RI-detector (HPLC). UV-C and HHP significantly reduced the initial number of AMB (reduction of 1 log CFU/g), but also significantly slowed their growth during storage, resulting in a reduction of 5 log CFU/g on day 15 when HHP was used. The colorimetric results showed significantly higher brightness (L*) for the samples treated with UV-C and HHP. According to the sensory results, the treated samples were less susceptible to browning at the end of the storage period than the untreated ones. For the same samples, odor was maintained during storage, although the HHP treated samples had a slightly lower score. The UV-C and HHP treatments also significantly reduced the chlorogenic acid content compared to the untreated samples. Although the content did not change significantly during storage, a slight increase was observed in the untreated and UV-C samples. The sugar content was not significantly different for all samples until the 15th day

of storage, when a higher content was observed in the UV-C and HHP samples. A similar trend was observed for acrylamide content in fried samples. Treatment of FCP with UV-C and HHP was found to be effective in maintaining the microbiological quality (AMB), color, and odor of FCP during 15 days of storage. In addition, the acrylamide content in fried potatoes was kept below the recommended limits.

Characterization of oil stored in novel bio-based films

Arsène Pitois[1], Anaïs Julou[1], Mia Kurek[2], Nadine Vallet[1], Emilie Descours[1]*

[1] Institut Supérieur International Parfum Cosmétique Arômes, Plateforme scientifique, ISIPCA,

Versailles, France

[2] Faculty of Food Technology and Biotechnology, University of Zagreb,Croatia

Poster presentation, presenting author Nadine Vallet; nvallet@isipca-lafabrique.fr

In the age of ecological transition, a general rethink of the use of plastics is needed. Indeed, according to OECD, global plastic waste, which management remains an issue to this day, has doubled to 357 million tonnes during the last 20 years. In this respect, alternatives to plastic packaging's must be found. Currently, the most promising one seems to be chitosan . In this context, biodegradable, edible and single-dose chitosan-based food packaging pouches were formulated, with the aim of storing olive oil in a first place. Bio-based films were formulated with different content of antioxidant in order to see if the presence of an antioxidant could slow the olive oil oxidation. The purpose is to study the olive oil degradation over time depending on storage conditions: a) glass vials as commercial benchmark and b) novel bio-based films. The main idea is to find out if chitosan-based bioplastic could represent an interesting eco-friendly and sustainable alternative to conventional materials e.g. plastic and glass. Moreover, by adding natural antioxidants to produce active packaging, another aim was to determine the olive oil degradation and oxidation in bio-based pouches. Quality of olive oil was estimated by measuring the amount of fatty acids and of volatile organic compounds (VOCs) over time. Changes in oil colour over time was also studied. Gas chromatography and supercritical fluid chromatography were respectively used to analyse olive oil's VOCs and olive oil's fatty acids at different storage periods, whereas colour degradation was studied by spectrocolorimeter. It appeared that olive oil stored in antioxidant-formulated biofilms

present a greater nutritional quality than olive oil stored in glass or in bio-based films formulated without antioxidant. Furthermore, for each type of packaging, the different olive oils seemed to present comparable colour degradation kinetics during the first six weeks of storage.

Potential of psyllium as an ingredient in 3D-printed gluten-free snacks evaluated by rheology, NIR and physical properties

Kristina Radoš[1], Maja Benković[1], Nikolina Čukelj Mustač[1], Bojana Voučko[1], Mislav Tujmer[2], Duška Ćurić[1], Dubravka Novotni[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia

Poster presentation, presenting author Maja Benković; mbenkovic@pbf.hr

With its good gelling properties, psyllium is a promising component that could improve the printability of food "ink", while its high soluble fiber content increases the nutritional value of food. In this study, we investigated how different amounts of psyllium (1, 2, 3%) and water (110, 115, 120%) affected the rheology and 3D printing properties of a gluten-free blend of millet flour (50 g), sweet potato flour (15 g), rice protein (25 g), salt (0.9 g), baking powder (1.8 g), and oil (18 g). The experiments followed a full factorial design. Frequency sweep tests (1-30 Hz, 30°C) were performed on MCR 92 rheometer to determine storage/loss modulus, loss factor, yield stress, and complex viscosity. Foodbot D2 with 1 mm nozzle diameter was used to print dough in the previously designed shape of the letter "K" in a circle with 16 layers. The printing parameters were: 30°C, 1.5 mm layer height, and 20 mm/s printing speed. The shape was frozen, weighed and photographed. Print quality (sample height, diameter, and printing precision) was evaluated using ImageJ image processing program. NIR spectroscopy was used for predicting dough quality by recording continuous NIR spectra (range 904-1699 nm) before printing. The influence of each parameter on the output values was assessed by analysis of variance (ANOVA) with $p<0.05$, while numerical optimization was performed to obtain the highest possible printing quality. The experimental design, ANOVA, optimization, multivariate analysis of spectral data and principal component analysis (PCA) were performed using Statistica. Optimization predicted that the best snack dimensions, print quality, and precision would be achieved with 1.8% psyllium and 113.5% water. After optimization

evaluation, prediction errors for height, diameter, precision, score, and loss factor were less than 10%, while prediction errors for other rheological parameters were about 30%. PCA showed good separation of samples based on the first three factors. The 3D PCA showed that the primal factor by which the samples differed was the amount of psyllium added. These results confirm the potential of NIR spectroscopy for qualitative analysis of dough composition prior to 3D printing.

Acknowledgement: This research was funded by the Croatian Science Foundation [IP-2020-3829 and DOK-2020-01]. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Croatian Science Foundation.

Application of pressurized liquid extraction for the isolation of phenols from sea buckthorn leaves

Maja Repajić, Ivona Elez Garofulić, Paula Pufek, Ena Cegledi, Branka Levaj, Verica Dragović-Uzelac*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Ivona Elez Garofulić; ielez@pbf.hr

Sea buckthorn (Hippophae rhamnoides L.) is a valuable and unique plant, rich in various bioactive compounds contained in the different parts of the plant, especially in the fruits and leaves. Due to its great potential, the scientific community is showing a great interest in this plant, and numerous studies have reported beneficial health effects, such as antioxidant, anticancer, antiinflammatory, etc. Compounds of interest can be isolated by various extraction methods, either conventional or advanced, however it is of great importance to optimize the process conditions to obtain maximum yield of target compounds. Therefore, this study examined the influence of temperature (80, 100, and 120 °C), static extraction time (5, 10, and 15 min) and number of extraction cycles (1, 2, and 3) during the pressurized liquid extraction (PLE) of phenols from freeze-dried sea buckthorn leaves using an aqueous ethanol solution (70%) as extraction solvent. The extracts obtained were analyzed spectrophotometrically for the content of total phenols (TPC) using the Folin-Ciacolteau method, while the FRAP method was used to determine antioxidant capacity (AC). All results were statistically analyzed by multifactorial analysis of variance and Tukey's HSD test. The TPC was determined in a range of 69.05-112.96 mg GAE g-1 of dry matter (DM) and the values of AC ranged from 766.72-1182.02 µmol TE g-1 DM. Statistical analysis showed a significant influence of all tested PLE parameters on the TPC as well as on the AC of the extracts. The highest TPC were measured in extracts obtained at the highest temperature and cycle number, while there was no significant difference in the TPC extracted during a static extraction time of 10 or 15 min. On the other hand, the AC values of the extracts were highest at the highest level of all three PLE parameters tested. In conclusion, PLE using 70% ethanol

showed to be an effective method for the successful extraction of phenols from sea buckthorn leaves, where PLE conditions of 120 °C/10 min/3 cycles provided the highest TPC, while the highest value of AC was obtained at 120 °C/15 min/3 cycles.

Case study: Innovation with strawberry tree fruits (*Arbutus unedo* L.) for agri-food industry

Ivo Rodrigues, Goreti Botelho, Filomena Gomes*
CERNAS - Center for Natural Resources, Environment and Society, Polytechnic Institute of Coimbra, Coimbra Agriculture School, Portugal

Oral presentation, presenting author Ivo Rodrigues; ivorod@esac.pt

The strawberry tree fruit (*Arbutus unedo* L.) is an endogenous resource from the Mediterranean region that has unique nutritional, functional and organoleptic characteristics. Much of the production of this fruit in Portugal is directed towards the production of a spirit (locally called Aguardente de Medronho). However, its nutritional and functional value indicates that it should be included in several food products with high added value. The objective of the work was to develop innovative food products or a paste from strawberry tree fruits suitable for the food industry and with commercial potential. This fruit that can be easily dehydrated or freeze-dried and these preservation technologies increase its potential for incorporation into new food products such as yogurts, breakfast cereals or bars with cereals. Innovative vegan products from these fruits have been developed, such as, sweet without sugar addition, gelatin-like products with algae, and chutneys. Moreover, the use of enzymes to extract the pulp to obtain a ready-to-use paste in the food industry through incorporation and use in new food products, like pastry products, was successfully achieved in our research work. In conclusion, the strawberry tree fruit has a huge potential to be exploited in future by the agrifood industry with an added value and promoting the consumption of fruits, as desirable in a context of a healthy and well-balanced diet.

Acknowledgments: CERNAS is funded by national funds through the Foundation for Science and Technology (FCT/MCTES) by project UIDB/00681/2020. Project PDR2020-784-042742 RG-PCMG-Medronheiro - Conservação e Melhoramento Genético Vegetal para o medronheiro (*Arbutus unedo* L.).

The preparation of N-doped carbon quantum dots from citric acid and *Citrus clementina* peel – The application in iron(III) detection in herbs and spices

*Silvija Šafranko[1], Šimun Mandić[2], Stela Jokić[1]**

[1] Faculty of Food Technology Osijek, Josip Juraj Strossmayer University in Osijek, Croatia

[2] Center of Excellence for Advanced Materials and Sensing Devices, Institute of Physics, Zagreb, Croatia

Poster presentation, presenting author Stela Jokić; stela.jokic@ptfos.hr

Carbon quantum dots (CQD) are relatively new class of photoluminescent carbon nanomaterials composed of discrete and quasi-spherical carbon nanoparticles, which due to their outstanding chemical and optical properties, excellent biocompatibility and overall great sensing performance, have attracted the enormous amount of interest in the scientific community. The possibility of facile surface modifications and heteroatom doping for the properties and performance enhancement, CQD have found versatile applications in a wide range of analyses: in biomedicine and pharmacy, water monitoring and food quality control, environmental and pesticide analysis. This study represents a novel investigation of N-doped CQD derived from citric acid and citrus peel for the selective response of Fe3+ ions in both model and real sample systems. The hydrothermal synthesis of the samples was carried out at temperature of 180° C during 9 hours. The amino acid leucine (Leu, L) has been used as nitrogen dopant in the CQD synthetic procedure, and the CQD@hybrid was obtained as a result of mixing citric acid/citrus peel and Leu before initiating the synthesis. The physico-chemical characterization (AFM, PXRD, dispersibility in water, EDS) od the prepared CQD samples was performed, while optical characterization has shown that quantum yield for the CQD@Leu sample was calculated to be QY=36.43% and for the CQD@hybrid was QY=10.04%. Also, investigation of the excitation-dependent photoluminescence (PL) and influence of the

solvents on the PL intensity was also carried out. Finally, selectivity toward metal ions were studied in the presence of CQD@Leu and CQD@hybrid and it was determined that both samples were highly selective toward Fe3+ ions. Hence, two different models were developed for the detection of Fe3+ ions in model systems described by exponential functions, and the linear responses were established in the concentration ranges: 1) 0.3 µmol dm-3 to 30 µmol dm-3 (R2=0.9982) with a determined limit of detection of LOD = 1.77 ± 0.01 µmol dm-3 and limit of quantification of LOQ = 5.88 ± 0.04 µmol dm-3 for CQD@Leu; 2) 0.5 µmol dm-3 to 15 µmol dm-3 (R2=0.9851) with a determined limit of detection of LOD = 2.72 ± 0.39 µmol dm-3 and limit of quantification of LOQ = 9.06 ± 1.29 µmol dm-3 for CQD@hybrid. Moreover, the photoluminescent nanoprobes were successfully used for the determination of Fe3+ ions in herbs (nettle) and spices (oregano).

Characterisation of chitosan films with Vitamin C

Mario Ščetar, Ivan Lenard, Mia Kurek, Dunja Molnar, Kata Galić*

Faculty of Food Technology and Biotechnology, Univesity of Zagreb, Croatia

Poster presentation, presenting author Mario Ščetar; mscetar@pbf.hr

The concept of having the additional value in edible packaging is an important tool in enhancing the nutritional aspect and the process of creation of novel food products beyond the existing traditional technology for shelf-life prolongation. Antioxidant compounds such as vitamin C, could be applied to produce novel functional products thus improving their quality. This research is aimed to optimize the formulation of edible films made from chitosan (CS) and Vitamin C enriched chitosan (CSC). Films are aimed to be furtherly used as antioxidant coatings, thus Vitamin C was chosen for its known antioxidant properties. Influence of chitosan concentration (2% w/v) and presence of Vitamin C (0.2, 0.4 and 0.6% w/v) on structural, optical and barrier properties of films was tested. Knowledge on these parameters is important to tailor good coating design. By increasing Vitamin C concentration, lightness *L** and *b** decreased indicating green film taint. Additionally, the light transmittance of CSC films were further reduced with the increasing concentration of ascorbate. Formulations with Vitamin C were significantly different from the control (CS film as control). In addition, they were more soluble in water but also had decreased water content and water vapor permeability. Fourier Transform Infrared (FTIR) Spectroscopy showed that characteristic CS bands were weak and new peaks were detected, which can be attributed to the $-NH^{3+}$ bending vibration an -COO- symmetrical stretching vibration resulting from the electrostatic interaction. Thermal degradation showed much lower degradation temperature and higher weight loss in the decomposition process of the CSC. Reduced thermal stability might be related to lower crystallinity of chitosan films. Those changes in physical properties were due

to the stronger destructive capacity of ascorbic acid to the crystalline structure of the chitosan matrix as well as related to intermolecular chitosan chains bonding.

Effect of mixture composition on physical properties of honey based cocoa powder

*Kristina Tušek[1] and Maja Benković[2]**

[1] Health Centre Krapina-Zagorje County, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Maja Benković; maja.benkovic@pbf.unizg.hr

Honey is a natural biological product produced from nectar by honeybees. It contains glucose, fructose and water, as well as a mix of amino acids, vitamins, minerals, iron, zinc and antioxidants. In addition to its use as a natural sweetener, honey is used for medical purposes as an anti-inflammatory, antioxidant and antibacterial agent. Similar to honey, cocoa also has potent anti-inflammatory, antioxidant effects due to high content of polyphenols, but is low in sugar. In this work honey based cocoa powders containing different percentage of honey were produced and the effect of mixture composition on powders physical properties was analysed. Three honey based cocoa powders containing 60%, 50% and 40% of honey were produced by convective thin layer drying at 70˚C. The following physical properties of the cocoa powders were analysed: moisture content, bulk density, flowability, dispersibility, wettability and colour characteristics. The moisture content rises from 6.2% for the honey based cocoa powder containing 40% to 7.2% for powder containing 60% of honey. The flowability according to Hausner ratio is excellent for all three samples, showing that all of them are free-flowing powders, while Carr index values show that samples containing 50% and 60% honey are also free-flowing, while the sample with 40 % honey has lightly poorer flowability. Dispersibility was the best for the powder containing 60% honey, while wettability was the best for the powder containing 40% of honey. Colour values also changed with the addition of honey: powders with higher honey content had lower *L** and *b** values, and higher *a** values. The obtained results show that by increasing the amount of honey in the mixture, moisture content rises. Flowability of all produced samples was good, regardless of the amount of honey added to the mixture. Dispersibility was the best for the powder containing

the highest percentage of honey. It can be concluded that honey can be efficiently used as a natural sweetener for cocoa power production.

Influence of thermal and non-thermal pre-treatment of dough on the quality of 3D printed gluten free cereal snacks

Bojana Voučko, Nikolina Čukelj, Kristina Radoš, Tomislava Vukušić Pavičić, Višnja Stulić, Filip Dujmić, Duška Ćurić, Dubravka Novotni*
Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Višnja Stulić; vstulic@pbf.hr

Due to its specific rheological properties, successful three-dimensional (3D) printing of gluten-free dough is particularly challenging. One way to improve the viscosity and thus the physicochemical properties of the printed gluten-free product is to thermally and non-thermally pre-treat the dough. Therefore, the aim of this research was to investigate how cooking and high-intensity ultrasound as pre-treatment processes, as well as temperature during printing, affect the quality of 3D-printed gluten-free doughs and snacks. Pre-treatment cooking was conducted for 10 min under vacuum, without or with the use of a 34 kHz high-intensity ultrasound, at 380 W and three different temperatures (30, 55, 80 °C). Additionally, the influence of four different temperatures (26, 30, 55, 80 °C) of the printer (atmospheric cooking) was investigated. Dough was printed on a Foodbot D2 Multi Ingredient Dual Head Food 3D Printer, and afterwards baked for 18 min, at 160 °C upper heater, and 140 °C lower heater temperature. Shape dimensions (height, width and thickness) of the 3D-printed dough and snacks (after cooling) were compared with the computer designed model, while the printing precision, baking loss, and deformations were calculated. The results showed that both the pre-treatment conditions and the printing temperature affect the quality of dough and snack products. Printing of dough pre-treated at 80 °C in both water and ultrasonic bath, as well as at a printing temperature of 80 °C, was not possible due to a strong change in the viscosity of the dough. Snack products printed at printing temperature of 26 °C were visually inferior to the ones printed at 30 and 55 °C and had a 5% lesser baking loss. Pre-treatment in a high-intensity ultrasonic bath helped to maintain the shape (height and width) of the printed dough piece. The shape of the dough pre-treated at 55°C in a high-intensity ultrasonic bath

showed a printing precision of 96 % and the lowest baking loss (45%) of the snack product. Further research of the investigated parameters is required in order to determine the optimal temperature and time of high-intensity ultrasound treatment.

Acknowledgement: This research was funded by the Croatian Science Foundation [IP-2020-3829 and DOK-2020-01]. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Croatian Science Foundation.

NUTRITION, HEALTH AND CONSUMER

Ethical issues in food chain

Rui Costa

Polytechnic Institute of Coimbra, Coimbra Agriculture School, Bencanta, Portugal

Research Centre for Natural Resources, Environment and Society (CERNAS), Coimbra Agriculture School, Bencanta, Portugal

ISEKI Food Association, Vienna, Austria

EASPA e.V., c/o ASIIN e.V., Düsseldorf, Germany

Invited lecture, presenting author Rui Costa; rcst344@gmail.com

The agri-food sector has the essential role of feeding the world and is the most relevant sector in revenue and employment. Though the transformation of food materials has a long history, the development of new products and economic and environmental developments affect the performance of this sector, raising new ethical issues. This sector suffers from production-related ethical issues and consumption-related ethical issues, ranging from consumer criticism of its environmental impact, either at the national level or even abroad, to fair trade, and food safety issues, among others. Ethical issues in the food chain have been increasing in number and have been given higher relevance in public debate and consumer choice, demanding more skills from food professionals, in particular, that these have ethical judgement skills to take adequate decisions and be able to communicate these with the public. This emergent trend justifies the inclusion of ethics in food studies curricula to better equip graduates for the world of work and the adoption of deontological codes by organized societies of professionals. Additionally, ethical behavior is obviously demanded to food professionals, specially in what is related to food safety. Although there are numerous laws about food standards and food safety, frequent foodborne diseases, from E. coli infections to contamination of food with plastic materials, occur in many countries. Based on the management procedures that enabled these outbreaks, in recent years, whistleblowing has been considered an essential element of risk management and a mechanism for combating

corruption and fraud. However, whistleblowers do not have adequate support in almost every country. This presentation will provide an overview of ethical issues in the food chain, focusing on the relevance of ethics education and on the debate on the protection of whistleblowers.

Diet or δίαιτα ? Nutrition science today

Željko Krznarić

School of Medicine Zagreb, University of Zagreb, Department of Gastroenterology, Hepatology and Nutrition, Zagreb, Croatia

Invited lecture, presenting author Željko Krznarić; zeljko.krznaric1@zg.t-com.hr

The word 'δίαιτα' originates from the Ancient Greek and was used to describe 'the way of life' in comedies, but later became a part of the proto-medicine in works of Hippocrathes. The diaita or diet means way of living, mode of life or in a word - lifestyle. The original definition is still aplicable today, as it is the basis of a 'newer' branch in medicine – the lifestyle medicine. The six main components of lifestyle medicine are natural and unprocessed food, plant based diet, physical activity, restorative sleep, stress management, avoidance of potentially harmful ingredients and positive social connections. These are fundaments in effective prevention of chronic medical conditions. The intrinsic link between diet and health is undeniable - balanced nutrition is essential for health optimization, and crucial in prevention and management of many diseases. Nevertheless, this diet-health relation is always open to further research, discussion and investigation. Nowdays, daily meal planning is tailored to particular choices based on an individual basis such as health condition, tradition, lifestyle, beliefs, sports. Over the last century, innovative changes in all areas of life have allowed us to improve our diet based on a better scientific understanding of the health benefits it provides. Therefore, more than ever before, diet is adjusted to a specific groups of people according to age, physical activity or certain medical conditions. Additionnaly, with the increased life expectancy, the search for specific diets that will help us to age gracefully is expanding. Although future roles of nutrition and dietetians were described as a whole spectrum of activities, such as diet optimization, changing eating habits or promoting healthy diet, science is the unifying framework for these profession. Such professionals should become essential members of multidisciplinary teams which manage patients with for ex. inflammatory bowel disease or

intestinal failure. As in all professions, flexibility combined with critical thinking, curiosity and empathy should be the modus operandi for nutritional professionals, as well as lobbying, science translation and lidership skills. Back to the future could become motto of our activities.

Are herring milt protein concentrates ingredients of future foods?

Miroslava Atanassova, Janne Kristin Stangeland, Thomas Hagby Dahl, Daniel Kvam, Lars André Langøyli Giske, Wenche Emblem Larsen*

Møreforsking Ålesund, Ålesund, Norway; Optimar AS, Valderøy, Norway

Poster presentation, presenting author Miroslava Atanassova;

miroslava.atanassova@moreforsking.no

Milt is mostly a byproduct from fish processing of many species, currently not consumed directly as such in the EU. It is used as food & feed ingredient under the form of frozen flour (hydrolysate), meal and/ or pellets. Herring milt is consumed traditionally on toast in the UK as part of the British breakfast and has a niche in several specific country markets (Russia, Italy – together with tuna milt, etc.). The health-beneficial properties of herring milt protein concentrates against metabolic syndrome have been extensively studied in vitro and in animal models and several nutraceutical products are available on the market. Still, consumer acceptance is limited, and most niche food products incorporate herring milt directly. The required quality of milt as food raw material presents several challenges to the current industrial fish processing lines. Our study has focused on establishing the needed technological modifications in the commercial processing lines and the sensorial and functional optimization of herring milt protein hydrolysis as alternative food ingredient. Machine learning approaches (using photo vision and image analysis in Azure Auto ML®) have been applied for studying the possible automatic detection of milt as part of the byproducts from the current high-throughput herring processing lines in Norway. Selection of specifically tailored proteolytic enzymes for the hydrolysis was made on basis of provision of best functional and technological properties of the final protein concentrates. Physicochemical characterization (nutritional composition, amino acid, free amino acid, fatty acid profiling and total DNA), antioxidant, anti-diabetes activity screening, and gel-forming properties were

studied in the hydrolysates. As a proof of concept, a machine learning model through artificial vision was established able to recognize herring milt among the other by products of fish filleting with 70% mean average precision. Further validation of the model is required as well as establishing best storage and transport conditions for the milt. Due to the high-water content and presence of active proteolytic enzymes from the fish viscera in the byproduct mix, rapid controlled hydrolysis of milt with selected sensorially active commercial proteases could be an alternative solution for the development of food products with high nutritional and functional properties.

Impact of mash maceration duration and temperature on non-flavonoid phenolics in Malvazija istarska wines

Ena Bestulić[1], Sara Rossi[1], Fumica Orbanić[1], Ivana Horvat[1], Igor Lukić[1], Tomislav Plavša[1], Ana Jeromel[2], Sanja Radeka[1]*

[1] Institute of Agriculture and Tourism, Poreč, Croatia

[2] University of Zagreb Faculty of Agriculture, Department of Viticulture and Enology, Zagreb, Croatia

Poster presentation, presenting author Ena Bestulić; ena@iptpo.hr

Phenolic acids and stilbenes are important groups of non-flavonoid phenolic compounds present in grapes and wine. Their content in wine may be modulated by the vinification technique applied. The present study aimed to determine the impact of the application of different grape mash maceration treatments on the composition of hydroxycinnamic (HCA) and hydroxybenzoic acids (HBA) and stilbenes in Malvazija istarska wines. The research was conducted at the Institute of Agriculture and Tourism (Poreč, Croatia) with Malvazija istarska (Vitis vinifera L.), an autochthonous Croatian white grape variety. A total of six vinification treatments were carried out: two days maceration treatment at 8 °C (CRYO), and seven (M7), 14 (M14), 21 (M21), and 42 days (M42) maceration treatments at 16 °C, compared with the control treatment without maceration (C). Identification and quantification of phenolic acids and stilbenes was performed after direct injection of the filtered wine sample, using a high performance liquid chromatograph (HPLC) equipped with a diode array detector (DAD). The obtained results were statistically processed by one-way analysis of variance (ANOVA) and Fisher's test of least significant differences (LSD). According to the obtained results, the highest concentration of total HBAs was recorded in prolonged post-fermentative maceration treatment M42, and among all HBAs gallic acid had significantly the highest concentrations. Regarding HCAs, the total content was significantly the highest in seven days maceration treatment (M7), while in longer maceration treatments (M14, M21, M42) total HCA content

gradually decreased as maceration progressed. When observing individual HCAs, trans-caftaric acid had the highest concentrations, especially in M7 treatment wine, while caffeic and ferulic acids reached the highest concentrations in pre-fermentative two days (CRYO) treatment. Regarding total stilbene content, treatments M7, M14, and M21 obtained the highest concentrations, but did not significantly differ between each other, and when observing individual stilbenes, cis-piceid concentrations were the highest in those treatments and among all identified stilbenes. Obtained results show that HBA content benefits from the prolonged maceration, while for the most HCAs and stilbenes concentrations increase up to seven days of maceration and then decrease during prolonged maceration, possibly due to oxidation and other reactions.

A targeted and untargeted approach to volatile metabolite characterization of „Maraština“ wines produced by spontaneous fermentation

Ana Boban[1], Urska Vrhovsek[2], Silvia Carlin[2], Ana Mucalo[1], Irena Budić-Leto[1]*

[1] Institute for Adriatic Crops and Karst Reclamation, Split, Croatia

[2] Department of Food Quality and Nutrition, Research and Innovation Centre, Fondazione Edmund Mach

(FEM), San Michele all'Adige, TN, Italy

Poster presentation, presenting author Ana Boban; aboban@krs.hr

Spontaneous fermentation in winemaking is a complex microbial reaction that involves influences from many factors, including the microbiota, the grape variety, climatic and soil conditions, and vinification technology. The perceived aroma of the produced wine is the result of interactions between all the volatile and nonvolatile metabolites. The study aimed to investigate the volatile metabolite profile of „Maraština“ wines produced by spontaneous fermentation, thus supporting the concept of terroir impact on the aromas of the wine. The „Maraština“ grapes were harvested in 10 vineyards from two Croatian vine-growing regions: Northern Dalmatia and Central and Southern Dalmatia. A total of 10 experimental fermentation trails in three repetitions were set up on the laboratory scale. Volatile compounds from the wine samples were isolated by solid-phase extraction (SPE) and analyzed by an untargeted approach using two-dimensional gas chromatography coupled with time-of-flight mass spectrometry (GCxGC-TOF-MS) and a targeted approach by gas chromatography-tandem mass spectrometry (GC-MS/MS). Comprehensive two-dimensional GCxGC analysis provided a detailed characterization of total volatile metabolites in the wines due to its excellent separation ability. More than 900 compounds were detected after untargeted profiling and 222 of them were identified or tentatively identified by comparison of experimental retention indices and mass spectra with literature data from the NIST

database. A total of 56 volatile compounds were identified and quantified using GC-MS/MS analysis, including terpenes (14), C13- norisoprenoids (3), esters (18), alcohols (4), phenols (4), aldehydes (2), ketones (2), acids (4), lactones (4) and indole (1). The Fischer ratio was useful for establishing the compounds responsible for the main differences between grapes harvested from different subregions. „Maraština“ wines from the Northern Dalmatia subregion had a significantly higher concentration of total volatile compounds than the wines from the Central and Southern Dalmatia subregion, especially the following compounds: cis-Rose oxide, trans-Rose oxide, β-Damascenone, TDN, ethyl leucate, diethyl succinate, phenylacetaldehyde, benzaldehyde and octanoic acid.

Quantitative descriptive analysis of reduced fat butter biscuits by trained panels from Ljubljana and Zagreb: a comparison of panel data and feasibility study

*Anja Bolha[1], Jasna Bertoncelj[1], Sebastjan Filip[2], Nada Vahčić[3], Mojca Korošec[1]**

[1] Biotechnical Faculty, University of Ljubljana, Slovenia

[2] Pekarna Pečjak d.o.o., Slovenia

[3] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Mojca Korošec; mojca.korosec@bf.uni-lj.si

This work aimed at improving the composition of butter biscuits by reducing the amount of butter by 10-40%, and in the same time preserving sensory properties. By conducting sensory analysis in Croatia and Slovenia we also wanted to investigate if the panels of trained sensory assessors from both countries are comparable in their results. Biscuits were prepared in the research bakery at Biotechnical Faculty, according to the recipe of industrial partner. The amount of butter was reduced in 4 steps to produce biscuits samples with 10%, 20%, 30% and 40% butter reduction. Two trained panels of 9 assessors in Ljubljana and 11 in Zagreb evaluated sensory attributes of odour, taste, aroma and texture by quantitative descriptive analysis (QDA) over 12 weeks. A total of nine evaluations in Ljubljana and six in Zagreb were performed. Obtained data were treated by statistical analysis to confirm possible differences between sensory profiles of biscuits provided by the two panels. By a general linear model, we did not confirm a co-influence of assessment location and sample on the results of the QDA, nor were they co-influenced by a sample and storage time. However, QDA results for overall odour ($p<0.005$), buttery odour ($p=0.026$) and crumbliness ($p=0.008$) were co-influenced by the location and storage time of the biscuits. We observed that Ljubljana panel rated crumbliness of biscuits in weeks 2-8 significantly higher than Zagreb panel. The difference in crumbliness quantification by the two panels may be due to the transport and possibly different storage conditions, as well the fact that the two panels were not previously

harmonised in the intensity scale using nor were provided with reference materials for individual descriptors. As both panels consisted of trained assessors they were provided with oral information and instructions for the method used. Overall, QDA results of both sensory panels showed a decline in the fragility, crumbliness and solubility, and an increase in crispness of biscuits by reducing the proportion of butter, but were not significantly different for a control and 10-20% butter reduced biscuits. By the time of storage, the overall intensity of odour, crumbliness and crispness were reduced.

