Food industry by-products : book of abstracts : 4rd International Scientific and Professional Conference FOOD INDUSTRY BY-PRODUCTS

Ačkar, Đurđica; Adamović, Maja; Ahmetović, Melisa; Aladić, Krunoslav; Aldžić, Asmir; Aličić, Damir; Antunović, Boris; Antunović, Martina; Babić, Jurislav; Badanjak Sabolović, Marija; ...

4th International Scientific and Professional Conference /
4. međunarodni znanstveno-stručni skup

FOOD INDUSTRY BY-PRODUCTS

BOOK OF ABSTRACTS / KNJIGA SAŽETAKA

6th and 7th June 2024
Osijek, Croatia

Faculty of Food Technology Osijek / Prehrambeno-tehnološki fakultet Osijek
Croatian Academy of Engineering / Akademija tehničkih znanosti Hrvatske
Faculty of Tourism and Rural Development in Požega / Fakultet turizma i ruralnog razvoja u Požegi
Faculty of Agriculture and Food Technology, University of Mostar (B&H) / Agronomski i prehrambeno-tehnološki fakultet Sveučilišta u Mostaru (BiH)
Association for Nutrition and Dietetics (B&H) / Udruženje za nutricionizam i dijetetiku (BiH)
Agricultural Institute Osijek / Poljoprivredni institut Osijek
Croatian Veterinary Institute / Hrvatski veterinarski institut
Institute of Agriculture and Tourism / Institut za poljoprivredu i turizam
European Hygienic Engineering & Design Group – EHEDG (*The Netherlands*/ Nizozemska)
Croatian Science Foundation / Hrvatska zaklada za znanost

4th International Scientific and Professional Conference /
4. međunarodni znanstveno-stručni skup

FOOD INDUSTRY BY-PRODUCTS

Book of Abstracts / Knjiga sažetaka

IV. FIB CONFERENCE, 2024

6th and 7th June 2024
Osijek, Croatia

BOOK OF ABSTRACTS	*4th International Scientific and Professional Conference FOOD INDUSTRY BY-PRODUCTS*
KNJIGA SAŽETAKA	4. međunarodni znanstveno-stručni skup *FOOD INDUSTRY BY-PRODUCTS*
***Published by* / Izdavač**	*Faculty of Food Technology Osijek* Prehrambeno-tehnološki fakultet Osijek
***Editors* / Urednici**	Drago Šubarić, Antun Jozinović
***Technical Editor* / Tehnički urednik**	Antun Jozinović
***Organizers* / Organizatori**	*Faculty of Food Technology Osijek* / Prehrambeno-tehnološki fakultet Osijek; *Croatian Academy of Engineering* / Akademija tehničkih znanosti Hrvatske; *Faculty of Tourism and Rural Development in Požega* / Fakultet turizma i ruralnog razvoja u Požegi; *Faculty of Agriculture and Food Technology, University of Mostar (B&H)* / Agronomski i prehrambeno-tehnološki fakultet Sveučilišta u Mostaru (BiH); *Association for Nutrition and Dietetics (B&H)* / Udruženje za nutricionizam i dijetetiku (BiH); *Agricultural Institute Osijek* / Poljoprivredni institut Osijek; *Croatian Veterinary Institute* / Hrvatski veterinarski institut; *Institute of Agriculture and Tourism* / Institut za poljoprivredu i turizam; *European Hygienic Engineering & Design Group – EHEDG* (*The Netherlands/* Nizozemska); *Croatian Science Foundation* / Hrvatska zaklada za znanost
***Scientific and Organising Committee* / Znanstveno-organizacijski odbor**	Drago Šubarić (*chairman*/predsjednik) (*Croatia*/Hrvatska), Đurđica Ačkar (*vice-chairman*/zamjenik predsjednika) (*Croatia*/Hrvatska), Ante Lončarić (*vice-chairman*/zamjenik predsjednika) (*Croatia*/Hrvatska), Krunoslav Aladić (*Croatia*/Hrvatska), Daniela Amidžić Klarić (*Croatia*/Hrvatska), Jurislav Babić (*Croatia*/Hrvatska), Dean Ban (*Croatia*/Hrvatska), Marija Banožić (*Bosnia and Herzegovina*/Bosna i Hercegovina), Veronika Barišić (*Croatia*/Hrvatska), Sandra Budžaki (*Croatia*/Hrvatska), Eva Falch (*Norway*/Norveška), Vlado Guberac (*Croatia*/Hrvatska), Artur Gryszkin (*Poland*/Poljska), Andrea Humski (*Croatia*/Hrvatska), Midhat Jašić (*Bosnia and Herzegovina*/Bosna i Hercegovina), Antun Jozinović (*secretary*/tajnik) (*Croatia*/Hrvatska), Stela Jokić (*Croatia*/Hrvatska), Goran Jukić (*Croatia*/Hrvatska), Ivana Lončarević (*Serbia*/Srbija), Draženka Komes (*Croatia*/Hrvatska), Mario Kovač (*Bosnia and Herzegovina*/Bosna i Hercegovina), Helga Medić (*Croatia*/Hrvatska), Borislav Miličević (*Croatia*/Hrvatska), Tihomir Moslavac (*Croatia*/Hrvatska), Ivan Ostojić (*Bosnia and Herzegovina*/Bosna i Hercegovina), Biljana Pajin (*Serbia*/Srbija), Mario Panjičko (*Croatia*/Hrvatska), Vlasta Piližota (*Croatia*/Hrvatska), Jelka Pleadin (*Croatia*/Hrvatska), Jasmina Ranilović (*Croatia*/Hrvatska), Darja Sokolić (*Croatia*/Hrvatska), Antonija Šarić (*Croatia*/Hrvatska), Domagoj Šubarić (*Croatia*/Hrvatska), Marina Tišma (*Croatia*/Hrvatska), Natalija Velić (*Croatia*/Hrvatska), Zvonimir Zdunić (*Croatia*/Hrvatska)

A CIP catalogue record of this publication is available from the City and University Library Osijek under the number 151003079.

CIP zapis dostupan u računalnom katalogu Gradske i sveučilišne knjižnice Osijek pod brojem 151003079.

ISBN: 978-953-7005-99-3 (USB)
ISBN: 978-953-7005-98-6 (mrežno izdanje)

Osijek, 2024.

Supported by:	**Uz potporu:**	
Ministry of Science, Education and Youth of the Republic of Croatia	Ministarstvo znanosti, obrazovanja i mladih Republike Hrvatske	
Ministry of Agriculture, Forestry and Fisheries of the Republic of Croatia	Ministarstvo poljoprivrede, šumarstva i ribarstva Republike Hrvatske	
Josip Juraj Strossmayer University of Osijek	Sveučilište Josipa Jurja Strossmayera u Osijeku	
Croatian Chamber of Economy	Hrvatska gospodarska komora	
Osijek-Baranja County	Osječko-baranjska županija	
City of Osijek	Grad Osijek	

Održavanje Skupa sufinancirala je Hrvatska zaklada za znanost projektom „Mogućnost iskorištavanja tradicionalnih sorti jabuka za proizvodnju jabuka i soka od jabuka sa smanjenim udjelom patulina“ (UIP-2020-02-8461).

The Conference was supported by Croatian Science Foundation under the project “The possibility of exploiting traditional apple cultivars for the production of apples and apple juice with the reduced patulin content” (UIP-2020-02-8461).

SPONSORS

GOLDEN

Altium International d.o.o., Croatia
Croatian Science Foundation, Croatia
CROTEH d.o.o., Croatia
Croatian Chamber of Economy, Croatia

BRONZE

Agroproteinka d.d., Croatia
Shimadzu d.o.o., Croatia

OTHER SPONSORS AND DONORS

Mettler-Toledo d.o.o., Croatia
Bioquanta d.o.o., Croatia
Croatian Agency for Agriculture and Food, Croatia
C-pharm d.o.o., Croatia
Ru-Ve d.o.o., Croatia
Labena d.o.o., Croatia
Studio HS internet d.o.o., Croatia
Croatia osiguranje d.d., Croatia
Podravka d.d., Croatia
Kandit d.o.o., Croatia
Koestlin d.d., Croatia
Prvo hrvatsko pivo 1664 d.o.o., Croatia

EXHIBITORS

Altium d.o.o., Croatia
Agroproteinka d.d., Croatia
C-pharm d.o.o., Croatia
Mettler-Toledo d.o.o., Croatia
Shimadzu d.o.o., Croatia

SPONZORI

ZLATNI

Altium International d.o.o., Hrvatska
Hrvatska zaklada za znanost, Hrvatska
CROTEH d.o.o., Hrvatska
Hrvatska gospodarska komora, Hrvatska

BRONČANI

Agroproteinka d.d., Hrvatska
Shimadzu d.o.o., Hrvatska

OSTALI SPONZORI I DONATORI

Mettler-Toledo d.o.o., Hrvatska
Bioquanta d.o.o., Hrvatska
Hrvatska agencija za poljoprivredu i hranu, Hrvatska
C-pharm d.o.o., Hrvatska
Ru-Ve d.o.o., Hrvatska
Labena d.o.o., Hrvatska
Studio HS internet d.o.o., Hrvatska
Croatia osiguranje d.d., Hrvatska
Podravka d.d., Hrvatska
Kandit d.o.o., Hrvatska
Koestlin d.d., Hrvatska
Prvo hrvatsko pivo 1664 d.o.o., Hrvatska

IZLAGAČI

Altium d.o.o., Hrvatska
Agroproteinka d.d., Hrvatska
C-pharm d.o.o., Hrvatska
Mettler-Toledo d.o.o., Hrvatska
Shimadzu d.o.o., Hrvatska

***Reviewers* / Recenzenti**

Đurđica Ačkar, Krunoslav Aladić, Jurislav Babić, Marija Banožić, Veronika Barišić, Sandra Budžaki, Stela Jokić, Antun Jozinović, Ante Lončarić, Domagoj Šubarić, Marina Tišma, Natalija Velić

All pieces of information provided in this BOOK OF ABSTRACTS are the sole responsibility of the authors of the abstracts. Publishers are not responsible for any use that might be made of the data appearing in this document. Also, publishers shall not be liable for any errors that are found in the works of authors.

Sadržaj sažetaka u ovoj *KNJIZI SAŽETAKA* isključiva je odgovornost autora. Izdavač nije odgovoran za upotrebu podataka objavljenih u sažetcima, greške i sl.

TABLE OF CONTENTS / SADRŽAJ

SCIENTIFIC PROGRAMME / PROGRAM SKUPA

Thursday, 6 June 2024 / Četvrtak, 6. lipnja 2024.

9:30 – 10:00	***Registration of participants*** **Prijava i registracija sudionika**
10:00 – 10:30	***Conference opening Ceremony*** **Otvorenje Skupa**
10:30 – 11:00	***Coffee Break, Poster Session*** **Pauza za kavu, razgledavanje postera**

***Plenary lectures and Invited lectures* /**
Plenarna predavanja i pozvana predavanja
***Moderators* / Moderatori:**
Stela Jokić, Jelka Pleadin

***Plenary lectures* / Plenarna predavanja**

11:00 – 11:25	**THE MAGIC OF STARCH – A SCIENTIFIC JOURNEY WITH STARCH AND STARCH BY-PRODUCTS FOR FOOD AND NON-FOOD APPLICATIONS** *Janusz Kapusniak*
11:25 – 11:50	**CLIMATE CHANGE: CHALLENGES AND OPPORTUNITIES FOR THE FOOD PRODUCTION SYSTEMS** *Ivan Güttler*

***Invited lectures* / Pozvana predavanja**

11:50 – 12:05	**HOW MICROPLASTIC AS UBIQUITOUS POLLUTANT MIGHT AFFECT THE GLOBAL FOOD PRODUCTION CHAIN** *Tanja Bogdanović, Sandra Petričević, Jelka Pleadin, Federica Di Giacinto*
12:05 – 12:20	**BY-PRODUCTS OF THE FOOD INDUSTRY AS GREEN BIOCATALYSTS IN ORGANIC REACTIONS** *Dajana Gašo-Sokač, Valentina Bušić*
12:20 – 12:30	***Discussion and conclusions* / Rasprava i zaključci**

***Book presentation* / Predstavljanje knjige**
***Promoters* / Promotori:**
Drago Šubarić, Draženka Komes, Jurislav Babić

	***Book presentation* / Predstavljanje knjige**
12:30 – 13:00	**NEKE MOGUĆNOSTI ISKORIŠTENJA NUSPROIZVODA PREHRAMBENE INDUSTRIJE – KNJIGA 5** *Drago Šubarić, Midhat Jašić, Stela Jokić*
13:00 – 14:30	***Lunch break, Poster Session*** **Pauza za ručak, razgledavanje postera**

Invited lectures and Oral presentations /
Pozvana predavanja i usmena priopćenja
***Moderators* / Moderatori:**
Đurđica Ačkar, Jasmina Ranilović

***Invited lectures* / Pozvana predavanja**

14:30 – 14:45	**SUBCRITICAL SOLVENT EXTRACTION – DIFFERENNT APLICATION METHODS IN BY-PRODUCTS TREATMENT** *Krunoslav Aladić, Ante Lončarić, Aly Jesús Castillo Zamora, Ema Pavičić, Stela Jokić*
14:45 – 15:00	**THE POTENTIAL FOR CIRCULARITY, DECARBONISATION AND HYDROGEN UTILIZATION IN THE FOOD INDUSTRY** *Ilja Gasan Osojnik Črnivec, Blaž Likozar*
15:00 – 15:15	**FROM BY-PRODUCT OF FOOD INDUSTRY TO VALUABLE INGREDIENT FOR COSMETIC INDUSTRY** *Tanja Cvetković, Jasmina Ranilović, Stela Jokić*

***Oral presentations* / Usmena priopćenja**

15:15 – 15:25	**POTENTIAL OF KERATIN FROM BIOLOGICAL RESOURCES** *Mojca Škerget, Maja Čolnik, Simona Strnad, Olivija Plohl, Lidija Fras Zemljič*
15:25 – 15:35	**FOOD INDUSTRY BY-PRODUCTS AS FOOD SUPPLEMENTS IN SUPPORT OF TREATMENT MODERN SYSTEMIC NON-COMMUNICABLE DISEASES** *Nermina Beganović, Midhat Jašić, Drago Šubarić, Asmir Aldžić*
15:35 – 15:45	**AGRO-INDUSTRIAL PLANT PROTEIN HYDROLYSATES IN CULTIVATED MEAT PRODUCTION** *Igor Slivac*
15:45 – 15:55	**THE EFFECT OF LACTIC ACID BACTERIUM AND NON-CONVENTIONAL YEAST ON BREWERS' SPENT GRAIN FERMENTATION** *Anita Lalić, Jolita Jagelavičiūtė, Tonči Rezić, Zorana Trivunović, Loreta Bašinskienė*
15:55 – 16:05	**THE POTENTIAL OF BIVALVE SHELLS AS VALUABLE AQUACULTURE BY-PRODUCT** *Kristina Kvrgić, Natalija Džafić, Jelka Pleadin*
16:05 – 16:15	**IMPACT OF DIFFERENT VINIFICATION TECHNOLOGIES ON PHENOLIC COMPOSITION OF WINE LEES FROM TERAN RED GRAPE VARIETY (*Vitis vinifera* L.)** *Fumica Orbanić, Sara Rossi, Ena Bestulić, Ivana Horvat, Ana Jeromel, Sanja Radeka*
16:15 – 16:30	***Discussion and conclusions* / Rasprava i zaključci**

20:00	***Conference dinner* / Zajednička večera**

Friday, 7 June 2024 / Petak, 7. lipnja 2024.

9:30 – 10:00	***Registration of participants*** **Prijava i registracija sudionika**

Plenary lecture and Invited lectures /
Plenarno predavanje i pozvana predavanja
Moderators / **Moderatori:**
Marina Tišma, Marija Banožić

Plenary lecture / **Plenarno predavanje**

10:00 – 10:25	**BIOTECHNOLOGY IN CIRCULAR ECONOMY – LAB-GROWN FOOD OF ANIMAL AND PLANT ORIGIN** *Blaženka Kos, Jagoda Šušković, Jasna Novak, Andreja Leboš Pavunc, Martina Banić, Katarina Butorac, Nina Čuljak*

Invited lectures / **Pozvana predavanja**

10:25 – 10:40	**APPLICATION OF ULTRASOUND ASSISTED EXTRACTION WITH AIM TO VALORIZE BY-PRODUCTS OF THE AGRO-FOOD INDUSTRY** *Aleksandra Gavarić, Senka Vidović, Stela Jokić, Krunoslav Aladić, Mirjana Sulejmanović, Slađana Krivošija, Ioannis Mourtzinos, Anastasia Kyriakoudi*
10:40 – 10:55	**BIOREFINERY APPROACH FOR USE OF SUGAR BEET COSSETTES FOR PRODUCTION OF HIGH ADDED VALUE CHEMICALS AND BIOFUELS** *Nenad Marđetko, Mario Novak, Antonija Trontel, Mladen Pavlečić, Vlatka Petravić Tominac, Božidar Šantek*
10:55 – 11:00	***Discussion and conclusions /*** **Rasprava i zaključci**
11:00 – 11:30	***Coffee Break, Poster Session*** **Pauza za kavu, razgledavanje postera**

Invited lectures and Oral presentations /
Pozvana predavanja i usmena priopćenja
***Moderators* / Moderatori:**
Ante Lončarić, Domagoj Šubarić

***Invited lectures* / Pozvana predavanja**

11:30 – 11:45	**AVOCADO PEEL DRYING: EFFECT OF DRYING PROCESS ON SOME PHYSICO-CHEMICAL PROPERTIES** *Marija Badanjak Sabolović, Suzana Rimac Brnčić, Roko Marović, Mirna Tadić, Mladen Brnčić*
11:45 – 12:00	**APPLICATION OF DEEP EUTECTIC SOLVENTS IN THE EXTRACTION OF BIOACTIVE COMPOUNDS FROM FOOD INDUSTRY BY-PRODUCTS** *Mario Komar, Martina Jakovljević Kovač, Maja Molnar*