An outlook about alternatives to meat and dairy products in food industry

Goreti Botelho[1,2], Miguel Lima[1], Ivo Rodrigues[1,2], Jorge Lameiras[1,3], Rui Costa[1,2]*

[1] Polytechnic Institute of Coimbra, Coimbra Agriculture School, Bencanta, Portugal

[2] CERNAS - Center for Natural Resources, Environment and Society, Polytechnic Institute of Coimbra,

Coimbra Agriculture School, Bencanta, Portugal

[3] Regional Health Directorate of Centre - Health Centres Group of Baixo Mondego, Coimbra, Portugal

Oral presentation, presenting author Goreti Botelho; goreti@esac.pt

The food industry, in response to growing consumers' concerns about environmental sustainability, public health and ideological nature, has been making progress with the development of an increasingly diverse set of meat and dairy alternatives, such as meat analogues and plant-based drinks. Our work reviewed the literature to systematize the main technological processes used in the production of meat analogues and the properties of these products. From a total of 310 scientific papers identified in databases, such as, b-on, PubMed and Science Direct, 194 papers were considered. It was found more research papers on products such as insects, algae, and alternatives of milk. On the other hand, there are products that need more research, as is the case of mycoprotein, artificial meat and alternatives to meat and dairy products. With the purpose of systematizing the main themes focused on in this review work, a scheme was built. Fundamentally, this framework, based on the reviewed literature, aims to answer the why, the how and the what and take a forward-looking approach to potential challenges that the food industry may face. The openness to meat-alternative products may be improved by tasty food products, leading to optimizing existing technologies and innovation to improve the organoleptic properties and nutritional composition of meat analogues. The food industry has shown the capability to rapidly adapt and innovate to meet the growing demand for more sustainable diets. Alternative protein

sources encompass everything, from algae to re-engineered plant-based products, innovative use of legumes and a variety of meat substitutes. Nowadays, there is a large range of possibilities available in the market: lab-grown meat, plant-based meat, single-cell proteins from yeast or algae and edible insects.

Acknowledgments: CERNAS is funded by national funds through the Foundation for Science and Technology (FCT/MCTES) by project UIDB/00681/2020. EQVEGAN project—European Qualifications & Competences for the Vegan Food Industry 621581-EPP-1-2020-1-PT-EPPKA2-SSA-EQVEGAN. European Education and Culture Executive Agency.

Pollen profiles of Polish spring nectar honeys from different apiary

*Marta Burzyńska and Dorota Piasecka-Kwiatkowska**

Department of Food Biochemistry and Analysis, Poznan University of Life Sciences, Poland

Poster presentation, presenting author Dorota Piasecka-Kwiatkowska; dorota.piasecka-kwiatkowska@up.poznan.pl

It is obvious that nectar honeys contain plant pollen from nectar-source plants, but also from wind-pollinated plants that naturally stick to sticky nectar and during feeding and flying to the bees' body hairs. Some of the pollen grains of anemogamous plants are allergenic so also containing them honey consumption may be in dangerous for sensitive individuals. In this context melissopalynological analysis of honey takes additional particular importance. The melissopalynological analysis of typical in Poland spring nectar honeys, rapeseeds' and acacias', collected from apiaries located in seven different part of Poland with special attention to aeroallergens presence. The melissopalynology analysis of the tested honeys was performed using a microscope optical UB200i at 40x and 100x magnification. The honey samples were prepared according to the International Commission of Beekeeping Botany and the Polish Ministry of Agriculture and Rural Development Regulation. To identify pollen, available pollen determination keys were used. To quantify each pollen type, at least 300 pollen grains were counted. Then the percentage frequency of the pollen types was calculated in all honey samples. All samples were analysed in duplicate. The content of anemophilous plant pollen grains in relation to the total number of pollens present in the honey samples were different according the honey variety and apiary. Average nonnectariferous pollens in rapeseed honey samples accounted 7,4% (from 2,6 to 11,4%) whereas in acacia 8,8% (from 4,7 to 10,9%). The nonnectariferous pollens found in the tested honeys were typical to the pollen season in Poland, with predominance of species Quercus, Corylus, Juniperus, Pinus, Betula in rapeseed honey and Pinus, Urtica dioica, Zea mais, Betula, Plantago in acacia honeys.

Additionally in four samples of rapeseed honey and two of acacia were identified honeydew indicators, fungal spores of the genus Alternaria and Cladosporium. The nonnectariferous plants pollens found in the tested honeys were typical for pollen season surrounding apiary environment. Since in spring the most of airborne pollens are recognize as aeroallergens it can be assumed that the consumption of honey can be dangerous for individuals with oral allergy syndrome (OAS) as well as other extremely sensitive.

Influence of spray drying conditions on encapsulation of sea buckthorn oil (*Eleagnus Rhamnoides* (L.) A. Nelson)

*Patricija Čulina, Ivona Elez Garofulić, Maja Repajić, Zoran Zorić, Verica Dragović-Uzelac, Sandra Pedisić**

Faculty of Food Technology and Biotechnology University of Zagreb, Croatia

Poster presentation, presenting author Sandra Pedisić; spedisic@pbf.hr

Sea buckthorn (*Eleagnus Rhamnoides* (L.) A. Nelson) berry oil (SBO) as a rich source of bioactive compounds (carotenoids, tocopherols, omega-3, 6, 7, and 9 fatty acids) is susceptible to oxidative deterioration and unstable under processing and storage conditions, limiting its use in the food industry. Encapsulation by spray drying (SD) is a reliable technique widely used to overcome the above-mentioned problems. However, to achieve high encapsulation efficiency (EE) and the desired powder quality, the SD parameters such as drying temperatures, carriers and carrier-oil ratios should be optimized. Successful encapsulation of oils should result in an encapsulated powder with minimum surface oil content and maximum retention of oil in the powder particles (Jafari et al., 2008). Gum arabic is the most commonly used carrier for the encapsulation of oils. Therefore, the objective of this study was to determine the influence of SD conditions on EE and product yield (PY) using gum arabic as a carrier at different drying temperatures (120 to 180 °C) and carrier-oil ratios (2 to 4). The EE of all SBO powders ranged from 79.33 to 93.18%, and the highest EE was obtained at a drying air temperature of 180 ˚C and a carrier-oil ratio of 4. Increasing the drying temperature and adding more carrier to the initial emulsion resulted in a higher EE of SD, probably due to less diffusion of the oil to the surface, as the time to form a crust around the droplets is reduced and the amount of unencapsulated surface oil decreases (Di Giorgio, Salgado & Mauri, 2019; Tonon & Hubinger, 2014). The PY of all SBO powders ranged from 35.79 to 52.28 % and the highest PY was obtained at a drying air temperature of 120 ˚C and a

carrier-oil ratio of 3. Higher drying temperatures resulted in lower PY which could be due to extreme vaporization at high inlet air temperatures and degradation or loss of encapsulated cores. Drying temperature, carrier oil ratio and their combined effect significantly influenced EE and PY. The SD is an effective method for producing SBO powders with great potential as functional food ingredients.

The impact of the COVID-19 pandemic outbreak on eating and lifestyle habits of adolescents in Bosnia and Herzegovina: A Cross-Sectional Study

Nevena Ćorić[1,2], Anita Jurić[2], Andrea Karlovi [2]*

[1] University Clinical Hospital Mostar, Service for Patient Food and Nutrition, Mostar, Bosnia and Herzegovina

[2] Faculty of Agriculture and Food Technology, University of Mostar, Mostar, Bosnia and Herzegovina

Poster presentation, presenting author Nevena Ćorić; nevena.coric@aptf.sum.ba

Background: Pandemic caused by the COVID-19 virus brought tremendous changes in the lifestyle of adolescents, about which numerous studies have been published. Due to extended restrictions, long term impact should be investigated. Methods: This cross-sectional study enrolled 953 voluntary participants aged 14 to 21, from different regions of Bosnia and Herzegovina. Participants were asked to complete an online 37-item survey, regarding socio-demographics, geographic, social characteristics, dietary and lifestyle habits, physical activity, including their consumption of dietary, vitamin and mineral supplements. They also needed to provide information about their weight, height and weight change during the entire period of the COVID-19 pandemic from March 2020 until the end of November when the study was completed. For data entry and analysis, SPSS (version 25) and Microsoft Excel were used. Results: At the time of completing the survey, a slightly lower BMI of participants was noticed compared to the time before the pandemic. A statistically significant difference was determined between males and females BMI, boys BMI was slightly higher. Females gained and men lost BW. Increased intake of unhealthy types of food was associated with weight change. Increased mental stress during the pandemic was associated with dietary changes, respectively with decreased as also increased food amount. High percent of participants (40.4%) who increased their physical activity did not alter their eating in the form of the food

amount. This study reported use of some dietary supplements which have not been used before the pandemic by 63.5% participants. Conclusions: This paper presents a unique insight into the changing lifestyle and eating habits of adolescents in B&H during lockdown and post-lockdown period of research. Considering that pandemic is still ongoing, data from study like this may be useful to create further steps in battling the pandemic.

Qualitative abundance of volatile esters in Malvazija istarska white wine as revealed by comprehensive two-dimensional gas chromatography: effect of non-Saccharomyces yeasts

Doris Delač Salopek[1], Ivana Horvat[1], Sanja Radeka[1], Tomislav Plavša[1], Ana Hranilović[2], Silvia Carlin[3], Urska Vrhovšek[3], Igor Lukić[1]*

[1] Institute of Agriculture and Tourism, Poreč, Croatia

[2] Department of Wine Science, The University of Adelaide, Australia

[3] Fondazione Edmund Mach - Istituto Agrario San Michele All'Adige, Italy

Oral presentation, presenting author Doris Delač Salopek; doris@iptpo.hr

Yeasts from the genus Saccharomyces are most commonly used in wine production. On the other hand, in the last years there is a growing interest in use of non-Saccharomyces yeasts for reducing the content of ethanol, modifying acidity, improving protein stability, and enhancing wine aroma. In this experiment, grape must of Malvazija istarska was inoculated with five commercial non-Saccharomyces yeasts and a Saccharomyces cerevisiae/Saccharomyces paradoxus hybrid with the aim to investigate the effect of yeast on the content of volatile esters, key compounds that determine wine aroma and flavour. Saccharomyces cerevisiae was inoculated at 1.5-2.0 % (v/v) of ethanol to finish fermentations and was also inoculated in monoculture as a control treatment. Ester profiles were analysed by comprehensive two-dimensional gas chromatography with time-of-flight mass spectrometry (GC×GC-TOF-MS) combined with conventional mono-dimensional GC–MS. More than a hundred esters were identified or tentatively identified, providing one of the most detailed profiles of volatile esters in wine in general. Torulospora delbrueckii showed the highest potential to produce ethyl isobutyrate, isopropyl, isoamyl, 2-phenethyl, and geranyl acetates, ethyl 3-hexenoate, and ethyl 4-hexanoate. Pichia kluyveri produced most trans-3-hexenyl acetate, ethyl 2-methylbutyrate, and ethyl 3-methylbutyrate, Metschnikowia

pulcherrima produced the highest amounts of ethyl decanoate and ethyl phenyl lactate, S. cerevisiae/paradoxus hybrid excelled in the production of 2-phenethyl isobutyrate and ethyl benzeneacetate, while Lachancea thermotolerans wine was the most abundant in isobutyl octanoate. Schizosaccharomyces pombe treatment wine was characterized by elevated concentrations of particular esters not commonly reported in wine aroma studies, such as esters of isoamyl alcohol with propanoic, isobutyric, isovaleric, lactic, and succinic acid, esters of 2-phenylethanol with formic, propanoic, isovaleric, hexanoic, and octanoic acid, as well as S-ethyl octanethioate. The control S. cerevisiae treatment wine contained most ethyl 4-hydroxybutyrate and amyl methacrylate. The approach reported may have practical application in better understanding and managing the content and composition of odoriferous volatile esters in Malvazija istarska and wine in general. This study was funded by Croatian Science Foundation under the projects IP-2020-02-4551 and DOK-2021-02-5500.

The analysis of dietary habits in acne patients

Esma Karahmet Farhat[1], Ines Banjari[1], Emina Karahmet Sher[2]*

[1] Faculty of Food Technology, University Josip Juraj Strossmayer in Osijek, Croatia

[2] School of Science and Technology, Nottingham Trent University, Nottingham, UK

Oral presentation, presenting author Esma Karahmet Farhat; esmakarahmet1@gmail.com

Introduction: Acne is the most common skin disease and ranks eighth in incidence among diseases in the world. 95% of adolescents have acne, and the number of acne in adults, especially women, over the last 30 years has increased. Acne pathology is related to triggers of increased sebum secretion and Propionibacterium acnes colonization. Nutrition plays an important role in the etiology of acne and gene expression, and Paleo diet provides promising results for mild and moderately severe forms of acne. Material and methods: Observational study with a study-specific questionnaire (data on anthropometry, general health status, comorbidities, medications and supplement use, dietary and lifestyle habits, menstrual cycle) was completed by 60 dermatological patients of both gender, aged 15-46 years, from Sarajevo. Compliance between patients' diet and the Paleo diet principles was analysed with a point-based questionnaire. Acne-specific data was collected from medical records. The research aimed to determine the role of dietary and lifestyle habits in acne patients. Results and discussion: Men have less acne, but a more severe form. 53% of patients had a positive family history for acne. The majority of acne is of unknown etiology (41.7%), followed by bacterial (30.0%), and hormonal (28.3%), which were exclusively present in women. The average compliance with the Paleo diet was 54%, with the lowest consumption of fish, but high consumption of sweets and fast food. The compliance did not differ accoridng to patients age, Body Mass Index, or acne etiology. Also, patients with severe acne in comparison to mild acne, had more meals per day (p=0.046). Dietary supplements are taken daily by 82% of patients; herbal teas (67%), vitamin C (40%), and vitamin D (38%) being the most commonly used. Conclusion: Patients with hormonal acne are most likely to avoid highly processed

foods, i.e. to have diet with higher compliance with the Paleo diet. For the majority of acne patients, the role of diet is unclear. We identified the use of whey proteins as potential triggers of acne in 10% of patients.

Optimization of the DSC method for determining the oxidative stability of virgin olive oil

Katarina Filipan, Klara Kraljić, Ivana Hojka, Mia Ivanov, Zoran Herceg, Sandra Balbino, Marko Obranović, Dubravka Škevin*

Faculty of Food Technology and Biotechnology, University of Zagreb

Poster presentation, presenting author Katarina Filipan; kfilipan@pbf.hr

The oxidative stability of fats and oils is a crucial parameter that determines the shelf life of a product, but also the general use of the fats and oils. Differential scanning calorimetry (DSC) is a promising new technique that is fast, reliable and uses the exothermic character of the oxidation reaction to determine the induction time (in the isothermal DSC method) or the induction temperature (in the non-isothermal, i.e., dynamic DSC method). The objective of the present study was to optimize the conditions of the DSC method to determine the oxidative stability of virgin olive oil. Both the isothermal and dynamic methods were developed on a 214 Polyma DSC (NETZSCH-Gerätebau GmbH) and optimized using extra virgin olive oil from the Croatian market. The parameters studied were sample size (4, 8 and 12 mg), sample preparation (use of an open or a sealed pan with a pinhole), temperature (130, 140 and 150 °C) for the isothermal method and heating rate (5, 10, 15 and 20 °C/min) for the dynamic method. The results show that the DSC method is a reliable method for determining oxidation stability for both isothermal and non-isothermal methods. Sample size did not affect induction time, but a smaller portion size resulted in better reproducibility of the results. Regarding sample preparation, there was no statistical difference between results obtained with an open or sealed aluminum pan. However, it is better to use a hermetically sealed pan with a pinhole to protect the instrument from possible contamination. The induction time at 130 °C was 287 minutes, which was considered unacceptable, while a temperature of 140 °C proved to be optimal. A temperature of 150 °C also showed satisfactory reproducibility of results, but a longer induction time at 140 °C makes it easier to track

changes between different oils or during storage. For the determination of the induction temperature (dynamic DSC), a heating rate of 15 °C/min proved to be optimal. Although repeatable results were also obtained with a heating rate of 10 °C/min, the use of a higher temperature rate can significantly speed up the analysis. The other two heating rates were considered unsuitable due to the lack of reproducibility.

The analysis of prenatal supplements on the Croatian and Polish market

Esma Karahmet Farhat[1], Agnieszka Piekara[2], Ines Banjari[1], Małgorzata Krzywonos[3], Karolina Rybczyńska[2]*

[1] Faculty of Food Technology, University Josip Juraj Strossmayer in Osijek, Croatia

[2] Department of Bioprocess Engineering, Wrocław University of Economics and Business, Poland

[3] Department of Processes Management, Wrocław University of Economics and Business, Poland

Poster presentation, presenting author Esma Karahmet Farhat; esmakarahmet1@gmail.com

A properly balanced diet provides nutrients the human body needs to function. During pregnancy it is difficult to obtain the desired macro and micronutrients supply only from food, and supplementation is recommended. Excessive intakes of prenatal supplements are of no safety concern since nutritional deficiencies during pregnancy can have devastating long-term consequences. Pregnant women take supplements at large (in Croatia around 80% and in Poland around 70%), nonetheless their diet is poor as in the general population, precaution is necessary. The purpose of the research was to compare the types and composition of dietary supplements (DS) for pregnant women available in the Polish (PL) and Croatian (CR) markets, comparing the content of selected ingredients with the recommended nutritional intakes for European population, alongside analyzing possible negative effects. The survey conducted in July 2022 evaluated supplements labeled "for pregnant women", excluding products containing only folic acid (FA) as an active ingredient. 60 supplements were sold in Poland, while 35 were in Croatia, with three mutual products available in both countries. Product prices ranged from 3,82 to 59,00 euros (median 8,36 euros) for Poland and from 6,20 to 64,88 euros (median 18,58 euros) for Croatia, respectively. Focusing on the content of FA in supplements, 18 products do not have FA in their composition. Following the conducted evaluation: 2 DS with 1 g of FA (Croatia), 6 with 800 µg (4 from Croatia), 2 with 600 µg (Poland),

one 540 µg (Poland), and 4 with 500 µg (3 from Croatia) and 49 have 400 µg of FA, 12 less than 400 µg. The basic form of FA contains 62 products (31 of PL and 31 of CR) however 19 of PL and 4 of CR contain additionally metapholates. Many supplements contain ingredients that can be easily delivered with a regular meal (e.g. Vitamin C) or are a vitamin bomb whose consumption will mostly not be justified. All analyzed supplements contain the recommended active form of FA. The market for supplements is growing. Proper education regarding women's body needs and the influence of selected nutrients can ensure proper supplementation before and during pregnancy.

Innovative, sustainable and healthy blue food and consumer engagement

*Wilson Fernandes, Filipa R. Pinto, Sónia Barroso, Maria M. Gil**

MARE / ARNET, School of Tourism and Maritime Technology, Polytechnic of Leiria, Portugal

Oral presentation, presenting author Maria Manuel Gil; maria.m.gil@ipleiria.pt

Nowadays, human nutrition is facing a huge paradigm, on the one hand there is increasing world hunger and on the other hand there is food waste and the high ecological footprint of food production. This means that there is an inefficient food management, a fact that has been the subject of study and concern, with the development of different strategies. One of these strategies involves the development of more sustainable, nutritious and affordable food products. In this sense, the ProReMar Project arises with the development of innovative food products based on marine resources of low or no commercial value, including a fish ham. The fish ham is an innovative product developed from Portuguese low commercial value fish (60%). The nutritional profile was obtained using the following methods: Kjeldakl for crude protein; Folch for total fat; colorimetric phenol-sulfuric acid method for sugars. The mineral profile was determined by ICP-OES and the fatty acid profile by GC-FID. The product shelf-life was determined and consumer acceptance tests were carried out (n=82). The developed product demonstrated a balanced nutritional profile with an energetic value of 73.24 kcal/100g; 0.38±0.01g lipids/100g; 6.53g carbohydrates/100g of which 0.11g sugars/100g; 1.37±0.01g fibre/100g; 10.24±0.54g protein/100g; 0.36± 0.02 g Na/100g and 2.96±0.06 mg Zn/100g. These results allow to claim that it is a product "Source of Protein", "Fat Free" and "Source of Zn"(Regulation(CE)No.1924/2006). Furthermore, the fish ham has a NutriScore A, which corroborates the fact that this is a healthy and nutritionally rich food product that can be a healthy and sustainable alternative to the meat hams on the market, which are low classified. The fatty acid profile of the product is mainly characterised by UFA, highlighting 44.92±0.32% PUFA (ω-3 and ω-6) and 23.3±1.0% MUFA (ω-9). A shelf life of 84 days was estimated for this product, considering microbiological, physicochemical and sensorial

attributes. The consumer acceptance test showed that 63% found the product interesting (>5, scale 1-7), 48% would consider buying it, and 83% would consider giving it to their children. Fish ham shows promise and have the potential for market insertion, meeting healthy, sustainable (economically and environmentally) and tasty trends.

Monitoring salt content in selected foods in Portuguese market

Paulo Fernandes, Andreia Lopes, Roberto Brazão, Maria Graça Dias*

Food and Nutriton Department, National Institute of Health Dr. Ricardo Jorge, Portugal

Poster presentation, presenting author Paulo Fernandes; paulo.fernandes@insa.min-saude.pt

In 2017, Portugal created the Integrated Strategy for Healthy Eating Promotion (EIPAS) aiming, through several initiatives, to reduce the intake of sugar, salt and trans fatty acids by the population. For salt, the goal was reaching individual intake of 5 g/day by 2020, as established by WHO. One of the initiatives was an agreement between health authorities and food business operator's associations to reformulate foods accordingly. A progress report of EIPAS was released in 2022 showing the achievement of a salt content reduction through product reformulation of pre-packaged pizzas, chips and snacks and breakfast cereals of 11.5% was achieved which represented a global reduction of the intake by the Portuguese population of 25.6 tons of salt. To assess compliance of salt content with the EIPAS goal of 0.3 g/100 g in pizzas, chips and snacks and breakfast cereals on Portuguese market in 2022 by monitoring labelling information. The information on the labelling of pre-packaged pizzas, chips and snacks and breakfast cereals available on Portuguese market, independently of production country, was gathered and analysed through the nutritional declaration available at the online store of a main national supermarket chain, considering the salt content. Foods without nutritional declaration were not considered. 37 pizzas, 110 chips and snacks and 120 breakfast cereals were considered totalling 267 products from an initial selection of 360. Salt content ranged from 0.69 to 1.8 g/100 g in pizzas, from 0.1 to 2.9 g/100 g in chips and snacks and from 0 to 0.98 g/100 g in breakfast cereals. The average salt content was 1.15, 1.27 and 0.55 g/100 g in pizzas, chips and snacks and breakfast cereals, respectively. Despite the total salt intake reduction by the Portuguese population, the average salt content of the selected

foods is still above EIPAS recommendation of 0.3 g/100 g, for the selected foods. Only 2.7% of chips and snacks and 37.5% of breakfast cereals complied with EIPAS recommendation, while 0% of pizzas did. These results suggest that there is still work to be done regarding food reformulation.

Production of neuroactive extracts for prevention/delay of Alzheimer disease: an opportunity for a sustainable use of undervalued fish species

Ana Gomes-Bispo[1,2], Romina Gomes[1,3,4], Inês Mendes[1,5], Paula Duarte[3], Cláudia Coelho[5], Carlos Cardoso[1,2], Cláudia Afonso[1,2], Narcisa M. Bandarra[1,2]*

[1] Portuguese Institute for the Sea and Atmosphere (IPMA, I.P.), Avenida Alfredo Magalhães Ramalho, Portugal

[2] Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal

[3] NOVA School of Science and Technology, FCT NOVA, Universidade Nova de Lisboa, Caparica, Portugal

[4] IIFA-Instituto de Investigação e Formação Avançada, Universidade de Évora, Pólo da Mitra, Évora, Portugal

[5] Barreiro School of Technology, Polytechnic Institute of Setubal, Rua Américo da Silva Marinho, Lavradio, Portugal

Oral presentation, presenting author Ana Gomes-Bispo; ana.bispo@ipma.pt

Docosahexaenoic acid (DHA) is a key component of healthy brain tissues, where it is involved in several physiological functions. Low levels of this fatty acid (FA) were associated with the cognitive decline during ageing and neurological disorders, like Alzheimer Disease (AD). Since DHA cannot be produced by neurons, it must be obtained from the diet and cross blood brain barrier (BBB) so that it can be absorbed. In the brain, DHA is absorbed as a phospholipid (PL), particularly as lysophosphatidylcholine (LPC) which is the preferred carrier form of DHA into the brain, instead of its free from (found in fish oil supplements) or as triacylglycerol (in fish). Considering Atlantic mackerel (Scomber scombrus) is a good source of DHA, and this FA is mainly located in its PL fraction, this abundant and cheap species was used to produce extracts rich in LPC-DHA intended for AD patients. For this, the Atlantic mackerel was primarily used to extract with ethyl acetate and then with ethanol (to obtain the PL fraction).

The ethanolic extract was then enzymatically hydrolysed with Rhizomucor miehei lipase to convert the existing phosphatidylcholine (PC) into LPC. Both PL extracts (before and after hydrolysis) were characterised in terms of its lipid classes and FA profile. The PL represented 48.9±4.4% of total lipids found in ethanolic extract obtained from the fish extraction. In this extract, PC corresponded to 57.8±1.7% of total PL. After hydrolysis, PC and LPC represented 21.7±3.7 and 25.2±3.0% of found PL, respectively. The study of the FA profile of these lipid classes showed an increase of DHA in 40%, between PC before hydrolysis (33.6±2.6%) and LPC after hydrolysis (73.6±2.6%). These results show that the production of LPC-rich extracts suitable for supplementation/food fortification from undervalued species like Atlantic mackerel may represent a promising strategy to increase DHA uptake in brain cells, thus contributing to AD prevention/delay, while allows for this species valorisation.

Distribution of carotenoids in endosperm lipid fractions of maize kernel

Veronika Gunjević[1], Dora Zurak[1], Manuela Koševića[2], Zlata Kralik[2], Darko Grbeša[1], Kristina Kljak[1]*

[1] Faculty of Agriculture, University of Zagreb, Croatia

[2] Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University in Osijek, Croatia

Oral presentation, presenting author Veronika Gunjević; vgunjevic@agr.hr

Part of maize kernel lipids are located in endosperm where they can occur as free lipids (FL), as lipids weakly bound to the surface of starch granules [bound lipids (BL)], and as lipids located in the structure of the starch [starch lipids (SL)]. Important compounds in the maize endosperm are carotenoids, tetraterpene pigments that exhibit numerous health-promoting effects. Since carotenoids are lipophilic compounds probably related to endosperm lipids, the aim of this study was to evaluate the distribution of carotenoids among lipid fractions. The endosperm of 20 commercial maize hybrids was separated from the kernel. Lipid fractions in the endosperm were recovered sequentially, allowing simultaneous sequential isolation of carotenoids. The FL and BL and the corresponding carotenoids were extracted at room temperature with n-hexane and water-saturated n-butanol, respectively. The SL and the carotenoids in this fraction were extracted with n-propanol-water solution at 85 °C to ensure starch gelatinization. Individual and total carotenoids were quantified by HPLC. In the endosperm of tested hybrids, FL content ranged from 0.74 to 1.17%, while BL and SL were present in much lower quantities (0.12-0.56 and 0.13-0.75%, respectively). The highest portion of carotenoids was found in the fraction BL, averaging 73.84% of the total endosperm carotenoids, while carotenoid content in FL and SL was substantially lower (13.88 and 12.29%, respectively). The distribution of carotenoids varied greatly among the tested hybrids; the average ranges were 5.29-37.52% for FL fraction, 48.90-90.53% for BL fraction and 2.35-28.90% for SL fraction. The content of lutein, zeaxanthin, α- and β-cryptoxanthin and total

carotenoids in the BL fraction increased with increasing BL and total endosperm lipid content ($P < 0.05$). On the other hand, the content of individual and total carotenoids in FL fraction decreased with their increasing content in SL and total endosperm fraction ($P < 0.05$). The carotenoids in the FL and BL fractions present non-starch compounds, whereas the carotenoids in SL are contained within the starch granules. Consequently, 87.72% of the carotenoids in maize are located in the lipoprotein layer outside starch granules in the endosperm matrix.

The influence of social factors on the quality of life of celiac disease patients

Ivana Herak[1], Natalija Uršulin-Trstenjak[2], Dijana Biškup[1], Tomislav Meštrović[1], Ivana Dodlek Šarkanj[2]*

[1] University North, Varaždin, Croatia

[2] University North, Koprivnica, Croatia

Poster presentation, presenting author Natalija Uršulin-Trstenjak; nursulin@unin.hr

Celiac disease is an autoimmune disease of a chronic type, which occurs as a result of eating foods with gluten and its related proteins. It is present in about 1% of the total population of Europe, while in many the disease has unclear symptoms and remains unrecognized for a long time. Given that celiac disease is a lifelong disease, with inadequate treatment, it can lead to various serious complications, which greatly affects the quality of life of sufferers of this disease. The only successful way to keep the disease under control is for life introducing gluten-free preparations into the diet. To examine how celiac disease and social factors affect the quality of life of patients with celiac disease. A quantitative survey was conducted in which 48 participants from the area of northwestern Croatia participated. As an instrument, a self-made survey questionnaire was used for the purposes of the research. The questionnaire was filled out by parents for their minor child with celiac disease or an adult with celiac disease. Celiac patients of different age groups rate their quality of life differently and more than half of the participants are members of the celiac disease association. The obtained results show the dissatisfaction of the participants due to the insufficient availability of gluten-free products in stores, the lack of adaptation of school and kindergarten meals for children with celiac disease, and the unavailability of gluten-free dishes in most restaurants. The disease requires more frequent controls, and patients with abdominal disorders who do not adhere to a gluten-free diet, they have a reduced quality of life. Also, the participants of other researches have a negative assessment of the situation for patients with celiac disease which

they encounter every day in shops, schools, kindergartens, restaurants and bakeries. Early detection and treatment of celiac disease improves the quality of life, and the availability of gluten-free products in all aspects of social life positively affects the satisfaction of patients.

Knowing the Albanian "hurma" (Diospyros kaki Thunb.) fruit and its drying behavior based on quality characteristics and bioactive compounds

Luziana Hoxha
Food Research Center, Agricultural University of Tirana, Albania

Poster presentation, presenting author Luziana Hoxha; lhoxha@ubt.edu.al

The study aims to investigate main physico-chemical parameters, polyphenols and antioxidant potential of Albanian hurma (Diospyros kaki Thunb.) in fresh and dried state. The study was conducted during 2020-2021, and samples were collected randomly by trees over 40 years, in full maturity stage, from Tirana, Durres, and Elbasan regions in the central part of Albania, which are recognized traditionally for hurma fruits growing. Among physico-chemical parameters, dry matter, total soluble solids (TSS), total acidity, pH, total ash, vitamin C, color values (L*, a*, b*), and water activity (aw) were studied. As well, total polyphenols, flavonoids, and antioxidant potential were studied. Drying hurma resulted in a change of all parameters, resulting in an increase of dry matter over 3-fold, total acidity 0.154-0.192 g/100 g increased over 2-fold, pH from 6.6 decreased to 4.6, vitamin C was in a low amount of 7.22-7.74 mg/ 100 g and lost all content after drying, aw 0.929-0.938, was decreased after drying 0.74-0.75. The antioxidant activity in fresh and in dried hurma fruit ranged 37.9-39.3 and 78.2-80.7 ascorbic acid equivalent/100 g, the total polyphenolic ranged 74.2-93.3 and 101.7-125.2 mg gallic acid equivalent/100 g, flavonoid content 21.1-37.8 and 76.7-98.9 mg catechin equivalent/100 g. This study may serve as basis for selecting hurma varieties, for further development and prospect in fruit growing sector and with potential for diversification by food industry into new products.