***Oral presentations* / Usmena priopćenja**

12:00 – 12:10	**BIOECONOMY EXCELLENCE ALLIANCE FOR STIMULATING INNOVATIVE AND INCLUSIVE GREEN TRANSITION** *Marina Tišma*
12:10 – 12:20	**SAFETY ASPECT OF USING FOOD WASTE AS ANIMAL FEED WITHIN THE CIRCULAR ECONOMY** *Brigita Hengl, Andrea Gross-Bošković, Jasenka Petrić*
12:20 – 12:30	**CARBON FARMING: HOW TO SUPPORT STAKEHOLDERS FOR BETTER AGROINDUSTRIAL WASTE MANAGEMENT PRACTICES** *Marija Banožić*
12:30 – 12:40	**INFLUENCE OF PRE-TREATMENT AND DRYING PROCESSES ON THE CHEMICAL PROFILE OF PUMPKIN BY-PRODUCTS** *Antonela Ninčević Grassino, Suzana Rimac Brnčić, Mirna Tadić, Sven Karlović, Filip Dujmić, Mladen Brnčić*
12:40 – 12:50	**BUCKWHEAT HULL BIOCHAR AS BIOSORBENT FOR THE REMOVAL OF MALACHITE GREEN FROM WASTEWATER** *Maja Adamović, Marija Ćosić, Marija Stjepanović, Marek Wrobel, Marcin Jewiarz, Natalija Velić*
12:50 – 13:00	***Discussion and conclusions* / Rasprava i zaključci**

13:00 – 13:15	***Conclusions and Conference closing*** **Zaključci i zatvaranje Skupa**

	***Altium – PTFOS Workshop /* Altium – PTFOS radionica** ***ONLY FOR REGISTERED PARTICIPANTS* / SAMO ZA PRIJAVLJENE SUDIONIKE** ***Venue* / Mjesto održavanja:** ***Faculty of Food Technology Osijek /* Prehrambeno-tehnološki fakultet Osijek** **Franje Kuhača 18, 31000 Osijek**
14:00 – 16:30	**UPOZNAJTE TEKUĆINSKU I PLINSKU KROMATOGRAFIJU U PRAKSI** ***Workshop Leaders* / Voditelji radionice:** ***doc. dr. sc. Krunoslav Aladić, Prehrambeno-tehnološki fakultet Osijek*** ***Tomislav Gregorić, Application and Service Engineer za tekućinsku kromatografiju, Altium International*** ***Barbara Vučić, Sales Application Engineer za plinsku kromatogafiju, Altium International***

POSTER PRESENTATIONS / POSTERSKA PRIOPĆENJA

P-01 **FOOD INDUSTRY BY-PRODUCTS UTILIZATION IN DAIRY PRODUCTS FORTIFICATION: AN OVERVIEW**
Mirela Lučan Čolić, Martina Antunović, Jasmina Lukinac

P-02 **ENCAPSULATION OF BIOACTIVE COMPOUNDS FROM CITRUS POMACE**
Marija Banožić, Anita Ivanković, Jozo Ištuk, Mario Kovač, Krunoslav Aladić, Stela Jokić

P-03 **NEW VALORIZATION OF MALT SPROUTS, BY-PRODUCT OF MALTED BARLEY GRAINS**
Sunčica Beluhan, Nataša Cerovečki, Božidar Šantek, Mirela Ivančić Šantek

P-04 **SMART AGRICULTURE IN A COMBINATION WITH ADVANCED TECHNOLOGIES AND ITS MULTIFUNCTIONALITY**
Marijana Blažić, Ines Cindrić, Elizabeta Zandona, Martina Stvorić, Karmen Matković Melki

P-05 **WHEY-BASED FUNCTIONAL BEVERAGE AND FREEZE-DRIED FORMULATION RICH IN BIOACTIVE PEPTIDES**
Katarina Butorac, Martina Banić, Andreja Leboš Pavunc, Jasna Novak, Katarina Tonković, Ana Butorac, Marija Lovrić, Jagoda Šušković, Blaženka Kos

P-06 **PREBIOTIC EFFECT OF BY-PRODUCT DIETARY FIBERS FORMULATED FOR FOODS FOR SPECIAL MEDICAL PURPOSES**
Katarina Butorac, Lenkica Penava, Andreja Leboš Pavunc, Martina Banić, Nina Čuljak, Jasna Novak, Marijana Ceilinger, Jelena Miličević, Ivanka Jerić, Jagoda Šušković, Blaženka Kos

P-07 **SUBCRITICAL WATER EXTRACTION OF PHENOLIC COMPOUNDS FROM CHAMOMILE WASTE**
Nela Drača, Krunoslav Aladić, Marija Banožić, Stela Jokić, Snježana Keleković, Ivana Nemet

P-08 **HYDROLYZED OILSEED MEAL PROTEINS IN DIFFERENTIATION AND ATROPHY OF C2C12 MYOBLASTS**
Višnja Gaurina Srček, Anja Damjanović, Kristina Radošević, Igor Slivac

P-09 **UNUSED APPLES AFTER STORAGE CAN BE A VALUABLE BY-PRODUCT RICH IN BIOACTIVE COMPOUNDS**
Ana-Marija Gotal Skoko, Antun Jozinović, Martina Skendrović Babojelić, Ante Lončarić

PLENARY LECTURES /
PLENARNA PREDAVANJA

CLIMATE CHANGE: CHALLENGES AND OPPORTUNITIES FOR THE FOOD PRODUCTION SYSTEMS

Ivan Güttler*

Croatian Meteorological and Hydrological Service, Ravnice 48, 10000 Zagreb, Croatia
**ivan.guettler@cirus.dhz.hr*

plenary lecture

Modern climate change is driven by the extensive emissions of the greenhouse gasses, leading to a buildup in their atmospheric concentrations. This disrupts global energy flows, rises surface air temperature, alters precipitation patterns, and increases the frequency of the extreme weather events. This presentation will summarize the latest estimates on global sources and sinks of the greenhouse gasses. Additionally, it will differentiate between energy and food systems, focusing on the most critical measures for mitigating climate change and adapting to its impacts. Based on potential greenhouse gas concentrations trajectories through the end of the 21st century, the presentation will present projections of the climate change impacts relevant to food systems. Finally, it will highlight the capabilities of Croatian Meteorological and Hydrological Service in supporting climate change adaptation activities in Croatia, particularly those relevant to agriculture.

Keywords: climate change, greenhouse gasses, food production systems, Croatian Meteorological and Hydrological Service

THE MAGIC OF STARCH – A SCIENTIFIC JOURNEY WITH STARCH AND STARCH BY-PRODUCTS FOR FOOD AND NON-FOOD APPLICATIONS

Janusz Kapusniak[1,2*]

[1]Department of Dietetics and Food Studies, [2]Innovative and Pro-Health Food (InnoFood) Research Centre, Faculty of Science and Technology, Jan Dlugosz University in Czestochowa (JDU), Waszyngtona 4/8, 42-200 Czestochowa, Poland
[*]j.kapusniak@ujd.edu.pl

plenary lecture

Worldwide industry strives to reduce the pollutions associated to raw materials processing and new materials production. More and more attention is paid to the use of clean, environmentally friendly technologies. There is a search for cheap, natural and biodegradable materials. One of them is starch. It has long been known that starch as a raw material is of strategic importance for meeting primarily the nutritional needs of people around the world. Year by year, the demand not only for traditional, but also for functional foods based on starch and its derivatives is growing. During the lecture, research by Department of Dietetics and Food Studies and the Innovative and Pro-Health Food (InnoFood) Research Centre at JDU on development, characterization and implementation of new food products with health-promoting properties will be presented. In particular, the team's achievements in research on the preparation and characterization of new preparations from starch with the properties of dietary fibre and prebiotics and the development of new food products enriched with dietary fibre and prebiotics will be discussed. The production of food, mainly health-promoting, based on both natural and functionalized starch, is a priority and strategic goal from an economic point of view. For this reason, any uses of this biopolymer for purposes other than food are often met with social criticism, and in some countries they are not recommended or even banned. However, there is a growing number of supporters of using starch obtained from food industry by-products for non-food applications in other industries. The methods of starch hydrophobization by its esterification with fatty acids, also those carried out by Laboratory of Green Technologies and Functionalization of Natural Resources at JDU will be presented. The classical methods using organic solvents with or without chemical catalysts, solid state esterification by microwave irradiation, biocatalyzed esterification with lipase enzymes and esterification in ionic liquids will be discussed. An application of new functional polymeric materials based on hydrophobized starch derivatives for the production of biodegradable packaging, designing and developing scaffolds for growing cells, carriers for controlled drug release, carriers for aroma encapsulation in the food industry, and effective biosurfactants will be presented.

Keywords: starch, functionalization, packaging, dietary fibre, food and non-food applications

BIOTECHNOLOGY IN CIRCULAR ECONOMY – LAB-GROWN FOOD OF ANIMAL AND PLANT ORIGIN

Blaženka Kos*, Jagoda Šušković, Jasna Novak, Andreja Leboš Pavunc, Martina Banić, Katarina Butorac, Nina Čuljak

University of Zagreb, Faculty of Food Technology and Biotechnology, Laboratory for Antibiotic, Enzyme, Probiotic and Starter Cultures Technology, Pierottijeva 6, 10000 Zagreb, Croatia
**blazenka.kos@pbf.unizg.hr*

plenary lecture

By-products and wastes from the food industry, including the edible parts discarded during food distribution and consumption, become substrates for the biotechnological production of functional compounds and new products with a market value. Various biotechnological approaches include biorefineries for the production of biofuels, biochemicals and biodegradable plastics. More recently developed bioprocesses include the production of nanoparticles, biopreservatives, edible and smart packaging components, commercially important enzymes, nutraceuticals and food additives such as polyphenols, vitamins, aroma components, biosurfactants, exopolysaccharides, bioactive peptides, probiotics and prebiotics, using by-products from the food industry. For the production of nano- and microencapsulated, as well as lyophilized free probiotic cells, by-products from the food industry are increasingly being used, which we are intensively investigating in our scientific projects funded by the Croatian Science Foundation. In terms of sustainability, climate change, reduced use of antibiotics and animal welfare, new approaches are also focusing on the biotechnological production of cultured, artificial, animal-free meat, milk, egg white and leather, as well as on laboratory-produced food supplements, that are otherwise of plant origin, such as cocoa butter, vanillin and palm oil. These productions are carried out by fermentations with lactic acid bacteria, yeasts, fungi and micro(algae), which are genetically, protein and metabolically engineered, and enable the use of by-products and the development of new biotechnological processes for the production of artificial laboratory food and food supplements.

Keywords: by-products as biotechnological raw materials, lab-grown food of animal and plant origin, nutraceuticals, food additives, microencapsulation, nanoencapsulation, lyophilization

INVITED LECTURES /
POZVANA PREDAVANJA

SUBCRITICAL SOLVENT EXTRACTION – DIFFERENNT APLICATION METHODS IN BY-PRODUCTS TREATMENT

Krunoslav Aladić[1*], Ante Lončarić[1], Aly Jesús Castillo Zamora[2], Ema Pavičić[1], Stela Jokić[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]Universidade de Santiago de Compostela, Faculty of Chemistry, 15782 Santiago de Compostela, Spain
[*]krunoslav.aladic@ptfos.hr

invited lecture

Every industry, including the food industry, needs to dispose by-products, and minimization greatly reduces the impact on the environment. Food industry by-products can be a good source of valuable compounds that need to be further used in order to increase the utilization and to produce new functional products. One of the techniques that can be used to significantly reduce the impact on the environment is subcritical water application. The main goal of this paper was to review subcritical application methods for extraction of food industry by-products and waste treatment for reduction of environmental impact. The most commonly used solvent is water, however, in particularly safe conditions, ethanol can also be used as a green solvent. For extraction purposes, used temperatures are mainly from 100 to 200 °C, depending of material for extraction. On other hand if much higher temperature and pressure are applied (near supercritical conditions, above 15 MPa and 300 °C) subcritical water can be applied for total degradation of organic compounds resulting to have much more acceptable waste flow to the environment and minimize industrial waste. The main goal of the work was to review where subcritical extraction can be applied, to investigate influence of different process conditions. Mainly used subcritical solvent is water but ethanol also known as a green solvent can be used.

Keywords: subcritical water application, bioactive components, waste treatment reduction, green solvents, food industry by-products

AVOCADO PEEL DRYING: EFFECT OF DRYING PROCESS ON SOME PHYSICO-CHEMICAL PROPERTIES

Marija Badanjak Sabolović*, Suzana Rimac Brnčić, Roko Marović, Mirna Tadić, Mladen Brnčić

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
**mbadanjak@pbf.hr*

invited lecture

Fruits and vegetables processing generates a large amount of food waste still containing nutritive valuable components. The food industry faces a great challenge in using this waste for fortification of existing or development of new innovative and functional products with health benefits, with simultaneously reducing its amount and negative impact on the environment.
Avocado (*Persea americana*) due to its valuable nutrients as well as numerous health benefits become a popular fruit among consumers. This led to growth of avocado production and processing but consequently and its by-products generation. Avocado peel, one of the by-products of avocado processing industry, due to its valuable composition has a great potential for reuse, in either in food or other industries. For this purpose, drying can be used as efficient preservation method, which facilitate reuse of avocado peel especially in production of high value added products.
The main goal of this research was to determine the influence of different drying processes (conductive vacuum drying, microwave-assisted convective drying) as well as process conditions (temperature, pressure) on some physical (color, rehydration ability, water/oil binding capacity, bulk density) and chemical properties (phenols content, antioxidant activity) of dried avocado peel. According to obtained results, used drying processes showed a good potential for avocado peel preservation while maintaining a good product quality. However, although drying assisted by microwaves was shorter, and with better retention of total phenols and antioxidant activity, suitable drying process can be chosen depending on the preferred physico-chemical properties of final dried product.

Keywords: avocado peel, microwave-assisted drying, vacuum drying, by-products

Acknowledgement: The work was supported by the Croatian Science Foundation (research project "Hybrid drying and valorization of plant food waste and by-products" IP-2019-04-9750) – HYDRYBY.

HOW MICROPLASTIC AS UBIQUITOUS POLLUTANT MIGHT AFFECT THE GLOBAL FOOD PRODUCTION CHAIN

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

[1]Croatian Veterinary Institute, Poljička cesta 6, 21000 Split, Croatia
[2]Croatian Veterinary Institute, Savska cesta 141, 10 000 Zagreb, Croatia
[3]Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale" (IZSAM), Campo Boario, 64100 Teramo, Italy
[*]t.bogdanovic.vzs@veinst.hr

invited lecture

A variety of chemical substances used in plastic production may be released throughout the entire life cycle of the plastic, posing risks to human health, the environment, and recycling systems. During its relative persistence in the environment, plastic is transformed into microplastics (MPs), polymeric particles measuring up to 5 mm containing many substances that are not chemically bound to the polymer matrix, including unreacted monomers, residual processing aids and additives. Environmental pollution management combined with food safety represents two of the main challenges of the last decades. Soil and water contamination has historically threatened food safety. Plastic particles are contaminating the ecosystems and the whole food chain, including primary and secondary food ingredients intended for consumption. From the moment that the impact of MPs on plant and animal throphic chains was registered, it was realized that MPs would result in direct and indirect effects on human large-scale food production. Furthermore its abundance varies widely within and among studies of food waste, compost and digestates. The aim of this work is to highlight MP as new class of pollutants affecting living organisms present in agricultural soils and aquaculture systems, the adverse effects in food production cycles and sustainable solution of circular economy to abate the adverse effects of plastics through increase reuse of plastic materials and MPs reduction introduced into the environment and consequently to the food itself and its waste.

Keywords: microplastic, food chain, food safety

FROM BY-PRODUCT OF FOOD INDUSTRY TO VALUABLE INGREDIENT FOR COSMETIC INDUSTRY

Tanja Cvetković[1*], Jasmina Ranilović[1], Stela Jokić[2]

[1]Podravka d.d., Ante Starčevića 32, 48000 Koprivnica
[2]Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, 31000 Osijek
[*]tanja.cvetkovic@podravka.hr

invited lecture

The utilization of food by-products is a challenge. The potential of using by-products depends on their physico-chemical, nutritional and other properties. The paper will present the results of testing the SPF factor of cold-pressed red pepper seed oil (by-product of industrial pepper processing). Red pepper seed oil has an SPF factor of 7.1 and is a natural ingredient with a high potential for use in the cosmetic industry and preparations that protect the skin from harmful UV radiation, with an additional ecological dimension.

Keywords: red pepper seed oil, by-product, cosmetic industry

BY-PRODUCTS OF THE FOOD INDUSTRY AS GREEN BIOCATALYSTS IN ORGANIC REACTIONS

Dajana Gašo-Sokač*, Valentina Bušić

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**dajana.gaso@ptfos.hr*

invited lecture

In accordance with the principles of green chemistry, there is a constant trend in organic synthesis for the application of new green processes that have numerous advantages over classical ones. Green organic syntheses include the use of non-toxic solvents, non-toxic reagents and catalysts, performing reactions at room temperature, reducing the amount of waste, increasing atomic efficiency, and using alternative reaction conditions. Research is also aimed at finding new catalysts that should be as selective as possible and have the possibility of repeated use. Reduction of carbonyls, oxidation of alcohols, hydrolysis of esters are well-known organic synthesis reactions that take place with a suitable catalyst. In addition to standard catalysts, which are highly toxic, flammable, corrosive and expensive, the above reactions can be catalyzed by enzymes. The by-products of the food industry can be a source of enzymes and catalysts for organic synthesis reactions, so there is an increasing number of researches on reactions that can be catalyzed by the by-products of the food industry. Special emphasis is placed on the reactions of reduction of aldehydes and ketones, ester hydrolysis, esterification, copulation, condensation and multicomponent reactions, which can be carried out with high utilization using waste from the food industry. By-products of the food industry, for example, orange peel, papaya peel, passion fruit, pomegranate, banana peels and leaves, onion skins, freshwater mussel shells, peanut skins, sugar cane juice, corn leaves have potential applications as substitutes for standard catalysts in the mentioned organic transformations. The conversion of biowaste into catalysts for organic reactions is of great interest to chemists to meet the goal of achieving sustainable chemistry in the near future. Such biocatalysis is in accordance with the principles of green chemistry and represents a promising route for the synthesis of important intermediates, active pharmaceutical compounds and other commercial products

Keywords: green chemistry, catalysts, organic reactions, by-products

APPLICATION OF ULTRASOUND ASSISTED EXTRACTION WITH AIM TO VALORIZE BY-PRODUCTS OF THE AGRO-FOOD INDUSTRY

Aleksandra Gavarić[1*], Senka Vidović[1], Stela Jokić[2], Krunoslav Aladić[2], Mirjana Sulejmanović[1], Slađana Krivošija[1], Ioannis Mourtzinos[3], Anastasia Kyriakoudi[3]

[1]University of Novi Sad, Faculty of Technology, Blvd. cara Lazara 1, 21000 Novi Sad, Serbia
[2]University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek, Franje Kuhaca 20, 31000 Osijek, Croatia
[3]Laboratory of Food Chemistry and Biochemistry, Department of Food Science and Technology, Faculty of Agriculture, Aristotle University, Thessaloniki 541 24, Greece
[*]cvejina@uns.ac.rs

invited lecture

The agro-food industry indeed generates a substantial amount of waste, by-products, and effluents globally. These by-products can come from various stages of food production, processing, and distribution. Addressing the challenges associated with agro-food industry waste, by-products, and effluents requires comprehensive strategies involving waste reduction, reuse, recycling, and proper management practices. In order to valorize agro-food by-products and waste, prior to reuse, different green extraction techniques are employed with emphasis on their advantages over conventional ones. One of the most perspective is ultrasound assisted extraction due to its reduced extraction periods and solvent usage, increased extraction efficiency, and avoidance of degradation of thermally sensitive compounds. This advanced tool for the recovery of valuable phenolic compounds has been applied and validated on numerous herbal species. However, in this case study the focus is pointed on the agricultural waste (onion peel and garlic peel/pseudostem) and food processing waste (aronia pomace, orange peel and ginger herbal dust) discharged from the filter tea factory. Furthermore, an evaluation is made on the dominant process parameters of ultrasound assisted extraction which can contribute to improving extraction yield and certain phenolic compound concentrations in obtained extracts.

Keywords: ultrasound assisted extraction, agro-food industry, by-product, valorization

APPLICATION OF DEEP EUTECTIC SOLVENTS IN THE EXTRACTION OF BIOACTIVE COMPOUNDS FROM FOOD INDUSTRY BY-PRODUCTS

Mario Komar*, Martina Jakovljević Kovač, Maja Molnar

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**mkomar@ptfos.hr*

invited lecture

Nowadays, the food industry generates a significant amount of different by-products during the production process. These by-products can have various applications as a great source of bioactive compounds. Deep eutectic solvents (DESs) are a worthy alternative as sustainable solvents compared to conventional organic solvents. DESs are formed by the combination of two or more components such as quaternary ammonium salts, and hydrogen bond donors (e.g., carboxylic acids, polyols, metal salts and hydrated metal salts). Due to their physicochemical properties, DESs have a potential application in various fields including extraction processes, specifically in the extraction of bioactive compounds from food industry by-products. Some of them are polyphenols, proteins, terpenes, carotenoids, essential oils, chitosan, pectin, and lignans. These compounds extracted from food industry by-products offer a possibility in the production of biofuel, animal feed, pharmaceuticals, cosmetics, etc. Efforts to extract and utilize these bioactive compounds products will contribute to reducing waste and enhancing sustainability. The effectiveness of extraction with DESs is usually better combined with microwaves and ultrasound. However, it's essential to ensure proper DES and extraction techniques to maintain the bioactivity and safety of these compounds for various applications. This review will provide an insight of the current trends in the extraction of mentioned bioactive compounds from the food industry by-products described in the literature in the last few years.

Keywords: deep eutectic solvents, food industry by-products, bioactive compounds, extraction

BIOREFINERY APPROACH FOR USE OF SUGAR BEET COSSETTES FOR PRODUCTION OF HIGH ADDED VALUE CHEMICALS AND BIOFUELS

Nenad Marđetko, Mario Novak*, Antonija Trontel, Mladen Pavlečić, Vlatka Petravić Tominac, Božidar Šantek

University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Biochemical Engineering, Laboratory of Biochemical Engineering, Industrial Microbiology, Malting and Brewing Technology, Pierottijeva 6, 10000 Zagreb
**mnovak@pbf.hr*

invited lecture

The development of economically and ecologically sustainable production is necessary in all industries considering the limitation of non-renewable resources. Sugar production with the implementation of new technologies can be a good example of a biorefinery production plant where by-products can be further exploited, for example sugar beet juice and exhausted sugar beet cossettes (ESBC). With adaptation of production facilities and equipment with application of new technologies in the biorefinery system utilization of by-products of sugar beet processing, various bioproducts can be produced (organic acids, alcohols, sugar alcohols, biogas, enzymes, etc.) and thus more products of higher added value can be obtained, with increased value. Therefore, an overview of the methods required for the pretreatment of ESBC and biorefinery-type bioprocesses with the aim of maximizing the utilization of ESBC will be shown. Based on the availability of ESBC as a raw material, a biorefinery system was developed that represents an example of maximizing the utilization of raw and exhausted sugar beet. In the first stage, simultaneous extraction and fermentation of raw sugar beet was carried out in a vertical fixed-bed bioreactor with the help of *Saccharomyces cerevisiae* yeast. Waste ESBC from the first stage were treated with low-concentration sulfuric acid in a specially designed high-pressure reactor, which produced fermentable sugars in the liquid phase. The obtained liquid hydrolysate was used in the third stage as a nutrient medium for the production of arabitol using non-*Saccharomyces* yeasts (*Spathaspora passalidarum* CBS 10155 and *Spathaspora arborariae* CBS 11463).

Keywords: sugar beet, biorefinery, biochemicals, biofuels, sustainable development

THE POTENTIAL FOR CIRCULARITY, DECARBONISATION AND HYDROGEN UTILIZATION IN THE FOOD INDUSTRY

Ilja Gasan Osojnik Črnivec[1,2*], Blaž Likozar[1]

[1]Center for Development, Demonstration and Training for Carbon-Free Technologies, National Institute of Chemistry, Hajdrihova 19, 1001 Ljubljana, Slovenia
[2]University of Ljubljana, Biotechnical Faculty, Department of Food Science and Technology, Jamnikarjeva 101, 1000 Ljubljana, Slovenia
[*]gasan.osojnik@ki.si

invited lecture

Demand for food and its energy consumption, as well as resource use per unit of production, has grown significantly over the past few decades. For every 1 J consumed in food, about 10 J is required for its production and delivery. Estimates suggest that EU food consumption already exceeds three planetary boundaries with an excepted 50 % increase in food production needs by 2030. Thus, decarbonisation will be an immensely important component of sustainable food systems, which are traditionally notoriously linear.

Amongst food and beverage products and food producer locations, thermal and electrical energy needs (50-3000 kWh/t) as well as carbon intensities (cca. 0.3 – 3 kg CO_2 per Euro) differ greatly. Here, typical decarbonisation measures target (i) heat cycling, (ii) heat electrification, (iii) water reduction and (iii) anaerobic digestion.

Our outline will present decarbonisation strategies for:
1. Food waste prevention.
2. Bioactive compounds and functional materials extraction.
3. On site (green) hydrogen production.
4. Bio-hydrogen generation.
5. Hydrogen combustion as fuel or for steam and/or electricity production.

The supporting facilities targeted to green hydrogen production, hydrogen and carbon dioxide transformation to gaseous and liquid products, carbon capture through carbon dioxide absorption and absorption, as well as biomass and nanomaterial characterisation within the unique Center for Development, Demonstration and Training for Carbon-Free Technologies, will also be presented.

Keywords: decarbonisation, hydrogen, carbon capture, renewable energy production, renewable energy use, waste prevention, production residues valorisation

ORAL PRESENTATIONS / USMENA PRIOPĆENJA

CARBON FARMING: HOW TO SUPPORT STAKEHOLDERS FOR BETTER AGROINDUSTRIAL WASTE MANAGEMENT PRACTICES

Marija Banožić*

University of Mostar, Faculty of Agriculture and Food Technology,
Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
**marija.banozic@aptf.sum.ba*

oral presentation

Carbon farming is a promising strategy for mitigating climate change by sequestering carbon in agricultural soils and reducing emissions throughout the food supply chain. The newly released European carbon removal framework highlighted the importance of greenhouse gases emissions reduction in the food sector starting from primary production to final consumption including also scope 3 (not owned, not controlled) emissions. Effective management of agroindustrial waste, such as pruning residue management is crucial for maximizing the potential of carbon farming practices. By implementing sustainable waste management strategies, such as regenerative agricultural practices, composting, anaerobic digestion, and bioenergy production, stakeholders can not only reduce greenhouse gas emissions but also enhance soil health and agricultural productivity. Collaboration between farmers, policymakers, researchers, and industry players is essential to promote the adoption of innovative waste management practices and achieve sustainable agricultural development. Business models delivered through the voluntary carbon market (VCM) could be promising tools for bringing economic, environmental, and social benefits to food chain stakeholders and foster knowledge transfer, innovation, and the development of new technologies and practices that benefit the entire food chain. The aim of this study is to present a carbon farming strategy as an effective tool for better agroindustrial waste management practices where stakeholders can benefit with additional income delivered through a VCM while at the same time, increased environmental benefits are achieved. Different strategies will be presented together with the opportunities and limitations of VCM.

Keywords: carbon farming, food waste management, voluntary carbon market, carbon removals

THE EFFECT OF LACTIC ACID BACTERIUM AND NON-CONVENTIONAL YEAST ON BREWERS' SPENT GRAIN FERMENTATION

Anita Lalić[1], Jolita Jagelavičiūtė[2], Tonči Rezić[3], Zorana Trivunović[4], Loreta Bašinskienė[2*]

[1]University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[2]Kaunas University of Technology, K. Donelaičio St. 73, Kaunas, Lithuania
[3]University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
[4]University of Novi Sad, Faculty of Technology, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia
[*]loreta.basinskiene@ktu.lt

oral presentation

The purpose of this research was to examine the fermentative capabilities of two microorganisms: the lactic acid bacterium *Lactobacillus acidophilus* DSM 20079 and the non-conventional yeast *Yarrowia lipolytica*. We investigated their performance in both pure and mixed cultures on brewers' spent grain composed of old wheat bread and barley malt. These cultures were tested on hydrolyzed substrates, treated with commercial preparations of cellulolytic and hemicellulolytic hydrolases (Viscozyme and Celluclast), as well as on non-hydrolyzed brewers' spent grains. The analytical parameters included the assessment of reducing sugars content, total titratable acidity, pH value, colony-forming units per gram and fatty acids composition. It can be concluded that brewers' spent grain can be fermented with *Yarrowia lipolytica* even without substrate hydrolysis. This sample seems to have a composition that aligns relatively well with nutritional requirements, with a balance of monounsaturated fatty acids, polyunsaturated fatty acids, and moderate levels of saturated fatty acids. Comparative analysis between hydrolyzed and non-hydrolyzed samples unveiled discernible differences in the fatty acid methyl ester composition, particularly in fatty acids such as C14:0, C16:0, C18:0, C18:1n9c, and C18:3n3. Additionally, the outcomes of measured parameters post-hydrolysis underscore that the optimal fermentation is achieved through the combined action of *Lactobacillus acidophilus* and *Yarrowia lipolytica* These results provide valuable insights into the fermentation dynamics of brewers' spent grain and its effects on the fatty acid composition.

Keywords: *Lactobacillus acidophilus*, non-conventional yeast, *Yarrowia lipolytica*, fermentation, brewers' spent grains

Acknowledgement: This publication is based upon work from COST Action YEAST4BIO (CA18229), supported by COST (European Cooperation in Science and Technology)

SAFETY ASPECT OF USING FOOD WASTE AS ANIMAL FEED WITHIN THE CIRCULAR ECONOMY

Brigita Hengl*, Andrea Gross-Bošković, Jasenka Petrić

Croatian Agency for Agriculture and Food, Croatia, Osijek, Ivana Gundulića 36b, 310000 Osijek, Croatia
**brigita.hengl@hapih.hr*

oral presentation

The circular economy (CE) is an approach that promotes an economic model based on sharing, reusing, repairing, restoring and recycling, in a closed system. This approach was adopted by the European Commission in the CE Plan (2020), with the aim of reducing the pressure on natural resources and creating sustainable economies and jobs.
Food and feed safety requires a specific approach, as in terms of practical applications within the CE. Therefore, they are divided into four categories: 1) primary production, 2) reduction of processed/industrial waste, 3) reduction of waste on the market and households, and 4) reduction of packaging waste.
Just to address the second category, in Croatia about 70 kg of food waste per inhabitant is disposed of annually. The utilization of food waste for feeding purposes has been practiced for a long time, but in light of new approaches, a special safety assessment is required. European regulations still prohibits the use of food waste from restaurants, catering and households. As far as the safety of animal feed is concerned, there are several known risks associated with animal feed from food waste. These are: the risk of transmission of prions, bacteria, viruses and parasites, the risk of accumulation of heavy metals, allergens, mycotoxins, biotoxins and other plant toxins, and contamination by insects . In addition, the impact on the environment must also be assessed, as part of the CE, and the existing legal frameworks must be observed. All these make the implementation of these activities within the framework of CE an particular challenge.

Keywords: circular economy, food waste, safety

FOOD INDUSTRY BY-PRODUCTS AS FOOD SUPPLEMENTS IN SUPPORT OF TREATMENT MODERN SYSTEMIC NON-COMMUNICABLE DISEASES

Nermina Beganović[1], Midhat Jašić[2*], Drago Šubarić[3], Asmir Aldžić[4]

[1]JZU Dom zdravlja Banovići, Ul. Alije Dostović no. 5, 75290 Banovići, Bosnia and Herzegovina
[2]University of Tuzla, Faculty of Pharmacy, Dr. Tihomila Markovića 1, 75000 Tuzla, Bosnia and Herzegovina
[3]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]jasic_midhat@yahoo.com

oral presentation

Mass, non-communicable diseases are today the most common cause of morbidity and mortality in the world. The most common are: cardiovascular, malignant, chronic respiratory diseases and diabetes type 2. Nutritional support in the framework of healthy lifestyle habits is extremely important and can reduce the risk of occurrence and development. There are numerous food industry by-products that can be used as food supplements to support the treatment of modern systemic non-infectious diseases.

This paper provides an overview of the current state of use of nutritional supplements that are potential or obtained as by-products of the food industry.

Some ingredients have a stronger impact on health, whether they prevent the onset or act as a support in the treatment of diseases. The ingredients or food components are common products in the food industry, such as: colostrum, whey, coenzyme Q10, probiotics and prebiotics, cereal germs, and extracts of fruits, especially berries and strawberries, then herbs, mushrooms, bee products atc. Numerous phytochemicals are the main active ingredients of food supplements, and they are obtained as by - products. Characteristic examples are: carotenes such as lycopene and lutein, phenolic acids such as gallic and ellagic, polyphenols such as quercetin, rutin, proanthocyanidin, catechin and many others. Polyphenol extracts in food supplements play a role in the prevention of chronic diseases such as cardiovascular diseases, diabetes, osteoporosis, neurodegenerative diseases. In doing so, they exhibit antioxidant, antimicrobial, anti-inflammatory and regenerative activity as well as antiatherogenic and hypoglycemic effects.

Omega 3 fatty acids, glucosamines, beta glucans, glucomannans are often potential side products from the food industry. Most of these ingredients in the form of concentrated active components are available commercially as dietary supplements.

It is necessary to make more use of the prophylactic and therapeutic applicability of nutritional supplements originating from food, especially those obtained as supplemental products, in support of the treatment of numerous chronic non-communicable diseases of the modern age.

Keywords: dietary supplements, by-products, systemic non-communicable diseases

THE POTENTIAL OF BIVALVE SHELLS AS VALUABLE AQUACULTURE BY-PRODUCT

Kristina Kvrgić[1*], Natalija Džafić[1], Jelka Pleadin[2]

[1]Croatian Veterinary Institute, Veterinary Center Rijeka, Podmurvice 29, Rijeka, Croatia
[2]Croatian Veterinary Institute, Savska cesta 143, Zagreb, Croatia
[*]kvrgic.vzr@veinst.hr

oral presentation

The seafood consumption has increased during recent years, given its recognition as an affordable and valuable source of nutrients and various bioactive compounds promoting human health. The seafood industry generates large volumes of waste, with up to 70% of aquatic resources ending up as low-value by-products or waste. When it comes to bivalve molluscs, the share of by-products is even greater, considering the edible part equals only 15 to 20% of the total weight, depending on the bivalve species. With the present lack of sustainable waste management, increased bivalve mollusc production represents a potential environmental hazard. Unregulated disposal of shells in the environment is common, and due to slow natural degradation, research regarding efficient utilization of these by-products is needed. Shells are valuable biomaterials that could be used for environmental benefit as well as added value of aquaculture production. Mollusc shells are one of the hardest animal tissues of often attractive appearance, valued since prehistoric times as currency, tools, ornaments, building material, and medicine. Nowadays, shells are used as agricultural liming agents, poultry feed, pet bird nutrition, pH buffers, biofilter medium, and shell aggregates. Research is being done in order to explore the possible use of bivalve shells as a sustainable resource of CaCO3 needed for CaO production, de-icer substance, green roofing substrate, and a source of the natural polymer chitosan used in fields such as biomedicine, cosmetics, pharmaceuticals, biotechnology, agriculture and food industry. In light of the above, the aim of this review is to examine the literature data on the potential use of bivalve shells, which proves that aquaculture of bivalves has the potential to be one of the currently available food sources with the least environmental impact and greatest sustainability.

Keywords: bivalve molluscs, aquaculture, by-product, shells, environment

INFLUENCE OF PRE-TREATMENT AND DRYING PROCESSES ON THE CHEMICAL PROFILE OF PUMPKIN BY-PRODUCTS

Antonela Ninčević Grassino*, Suzana Rimac Brnčić, Mirna Tadić, Sven Karlović, Filip Dujmić, Mladen Brnčić

University of Zagreb, Faculty of Food Technology and Biotechnology,
Pierottijeva 6, 10000 Zagreb, Croatia
**aninc@pbf.hr*

oral presentation

Pumpkin is an important crop that is cultivated and consumed worldwide due to its nutritional and health-promoting properties. However, pumpkin fruits are seasonal and susceptible to microbial and chemical reactions that can have a negative impact on product quality and shelf life. To avoid post-harvest losses of pumpkin by reducing water activity to a level that prevents spoilage, drying would be an effective solution. In this work, the effects of different drying processes such as hot air drying, vacuum drying and hybrid microwave-hot air drying on the chemical profile (moisture, ash, fats, fibres, proteins and sugars) of pumpkin pulp and peel were investigated to find suitable drying conditions that allow off-season consumption. Since drying is an energy-intensive and cost-efficient technology, the ultrasonic pretreatment was introduced to improve the recovery of the desired analytes from pumpkin pulp and peels before the drying process.
The results of the chemical analyses show that it is possible to extend the shelf life of pumpkin pulp and peel by using pretreatment and drying processes that ensure better preservation of nutrients and better product quality. However, which of the drying processes is preferable depends on the specific analytes and the further use of the pumpkin. In addition to the results of the chemical analysis, the current work also suggests that the peel, which is normally discarded and damaged by moisture, can be dried, stored and used as a substrate with a high nutrient content. Reuse in this dried form would therefore be of great importance to consumers.