Investigating the addition of red beetroot (*Beta vulgaris* L.) in the improvement of nutritional and sensory properties of tomato paste

Luziana Hoxha[1]*, Migena Kullaj[1], Adi Ismailaj[1], Silvana Ndoj[1], Çetin Kadakal[2]

[1] Faculty of Biotechnology and Food, Agricultural University of Tirana, Albania

[2] Faculty of Engineering, University of Pamukkale, Çamlık-Denizli, Türkiye

Poster presentation, presenting author Luziana Hoxha; lhoxha@ubt.edu.al

Investigating different components extracted from fruits and vegetables can help to know their specific effect on many applications, like natural food additives. Therefore, this study aims to investigate the role of the betalain of Beta vulgaris L. in the quality of tomato paste produced on a laboratory scale. With the purpose of exploring the effects of red beetroot application, the determined parameters were compared among raw tomato (Tr) and red beetroot (Br) samples, processed 100% tomato paste (TP100), in formulations m/m red beetroot-tomato: 30:70 (TBP30), 50:50 (TBP50) and 100% red beetroot paste (BP100), and a commercial tomato paste product (TPc). Samples were evaluated for nutritional profile, colour values (L*, a*, b*), and sensory characteristics. The total content of betalain, polyphenols, flavonoids, anthocyanins and antioxidant activity with two tests, DPPH and ABTS were determined too. Results showed that betalain content in beetroot was 313.91 mg/100 g, and a loss of 6 % happened during processing in BP100, whereas in TBP30 and TBP50 its content was preserved in the amount of 25% and 87%. It was noted that the addition of beetroot had a water-binding capacity of 1-3% more compared to tomato. Among protein, fat, carbohydrate, and ash content, no significant differences existed. Fresh tomato and beetroot colour values L*, a*, b* resulted respectively, 41.46, 27.06, 23.56 and 25.79, 18.07, 7.82, while after processing, an increase was noted in tomato paste and in TBP30 and TBP50. The content of polyphenols, flavonoids, anthocyanins and antioxidant activity in fresh and processed tomato paste reached values of 126 mg gallic acid equivalent/100 g, 64.4 mg

catechin equivalent/100 g, 11.9 mg C3G/100 g, 43.02 % and 91.6% of inhibition. The results of the study clearly show that red beetroot can improve the overall quality tomato paste, and has a positive effect on colour enhancement. Moreover, when red beetroot is added to tomato paste contribute to higher content of polyphenols (>2 fold), flavonoids, anthocyanins and antioxidant activity. Furthermore, the sensorial evaluation demonstrated that beetroot is a potential material that should be exploited for further development of tomato paste products.

Motivations associated with food choices among adults in the City of Zagreb

Ana Ilić[1], Ivana Rumbak[1], Dina Dizdarić[1+], Marijana Matek Sarić[2], Irena Colić Barić[1], Raquel de Pinho Ferreira Guiné[3]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia (+ alumna)

[2] Department of Health Studies, University of Zadar, Croatia

[3] CI&DETS, Polytechnic Institute of Viseu, Portugal

Poster presentation, presenting author Ana Ilić; ailic@pbf.hr

Food choice is determined by several factors, and one of them is motivation, which is the most important because it comes from within individuals. The aim of this study was to observe the food choice motivations and to estimate difference in socio-demographic and health characteristics according to the food choice motives in adult Croatian population. The study included 675 participants (54% women) aged ≥ 18 years. The socio-demographic and anthropometric characteristics were self-reported. The food choice determinants were observed from online questionnaire developed in Psycho-social motivations associated with food choices and eating practices (EATMOT) project. The K-means cluster analysis was used to divide participant into two clusters towards 6 food choice motivation categories (health, emotional, economic and availability, social and cultural, environmental and political, and marketing and commercial). Regarding the most and least important motivations, participants in cluster 1 chose food based on emotional motivations, and in cluster 2 based on environmental and political motivations. Although significant differences between clusters were observed in health motivations (2.95 ± 0.55 vs. 3.51 ± 0.42; $p<0.001$) and in economic and availability motivations (3.19 ± 0.64 vs. 3.03 ± 0.48; $p=0.040$), both were important motivators in both clusters. The least important motivations in both clusters were marketing and commercial (2.90 ± 0.61 vs. 2.98 ± 0.48), and social and cultural motives (2.83 ± 0.57 vs. 2.87 ± 0.47). From observe socio-demographic and health characteristics, clusters differed

with respect to the age ($p<0.001$) and weight status ($p=0.036$) of the participants. The half of the participants in cluster 1 were 18 – 30 years aged, while in cluster 2 was an equal distribution of respondents in all three age groups. In terms of weight status, in the cluster 1 there were more obese participants (18.6% vs. 10.2%), while in the cluster 2 were more overweight participants (25.7% vs. 35.7%). In conclusion, health motivation, and economic and availability were most pronounced motivations in the population, while it differed with respect to the emotional, and environmental and political factors. Younger and obese individuals had more pronounced emotional motivations.

Physical properties and total phenol content of encapsulated *Pistacia lentiscus* leaf extract

Tanja Jović[1], Ivona Elez Garofulić[2], Patricija Čulina[2], Zrinka Čošić[2], Zdenka Pelaić[2], Verica Dragović-Uzelac[2], Zoran Zorić[2]*

[1] Pharmacy Zadar, Zadar, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Tanja Jović; tanjajovic3003@gmail.com

Pistacia lentisucus is a evergreen shrub growing in the Mediterrean and Middle East region. Extracts of the leaves are rich in polyphenols with leaves being the richest source. They are especially rich in tannins and flavonoids and exhibit antioxidant and a wide range of biological activities. Plant derived phenolic compounds have low stability regarding pH, enzymes, temperature, oxygen and light so they have to be encapsulated to enhance their stability to environmental factors. Many techniques have been developed to microencapsulate food ingredients but spray-drying is the most common technology used in food industry due to low cost and available equipment. Therefore the objective of this study was to investigate the influence of different carriers (β cyclodextrin (BCD), maltodextrin DE 13-17 (MD) and gum arabica (GA)) on total phenolic content (TPC) and physical properties of obtained powders at spray drying temperature 150 °C and sample:carrier ratio 1:20. The highest yield was obtained when GA was used as a carrier (51.92±0.36 g) and the lowest for BCD powders (43.06±0.35 g) but BCD powders had the highest TPC content (13744±2232 mg/100 g dry mater of extract) followed by MD (6793±1091 mg/100 g d.m. of extract) and GA (3392±856 mg/100 g d.m. of extract) powders. BCD powders had the highest moister content (7.83±0.04 mg/g), lowest solubility (32.80±0.79%), lowest hygroscopicity (0.12±0.03 mg/g) and lowest bulk density (0.32±0.01 mg/mL). MD powders had the highest solubility (84.35±0.55%), and lowest moister content (4.02±0.02 mg/g). GA powders had the highest hygroscopicity (3.95±0.24 mg/g) and bulk density (0.82±0.01 mg/mL). According to the obtained results it can be

concluded that BCD powders had the lowest yields, lowest solubility and highest moister content but they were superior to GA and MD powders regarding TPC content. On the other hand, GA and MD powder had higher yields, lower moister content and considerably higher solubility.

Phenolic compounds in buds and flowers of 'Oblica' and 'Lastovka' olive cultivars

Maja Jukić Špika[1,2], Maja Veršić Bratinčević[1], Ana Bego[1], Marija Mandušić[1], Jakša Rošin[1], Tonka Ninčević Runjić[1], Marijana Popović[1], Mirella žanetić[1,2], Elda Vitanović[1]*

[1] Institute for Adriatic Crops and Karst Reclamation, Split, Croatia

[2] Centre of Excellence for Biodiversity and Molecular Plant Breeding, Zagreb, Croatia

Poster presentation, presenting author Maja Jukić Špika; maja@krs.hr

Olea europaea L. products such as extra virgin olive oils and olive leaves contain a wide variety of bioactive compounds that are profoundly analyzed for their various pharmacological properties. Scientific data on composition analyses of olive by-products such as olive milled waste, fruit pulp and seeds exist, however, information's regarding the phenolic composition of olive organs as buds and/or flowers are available really scarce. Phenolic compounds in plants are of considerable physiological and morphological importance, playing an important role in pigmentation, growth, and reproduction, but also for resistance to pathogens. Therefore, the aim of this study was to characterize olive buds and open flowers of two Dalmatian cultivars 'Oblica' and 'Lastovka', and determine whether these two cultivars differ in phenol composition within the analyzed organs. From the buds and open flowers polar fractions were extracted (3 of each cultivar) using solid–liquid extraction with hydro-alcoholic solvent, while the extracts were analyzed using high performance liquid chromatography. Among twenty-three identified compounds classified into groups that have been characteristic for olive products as secoiridoids, phenolic acids, phenolic alcohols, flavonoids, and lignans, oleacin and oleuropin were the most abundant in olive buds of both studied cultivars. Their significantly higher content had 'Lastovka' compering to 'Oblica'. In 'Oblica' open flowers oleacin and more over oleuropein content increases relatively to buds, although the highest increase was established for the verbascoside that was most abundant compound in 'Oblica's open flowers. For 'Lastovka' similar trend of increase was visible with an indication

that the highest proportion recorded in 'Lastovka' open flowers was oleacin. Except phenolic's, dynamics of anthocyanins cyanidin 3-O-glucoside and cyanidin 3-O-rutinoside was followed. This data are the first report on the characterisation of phenolic compounds in buds and open flowers of the Croatian olive cultivars.

A successful reformulation of lacto-vegetarian product

Terhi Junkkari[1], Leena Arjanne[1], Maija Paakki[2], Maija Kantola[3], Harri Luomala[3], Anu Hopia[2]*

[1] Seinäjoki University of Applied Sciences, Finland

[2] University of Turku, Finland

[3] University of Vaasa, Finland

Oral presentation, presenting author Junkkari Terhi; terhi.junkkari@seamk.fi

Excessive intake of salt, sugar, and fat or more generally unhealthy eating increases the risk for many lifestyle diseases, like cardiovascular diseases and diabetes. Food industry experts constantly develop innovations and new technological solutions to improve the healthiness of their products. Development of healthier products is challenging as consumers do not readily accept changes in products' sensory profile. Yet, healthy products have a substantial commercial potential as consumers are more and more interested in their well-being. The aim of this study is to test whether a lacto-vegetarian food product, vegetable lentil soup, with an unhealthy nutrient profile could be reformulated to meet the criteria for the Heart Symbol (based on the Finnish nutrition recommendations) without sacrificing consumer acceptance. To meet the criteria for the Heart Symbol, the amount of salt, oil and full-fat cream was reduced, and the full-fat cream (35% fat) was replaced with a smaller amount of light cream (15% fat) in the reformulated vegetable lentil soup. The reduced salt content was compensated by increasing the amount of apple and lemon juices in the recipe. The consumer acceptance was evaluated by asking the appearance, smell, taste, texture, and overall pleasantness of the products (N=123). Compared to original, reformulated product gain higher ratings in smell, but there was no difference in the overall pleasantness between original and reformulated products. The trained sensory panel (N=9, ISO 8589 sensory evaluation laboratory) evaluated the sensory profile of the products using 16 sensory attributes. Among the trained panelists, the original vegetable lentil soup was evaluated a significantly richer in texture-mouthfeel than the reformulated version, but no differences in

other sensory attributes between products were observed. The results show that reformulation of a lacto-vegetarian product with a conventional nutrient content is possible without adverse effects on consumer acceptance. In this study, the nutrient content profile of vegetable lentil soup improved remarkably (~50% decrease in fat and ~20% decrease in salt content). Future research needs to address the effects of longer storage and self-life on the sensory quality of the reformulated product.

The influence of 3',8" dimerization on the antioxidant and antifungal activity of flavonoids: the example of apigenin and amentoflavone

*Iva Jurčević, Bojan Šarkanj, Dunja Šamec**

University North, Koprivnica, Croatia

Poster presentation, presenting author Šamec Dunja; dsamec@unin.hr

Flavonoids are widely distributed secondary metabolites in various plants and plant foods. They are used in the food industry as preservatives and make an important contribution to colour and flavour of food. Rarely they are present in the form of aglycones, more often they are in the form of glycosides or polimerized to various degrees. They may be present as dimeric forms known as biflavonoids. Biflavonoids are dimers of flavone-flavone, flavone-flavone, flavone-flavone subunits, and in rare cases, dimers of chalcones. In recent years, they have become the focus of scientific attention due to their diverse biological activity. However, it is not clear how the dimerization of flavonoids affects their biological activity. In the present work, we aim to investigate how 3',8" dimerization affects the antioxidant and antifungal activity of apigenin and its 3',8" dimer amentoflavone. We performed a series of assays directly comparing the antioxidant and antifungal activities of apigenin and amentoflavone standard. Our preliminary data show that dimerization has an effect on the biological activity tested, but the trend depends on the method used for antioxidant activity and the fungal strains tested.

Funding: “This work has been supported by Croatian Science Foundation project “Biflavonoids role in plants: Ginkgo biloba L. as a model system” under the project no. UIP-2019-04-1018”

The quality of breakfast eaten at home vs. school in primary school children

Tea Knezović[1+], Ana Ilić[1], Ivana Rumbak[1], Ružica Brečić[2], Irena Colić Barić[1], Martina Bituh[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Faculty of Economics & Business, University of Zagreb, Croatia

Poster presentation, presenting author Ana Ilić; ailic@pbf.hr

Similar to skipping of breakfast, the consumption of low-quality breakfasts may contribute to nutritional deficits and poor academic performance in primary school children. The aim of this study was to estimate breakfast quality of primary school children and whether quality differs between breakfasts consumed at home from ones served in the school. The breakfast consumption on weekdays was observed from 3-day dietary records of 192 children (52.1% of boys) aged 8.9 ± 0.5 years from the City of Zagreb. Breakfast was defined as first meal of the day eaten before 10.30 AM. The energy and nutritional value of breakfasts was calculated using Croatian National Food Composition Tables and food labels of products. Breakfast quality was estimated using Breakfast Quality Index (BQI) for children. On total, children consumed 422 breakfasts on weekdays, of which 329 were consumed at home and 93 at school. The average daily energy intake from consumed breakfasts was 287 kcal (211 kcal – 375 kcal). The number of points achieved by BQI was on average 4.0 (4.0 – 5.0) out of a possible 10. The breakfast quality did not differ (p=0.722) between breakfasts consumed at home (4.0; 4.0 – 5.0) and at school (4.0; 3.0 – 5.0). Similar proportion (p=0.304) of breakfasts consumed at home (76.0%) and at school (72.0%) were classified as medium-quality breakfasts, while poor quality had 22.2% and 28.0% breakfasts, respectively. According to BQI components, similar proportion of breakfasts from both locations contained food rich in simple sugars, had lower ratio of monounsaturated and saturated fatty acids than study population's median, provided 200-300 mg of calcium and contributed 20-25% to daily energy intake. A greater proportion of breakfasts consumed at home contained dairy products and monounsaturated fatty acids rich food. However, a greater proportion of breakfasts

consumed at school contained cereals, fruit and/or vegetables, combination of cereals, fruit and dairy products in one meal but also saturated fatty acids rich food. In conclusion, it is necessary to improve the quality of breakfasts at both locations, conducting nutritional education and creating an environment that supports desirable eating habits.

The association of nutrition knowledge and diet quality of young Croatian elite swimmers

Gordana Kenđel Jovanović[1], Vanja Đurica[2]*

[1] Teaching Institute of Public Health of Primorsko-Goranska County, Rijeka, Croatia

[2] Clinic for treatment Rehabilitation and Prevention of Cardiovascular disease, Thalassotherapia Opatija,
Special Hospital for Medical Rehabilitation from Heart, Lung and Rheumatism, Opatija, Croatia

Poster presentation, presenting author Gordana Kenđel Jovanović; gordana.kendel-jovanovic@zzjzpgz.hr

Most young athletes do not adequately meet all dietary recommendations, mostly due to their specific higher needs, but also to insufficient nutrition knowledge and personal goals. Sports nutrition education is necessary for understanding specific principles of sports nutrition, important for better sports performance, recovery, and avoiding injuries and eating disorders and disordered eating common among athletes. The aim was to determine the association between nutrition knowledge and diet quality of young Croatian elite swimmers. A cross-sectional study among 16 Croatian young elite swimmers (mean age 18 years) assessed actual nutrition knowledge (NK) with a 60-item general NK and 10-item sports NK questionnaire (total 70 points). Their diet quality was assessed with 70-item FFQ for the previous week. The association of total NK with dietary variables was determined with Pearson's correlation. Mean total NK scored 39 points, only 38% of swimmers scored over 50 points meaning adequate knowledge. Swimmers' average diet was energy insufficient regarding their needs, abounded in proteins and fats as a result of animal origin foods consumption higher than recommendations. They consumed adequate amounts of cereals, fish and vegetables, and a third of the recommended daily servings of legumes and nuts. Total NK knowledge was negatively associated to energy (r=-0.68; p=0.001) and saturated fatty acids intake (r=-079; p<0.001), and positively to carbohydrates (r=0.45; p=0.039), fish (r=0.67;

p=0.002), legumes (r=0.79; p<0.001), and vegetables intake (r=0.61; p=0.006). Most of the surveyed young swimmers had insufficient knowledge about nutrition and sports nutrition, and an average diet that deviates from the recommendations for their age and activity needs. Still, a significant positive association between higher nutrition knowledge and consumption of desirable dietary pattern shows the essentiality of athletes' nutrition education. Adequate nutrition education is needed at younger athletes aimed at better performance and health and for the prevention of eating disorders and disordered eating due to their rising prevalence among athletes.

European Project Sports Community Against Eating Disorders

Gordana Kenđel Jovanović[1], Tatjana Čulina[1], Lina Velčić[1], Paolo Menescardi[2], Chiara Campi[2], Sara Marini[2], Giulia Mussoni[2], Yoanna Dochevska[3], Yvaylo Zdravkov[3], Stefka Djobova[3], Emmanouil Chrysostalis[4], Pavlos Kaklatzis[4], Marios Ioannis Nomikos[4], Begovikj Aamir[5], Todorova Dragana5, Sambolec Martina[5], Krstevski Viktor[5], Pawlowski Andrzej[6], Luks Dariusz[6], Radmski Jakub[6], Pietrzok Michal[6]*

[1] Teaching Institute of Public Health of Primorsko-goranska County, Rijeka, Croatia

[2] L'Orma s.s.d.r.l., Milano, Italy

[3] Bulgarian sports development association, Sofia, Bulgaria

[4] European Institute for Local Development, Thessaloniki, Greece

[5] Karate Klub Metalurg-Skopje, North Macedonia

[6] Klub Sportowy Jastrzębie-Borynia, Jastrzębie-Zdrój, Poland

Poster presentation, presenting author Gordana Kenđel Jovanović; gordana.kendel-jovanovic@zzjzpgz.hr

There is an increasing incidence of eating disorders in the world, and particularly worrying is an increase among the sports population, especially among young athletes where the incidence is still unclear. Early detection of eating disorders and problem-solving are highly important since eating disorders have high rates of morbidity and mortality. Bulgaria, Croatia, Greece, Italy, Macedonia, and Poland will with the European project act as a Sports Community Against Eating Disorders (SCAED) and provide the necessary resources to the sports sector, as well as preventive and active tools to the target population, which should help mitigate the spread of eating disorders throughout Europe. The project goal is to identify eating disorders among non-professional European athletes and to create interactive material (manual, European entities map to raise awareness and promote best practices exchange among institutions) intended for sports organizations. The project basis is research on the

prevalence of eating disorders, behavior, attitudes, and opinions related to diet, body weight, and body shape of non-professional athletes aged 12 to 21 years. The knowledge, attitudes, and opinions regarding eating disorders among their parents and coaches will also be investigated. The outcomes of the cross-sectional research in project partner European countries will serve as a basis for future research and projects. The resulting manual will be put into practice through basic workshops that should long-term help athletes, coaches, and athletes' families and by that, help decrease the incidence of eating disorders among athletes. Athletes and professionals working with athletes should have evidence-based sports nutrition and eating disorders education. The Sports Community Against Eating Disorders project can help early detection of eating disorders among athletes and provide them education and support, as well as their coaches, sports staff, and parents, which can help protect and maintain their health.

Changes in quality and composition of phenolic and volatile compounds in selected Croatian monovarietal extra virgin olive oils after heating

*Dora Klisović[1], Anja Novoselić[1], Marina Lukić[1], Klara Kraljić[2], Karolina Brkić Bubola[1]**

[1] Institute of Agriculture and Tourism, Poreč, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Karolina Brkić Bubola; karolina@iptpo.hr

The health benefits of the Mediterranean diet have been associated with the consumption of extra virgin olive oil (EVOO) as the main source of fats. Nowadays, the usage of EVOO as cooking oil to prepare meals is highly recommended. During heating, the oil undergoes several chemical reactions that influence its chemical composition and quality. Therefore, this study aimed to investigate the influence of heating on quality parameters, phenolic and volatile compounds in Leccino, Istarska bjelica, and Buža monovarietal EVOO. The oil samples were submitted to heating in an air oven at two different temperatures (180 °C and 220 °C), simulating usual roasting conditions typical for Mediterranean cuisine. Fresh, unheated oil was used as a control. Quality parameters related to oxidation status of oil, peroxide value, and spectrophotometric indices (K232, K268, and ΔK) were determined according to the analytical methods described in the European Commission Regulation from 1991, amendments included. The composition of phenolic compounds was determined by HPLC-DAD, and volatiles' profiles using SPME and GC-FID techniques. Significant losses in oxidative stability and decrease in phenolic and volatile compounds were more pronounced at higher heating temperatures, which underlined the temperature dependency of oxidative degradation during cooking conditions. However, there was still a considerable amount of phenolic compounds preserved after heating. In addition to quality parameters that served as oxidation indicators, hydroxytyrosol acetate among phenolic compounds and octanal, (E)-2-octenal, hexanal, 3-pentanone, and 1-penten-3-one among volatiles, were underlined as

possible thermal oxidation markers. Aside from being influenced by the heating temperature, the changes in the phenolic composition were cultivar dependent, while the changes in the composition of volatile compounds were found to be caused primarily by the heating temperature with no significant influence of the cultivar as an investigated factor. The obtained results contribute to the understanding of changes in quality and composition of Croatian monovarietal EVOO after heating, as well as provide new insights on the preservation of bioactive compounds in the course of the cooking process. Acknowledgement: This work has been supported by the Croatian Science Foundation under the project “Young researchers' career development project – training of new doctoral students”, DOK-2018-09-2293.

The effect of elevation on the phytochemical profile in *Allium ursinum L.*

Tvrtko Karlo Kovačević[1], Nina Išić[1], Josipa Perković[1], Iva Bažon[2], Dean Ban[2], Marta Sivec[1], Smiljana Goreta Ban[2], Nikola Major[1]*

[1] Institute for Agriculture and Tourism, Poreč, Croatia

[2] The Centre of Excellence for Biodiversity and Molecular Plant Breeding, Zagreb, Croatia

Oral presentation, presenting author Tvrtko Karlo Kovačević; tvrtko.karlo@gmail.com

Allium ursinum L., otherwise known as wild garlic, ramson, wood garlic, bear's garlic, wild cowleek, and buckram, is a wild relative of onion and garlic along with many other species of the numerous Allium genus. Being described as a plant that grows in the wilderness, the plant itself has adapted to various environmental conditions. Wild garlic is full of compounds that promote overall good health. Those properties are mostly attributed to the organosulfur compounds and antioxidants. Allium species are characterized by an abundance of organosulfur compound which are directly responsible for the distinct flavor and pungent odor. In addition, polyphenols are a group of numerous compounds that possess antioxidant properties and as such they promote good health on molecular level by scavenging radicals. The aim of this study was to investigate the differences in antioxidant capacities, total polyphenol contents, volatile profiles, and amino acid levels between bulbs and leaves of wild garlic originating from 8 different locations. Moreover, effect of above sea elevation on antioxidant capacities, total polyphenol contents, volatile profiles, and amino acid levels in bulbs and leaves of wild garlic was investigated as well. Antioxidant capacity and total polyphenol content were determined by spectrometric methods (DPPH, FRAP, ORAC, TPC) while volatile profile and amino acid levels were determined using GC-MS and HPLC, respectively. In total, 28 volatile compounds were determined in bulb samples and 23 volatile compounds in leaf samples. Also, 14 amino acids were quantified in bulb samples, while in leaf samples 12 amino acids were quantified. Furthermore, statistical analysis (factorial

ANOVA) showed how the quantity of investigated compounds is not only dependent on the plant's organ, but on elevation as well. Therefore, significant interaction between plant organ and elevation was established in 56.5% of determined compounds. In leaves, the effect of elevation was not significant in most investigated compounds, while in bulb samples that grew on lower elevation higher antioxidant capacity and amino acid content was observed. Meanwhile, bulbs from higher elevation exhibited higher level of volatile compounds compared to bulbs from lower elevation.

Chemical characterization and antioxidant potential of the Rowan berry fruits (*Sorbus aucuparia* L.) from various natural habitats in Croatia

Karla Kragić[1], Antonija Sulimanec Sulimanec Grgec[2], Josipa Vlahov[1], Božica Jerak[1], Ankica Sekovanić[2], Jasna Jurasović[2], Ines Panjkota Krbavčić[1], Nada Vahčić[1], Ivana Rumora Samarin[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Institute for Medical Research and Occupational Health, Zagreb, Croatia

Poster presentation, presenting author Antonija Sulimanec Grgec; asulimanec@imi.hr

The Rowan berry (*Sorbus aucuparia* L.) is a tree in the Rosaceae family with characteristic orange-red berries. Raw fruits can be used for making jams, juices, purees, as well as dried ones for teas. In alternative medicine, they are used to prevent scurvy and bleeding or as a diuretic and laxative. Aim of this study was to characterize the basic chemical composition, antioxidant potential and mineral profile of the Rowan berry fruits for the potential use as functional food. Fruits were collected in the mountain region of Croatia at six different locations of both Gorski kotar and Velebit. After collection, samples were transported to the laboratory, chopped into small pieces, placed in plastic containers and stored at -20 ºC until analysis. Basic chemical composition, including moisture, total ash, fiber, total fat, crude protein and total sugar, was determined according to the official AOAC methods (n=63). Total phenolic content (TPC) and antioxidative capacity (TAC) were also measured (n=49). For multielement analysis, samples of fresh fruits (n=28) were cleaned from the dust, lyophilized, homogenized and acid digested in a microwave system. Concentrations of elements were quantified using ICPMS method. The basic constituents in analyzed fruits were 76% of moisture, 4.7% of total sugars, 2.9% of crude proteins, 1.5% of total fats, 1.3% of cellulose and 1.1% of ash. The TPC was in range from 6.8 to 12.6 mg gallic acid equivalents/g dry weight (dw). Average TAC of extracts measured by DPPH and FRAP assay was 60.1% and 23.7 mmol Fe2+/100 g dw, respectively. On average, element concentrations (mg/kg dw) decreased as follows: K (9520) > Ca (1723) > P (804) > Mg (784) > Na (25) > Fe, Mn (14) > Zn (4.3) > Cu (2.8)

> Mo (0.38) > Co (0.01) > Se (0.005). In comparison with literature, we found that phenolic and mineral content of the Rowan berry fruits are similar with that of raspberry and blueberry. Finally, our results suggest that the Rowan berry fruits have valuable nutritional properties and could be useful for the fortification in food industry.

Influence of cultivar and ripening stage of Croatian olives on endogenous enzyme activity

Klara Kraljić[1], Mirella Žanetić[2,3], Maja Jukić Špika[2,3], Katarina Filipan[1], Nika Butula[1], Igor Stuparević[1], Olivera Koprivnjak[4], Dubravka Škevin[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Institute for Adriatic Crops, Split, Croatia

[3] Centre of Excellence for Biodiversity and Molecular Plant Breeding (CoE CroP-BioDiv), Zagreb, Croatia

[4] The Faculty of Medicine, University of Rijeka, Croatia

Poster presentation, presenting author Mirella Žanetić; mirella.zanetic@krs.hr

Endogenous olive enzymes represent a crucial link between fruit composition and the nutritional and sensory characteristics of virgin olive oil. Enzymes such as β-glucosidase, polyphenol oxidase and peroxidase influence the content and composition of polyphenols, the main antioxidants in virgin olive oils. Lipoxygenase and hydroperoxide lyase convert fatty acids into volatile components responsible for the specific sensory properties of the oil. The aim of the present study was to determine the influence of fruit ripeness on the enzymatic activity of β-glucosidase, polyphenol oxidase, peroxidase and lipoxygenase in four Croatian autochthonous olive cultivars. For this experiment, olive fruits from two Dalmatian (Oblica and Levantinka) and two Istrian cultivars (Rosulja and Istarska bjelica) grown in their area of origin were harvested on three different harvest dates, from October 28 to November 9, 2021. The β-glucosidase, polyphenol oxidase and peroxidase were isolated from the acetone powder of the paste. The activity of these enzymes was determined spectrophotometrically, and the formation of p-nitrophenol from p-nitrophenyl glucopyranoside was measured for β-glucosidase, the formation of o-quinone from catechol for polyphenol oxidase, and the formation of tetraguaiacol from guaiacol for peroxidase. Lipoxygenase was isolated directly from olive paste, and its activity was determined by measuring the concentration of formed

hydroperoxides by HPLC. The activity of β-glucosidase was detected only in a few samples, which was not sufficient to determine the influence of the factors studied on its activity. Polyphenol oxidase activity increased between the first and second harvest dates, and this increase was significantly higher in the Istrian cultivars. At later harvest dates, the activity decreased, but to a greater extent in the Dalmatian varieties. Peroxidase activity was significantly affected by both ripening and cultivar. Istrian cultivars had significantly higher peroxidase activity than Dalmatian cultivars. The activity was lower in riper fruits, with the exception of Levantinka, which had the highest activity in ripe fruits. Lipoxygenase activity was influenced primarily by harvest date: on the first date, activity was highest in Rosulja and Levantinka, on the second date in Istarska bjelica, and on the third date in Oblica. Throughout the harvest period, lipoxygenase activity was higher in Rosulja and Levantinka than in the other two cultivars.

Mineral content of dry-fermented sausages produced in Croatian households

Nina Kudumija, Tina Lešić, Ana Vulić, Jelka Pleadin*

Croatian Veterinary Institute, Zagreb, Croatia

Poster presentation, presenting author Nina Kudumija; kudumija@veinst.hr

Dry-fermented sausages are traditionally produced in many parts of Croatia, but, notably, in a non-standardised manner and according to the specific recipe of each rural household. In general, homemade sausages are produced from high-quality chopped meat and solid fatty tissue spiked with various spices, and subjected to fermentation, smoking, and drying. They represent high-quality products harbouring at least 16% of meat proteins and not more than 40% of water. Due to their high protein and mineral content, these products are regarded as high-value food, but their overconsumption leads to health problems arising from the high sodium-chloride (NaCl) and saturated fatty acid content. During 2020 and 2021, 46 samples of Kulen (n=17), Kulenova Seka (n=17), and Slavonian sausage (n=12) were collected from the Eastern and Northern Croatia. After acid digestion, minerals (sodium (Na), calcium (Ca), potassium (K), magnesium (Mg), copper (Cu), zinc (Zn), and iron (Fe)) were determined using flame atomic absorption spectroscopy (AAS). The results showed that a statistically significant difference ($p<0.05$) in macro-mineral content of the analysed sausages exists only when it comes to Na ($p=0.0389$), Ca ($p=0.0329$), and Zn ($p=0.0019$). Of all analysed minerals, the one most represented in all analysed sausages was Na, whose average content in Kulen equalled to 16,561 mg/kg, that in Kulenova Seka to 16,179 mg/kg and that in Slavonian sausage to 14,069 mg/kg. Such a high Na content can be attributed to the addition of NaCl in quantities dependent of the household recipe, i.e., the production technology. These products were also shown to contain a large amount of K ranging from 5,674 mg/kg in Kulen to 5,847 mg/kg in Slavonian sausage. The content of Ca spanned from 281.1 mg/kg in Kulenova Seka over 309.7 mg/kg in Slavonian sausage to 372.8 mg/kg in Kulen. The study revealed that dry-fermented sausages harbour a significant share of micro-minerals: Mg (206.9-533.5 mg/kg), Zn (19.19-

51.04 mg/kg), Fe (9.70-31.20 mg/kg), and Cu (0.94-2.53 mg/kg). The results of this study demonstrate that dry-fermented sausages traditionally produced in Croatian households represent a valuable source of different minerals, including biogenic ones.

Steviol glycosides attenuate lipid metabolism abnormalities by affecting gene expression in type 2 diabetic rats

Jakub Michał Kurek, Joanna Mikołajczyk-Stecyna, Zbigniew Krejpcio*

Poznań University of Life Sciences, Department of Human Nutrition and Dietetics, Poznań, Poland

Poster presentation, presenting author Jakub Michał Kurek; jakub.kurek@up.poznan.pl

A number of studies showed that steviol glycosides (SG) isolated from *Stevia rebaudiana* Bertoni - apart from their sweet taste, can provide important health promoting properties, i.e. anti-inflammatory, lipid and glucose regulatory potential or blood pressure normalising effects. The aim of the study was to determine the anti-diabetic potential of two specific SG: stevioside and rebaudioside A in a type 2 diabetic model of Wistar rat. The experiment was carried out on 70 rats. Ten animals constituted the healthy control group, while other sixty animals were made type 2 diabetic (by high fat diet feeding + STZ injection) and divided into experimental groups (n = 10) receiving high fat diet (no supplement), high fat diet + metformin (150 mg/kg diet) or high fat diet + the compounds mentioned above (stevioside or rebaudioside A, at doses of 500 and 2500 mg/kg b.w.) for 5 weeks. At the end of the experiment all rats were sacrificed to collect blood and tissue samples for biochemical analyses. It was found that SG normalized blood hyperlipidaemia indices (triacylglycerols, LDL-C and T-C). RT-PCR analyses of mRNA isolated from tissue samples (liver, muscle, adipose) revealed that these effects correlated with significant changes in the expression of lipid and glucose metabolism related genes (Cebp-α, Fasn). The results of the experiment showed that steviol glycosides can potentially normalise disturbed lipid profile parameters by regulating the expression of Cebp-α and Fasn, genes associated with lipid metabolism.

The presented work is an integral part of the research project (National Science Centre, Poland, NCN 2017/27/B/NZ9/00677).

Effects of supplementary steviol glycosides on tissular trace elements levels in type 2 diabetic rats

*Jakub Michał Kurek and Zbigniew Krejpcio**

Poznań University of Life Sciences, Department of Human Nutrition and Dietetics, Poznań, Poland

Poster presentation, presenting author Zbigniew Krejpcio; zbigniew.krejpcio@up.poznan.pl

Steviol glycosides, the sweet compounds isolated from *Stevia rebaudiana* Bertoni, have been reported to have blood pressure normalising, anti-inflammatory or lipid and glucose regulatory potential. It has been reported that diabetes can disturb trace elements status (i.e. Fe, Zn, Cu, Cr) in tissues of animals and humans, that can contribute to increased oxidative stress and amplification of disease complications. The aim of this experiment was to determinate the effect of supplementary steviol glycosides, stevioside (ST) and rebaudioside A (RA), at doses of 500 and 2500 mg/kg b.w., on tissular Fe, Zn and Cu contents in type 2 diabetic rats. The experiment was conducted on 70 Male Wistar rats, of which 60 rats were fed high fat (HF) diet for 8 weeks, followed by intraperitoneal streptozotocin injection (35 mg/kg b.w.) resulting in hyperglycaemia FBG > 400 mg/dL, while 10 healthy control rats were fed AIN-93M diet. Afterwards, diabetic rats were randomly allocated into 6 experimental groups (n =10) fed HF diet: untreated, supplemented with ST or RA (500 mg or 2500 mg kg/b.w), and treated with metformin (0.15%) for 6 weeks. After termination of experiment all rats were sacrificed to collect blood and internal organs for various biochemical and histopathological analyses. The Fe, Zn and Cu content in tissues was determined after MW mineralization of samples by the AAS method. It was found that diabetic rats (both untreated and treated) had significantly decreased the kidney Fe content. Supplementary stevioside and rebaudioside A tended to increase the kidney Cu content in diabetic rats.

The presented work is an integral part of the research project (National Science Centre, Poland, NCN 2017/27/B/NZ9/00677).

The process of making plant-based milk alternative

Tiina Laitila, Juuso Kumpulainen, Markus Ojala, Lotta Haapala, Jarmo Alarinta, Gun Wirtanen*

Seinäjoki University of Applied Sciences, Finlad

Oral presentation, presenting author Tiina Laitila; tiina.laitila@seamk.fi

Purpose - The purpose of this work was to prepare a plant-based milk alternative, oat drink, on a laboratory scale. The main goal was the maximum extraction of starch, proteins, and dietary fibers from the oats to the final product. The process and used methods related to the production of oat drinks are presented. Approach - The work was carried out for the EQVegan project. The material will be used as a learning material for the plant-based milk alternatives. Methods - Oat drink was prepared by using two different oat products, oat protein concentrate and oatmeal, by extracting desired substances with water. The oat protein concentrate was mixed in hot water bath using a rotor stator homogenizer. Centrifugation was used as a suitable separation technique while using fine oat powder. The oatmeal was extracted in an automated malting system, and the separation was done by filtering. The dry matter content of the mixtures was measured with an automated dry matter content analyzer. The aimed dry matter content was 8-10%, as in commercial products. After the separation process, addition of other ingredients e.g., oil took place. The pre-homogenization of the mixtures was done with a rotor stator homogenizer. After the previous step, homogenization of the mixture was done with a high-pressure homogenizer to stabilize the final product. The product should be pasteurized (e.g., 85°C for 5 minutes) before the cold storage. Results and conclusions - Oat drinks with different properties were successfully prepared. The solid content of the final products were 4.4% in oatmeal and 0.5% in oat protein concentrate. Altering the process parameters (pH, temperatures and extraction time) affects the properties of the final oat drink product.

PortFIR: An integrated approach for promoting multisectoral cooperation – contributing to Sustainable Development Goals achievement

Andreia Lopes, Paulo Fernandes, Roberto Brazão, Maria Graça Dias.*

Food and Nutrition Department, National Institute of Health Dr. Ricardo Jorge (INSA), Lisbon, Portugal

Poster presentation, presenting author Andreia Lopes; andreia.lopes@insa.min-saude.pt

The 2030 United Nations Agenda for Sustainable Development is an action plan for people, planet and prosperity, based on 17 Sustainable Development Goals (SDGs), of which stands out: end hunger, achieve food security and improved nutrition and promote sustainable agriculture; ensure healthy lives and promote well-being; ensure sustainable consumption and production patterns. The Portuguese Food Information Resource (PortFIR) is a network of partnership and cooperation, coordinated by the National Institute of Health Dr. Ricardo Jorge, for food data sharing, based on quality, transparency, reliability, with validated, documented and quality indexed data. To support food data (composition, contamination and consumption) production, compilation, standardization, availability and the production of scientific documentation, providing a basis for food policy-making, including contribution to SDGs achievement. PortFIR integrates networks in food composition, chemical contamination and microbiological information, involving governmental and non-governmental organizations, laboratories, academy, food business operators, health and economy sectors. PortFIR members cooperate to support food data activities, namely the Portuguese Food Composition Database, defining update priorities, sharing analytical data, producing and disseminating knowledge. PortFIR's 150 members work together on food composition, contamination, consumption data, and effective communication on food and diet, having regular meetings. It hosts the Portuguese Food Composition Table and some related features, as a calculation tool, providing nutritional information of users' recipe. As a

scientific source of data on food composition, it´s relevant for diet assessment, associated risk-benefit, food labelling, health literacy promotion and populations' nutritional status. PortFIR, through its networks and working groups, contributes to food and nutrition literacy improvement, to optimize risk and risk-benefit assessment and to provide a scientific basis for nutrition and public health advice and policies. It can support legislation, industry, commerce, people's way of life and health, and ultimately contributes to SDGs application. Work was developed within PortFIR to support the National Strategy for the Promotion of Healthy Eating, which aims to reduce salt and sugar in products available on the market, focusing on public health protection.

Current trends in buttermilk utilization: A quick overview

*Mirela Lučan Čolić, Martina Antunović**

Faculty of Food Technology Osijek, Josip Juraj Strossmayer University in Osijek, Croatia

Poster presentation, presenting author Martina Antunović; martina.antunovic@ptfos.hr

Buttermilk is a liquid by-product obtained by the churning of cream into butter and is considered one of the most important by-products of the dairy industry. Buttermilk has excellent nutritional properties, due to the content of lactose, vitamin, and high-quality protein, and especially due to the high content of the milk fat globule membrane (MFGM). The MFGM is rich in phospholipids and bioactive proteins that have been associated with various health benefits, such as cholesterol-lowering, anti-inflammatory and chemotherapeutic effects, and positive impact on the nervous system. Due to its good nutritional and sensory properties, emulsifying and stabilizing effects, and health-promoting benefits, the utilization of buttermilk is increasing steadily, focusing on the production of functional food. Although most of the buttermilk is used in the dairy industry, it also finds application in the bakery industry, chocolate production, pharmaceutical and cosmetics industry. In recent years, as new techniques of isolation and purification of buttermilk ingredients have been developed, buttermilk and MFGM-enriched fragments derived from buttermilk find an increasingly wide range of applications. The focus of this overview is to provide the most recent research findings about the novel methods of buttermilk utilization in the food and non-food areas.findings about the novel methods of buttermilk utilization in the food and non-food areas.

The effects of thermal processes on the quality of preterm human milk

Nikoleta Lugonja[1], Vesna Marinković[2], Srdjan Miletić[1], Jelena Avdalović[1], Snežana Spasić[1], Miroslav M. Vrvić[2]*

[1] University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, Belgrade, Serbia

[2] Institute of Neonatology, Belgrade, Serbia

[3] NRK ENGINEERING, Ltd., Belgrade, Serbia

Poster presentation, presenting author Nikoleta Lugonja; nikoleta.lugonja@ihtm.bg.ac.rs

The storage of human milk, the gold standard in infant nutrition, in a milk bank requires its freezing and then a pasteurization process immediately before its use in the diet of preterm infants. Thermal processes affect the composition and quality of milk. The objective of this research was to examine the influence of thermal processes on nutritive properties and quality of preterm milk. The effects of thermal processes were estimated on mature preterm milk of 30 breastfeeding women. Total proteins, lipids, lactose and minerals were determined before and after thermal processing and supplementation of mature preterm milk with fortifier. The protein concentration decreased after frozen storage and pasteurization. Pasteurization further reduced the lipid concentration after freezing, while there was no effect on lactose concentration. The mineral contents of mature milk were lower than necessary for the optimal growth of preterm infants, and thermal processes did not change its concentration. The supplementation of mature milk with a fortifier increased the concentration of macronutrients and micronutrients. Our study examined the influence of thermal processes on the nutritive properties of infant meals for preterm babies. Storage and pasteurization processes affect the basic nutritional composition and quality of preterm human milk. In order to ensure adequate nutrition for preterm infants with preterm human milk, supplementation, especially with high concentrations of proteins and lipids, is necessary after thermal treatments.

Influence of vegan product factors on purchase

*Helena Lukša, Dijana Vuković, Anica Hunjet**

University North, Varaždin, Croatia

Oral presentation, presenting author Anica Hunjet; anica.hunjet@unin.hr

Proper nutrition is one of the key prerequisites for health. In order to be able to plan the diet in such a way as to provide the body with all the necessary nutrients, it is important to understand the guidelines of proper nutrition and the function, sources and quantity of the necessary nutrients. As people, we are determined by internal and external factors. External factors are our living environment, the society we belong to, culture, family and other social groups with whom we share the same interests. While internal factors are precisely the motives that move us to action, a complicated set of emotions and personality traits. All of the above defines a lifestyle. Humans by definition are not scales, animals have always been an integral part of the human diet. However, it is precisely under the influence of internal and external factors that people consciously decide on the lifestyle they will follow. Ethical motives, such as concern for the welfare of animals, are the strongest motivators for switching to veganism. The production of vegan products is one of the biggest and fastest growing trends in the food industry in recent years. Taking into account the lifestyle, the impact of veganism on health, the environment and current trends in the food industry, this work tries to determine which product factors and internal factors such as lifestyle and motivation are important, in terms of their influence on choosing a vegan product. In order to confirm the above, research will be conducted on a deliberate sample of 205 subjects who continuously use vegan products.

The phytochemical diversity of shallots in Croatia

Nikola Major, Josipa Perković, Igor Palčić, Iva Bažon, Ivana Horvat, Dean Ban, Smiljana Goreta Ban*

Institute of Agriculture and Tourism, Poreč, Croatia

Oral presentation, presenting author Nikola Major; nikola@iptpo.hr

Shallots are a perennial plant from the Alliaceae family classified within the common onion under the name Allium cepa Aggregatum group. The term shallot is also used for diploid and triploid viviparous onions known as Allium × proliferum (Moench) Schrad and Allium × cornutum Clementi ex Vis., respectively. In this study we compared the dry matter, pyruvic acid content, sugar content, flavonoid content, and antioxidant capacity of 34 shallot accessions falling into three shallot species (Allium × cornutum, Allium × proliferum and A. cepa Aggregatum). Shallot accessions belonging to the A.× cornutum and and A. × proliferum groups are characterized by high dry matter content (around 25%) of which a little less than 50% is of inulin-type sugars, polysac-charides considered an excellent prebiotic with beneficial effects on human health. On the other hand, accessions belonging to the A. cepa Aggregatum group have lower dry matter content and as a result lower pungency (measured as pyruvic acid content) making them more acceptable for fresh consumption by a broader range of consumers but at the same time abundant in phenolic compounds especially in quercetin and isorhamnetin glycosides. We also observed a greater biodiversity among accessions within the A. cepa Aggregatum group in all analyzed parameters compared to the other shallot groups. The investigated shallot accessions have excellent in vitro antioxidant capacity as well as excellent nutritional properties.

Influence of processing time on physicochemical parameters, sensory properties, and volatile compounds of smoked dry-cured ham "Dalmatinski pršut"

Nives Marušić Radovčić[1], Ivna Poljanec[1], Krešimir Majcen[1], Sandra Petričević[2], Helga Medić[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Croatian Veterinary Institute, Regional Institute Split, Croatia

Oral presentation, presenting author Nives Marušić Radovčić; nmarusic@pbf.hr

The effects of ripening time (12 and 18 months) on physicochemical parameters, sensory properties, and volatile compounds of biceps femoris (BF) and semimembranosus (SM) muscles of smoked dry-cured ham "Dalmatinski pršut" were studied. Water, fat, protein, ash and NaCl content, water activity (aw), pH and colour parameters (L*a*b*) were determined in all samples of smoked dry-cured ham. The degree of fat oxidation was determined by the TBARS method. Free fatty acids were analysed by gas chromatography (GC), while volatile compounds were isolated by headspace solid-phase microextraction (SPME) and analysed by gas chromatography/mass spectrometry (GC/MS). Sensory evaluation was performed by quantitative descriptive analysis (QDA) and 16 attributes were analysed. The different processing time did not affect pH and ash content, but both muscles showed lower aw, water, NaCl and protein content. The L* value decreased after 18 months of processing while the a* and b* values were not affected by processing time. The TBARS value was not affected by processing time or muscle location. Prolonged ripening did not affect SFA, MUFA, and PUFA content in either muscle. Eighty-eight volatile compounds were identified, and at 18 months of ripening, the amount of all identified groups of compounds was higher. Aldehydes were the predominant group, followed by phenols, alcohols, ketones, aromatic hydrocarbons, esters, aliphatic hydrocarbons, terpenes, and acids. Sensory analysis showed that processing time improved odour intensity, red colour, marbling, and juiciness, while fat colour, colour homogeneity, sheen, saltiness, and hardness decreased.

*Funded by the Croatian Science Foundation project: “The application of innovative methods in monitoring of proteolytic, lipolytic and oxidative changes throughout the dry-cured ham process- IM-HQHAM” (HRZZ IP-2016-06-6793).

Our take on sodium intake among Croatian children with celiac disease: sodium content of their gluten-free diets and the contribution of commercial products

Katja Radolović[1], Jelka Pleadin[2], Nina Kudumija[2], Nada Vahčić[1], Martina Bituh[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Croatian Veterinary Institute, Zagreb, Croatia

Poster presentation, presenting author Katja Radolović; katjar10@gmail.com

Excess sodium intake in children is related to lower overall diet quality and a greater hypertension risk later in life. Previous research has shown that sodium intake among Croatian adults is more than two times higher than the current WHO recommendations. Daily sodium intake in children worldwide often exceeds the recommended intakes as well. However, the data on sodium intake among Croatian children are scarce, especially in those with celiac disease. Many gluten-free products found on the market are highly processed and also high in sodium. The aim of this study was to determine dietary sodium intake as well as exact sodium sources in the diet of children with celiac disease. Sodium intake of eight participants (aged 3-15) following a gluten-free diet were assessed using the duplicate diet method and two-day dietary records in order to obtain both qualitative and quantitative information on all food consumed. A total of 16 samples of whole-day gluten-free meals were analyzed using flame atomic absorption spectrometry (AAS) to obtain the sodium content (mg/kg). Average daily sodium intake was 2389 ± 933 mg which equals 6.0 ± 2.3 g of salt intake. Most of the participants' daily intakes exceeded recommendations. On average, 14 % of daily sodium was naturally present in consumed food, while as much as 86 % came from either processed food and food products (27 %), commercial gluten-free products (29 %) or table salt added during meal preparation (30 %). These results support the fact that daily sodium intake could easily be manipulated. Educating parents and children to choose products lower in sodium, substituting table salt with different herbs and spices during meal preparation and preparing homemade meals should be a priority.

Nutritional and functional potential of Black Sea shellfish (*Mytilus galloprovincialis, Chamelea gallina and Donax trunculus*)

Albena Merdzhanova[1], Veselina Panayotova[1], Nadezhda Petkova[2], Diana A. Dobreva[1], Katya Peycheva[1]*

[1] Faculty of Pharmacy, Medical University of Varna, Varna, Bulgaria

[2] Technological Faculty, University of Food Technologies, Plovdiv, Bulgaria

Poster presentation, presenting author Albena Merdzhanova; a.merdzhanova@gmail.com

The Mediterranean mussel (*Mytilus galloprovincialis*), striped venus clam (*Chamelea gallina*) and wedge clam (*Donax trunculus*) are the most important commercial bivalve species in the Black Sea. The aim of the present study was to determine bioactive compounds, antioxidant activity and chemical composition of three Black Sea bivalve species: *M. galloprovincialis, C. gallina and D. trunculus*. Crude protein, carbohydrates and total lipids were determined using standard procedures. Macroelements (K, Ca, Mg, Na) were determined by ICP-OES. Total phenolic contents (TPC) were determined by Folin-Ciocalteu method. All samples were subjected to RP-HPLC/UV/FL to analyze phenolic compounds, fat soluble vitamins and carotenoids. Antioxidant activities were evaluated by ABTS, DPPH, CUPRAC and FRAP methods. All three species had high protein (11–18.85%) and were low in lipid (1.7–5%), carbohydrate (1.8–7.6%) content and energy value (average 100 kcal/100 g ww). *M. galloprovincialis* and *C. gallina* presented higher Na, K, Ca and Mg content compared to *D. trunculus. M. galloprovincialis* showed the greatest potential for antioxidant activity (ABTS and CUPRAC), a higher content of phenolic compounds (330 mgGAE/kg), β-carotene (102 µg/100g ww) and astaxanthin (50.2 µg/100g ww). All three species are good sources of vitamin D3: from 15 µg/100g ww in D. trunculus to 40 µg/100g ww in *C. gallina*. *C. gallina* also had significantly higher vitamin E and K contents compared to the other species, while vitamin A was highest in *M. galloprovincialis.* In conclusion, the studied shellfish species from the

Black Sea coast presented high nutritional and functional potential due to the quality of proximate composition, wealth of bioactive compounds and related health-beneficial effects.

Acknowledgements: This study was financially supported by the National Science Fund of Bulgaria, Project № КП-06-ОПР03/11 from 18/12/2018.

Physico-chemical parameters and antioxidant activity of different types of honey from Northwestern Bosnia and Herzegovina

Melisa Oraščanin[1], Mejra Bektašević[1], Edina Šertović[1], Zlatan Sarić[2], Vildana Alibabić[1]*

[1] Biotechnical Faculty, University of Bihać, Bosnia and Herzegovina

[2] Faculty of Agriculture and Food Sciences, University of Sarajevo, Bosnia and Herzegovina

Poster presentation, presenting author Edina Šertović; edina.sertovic@gmail.com

The use of honey and bee products is constantly increasing. Their therapeutic properties are increasingly being researched with the aim of preserving health and improving people's quality of life. Thanks to the climatic and geographical conditions, the area of the northwestern part of Bosnia and Herzegovina has a long tradition of producing honey and bee products. There are many studies comparing the biological characteristics and quality of honey from different geographical and botanical origins. However, there is little or no literature data on the physico-chemical properties and biological activity of different types of honey and bee products from Bosnia and Herzegovina. In this paper, five different types of honey from the northwestern part of Bosnia and Herzegovina were analyzed: monofloral acacia honey (*Robinia pseudoacacia* L.), chestnut honey (*Castanea sativa* L.), linden honey (*Tilia spp.* L.), meadow honey and forest honey. Physico-chemical parameters (water content and electrical conductivity) were analyzed in five types of collected honey samples, sensory analysis was performed, honey color, antioxidant activity and content of total phenolic compounds were determined. The analyzes performed showed that chestnut honey contains the highest (34.3 mg GAE/100 g) and acacia honey the lowest content of total phenolic compounds (14.23 mg GAE/100 g). Antioxidant activity was determined by the ferric reducing antioxidant power method (FRAP) and the DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical quenching method. The forest honey showed the best antioxidant activity compared to other tested honey samples (874.11 Fe^{2+} µmol/L and 59.15% inhibition of DPPH radicals for a 10% solution). The obtained values for water content and electrical conductivity for all tested

honey samples were in accordance with valid honey quality requirements. The color of the honey was measured according to the CIELab system and the estimated L□, a□, b□ parameters show that all types of honey from this area can be characterized as dark types of honey (L□□50) with the presence of a yellow color. The obtained results show that the analyzed samples of five different types of honey meet the quality standards, they are rich in polyphenolic components and represent a good source of antioxidants in the human diet.

Physicochemical characterisation of royal jelly from northwestern Bosnia and Herzegovina

Melisa Oraščanin[1], Mejra Bektašević[1], Edina Šertović[1], Ivana Flanjak, Milica Cvijetić Stokanović[2]*

[1] Biotechnical Faculty, University of Bihać, Bosnia and Herzegovina

[2] Faculty of Food Technology Osijek, Josip Juraj Strossmayer University in Osijek, Croatia

Poster presentation, presenting author Mejra Bektašević; mejra_b@yahoo.com

The consumption of royal jelly is increasing due to its unique chemical composition and high nutritional value. With the discovery of the main bioactive compounds, royal jelly takes a significant role in the food and pharmaceutical industry. One of the most important ingredients of royal jelly is 10-hydroxy-2-decenoic acid (10-HDA), which is specific only to royal jelly. Due to the season and geographical origin, there are differences in the quality of royal jelly. In this paper, ten samples of royal jelly were analyzed, which were collected from the area of northwestern Bosnia and Herzegovina. In addition to 10-hydroxy-2-decenoic acid (10-HDA), physicochemical parameters were analyzed: pH value, total acidity, protein content, and antioxidant activity of royal jelly. The obtained results show that samples of royal jelly from the area of northwestern Bosnia and Herzegovina meet international standards for the specification of royal jelly with regard to the content of 10-HDA (from 2.19 to 3.65%) and other parameters for fresh and authentic samples. The examination of the antioxidant activity of royal jelly was performed by the DPPH and FRAP methods. The DPPH radical inhibition potential for the 10% solution ranged from 36.63 to 41.69%. Considering the established quality and very high antioxidant activity of the analyzed samples, they represent a significant potential for use in the development of functional products with pronounced nutritional and biological capacity. It is important to point out that this is the first study of royal jelly, as well as its physico-chemical characteristics, in Bosnia and Herzegovina and represents the

beginning of further research, assessment and establishment of royal jelly quality criteria in this area.

Impact of pre-fermentative mash cooling, heating, saignée technique and prolonged macerations on antioxidant capacity and total phenolic content in Teran red wine

Fumica Orbanic[1], Sara Rossi[1], Ena Bestulić[1], Karin Kovačević Ganić[2], Natka Ćurko[2], Marina Tomašević[2], Tomislav Plavša[1], Ana Jeromel[3], Sanja Radeka[1]*

[1] Institute of Agriculture and Tourism, Poreč, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[3] Faculty of Agriculture, University of Zagreb, Croatia

Poster presentation, presenting author Fumica Orbanić; fumica@iptpo.hr

This study aimed to determine antioxidant capacity and total phenolic content in red wine obtained from cv. Teran (*Vitis vinifera* L.), autochtonous Croatian grape variety. Five different vinification treatments were submitted to: 48-hour pre-fermentative mash cooling (8 °C) followed by prolonged post-fermentative maceration of 13 days (C15), 28 days (C30), and saignée technique (juice runoff) proceeded with maceration of 13 days (CS15); and to 48-hour heating (50 °C) followed by maceration of 13 days (H15) and 28 days (H30). Also, this experiment included a control treatment (K7), with a standard 7-day maceration. The antioxidant capacity of the wines was determined by the ferric reducing/antioxidant power (FRAP) assay and the oxygen radical absorbance capacity (ORAC) assay. Fluorescence was measured by spectrofluorometer. The FRAP assay results are expressed in mmol/L FeSO4 × 7H2O, and the ORAC assay results are expressed as mmol/L of Trolox equivalents (TE). Total phenolic content (TPC) was determined by the Folin–Ciocalteu colorimetric method using a UV/Vis spectrophotometer. The results are expressed as gallic acid equivalents in mg/L of wine (mg GAE/L). Obtained results showed that both FRAP and ORAC assay values in all treatments were significantly higher compared to the control treatment (K7). Also, the two assays showed a strong correlation (r= 0.998). FRAP assay values ranged from 10.77 to 23.67 mM Fe2+, and ORAC assay values ranged from 17.77 to 31.67 mM Trolox. The highest values of both assays were obtained in treatment submitted to pre-fermentative heating and 30-day

maceration (H30). Total phenolic content varied from 821.52 mg GAE/L in control wine (K7) to significantly the highest value, 2710.61 mg GAE/L in treatment where saignée technique and 15-day maceration were performed (CS15). In comparison to control wine (K7) TPC in all treatments was statistically higher. Obtained results suggested a noticeable impact of saignée technique and 15-day maceration on TPC, and the impact of pre-fermentative mash heating and 30-day maceration on antioxidant capacity. According to our results, Teran red wine, affected by particular vinification processes considered a strong source of bioactive compounds, as well their beneficial properties can contribute to human health.

Changes in the nutritional status, physical activity habits, and diet of children in elementary school during the Covid-19 epidemic

Sandra Pavičić Žeželj[1,2], Gordana Kenđel Jovanović[2], Matea Posedel[1]*

[1] Faculty of Medicine, University of Rijeka, Croatia

[2] Teaching Institute of Public Health of Primorsko-goranska County, Rijeka, Croatia

Poster presentation, presenting author Gordana Kenđel Jovanović; gordana.kendel-jovanovic@zzjzpgz.hr

The Covid 19 pandemic caused major changes in the lifestyle and habits of school children, but also disrupted interpersonal relationships. This situation had a great impact on children and young people, their health, intellectual, emotional, and physical development. The aim of this research was to assess changes in the nutritional status, physical activity, and eating habits of schoolchildren during the Covid-19 pandemic. A total of 197 children from the fifth to the eighth grade of the elementary school participated in the research. The research was conducted in two parts. The first part was in the form of a questionnaire in which food and lifestyle habits were examined before and after the online classes. The second part of the questionnaire contained kinanthropological measurements - long jump, trunk lifting in 1 min, running 800 m for boys and 600 m for girls. The measurements were taken before and after the online classes. Adherence to the Mediterranean diet was assessed with the Mediterranean Diet Quality Index for children and adolescents (KIDMED) index. Nutritional status was determined using the percentile curve from the previously calculated body mass index (BMI). Kinanthropological data were compared with Croatian norms for each exercise separately. The obtained results showed that the nutritional status of the schoolchildren did not change during online classes. The KIDMED index showed that the examined children belong to the group of medium-quality nutrition (5.98). The study found changes in daily activity patterns. Physical activity, which was replaced by a sedentary lifestyle, was statistically significantly reduced (1.98±1.62, 1.03±1.45; $p<0.001$, respectively). The results of

trunk lifting (28.06 ± 7.35, 25.38 ± 8.64; p<0.001, respectively) and running measurements (3.47 ± 1.01, 3.61 ± 1.25; p<0.001, respectively) are statistically significantly lower after the implementation of the online classes compared to the results achieved before the online classes. In addition to the important influence that parents have on the adoption of healthy eating habits, the promotion of physical activity as well as quality leisure time, it is also of great importance to implement public health programs in schools that promote a healthy lifestyle.

Cold gelation of leaf protein concentrate for nanoencapsulation of vitamins

Neda V. Pavlović[1], Jelena R. Mijalković[2], Nataša Ž. Šekuljica[1], Predrag M. Petrović[1], Verica B. Đorđević[2], Branko M. Bugarski[2], Zorica D. Knežević-Jugović[2]*

[1] Innovation Center of the Faculty of Technology and Metallurgy ltd., Belgrade, Serbia

[2] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Poster presentation, presenting author Neda V. Pavlović; nedanikolic@tmf.bg.ac.rs

Nowadays, the necessity for dietary nutrient encapsulation emerges largely since the action of digestive enzymes causes the loss of structural integrity and function of nutrients. Proteins have high nutritional value and thus are considered as the most nutritionally beneficial carriers; moreover, due to their versatility, proteins can be generated in a variety of structures (nanoparticles, nanofilms, nanofibers, coacervates, and hydrogels), allowing for the delivery of hydrophobic or hydrophilic nutrients. Proteins of vegetable origin have broader application potential over proteins of animal sources. Thus, the modern research focuses on waste leaf biomass, such as pumpkin leaves, as a rich source of plant proteins, specifically the most abundant protein in the world, ribulose-1,5-bisphosphate carboxylase-oxygenase, RuBisCo protein. The aim of this work was to isolate the water-soluble proteins, mostly RuBisCO protein, from pumpkin leaves in order to utilize it as a carrier for folic acid (FA) encapsulation. The resulting protein leaf concentrate was lyophilized and used as such to form nanoparticles. Leaf protein nanoparticles were prepared by employing a Ca-induced cold gelation method. The results showed that the Ca-induced protein nanoparticles have a small particle size (58–208 nm), polydispersity index (PDI) of 0.241 to 0.377, and negative zeta potential (-16.2 to -23.9 mV). Protein leaf nanoparticles exhibited uniform unimodal size distribution and spherical shape with a unique honeycomb-like core structure. Nanoparticle characteristics including size, surface charge and hydrophobicity could be adjustable by changing calcium chloride concentration from 2 to 10 mM and environmental pH (7 to 9). All manufactured

nanoparticles demonstrated good stability over seven days, with no significant changes in zeta potential or formation agglomerates. Release studies showed that the leaf protein nanoparticles with FA, encapsulation efficiency amounted 40.2%, were resistant to pepsin and low pH in simulated gastric fluid (10% of initial FA amount was realized), but released the encapsulated FA in simulated intestinal conditions was enriched, even another 50% was achieved. Pumpkin leaf protein nanoparticles have a promising possibility for bioactive ingredient delivery owing to the characteristics described above. These findings would be of great importance for the development of food-grade nanoparticles suitable for the formulations of functional foods.