Keywords: pumpkin, by-products, drying, ultrasonics, chemical composition

Acknowledgement: The work was supported by the Croatian Science Foundation (research project "Hybrid drying and valorization of plant food waste and by-products" IP-2019-04-9750) – HYDRYBY.

IMPACT OF DIFFERENT VINIFICATION TECHNOLOGIES ON PHENOLIC COMPOSITION OF WINE LEES FROM TERAN RED GRAPE VARIETY (*Vitis vinifera* L.)

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

[1]Institute of Agriculture and Tourism, Karla Huguesa 8, 52440 Poreč, Croatia
[2]University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, 10000 Zagreb, Croatia
[*]fumica@iptpo.hr

oral presentation

This study aimed to determine concentration of phenolic compounds in red wine lees obtained upon grape vinification of *cv*. Teran *(Vitis vinifera* L.). Six different vinification treatments, including the control treatment (7-day standard maceration), were performed: 48-hour pre-fermentative mash cooling (8°C) followed by prolonged post-fermentative maceration of 13 days (C15), 28 days (C30), and saignée technique proceeded with prolonged post-fermentative maceration of 13 days (CS15); and 48-hour heating (50°C) followed by prolonged post-fermentative maceration of 13 days (H15) and 28 days (H30). After mash pressing and wine sedimentation, wine was racked and lees were collected and lyophilized. Extraction of lees was permormed by solid-liquid method. Individual phenolic compounds were analyzed by high-performance liquid chromatography (HPLC). The total concentration of phenols in wine lees from all treatments ranged from 3013.87 – 5606.77 $mgkg^{-1}$ of dry weight (dw). Significantly the highest concentration was found in lees from treatments submitted to 30-day macerations (C30 and H30), regardless of pre-fermentative procedure. The most elevated concentration of anthocynins was found in treatment subjected to pre-fermentative cooling, while the highest concentration of hydroxycinnamic acids was detected in treatments submitted to pre-fermentative heating. The treatment resulting in the highest concentration of stilbenes was the one involving pre-fermentative cooling and 15-day maceration (C15), where also the highest concentration of resveratrol was identified. The most abundant phenolic compounds in wine lees were caftaric acid, quercetin hydrate and malvidin-3-*O*-glucoside. The findings implied a significant impact of pre-fermentative procedures and prolonged macerations in compariosn to control treatment on phenolics in red wine lees from Teran.

Keywords: Teran variety, red wine lees, HPLC phenols, pre-fermentative mash procedure, post-fermentative maceration

POTENTIAL OF KERATIN FROM BIOLOGICAL RESOURCES

Mojca Škerget[1*], Maja Čolnik[1], Simona Strnad[2], Olivija Plohl[2], Lidija Fras Zemljič[2*]

[1]University of Maribor, Faculty of Chemistry and Chemical Engineering, Laboratory for Separation Processes and Product Design, Smetanova 17, 2000 Maribor, Slovenia
[2]University of Maribor, Faculty of Mechanical Engineering, Laboratory for Characterization and Processing of Polymers, Smetanova 17, 2000 Maribor, Slovenia
[*]mojca.skerget@um.si

oral presentation

One of the highly interesting material streams that are produced in considerable quantities and are currently not utilised, although they are rich in valuable polymer keratin, is waste from agriculture and the food industry, such as feathers and animal hair. Currently, only a small proportion of feathers are processed into products such as feather meal and fertilisers, while the majority of feathers and wool are disposed of as waste, usually by incineration or burial in controlled landfills. These organic streams must be considered as a valuable source of protein keratin, which can be utilised for conversion into a range of high-value biomaterials and bioproducts for various applications, e.g. in the medical, pharmaceutical, cosmetic, textile, plastics and packaging industries. In addition to the specific properties of keratin such as biodegradability, mechanical strength, good cell adhesion and biocompatibility, keratin also has good processing properties that enable the production of various forms such as gels, films, beads, fibres and nano/microparticles.
The aim of this contribution is to present different methods for the isolation of keratin, focussing on an environmentally friendly approach, i.e. hydrothermal processing using subcritical water, and to show the properties of the isolated keratin and possible applications in different industries. Several examples of keratin applications will be presented, such as drug delivery systems, functional coatings for textiles and packaging materials, fabrication of biomaterials as bioactive nanofibers for use as wound dressings, and future perspectives will be highlighted.

Keywords: poultry feathers, waste wool, subcritical water hydrolysis; keratin properties, keratin application

Acknowledgments: The authors would like to acknowledge financial support from the Slovenian Research Agency (research projects J7-4492 and programmes P2-0118 and P2-0421).

AGRO-INDUSTRIAL PLANT PROTEIN HYDROLYSATES IN CULTIVATED MEAT PRODUCTION

Igor Slivac*

*University of Zagreb, Faculty of Food Technology and Biotechnology,
Pierottijeva 6, 10000 Zagreb, Croatia
islivac@pbf.unizg.hr

oral presentation

With the global population on the rise, cultivated or lab-grown meat has emerged as a prospective solution to satisfy future protein needs. The meat analogues are created by cultivating certain types of animal cells while relying on techniques developed for cell bioprocessing and tissue engineering. This innovative approach embraces sustainable practices, thus positively impacting animal welfare, human health, and environment. Within that context, edible plant proteins derived from agro-industrial byproducts may contribute to cultivated meat technology as an abundant and inexpensive resource. The proteins serve either to build scaffolds for cell attachment or to supplement nutrients in cell growth media. Scaffolding provides a surface for cell adhesion, which in turn supports cell proliferation, differentiation, and self-organization due to the mechanical support and tissue-mimicking micro-environment. Supplementation of cell growth media with plant protein hydrolysates substitutes for critical components contained in fetal bovine serum or expensive recombinant products. Despite the lack of standardization in the composition of the applied plant material, an increasing body of research suggests that the benefits of described protein utilization may outweigh the drawbacks. This presentation brings a comprehensive overview of achievements within this rapidly evolving domain.

Keywords: plant proteins, cultivated meat, sustainability

BIOECONOMY EXCELLENCE ALLIANCE FOR STIMULATING INNOVATIVE AND INCLUSIVE GREEN TRANSITION

Marina Tišma*

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**marina.tisma@ptfos.hr*

oral presentation

The bioeconomy is an economic system that utilizes renewable biological resources to produce a wide range of goods and services, aiming for sustainability and reduced reliance on non-renewables. However, in the present day, bioeconomy faces significant challenges.
In this presentation, the project The Bioeconomy Excellence Alliance for Stimulating Innovative and Inclusive Green Transition (BEAMING), which started in January 2024, will be presented. BEAMING is dedicated to advancing excellence and promoting innovation within the field of bioeconomy. The initiative seeks to address the need to enhance the competitiveness and visibility of Higher Education Institutions (HEIs) in Europe, with a particular focus on Widening countries in Eastern European EU Member States, and the Western Balkans. The project will bring together HEIs from diverse regions, promoting the transfer of knowledge and technology, and fostering a culture of collaboration by focusing on various key objectives: strengthening the skills and capacities of early-career researchers in bioeconomy research, fostering institutional reform, promoting cross-disciplinary collaboration, enhancing technology transfer, and encouraging an inclusive institutional culture. The initiative will follow a methodology based on the Quadruple Helix innovation ecosystem approach, which involves collaboration between HEIs, industry, government, and civil society. This approach will enhance the capacity for innovation and the practical application of research results, as well as engage the general public in processes facilitating changes in consumer behavior and environmental awareness.

Keywords: bioeconomy, innovation, institutional reform, inclusive culture, technology transfer

BUCKWHEAT HULL BIOCHAR AS BIOSORBENT FOR THE REMOVAL OF MALACHITE GREEN FROM WASTEWATER

Maja Adamović[1], Marija Ćosić[2], Marija Stjepanović[2], Marek Wrobel[3], Marcin Jewiarz[3], Natalija Velić[2*]

[1]EKOS d.o.o., Trg Lava Mirskog 3A, Osijek, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[3]Department of Mechanical Engineering and Agrophysics, University of Agriculture in Krakow, 21 Ada-ma Mickiewicza Al., 31-120 Kraków, Poland
[*]natalija.velic@ptfos.hr

oral presentation

Buckwheat hull biochar was investigated for its potential to remove the cationic dye malachite green (MG) from model dye solutions and synthetic wastewater with MG added. The biochar was prepared by roasting buckwheat hulls at a temperature of 220 °C. The batch adsorption experiments were conducted to investigate various parameters affecting the biosorption process: Particle size and concentration of biosorbent (0.4 - 1.4 g dm^{-3}), contact time (1 - 120 min), initial dye concentration (1 - 100 mg dm^{-3}) and temperature (15 - 45 °C). Increasing the concentration of the biosorbent led to a decrease in the amount of MG adsorbed per unit mass of biosorbent and an increase in the percentage of MG removal. The biosorbent particle size of 0.075 – 0.75 mm showed better performance compared to the particle size of 0.1 – 0.5 mm. An increase in the initial dye concentration (10 – 100 mg dm^{-3}) resulted in an increase in the amount of MG adsorbed per unit mass of biosorbent and a decrease in the percentage of MG removal. Biosorption of MG from synthetic wastewater with the addition of MG was more efficient compared to biosorption from model dye solutions. When analysing the biosorption data with the Freundlich and Langmuir models, both models described the adsorption process well. The kinetics of the process were better described by a pseudo-second order kinetic model than by a pseudo-first order model.

Keywords: buckwheat hulls, biochar, biosorbent, Malachite Green, biosorption

POSTER PRESENTATIONS /
POSTERSKA PRIOPĆENJA

FOOD INDUSTRY BY-PRODUCTS UTILIZATION IN DAIRY PRODUCTS FORTIFICATION: AN OVERVIEW

Mirela Lučan Čolić, Martina Antunović*, Jasmina Lukinac

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**mantunovic@ptfos.hr*

poster presentation

Nowadays, the food industry has become oriented toward the utilization of food by-products for the improvement of existing and/or development of new, functional products. Furthermore, there is increased demand for food that exhibits therapeutic effects and contributes to overall well-being. Considering that milk and dairy products are commonly used in the human diet, the possibilities of modifying and enriching them become the focus of various research. Therefore, this review aims to summarize the research progress related to the inclusion of food industry by-products in dairy products, focusing on winery by-products, fruit and vegetable processing by-products, and by-products obtained during the cold pressing. These by-products stand out as high-valuable materials for further use, mostly due to their nutritional value and antioxidant properties. The available literature indicates that there is a possibility of using these by-products in the enrichment of dairy products. The emphasize is on the employment of by-products such as passion fruit, pineapple, banana, and pomegranate peels, cold pressed cakes, grape seeds and skin flours as natural enhancers of dairy products' nutritive quality and health-promoting properties. In addition, some of the investigated by-products have been also proposed as potential dairy product stabilizing (chia seed press cake) and texturizing (orange peels and seeds, date by-products) agents, natural colorants (hemp seed press cake, wine pomace extract and flour), emulsifiers, or even fat substitutes (chia seed press cake). However, the negative impair on some physicochemical and sensory properties are noticed, so there is a need for balanced by-product addition to ensure product quality and consumer satisfaction.

Keywords: dairy, food-industry by-products, health-promoting, physicochemical and sensory properties

ENCAPSULATION OF BIOACTIVE COMPOUNDS FROM CITRUS POMACE

Marija Banožić[1*], Anita Ivanković[1], Jozo Ištuk[1], Mario Kovač[1], Krunoslav Aladić[2], Stela Jokić[2]

[1]University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]marija.banozic@aptf.sum.ba

poster presentation

Citrus pomace, a by-product generated from citrus juice production, is rich in bioactive compounds such as flavonoids, polyphenols, and essential oils. These compounds have demonstrated numerous health benefits, including antioxidant, anti-inflammatory, and antimicrobial properties. However, the efficient extraction, stabilization, and delivery of these bioactive compounds remain a challenge. This study explores the encapsulation of bioactive compounds from citrus pomace as a promising approach to enhance their stability, solubility, and bioavailability. Citrus pomace was obtained from Regius dd, was freeze-dried and extracted using ultrasound-assisted technology. Obtained extracts were encapsulated using spray drying and freeze-drying with Maltodextrin, Arabic gum and Carboxymethyl Cellulose (CMC) as carriers. The antiradical activity and the total phenolic content of the extracts were determined using spectrophotometric assays. The identification and quantification of individual phenolics were performed using high-performance liquid chromatography with a diode array detector (HPLC-DAD). Obtained encapsulates were tested for physical properties, including solubility, bulk density and flowability. The controlled release of these encapsulated compounds allows for the development of functional foods, nutraceuticals, and cosmeceuticals with improved sensory attributes and prolonged efficacy. Repurposing citrus byproducts not only adds value to the agro-industrial waste but also aligns with the principles of circular economy and waste reduction.

Keywords: citrus pomace, encapsulation, citrus byproducts

Acknowledgement: This work has been supported by the Federal Ministry of Education and Science Bosnia & Herzegovina under the project "Valorization of the by-product of citrus production and processing through the application of innovative extraction and encapsulation techniques" (05-35-2120-2/ 23).

NEW VALORIZATION OF MALT SPROUTS, BY-PRODUCT OF MALTED BARLEY GRAINS

Sunčica Beluhan[1*], Nataša Cerovečki[2], Božidar Šantek[1], Mirela Ivančić Šantek[1]

[1]Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10 000 Zagreb
[2]Food Control Center PBF, Jagićeva 31, 10 000 Zagreb
[*]sbeluhan@pbf.hr

poster presentation

The economy of production is imperative to every production process and includes the rational use of raw materials and energy. It can be said with certainty that the most successful and rational production is the one in which there are no redundant by-products and waste materials, that is, technology in which the input raw materials are entirely transformed into the final product. Unfortunately, there are still no such fully effective technologies, especially in fermentation technology, which also includes malt and beer technology, and there is little probability that there will be any soon. Population growth, the lack of proteins with high added value, and the beneficial effect of crude fiber on human health have stimulated research into using by-products from various industries to produce valuable food ingredients. That is why malt sprouts became the research subject because of the large amount of vitamins, proteins, and raw fibers. In our country, even though they are a GRAS product, malt sprouts are primarily used as ingredients in animal feed concentrates. However, their market price is low, so exploring other possibilities for using this high-value by-product is necessary due to their value. This work highlights the promising potential of using malt sprouts in food products and fermentations due to their nutritional value and as a source of enzymes, antioxidants, and biochar production. The conversion of this by-product into other/new products would reduce the production of waste of industrial origin and alleviate the environmental concern associated with the production of by-products.

Keywords: malt sprouts, nutritional value, by-products valorization

SMART AGRICULTURE IN A COMBINATION WITH ADVANCED TECHNOLOGIES AND ITS MULTIFUNCTIONALITY

Marijana Blažić[1*], Ines Cindrić[1], Elizabeta Zandona[1], Martina Stvorić[2], Karmen Matković Melki[2]

[1]Karlovac University of Applied Sciences, Trg J. J. Strossmayera 9, 47000 Karlovac,Croatia
[2]Aspira University of Applied Sciences, Mike Tripala 6, 21000 Split, Croatia
[*]mblazic@vuka.hr

poster presentation

The increase in world population and limited arable land, require farmers to find innovative ways of producing the same or larger amounts of food on the same or smaller area. Smart agriculture is linked to the application of modern information and communication technologies in agriculture. A smart agricultural economy can achieve more productive and sustainable production that is based on a more precise and efficient approach. Apart from food production, agriculture also has other broader societal functions and aspects, such as maintaining production potential, encouraging rural development, which includes young people staying in the countryside, the cultural appearance of the landscape and environmental protection. Greater productivity and profitability is expected from smart agriculture. Reasons for that are decisions making at the right time based on the precise information obtained, better use of land and technologies, and more efficient management of the agricultural economy. The aim of this paper is to present smart agriculture in a combination with advanced technologies and its multifunctionality. The priorities in the implementation of public policies that will contribute to the development of a globally competitive, green and digital industry are: encouraging the development of the circular economy; encouraging investment in research, technological development and innovation; encouraging cooperation between the business and research sectors; improvement of the business environment; modernization and decarbonization of energy-intensive industries. Considering that, innovative devices based on green technologies (such as supercritical CO_2 extraction) are the future because, among other things, they will be able to be used in the production/processing of agricultural and food products based on the circular bioeconomy.

Keywords: smart agriculture, multifunctionality, circular bioeconomy, AgriNext

WHEY-BASED FUNCTIONAL BEVERAGE AND FREEZE-DRIED FORMULATION RICH IN BIOACTIVE PEPTIDES

Katarina Butorac[1*], Martina Banić[1], Andreja Leboš Pavunc[1], Jasna Novak[1], Katarina Tonković[3], Ana Butorac[2], Marija Lovrić[2], Jagoda Šušković[1], Blaženka Kos[1]

[1]University of Zagreb, Faculty of Food Technology and Biotechnology, Laboratory for Antibiotic, Enzyme, Probiotic and Starter Cultures Technology, Pierottijeva 6, 10000 Zagreb, Croatia
[2]BICRO Biocentar Ltd., Zagreb, Borongajska cesta 84, Zagreb, Croatia
[3]Probiotik Ltd., Ulica Grada Gospića 3, 10000 Zagreb, Croatia
[*]katarina.butorac@pbf.unizg.hr

poster presentation

Lactic acid bacteria (LAB), selected from artisanal fermented products and characterised in our laboratory as producers of potential therapeutic biomolecules with rare strain-specific traits, were used for the production of dried fresh cheeses and whey-based beverages rich in bioactive peptides. Strains expressing S-proteins (*Levilactobacillus brevis* ZG1, D6 and M92), antimicrobial peptides plantaricins (*Lactiplantibacillus plantarum* ZG1C, D13 and M92C), *Limosilactobacillus fermentum* D12 producing exopolysaccharides and *Enterococcus faecium* ZGZA7-10 with a defined proteolytic activity system were used as functional probiotic starter cultures. High-quality functional beverages with low fat and lactose content were produced, with or without the addition of raspberry and vanilla flavor components with a positive effect on the organoleptic properties. The high number of biologically active probiotic cells maintained during freeze-drying and storage of functional whey beverages and freeze-dried powders was determined using the plate method and Illumina MiSeq next-generation sequencing. Proteomic analysis, performed using the combined techniques of nano-HPLC liquid chromatography and MALDI-TOF mass spectrometry, revealed the presence of various bioactive peptides attributable to the proteolytic activity of the probiotic cultures used. The utilization of whey as a by-product to obtain high-quality nutraceutical probiotic beverages and freeze-dried formulations enriched with bioactive peptides follows the principles of a sustainable circular bioeconomy.