Protein and proline content of honeydew and nectar honey of different botanical origin from Croatia

Petra Petek, Petra Škrtić, Ksenija Marković, Mirjana Hruškar, Marina Krpan, Nada Vahčić*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Ksenija Marković; kmarkov@pbf.hr

Proteins are present in small amounts in honey, but their content and composition is important for quality and authenticity assessment. Total proteins and proline, the major amino acid in honey, were determined in 101 sample of honeydew and nectar honey (floral, meadow, acacia, chestnut, forest, and linden honey) by Kjeldahl and spectrophotometric method, respectively. The content of total proteins in analysed samples (n=101) of different types of honey produced in Croatia during the season 2021, ranged from 0.19 % to 1.17 %, and was on average 0. 42 %. The proline content, which is proposed as a honey ripeness indicator with a minimum set value, according to the results of this study ranged from 81.78 mgkg-1 to 2796.03 mgkg-1 with an average value of 948.60 mgkg-1. The highest average total protein content was determined in forest honey (0.53 %), and the lowest in acacia honey (0.21 %), while honeydew honey contained 0.45 % of total proteins in average. The average values of proline content, as in the case of total protein content, indicate higher values in dark honey types with the highest proline content determined in chestnut honey (1066.76 mgkg-1), and the lowest in linden honey (490.81 mgkg-1). The obtained analytical results can represent a contribution to the assessment of the quality of different honey types produced in Croatia.

Probiotic activity of Lacticaseibacillus casei 431® in food for special medical purposes

Lenkica Penava[1], Andreja Leboš Pavuc[2], Martina Banić[2], Katarina Butorac[2], Jasna Novak[2], Marijana Ceilinger[1], Nina Čuljak[2], Jelena Miličević[1], Danijela Čukelj[1], Jagoda Šušković[2], Blaženka Kos[2]*

[1] Belupo d.d., Drugs and Cosmetics Inc., Nutraceuticals, Business Development and Registration, Koprivnica, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Lenkica Penava; lenkica.penava@belupo.hr

Increased awareness about the importance of nutrition in health promotion and disease prevention has driven the development of nutraceuticals. In this research, probiotic strain Lacticaseibacillus casei 431® was incorporated into the food for special medical purposes to develop an innovative nutraceutical product. Therefore, the aim was to investigate the influence of the target food matrix on the specific probiotic properties of the strain in vitro. Both cultures, the pure lyophilized and the one isolated from food for special medical purposes, efficiently survived the adverse conditions in simulated gastrointestinal conditions, without significant effect of the food matrix. The observed effect of matrix on bile salts deconjugation activity was minimal, however, cholesterol assimilation was increased by 16.4%. Lb. casei 431® exhibited antibacterial activity against Gram-positive bacteria as revealed by the agar spot-test method, which was not impacted by the food matrix. Contrariwise, bacterial cells culture from food matrix showed a significantly higher inhibitory effect on test-microorganisms determined by the agar diffusion method. The result of the turbidimetric method indicated that the food for special medical purposes enhanced the antimicrobial effect of Lb. casei 431® probably due to the stimulation of metabolic activity and production of antimicrobial metabolites in the presence of matrix. The autoaggregation capacity of L. casei 431® cells was not affected by the food matrix. Furthermore, in adhesion

assays, the adherence of the bacterial cells of 431® to the extracellular matrix proteins, fibronectin, collagen and laminin found in intestinal tissues, was reduced after treatment with proteinase K where the highest adhesion to laminin was observed. Adhesion of Lb. casei 431® decreased the binding of E. coli 3014 by 1.81 log units and the binding of S. Typhimurium FP1 by 1.85 log units in model Caco-2 cell lines suggesting the potential of the pathogen competitive exclusion.

Enzyme-assisted extraction of various bioactive components from blackcurrant (*Ribes nigrum*)

Anja Petrov Ivanković[1], Milica Veljković[1], Ana Vukoičić[1], Ana Milivojević[2], Marija Ćorović[2], Rada Pjanović[3], Dejan Bezbradica[2]*

[1] Innovation center of Faculty of Technology and Metallurgy, Belgrade, Serbia

[2] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

[3] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Poster presentation, presenting author Milica Veljković; mveljkovic@tmf.bg.ac.rs

According to experts, berries are a major source of phytochemicals, disease-fighting components, which can help to boost the immune system and lower the risk of many aging-related conditions. The simplest way to isolate these compounds is through solvent extraction. However, this method is not entirely successful since, in addition to free phytochemicals, there are also significant amounts of bound components that are trapped in the cell wall. For these reasons, the addition of enzymes such as cellulases and pectinases provides the hydrolysis of the cell wall, facilitate the release of molecules and increase the extraction yield of phytochemical. Therefore, in this work, enzyme-assisted extraction of lyophilized blackcurrant (LCR), a fruit that is increasingly used for pharmaceutical and cosmetic purposes, was examined. Extraction was performed in acetate buffer pH 4.5, at 50° C using four enzymes: Pectinex® Ultra SP-L, Viscozyme® L, Cellic® CTec3, Rohapect® MC. In the first step of the experiment, the extraction was optimized by different-time varying, from 10 to 120 min, and after choosing the optimal time, the influence of the solid-liquid ratio (1:4, 1:10, 1:40) on the extraction efficiency was examined. The progress of extraction was monitored spectrophotometrically, through antioxidant properties, the total content of polyphenols, flavonoids, and phenolic acids from all blackcurrant extracts and compared to the control (extract without enzyme). Regarding the total content of polyphenols, it was revealed that 60 min was the optimal extraction time. On the other hand, it was found that

for a solid-liquid ratio of 1:4, all results were about 1.5 times higher than the control values. In terms of enzymes, Viscozyme® and Pectinex® Ultra SP-L enabled the recovery of the highest total phenolic content (~28 mg GAE/g LCR) and phenolic acids (~3 mg CA/g LCR), while, on the other hand, Rohapect® MC enhanced the extraction of antioxidants (FRAP 380 µmol Fe2+/g LCR), as well as total flavonoids (2.85 mg QE/g LCR). Obtained results open new possibilities for blackcurrant extracts treated with different enzymes as value-added ingredients for the cosmetic and food industry.

Are Italian parents willing to accept that their children eat insect-based products? A preliminary study

Giulia Secci, Fabio Boncinelli, Isabella Tucciarone, Giuliana Parisi*

University of Firenze, Department of Agriculture Food Environment and Forestry – DAGRI, Firenze, Italy

Poster presentation, presenting author Giulia Secci; giulia.secci@unifi.it

The challenge to ensure access to safe and sustainable animal protein has been deeply shifting food systems from intensification of production toward an economy that is increasingly circular, looking at waste prevention, recovery and valorization. Among the strategies put in place at the EU level, insects, approved as novel food with the Regulation (EU) 2015/2283, have been warmly promoted for human nutrition. However, European consumers are still reluctant to accept entomophagy, perceived as a primordial practice. This barrier could be possibly overcome if insects are introduced into the diet during childhood. In this sense, public canteens in kindergartens or elementary schools could introduce insect-based products to make the consumption of these food familiar starting from young age. Due to these premises, our preliminary study aimed at understanding if parents are prone to accept that the canteen service would offer to their children (3-10 years old) a traditional Italian food, namely bread, containing a percentage of flour made with insect (Tenebrio molitor). This study uses data collected from an online survey on 210 Italian parents. The questionnaire included a contingent valuation with a Double bounded dichotomous choice format. The respondents had to elicit if they are willing to accept the insect-based bread for their pupils in exchange of a given discount on the school lunch fee (between 10%, 20%, 30%, 40% and 50%, allocated randomly to each participant). Additional questions collected information about the children's favorite food offered by the canteens, children's food fussiness, family eating habits, the respondents' degree of neophobia and their health concerns. Results showed that parents, mostly neophobic, are not willing to approve the introduction of insects in children's

school lunch, even in exchange for a discount. On the contrary, excessive discounts seem to have been perceived as indicating poor quality of the bread with insect flour. This rejection seems to be rooted in the fear of giving their children food they are unfamiliar with and about whose safety they have very little information. In fact, only 36.2% are sure that insects have no negative consequences on human health.

Relationship of gestational diabetes with anthropometric parameters of pregnant women and dietary habits with emphasis on vitamin D

Vedrana Škoro Rendulić[1], Nikolina Zovko[2], Mirjana Hruškar[2], Marina Krpan[2], Vesna Košec[1]*

[1] Sestre milosrdnice University Hospital Centre, Zagreb, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Vedrana Škoro Rendulić; vedrana.skoro@gmail.com

Pregnancy is a physiological condition of a woman in which a series of changes and adaptations of the mother's body occur for the growth and development of the fetus and preparation for childbirth. A woman's age at conception, anthropometry and dietary habits, with an emphasis on vitamin D, before and during pregnancy are common risk factors for the development of gestational diabetes, which is one of the most common complications in pregnancy. The aim of the research was to determine the anthropometric parameters of women and their dietary habits with an emphasis on vitamin D with the incidence of gestational diabetes in pregnancy. The research was conducted using an online questionnaire from June to July 2022 and included mothers (N=373) with singleton completed pregnancies who were voluntarily recruited through social networks. The questionnaire included general characteristics, anthropometry, dietary habits according to the frequency of food and drink consumption and foods that are the greatest source of vitamin D, supplementation before and during pregnancy with an emphasis on vitamin D, and the occurrence of gestational diabetes in pregnancy. Analyzing the collected data, the results of the research confirmed some of the previous findings. Statistically significant difference in the occurrence of gestational diabetes in pregnancies was determined depending on the body mass index before pregnancy ($p=0.003$) as well as on the age of the woman at conception ($p=0.044$). A statistically significant difference between the frequency of food consumption and the incidence of gestational diabetes was found for a smaller proportion of foods, but the

difference was not observed with regard to the consumption of dietary supplements with vitamin D (p=0.991). The results of the research are indicators of the extent to which additional education and nutritional intervention is needed before conception and during pregnancy as part of prevention for an orderly course of pregnancy. Also, considering the numerous previous studies on vitamin D deficiency in pregnant women as a risk factor in pregnancy, further, more detailed studies are needed in Croatia on the status of vitamin D in pregnancy and the impact on perinatal risks and pregnancy outcome.

Improvement of cookies nutritional characteristics by the addition of soybean husk

Dragana Šoronja-Simović, Biljana Pajin, Jovana Petrović, Ivana Lončarević, Zita Šereš, Nikola Maravić*

Faculty of Technology, University of Novi Sad, Serbia

Poster presentation, presenting author Dragana Šoronja-Simović; dragana@tf.uns.ac.rs

Production of new, functional products with the use and valorization of by-products of all branches of the food industry is one of the leading trends in the food industry. When processing soybeans and obtaining oil and flour, soybean hulls remain as the main byproduct. However, soybean hulls contain significant amounts of dietary fiber and phenolic compounds that have antioxidant properties, which is very important from a nutritional point of view. Due to the high content of dietary fiber (more than 70%), soybean husk has great potential as a raw material for obtaining products that will have a positive impact on human health. In this work, the control sample was produced only from wheat flour, and in the other samples the wheat flour was replaced with ground soybean husk in the amount of 5%, 10% and 15%. Chemical analysis of cookies showed that with the increase in the percentage of substitution of wheat flour with ground soybean husk, there has been a significant increase in the content of total dietary fiber from 1.98 % to 8.43 %, while the content of insoluble dietary fibers increased from 1.19 % in control sample to 8.43 % in sample with 15 % soybean husk. Cookies protein content increased from 7.74 % (control sample) to 14.12 % (sample with 15 % soybean husk). The content of minerals, which was 0.57 % in the control sample, significantly increased with the addition of soy husks, to as much as 3.40 % in the sample containing 15 % of soy husks. Overall, soybean husk is a promising raw material for the production of functional products. Acknowledgment: This work was supported by the project of the Ministry of Agriculture, Forestry and Water Management, Directorate for Agrarian Payments: "Creation of new functional products by transfer of knowledge between scientific research organization and small food producers", decision no. 680-00-00099/2/2022-02 from 25.05.2022.

In situ transformation of sucrose in maple syrup in order to produce fructo-oligosaccharide enriched product

Milica Veljković[1] , Milica Simović[2], Anja Petrov Ivanković[1], Ana Vukoičić[1], Katarina Banjanac[1], Dejan Bezbradica[2]*

[1] Innovation center of Faculty of Technology and Metallurgy, Belgrade, Serbia

[2] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Poster presentation, presenting author Milica Veljković; mveljkovic@tmf.bg.ac.rs

It is well known that maple syrup, a product obtained by processing maple tree sap, is widely used in many households due to its sweetness and beneficial ingredients. It is most often used as a topping for pancakes, waffles, donuts, and other desserts, but also as a sweetener for numerous beverages such as coffee, tea, lemonade, and many others. This natural syrup, in which, in addition to numerous minerals, antioxidants, carbohydrates and other components, sucrose predominates, presents an excellent substrate for the synthesis of bioactive molecules, i.e. fructo-oligosaccharides (FOS). These indigestible oligosaccharides which belong to a group of established prebiotics are very suitable from the standpoint of human health because they enable the normal functioning of the gastrointestinal tract, have a positive effect on the immune system as well as many other benefits for the human organism. With the approach which include the conversion of sucrose into FOS, it is possible to obtain a product with improved characteristics, i.e. higher functional and lower caloric values. Accordingly, in this study, a detailed optimization of the enzymatic synthesis of FOS was performed using maple syrup as a source of sucrose and commercial enzyme mixture Pectinex® Ultra SP-L as a source of fructosyltransferase. Namely, by individual varying of enzymatic synthesis key factors such as temperature (30-80 °C), enzyme concentration (1, 3 and 5%) and reaction time (0-25 h), optimal conditions were selected. It was determined that by performing the synthesis reaction at a temperature of 60 °C with an enzyme concentration of 3% for 12h, a remarkable sucrose hydrolysis degree of 82% and a FOS yield of

approximately 55% were achieved. In this case, the estimated caloric value of the obtained product is about 2.2 kcal/mL, which is around 1.6-fold lower compared to the initial value of 3.6 kcal/mL. The product obtained in this manner could represent a low-calorie sweetener with high fiber content and could potentially be included in the diet of diabetics and obese people, as well as all those who aim to maintain better overall health.

Specialized metabolites content of broccoli microgreens grown under the different LED wavelengths

Roberta Vrkić, Jana Šic Žlabur, Mia Dujmović, Božidar Benko*

Faculty of Agriculture, University of Zagreb, Croatia

Oral presentation, presenting author Roberta Vrkić; roberta.vrkic@gmail.com

Growing microgreens in greenhouses requires controlled growing conditions such as temperature, humidity and light. Light, as the most important factor for growing plants, with its quality (wavelenghts) and photoperiod (duration), directly affects the accumulation of specialized metabolites (SM) with the aim of growing plant material of high nutritional value. Photosynthetically active radiation (PAR) includes wavelengths in the range of 400-800 nm. Specific photoreceptors of plant cells absorb blue (400-500 nm), red (600-700 nm) and dark red (700-800 nm) wavelengths. Red wavelengths have the most effect on morphological properties of plant, while blue wavelengths have an effect on SM synthesis. The aim of this research was to determine the effect of supplemental LED's lighting with blue (450 nm), red (620 nm) and combination of blue and red spectrum (50:50) in the photoperiod of 14 h on SM content of broccoli microgreens (Brassica oleracea L. var. italica Plenck). Broccoli microgreens were grown in a climate chamber with fully controlled conditions for plant cultivation (25 °C, 60% RH). Microgreens were manually cut at the base of the hypocotyl in the cotyledon phenophase at a height of 7.5 cm after eight days. At harvest, plant material samples weighted 50 g were taken for the following analyses: total dry matter (TDM), ascorbic acid content (AsA), total phenolic content (TPC), clorophyll content, color content and antioxidant capacity. The highest TDM content (6.72%), TPC content (95.36 mg GAE/100 g) and antioxidant capacity (1228.2 µmol TE/l), as well as color content was recorded under combined lighting. Samples grown under LED supplemental lighting of 620 nm (red spectrum) showed the highest AsA content (88.17 mg/100 g fw). The most clorophyll (0.92 mg/l) and

carotenoids (0.41 mg/l) were acumulated under LED lighting of 450 nm (blue spectrum). According to the results, the most SM accumulated under the combined wavelengths, while the red lighting affected vitamin C accumulation. Clorophylls and carotenoids, which are also important antioxidants, were highly accumulated under blue lighting. LED's supplemental lighting has a positive effect on the SM accumulation in broccoli microgreens, which represents broccoli microgreens as a health-promoting functional food.

Chemical composition of meat-based meals for tube feeding

Anja Vukomanović[1], Matija Jagodić[1], Ivica Vrdoljak[2], Katarina Šanko[2], Nada Vahčić[1], Ivana Rumora Samarin[1], Zvonimir Šatalić[1], Ines Panjkota Krbavčić[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Clinical Hospital Center Rijeka, Hospital Nutrition and Dietetics Service, Rijeka, Croatia

Poster presentation, presenting author Nada Vahčić; nvahcic@pbf.hr

Meals prepared for tube feeding should be high-quality, properly planned, and of a certain consistency to satisfy all nutritional requirements of patients. However, studies showed that the composition of tube feeding meals can be very heterogeneous and affect the nutritional intake of patients. Therefore, this study aimed to analyze the basic chemical composition of meat-based meals for tube feeding prepared in the hospital system and to compare them with theoretical values. Samples of 13 different freshly prepared meat-based meals were collected in the Clinical Hospital Center Rijeka. Every meal contained vegetables, starch, and meat component, chicken (n=5), turkey (n=4), or veal (n=4). Meals were prepared according to standard methods of thermal food processing. Onwards, meals were blended with a mixer while adding water remained from cooking until reaching proper consistency for tube feeding. All samples were subjected to the freeze-drying process out of practicality and their basic chemical composition was determined by standard analytical methods. A standard national food composition database was used for determing the theoretical chemical composition of meals. Chemical composition of meat-based meals for tube feeding showed that all meals contained higher content of water when compared with theoretical values, while the content of carbohydrates, fat, protein, and minerals was lower. Accordingly, energy values of analyzed meals were lower than theoretical values, as determined by statistically significant difference ($p<0.05$). A significant difference in energy values was also determined between meals containing chicken ($p=0.001$), turkey ($p<0.001$), and veal ($p<0.001$). Some of the factors that could affect the chemical composition of meat-based meals are thermal processing methods

and variations in meat and vegetable composition. Also, there are certain limitations of the national food composition database from which theoretical chemical composition of meals was calculated. Additional chemical analysis should be made to determine with certainty the reason for the deviation of the analytical and theoretical values of the composition of the meal. Obtained results should further be applied in the hospital system to ultimately meet the energy and nutritional needs of patients on tube feeding.

Pregnant women with gestational diabetes mellitus have inadequate dietary fiber intake

Anja Vukomanović[1], Matea Horvatović[1], Ivana Rumora Samarin[1], Zvonimir Šatalić[1], Ines Panjkota Krbavčić[1]*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Anja Vukomanović; avukomanovic@pbf.hr

Gestational diabetes mellitus is a condition characterized by hyperglycemia first detected in pregnancy. Studies showed that adequate consumption of total dietary fiber before and during pregnancy might have protective effects on the appearance of gestational diabetes. Therefore, this study aimed to examine dietary habits of pregnant women diagnosed with gestational diabetes, highlighting the intake of dietary fibers. This study included 40 pregnant women with gestational diabetes in Croatia, aged 22-48 years. Dietary intake of fibers was assessed with semi quantitative Food Frequency Questionnaire (FFQ) validated among pregnant women in the Mediterranean area, containing nine responses starting from „never or less than once per month“ to „six or more per day“. Some foodstuffs and their portion sizes were adapted to the needs of this research. Fiber dietary intake was linked with anthropometric characteristics of respondents and changes in their dietary habits due to diagnosis of gestational diabetes, which were collected with the general questionnaire. Results showed that 80 % of participants did not meet the recommendations for daily dietary fiber intake, while the average intake was 49.3 % of recommended 28 g/day. Although vegetables were the main dietary source of fiber (47.2 %), only 60 % of participants met the recommended 400 g/day of fruits and vegetables. There was 45 % of women who were overweight or obese at the begining of pregnancy, but no difference in dietary fiber intake was found between overweight and normal weight participants (p=0.786). After being diagnosed with gestational diabetes, 88 % of participants changed their dietary habits, mainly by restricting the intake of simple carbohydrates (70 %) and sweetened beverages (70 %),

while increasing the intake of vegetables (38 %) and complex carbohydrates (38 %). Large number of women with gestational diabetes do not consume enough dietary fibers. Educating women about the importance of adequate dietary fiber intake and its benefits is necessary in preventing gestational diabetes mellitus and ultimately reducing the risk of health complications for child and mother during pregnancy.

Vitamin A and vitamin E content in sea bass and sea bream farmed in the Adriatic Sea and its seasonal variability

Ana Vulić, Tina Lešić, Nina Kudumija, Snježana Zrnčić, Dražen Oraić, Jelka Pleadin*

Croatian Veterinary Institute, Zagreb, Croatia

Poster presentation, presenting author Ana Vulić; vulic@veinst.hr

Fish represents one of the main animal protein sources. Due to its nutritional value, it is widely represented in global human diet. As compared to the proteins of homeotherms, fish proteins are easier to digest (due to the lower collagen content), are better utilised (93-98%), and have a high chemical score owing to the presence of essential amino acids. The nutritional value of fish also comes from the excellent fatty acid profile and mineral and fat- soluble vitamin content. Vitamin A supports immune function, foetal development, and vision, while vitamin E acts as an antioxidant important for immune health and cellular signalling, thereby also promoting the omega 3 effects. The content of vitamin A and E in fish varies depending on the fish species, feed material, and environment, but also on the season. In Croatia, the most important aquacultural fish species are sea bass and sea bream. During four seasons of the year 2020, 40 sea basses and sea breams were sampled from fish farms located in the Adriatic Sea and analysed for their vitamin A and vitamin E content. Samples were extracted, saponified, and analysed using Ultra High Performance Liquid Chromatography (UHPLC) coupled with an ultraviolet (UV) detector. The mean vitamin E content in sea bass and sea bream was 0.19 mg/100g and 0.30 mg/100g, respectively, with no significant inter-species difference ($p > 0.05$). On the contrary, a significant difference ($p < 0.05$) in vitamin A content of the two was determined. Vitamin A content in sea bass and sea bream was 11.78 µg/100g and 19.76 µg/100g, respectively. Vitamin A and vitamin E content of both fish species varied greatly across seasons. In both fish species, vitamin E reached its peak during winter (0.52 mg/100g in sea bream and 0.35 mg/100g in sea bass), while the highest vitamin A

concentration was seen during summer (34.5 µg/100g in sea bream and 18.9 µg /100g in sea bass). It can be concluded that vitamin A content varies depending on the fish species, and that season has a significant influence on fat-soluble vitamin content of both of the investigated fish species.

From traditional culinary plants to potential cytotoxic agents against the brain cancer: Melocan (Smilax excelsa L.) and Galdirik (Trachystemon Orientalis)

*Diaa Al Yassine[1], Nourtane El Massri[1], Günnur Demircan[2], Gulay Bulut[3], Demet Akin[4], Zeynep Tacer-Caba[5]**

[1] Bahcesehir University Graduate School, Bioengineering Program, Istanbul, Türkiye

[2] Faculty of Medicine, Demiroglu Bilim University, Istanbul, Türkiye

[3] Faculty of Medicine, Karabuk University, Türkiye

[4] Bahçeşehir University School of Medicine, Istanbul, Türkiye

[5] Faculty of Engineering and Natural Sciences, Bahçeşehir University, Istanbul, Türkiye

Oral presentation, presenting author Zeynep Tacer Caba; zeynep.tacercaba@sad.bau.edu.tr

Brain cancer is confirmed as one of the harest cancer types to be cured. It has severe influence on the life of individuals due to the insufficiency of the treatments used in addition to their side effects. Therefore, the trials on the search of novel alternatives as potentials for the treatment is ongoing. Melocan (Smilax excelsa L.) and Galdirik (Trachystemon Orientalis) are among significant contributors to traditional culinary culture and traditional medicine, however the findings on their antioxidative and cytotoxic effects are quite limited. This study aimed to reveal their antioxidant and cytotixic activity against the C6 glioblastoma cell line. Smilax excels and Trachystemon Orientalis plant were dried and extracted and then the total phenolic content (TPC) and their phenolic profile were studied. In addition, Total Antioxidant Status (TAS) and Total Oxidant Status (TOS) by the assay kit, as well as their total antioxidant activity (TAA) by DPPH radical scavenging assay and the cytotoxic impact on glioma cells via 3-(4,5-dimethylethiazol-2 yl)-2,5- diphenyltetrazolium (MTT) assay were also determined. According to the results, the water extracts of both of the Smilax excels (1158.17 mg Gallic acid Eq./100 g dry matter) and Trachystemon Orientalis (262 mg Gallic acid Eq./100 g dry matter) had higher TPC than the ethanol extracts. TAA were measured as 192.86 mg and

131.92 TROLOX Eq./100 g dry matter for the Smilax excels and Trachystemon Orientalis, respectively. The MTT assay revealed that the Trachystemon Orientalis had a higher cytotoxic effect. In conclusion, the findings of the current study were promising to depict the possible use of these plants in the future cancer related studies.

Nutritional status of vitamin D in elite Croatian athletes

Jadran Zonjić[1], Mimi Vurdelja[2], Ines Panjkota Krbavčić[1], Marina Krpan[1], Zvonimir Šatalić[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Croatian Olympic Committee

Poster presentation, presenting author Jadran Zonjić; zsatalic@pbf.hr

Vitamin D is gaining attention among athletes and in sports nutrition, inadequate nutritive status is observed among various disciplines, and regular screening and respective correction is a recommendation, because of expected impact on muscle functioning, body composition, immunity, chronic disease risk, etc. The aim of this research was to determine vitamin D status of elite Croatian athletes during June and to make a systematic review of recent literature about vitamin D status of athletes around the world. This research included 20 elite Croatian athletes that won medals at european, world championships and/or the Olympic games. 25(OH)D (calcidiol) concentrations in serum were: <50 nmol/L (vitamin D deficiency) in 2 athletes (10 %), 50-75 nmol/L (insufficiency) in 9 (45 %), and only 9 athletes had a concentration >75 nmol/L, which is considered sufficient. These results are even lower compared to results from 18 studies published 2020-2022 in which 25(OH)D status was determined, namely 55 % of Croatian athletes had inadequate vitamin D levels compared to 35 % athletes in other recent studies. Additional research on athletes is needed in order to observe the cause-and-effect relationship between 25(OH)D status and sports performance, as well as better nutrition education of athletes about the importance of vitamin D and relation with sports outcomes.

Carotenoid content in egg yolk increases with the amount of digestible carotenoids in hen diets differentiated in maize hybrid

Dora Zurak[1], Veronika Gunjević[1], Dalibor Bedeković[1], Marija Duvnjak[1], Darko Grbeša[1], Zlatko Janječić[1], Goran Kiš[1], Vasil Pirgozliev[2], Kristina Kljak[1]*

[1] Faculty of Agriculture, University of Zagreb, Croatia

[2] National Institute of Poultry Husbandry, Harper Adams University, Shropshire, UK

Oral presentation, presenting author Dora Zurak; dzurak@agr.hr

Carotenoids in eggs are a group of health-promoting bioactive compounds that contribute to the pigmentation of the yolk. Among the various dietary sources, yellow maize is the only cereal with significant carotenoid content used for laying hen diet. However, the efficiency of pigmentation and the final carotenoid concentration in the yolk largely depend on their release from the maize grain during digestion. Objective of the present study was to investigate the relationship between the digestibility of carotenoids in vitro and their concentration in the yolk of laying hens in vivo. The INFOGEST in vitro method was used to determine the digestibility of carotenoids from 15 maize hybrids. For the in vivo experiment, 225 Lohmann Brown laying hens were allocated into 15 treatment groups in a completely randomized design (15 treatments×5 cages). After the depletion period, hens were fed 15 experimental diets without added pigment, differing only in maize hybrid (60% of diets) for 8 weeks. Eggs were collected every three days until stabilization, and then once a week until the end of the eighth week. The carotenoid profile in maize grains, digesta and egg yolks was determined by the HPLC method. The commercial maize hybrids analysed showed significant differences in total carotenoid content (16.99-40.14 µg/g DM). The amount of digestible carotenoids averaged (µg/g DM) 6.43 for zeaxanthin, 5.54 for lutein, 0.52 for β-cryptoxanthin, 0.29 for α-cryptoxanthin and 0.27 for β-carotene. Maize hybrid affected ($P<0.001$) carotenoid profile in egg yolks, as evidenced by the highest levels of zeaxanthin and lutein, followed by

β-cryptoxanthin, α-cryptoxanthin and β-carotene (on average 15.98, 12.68, 0.54, 0.50, 0.48 µg/g, respectively). Furthermore, the content of both individual and total carotenoids in egg yolk correlated with the content of corresponding digestible carotenoids in maize ($P<0.001$). The obtained results indicate that the applied in vitro digestion protocol is suitable for the prediction of carotenoid content in egg yolk in vivo. Since carotenoids in eggs have high bioavailability, increased digestibility of maize carotenoids implies higher yolk content of these compounds in human diet.

SAFETY

Nano/Micro-plastics as emerging food contaminants: a challenge for food safety

Tanja Bogdanović[1], Jelka Pleadin[2], Federica Di Giacinto[3], Sandra Petričević[1], Eddy Listeš[1]*

[1] Croatian Veterinary Institute, Veterinary Institute Split, Croatia

[2] Croatian Veterinary Institute, Zagreb, Croatia

[3] Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale" (IZSAM), Teramo, Italy

Invited lecture, presenting author Tanja Bogdanović; t.bogdanovic.vzs@veinst.hr

Plastic has a great potential to become a marker horizon of human pollution in the Anthropocene era, an era of significant human impact on Earth's geology, climate and ecosystems. An exponential increase in annual global plastics production from 1.7 million tons in 1950 to 359 million tons in 2018. has faced us with the new contaminant of emerging concern nano/micro-plastics (NMPs). NMPs present very different hazards, with four key areas of concern being: leaching of additives; plastic particles as vectors for environmental contaminants and microorganisms; indirect effects through actions at the lining of our guts or lungs; and, for particles small enough to pass through biological barriers, direct effects within tissues. To ensure food safety and to protect consumers' health, the presence of food contaminants must be investigated carefully. One contaminated food might, and mostly do, contain several types of NMPs. These particles differ in many ways, including chemical structure, size, shape and biological and chemical load on them. NMPs can be found in food because of environmental pollution but also, there is a growing interest in the possibility of release/leakage of NMPs from food packaging materials, such as tea bags, bottles etc. NMPs internalised by plants are another potential source of human exposure. Existing research on NMPs occurrence in food including the advantages and limitations of the analytical methods and their complementary for the comprehensive characterization of NMPs in food will be presented by the lecture. Special focus of the lecture are the unreacted residual monomers originating from the polymeric material and additives. Among them, bisphenol A (BPA), vinyl

chloride, acrylamide and styrene are of greatest concern as representative of monomers and in the field of several hundreds of additives used in plastic production today phthalates, polybrominated diphenyl ethers, and heavy metals due to the greatest concerns arise from the leaching.

Controlling bacterial spoilage in both vegan and meat based products

Gun Wirtanen

Seinäjoki University of Applied Sciences, Seinäjoki, Finland

Invited lecture, presenting author Gun Wirtanen; gun.wirtanen@seamk.fi

Purpose – The purpose of this paper is to report how *Listeria monocytogenes* grow in different types of meat based food products using challenge tests. Furthermore, it was investigated how the pathogenic surrogate microbes *Escherichia coli* and *Listeria innocua* reproduce in both liquid and solid ready-to-eat (RTE) vegan products. Based on these studies conclusions about health risks due to post-process contamination can be drawn. Approach – The research was carried out based on the EURL Lm document how to conduct shelf-life studies in RTE foods from 2019. The microbes used were *L. monocytogenes*, in meat based food and *L. innocua* as well as non-pathogenic *E. coli.* as surrogates in RTE vegan foods. Findings – Through the challenge tests it was found that there were no physico-chemical properties (acidity (pH), water activity (a_w), salt concentration, temperature), which prevent growth of neither *L. monocytogenes* nor the substitute *L. innocua*. in post-contaminated RTE foods. When assessing the growth potential of non-pathogenic *E. coli*, the temperature in the tested products suppressed the growth. Additional testing is needed to confirm the results obtained. Iimplications – Both *Listeria* sp. and coliforms can occur as post-contaminants in RTE foods e.g. cold cuts as well as prepared vegetable snacks and drinks. Non-spore forming post-contaminants are destroyed, when the product's internal temperature rises above +72°C. Furthermore, it is very important to use hygienically designed equipment in properly designed facilities and to clean both premises and equipment properly between the processes to avoid biofilm formation. Products can be contaminated with microbes in the food processing premises after heating, especially when there are deficiencies in the production hygiene. The more the products are treated before packaging, the greater the contamination risk is. The risky foods are e.g. long shelf-life foods, which are not heated after the manufacturing.