Keywords: bioactive peptides, functional beverage, whey, freeze-drying, circular bioeconomy

PREBIOTIC EFFECT OF BY-PRODUCT DIETARY FIBERS FORMULATED FOR FOODS FOR SPECIAL MEDICAL PURPOSES

Katarina Butorac[1*], Lenkica Penava[2], Andreja Leboš Pavunc[1], Martina Banić[1], Nina Čuljak[1], Jasna Novak[1], Marijana Ceilinger[2], Jelena Miličević[2], Ivanka Jerić[3], Jagoda Šušković[1], Blaženka Kos[1]

[1]University of Zagreb, Faculty of Food Technology and Biotechnology, Laboratory for Antibiotic, Enzyme, Probiotic and Starter Cultures Technology, Pierottijeva 6, 10000 Zagreb, Croatia
[2]Belupo d.d., Drugs and Cosmetics Inc., Nutraceuticals, Business Development and Registration, Danica 5, 48000 Koprivnica, Croatia
[3]Ruđer Bošković Institute, Laboratory for Biomimetic Chemistry, Bijenička cesta 54, 10000 Zagreb, Croatia
[*]katarina.butorac@.pbf.unizg.hr

poster presentation

A new class of prebiotic substrates obtained as by-products, such as acaccia, citrus and pea fibers, has been added in dietary fibers mixtures intended for specialised food products in the Food for Special Medical Purposes (FSMPs) category, specifically formulated for the dietary management of diseases, disorders or medical conditions in patients. The consumption of dietary fiber has a strong influence on the composition of the gut microbiota, which can be disturbed in patients. The aim of this study was therefore to investigate the lactogenic and bifidogenic effects of different fiber mixtures, which also contain by-products, in order to develop new innovative formulations. Experimental mice and metagenomic analyses of their gut microbiota as well as *in vitro* mouse feces were used as a model system. All tested dietary fibers showed a lactogenic effect, which differed depending on the fiber used. The highest bifidogenic effect was achieved by dietary fibers from acacia and citrus fibers as by-products. The fiber mixtures tested showed both a lactogenic and a bifidogenic effect, which can be attributed to the synergistic effect of the individual fibers. In addition, dietary fiber mixtures created for different formulations of FSMPs showed prebiotic effects on the fecal microbiota of mice *in vivo*, in terms of enrichment of beneficial and depletion of potentially harmful gut bacteria.

Keywords: dietary fibers as by-products, food for special medical purposes (FSMPs), lactogenic and bifidogenic effect, prebiotics, gut microbiota

SUBCRITICAL WATER EXTRACTION OF PHENOLIC COMPOUNDS FROM CHAMOMILE WASTE

Nela Drača[1*], Krunoslav Aladić[2], Marija Banožić[3], Stela Jokić[2], Snježana Keleković[2], Ivana Nemet[1]

[1]Technological and innovation center Virovitica, Matije Gupca 78, 33000 Virovitica, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[3]University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[*]nela.draca@ticvt.hr

poster presentation

German chamomile (lat. *Matricaria chamomila* L. syn. *Matricaria recutita*) comes from the Asteraceae family, which has been scientifically proven to possess various medicinal and aromatic properties such as antimicrobial, anti-inflammatory, antioxidant and sedative properties. In the process of producing chamomile tea, a by-product is created, which could serve as a possible potential source of bioactive compounds for obtaining different products from chamomile. Chamomile as a medicinal plant contains over 120 bioactive compounds, including terpenoids, flavonoids, coumarins, organic acids and polysaccharides.

Chamomile powder (pulver or plant powder) with a particle size of 0.2 mm is discharged as waste from the tea factory Spider Grupa Pitomaca. The amount of this type of by-product is about 10 to 15% of the total fraction. In this study, extracts were obtained using subcritical water extraction (SWE) and analyzed using high-performance liquid chromatography (HPLC). The SWE was performed under different values of temperature (100, 150 and 200 °C), time (10, 20 and 30 min), solvent type (distilled water, 48% v/v ethanol and 96% v/v ethanol) and solvent-solid ratio (10, 30 and 50 mL/g) at a fixed pressure of 40 bar.

In the obtained extracts, the most dominant phenolics were protocatechuic acid, neochlorogenic acid, transferulic acid, chlorogenic acid, benzoic acid, rutin and apigenin. In summary, the chemical composition and quality of chamomile waste extracts depend on the raw materials and processing conditions as well as the extraction conditions used.

Keywords: German chamomile, waste, subcritical water extraction

HYDROLYZED OILSEED MEAL PROTEINS IN DIFFERENTIATION AND ATROPHY OF C2C12 MYOBLASTS

Višnja Gaurina Srček*, Anja Damjanović, Kristina Radošević, Igor Slivac

University of Zagreb, Faculty of Food Technology and Biotechnology,
Pierottijeva 6, 10000 Zagreb, Croatia
**visnja.gaurina.srcek@pbf.unizg.hr*

poster presentation

The utilization of proteins from agro-industrial by-products and residues from the food industry presents a sustainable solution to reduce waste disposal, optimize resources, and enhance the market value of various products. Recent research has focused on producing peptides/hydrolysates that can be applied in the food and nutraceutical industries. Oilseed meals, which are the primary by-products obtained after extracting oil from seeds such as soybean, rapeseed, cottonseed, and flaxseed, are particularly interesting due to their protein content (15-30%), making them suitable for animal or human consumption in the form of protein isolates and hydrolysates. Moreover, this cost-effective raw material can serve as a valuable source of plant peptides for animal cell culture media. In this particular study, we examined the impact of flaxseed protein hydrolysate (FPH) and soybean protein hydrolysate (SPH) on myotube formation and muscle atrophy using C2C12 myoblasts. FPH was derived from enzymatically treating flaxseed protein isolate, while SPH was obtained from commercial sources. The results obtained demonstrated that both FPH and SPH exhibited stimulating effects on C2C12 cell differentiation by promoting myotube formation. Furthermore, both hydrolysates displayed a slight protective effect against muscle atrophy induced by dexamethasone. In conclusion, this study suggests that FPH and SPH have the potential to be utilized as functional food ingredients that can promote muscle differentiation and prevent muscle atrophy.

Keywords: flaxseed, soybean, meal, protein hydrolysate, myoblast differentiation

UNUSED APPLES AFTER STORAGE CAN BE A VALUABLE BY-PRODUCT RICH IN BIOACTIVE COMPOUNDS

Ana-Marija Gotal Skoko[1*], Antun Jozinović[1], Martina Skendrović Babojelić[2], Ante Lončarić[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]University of Zagreb, Faculty of Agriculture, Department of Pomology, Svetošimunska 25, 10000 Zagreb, Croatia
[*]amgotal@ptfos.hr

poster presentation

There is a growing demand for natural ingredients and food products using fruits. Moreover, industry has driven the development of high-added-value food products using fruits and vegetables as a source of bioactive compounds and nutrients. Apart from the fact that apples are produced in large quantities throughout the year, they are also great source of bioactive compounds such as polyphenols. After long term of storage unused apples lose their texture, flavour, water, firmness, etc. and mainly considered as a waste causing huge losses. Such apples are undesirable for customers but on the other hand, they are a rich source of highly valuable bioactive compounds. In this work we determined the content of total polyphenols, soluble dry matter, pH, water, total acids, flavonoids, natural and total sugar, anthocyanins, polyphenol profile and antioxidant activity in three traditional apple cultivars (´Winter Banane´, ´Kraljevčica´, ´Božićnica´) after they become unusable to consumers in our terms of storage. The content of total acids, water and flavonoids in selected apple cultivars decreased during storage. On the other hand, the content of total soluble solids, pH, natural and total sugars, total polyphenols, anthocyanins and antioxidant activity increased during storage. The highest content of total polyphenols, flavonoids and anthocyanins had ´Božićnica´ (645.43 g/kg; 179.01 g/kg; 20.79 mg/kg). The content of some individual polyphenols increased during storage such as chlorogenic acid, procyanidin B1, procyanidin B2, myricetin, quercetin-3-rutinoside and *p*-coumaric acid. Therefore, the extraction of natural antioxidants from unused apples after storage could be used in cosmetics, nutraceutical industries, as a natural food additive, for fortification of yoghurt, retaining the quality of meat and meat products, for replacing synthetic products and more.

Keywords: storage, polyphenols, by-product

Acknowledgement: This work was supported by the Croatian Science Foundation under the project "The possibility of exploiting traditional apple cultivars for the production of apples and apple juice with the reduced patulin content" (UIP-2020-02-8461).

GREEN SYNTHESIS OF SILVER NANOPARTICLES USING WALNUT FRUIT SEPTUM EXTRACTS

Vlatka Gvozdić[1*], Valentina Pavić[2], Elvira Kovač Andrić[1], Klara Kirchbauer[1], Domagoj Vidosavljević[3], Zvonimir Užarević[4]

[1]Josip Juraj Strossmayer University of Osijek, Department of Chemistry, Cara Hadrijana 8/A, 31000 Osijek, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Department of Biology, Cara Hadrijana 8/A, 31000 Osijek, Croatia
[3]Josip Juraj Strossmayer University of Osijek, Faculty of Medicine, Josipa Hutlera 4, 31000 Osijek, Croatia
[4]Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, 31000 Osijek, Croatia
[*]vgvozdic.kemija@unios.hr

poster presentation

Walnut (*Juglans regia* L.) ranks among the top four most consumed dry fruits. Apart from its edible kernel, the walnut fruit comprises of a shell and a septum, which are typically discarded during processing and consumption. However, these non-edible parts have been historically utilized in traditional medicine for various ailments. Nanoparticles have a promissing applicability across diverse industries, including medicine, textiles, and electronics. Green synthesis, increasingly popular for its cost-effectiveness and ecological soundness, is particularly prevalent in the synthesis of silver nanoparticles. In this study, silver nanoparticles were synthesized via green chemistry priniples by using walnut fruit septum extract and silver nitrate aqueous solution. Characterization via FT-IR analysis, UV-visible spectrophotometry, and powder X-ray diffraction (PXRD) confirmed successful nanoparticle synthesis. The nanoparticles exhibited a size of 29 nm, determined via Scherrer's equation. FT-IR analysis elucidated the biomolecules responsible for efficient nanoparticle synthesis. Furthermore, the synthesized nanoparticles demonstrated potent antibacterial activity against *E. coli*, *P. aeruginosa*, *B. subtilis*, and *S. aureus.*

Keywords: silver nanoparticles, walnut fruit septum, antibacterial properties

EXTRACTION OF TARGETED BIOACTIVE COMPONENTS FROM THE WALNUT SEPTUM USING GREEN SOLVENTS

Stela Jokić[1*], Anamarija Burilo[1], Krunoslav Aladić[1], Ivana Flanjak[1], Huska Jukić[2], Ema Pavičić[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]University of Bihać, Faculty of Health Studies, Nositelja hrvatskog trolista 4, 77000 Bihać, Bosnia and Herzegovina
[*]stela.jokic@ptfos.hr

poster presentation

The primary aim of this paper was to investigate the possibility of utilizing the by-products that are produced during walnut processing using innovative green extraction techniques. The first step of our research included the extraction of fatty acids from the inner partitions of the walnut using supercritical CO_2 (SC-CO_2) at 300 bar pressure and a temperature of 40˚C. The composition of fatty acids was analysed using gas chromatography with a flame ionization detector (GC-FID), and the most important fatty acids were linoleic, oleic, α-linoleic and palmitic acids. After SC-CO_2 extraction, the remaining materials were rich in phenolic compounds (mainly ellargic acid, peonidin 3 arabinoside, epigallocatechin, herniarin, gallic acid) which were extracted applying ultrasound-assisted extraction under different process conditions. Identification and quantification of phenols were carried out using high-performance liquid chromatography with a diode array detector (HPLC-DAD). Additionally, total phenol content and antioxidant activity were determined using spectrophotometric assays. The highest content of total phenols in the extracts was obtained using 96% ethanol, amplitude 100% and impulse 60%, and the highest antioxidant activity was recorded in extracts prepared with 96% ethanol, amplitude 20% and impulse 60%.

Keywords: walnut inner partitions, bioactive components, DPPH, total phenols

UTILIZING OF BY-PRODUCT ARONIA POMACE USING INNOVATIVE EXTRACTION TECHNIQUES

Tomislav Jurendić[1], Krunoslav Aladić[2], Ante Lončarić[2], Antun Jozinović[2], Đurđica Ačkar[2], Drago Šubarić[2], Jurislav Babić[2], Stela Jokić[2*]

[1]Bioquanta Ltd., Trg Zlate Bartl 11a, 48000 Koprivnica, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]stela.jokic@ptfos.hr

poster presentation

The primary aim of this paper was to investigate the possibility of utilizing the by-product aronia pomace - a solid residue after pressing the aronia berries. The first step included the extraction of phenolic compounds by applying ultrasound using an ultrasound probe and 50% aqueous ethanol solution as a solvent. Before extraction, the samples were dried using different drying techniques (freeze drying, vaccum drying, classic drying). Identification and quantification of phenols in extracts was carried out using high-performance liquid chromatography with a diode array detector (HPLC-DAD). The results show that aronia pomace was rich in phenolic compounds especially in the extracts obtained from freeze dried aronia pomace, where the predominant compounds were epigallocatechin followed by neochlorogenic acid, peonidin 3 arabinoside, chlorogenic acid.
Furthermore, the obtained extracts were subjected to spray drying process to obtain powder for possible further application in preparation of extruded snacks.

Keywords: aronia pomace, ultrasound extraction, phenolics, spray drying

Funding: This research was funded by project "Cascade utilization of hazelnut and aronia byproducts in yield increasing and new product development", Operational groups within the European Innovation Partnership, Rural Development Programme of the Republic of Croatia 2014-2020.

FROM WASTE TO WEALTH: THE NUTRITIONAL COMPONENTS OF COFFEE GROUNDS AND THEIR EXPLOITATION

Nikolina Kajić[1*], Marija Banožić[1], Leona Puljić[1], Mario Kovač[1], Antun Jozinović[2], Đurđica Ačkar[2], Jurislav Babić[2]

[1]University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]nikolina.kajic@aptf.sum.ba

poster presentation

Coffee grounds, a byproduct of instant coffee preparation, represent a significant waste in coffee production. However, this waste has great potential for recycling and use in various applications, including the production of new products based on its nutritional components. Nutritionally, coffee grounds are rich in dietary fibers, mainly insoluble, and have a low glycemic index due to the negligible amount of free glucose. The protein content varies depending on the conditions of instant coffee production, and coffee grounds also contain fats that remain after extraction with hot water during instant coffee production. With the development of innovative technologies for extraction, fractionation, and purification of compounds, it is possible to expand the use of products obtained from coffee grounds. These products can be used for various purposes, such as the production of building materials, cosmetics, biopolymers, biocatalysts, food packaging, and energy. In conclusion, coffee grounds have great potential for exploiting their nutritional components for the purpose of obtaining new products, contributing to sustainability and reducing waste in coffee production.
The aim is to provide an insight into the potential of using coffee grounds components, as a resource rich in nutrients, for the development of new products in different areas.

Keywords: coffee grounds, by-products, proteins, lipids, fibers

PREPARATION AND CHARACTERIZATION OF SOLUBLE DEXTRIN FIBER FROM POTATO STARCH OBTAINED ON SEMI-INDUSTRIAL SCALE

Kamila Kapusniak[1*], Malwina Wojcik[2], Arkadiusz Zarski[2], Janusz Kapusniak[2]

[1]Department of Biochemistry, Biotechnology and Ecotoxicology, Faculty of Science and Technology, Jan Dlugosz University in Czestochowa, Armii Krajowej 13/15, 42-200 Czestochowa, Poland
[2]Department of Dietetics and Food Studies, Faculty of Science and Technology, Jan Dlugosz University in Czestochowa, Armii Krajowej 13/15, 42-200 Czestochowa, Poland
[*]k.kapusniak@ujd.edu.pl

poster presentation

Starch, the second most abundant polysaccharide in nature after cellulose, is a glucose polymer that performs various biological functions and plays a key role in human nutrition and industrial applications. Dextrinization is the partial hydrolysis of starch by heating in the presence of an acid or enzyme. The implementation of the PreSTFibre4Kids project resulted in the need to develop, on a semi-industrial scale, the production of resistant dextrin from potato starch with prebiotic properties in order to enrich fruit and vegetable mousses intended for overweight and obese children. The study focused on the production of soluble dextrin fiber (SDexF) by heating potato starch with hydrochloric and citric acids in a prototype dextrinizer. The objective was to optimize the SDexF production process and characterize physicochemical properties of the obtained product. Additionally, the molecular structure of SDexF was analyzed using SEM and FTIR. Obtained product was characterized by nearly 100% solubility in water, a total dietary fiber (TDF) content exceeding 30%, low viscosity, and no tendency for retrogradation. The lightness of SDexF was similar to native starch, but the measured difference in color (ΔE) was high. A partial loss of granularity was observed in the SDexF structure compared to native potato starch. The characteristics of the obtained SDexF indicate the successful implementation of a semi-industrial scale for the production of dextrins. Potato is a relatively inexpensive and easily available raw material in Poland, which means that a similar dextrinization process can be used for a by-product such as potato starch from washing potatoes.

Keywords: starch, resistant dextrins, semi-industrial scale

Acknowledgement: This research was funded by The National Centre for Research and Development, Poland, project no. POIR.04.01.02-00-0102/17-00.

USE OF BENTONITE IN THE PRODUCTION OF CLEAR FRUIT AND VEGETABLE JUICE

Emina Kovačević*, Husejin Keran, Ema Obralić, Hanka Rizvanović, Damir Aličić, Melisa Ahmetović

University of Tuzla, Faculty of Technology, Urfeta Vejzagića 8, 75000 Tuzla, Bosnia and Herzegovina
**emina.kovacevic@untz.ba*

poster presentation

The production of fruit juices represents a strong and promising industry worldwide. Freshly squeezed fruit juices are typically cloudy due to the presence of insoluble plant residues (such as fibres, cellulose, and hemicellulose) and colloidal macromolecules (such as pectin, proteins, soluble starch components, etc.). Clear juice is obtained through clarification and filtration of fruit juice containing soluble components. The essential characteristics of clear juice include clarity without opalescence or sediment formation. To achieve these properties, all components that make the juice cloudy are completely removed by clarification with approved agents and thorough filtration.

Bentonite, an aluminosilicate clay, more precisely a dioctahedral smectite, belongs to the group of phyllosilicates. It is used to improve protein stability in juices and white wines.

In the experimental part of this study, analyses were conducted to determine the total acidity using potentiometric methods. The highest total acidity was observed in the beetroot sample, while the lowest was in the apple sample. Additionally, pH values were determined using an instrument (pH meter), with the highest value found in the apple sample and the lowest in the beetroot sample. The clarification time for samples using bentonite was also assessed, revealing that beetroot juice sedimented most rapidly, while apple juice sedimented more slowly.

Regarding the amount of bentonite required to achieve protein stability in grape juice, it was found that sodium bentonite can bind significantly more grape proteins than activated sodium bentonite.

Keywords: clarification, filtration, fruit juices, bentonite, potentiometry, pH

EGGSHELL – BIO-WASTE AS A SIGNIFICANT SOURCE OF MINERALS

Nina Kudumija[1*], Goran Kiš[2], Tina Lešić[1], Ana Vulić[1], Zlatko Janječić[2], Dalibor Bedeković[2], Jelka Pleadin[1]

[1]Croatian Veterinary Institute, Laboratory for Analytical Chemistry, Savska cesta 143, Zagreb, Croatia
[2]University of Zagreb Faculty of Agriculture, Department of Animal Nutrition, Svetošimunska 25, 10000 Zagreb, Croatia
[*]kudumija@veinst.hr

poster presentation

On a global level, eggshells represent bio-waste from family households, food, pharmaceutical and biotechnology industries, measurable in tons per day. Eggshells are rich source of minerals, especially calcium (Ca) and it is considered that Ca from eggshells is more digestible than from limestone, the main source of Ca in the production of feed for laying hens. The aim of this study was to investigate the effects of mineral supplements with inorganic and organic forms of trace elements on mineral composition of eggshells. A total of 144 Lohmann Brown, 40 weeks old, hens were randomly assigned to two dietary treatments with 12 replicates each (3-hen cage). The trial lasted four weeks, after which the eggs were collected for analysis. After washing eggshells with distilled water, the minerals sodium (Na), calcium (Ca), potassium (K), magnesium (Mg), zinc (Zn), copper (Cu) and iron (Fe) were determined using flame atomic absorption spectroscopy (AAS), while the concentration of phosphorus (P) was determined spectrophotometrically. The results showed that there is a statistically significant difference ($p<0.05$) in the content of Mg ($p=0.0342$), Na ($p=0.0059$) and Zn ($p=0.0018$) in the analysed eggshells. Of all analysed minerals, the one most represented in the analysed eggshells was Ca, whose content varied from 32.93% to 36.97%. The results demonstrate that the form of trace elements does not affect eggshell Ca concentration, the quantitatively most represented mineral, but they can be used in the production of calcium salts and animal feed due to their mineral composition.

Keywords: eggshells, minerals, calcium, flame atomic absorption spectroscopy

ANTIOXIDANT AND PHYSICOCHEMICAL PROPERTIES OF CHOKEBERRY POMACE AS VALUABLE FOOD INDUSTRY BY-PRODUCT

Amela Kusur*, Amel Selimović, Dijana Miličević, Ljilja Bojanović

University of Tuzla, Faculty of Technology, Urfeta Vejzagića 8, 75000 Tuzla, Bosnia and Herzegovina
**amela.kusur@untz.ba*

poster presentation

Chokeberry (*Aronia melanocarpa*) pomace is by-product formed after extracting the juice from aronia berries. It represents a solid residue that contains significant amounts of antioxidants, fiber and other nutritionally valuable ingredients. The transformation of by-products into valuable products and food ingredients should be conducted rapidly to ensure a safe and stable product and drying of the pomace is the first step of the valorization process. In this study, chokeberry pomace was dried at a temperature of 50°C to a moisture content of about 8%. After drying and cooling, the pomace was ground and then analyzed. The greatest value of pomace is reflected in the content of bioactive components. Results showed that pomace contains a large amount of polyphenols (5923.37 ± 249.31 mg GAE/100 $g_{dry\ matter}$), flavonoids (598.47 ± 30.07 mg CE/100 $g_{dry\ matter}$), an extremely high antioxidant capacity determined by the FRAP assay 88.51 ± 4.40 mmol Fe^{2+}/100 $g_{dry\ matter}$, and DPPH assay 31.93 ± 0.09 mmol TE/100 g $_{dry\ matter}$, i.e. IC50 value is 10.66 ± 3.30 µg/mL. In addition to the antioxidant capacity, the physicochemical properties (total dry matter content, pH value, water activity, ash content, sugar content and color) were also determined. Considering these results, chokeberry pomace can be used to enrich food products (especially bakery and confectionery products) in order to increase the nutritional value, antioxidant capacity, and sensorial properties.

Keywords: chokeberry pomace, antioxidant capacity, by-product

REUSE OF BREWERS' SPENT GRAIN AS INGREDIENT FOR PRODUCTION OF RED ĆUPTER, TRADITIONAL HERZEGOVINIAN PRODUCT

Andrea Karlović, Ivana Šimić, Anita Lalić*

University of Mostar, Faculty of Agriculture and Food Technology,
Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
**anita.juric@aptf.sum.ba*

poster presentation

The literature record on the ćupter as a traditional product from Bosnia and Herzegovina is extremely limited. However, research about its nutritive value and preparation is emerging, which warrants establishing a baseline annotation for ćupter to be labeled by EU Quality Schemes for Agricultural Products. Improved traditional recipes tend to keep them viable and make it possible for future generations to learn about and enjoy traditional foods. Ćupter is traditionally dried in the sun in the open air. It had been suggested in previous research that nutritive value is improved with the addition of Brewer's Spent Grain, but recipes and drying should be modified to improve consumer acceptance. This report lays the groundwork for how drying ćupter in a solar dryer is a potentially easier, faster, and healthier way of drying red ćupter.

Keywords: ćupter, brewers' spent grain, red grape must, traditional product, solar drying

NON-THERMAL PLASMA TECHNOLOGY – A POTENTIAL SOLUTION FOR ENHANCEMENT OF PLANT STRESS TOLERANCE

Tihana Marček*

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**tihana.marcek@ptfos.hr*

poster presentation

Non-thermal plasma technology (NTP) has been gaining more attention recently across interdisciplinary studies dealing with environmental impact on plant growth and food production. The application of these technologies constantly increases because of simplicity in handling, cost-effectiveness, and environmental friendliness. In plants, NTP treatments operate on cellular, metabolic, and physiological levels which enables to use of such technologies for improving plant health, growth, and stress tolerance. There is a plethora of unstandardized NTP treatments that differ in operating variables such as flow rate, medium (gas or liquid), voltage, duration of treatment, device construction, and frequency so the selection of the best one can be challenging. Plasma-activated water (PAW) treatment belongs to NTP technology which shows potential for increasing seed performance and has a beneficial effect on early seedling establishment. PAW is created by subjecting water medium to high-voltage electrical discharge which forms a mixture of highly reactive radicals and molecules that induce reactive oxygen species (ROS) regulatory signaling pathways responsible for expression of stress-coding genes leading to improved plant stress tolerance. H_2O_2 and nitric oxides may modify the phytohormone balance in the seeds and promote germination. Besides water molecule structure modifications, a high voltage also produces cavitation bubbles creating the mechanical signal for seed dormancy breaking. Treated seeds show uniform germination, higher seed vigor, and growth rate even under stress conditions. However, the final success of PAW treatment depends on stress type, developmental stage, seed coat properties, seed type, plant organ, plant species, and genotype properties. Therefore, it is essential to optimize PAW treatment protocol tailored to the needs of specific plant species facing particular stress factors.

Keywords: non-thermal technologies, plasma-activated water, seed germination, stress tolerance, growth promotion

EFFECTIVENESS OF FRUIT PROCESSING BY-PRODUCTS IN TREATMENT OF HEAVY METAL-CONTAMINATED WATER

Sunčica Mileta[1], Ivona Nuić[2*], Nina Jolić[2], Marin Ugrina[2], Ana Palčić[3], Sanja Perinović Jozić[2]

[1]Ivanal d.o.o., Gorička 19, Industrijska zona Podi, 22000 Šibenik, Croatia
[2]Faculty of Chemistry and Technology, University of Split, Ruđera Boškovića 35, 21000 Split, Croatia
[3]Ruđer Bošković Institute, Bijenička Cesta 54, 10000, Zagreb, Croatia
[*]ivona@ktf-split.hr

poster presentation

Due to increasing problems in the solid waste management and efforts in minimizing waste generation, the solutions for utilization of industrial by-products is highly desirable. Fruit processing by-products are mostly recognized as a source of valuable bioactive compounds, but even after their extraction, solid waste remains. Therefore, this research considers possible application of the cherry and sour cherry pits as biosorbents in treatment of zinc-contaminated water containing 200 mg Zn/L. Pits were firstly washed in distilled water to remove impurities, dried at 40 °C to a constant mass, ground without separating the kernels from the outer shell, and sieved. The particle size fraction of 0.56-1.00 mm was chosen for this experiment. Biosorbents were used in their native form, without any activation/modification treatment, thereby avoiding an increase in costs and possible secondary pollution. Zinc sorption was carried out by a batch mode at different solid/liquid (S/L) ratios in the range 0.25 g/50 mL-2.5 g/50 mL, at 250 rpm, pH=5.55 (the pH of zinc aqueous solution), for 24 h. The highest removal efficiency for both biosorbents was achieved at the highest S/L ratio. It is interesting that the sorption efficiency of sour cherry pits (69.5%) was significantly higher than that of cherry pits (26.8%), pointing how small differences in pits compostion can result in notable differences of surface functional groups activity/accessibility, and consequently in interaction with the target pollutant. These observations are confirmed by FTIR spectra. Moreover, inhomogeneity in the composition of ground pits can also affect their binding affinity. The sorption efficiency of sour cherry pits resulted in a significant decrease in zinc concentration (up to the 59.1 mg/L), indicating their potential for economically and ecologically acceptable treatment of zinc-contaminated water. However, the increasing in sorption efficiency will be the subject of further research. Finally, the reuse of waste makes it possible to approach the concepts of circular economy and zero-waste, with the ultimate goal of preserving and protecting the environment for future generations.

Keywords: low-cost wastewater treatment, zinc, sorption, cherry and sour cherry pits

THE INFLUENCE OF CONDITIONING AND SUNFLOWER SHELL ADDITION ON THE PRODUCTION OF EDIBLE PLUM KERNEL OIL

Tihomir Moslavac[1*], Drago Šubarić[1], Dora Veselovac[1], Benjamin Čaušević[2], Antun Jozinović[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]Institut for Health and Food Safety Zenica, Fra Ivana Jukića 2, 72000 Zenica, Bosnia and Herzegovina
[*]tihomir.moslavac@ptfos.hr

poster presentation

As a by-product of the food industry, plum kernel is eminently suitable for processing to get edible vegetable oil due to its properties. In experimental work, the seed of *Stanely* plum kernel represented the organic matter which is used for production of cold pressed oil. A laboratory screw press manufactured by Gorenje, with a 650 W electric motor, was used for oil production. Two process parameters were examined in this research, the first was the influence of conditioning and the second one was the influence of sunflower shell addition on oil production. Higher production of crude oil and cold pressed oil was obtained with conditioning at 40 °C and the addition of 6% sunflower shell. The volumes of crude and final oil were established, as well as the content of oil and water in plum kernel and cake. In addition, basic parameters of the quality of cold pressed oil such as: peroxide number, moisture content, free fatty acids content, and the content of insoluble impurities were determined. By comparing the obtained results with the Directive of edible oils and fats (NN 11/19), it was determined that the produced oil meets the requirements of the aforementioned Directive, and cold pressed plum kernel oil of good quality was obtained.

Keywords: plum kernel, conditioning, sunflower shell, pressing

CHEMICAL COMPOSITION OF BLACK RASPBERRY (*Rubus occidentalis* L.) FRUITS AND POMACE: COMPARATIVE ANALYSIS

Nemanja Krgović[1], Zorana Mutavski[1*], Jelena Živković[1], Milica Radan[1], Katarina Šavikin[1], Milan Ilić[2], Nebojša Menković[2], Nada Ćujić Nikolić[1], Jelena Mudrić[1]

[1]Institute for Medicinal Plants Research "Dr. Josif Pančić", Tadeuša Košćuška 1, 11000 Belgrade, Serbia
[2]University Business Academy Novi Sad, Faculty of Pharmacy, Trg Mladenaca 5, 21000 Novi Sad, Serbia
[*]zmutavski@mocbilja.rs

poster presentation

The industrial processing of various fruits left behind a large amount of unutilized by-products. Since waste management represents a key element of the circular economy, a cross-sectoral strategic concept based on the sustainable use of resources and energy, the assessment of fruit by-products in terms of their chemical composition or medicinal properties seems to be a useful solution to address the environmental and financial challenges involved. Black raspberry (*Rubus occidentalis* L., Rosaceae), a deciduous shrub native to eastern North America and now cultivated in a number of countries around the world, is considered a rich source of phenolic flavonoids, particularly anthocyanins (cyanidin derivatives), along with ellagitannins, which provide a range of health benefits including antioxidant, anti-inflammatory, hypoglycemic and antiproliferative activities. The aim of this study was to comparatively analyse the fruits and pomace of black raspberry for their chemical composition using HPLC technique. For these purposes, ultrasound-assisted extraction was used to produce hydroethanolic extracts (1:10, w/v) from the fruit collected in western Serbia (F) and the pomace (P) obtained by pressing the fresh berries in a commercial juicer. The results of HPLC analysis showed the same chemical profile of the analysed extracts, although the amount of active compounds was significantly different. The main secondary metabolites identified and quantified in F and P extracts included anthocyanins (cyanidin-3-sambubioside: 4.39 vs. 5.59 mg/g; cyanidin-3-glucoside: 2.01 vs. 2.73 and cyanidin-3-rutinoside: 22.58 vs. 28.39 mg/g), flavonols (rutin: 1.36 vs 1.60 and isoquercitrin: 0.26 vs. 0.31 mg/g) and phenolic acids (protocatechuic acid: 0.13 vs. 0.16 and ellagic acid: 0.26 vs. 0.24 mg/g). The present study showed that the content of the main phenolic compounds in black raspberry pomace was higher in comparison to fruits, suggesting that this by-product is an even better source of phytochemicals than fruits, with a promising potential to be used in the food or pharmaceutical industry.

Keywords: black raspberry, *Rubus occidentalis* L., pomace, anthocyanins, ultrasound-assisted extraction

TOMATO WASTE: FROM THE ROLE OF NEW TECHNOLOGIES TO THE POTENTIAL FOR CREATING SUSTAINABLE SOLUTIONS

Nela Nedić Tiban*, Hrvoje Pavlović, Fabijan Šiškić

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**nela.nedic@ptfos.hr*

poster presentation

Today, tomato producers and the food industry face the challenges of more rational utilisation of waste, starting from the plant mass remaining after harvesting, to the peel, seeds and tissue parts after tomato processing. Tomato waste is a rich source of bioactive substances that can be used in the food, pharmaceutical and cosmetics industries, as well as biotechnology. To date, numerous biologically effective applications of the active ingredients of tomato by-products have been proven, as well as their antagonistic effect on pathogenic microorganisms or food spoilage agents.
A number of reasons, including environmental ones, promote the need to develop and introduce new, sustainable technologies in the tomato processing industry. It is important to highlight their potential integration in tomato peeling and extraction, whose performances are crucial for maximising the efficiency of the entire process as well as the quality of the product. On the other hand, increasing attention is being paid to the development of sustainable alternatives in the direction of bioprocessing, the direct use of tomato by-products and the obtaining of various components in the integral valorisation of by-products („zero waste“). In this paper, the use of tomato by-products in packaging systems is presented as one of the promising ways to promote sustainability and circular economy. Aside packaging, tomato by-products can be used to improve antioxidant, antimicrobial and nutritional properties of food.

Keywords: tomato, waste, by-product, sustainability, circular economy

CLOSING BIOMASS MATERIAL AND ENERGY FLOWS: SCENARIOS FOR SLOVENIAN AGRIFOOD CHAINS

Ilja Gasan Osojnik Črnivec[1,2], Sabina Berne[2], Rok Mihelič[2], Primož Oven[2], Luka Juvančič[2*]

[1]National Institute of Chemistry, Hajdrihova 19, p.p. 660, 1001 Ljubljana, Slovenia
[2]University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, 1000 Ljubljana, Slovenia
[*]luka.juvancic@bf.uni-lj,si

poster presentation

The contribution will present the state, progress, and the process of development of circular economy and bioeconomy in Slovenia in the national and wider European context.
Organizing business processes in the direction of closing biomass flows (material, energy) is a complex process. In each situation, the choice of a best scenario can be influenced by many factors. Besides biomass quantities and availability, business organisation processes are affected by many other factors, such as technological competence, technological cost competitiveness, demand trends, and so on. Optimal flow closure scenarios biomasses can also depend on general economic context, or they can be industry specific.

In this study, we:

(i) Focus on residues in primary production, food processing and consumption, as well as logging and industrial processing of wood.
(ii) Develop starting points for creating scenarios, drawing from inventories of material flows, gap analysis, examining already established RRI networks and establishing experimental communities for in-depth stakeholder discussion.
(iii) Identify five prospective technological pathways: (a) fibrous biomaterials, (b) green chemicals, (c) advanced biomaterials, (d) advanced technologies and (e) biomass energy use.

Through this approach, three mutually exclusive scenarios for closing biomass flows were identified and evaluated, differing in terms of organizational complexity, the number of economic entities involved, and levels of technological and organizational complexity. Thus, in scenario one, closed material flows were considered at the entity (farm/company) level. Scenario two was based on industrial symbiosis. Scenario three accounted for cross-sectoral integration (bioeconomy clusters).

Keywords: circular economy, bioeconomy, food supply chain, wood supply chain, closing biomass flows scenarios, technological pathways

CHICKEN EGG WHITE LYSOZYME

Marta Ostojčić*, Marija Stjepanović, Mirna Brekalo, Ivica Strelec, Sandra Budžaki, Drago Šubarić

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
**marta.ostojcic@ptfos.hr*

poster presentation

The glycoside hydrolase lysozyme (E.C. 3.2.1.17) is an important component of the antibacterial defence system. With its bacteriostatic and antibacterial properties, lysozyme is widely used in the food industry. One of the best sources of lysozyme is chicken egg white, which contains about 3.5% of the enzyme. The extremely valuable and essential lysozyme extracted from egg white is used in biochemistry, medicine and other disciplines.

The most important application of lysozyme in the food industry (as a natural preservative) is in the production of wine and beer, where it limits the proliferation of lactic acid bacteria and inhibits the growth of *Clostridia* bacteria during cheese ripening. As it breaks down the polysaccharide present in the cell walls of many bacteria, the enzyme has antibacterial properties. In addition, lysozyme can be used to control the occurrence of toxins, but also to increase the longevity of the product.