Value/originality – These studies focused on challenge testing of RTE foods to find out how selected bacteria can grow in the product under controlled circumstances in the study. The microbes to be used are strains isolated from a similar products or production environment. The tests can be used to determine the growth potential of the chosen bacterium, i.e. what conditions in the food can prevent the growth of the target microbe.

Quality characteristics of oils from selected edible seeds

Margarita Dodevska[1], Nevena Ivanović[2], Jelena Kukić Marković[3], Brižita Đorđević[2]*

[1] Institute of Public Health of Serbia „Dr Milan Jovanović Batut“, Center for Hygiene and Human Ecology, Belgrade, Serbia

[2] Faculty of Pharmacy, University of Belgrade, Serbia

[3] Faculty of Pharmacy, University of Belgrade, Serbia

Poster presentation, presenting author Nevena Ivanović;
nevena.ivanovic@pharmacy.bg.ac.rs

Many types of vegetable oils produce around the world. They are useful in nutrition, prevention and treatment of diseases. Some oils traditionally have been well known for a long time and have been shown many potential health benefits, such as, cardioprotective effect, effect on digestion, risk of some cancer and it is also used in the treatment of skin infections. This work was conducted to study some quality criteria of oil extracted from seven different raw seeds purchased in the Serbian market, namely: sunflowers, sesame seeds, black sesame seeds, tickles seeds, chia seeds, flax seeds and hemp seeds. Oils are essentially regarded in terms of quality based on their free fatty acid, iodine value and peroxides value. Oils were extracted from the seeds by cold extraction with petroleum ether. Quality characteristics, such as refractive index, acid value, peroxide value, iodine value and saponification value and unsaponifiable matter were determined. For the determination of these parameters, official methods (ISO 6320; ISO660; ISO 3960; ISO 3961; ISO 3657 and ISO 18609, respectively) were used. The contents of investigated parameters in seed samples were determined in the range of 1.467 to 1.485 nD for refractive index; 1.62 to 4.95 mg KOH/g for acid value; 5.21 to 7.45 for peroxide value; 118 to 197 for iodine value; 180 to 193 for saponification value and 3.14 to 7.26 g/kg for the unsaponifiable matter.

Data obtained in this investigation indicate that all quality parameters of the seed samples, except peroxide value , comply with the national and Codex standards.

Knowledge, attitudes, and practices of hand washing in a supermarket chain in Croatia

*Ana Maslać[1], Marina Krpan[1], Tibor Janči[1], Ada Rocha[2], Sanja Vidaček Filipec[1]**

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Faculty of Nutrition and Food Sciences, University of Porto, Portugal

Poster presentation, presenting author Sanja Vidacek Filipec; svidacek@pbf.hr

Inadequate hand hygiene is one of the most common causes of foodborne illness. The purpose of this study was to determine the level of knowledge about hand washing, attitudes, and practices of food handlers in units with varying food safety risks and the effects of demographic parameters on these variables. Questionnaires on handwashing knowledge and self-assessed attitudes and practices were distributed to 117 food handlers in 14 facilities of a supermarket chain in the Republic of Croatia. Within one facility, employees work in meat, fish, gastro, bakery, fruit and vegetables, delicatessen, dairy, or packaged products unit. Employees' knowledge and practices related to hand washing were further assessed using the questionnaire given to managers of the facilities (N=54). The results were analysed in SPSS 17.0. programme. The normality of the variables was tested using the Shapiro–Wilk test. ANOVA and post-hoc Tukey tests were performed to check for differences in normally distributed variables (knowledge scores). Mann-Whitney and Kruskal-Wallis tests were performed for non-normally distributed variables (attitudes and practices). The results showed that more than 50 % of the respondents did not know which pathogens are transmitted by unwashed hands, while the practical questions tended to be answered correctly. Only 73.50 % of workers surveyed always wash their hands exactly as instructed and believe that the risk of microbiological contamination of food is very high if hands are not washed before preparation. Almost all managers, i.e. 98.15 %, agree with the statement that employees know when and how to wash their hands, but 24.07 % of them believe that they

only partially wash their hands regularly and properly. None of the demographic parameters affected the knowledge scores (age, gender, work experience, food safety education, training, unit, or risk level). On the other hand, attitudes and practices differed between units. Hand washing practices were better in units with higher food safety risk, suggesting that awareness of food safety risks is greater in these units. However, employees' self-reported practices were not fully consistent with managers' perceptions of handwashing, implying that certain actions should be taken to further improve handwashing practices.

Dynamics of freshness loss and histamine formation in sardines (*Sardina pilchardus*) stored at different temperatures

Marko Milić[1], Tibor Jančí[2], Jasenka Gajdoš Kljusurić[2], Sanja Vidaček Filipec[2]*

[1] Mardešić d.o.o., Sali Dugi otok, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Tibor Janči; tjanci@pbf.hr

Histamine is a biogenic amine responsible for the majority of health problems associated with seafood consumption occurring worldwide. Histamine formation in fish is the result of bacterial, enzymatic decarboxylation of free histidine due to time – temperature mishandling of fish. Conventional methods for histamine analysis aren't suited for industrial quality control laboratories since they require complex analytical protocols and high-cost equipment. Quality control in the fish processing industry is mainly conducted through sensory assessment of freshness, which unfortunately can't be correlated to histamine content of fish as is confirmed by the constant number of histamine poisoning outbreaks worldwide. Therefore, this work was focused on investigation of dynamics of freshness loss and histamine formation in sardines (Sardina pilchardus) stored at different temperatures and possible development of models for prediction of histamine concentration in sardines based on time and temperature profile of fish. For this purpose, five batches of sardines were stored at 4°C, 7°C, 12°C, 16°C and 22°C and each batch was periodically analyzed for histamine content by reference HPLC method and freshness degree was assessed by sensory evaluation. Results obtained for each temperature were plotted in relation to storage time and models were developed by linear regression method. Relation among histamine content, degree of freshness, time and temperature of storage was also explored by factorial analysis and principal components analysis (PCA). Correlation coefficients of obtained linear models were in range 0,72 - 0,95 and best results were obtained for storage temperature of 12°C. At lower temperatures linear

models were less accurate due to the long period for initial histamine formation, while at higher temperatures data was deviating from linear trend due to rapid formation of maximum histamine content. Factorial analysis confirmed the storage time as the main factor influencing histamine content and PCA clearly distinguished samples stored at 4°C and 7°C from all other groups of samples, in terms of histamine content, as well as freshness score. Although linear models showed satisfactory predictive quality for real-life applications (r2 > 0,75), more data needs to be collected to enable development of reliable, non linear models for prediction of histamine content of sardines stored at different temperatures.

Antimicrobial and antioxidative evaluation of ferrocene-containing resveratrol and curcumin derivatives

Jasna Mrvčić, Veronika Kovač, Karla Hanousek Čiča, Damir Stanzer*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Karla Hanousek Čiča; khanousekcica@pbf.hr

Resveratrol and curcumin are naturally occurring polyphenols with a variety of biological benefits including antioxidative, antimicrobial, anti-inflammatory, neuroprotective and anticancer properties. However, due to their low bioavailability, structural modifications of natural compounds represent an important approach for improving stability, bioavailability and pharmacological activity. Ferrocene is an organometallic compound consisting of two cyclopentadienyl rings bound to a central iron atom in the so-called sandwich structure. Due to its redox properties and high lipophilicity and stability, bioisosteric replacement of phenyl ring with ferrocenyl group may lead to enhancement of biological activity. The aim of this study was to investigate antimicrobial and antioxidative activity of synthesized ferrocene-containing resveratrol and curcumin derivatives. The antimicrobial activity of ferrocene compounds was evaluated against Gram-positive bacteria (Staphylococcus aureus, Bacillus subtilis, Enterococcus faecium, Listeria monocytogenes), Gram-negative bacteria (Pseudomonas aeruginosa, Escherichia coli, Salmonella enterica s. Typhimurium), lactic acid bacteria (Leuconostoc mesenteroides, Lactobacillus plantarum) and yeasts (Candida albicans, Candida utilis, Rhodotorula sp, Saccharomyces cerevisiae) using a disc diffusion method. Antioxidant activity was evaluated by the 1,1-diphenyl-2-picryl-hydrazyl free radical scavenging assay. Six ferrocene-containing curcumin derivatives were found to have inhibitory activity on yeasts (1 mg/disc), while no growth inhibition was observed in any bacterial species. All test compounds at 1 mM concentration showed moderate antioxidant activity in the range of 0.0-0.44 mM Trolox equivalent. In conclusion, six out of ten synthesized curcumin analogues exhibited the antifungal activity, but the antioxidant activity was lower

compared to curcumin. On the other hand, the triester derivative of resveratrol showed no antimicrobial activity, and the antioxidant activity was also lower compared to resveratrol.

This work has been fully supported by the Croatian Science Foundation under the project IP-2020-02-9162.

Biological potential of ferrocene-containing peptides

Jasna Mrvčić, Monika Kovačević, Karla Hanousek Čiča, Damir Stanzer, Lidija Barišić*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Karla Hanousek Čiča; khanousekcica@pbf.hr

As multidrug-resistant bacterial strains become more widespread and numerous, it is important to provide effective antimicrobial agents to protect health. The ability to design and synthesize mimetics of natural peptides folded into predictable secondary structures contributes to their drug-like properties. The ferrocene template, when inserted into the peptide backbone, induces the formation of 𝛼-helices, turns, and 𝛽-sheets. Its stability, nontoxicity, and lipophilicity enable the use of ferrocene in medicinal chemistry for derivatization of drugs and natural products. Since ferrocene peptides are recognized as effective antimicrobial and antioxidant agents, the conformational and biological evaluation of ferrocene peptides 1 (Ac-L-Ala-D-Pro-NH-Fn-NH-D-Pro-Boc) and 2 (Ac-D-Ala-D-Pro-NH-Fn-NH-L-Pro-Boc) are studied in this work. Peptides 1 and 2 were subjected to spectroscopic and DFT analysis, followed by evaluation of (i) antimicrobial (disc diffusion and nutrient broth dilution method with determination of MIC) and (ii) antioxidant activity (FRAP and DPPH). The results obtained revealed that the MIC values for the tested bacteria and yeasts are above 2 mM. The antioxidant activity (1 mM) measured by the FRAP method corresponds to 0.9 mM Trolox, while the results obtained by the DPPH method show that their antioxidant activity corresponds to the those of 0.05 mM Trolox.

Acknowledgements: This work has been fully supported by Croatian Science Foundation under the project IP-2020-02-9162.

Coffee fraud detection using near infrared spectroscopy combined with artificial neural network

Leah Munyendo[1], Daniel Njoroge[2], Yanyan Zhang[1], Bernd Hitzmann[1]*

[1] University of Hohenheim, Stuttgart, Germany

[2] Institute of Food Bio-resources Technology, Dedan Kimathi University of Technology, Nyeri, Kenya

Oral presentation, presenting author Leah Munyendo; leah.munyendo@uni-hohenheim.de

Roasted ground coffee has been a target for adulteration performed to elicit economic gains. Thus, fast and reliable techniques to detect such malpractices is significant. This work proposes the detection of adulterants in roasted ground arabica coffee using near infrared (NIR) spectroscopy complimented by deep autoencoder neural networks. Adulterated samples were composed of either robusta coffee or chicory at adulteration levels ranging from 2.5 to 30 % in increments of 2.5 % at light, medium and dark roast levels. The autoencoder was trained using pure arabica coffee and applied to detect adulterants in mixed arabica samples. The results showed the capability of an autoencoder to detect adulterants in arabica coffee at different roast levels. Additionally, PCA analysis of adulterated samples showed grouping based on the type and concentration of the adulterant. Therefore, the use of deep autoencoder in combination with NIR spectroscopy could be adopted in the coffee industry as a quality control tool to verify the authenticity of products.

Microbial spoilage in vegan foods

Carolin Müller [1,2], Jarmo Alarinta [1], Björn Frahm [2], Gun Wirtanen [1]*

[1] Seinäjoki University of Applied Sciences, Seinäjoki, Finland

[2] Life Science Technologies, University of Applied Sciences and Arts Ostwestfalen-Lippe, Lemgo, Germany

Poster presentation, presenting author Carolin Müller; caro.m97@gmx.de

Microbial spoilage by E. coli and L. monocytogenes is observed in a vegan snack product and oat drink, both vegan ready-to-eat foodstuffs, to determine a possibly occurring decrease in food safety. Inocula of non-pathogenic E. coli, L. innocua or both microbes combined have been injected into the packages of the tested foodstuffs. Storage of contaminated products was performed at different surrounding conditions. The microbial development was determined on several sampling days by cultivation specific agar. Colony counting was performed connected to the subsequent calculation of the cell count. Physico-chemical properties of the foodstuffs were measured with certain devices.The snack's physico-chemical properties were not affected by the microbes. The oat drinks acidity was reduced by both bacteria. L. innocua reduced the particle size and increased the viscosity. The bacteria can grow in both tested products but they were not detected in the non-inoculated foods, contrary to a natural occurring flora. The results indicate supported growth of E. coli by L. innocua. E. coli grew only at 20°C, L. innocua at both 9°C and 20°C. E. coli and Listeria spp. were not detected in non-inoculated products. Both, oat drinks and vegan snacks can support growth of Listeria spp. and E. coli after a contamination has occurred, especially when stored at improper environmental conditions, leading to a decrease in food safety. It can be expected that the consumption of contaminated products affects the consumers health.

The impact of dry-cured meat products' production technology on their contamination with mycotoxins

Jelka Pleadin[1], Tina Lešić[1], Ivica Kos[2], Brigita Hengl[3], Ana Vulić[1], Manuela Zadravec[1], Nina Kudumija[1], Nada Vahčić[4]*

[1] Croatian Veterinary Institute, Zagreb, Croatia

[2] Faculty of Agriculture, University of Zagreb, Croatia

[3] Center for Food Safety, Croatian Agency for Agriculture and Food, Croatia

[4] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Jelka Pleadin; pleadin@veinst.hr

Mycotoxins are secondary metabolites produced by fungi commonly found in the environment. They contaminate a variety of foodstuffs and represent a heterogeneous group of substances with diverse and strong pharmacological and toxic effects on humans and animals. Documented cases of mycotoxin occurrence in dry-cured meat products call for further research into potential contamination sources, especially given an ever more increasing consumption of these nutritionally rich and delicious products. This study investigated into the occurrence of five unregulated mycotoxins considered to be the most important dry-cured meat products' contaminants. The study covered a total of 250 traditional homemade dry-fermented sausages and dry-cured meat products sampled in 2020 and 2021 from five Croatian regions. Aflatoxin B1 (AFB1), ochratoxin A (OTA), sterigmatocystin (STC), citrinin (CIT), and cyclopiazonic acid (CPA) were analysed using liquid chromatography-tandem mass spectrometry (LC-MS/MS). As compared to dry-cured meat products (41 %), the number of sausage samples contaminated with mycotoxins was higher (59 %) As for each mycotoxin, the total incidence of CPA and STC contamination of dry-fermented sausages and dry-cured meats was equal in both sampling years. The highest CPA (335.50 µg/kg) and STC concentration (3.93 µg/kg) was determined in sausages, while the highest OTA concentration was found in dry-cured meat products (4.81 µg/kg). The mean OTA

concentration was higher in dry-cured meat products (1.57±1.82 µg/kg) than in sausages (0.84±0.70 µg/kg). Although significant differences in concentrations of individual mycotoxins between the two types of products were not found ($p > 0.05$), the number of OTA-contaminated dry-fermented sausages was 3 times higher (75 %) than the number of OTA-contaminated dry-cured meats (25%). The investigated dry-cured meat products differ in their production technology, the most important parameters affecting mycotoxin occurrence thereby being ripening length and environmental conditions during production and storage. Mycotoxin presence can also be linked to physicochemical parameters characteristic of each product type, including pH, water activity (aw), and water & salt content, proven to affect the occurrence of mycotoxins in dry-cured meat products, as well.

Assessment of the antimicrobial effectiveness of cold plasma against the microflora of the shell of consumer eggs

Tomasz Szablewski[1], Renata Cegielska-Radziejewska[1], Łukasz Tomczyk[1], Kinga Stuper-Szablewska[2], Marta Ligaj[3], Joanna Kobus-Cisowska[1]

[1] Faculty of Food Sciences and Nutrition, Poznan University of Life Sciences, Poland

[2] Faculty of Forestry and Wood Technology, Poznań University of Life Sciences, Poland

[3] Institute of Quality Sciences, Poznań University of Economics, Poland

Poster presentation, presenting author Tomasz Szablewski;

tomasz.szablewski@up.poznan.pl

The presence of *Salmonella* bacteria on consumer egg shells is a significant problem for the poultry industry. A solution could be to introduce compulsory hygienisation of the surface of the shells of eggs placed on the market. However, the cleaning methods used shorten their shelf life and lower their quality. Detergents remove the cuticle, which is a barrier against contamination of the egg content with microorganisms from the outside and against loss of moisture. Therefore, it is not allowed to clean class A eggs in the European Union. Therefore, it is necessary to search for new methods of disinfection. Their main task should be the elimination of biological contamination, while maintaining the freshness of eggs and the safety of consumers. The aim of the research was to evaluate the antimicrobial effectiveness of cold plasma against the microflora of the shell of consumer eggs. The study assessed changes in the number of bacteria on the surface of the eggshell. The experiment was carried out in a chamber with a capacity of 0.012 m^3, equipped with 3 cold plasma generators with a negative ion emission efficiency of $100x10^6/cm^3$. The surface of the eggs placed in the chamber was decontaminated with different concentrations of negative ions (100-$300x10^6/cm^3$) and different duration of their exposure (15-120s). In the tested models, the total number of native mesophilic bacteria (TBC) and Salmonella spp was determined on the

surface of the eggshell. As a result of the conducted experiments, it was observed that the use of cold plasma generators makes it possible to virtually completely eliminate microorganisms from the surface of egg shells. From the initial contamination amounting to $1.4x10^2$ TBC/crust surface, after 15 seconds of application of $100x10^6$ negative ions/cm^3 of air, single colonies were found and no Salmonella species were present. The use of cold plasma can be an innovative, simple and cheap solution in terms of hygienizing the shell of consumer eggs while maintaining safety for both the personnel of poultry plants and future consumers.

This work carried out and financing under the project POIR 01.01.01-00-2169/20 “Development of technologies for the management of defective food eggs in SME enterprises to counteract food waste”, under the Szybka Ścieżka - Agrotech "competition of the National Center for Research and Development.

Effect of natural extracts and pure compounds on the fish burgers' quality parameters

Vida Šimat[1], Martina Čagalj[1], Roberta Frleta[2], Ivan Šimat[3], Sonja Smole Možina[4], Danijela Skroza[5]*

[1] University Department of Marine Studies, University of Split, Croatia

[2] Center of Excellence for Science and Technology-Integration of Mediterranean Region (STIM), Faculty of Science, University of Split, Croatia

[3] Centaurus Ltd., Solin, Croatia

[4] Biotechnical Faculty, University of Ljubljana, Slovenia

[5] Faculty of Chemistry and Technology, University of Split, Croatia

Poster presentation, presenting author Martina Čagalj; vida@unist.hr

To preserve the quality and safety of fishery products, research is focused on finding natural options that can replace synthetic additives. These should be able to delay spoilage and preserve quality parameters of fish while ensuring product safety. In this study, the combined effect of selected extracts and their dominant phenolic acids was tested on quality parameters of fish burgers. In particular, extracts of blackberry (Rubus fruticosus) leaves, essential oil by-products from common juniper (Juniperus communis), prickly juniper (Juniperus oxycedrus) needles, and brown seaweed (Padina pavonica), as well as catechin and vanillic acid, were mixed and added to fish meat batter (minced sea bass and hake meat plus 1% salt) at a final concentration of 2% (w/w). Four types of fish burgers were prepared: i) control burgers with no additives (C), ii) burgers with blackberry leaves and common juniper extracts in a 2:1 ratio (BCJ), iii) burgers with brown seaweed and prickly juniper needles extracts in a 1:1 ratio (PPJ), and iv) burgers with blackberry leaves extract with catechin and vanillic acid in a 2:1:1 ratio (BCV). The pH, thiobarbituric acid reactive substances (TBARS), total volatile basic nitrogen (TVB-N) and trimethylamine-nitrogen (TMA-N) were determined in fish burgers over storage at 0-2 ºC. All parameters studied were highest in the control burgers; pH increased from 7.05 to 7.15, TBARS from 0.88 to 2.62 μ malondialdehyde

(MA)/100g, TVB-N and TMA-N from 17.71 and 11.37 to 22.77 and 18.37 mg/100g, respectively. At the end of storage, the burgers with natural extracts and pure compounds had better quality parameters compared to the control sample. The pH values ranged from 6.62 to 6.93, being the lowest in the BCV burgers. TBARS values were more than three times lower than the control, and were 0.80, 0.62, and 0.71 µMA/100g for BCJ, PPJ and BCV, respectively. In addition, TVB-N and TMA-N values ranged from 15.38 to 20.03 mg/100g and from 10.64 to 15.63 mg/100g, respectively. Overall, the BCV burgers showed the best quality results. These findings confirm that natural extracts should be recognized as potential antioxidant agents that can be used in food industry to prevent lipid oxidation in fish products.

This research is supported by the PRIMA programme under project BioProMedFood (Project ID 1467). The PRIMA programme is supported by the European Union.

The effect of washing with antimicrobial solutions on *C. diffcile Enterobacterales* and TAMB load in spinach

*Melike Nur Tosun, Gizem Taylan Yalcın, Gizem Korkmazer, Murat Zorba Cengiz Caner, Nükhet N. Zorba**

Food Engineering Department, Canakkale Onsekiz Mart University, Canakkale, Türkiye

Oral Presentation, presenting author N.N. Zorba; nukhetzorba@gmail.com

Studies have reported that washing fruits and vegetables only with water is insufficient to inactivate pathogenic bacteria. Different washing solutions and natural disinfectants are required to ensure this inactivation in spinach leaves. For this purpose, the effects of two different natural washing solutions on *C. difficile Enterobacterales* and total aerobic mesophilic bacteria (TAMB) loads on spinach leaves were investigated against chlorine and tap water in our study. The green tea extract-acetic acid combination and natural disinfectant formulation developed in our laboratory were used as a washing solution for spinach leaves. The spinach was inoculated with spores of *C. difficile* ATCC 9689. The MIC, 2xMIC and 4xMIC (v/v) concentrations of the natural disinfectant solution with the green tea extract-acetic acid combination and the different concentrations of NaOCl were applied for the washing process for 5 and 15 min. Sterile tap water was evaluated as a control group in removing *C. difficile, Enterobacterales* and total aerobic mesophilic load. The green tea extract-acetic acid combination at 2xMIK concentration decreased the *C. difficile* load on spinach leaves by 1.47–1.54 log cfu/g, while the 4xMIK disinfectant formulation provided a decrease of 2.32 log cfu/g. No significant difference could be detected between concentrations and washing times in the inhibition of *C. difficile* in both wash solutions. The highest inhibition of *C. difficile* was achieved with the application of 50 ppm NaOCl for 15 min, with a decrease of 2.88 log cfu/g. The tea extract-acetic acid combination and disinfectant formulation reduced the TAMB

count by 3.08 log cfu/g and by 3.66 log cfu/g respectively. A decrease of 4.09 log cfu/g was observed in the number of TMAB in 15 min of washing with NaOCl. It was determined that the green tea extract-acetic acid combination and disinfectant solution decreased the *Enterobacterales* load in spinach by 2.22–2.58 log cfu/g, while NaOCl decreased by 4 log cfu/g. Considering the results, it was determined that the natural washing solutions have the potential as an alternative to NaOCl. This work was produced from the project number TUBITAK 120O998.

Determination of the inhibitory effects of lactic acid bacteria on *Clostridioides difficile* in-vitro

Gizem Taylan Yalçin[1], Melike Nur Tosun[1], Nükhet Nilüfer Demirel Zorba[2]*

[1] Çanakkale Onsekiz Mart University, School of Graduate Studies, Çanakkale, Türkiye

[2] Çanakkale Onsekiz Mart University, Engineering Faculty, Çanakkale, Türkiye

Poster Presentation, presenting author Nukhet Nilüfer Zorba; nukhetzorba@gmail.com

Clostridioides (Clostridium) *difficile* infection (CDI) is globally recognized as the leading cause of infectious diarrhea associated with healthcare. Although antibiotics are among the risk factors for CDI, they are also used in the treatment of *C. difficile*. For this reason, the use of probiotics and the use of natural microbiota are recommended in addition to antibiotic treatment. For this purpose, the inhibitory effects of standard lactic acid bacteria on *C. difficile* were investigated. In our study, as probiotic culture, the effects of *Lactobacillus reuteri* DSM 17938, *Lactobacillus rhamnosus* GG, *Lactobacillus plantarum* ATCC 20219, Lactobacillus casei NRRL B 1922 and Lactobacillus plantarum ATCC 334 strains as toxigenic C. difficile ATCC 1870 strains were investigated. Vancomycin was chosen as the control group. The effects of supernatants on *C. difficile* were investigated by using a microtiter assay to investigate the source of the effect on strains showing anti-*C. difficile* properties. All of the lactic acid bacteria whose effects were investigated on C. difficile provided an inhibition zone above the 25.06 cm zone formed by vancomycin. The greatest effect was on *Lactobacillus plantarum* ATCC 334 strain with a zone diameter of 49.27 cm. In addition, it was determined that all strains used against *C. difficile* provided more than 96% inhibition in the direct use of supernatants. However, it was observed that the neutralization of the supernatants caused a decrease in the inhibition effect depending on the strain. In addition, although the effect decreases depending on the strain, inhibition was observed in the heated supernatants of *L. casei* strain

in neutralized and heated supernatants. These results show us that in the inhibition effect of lactic acid bacteria used in the analysis on *C. difficile*, some thermostable compounds as well as low pH compounds such as organic acid formed by the strains are involved in the inhibition. This work was produced from the project number COMU FDK-2021-3497.

SUSTAINABILITY

Process analytical technology for continuous process monitoring and control in chemical, biochemical and food industry

Nenad Bolf

Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia

Invited lecture, presenting author Nenad Bolf; bolf@fkit.hr

Regulatory agencies, science and technology are forcing rapid change on manufacturing processes. Process Analytical Technology (PAT) is of major significance for the industry. PAT improves manufacturing described in the 'good manufacturing practices (cGMP) for the 21st century' initiative. The cGMP initiative stimulates process expertise and understanding. PAT offers companies in chemical, biochemical and food manufacturing the possibility to gain better control of their processes, also to introduce quality into the production process and eventually to move to real-time process control based on critical quality attributes. It brings major benefits in terms of product quality, reduced time to market, and tighter and more responsive supply chains. All industries are challenged to find optimal way to introduce PAT and to select the right tools and infrastructure to match manufacturing needs. A process is well understood when variability in the process is managed by process control that deliver a consistent process output; and when the key product quality attributes can be accurately and reliably predicted. This lecture will explain how PAT tools can be used for continuous monitoring and process control in the process industry. The method of in-situ spectrophotometric measurements, as well as process microscopy in order to build calibration models will be presented. These models are further used for continuous process monitoring and control thus replace infrequent and occasional laboratory assays that are standardly used for product quality testing. The potential of this technology for the gradual transition from batch to continuous production will also be highlighted.

Efficiency of waste water treatment of Slavonski Brod agglomeration

Korana Ambrozić[1], Valentina Velikanović[1], Dijana Grgas[2], Tea Štefanac[2], Tibela Landeka Dragičević[2]*

[1] Vodovod Ltd. Slavonski Brod, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Korana Ambrozić; korana.ambrozic@vodovod-sb.hr

The public sewage system of the city Slavonski Brod includes area agglomeration of Slavonski Brod which also includes its cadastral district, Brodski Varoš and Brodsko Vinogorje. Vodovod Ltd. manages the total of 215 km of sewage network in Slavonski Brod and 35 km in other area of agglomeration. C-Tech technology (Cyclic activated sludge technology) is being applied to the wastewater treatment plant in Slavonski Brod (WWTP SB). WWTP SB was put into operation in 2014 and is designed for 80,000 PE and it includes the 3rd stage of processing - removal of C, N and P. Biological wastewater treatment takes place in four SBR reactors comprising three steps: (i) filling / aeration, (ii) sedimentation and (iii) decantation. Each SBR reactor contains an anoxic biological selector and an aeration zone, and the anoxic/aerobic zone volume ratio is 2/25. In anoxic biological selectors the concentration of dissolved oxygen is ≤0.5 mgO2/L, and in the aeration zone DO is 1-2 mgO2/L. The paper presents the results of composite samples of treated wastewater (effluent), sampled with an automatic sampler during 24 hours. The effluent for all parameters defined by the Water Permit at WWTP SB meets the legally defined values as follows: COD <125 mgO2/L, BOD5 <25 mgO2/L, total N <15 mgN/L, total P <2 mgP/L and total suspended solids <35 mgTSS/L, observed during 2019, 2020 and 2021.

Health safety and nutritional value of coffee silverskin with impact of emerging techniques in the processing

Vedran Biondić Fučkar[1,2], Anamarija Grudenić[2], Angela Božić[2], Ilija Djekić[3], Anet Režek Jambrak[2]*

[1] Faculty of Pharmacy and Biochemistry, University of Zagreb, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[3] Faculty of Agriculture, University of Belgrade, Serbia

Poster presentation, presenting author Biondić Fučkar Vedran; biondic.vedran@gmail.com

Coffee silverskin (CS) is a thin tegument that directly covers the coffee seed. During the roasting process, coffee beans expand, and this thin layer is detached, becoming the main by-product of coffee roasting industries. CS, compared to other coffee by-products, is a relatively stable product due to its lower moisture content (5–7%). The nutritional potential of coffee by-products, but also most other by-products from the food industry, must encourage food industry to exploit and reuse these by-products (such as nutrient-rich products, functional foods, dietary supplements etc.). Investigation of all potentially applicable approaches in regard to food processing is an ongoing process with improvements in different ways. It is in strong connection with customer needs and marketing value. However, target goals are safe, healthy, sustainable and minimally processed food. In reaction to this demand, the intensification of food processes has emerged and has become an area of growing interest within the food industry. The Sustainable Development Guidelines (SDG) encourage the use of innovative techniques in extraction processes. One of them is extraction assisted by high power ultra-sound (Ultrasound-assisted extraction, UAE). New extraction techniques also involve the use of environmentally friendly solvents. The main goal of the industry is to produce efficient products, using energy efficient processes and make the most of resources and reduce waste. In this research, proteins and polyphenols,were extracted from CS using

UAE, and determined spectrophotometrically. In addition, the impact of the nonthermal technique was compared with available conventional techniques, to define LCA in regards with these techniques in the processing of CS.Additionally, after analysing health safety and nutritional parameters of the CS, furthermore, to examine whether the CS contains pesticides and heavy metals, minerals and fibres, it was concluded that CS, as the largest by-product of coffee roasting, is a healthy and nutritionally rich product that could be used in the production of new products in the food industry.

Effect of seasonal growth and extraction method on antioxidant activity of *Colpomenia sinuosa* extracts

Martina Čagalj[1], Vida Šimat[1]

[1] University Department of Marine Studies, University of Split, Croatia

Poster presentation, presenting author Martina Čagalj; martina.cagalj@unist.hr

Seaweeds are a possible sustainable food source or a matrix for obtaining natural antioxidants. They produce secondary phytochemicals that vary with the changes in environmental conditions during the growing season. These phytochemicals possess biological activities that could be of interest to food industry. The aim of this study was to investigate the variations in antioxidant activity of brown seaweed *Colpomenia sinuosa* in regard to seasonal growth and different extraction methods. Algal samples were collected from May to September in the Adriatic Sea, washed with tap water and freeze-dried. Samples were pulverised and extracted in 50% ethanol using novel green extraction methods, ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE). The total phenolic content (TPC) of the samples was determined by the Folin-Ciocalteu method. The antioxidant potential of *C. sinuosa* extracts was evaluated by the 2,2-diphenyl-1-picrylhydrazyl radical scavenging ability (DPPH), ferric reducing/antioxidant power (FRAP), and oxygen radical absorbance capacity (ORAC). DPPH inhibition results ranged from 22.2 ± 1.5 to 70.6 ± 0.8 % for UAE samples, and from 31.6 ± 0.9 to 76.2 ± 0.4 % for MAE samples. Reducing activity results, measured by FRAP, ranged from 129.2 ± 6.6 to 356.2 ± 8.3 µM trolox equivalents (TE) for UAE samples, and from 195.1 ± 7.5 to 461.5 ± 12.8 µM TE for MAE samples. For ORAC analysis, the extracts were diluted 100-fold. The highest ORAC result was 77.7 ± 2.1 µM TE in the July sample extracted by MAE. The results showed better efficiency of MAE compared to UAE, and the MAE samples had higher TPC results and antioxidant activity. Moreover, the highest TPC, DPPH, FRAP and ORAC results were obtained for samples collected in July. Overall, these results contribute to the knowledge of biotechnical

exploitation of brown seaweeds and suggest that harvesting *C. sinuosa* in July and extracting by MAE will result in extracts with higher TPC and antioxidant activity. This research is supported by the PRIMA programme under project BioProMedFood (Project ID 1467). The PRIMA programme is supported by the European Union.

Polyphenol profiles and antioxidant capacity of different berry fruit pomace and seeds

Ana Dobrinčić[1], Erika Dobroslavić[1], Iga Piasecka[2], Ena Cegledi[1], Zoran Zorić[1], Sandra Pedisić[1], Verica Dragović Uzelac[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Warsaw University of Life Sciences, Poland

Poster presentation, presenting author Ana Dobrinčić; adobrincic@pbf.hr

Berries are a variety of small fruits characterized by their red, purple or blue color. Their production reaches an amount of over 12.2 million tons worldwide. Berries can be consumed raw or processed into various products. During processing, a large amount of by-products is generated, mainly pomace which contains stem cells, skins and seeds. However, these by-products are still a rich source of bioactive, highly valuable compounds, such as phenolic compounds. Among phenolic compounds, berries are abundant with phenolic acids, anthocyanins, proanthocyanidins, and other flavonoids that have potential health-promoting effects. Conventional extraction (CE) of polyphenols has many disadvantages, such as long extraction time, high solvent and energy consumption, and usually results in lower yield. To overcome these drawbacks, advanced extraction methods such as microwave-assisted extraction (MAE), ultrasound-assisted extraction, or pressurised liquid extraction are frequently applied. The aim of this study was to extract polyphenols from the seeds of black currant (*Ribes nigrum*), red currant (*Ribes rubrum*), strawberry (*Fragaria ananassa*), black chokeberry (*Aronia melanocarpa*), and cranberry (*Vaccinium macrocarpon*), as well as from the pomace of black chokeberry, black currant, and red currant using MAE and CE. Both extraction methods were performed with water at 80°C for 10 minutes, MAE at 400 W and CE in a shaking water bath. UPLC-MS2 analysis of polyphenols was conducted and antioxidant capacity was measured by ORAC method. In general, MAE resulted in higher total phenolic content and extracts with higher ORAC values, confirming its superiority compared to CE. Strawberry and cranberry seeds had lower total phenolic content and antioxidant capacity,

while black chokeberry was the most abundant with polyphenols. The polyphenolic profile varied among species and differed between pomace and seeds. Pomaces were especially rich in anthocyanins. Phenolic acids were represented by hydroxycinnamic acids (e.g., ferulic acid, caffeic acid, p-coumaric acid), particularly in black currant and chokeberries, and hydrobenzoic acids (e.g., gallic acid, p-hydroxybenzoic acid, and ellagic acid) which were predominant in strawberry seed.

Polyphenolic profile of bay leaves (*Laurus nobilis* L.) collected in two coastal regions of Croatia

Erika Dobroslavić, Ivona Elez Garofulić, Zoran Zorić, Ana Dobrinčić, Verica Dragović-Uzelac*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Erika Dobroslavić; edobroslavic@pbf.hr

The growing demand on naturally derived ingredients has brought the need for finding new sources of biologically active molecules which can be isolated and used as functional ingredients in food. Bay leaf is a Mediterranean shrub well known in the folk medicine for its many health beneficial effects that can be largely attributed to the content of polyphenols. In order to enable efficient industrial utilization of these valuable compounds, it is necessary to isolate them from plant material. Various green extraction technologies, such as pressurized liquid extraction (PLE), have emerged in recent years due to many advantages over conventional techniques including the shorter extraction time, lower energy and solvent consumption as well as higher extraction efficiency and lower degradation of targeted compounds. Combined chromatographic and spectral techniques, such as ultra-performance liquid chromatography tandem mass spectrometry (UPLC/MS-MS) allow effective polyphenolic characterization of the obtained extracts, enabling the optimal choice of the extraction methodology as well as plant material whose chemical composition may vary significantly depending on the environmental factors, harvesting season and storage conditions. The aim of this research was to compare the polyphenolic content of bay leaves collected in November 2021 in the region of Rijeka, Croatia and Dubrovnik, Croatia and stored in the same conditions. The extracts were obtained from finely grinded dry leaf samples by PLE at previously established optimal conditions (50% ethanol, 150°C, 1 extraction cycle and 5 min static time) and analyzed by UPLC/MS-MS. The results showed that the sample collected in the region of Dubrovnik, Croatia had a higher content of total polyphenols (45,09

± 0,21 mg g-1) than the sample collected in the region of Rijeka, Croatia (36,12 ± 0,17 mg g-1). Flavonols were the most abundant group of compounds in both samples, followed by flavan-3-ols, phenolic acids, proanthocyanidins and flavones. Significant differences were observed in the content of individual polyphenols, showing that environmental growth factors have an important effect on the polyphenolic profile of bay leaf and should be further researched in order to produce extracts of maximum quality, while using less plant material, resulting in a more sustainable process.

Effect of ultrasound processing on microbiological safety of designed tomato-based products

Josipa Dukić[1], Maria Margarida Cortês Vieira[2], Maria Dulce Antunes[2], Mecit Halil Öztop[3], Nikolina Grgić[1], Ivona Marinčić[1], Anet Režek Jambrak[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] University of Algarve, Faro, Portugal

[3] Middle East Technical University, Ankara, Türkiye

Poster presentation, presenting author Josipa Dukić; jdukic@pbf.hr

In the development of new functional products, in addition to chemical analyses, it is necessary to carry out microbiological tests to determine the safety of the product. Regardless of the content and concentration of bioactive compounds, if one or more microbiological tests prove even partially unsatisfactory, all products of the batch shall be rejected and cannot be placed on the market. To avoid the above, it is extremely important to ensure the microbiological quality of the product. Therefore, the aim of this work was to investigate the influence of the preparation method (thermal, hot break and ultrasound) on the microbiological safety and stability of tomato-based functional products. The growth of coliform pathogenic bacteria Escherichia coli as well as the growth of Bacillus coagulans were not determined in any sample of functional tomato-based product (<10 CFU/g). The highest increase in aerobic mesophilic bacteria and mold were observed in the untreated control samples. After ultrasound treatment, in functional tomato-based products with the addition of Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) and olive powder (juice and sauce), the greatest reduction in the number of total plate count (TPC) (for juice 1,699 log reduction- 98% reduction, and 2 log reduction - 99% reduction for sauce samples) and of total mold count (TMC) (for juice 1 log reduction - reduction 90%) was measured. Also, 20% (0.097 log reduction) of TPC reduction and 91.11% (1.051 log reduction) of TMC reduction were observed for ultrasound treated sauce products with the addition of olive powder. In addition

to safety, microbiological stability was also observed after 7 days of storage time in a refrigerator at a temperature of +4°C. As expected, the control samples had the lowest microbiological stability. Considering the obtained results, ultrasound proved to be a very successful non-thermal processing method for the inactivation of microorganisms, and it could soon find application on an industrial level as well.

Effect of ultrasound processing on physicochemical parameters of tomato-based products: addition of RuBisCO and olive powder

Josipa Dukić[1], Maria Margarida Cortês Vieira[2], Maria Dulce Antunes[2], Mecit Halil Öztop[3], Nikolina Grgić[1], Ivona Marinčić[1], Anet Režek Jambrak[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] University of Algarve, Faro, Portugal

[3] Middle East Technical University, Ankara, Türkiye

Poster presentation, presenting author Josipa Dukić; jdukic@pbf.hr

It is already well known that functional products have a positive effect on the human body, and the development of such products is on the rise. To be classified as functional, product must contain one or more components that show one or more positive effects. For this purpose, in this work, olive powder or a combination of olive powder and Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) were added to tomato juice and sauce samples. Furthermore, it was investigated the influence of the preparation method (thermal, hot break and ultrasound) on the physicochemical parameters of tomato-based products. In the samples of juices with the addition of RuBisCO and olive powder in combination, the highest yield of phenolic compounds was observed in samples treated with ultrasound (0.749 ± 0.008 mg GAE/mL). Compared to the control samples, the obtained result represented an increase of 72.38%. A similar trend was observed in the yield of lycopene, where the highest yields were recorded in samples treated with ultrasound, namely 0.186 ± 0.000 mg/100 mL for juice samples and 0.306 ± 0.000 mg/100 mL for sauce samples. In the samples of juices and sauces with the addition of olive powder, the highest yield of phenolic compounds was observed in the samples treated with ultrasound, namely 0.058 ± 0.003 mg GAE/mL in the sauce samples and 0.072 ± 0.005 GAE/mL in the juice samples. Furthermore, the highest yield of lycopene was also observed in ultrasonically treated juice samples 0.119 ± 0.000 mg/100

mL. Compared to the control sample, the obtained value represented an increase of 103.42%. The obtained results are promising, and ultrasound in production facilities could replace traditional heat preparation techniques just as well, if not better. Therefore, its use in the production of these and similar products should be considered.

Polyphenol oxidase from Croatian traditional apple varieties and its role in anthocyanins degradation during storage

*Ana-Marija Gotal Skoko[1],Tihomir.Kovač[1], Goran Fruk[2], Antun Jozinović[1], Drago Šubarić[1], Krunoslav Aladić[1], Jurislav Babić[1], Ante Lončarić[1]**

[1] Faculty of Food Technology Osijek, University of Josip Juraj Strossmayer in Osijek, Croatia

[2] Faculty of Agriculture, University of Zagreb, Croatia

Poster presentation, presenting author Ante Lončarić; loncaric.a@gmail.com

The enzyme polyphenol oxidase (PPO) catalyses the oxidation of phenolic compounds into highly reactive quinones. Polymerization of PPO-derived quinones causes the postharvest browning of cut or bruised fruit. In this work, we investigate the activity of PPO and its role in anthocyanins degradation during the storage of Croatian traditional apple varieties. Polyphenol oxidase was extracted from five Croatian traditional apple varieties (‘Austrougarka’, ´Božićnica´, ´Čelenka´, Ílzer Rosenapfel´ and ´Kraljevčica´) after harvest and after three months of storage. Furthermore, the activity of polyphenol oxidase (POA) was determined with the substrate catechol by a continuous spectrophotometric test at 410 nm. The monomeric anthocyanin pigment content of extracts was determined using the pH-differential method. After harvest, the highest activity of polyphenol oxidase was determined in ´Božićnica´ (302%) and the lowest in ´Čelenka´ (172%). During storage, the activity of polyphenol oxidase was decreased in four apple varieties while in ´Ílzer Rosenapfel´ the activity of polyphenol oxidase was increased. After three months of storage, the highest activity of polyphenol oxidase had ´Ílzer Rosenapfel´ (349%) and the lowest had ´Čelenka´ (171%). Considering anthocyanins, the highest content of anthocyanins after the harvest had ´Čelenka´ (48.09 mg/L) and the lowest had ´Kraljevčica´ (3.0 mg/L). The highest content of anthocyanins after three months of storage had ´Čelenka´ (47.59 g/L) and the variety without anthocyanins after storage was ´Ílzer Rosenapfel´. The increase of polyphenol oxidase activity

during storage caused degradation of anthocyanins in Ílzer Rosenapfel´ apple variety which led to discolouration. This is due to the ability of polyphenol oxidase and polyphenol peroxidase to break covalent bonds between anthocyanin glycosides. In conclusion, varieties with the highest activity of polyphenol oxidase had the lowest content of anthocyanins and vice versa.

Acknowledgements: This work was supported by the project UIP-2020-02-8461 (The Croatian Science Foundation).

Denitrification of synthetic wastewater containing high nitrate concentration

Dijana Grgas[1], Marina Ugrina[1], Andrijana Brozinčević[2], Ana Špehar Ćosić[3], Tea Štefanac[1], Korana Ambrozić[4]*, Tibela Landeka Dragičević[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] National park Plitvice Lakes, Croatia

[3] Agroproteinka d.d., Sesvetski Kraljevac, Croatia

[4] Vodovod Ltd, Slavonski Brod, Croatia

Poster presentation, presenting author Dijana Grgas; dgrgas@pbf.hr

Objective: Some industries, such as metal finishing, explosives, nuclear energy, fertilizer, the stainless steel manufacturing, produce wastewater highly loaded with nitrate, up to 1000 mg NO3-N/L. Nitrogen compounds discharged into the environment can cause significant issues, such as hazards to human and animal health, eutrophication of water bodies, and deterioration of water sources. The treatment of such wastewater is challenging due to possible intermediate products (nitrite) accumulation, which in turn, pose a serious inhibition for microorganisms in activated sludge. Also, wastewater containing high-strength nitrate requires long acclimatization period. The different C/N ratios in the denitrification of synthetic wastewater containing 250±5 mg NO3-N/L was studied. Methods: The batch experiments were performed with sodium acetate as the carbon source and 250±5 mg NO3-N/L at ratios C/N 1, 2 and 3, in laboratory glasses of working volume 0.5 L placed on a magnetic stirrer. The activated sludge used originated from municipal wastewater treatment plant, and it was previously acclimatized to high nitrate concentration. The analysis of mixed liquor suspended solids (MLSS), chemical oxygen demand (COD), NO3-N and NO2-N were performed according to Standard Methods. The pH value, dissolved oxygen (DO) concentration and temperature were monitored with pH-meter (WTW 330i) and pH electrode (SenTix41), and DO meter (WTW Oxi3210) and oxygen electrode (DurOx). The experiments were performed under

anoxic conditions (DO ≤ 0.3 mg DO/L) at temperature 22±2 °C. Results: The ratio C/N 3 ensured sufficient amount of organics for complete denitrification. Denitrification at ratios C/N 1 and 2 was performed at two denitrification rates, with acetate, and then, after acetate depletion, with intracellular storage. The denitrification with intracellular storage was performed at lower denitrification rate. Conclusion: Denitrification of high nitrate wastewater could be performed with activated sludge previously acclimatized to high nitrate concentration for the development of suitable denitrifying community, and for the prevention of an inhibitory effect on the denitrifying bacteria. The ratio C/N 3 is required for complete denitrification and with organics present at low concentration at the end of the experiment.

Screening bean genotypes for drought resistance using high-throughput phenotyping

Tomislav Javornik[1,2], Boris Lazarević[1,2], Klaudija Carović-Stanko[1,2]*

[1] University of Zagreb, Faculty of Agriculture, Croatia

[2] Centre of Excellence for Biodiversity and Molecular Plant Breeding (CoE CroP-BioDiv), Zagreb, Croatia

Poster presentation, presenting author Tomislav Javornik; tjavornik@agr.hr

In the face of rapid climate change, drought is considered the most damaging environmental stress to agricultural production. It is estimated that 60% of beans are grown in regions suffering from water shortages, making drought the biggest problem for its production. The selection of drought-resistant genotypes would be very useful for bean production and the agricultural industry. With advances in modern technology, we can effectively combine knowledge of phenotype and genotype to promote breeding programs. At the University of Zagreb Faculty of Agriculture, samples of traditional bean cultivars from Croatia and surrounding countries are preserved. Traditional cultivars represent valuable genetic material that can be used for the selection of desirable agronomic traits. 200 different bean genotypes will be grown in a growth chamber under controlled conditions, inducing two treatments: Control (well-watered plants) and drought stress treatment. High-throughput phenotyping (HTP) techniques will include chlorophyll fluorescence imaging, multispectral imaging, and 3D scanning. Three measurements will be taken over a period of one week and the occurrence of drought and its effect on plant morphological and physiological traits will be monitored. DNA will be isolated from the leaves and genetic analysis of genotypes will be carried out using Microsatellites (SSR). Single Nucleotide Polymorphisms (SNP) markers will be detected using DartSeq technology. A detailed and in-depth analysis of the physiological background of gas exchange capacity will be performed on the selected tolerant and susceptible bean genotypes, including measurements of photosynthetic rate, transpiration rate, stomatal conductance, intercellular CO2 concentration, water use efficiency, light use efficiency, etc.

Association mapping will be carried out to find genetic regions associated with phenotypic parameters of chlorophyll fluorescence, gas exchange parameters, and vegetation indices. This research will help to select potentially resistant bean genotypes to drought stress, which may ultimately contribute to the development of breeding programs and agricultural production itself.

Processing of biodegradable PHBV and chitosan films as a multilayer structure for food packaging applications

*Pierre Lenoble[1], Jérôme Rousseau[3], Frédéric Debeaufort[1,2], Nasreddine Benbettaieb[1,2]**

[1] University of Burgundy, IUT Dijon-Auxerre, Dijon Cedex, France

[2] University Bourgogne Franche-Comté, UMR Food Processing and Microbiology, Dijon, France

[3] University Bourgogne Franche-Comté, DRIVE EA1859, Nevers, France

Poster presentation, presenting author Nasreddine Benbettaieb*;*
nasreddine.benbettaieb@u-bourgogne.fr

PHBV (poly(3-hydroxybutyrate-co-3-hydroxyvalerate)) is currently considered as one of the most promising substitutes of conventional plastics especially for food packaging applications. Indeed, it is considered as fully biodegradable and is obtained from renewable ressources. However, PHBV have serious disadvantages when compared to currently used thermoplastics. Indeed, it has high permeability to oxygen, high costs and thermal instability which still limit its industrial applications. By-products coming from seafood industries, such as chitosan, were largely used to produce active films with good barrier properties. In this study, biodegradable films based on PHBV, combined with chitosan was developed and characterized in regards to their functional (barrier, mechanical, surface...) and structural properties to obtain materials that better meet food packaging requirements. PHBV films were prepared by the solvent casting method (3% w/v in chloroform). Chitosan films were also prepared by wet casting methods (2% w/v in an aqueous 1% acetic acid) solution plasticized with glycerol at 15% (w/wt). Hot-press technique was used for assembling and shaping the multilayered films (PHBV-Chitosan and PHBV-Chitosan-PHBV). Barrier (WVP and PO2,...), thermal, mechanical and surface properties were investigated on the monolayer film as well as on the final laminate (multilayered). The hot-press process allowed a good adhesion

between the two biopolymers. The multilayer films displayed the most efficient barrier properties to gases and to the water vapor (more than 10 times compared to single layer). Thermal stability of multilayer films was also enhanced. This study certainly evidenced the potential of PHBV-Chitosan-PHBV complexes as a valid sustainable substitute for high performing conventional plastics. It also could open an unexplored PHBV market opportunity for high added value food products for which naturality and sustainability are of great importance.

Intelligent water treatment technologies for water preservation: case study presentation

Josipa Lisičar Vukušić, Roxanne Engstler, Sven Johann Bohr, Stéphan Barbe*

Faculty of applied natural sciences, Technische Hochschule Köln, Leverkusen, Germany

Poster presentation, presenting author Josipa Lisičar Vukušić; josipa.lisicar@th-koeln.de

Water is usually the most extensively used raw material for the production of high-value products. Increasing demand for industrial activities resulted in challenges to integrate environmentally and economically acceptable solution regarding wastewater management. The IntelWatt project aims to validate innovative and intelligent water treatment technologies combining fresh water preservation with resource recovery and energy conversion based on the circular economy concept. The case study of simultaneous metal recovery and wastewater treatment in plastic electroplating production will be presented. The treatment process involves state of the art membrane processes, which will result in purified water being directly reused in industrial activity. Preliminary results of the water treatment will be presented. Furthermore, status report on the case study will be discussed. The main objective is to reduce the consumption of fresh water by 65 %, reuse the electrolytes originating from rinsing baths in the electroplating process, avoid the chemical reduction as well as the evaporation of wastewater to preserve fresh water and significantly reduce environmental pollution.

Turning winery waste into valuable substrate for baker´s yeast production: A circular economy approach

Josipa Lisičar Vukušić[1], Thomas Millenautzki[1], Leon Reichert[1], Abdechafik Mokhlis Saaid[1], Lothar Müller[1], Leonardo Clavijo[2], Jendrik Hof[3], Marek Mösche[3], Stéphan Barbe[1]*

[1] Faculty of applied natural sciences, Technische Hochschule Köln, Leverkusen, Germany

[2] Faculty of engineering, Universidad de la República, Montevideo, Urugvay

[3] Uniferm GmbH & Co. KG, Monheim am Rhein, Germany

Oral presentation, presenting author Josipa Lisičar Vukušić; josipa.lisicar@th-koeln.de

Wine production, regarded as one of the most important industries in the world, is being associated with the utilization of a large number of resources. Grape cultivation as well as wine making produce high amounts of grape pomace as a by-product, that is generally used as fertilizer and animal feed. The present research aims to explore the possibility of introducing the integrated sustainability concept into traditional winemaking. The experimental part included the production of white wine and complete utilization of the grape pomace into grape pellets, tartaric acid and concentrated grape extract. The latter was tested as a substrate for baker´s yeast production. The results showed that the high quality yeast was produced on media, which was partly replaced with the concentrated grape extract. This study should be considered as an approach for turning the winery biowaste into high-value raw material for industrial baker´s yeast manufacture while fully complying with the circular economy concept.

Fourier transform infrared spectroscopy for characterization of pectin biofilms enriched with mandarin peel extracts

Antonela Ninčević Grassino and Senka Djaković*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Antonela Nincevic Grassino; aninc@pbf.hr

Mandarins are an important crop used mainly in the food industry for the production of fresh juice, with the peel being the main by-product during processing. Mandarin peels, accounting for about half of the fruit mass, are a rich source of value-added compounds. Therefore, reliable and practical methods for releasing natural compounds from them are of great interest. In this context, the present study describes the concept of practical reuse of mandarin peels for the production of edible pectin-based biofilms. First, the mandarin peel extracts were obtained by refluxing (3 h) using water containing different mass fractions of mandarin peels (7.5, 15, and 30 g). Subsequently, the obtained mandarin peel extracts were used on a water basis to dissolve 1% pectin powder. After addition of glycerol (50 and 70%) and calcium chloride (1%), the biofilms were prepared by casting method and analysed by Fourier transform infrared spectroscopy (FTIR). The FTIR results confirmed that there were no differences between the pectin biofilms with the addition of mandarin peel extracts, i.e., the structural characterization of the edible coatings revealed that the different mass fractions of mandarin peel used in the preparation of the biofilms did not affect their structure. The FTIR analyses also confirmed that all biofilms with mandarin peel extracts contained carbohydrates and phenols and were therefore richer than biofilms with water (control film). Overall, the mandarin peel waste could be successfully reused as a cheap bio-substrate for the isolation and conversion of extracts to produce new enriched edible materials, which is in line with the sustainability trend of bioorganic waste recycling.

Extraction and stabilisation of quercetin from yellow onion skin

Ilja Gasan Osojnik Črnivec[1], Mihaela Skrt[1], Danijela Šeremet[2], Draženka Komes[2], Nataša Poklar Ulrih[1,3]*

[1] Biotechnical Faculty, University of Ljubljana, Slovenia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[3] The Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins (CipKeBiP), Ljubljana, Slovenia

Oral presentation, presenting author Ilja Gasan Osojnik Črnivec; gasan.osojnik@bf.uni-lj.si

Onions (*Allium cepa* L.) are one of the most harvested fresh vegetables in the EU, with annual production of residues amounting to about 0.5 M tonnes. Onion skin is rich in flavonoids, especially quercetin, but this biomass is usually discarded during processing. These bioactive compounds could be useful for a protective nutrition or as a technical ingredient in food products. This research examined the stability and degradation of free quercetin, green solvents and procedures for the extraction of quercetin from onion peel, as well as stabilisation through liposomal encapsulation. Initial stability of quercetin was examined by UV-Vis spectrometry and antioxidant capacity determination (pH from 2 to 8, temperatures from 25 to 90 °C, exposure time up to 24 hours). At ambient conditions and pH 2 in the dark, the levels of quercetin were relatively well maintained in the initial hours of observation, and markedly depleted after 24 h. Higher pH values (> 7.4) and/or light at higher temperatures (> 60 °C) further accelerated the depletion profiles. Further metabolomic screening showed additional information regarding metabolite formation. Ethanol (70 %) extracts of onion peel were used in further examination and quercetin was monitored by HPLC-PDA. Either quercetin standard or onion peel extract were entrapped in liposomes, at different ratios between the standard/extract and liposomes (1:20 and 1:100). The greatest encapsulation efficienty was observed for quercetin standard prepared with liposomes in ratio 1:20 (roughly 90%), while encapsulation efficiency of quercetin from onion peel extract, was lower (roughly

75%) at the same conditions. The stability of encapsulated quercetin was followed for 30 days using HPLC- PDA. Over 80 % stabilisation of quercetin in yellow onion skin was achieved with liposomal preparation. Furthermoer, the interactions between quercetin and lipids were characterised by differential scanning calorimetry, indicating that quercetin interacted mainly with the polar headgroup regions of the liposomal bilayer. Onion peel thus presents a rich source of quercetin which could be employed in the formation of stable functional dosage forms. Liposomal encapsulation offers an approach to overcome quercetin degradation.

A study on ultrasound and microwave assisted water-based extraction of polyphenolic compounds from olive leaves

Melissa Prelac[1], Nikola Major[1,2], Maja Repajić[3], Dominik Anđelini[1], Danko Cvitan[1], Zoran Užila[1,2], Smiljana Goreta Ban[1,2], Tvrtko Karlo Kovačević[1], Dean Ban[1,2], Igor Palčić[1,2]*

[1] Institute for Agriculture and Tourism, Poreč, Croatia

[2] The Centre of Excellence for Biodiversity and Molecular Plant Breeding, Zagreb, Croatia

[3] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Melissa Prelac; melissa@iptpo.hr

Agricultural biomass is considered a byproduct with low or no value. Very often it is a threat to the environment if improperly disposed. However, olive leaves are characterized as a source of polyphenolic compounds with high antioxidant activity. In this research, distilled water was used as a solvent in polyphenolics extraction from olive leaves due to its low environmental impact and availability. The aim of this study was to investigate the impact of ultrasound and microwave irradiation on the yield of polyphenolic compounds from olive leaves and their activity at different temperatures and solid to liquid (s/l) ratios. In order to establish the solubility of the investigated compounds, different s/l ratios (1:25, 1:50, 1:100; 1:250, 1:500) were applied. The extractions were performed by microwave and ultrasound irradiation as well as in a water bath as the control. Different temperatures were set to extract the highest polyphenolic yield (30, 45, 60, 75, 90 °C). Total Phenolic Content (TPC) and Oxygen Radical Absorbance Capacity (ORAC) were used to assess the yield and antioxidant activity of the investigated compounds and the results were compared using ANOVA followed by Tukey's post-hoc tests. The ratio 1:25 at temperature of 30 °C showed the lowest yield of polyphenolic compounds regardless of the methodology applied. The highest yield of polyphenolics (45.8 – 47.6 mg GAE/g DW) and antioxidant activity (34.1 – 42.5 µmol TE/g DW) were observed in the water bath extractions at 90 °C with s/l ratios of 1:50 or less. Ultrasound

assisted extraction yielded the highest TPC (45.8 ± 2.0 mg GAE/g DW) and ORAC (36.7 ± 1.8 µmol TE/g DW) values using a s/l ratio of 1:500 and temperature of 45 °C. Similar TPC and antioxidant values could be achieved with higher s/l ratios (1:50 to 1:250) albeit a higher extraction temperature must be used (60 °C or higher). The yield of polyphenolics was lower if microwave assisted extraction was used compared to maceration or ultrasound assisted extraction, regardless of applied temperature and s/l ratio but the antioxidant activity of the extracts remained comparable to the other techniques tested.

The use of nonthermal techniques for the extraction of fibers and bioactive compounds from red beetroot peel

Iva Sabljak[1], Dora Vlahović[2], Anet Režek Jambrak[2], Aleksandra Samardžija[3]*

1 Eurofins Croatia, Zagreb, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[3] Naturala d.o.o., Slatina, Croatia

Poster presentation, presenting author Iva Sabljak; iva.sabljak@ftcee.eurofins.com

Because of climate change and emerging necessity to reduce overall environmental impact, sustainability has become one of the key aspects in food industry. High production rates combined with inadequate food processing techniques not only increase greenhouse gas emissions, but also create enormous amounts of waste. As food waste reduction presents an integral part of circular economy, ventures aimed towards its effective minimization supporting zero waste concept are of increased importance. The most researched area is sustainable conversion of agri-food wastes to value-added products and feasibility of green techniques to obtain them. Pulsed electric field (PEF) belongs to the new generation of innovative, nonthermal processing technologies and presents an environmentally friendly and cost-effective food processing technique. It improves mass transfer, extraction yield, reduces processing time, intensity of extraction parameters, preserves the food quality and minimizes nutrient loss during processing. PEF has multiple potential applications in food industry, especially reduction of unwanted microorganisms and achievement of structural modifications which may lead to desired texture modifications or improved extraction processes. From PEF-pretreated red beetroot peel, fiber and betaine were extracted ultrasonically and conventionally. Dietary fibers are part of balanced diet and play a key role in maintaining human health, since the benefits of consuming foods rich in dietary fibers are numerous. Average European citizen does not meet the recommended daily fiber intake. Along with encouraging increased intake of naturally fiber-rich foods, one of the ways is to

enrich foods and add fiber to different food products. Betaine is produced in the human body from choline and the amino acid glycine. As with folic acid and vitamins B6 and B12, betaine may function as a methyl donor and aid in proper liver function, cellular replication, and detoxification reactions. Some foods rich in betaine are beets and wheat bran, although exact values vary with different food sources and cooking methods. According to the results, obvious difference between conventional and ultrasound-assisted extraction procedures exists. Processing parameters and solvent choice influence the extraction yield of total fiber and betaine content. Combination of PEF (pretreatment) and nonthermal, ultrasound-assisted extraction has shown to be successful in delivering sustainable solution.