Since the extraction of lysozyme from egg white is one of the most important methods for the commercial production of lysozyme, it has become a popular field of research. Few of the numerous techniques used in the experimental field to isolate lysozyme from chicken egg white have been applied in the commercial field, such as direct crystallisation from egg white, chromatographic and membrane techniques. Since eggs and egg products belong to the eight main groups responsible for 90% of food allergies and most allergic reactions are due to the presence of lysozyme in food, lysozyme must be declared on the product declaration in accordance with allergen labelling, in the interest of consumer protection.

Keywords: lysozyme, chicken egg, egg white

THE BIOPOTENTIAL OF BERRY POMACE

Sandra Pedisić[1*], Ivona Elez Garofulić[2], Maja Repajić[2], Branka Levaj[2], Ana Dobrinčić[2], Zoran Zorić[3], Sandra Balbino[2], Verica Dragović-Uzelac[2]

[1]University of Zagreb, Faculty of Food Technology and Biotechnology, P. Kasandrića 3, 23000 Zadar, Croatia
[2]University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
[3]University of Zadar, Department of Ecology, Agronomy and Aquaculture, P. Kasandrića 3, 23000 Zadar, Croatia
[*]sandra.pedisic@unizg.pbf.hr

poster presentation

Berry fruit processing generates a relatively large amount of waste in the form of pomace which is rich in various bioactive compounds such as phenols, fatty acids, sterols and tocopherols which have potential health benefits. Berry pomace can be incorporated into food products as a fresh or dried ingredient, as a liquid or dry pomace extract, or as a powder obtained by encapsulation techniques. The incorporation of berry pomace contributes to the enhancement of nutritional and sensory properties and improves antioxidant capacity, microbiological and oxidative stability of foods. The addition of pomace is the most commonly used to enrich bakery and snack products as well as dairy and meat products. The production of innovative foods with natural ingredients or the enrichment of existing food products with berry pomace can bring benefits by avoiding artificial additives, food improvers or preservatives and replacing them with natural ingredients. The potential applications of berry pomace also include the production of edible films, active packaging and colorants for the food industry. The pomace modify the physico-chemical properties of food and might also deteriorate the taste of the final products. Therefore, considering the properties of the individual pomace, it is a major challenge to optimize the processes and develop new products.

Keywords: berry pomace valorization, bioactive compounds, extracts, powders, innovative foods

SAFETY AND SENSORY PROPERTIES OF COOKED SAUSAGES WITH THE ADDITION OF MOIST BREWER´S SPENT GRAIN

Irena Perković[1*], Krešimir Mastanjević[2], Dragan Kovačević[2], Kristina Habschied[2], Hrvoje Krajina[1], Mario Škrivanko[1]

[1]Croatian Veterinary Institute, Department Vinkovci, Josipa Kozarca 24, 32100 Vinkovci, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]perkovicirena1512@gmail.com

poster presentation

Cooked sausages, as well as other meat products, are a good source of protein and are widely consumed among consumers. In the food industry, there is an increasing trend towards reducing the use of animal-origin proteins and their replacement with alternative protein sources. One such source is brewer's spent grain (BSG), a by-product generated during beer production, which is rich in fiber and phenols besides proteins. The aim of this study was to examine the impact of adding moist brewer's spent grain (w = 0, 3, 6, 9%) on the safety and sensory properties of cooked sausages during storage for 7 days at 4 °C. The presence of enterobacteria, aerobic mesophilic bacteria, sulfite-reducing clostridia, coagulase-positive staphylococci/*Staphylococcus aureus*, *Salmonella*, and *Listeria monocytogenes* was determined. Sensory properties such as color, odor, taste, texture, and overall acceptability were evaluated. The addition of moist brewer's spent grain did not affect the number of enterobacteria, sulfite-reducing clostridia, coagulase-positive staphylococci/*Staphylococcus aureus*, *Salmonella*, and *Listeria monocytogenes*, while the number of aerobic mesophilic bacteria increased with the increase in the mass fraction of moist brewer's spent grain. Regarding the sensory properties examined, the addition of moist brewer's spent grain did not have a statistically significant effect, except for samples with 9% moist brewer's spent grain. The results of this study demonstrate that it is possible to produce health-safe and sensorily acceptable cooked sausages with the addition of moist brewer's spent grain, but further research in this area is needed.

Keywords: wet brewer´s grains, cooked sausages, safety, sensory properties

SCREENING FOR POTENTIAL NUTRACEUTICAL RESOURCES IN WINE PRODUCTION WASTE

Vedran Poljak[1*], Marijana Franičević[2], Ivica Ljubenkov[3], Boris Antunović[4]

[1]University of Split, University Department of Marine Studies, Ruđera Boškovića 37, 21000 Split, Croatia
[2]Institution for research and knowledge development of nutrition and health CEKOM 3LJ, Ugljane 115C, 21240 Trilj, Croatia
[3]University of Split, Department of Chemistry, Faculty of Science, Ruđera Boškovića 33, 21000 Split, Croatia
[4]Josip Juraj Strossmayer University in Osijek, Faculty of Agrobiotechnical Sciences, Vladimira Preloga 1, 31000 Osijek, Croatia
[*]vedran.poljak@unist.hr

poster presentation

Nutraceuticals are defined as a food or part of it with medical or health benefits, either as disease prevention or treatment. When considered as a nutraceutical source, plants provde vitamins and a wide array of phytochemicals available for extraction, among them fatty acids. Plants exposed to various stresses, biotic and abiotic, generate fatty acids in response to biotic and abiotic stress (injury, bacterial or fungal infection). Produced by *Vitis vinifera* as protection against plant pathogens, they are found in grapes, wine and winemaking by-products. The process of winemaking generates large amounts of by-products, when disposed as waste they present an environmental issue and a challenge for waste management. Grape skins and seeds that are a large part of this waste contain fatty acids and can be used as a source of nutraceuticals, alternative to use of lipids of animal origin making them a possible valuable resource with commercial potential. Not only an economical alternative, plant sourced fatty acids are beneficial, reducing the risk of serious diseases (cardiovascular, cancer, osteoporosis, diabetes). This study was conducted to investigate grape skins and seeds collected from wine production waste of two varieties, Chardonnay and Merlot, cultivated in vineyards in the Dalmatian hinterland as a possible source of fatty acids. Grape pomace from both varieties was dried and ground. The ground grape waste fractions were processed by supercritical fluid extraction using CO_2. The extracts were refrigerated until screening for fatty acids using gas chromatography. Results for all extracts showed that 5 fatty acids account for more than 95% of total fatty acid content – palmitic (16:0), stearic (18:0), oleic (18:1), linoleic (18:2) and linolenic (18:3). Linoleic acid comprised the majority of fatty acids in all samples. The conclusions provide alternative pathways for wine producers to utilize wine waste in accordance with circular economy principles, enabling them to depart from conventional make-use-dispose practices and achieve a more sustainable business model.

Keywords: fatty acids, wine production waste, grape skins, grape seeds, circular economy

BIOACTIVE PEPTIDES FROM MEAT BY-PRODUCTS

Leona Puljić[1*], Nikolina Kajić[1], Marija Banožić[1], Krešimir Mastanjević[2]

[1]University of Mostar, Faculty of Agriculture and Food Technology,
Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek,
Franje Kuhača 18, 31000 Osijek, Croatia
[*]leona.puljic@aptf.sum.ba

poster presentation

Meat processing industry produces by-products such as bones, blood and viscera, which could be further used for the production of bioactive compounds. Bioactive peptides derived from meat and its by-products have garnered significant attention due to their potential health benefits. These peptides exhibit various bioactivities, including antioxidant, anti-hypertensive, anti-inflammatory, antimicrobial, and antitumoral effects. Researchers have identified these peptides from different meat sources and explored their production methods. Enzymatic hydrolysis and fermentation are common techniques for generating bioactive peptides from meat proteins. Additionally, emerging technologies such as high hydrostatic pressure, subcritical extraction, and pulsed electric fields enhance peptide yield and bioactivity. Despite these advancements, challenges remain in commercializing these bioactive peptides effectively. In conclusion, bioactive peptides from meat by-products hold immense potential for improving human health. Continued research and collaboration between scientists, industry, and regulatory bodies are essential for harnessing these benefits effectively.

Keywords: meat, by-products, bioactive peptides, enzymatic hydrolysis

APPLICATION OF ULTRASOUND-ASSISTED EXTRACTION AFTER SUPERCRITICAL CARBON DIOXIDE EXTRACTION FOR THE INCREASE IN BIOACTIVITY OF ELDERBERRY FLOWERS EXTRACTS

Siniša Simić[1*], Senka Vidović[1], Mirjana Sulejmanović[1], Aleksandra Gavarić[1], Stela Jokić[2], Krunoslav Aladić[2]

[1]Faculty of Technology Novi Sad, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]sinisa.simic@uns.ac.rs

poster presentation

In order to increase yield of the extraction as well as to offer a pathway to possible utilisation of plant material that was considered as a waste, elderberry flowers were subjected to ultrasound-assisted extraction (UAE) after prior supercritical carbon dioxide extraction ($ScCO_2$) extraction. The effects of exposing the plant material to high pressures and removing lipophilic components (DEF) was investigated in comparison to untreated, raw plant material (EF). UAE was conducted on three different amplitudes (20, 60 and 100%), while the temperature was constantly kept under the 40°C. The efficiency of the extractions was determined in the terms of total phenolic profile (HPLC) and total phenolic content (TPC). Highest recorded TPC was 1.882 mgGAE/mL and it was observed in the extract obtained from $ScCO_2$ defatted plant material at 100% UAE amplitude (DEF 1). HPLC analysis showed that dominant components in all of the extracts were rutin (188.60 – 678.70 mg/L), chlorogenic acid (92.96 – 380.70 mg/L), neochlorogenic acid (7.57 – 27.62 mg/L), epicatechin (10.44 – 22.59 mg/L) and ellagic acid (5.13 – 11.81 mg/L), and that there was no variation in the phenolic profile of the DEF and EF extracts. Additionally, highest content of rutin, chlorogenic acid and neochlorogenic acid were also detected in DEF 1 extracts. Therefore, majority of the obtained results indicated that application of $ScCO_2$ prior to UAE, does not affect the phenolic profile and positively impacts the TPC. In accordance, these results are clear indication that material that was previously considered as a waste can be even more efficiently utilised for the recovery of the biologically active and high value components.

Keywords: ultrasound-assisted extraction, elderberry, polyphenols, rutin

POSSIBILITIES OF USING THE RESIDUES GENERATED IN THE PROCESSING OF STONE FRUITS AND OLIVES IN THE BIO-ENERGY PRODUCTION

Tomislav Soldo[1*], Nebojša Kojić[2], Ante Lončarić[3], Midhat Jašić[4]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Tourism and Rural Development Požega, Vukovarska 17, 34000 Požega, Croatia
[2]Nikola Tesla Technical School, Ul. Blage Zadre 4, 32010 Vukovar, Croatia
[3]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[4]University of Tuzla, Faculty of Technology, Urfeta Vejzagića 8, 75000 Tuzla, Bosnia and Herzegovina
[*]tsoldo@ftrr.hr

poster presentation

Agricultural plant waste left after processing is a growing problem for raw plant materials processors, including fruit and olives processors. The plant waste utilization through conversion into other products, such as the extraction of bioactive compounds or the production of bio-energy, is not satisfactory. Most of the remains of plant origin are today used to feed animals, compost, or produce heat, but a good part remains unused. Technological progress, new technologies development, and new production processes allow processors to convert plant waste into environmentally friendly bioenergy such as biogas, biofuel, bio coal, electricity, or heat. Thermo-chemical processes of pyrolysis and gasification are newer and very acceptable ways to dispose of the residues created in the processing of stone fruits and olives. In Croatia, we have great opportunities for investment in the construction of smaller industrial units that would produce bio-energy through gasification and pyrolysis processes.

Keywords: stone fruit, olive, pyrolysis, gasification, bio-energy

VALORIZATION OF TABLE OLIVE PROCESSING WASTEWATER

Mladenka Šarolić[1*], Zvonimir Marijanović[1], Žana Delić[2], Marko Šuste[2], Tomislav Svalina[2]

[1]*Faculty of Chemistry and Technology, University of Split, Ruđera Boškovića 35, 21000 Split, Croatia*
[2]*Marko Marulić Polytechnic of Knin, Petra Krešimira IV 30, 22300 Knin, Croatia*
[*]*msarolic@ktf-split.hr*

poster presentation

The processing of olives into olive oil generates a number of by-products whose potential valorization has been studied in numerous scientific papers in the recent period. However, in addition to olive oil, as the leading product of olive fruits, table olives also take significant place on the market. They are present on the market in various types and modifications depending on the variety, degree of maturity of the olive fruits as well as the applied technology. In the production of table olives, large amounts of wastewater (Table Olive Processing Wastewater, TOPW) are generated during the process of debittering (alkali treatment), fermentation, brining and washing of olive fruits. The amount and characteristics of the resulting wastewater as well as their impact on the environment depends on the variety of olives, climatic, pedological and agrotechnical characteristics of the growing area, and above all, on the applied technological process. This wastewater is characterized by a high content of salts, organic substances and phenolic compounds. Among them, phenolic compounds are of particular importance, as well as the possibility of extracting and adding them to other food products with the aim of increasing their stability and functionality. The aim of this review was to summarize: chemical composition and treatment process of TOPW as well as extraction methods of the high value functional compounds, such as phenolic compounds. Furthermore, to present possibilities of the subsequent reuse of these compounds in the food, pharmaceutical and cosmetic industry.

Keywords: by-products, table olives, wastewater, valorization, phenolic compounds

DETECTION OF METAL PARTICLES AS CONTAMINANTS IN CHOCOLATE PRODUCTION

Svjetlana Škrabal*, Maja Ergović Ravančić, Valentina Obradović, Helena Marčetić, Borislav Miličević

Josip Juraj Strossmayer University of Osijek, Faculty of Tourism and Rural Development Požega, Vukovarska 17, 34000 Požega, Croatia
**sskrabal@ftrr.hr*

poster presentation

Chocolate is a homogeneous product obtained by a special technological process of mixing cocoa mass, cocoa butter, cocoa powder, sugar, milk powder, emulsifiers and aromas. In the production of chocolate, there are four technological units: production of cocoa mass, production of cocoa powder and cocoa butter, production of chocolate mass and shaping of chocolate. Each of the mentioned technological units includes a series of technological operations for the implementation of which devices are used, the metal parts of which wear out during operation and end up in the cocoa mass, cocoa powder and cocoa butter, and are embedded in the chocolate as particles invisible to the eye. Further processes of chocolate production during the rolling and concreting of the chocolate mass, due to the wear of the five-roller and mixer in the threads, may lead to physical contamination with metal particles that cannot be eliminated by passing through the sieves, and may end up in the packaged chocolate. To detect the presence of metal as a contaminant in chocolate, metal detectors are used. The primary purpose of metal detectors is to protect consumers, because even with maximum attention, metal particles can remain in the chocolate. Carefully removing these threats protects brand integrity and is critical for a manufacturer to comply with regulations. A wide range of metal detectors have been developed that can be installed in the final chocolate packaging process with the purpose of eliminating chocolate contaminated with metal particles. Given that this is a rather large investment, as a potential solution to the described problem in order to increase food safety is research into the occurrence of metal particles in chocolate and a proposal to use a particular type of metal detector depending on the type of metal particles, their size and the shape of chocolate products.

Keywords: chocolate, contaminants, food safety, metal detector

POSSIBILITIES OF USING THE FOOD INDUSTRY BY-PRODUCTS FOR BIOSTIMULATORS, BIOFERTILIZERS AND BIOPESTICIDES PRODUCTION

Tihana Marček[1], Monika Marković[2], Marija Ravlić[2], Antonija Kojić[2*], Natalija Velić[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia
[*]akojic@fazos.hr

poster presentation

Sustainable agricultural production is based on the cultivation of agricultural products with reduced or complete absence of soil, water and air pollution, and includes the reuse of natural origin by-products with the aim of preserving biodiversity and preserving the environment. By processing the food industry by-products into resources applicable in plant production, it is possible to reduce the amount of waste, the amount of mineral fertilizers, use growth enhancers and reduce protection agents. The food industry is a competitive economical branch whose basic task is the processing of agricultural products with the consequent creation of a large amount of lignocellulosic biomass, i.e. plant biomass that can be used for the production of biostimulators, biofertilizers and biopesticides. The application of biostimulators in plant production stimulates the process of plant nutrition with an increase in tolerance to biotic and abiotic stress conditions, which results in an increase in the yield and quality of the cultivated crop. Through the processes of anaerobic digestion, hydrolysis and composting, the by-products of the food industry are processed into biofertilizers that increase soil fertility by fixing atmospheric nitrogen, mobilizing phosphorus, potassium and zinc while increasing the intensity of photosynthesis and the production of phytohormones and enzymes. Furthermore, by completely or partially replacing chemical pesticides with biopesticides, the harmful effects on non-target organisms, pesticide residues in food and environment and the risk of developing resistance are reduced. The high proportion of bioactive components makes the by-products of the food industry a potential alternative source for the production of microbiological pesticides or compounds with pesticidal activity. The wide range of utilization of the food industry by-products enables numerous positive changes in plant production and preserves a healthy and stable ecosystem.

Keywords: food industry by-products, biostimulators, biofertilizers, biopesticides, sustainable agricultural production

UPCYCLING OF TOMATO PRODUCTION RESIDUES THROUGH CASCADING EXTRACTION AND FIBRE VALORISATION

Filipa A. Vicente[1*], Ilja Gasan Osojnik Črnivec[1*], Javier Nión Fieira[1], Mija Sežun[2]

[1]National Institute of Chemistry, Hajdrihova 19, p.p. 660, 1001 Ljubljana, Slovenia
[2]Pulp and Paper Institute, Bogišićeva 8, 1000 Ljubljana, Slovenia
[*]filipa.andre.vicente@ki.si, gasan.osojnik@ki.si

poster presentation

Climate change, resource depletion, and biodiversity loss are making it imperative to transition from fossil fuels to a circular bio-economy. The European Commission has launched the European Green Deal to target climate neutrality by 2050 by prioritizing resource conservation while promoting zero waste and zero pollution initiatives.
In light of these challenges, researchers and industries are compelled to explore alternative feedstocks as renewable sources, where agricultural and food waste emerges as a compelling option due to its abundance. Tomato is the most produced fresh vegetable in the EU. Worldwide, there is the production of ~190 million metric tons of tomatoes per year, resulting in the generation of a significant amount of tomato stems waste.
Tomatoes stems contain small concentrations of phenolic compounds and large quantities of lignocellulosic fibres. To fully valorise this residue, this work aims to extract the phenolic compounds using greener solvents like deep eutectic solvents (DES) and subsequently use the remaining biomass to test paper packaging products. Herein, different parameters have been studied upon their aptitude to influence the extraction of the phenolic compounds, namely biomass particle size, extraction time, solid-liquid ratio as well as different hydrogen bond donors and acceptors composing the DES. The phenolic extraction stage also affects the obtained paper; being reflected in the standard array of physico-chemical, optical and mechanical properties.