Antimicrobial activity of by-product extracts in combination with pure compounds

Danijela Skroza[1], Martina Čagalj[2], Ivona Krivić[1], Roberta Frleta[3], Vida Šimat[2]*

[1] Faculty of Chemistry and Technology, University of Split, Croatia

[2] University Department of Marine Studies, University of Split, Croatia

[3] Center of Excellence for Science and Technology-Integration of Mediterranean Region (STIM), Faculty of Science, University of Split, Croatia

Poster presentation, presenting author Danijela Skroza; danci@ktf-split.hr

Numerous scientific studies indicate the possibility of using by-products to fortify other products or as substitutes for synthetic antimicrobials. The antioxidant and antimicrobial effects of berries have already been confirmed and are primarily related to their phenolic content, mainly compounds such as flavonoids and anthocyanins. The blackberry leaves contain interesting chemical profiles as well as strong biological activity. The aim of this work was to test the antimicrobial activity of blackberry leaf extract in combination with selected phenolic compounds (vanillic acid, catechin, rutin, apigenin and oleuropein) against the most common foodborne pathogens: *Staphylococcus aureus*, *Bacillus cereus*, *Listeria monocytogenes*, *Escherichia coli*, *Enterococcus faecalis* and *Salmonella enteritidis*. Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) methods were used in the study. The low MIC (0.63 mg/mL) and good bactericidal activity (MBC 1.25 mg/mL) were confirmed for the blackberry leaf extract against *S. aureus*, while the MIC values for other tested bacteria were 5 mg/mL. All binary mixtures of blackberry leaf extract and selected phenolic compounds showed very good antimicrobial activity and mostly indicated additive activity. The mixture of blackberry leaf extract and catechin had the best synergistic effect against *L. monocytogenes* (1.25+0.31 mg/L). The results show that the activity of blackberry leaf extract is enhanced by the addition of vanillic acid and oleuropein against *L. monocytogenes*, *E. coli* and *E. faecalis*.

This research is supported by the PRIMA programme under project BioProMedFood (Project ID 1467). The PRIMA programme is supported by the European Union.

Phenolic profile and biological potential of vinification byproducts

Danijela Skroza[1], Ivana Generalić Mekinić[1], Živko Skračić[2], Andrea Tadić[1], Antonia Nadilo[1], Martina Čagalj[3], Vida Šimat[3]*

[1] Faculty of Chemistry and Technology, University of Split, Croatia

[2] Secondary school "Braća Radić" Kaštel Štafilić, Kaštel Štafilić – Nehaj, Croatia

[3] University Department of Marine Studies, University of Split, Croatia

Poster presentation, presenting author Danijela Skroza; danci@ktf-split.hr

After grapes are processed and vinified, large quantities of valuable by-products such as pomace, skins, seeds and wine lees are generated. They are all rich in phenolic compounds with numerous beneficial biological properties, especially antioxidant and antimicrobial activity. The lees samples were taken during the production of white wine from the Malvazija dubrovačka grape variety (one sample was taken before fermentation and the other after the first racking), and rosé and red wine from the Plavac mali grape variety (sampling after the racking). Extracts from wine lees were prepared using an ultrasound bath (1 h, 60 °C, dried material:solvent (50% ethanol) = 1:5). Total phenols were determined by the Folin-Ciocalteu method, individual phenolic compounds by high-performance liquid chromatography (HPLC), and antioxidant activity by ferric reducing antioxidant power (FRAP), oxygen radical absorbance capacity (ORAC) and (2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging method. The obtained results showed an extremely high content of phenols (749-2964 mg GAE/L) and a diverse phenolic profiles of the samples. The results obtained by HPLC showed that p-hydroxybenzoic acid, epicatechin and rutin were the most abundant compounds in all samples. In addition to phenolic composition, good antioxidant activity was also confirmed by all methods. Although all samples gave surprisingly good results, the white wine lees obtained before fermentation and the red wine lees stood out with an almost 2-fold higher amount of phenols and better antioxidant activity compared to the other samples.

This research is supported by the PRIMA programme under project BioProMedFood (Project ID 1467). The PRIMA programme is supported by the European Union.

Solid-state cultivation of *Penicillium* sp. to produce xylanase for the extraction of xylooligosaccharides from soybean hulls

Nataša Ž. Šekuljica[1], Jelena R. Mijalković[2], Neda V. Pavlović[1], Sonja M. Jakovetić Tanasković[2], Ivana V. Gazikalović[1], Nevena D. Luković[2], Zorica D. Knežević-Jugović[2]*

[1] Innovation Center of Faculty of Technology and Metallurgy, Belgrade, Serbia

[2] Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Poster presentation, presenting author Neda Pavlović; nsekuljica@tmf.bg.ac.rs

Research background. The development of a method for generating xylooligosaccharides based on the 4R's concept is made possible by the integration of many techniques, in particular enzymatic modification, together with physical pre-treatment of renewable materials. This study aims to integrate the production of new xylanase from Penicillium sp. and its application in soybean hulls hydrolysis towards xylooligosaccharides production. Experimental approach. Solid-state cultivation using wheat bran as the substrate was carried out to produce xylanase. To obtain the most active crude xylanase extract possible, the timeframe of the cultivation process was first adjusted. Henceforth, the downstream process for the xylanase purification was developed by combining several different membrane separation units together with size exclusion chromatography. Additional characterization covered determination of optimum pH and temperature, molecular weight measurement of purified xylanase, kinetic parameters analysis, and substrate specificity assessment. Afterwards, the hydrolyzing capabilities of purified xylanase were investigated in the hydrolysis of hydrothermally pretreated soybean hulls (135 °C, 2.3 bar, 1h). Results and conclusions. Our findings indicate that during solid-state cultivation, Penicillium sp. produced extracellular xylanase with a yield of 21 IU/gsubstrate. Importantly, xylanase specificity tests revealed that the chosen strain produced both, arabinofuranosidase and endo-xylanase. The recovery yield of 49% and xylanase purification fold of 13 were obtained using two ultrafiltration membrane units of 10 and 3 kDa in combination with size exclusion

chromatography. Purified xylanase (25 kDa) aptly cleaved linear bonds (β-1→4) in beechwood xylan with a maximum velocity of 0.64 µmol/min mgprotein, a turnover of 4.5• 10-6 1/s, and a Michaelis constant of 44 mg/ml. At pH 6 and 45 °C, purified xylanase showed its best activity. Thin layer chromatography supported these findings, and showed that enzyme hydrolysis of soybean hulls increased the release of reducing sugars (mg/g), proving its usefulness in the manufacture of xylooligosaccharides with varied degrees of polymerization. Novelty and contribution. Future research focused on creating new enzymatic pathways for use in processes converting renewable materials into value-added products can rely on our findings.

Influence of experimental conditions on the yield of phenols and flavonoids obtained from tomato peel waste by microwave-assisted extraction

*Marina Tranfić Bakić[1], Sandra Pedisić[2], Zoran Zorić[2], Verica Dragović-Uzelac[2], Antonela Ninčević Grassino[2]**

[1] Faculty of Chemistry and Technology, University of Split, Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Antonela Ninčević Grassino; aninc@pbf.hr

Industrial processing of tomatoes generates a considerable amount of waste, such as peels and seeds. These residues are an environmental problem, so their reuse would bring several benefits. They are used to extract pectin, polyphenols and fatty acids, which are a valuable source of additives, natural antioxidants and edible oils, respectively. To maximize the extraction of polyphenols from tomato waste, different extraction techniques and operating conditions can be used. One of the innovative techniques is microwave-assisted extraction (MAE), which allows higher extraction efficiency in less time and at lower temperature. In this work, MAE was applied as an environmentally friendly technique for the extraction of total phenols (TP) and flavonoids (TF) from tomato peels with respect to the solvents used, i.e., water and aqueous solution of HCl (1%, v/v), methanol (50 and 70%, v/v), with or without addition of 1% HCl and ethanol (50 and 70%, v/v), temperatures (25, 55, and 90 °C), and times (5 and 10 min). The results showed that all samples contained high mass fractions of TP (53.12 g/kg) and TF (50.36 g/kg), which varied as a function of extraction time, temperature, and solvent. Increasing the temperature significantly improved the solubility of TP and TF, and the highest value was obtained for samples extracted at 55 and 90 °C. In contrast to the effects of temperature, increasing the extraction time from 5 to 10 min did not significantly affect the recovery of TP ($p = 0.333826$) and TF ($p = 0.519694$). As for the solvents used in MAE, the addition of HCl to 50 and 70% methanol had no significant effect ($p > 0.05$) on the amounts of TP and TF. Better extraction of flavonoids was ensured with 70% methanol and ethanol,

especially at higher temperatures. However, better extraction of TP was obtained with 50% methanol and ethanol. In conclusion, tomato peel waste contains remarkable amounts of phenols and flavonoids. Of the parameters evaluated, temperature had the greatest effect on their extraction. However, the yield of TP and TF also depended on the choice of the appropriate solvent and its combination with the extraction temperature.

Fermentation performance of carob flour, proso millet flour and bran for gluten-free flat bread production

Bojana Voučko[1], Nikolina Čukelj Mustač[1], Cleo Pereira[2], Ljiljana Nanjara[3], Tomislava Grgić[1], Duška Ćurić[1], Dubravka Novotni[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] IUT Dijon, France

[3] University ofApplied Sciences "Marko Marulić", Knin, Croatia

Poster presentation, presenting author Bojana Voučko; bojana.voucko@pbf.unizg.hr

Flat bread is a product acquiring popularity due to its simplicity of use and keeping but often has a poor nutritional value and can rarely be found on the market as gluten-free. Furthermore, sourdough is a promising ingredient in the production of clean label gluten free products. Previous research has shown carob flour and proso millet bran as promising functional ingredients for gluten-free bread due to their nutritional benefits, consumers liking and technological suitability. Aim of this research was to compare sourdough fermentation performances of carob flour, proso millet bran and proso millet flour, individually and combined, to be used in the production of a nutritious and sensory pleasing gluten free flat bread. Sourdoughs were fermented according to a mixture design (n=13) with Limosilactobacillus fermentum and Kluyveromyces marxianus, during 16 hours at 35°C. Fermentation performance was tested through titrable acidity (until pH 8,5), pH, lactobacillus and yeast count at end of fermentation, HPLC analysis of organic acids content (L- and D- lactic acids, acetic acid). At the end of fermentation, pH was in range 3.6 to 3.9, while TTA ranged from 9.5 to 18.4. Compared to previous research, sourdough fermentation of carob flour with the use of yeast K. marxianus has shown preferable to S. cerevisiae. The use of proso millet bran ensured a higher growth of lactobacillus and bigger production of L-lactic acid, while the

use of carob flour resulted in minimal concentrations of acetic acid. D-lactic acid, a non-physiological ingredient of sourdough, was present in highest amounts in sourdoughs prepared with individual flours, reaching up to 1.1 mg/g, indicating a complementary influence of combinations of these three flours in gluten free sourdough in which the maximum concentration was 0.38 mg/g. Higher preference of combinations of carob flour, proso millet flour and bran in sourdough fermentation could also ensure a higher fiber content and overall better nutritive value of the resulting gluten free flat bread while further development of sourdough with use of by-products ensures long-term sustainable food production. Acknowledgement: This paper is supported by the PRIMA program under grant agreement No 2031 project FLAT BREAD MINE. The PRIMA program is an Art.185 initiative supported and funded under Horizon 2020, the European Union's Framework Programme for Research, and Innovation.

INDUSTRY 4.0

Closing the loop and decreasing vegetable by-products in food industry production

Jasmina Ranilović and Tanja Cvetković*

Podravka Inc., Koprivnica, Croatia

Invited lecture, presenting author Jasmina Ranilović; jasmina.ranilovic@podravka.hr

The United Nations has identified 17 sustainable goals to protect the planet, reduce poverty and ensure a better life for people. The European Environment Agency has recognized the transition to a circular economy as a key business model that will use waste and return it to the supply chain, to achieve a balance between economic growth and environmental protection. The transition from a linear to a circular economy, through closing the circle in the practice of the food industry, carries a numerous challenge. Valorization and reuse of by-products implies investment costs, so a long-term vision, investment in research & innovation and technological adaptation are needed. On the example of the results of an industrial research project on the use of by-products during vegetable processing, the benefits, and barriers to the transition to a circular economy will be critically reviewed.

Development of Smart food Factory

Nedeljko Štefanić

Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia

Invited lecture, presenting author Nedeljko Štefanić; Nedeljko.Stefanic@fsb.hr

Industry 4.0 and digital technologies are also used in the food industry, which is facing with many challenges and changes in its environment, both regulatory (quality, safety) and global (increasing the number of people on earth, climate changes, plant-based food, new business models, new technologies, new knowledge and skills of the workforce, innovations).

The main product of Industry 4.0 is the Smart Factory, which provides food companies with a high level of automation and robotization, greater availability of machines and production lines, paperless production, application of new business models, management of large amounts of data, optimization of costs, predictive maintenance, identification of challenges in processes and reactions in real time.

The food industry is going through a digital transformation from a classic to a Smart factory in a very systematic and structured manner, where the Culis strategic and operational methodology for the development of the Smart Factory will be presented.

Production processes and parameters affecting the oil content in potato chips

Draženka Dite Hunje [1], Branka Levaj[2]*

[1] Intersnack Adria d.o.o., Croatia

[2] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Draženka Dite Hunjek; drazenka.dite@intersnack.hr

Potato chips are a popular snack product on the market, but health-conscious consumers avoid them because of their higher fat content. It is also desirable from an economic point of view and in terms of the product's shelf life to reduce oil absorption. For this reason, scientists are researching how to reduce the oil content in the product without negatively affecting the sensory properties. This presentation aims to summarize all the factors and mechanisms as well as new methods for reducing oil content in chips and to provide an overview of the latest published results on this topic. The factors that can contribute to the production of low-fat chips can be divided into several groups: (i) raw material (potato cultivars, agrotechnological methods, and storage conditions); (ii) pre-frying treatments to modify the surface such as pre-drying (osmotic dehydration, infrared vacuum pre-drying, ultrasonic and convective air drying), blanching, pulsed electric field pre-treatment, and ultrasonic treatment, or to modify the slice thickness and using edible films such as hydrocolloids; (iii) type of frying (e.g., vacuum frying) and frying parameters (temperature and time); (iv) post-frying treatment such as draining under vacuum. For example, potatoes with higher dry matter absorb less oil, and the altered surface of the fries contributes to lower oil content. In addition, frying at higher temperatures results in lower oil content in the chips. All of the above factors and their mode of action will be discussed in detail in the presentation. An overview of recent scientific research and the results obtained will also be given.

Artificial intelligence and causal analysis in food technology

Zelimir Kurtanjek

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral Presentation, presenting author Želimir Kurtanjek; zelimir.kurtanjek@gmail.com

Applications like “big data”, artificial intelligence tools (AI), and structural causality modeling (SCM) are considered for evaluation of key aspects of food science and technology. The focus is to predict the causal relationship between food chemical analytics and physicochemical data related to human perception of food quality. As an example, applications are deep learning, random forest, and causal Bayes networks for analytics of meat, bread, and wine. The considered data generation processes are NIR and FTIR spectra, biochemical analytics, rheology measurements, physicochemical data, associated with technological and human expert quality classifications. Due to the high biological variability of foodstuffs and their interrelations, predictions of quality metrics are subject to intricate confounding. The focus is on causal analysis based on Bayes networks to extract key pattern functional relations in presence of large data entropy. Based on the BN model structure applied is d-separation criteria to block noncausal confounding (interference). The causal relations are extracted as partial dependence plots predicted by adjustment covariate sets and Bayes neural networks. The results are discussed given available open-source software tools in an industrial environment.

Application of natural deep eutectic solvents for food waste valorisation

Manuela Panić, Anja Damjanović, Martina Bagović, Mia Radović, Marina Cvjetko Bubalo, Kristina Radošević, Ivana Radojčić Redovniković*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Poster presentation, presenting author Anja Damjanović; adamjanovic@pbf.hr

Many industrial processes use large quantities of volatile, flammable, and toxic organic solvents based on unsustainable resources such as oil, resulting in significant environmental and economic impacts. Over the past decade, natural deep eutectic solvents (NADES) have become promising alternatives to traditional organic solvents from both environmental and technological perspectives. The properties that have gained them the environmentally friendly label are nonvolatility (reduced air pollution), nonflammability (process safety), and excellent stability (potential for recycling and reuse). The number of structural combinations encompassed by NADES is tremendous, thus it is possible to design NADES with unique physicochemical properties for a particular purpose, such as the design of solvents for the efficient extraction of biologically active compounds. It is interesting to find the natural deep eutectic solvent structures that enable highly efficient processes. This work aims to prepare several natural deep eutectic solvents based on renewable sources and to apply these solvents in industrial interesting processes: (1) isolation of biologically active molecules from food waste and (2) valorisation of biological activity of prepared extracts. Based on the presented results, carefully selected NADES could be used to efficiently extract polyphenols from food waste and obtained NADES extracts could be used in a different industrial niche without the removal of extraction solvent since they are proven safe.

SmartCro

Self-healing Organogelators of Edible Oil as Solid Fat Alternatives

Nataša Šijaković Vujičić

Ruđer Bošković Institute, Division of Organic Chemistry , Zagreb, Croatia

Invited lecture, presenting author Nataša Šijaković Vujičić; natasa.sijakovic@irb.hr

The powerful applicability of oil gelators is envisaged in food, cosmetics, pharmaceutical industry, paints and coatings, and agrochemicals. Concerning regulations requiring the elimination of saturated fats, rising concerns among consumers health and ecological damage caused by palm oil production motivated us to design small organic molecules capable to efficiently transform liquid oil to solid state. The food sector searches for an effective way of structuring healthy edible oil to prevent health issues, cardiovascular diseases, obesity, and diabetes. In order to replace saturated fats with unsaturated fats (liquid oil) without disturbing structural characteristics of the food product, the properties of the liquid oil have to be structured to the state of solid fats. Patent protected Low molecular weight organic gelators show remarkable gelation efficiency in vegetable oils and emulsions, a thermal and mechanical stability, self-healing properties, a long period of stability and controlled delivery of hydro and liposoluble compounds. Structuring of healthy oil through gelation can serve as replacement of solid fats in both water-free and water-containing products with possibility for controlled delivery of nutraceuticals. The gelators of the present invention showed thermoreversible and thixotropic properties in vegetable oil and emulsions with a minimum gelation concentration of 0.025 wt%. Oil gels subjected to rheological measurements showed moderate to strong gelation ability examined at low concentrations from 0.5 to 0.05 wt%. Storage modulus (G') values of the gels from 0.1 to 0.5 wt% were in the range from 1 to 100 kPa, and yield point values from 10 Pa to 100 Pa, respectively. Frequency sweep studies of the gels indicated that the storage modulus (G') and the loss modulus (G") values are independent of the applied frequency. The properties of the gels and w/o gelled emulsions

were analysed by TEM, SEM, POM microscopy, X-ray scattering, DSC calorimetry and oscillatory rheology. The Proof of concept is explored in preparation of new margarine, spreads, and confectionary products in collaboration with the various food companies.

SATELLITE SYMPOSIUM “VERA JOHANIDES”

Biotechnology in Croatia

*Nenad Marđetko, Mario Novak, Antonija Trontel, Mario Pavlečić, Božidar Šantek**

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Invited lecture, presenting author Božidar Šantek; bsantek@pbf.hr

Biotechnology is dealing with living organisms, their parts or by-products in industrial scale to produce goods that improve the quality of life. Biotechnology is involved in all aspects of human activities and consequently it has crucial role in the world economic development. There are several classifications of biotechnology and the most popular one is the use of four (red, green, white and blue) colors, but classification with nearly all tones of rainbow is also known. Blue biotechnology is based on the exploitation of sea resources to create industrially interesting products and applications. In Croatia, it is characterized by marine fish and shellfish farming as well as microalgae cultivation. Blue biotechnology has great potential for further development through the high quality resources and knowledge how to convert these resources into valuable products. The creation of new varieties of agricultural plants and producing bio-fertilizers and bio-pesticides is in the focus of green biotechnology. In Croatia, a few companies are dealing with development of new varieties of corn, wheat, barley as well as production of bio-fertilizers. However, the whole domestic green biotechnology sector has to be more open for cooperation with research and development institutions in order to reach European and international levels. Red biotechnology includes health preservation, manufacture and discovery of drugs, therapies and diagnostics. In this biotechnological sector, a few Croatian companies are dealing with manufacture and discovery of drug substances and they are successful in European and international levels. Improvement of ecological and energetic efficiency of novel and traditional bioprocesses is in the focus of white (industrial) biotechnology. In Croatia, industrial biotechnology has great potential for production of traditional (e.g. wine, beer, baker's yeast) and novel (e.g. enzymes, biofuels,

bio-chemicals) products due to availability of different raw materials and industrial capacity and knowledge for these productions. However, the cooperation between research institution and companies is required for further improvement in this area. It is obvious that biotechnology has great potential to be the generator of further development of economy in Croatia.

This work has been supported by Croatian Science Foundation under the project OPB-SLS (9717).

Mathematical modelling at Faculty of Food Technology and Biotechnology: From regression to artificial intelligence

Želimir Kurtanjek

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Invited lecture, presenting author Želimir Kurtanjek; zelimir.kurtanjek@gmail.com

Education and research in mathematical and computer modelling in biotechnology started in 1970 when the University Computer Centre (SRCE) was established. Since 1980 two programs for students of biotechnology and food technology and nutrition were introduced. The programs became fully active in 1990 with CARNET project. Prof. Vera Johanides as a co-founder of the European Federation of Biotechnology (EFB) delegated a PBF a member at Working Party of Process Control. Cooperation with Pliva company led to cooperation of faculty and students with industry. Initially, most of the modelling methodologies were the application of regression and estimation of kinetic parameters and process dynamics. The parameter regression models were followed by principal component analysis (PCA) and least squares (PLS) models. In the field of food technology and nutrition, the application of linear programming for process and food quality optimization were dominant topics followed by advanced modelling of cell metabolic networks. Initial advances in artificial intelligence were applied for the application of fuzzy logic models in food technology and nutrition. Use of NIR spectroscopy of foodstuff led to the wide application of artificial neural networks (ANN). Nowadays importance of artificial intelligence (AI) is recognized by application of structural causal models (SCM) for complex enzymatic processes. Hopefully, in the near future, AI and mathematical modelling will become the main focus of biomolecular engineering at PBF.

Modern vaccines: State of the art and future trends

Antun Vrdoljak

Product development - vaccines, Genera d.d., part of Dechra Plc. Group, Zagreb, Croatia

Invited lecture, presenting author Anto Vrdoljak; anto.vrdoljak@dechra.com

Vaccination benefits humanity for over two centuries. While basic concepts of vaccination and art of making vaccines have survived the challenge of time, new pandemic threats complicated with sociological aspects of modern living pose unprecedented challenges to world healthcare systems. Emerging new pathogenic strains, rising antimicrobial resistance, globalization and increasing skepticism against vaccination pave the way to devastating global pandemics. These new challenges ask for innovative approaches in development of new vaccines as well as rethinking traditional way of communication of vaccination benefits to patients. Microbial evolution efficiently uses modern way of living as a leverage for development and efficient spread of new pathogens. New scientific concepts therefore need faster adoption and reduced regulatory framework to allow rapid responses to pandemic threats.

How biotechnology met circular economy at the Faculty of Food Technology Osijek

Natalija Velić[1], Mirna Tišma, Vinko Krstanović, Ivica Strelec, Tihana Marček, Tihomir Kovač*

Faculty of Food Technology Osijek, University of Osijek, Osijek, Croatia

Invited lecture, presenting author Natalija Velić; natalija.velic@ptfos.hr

Since food is inseparable from biotechnology, it is not surprising that food biotechnology has been included in the curriculum of the Faculty of Food Technology Osijek, University of Osijek (PTFOS) since its foundation some 50 years ago. The choice of research topics of a small core of researchers in the field of biotechnology at PTFOS, which has grown over the years, was also mainly related to food biotechnology and included the study of abiotic and biotic stress factors of crops, enzyme activities related to grain storage, the study of mycotoxigenic fungi related to food and feed safety, enzyme (bio)catalysis and the general improvement of biotechnological methods for the production of fermented foods (especially beverages, beer and fruit wine). However, the emerging need for the food industry to move to more sustainable primary production and processing systems has led to a rethinking of how resources are used within traditional food processing systems, e.g. the production residues from the agri-food industry have been recognised as a valuable resource for the production of high-value products and biofuels. This is where biotechnology and the circular economy met at PTFOS. The European Commission defines the circular economy as a model in which the generation of waste is minimised and the value of products, materials and resources is retained for as long as possible, so that what was once considered waste becomes a resource. Production residues, i.e., by-products and waste materials, from the food industry, including the same fermentation technologies that were the subject of research at PTFOS, are now being reused for the isolation of biologically active compounds, the production of enzymes, biofuels, and other valuable products, or as enzyme carriers and biosorbents. An overview will be given of the previous research topics and projects in the field of biotechnology, as well

as the topics and projects related to biotechnology and the circular economy that are currently being carried out at PTFOS.

Structural and functional characterization of exopolysaccharides produced by Limosilactobacillus fermentum MC1 isolated from mother's milk

Nina Čuljak[1], Barbara Bellich[2], Paola Cescutti[2], Katarina Butorac[1], Jasna Novak[1], Martina Banić[1], Andreja Leboš Pavunc[1], Krešo, Bendelja[3], Ksenija Durgo[1], Jagoda Šušković[1], Blaženka Kos[1]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Department of Life Sciences, University of Trieste, Italy

[3] Center for Research and Knowledge Transfer in Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Nina Čuljak; nculjak1@pbf.hr

Exopolysaccharides (EPS) are extracellular cell structures tightly bound to the cell envelope or loosely excreted in the microenviroment. They consist of linear or branched repeating units of sugars, but may also contain non-carbohydrate substituents. Depending on sugar composition, EPSs are classified as homo-EPS (HoEPS), made of one repeated monosaccharide unit, and hetero-EPS (HeEPS), made of more than one monosaccharide unit. Among microbial polysaccharides, EPS produced by generally regarded as safe (GRAS) lactic acid bacteria (LAB) have various applications. Most commonly, their role is recognized in improving the texture of the fermented food products. Also, their importance as functional molecules has recently been recognized due to the capacity of bifidogenic, and even antitumor, antiulcer, immunomodulating or cholesterol-lowering effects in vivo. The main challenge for large-scale industrial production is increasing the yield of synthesis. The total yield of EPS depends on several factors including producer strain, medium composition, growth conditions such as temperature, pH and incubation time. Therefore, the aim of this research is a structural and functional analysis of the EPS produced by MC1 strain isolated from mother´s milk. EPS-producer showing characteristic „ropy phenotype" was identified as Limosilactobacillus fermentum MC1 by 16S RNA sequencing. Whole genome sequencing of the MC1 genome following functional annotation by RAST enabled the detection of the eps

cluster for EPS biosynthesis. 1H NMR and 2D NMR analysis showed that EPS isolated from L. fermentum MC1 is composed of two structurally different polysaccharides – the main polysaccharide is composed of repeating units of 1,6 linked galactofuranose with glucose branches on C2 of the galactose residue, while the determination of the structure of the second polysaccharide is still ongoing. L. fermentum MC1 has shown the ability to survive under simulated gastrointestinal tract conditions, as well as the potential to reduce adhesion of Escherichia coli 3014 via competitive exclusion mechanism. Fluorescence microscopy confirmed the adhesion of L. fermentum MC1 to the Caco-2 cell line. Moreover, addition of EPS further increased adhesion to Caco-2 cell line in vitro. Further experiments will be focused on the determination of the role of EPS related to effects of MC1 strain within the probiotic concept.

Involvement of the RNA exosome in the maintenance of cell wall stability in the yeast Saccharomyces cerevisiae

Nada Šupljika, Ana Novačić, Igor Stuparević*
Laboratory for Biochemistry, Department of Chemistry and Biochemistry, Faculty of Food Technology and Biotechnology

Oral presentation, presenting author Nada Šupljika; nsupljika@pbf.hr

The yeast cell wall is an extracellular organelle important for shape, protection, and communication with the environment. It is composed mainly of β-glucans and chitin, to which mannoproteins are attached. It represents the primary shield that protects cells from environmental stress influence such as high temperatures or agents that compromise the integrity of the cell. The cell wall is constantly remodelled depending on the phase of the cell cycle, the presence of nutrients and environmental conditions such as pH, temperature and oxygen availability. Recently, it was shown that the conserved nuclear RNA exosome complex, consisting of the EXO-9 core and two catalytic subunits, Dis3 and Rrp6, plays an important role in cell wall remodelling. Dis3 is essential for viability, whereas deletion of the gene encoding Rrp6 leads to temperature sensitivity and slower growth. It provides 3'→5' exoribonuclease activity, which is critical for maintaining yeast cell wall stability and integrity under stress conditions. In this work, we show that the temperature sensitivity of RNA exosome mutants in the W303 genetic background is particularly pronounced due to the non functional ssd1-d allele. This gene encodes the RNA-binding protein Ssd1, which is involved in the posttranscriptional regulation of cell wall-related genes. This short talk will highlight the importance of the parallel pathways of the RNA exosome catalytic subunit Rrp6 and Ssd1 in maintaining yeast cell wall stability and cell wall integrity under stress conditions.

Versatile microfluidic systems applications: From biotransformation to extraction

Ana Jurinjak Tušek[1], Anita Šalić[2], Davor Valinger[1], Bruno Zelić[2,3]*

[1] Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

[2] Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia

[3] University North, Koprivnica, Croatia

Oral presentation, presenting author Ana Jurinjak Tusek; ana.tusek.jurinjak@pbf.unizg.hr

In recent years, the interest of chemical engineers and biotechnologists has focused on technologies with micro dimensions (e.g., microreactors, microseparators, microheat exchangers, etc.) in order to find new and sustainable solutions for production, separation, detection and analysis. By reducing the dimensions of process equipment by several orders of magnitude, considerable economic savings, higher process reliability, and significantly lower environmental impact are achieved. In addition, process intensification leads to a reduction in the time required to bring products to the market. Literature indicates that about 50% of the reactions used in the production of fine chemicals and pharmaceutical products could be significantly improved by performing continuous processes in microfluidic systems, and for the majority (~44 %), microfluidics would be the best reaction system. In addition, most of the existing downstream processes require more than 70% of the total consumption of process aids such as solvents, energy and cooling water. Therefore, it is necessary to take a step forward and improve these technologies. Important advantages of microfluidics include a reduced amount of used solvents, reactants and catalysts, reduced exposure to harmful and toxic substances, and the ability to perform specific chemical and biochemical reactions. Improved process control allows good process selectivity and ensures the recovery of a product with a high degree of purity. In addition, due to the high flexibility of microfluidics, it is possible to fabricate them to specific process requirements.

In this work, the efficient application of microfluidic systems for (i) biotransformation of catechol, (ii) extraction of polyphenols, and (iii) biodiesel synthesis is presented. The

advantages of using microfluidic systems over classical reactor systems are also highlighted, without excluding the challenges in commercial application.

Plant-derived protein hydrolysates and its use in animal cell technology

Marijan Logarušić[1], Tino Ursić[1], Igor Slivac[1], Višnja Gaurina Srček[1]*

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Oral presentation, presenting author Marijan Logarušić; mlogarusic@pbf.unizg.hr

Agriculture and the food industry generate a large number of plant-based side products often applicable in the creation of wide diversity of new products. A good example is plant protein hydrolysates that can be used in food technology as well as in cosmetics and pharma biotechnology. The most common raw materials for the production of protein hydrolysates are oil-plant seeds and their derivatives called oil cakes. This work gives an overview of recent achievements in exploiting the leftover proteins from such materials for the production of protein hydrolysates. Protein content ranging from 15-50 % as well as the presence of various bioactive compounds make the oil cake a great source of nutrients. Therefore, we put focus on the preparation of hydrolysates and their application in animal cell technology. Given as a nutritional supplement to the cell culture, the hydrolysates have the potential to boost cell growth and productivity. With such benefits, the hydrolysates very often become an integral component in novel growth media formulations. This has a great impact on lowering the cost of bioprocessing as well as on bioprocess sustainability.