Keywords: tomato stems, phenolic compounds, lignocellulosic biomass, deep eutectic solvents, packaging

THE POTENTIAL OF COMMON REED (*Phragmites australis* L.) AS A NON-DIETARY SOURCE OF POLYPHENOLS

Aleksandra Vojvodić Cebin[1*], Karla Zrnić[1], Mateja Budisavljević[1], Danijela Šeremet[1], Ana Mandura Jarić[1], Božidar Šantek[2], Draženka Komes[1]

[1]University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Food Engineering, Pierottijeva 6, 10000 Zagreb, Croatia
[2]University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Biochemical Engineering, Pierottijeva 6, 10000 Zagreb, Croatia
[*]avojvodic@pbf.hr

poster presentation

Polyphenols are an abundant and diverse group of plant secondary metabolites that exert health-beneficial properties in the human body. Although they are natural constituents in foods of plant origin, storage and processing conditions can notably reduce their content. For this reason, formulations containing dry polyphenolic extracts or isolated compounds are available and may offer the advantage of high concentration and prolonged stability within a dry matrix. In addition, various non-dietary plant sources, such as agro-industrial wastes or weeds can be used as novel sources of polyphenols in such formulations. Common reed (*Phragmites australis* L.) from the *Poaceae* family, is a highly productive (up to 30 t/ha*y) and most widely distributed wetland plant species, often considered invasive. The plant biomass can be used in many different ways, including energy production (biofuel and biogas) among innovative uses. Polyphenol extraction may serve as a biomass pretreatment to such processes, thus diversifying the biorefinery potential of common reed. This work aimed to evaluate the bioactive potential of the extracts prepared from different dried aerial parts of the reed. Conventional heated extraction was employed, using a water-ethanol solution in different ratios (80% and 40% EtOH and pure water). The extracts were evaluated for total phenolic content (TPC, Folin-Ciocalteu) and antioxidant capacity (DPPH and ABTS), in combination with HPLC-DAD profiling. Higher concentrations of ethanol favored the extraction, especially from the leaves as the part richest in polyphenols (14.74 mg GAE/g). The stem exhibited the lowest content of phenolics (5.58 mg GAE/g). A high positive correlation was obtained between TPC and antioxidant capacity. HPLC analysis revealed glycosylated flavonols and flavones as major peaks. This study presents common reed as a potentially valuable source of bioactives and sets a base for further investigations since this plant is understudied in this sense.

Keywords: extraction, HPLC-DAD, non-dietary sources, *Phragmites australis*, polyphenols

Acknowledgement: This work was supported by the Croatian Science Foundation through the project "Biorefinery system for biofuels and biochemicals production from non-food lignocellulosic raw materials" (IP-2022-10-3075).

WHEAT GERM UTILIZATION: THE INFLUENCE OF EXTRUDED WHEAT GERM ON COOKIES' COLOUR AND DIMENSIONS

Jovana Petrović[1], Biljana Pajin[1], Ivana Lončarević[1], Antun Jozinović[2], Dragana Šoronja-Simović[1], Jana Zahorec[1*], Zita Šereš[1], Nikola Maravić[1]

[1]University of Novi Sad, Faculty of Technology, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia
[*]jana.zahorec@uns.ac.rs

poster presentation

Since significant quantities of wheat are processed in Serbia, as well as worldwide, during these processes, significant amounts of by-products are generated – wheat bran and wheat germ, which contain valuable nutritional components. They are a good source of dietary fiber, but other components such as polyphenols, vitamins, and minerals provide additional nutritional value to these raw materials, and so far, these raw materials have been most commonly used as animal feed. By using wheat germ, we can nutritionally enrich cookies that are ready-to-eat, widely consumed food and have a long shelf life. The use of wheat germ is still challenging due to the poor stability and the presence of antinutritional factors such as wheat germ agglutinin and high lipase and lipoxygenase activities. This problem could be overcome by inactivating enzymes under heat, microwave and extrusion cooking treatments. In this work, the influence of extruded wheat germ on the physical characteristics (colour and dimensions) of cookies was investigated. In the cookie samples, 5%, 10% and 15% of wheat flour was substituted with extruded wheat germ. Incorporating extruded wheat germ facilitated the enhancement of cookie colour, resulting in a decrease in lightness (L^* value) from 79.02 in the control sample to 76.73 in the sample containing 15% extruded wheat germ. Cookie redness (a^*) increased with the addition of extruded wheat germ, while there was no significant difference observed in b^* values (yellowness) with the increase in extrudate from 5 to 15%. The addition of extruded wheat germ in a content of 15% caused slight deformation of the cookie shape. There was an increase in cookie length, a decrease in cookie width and an increase in the cookie thickness compared to the control sample, which may be a consequence of higher water absorption of the extrudate compared to wheat flour. It can be concluded that the substitution of wheat flour with wheat germ extrudates up to 15% did not adversely affect cookie colour and dimensions, and will not cause consumer dissatisfaction.

Keywords: wheat germ, cookies, colour, dimensions

Acknowledgement: The research was financed by the Ministry of Science, Technological Development and Inovations of the Republic of Serbia, No. 451-03-66/2024-03/ 200134 and 451-03-65/2024-03/ 200134.

POTENTIAL OF BEETROOT POMACE AS SOURCE OF FIBER AND MINERALS IN CEREAL BASED DIET ENRICHMENT

Snežana Zlatanović[1*], Margarita Dodevska[2], Darko Micić[1], Ferenc Pastor[3], Stanislava Gorjanović[1]

[1]University of Belgrade, Institute of General and Physical Chemistry, Studentski trg 12/V, 11158 Belgrade, Serbia
[2]Institute of Public Health of Serbia »Dr Milan Jovanovic Batut«, Center for Hygiene and Human Ecology, Dr Subotica Starijeg 5, 11000 Belgrade, Serbia
[3]University of Belgrade, Faculty of Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia
[*]snezana.zlatanovic@gmail.com

poster presentation

Incorporation of anti-grain flour originating from minimally processed fruit and vegetable pomace into cereal products leads to an increase in biologically active compounds, including anti-obesity factors, and a decrease in the ratio of carbohydrates to fiber. This study aims to provide comprehensive insights into the potential of beetroot pomace flour (BPF) addition in cereal-based diets. BPF was obtained through laboratory-scale juice extraction of both peeled and whole beetroot and subsequent dehydration and grinding. Comparison was also extended to various cereal and pseudocereal flours. The observed beetroot samples exhibited a range of total dietary fiber (DF) content spanning from 21% to 35%. Notably, both wheat (3.45 ± 0.01 g/100 g) and gluten-free flours derived from oats (0.43 ± 0.15 g/100 g), buckwheat (4.05 ± 0.40 g/100 g), maize (2.18 ± 0.11 g/100 g), and rice (2.62 ± 0.45 g/100 g) showed comparatively low levels of DF. Conversely, samples from unpeeled beetroot demonstrated significantly higher DF content (34.9 ± 0.5 g/100 g) than rice, buckwheat, maize, and wheat flour, respectively. Addition of BPF efficiently reduced the carbohydrates to fiber ratio, enabling the recommended value (10:1) to be reached. The concentrations of minerals such as potassium (2,349 ± 40 and 1,370 ± 59 mg/100 g), calcium (245 ± 31 and 208 ± 19 mg/100 g), sodium (972 ± 49 and 620 ± 32 mg/100 g), magnesium (377 ± 28 and 210 ± 16 mg/100 g), copper (1.15 ± 0.15 and 0.59 ± 0.10 mg/100 g), and zinc (2.97 ± 0.20 and 2.05 ± 0.17 mg/100 g) were notably higher in unpeeled BPF samples compared to their peeled counterparts. Importantly, unlike flours derived from cereals and pseudocereals, BPF lacks phytic acid, which typically reduces the bioavailability of essential minerals such as calcium, magnesium, zinc, and copper. Adequate potassium intake, often lacking in typical Western diets, is crucial for maintaining overall health. Unpeeled beetroot pomace exhibits even higher levels of dietary fiber and essential minerals compared to peeled pomace, emphasizing the importance of utilizing the entire beetroot in juice extraction processes. The utilization of beetroot pomace flour as a functional ingredient in confectionery and bakery products presents a promising avenue.

Keywords: waste valorization, anti-grain pomace, beetroot, diet enrichment, fibre

SPONSORS, DONORS AND EXHIBITORS /
SPONZORI, DONATORI I IZLAGAČI

SPONSORS / SPONZORI

GOLDEN / ZLATNI

Altium International d.o.o.

***Croatian Science Foundation* /**
Hrvatska zaklada za znanost

CROTEH d.o.o.

***Croatian Chamber of Economy* /**
Hrvatska gospodarska komora

BRONZE / BRONČANI

Agroproteinka d.d.

Shimadzu d.o.o.

OTHER SPONSORS AND DONORS / OSTALI SPONZORI I DONATORI

Mettler-Toledo d.o.o.	METTLER TOLEDO
Bioquanta d.o.o.	
***Croatian Agency for Agriculture and Food* / Hrvatska agencija za poljoprivredu i hranu**	HAPIH
C-pharm d.o.o.	C-PHARM
Ru-Ve d.o.o.	Ru-Ve
Labena d.o.o.	Labena
Studio HS Internet d.o.o.	studio hs
Croatia osiguranje d.d.	CROATIA OSIGURANJE
Podravka d.d.	Podravka GRUPA
Kandit d.o.o.	Kandit
Koestlin d.d.	Koestlin
Prvo hrvatsko pivo 1664 d.o.o.	OSJEČKO 1664

EXHIBITORS / IZLAGAČI

Altium

AGROPROTEINKA

C-PHARM

METTLER TOLEDO

SHIMADZU
Excellence in Science

GOLDEN SPONSOR / ZLATNI SPONZOR

GOLDEN SPONSOR / ZLATNI SPONZOR

GOLDEN SPONSOR / ZLATNI SPONZOR

HGK
1852

HRVATSKA
GOSPODARSKA
KOMORA

BRONZE SPONSOR / BRONČANI SPONZOR

Agroproteinka d.d. je hrvatski lider u ekološkom zbrinjavanju nusproizvoda životinjskog podrijetla i biorazgradivog otpada. Poslovanje tvrtke temelji se na kružnom gospodarstvu gdje se nusproizvodi životinjskog i biljnog podrijetla, biorazgradivi otpad te otpadna jestiva ulja pretvaraju u korisne resurse u tri pogona.

Agroproteinka Energija, poznata i kao Biowatt je vodeće bioplinsko postrojenje u Hrvatskoj. Koristeći otpad iz kantina, kuhinja i prehrambene industrije, pretvaramo ga u električnu i toplinsku energiju. Ovo postrojenje koristi isključivo biorazgradivi otpad kao sirovinu, a restorani, kuhinje i druge institucije postaju ključni sudionici u našoj pozitivnoj ekološkoj priči.

Očuvanje prirode odgovornost je koju svakodnevno preuzimamo. U tvornici za kategoriju 1 i 2, SafeVet, prerađujemo opasne nusproizvode za zdravlje ljudi i životinja čime sprječavamo negativne posljedice lošeg gospodarenja otpadom, a sve što uđe pretvaramo u zelenu energiju te na taj način pridonosimo očuvanju okoliša.

Petprotein, naš najstariji pogon koristi nusproizvode i otpade iz klaonica, kosti, dijelove peradi itd., od čega dobivamo tri proizvoda; peradarsko brašno, životinjski protein i životinjsku mast.

Naši stručni timovi su uvijek na raspolaganju veterinarskim službama, farmerima, mesarima, maloprodajnim lancima, restoranima i široj javnosti. Sa sjedištem u Sesvetskom Kraljevcu, tri pogona za preradu i mrežom sabirališta diljem zemlje osiguravamo svježu sirovinu, a naši pogoni zadovoljavaju europske standarde što nas čini konkurentima na tržištu.

Ustrajemo u našoj misiji izgradnje održive budućnosti za sve te kao aktivni članovi zajednice doprinosimo izgradnji boljeg društva kroz razne humanitarne akcije, kulturne manifestacije i podršku sportskim klubovima. Posebnu pažnju posvećujemo najmlađima pružajući im pomoć i podršku.

AGROPROTEINKA

BRONZE SPONSOR / BRONČANI SPONZOR

OTHER SPONSORS AND DONORS / OSTALI SPONZORI I DONATORI

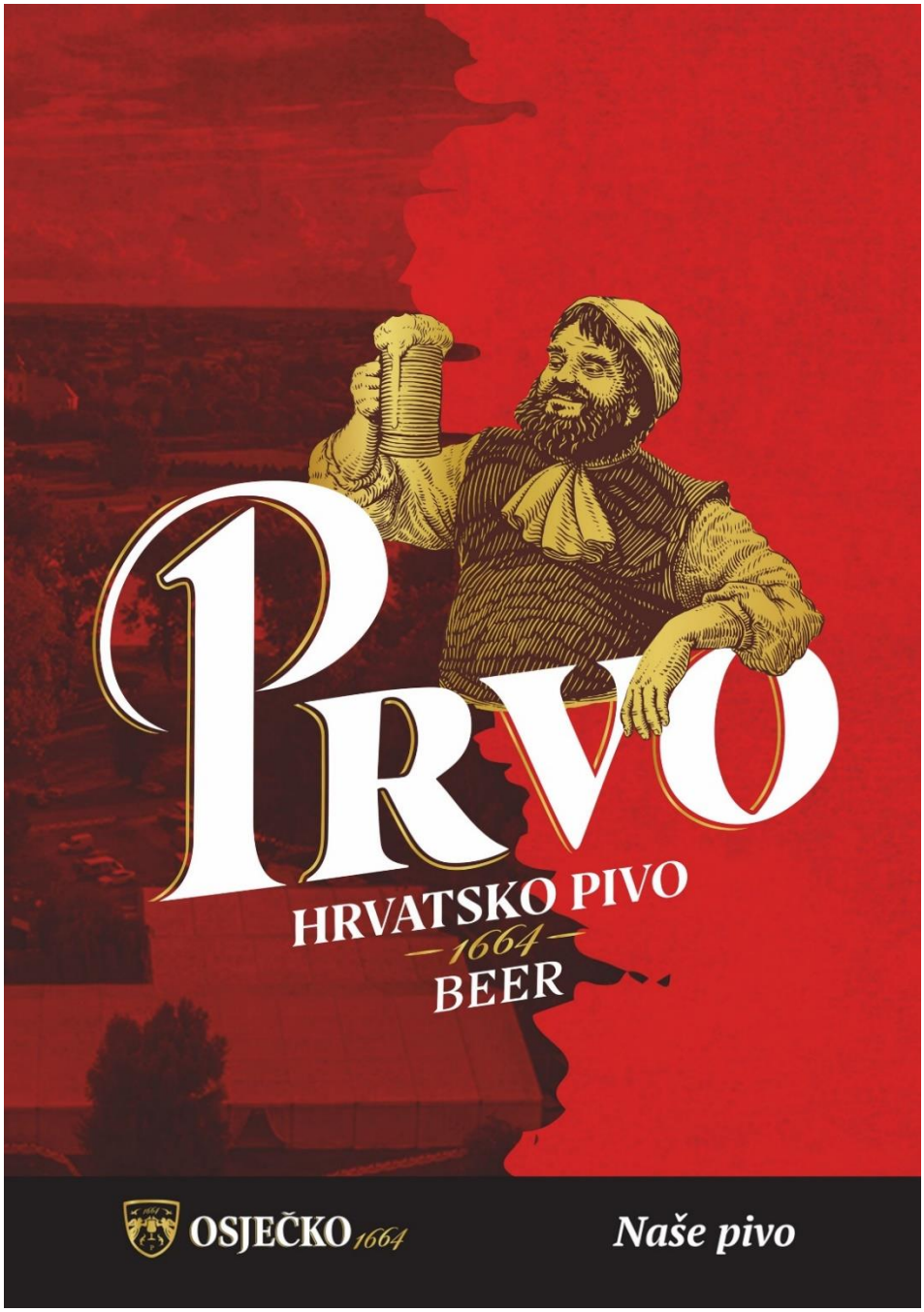
BIO*kvanta*

BIOQUANTA d.o.o. za istraživanje i razvoj
Trg Zlate Bartl 11/A
48000 Koprivnica
OIB: 12026620869
info@bioquanta.hr

Bioquanta d.o.o. je hrvatsko poduzeće koje se bavi istraživanjem, razvojem i savjetovanjem.
U istraživačkom radu poduzeće se bavi istraživanjem bioaktivnih molekula te prirodoskladnih tehnologija i bioprocesa. Posebno područje interesa je bobičasto voće. U tom smislu Bioquanta provodi više vlastitih istraživačkih projekata gdje surađuje sa znanstveno-istraživačkim institucijama u zemlji i inozemstvu.
U području razvoja Bioquanta zajedno s domaćim i inozemnim partnerima sudjeluje u razvoju projekata za industriju, posebice prehrambenu i druge industrije, dajući svoja znanja i iskustva u području tehnologije, inženjerstva i financija, prateći projekte od ideje do realizacije. Do sada je u suradnji s našim kupcima razvijeno više desetaka različitih projekata.
U području savjetovanja poduzeće se bavi pripremom i provedbom projekata financiranih iz Europskih strukturnih i investicijskih fondova i drugih izvora. U tom smislu je tijekom proteklog razdoblja za naše kupce odobreno više od 40 milijuna eura bespovratnih sredstava. Ukupna vrijednost projekata na kojima je poduzeće do sada radilo iznosi više od 80 milijuna eura.

Ključne kompetencije poduzeća su istraživanje i razvoj proizvoda i usluga; inženjerski pristup rješavanju problema; priprema i provedba projekata za poduzetnike, obiteljska poljoprivredna gospodarstva, ustanove i jedinice lokalne samouprave; izrada studija izvedivosti, poslovnih planova, investicijskih i predinvesticijskih studija; primjena znanstvene metodologije u upravljanju projektima.

OTHER SPONSORS AND DONORS / OSTALI SPONZORI I DONATORI



IV. FIB CONFERENCE, 2024

ISBN: 978-953-7005-99-3 (USB)
ISBN: 978-953-7005-98-6 (mrežno izdanje)