



**UNIVERSITY OF FOOD
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Bulgarian National Association
Essential Oils, Perfumery & Cosmetics

MAEP&WASTE

**Medicinal, Aromatic and Edible Plants (MAEPs) and their by-products:
Utilization and valorization for a sustainable and circular economy**

Conference program

of the 1st International Applied Scientific Conference **Medicinal, Aromatic and Edible
Plants (MAEPs) and their by-products: Utilization and valorization for a
sustainable and circular economy - MAEP&WASTE 2020**

Wednesday September 08 2021
Arrival and accommodation

Thursday September 09 2021 – Grand Hotel Plovdiv



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08:00-11:00 – registration (lobby at the hotel)

08:45-09:00 – opening of the conference – Welcome address:

CEO of BNAEOPC – 5 min;

RECTOR of UFT – 5 min;

Organizers welcome – 5 min

Moderator – Associate Professor PhD Anton Slavov

09:00-09:30 – **plenary lecture (on site): Kemal Husnu Can Baser** – Turkey as a source for medicinal and aromatic plants. *Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia, N. Cyprus*

09:30-10:00 – **plenary lecture (on line): Liudmil Antonov**, Daniela Nedeltcheva, Vera Deneva, Kamelia Gechovska, Viktor Markuliev, Ivan Bakardzhiyski, Krasimir Bambalov, Diana Tsobanova, Valentin Bambalov – Big abilities of small instruments: portable NIR and Raman spectroscopy in analysis of wine and natural products. *Bulgarian Academy of Sciences, Institute of Organic Chemistry with Center of Phytochemistry, Akad. Georgi Bonchev Str., building 9, Sofia, Bulgaria*

10:00-10:15 – short presentation (**on site**): Nicole Parapanova, Sofia Dimova, Ivelina Koicheva, Kuril Simitchiev¹, Ginka Antova², Galya Toncheva³ – ICP-MS and MP-AES investigation of the essential and trace element content in green and red algae from coastal waters of the Bulgarian Black Sea area. ¹*Department of Analytical Chemistry and Computer Chemistry, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria;* ²*Department of Chemical Technology, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria;* ³*Department of General and Inorganic Chemistry, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria*

10:15-10:30 – short presentation (**on site**): Milena Dimitrova, Ivelina Ivanova, Galin Ivanov, Kiril Mihalev – Influence of the polyphenol extract from rose (*Rosa damascena* Mill.) petals on the growth and activity of probiotic bacteria in yogurt. *University of Food Technologies, Technological Faculty, Department of Milk and Dairy Products Technology, Department of Analytical Chemistry, Department of Food Preservation and Refrigeration Technology, 26 Maritza Blvd. BG 4000 Plovdiv, Bulgaria*

10:30-10:45 – coffee break (posters could be placed)

10:45-11:00 – short presentation (**on line**): Ivan Atanasov, Krasimir Rusanov, Tzvetelina Zagorcheva, Mila Rusanova, Marina Alexeeva, Romyana Velcheva – Current experience and research directions in AgroBioInstitute, related to sustainable utilization of bio-resources of medicinal and aromatic plants and valorization of agro-industry wastes and by-products. *Agrobiointitute, Agricultural Academy, 8 Dragan Tsankov Blvd., Sofia, Bulgaria*

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11:00-11:15 – short presentation (**on line**): Krasimir Rusanov¹, Ivan Atanassov¹, Natasha Kovacheva² – Essential oil roses – current status of genomics and metabolomics studies with capacity for practical application. ¹Agrobiointitute, Agricultural Academy, 8 Dragan Tsankov Blvd., Sofia; ²Rosa Select Ltd., Bulgaria

11:15-11:30 – short presentation (**on line**): Biliana Georgieva¹, Daniela Karashanova¹, Radoslav Angelov¹, Ivelina Vasileva², Totka Dodevska², Anton Slavov² – TEM analysis on morphology and phase composition of silver nanoparticles, obtained by a “green” method. ¹Institute of Optical Materials and Technologies “Acad. J. Malinowski”, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 109, 1113 Sofia, Bulgaria; ²Department of Organic Chemistry and Inorganic Chemistry, Technological Faculty, University of Food Technologies, 26 Maritsa Blvd., Plovdiv 4000, Bulgaria

11:30-11:45 – short presentation (**on site**): David Lewis – Advances in minimal processing of high acid and low acid ingredients and products for food, cosmetic and medical applications. Foodstream Pty Ltd., ABN 56 117 205 311, PO Box 767, Mount Ommaney QLD 4074, Australia

11:45-12:00 – short presentation (**on site**): Hristo Kalaydzhev¹, Radoslav Georgiev¹, Petya Ivanova¹, Magdalena Stoyanova², Cristina L. M. Silva³, Vesela Chalova¹ – Enhanced solubility of rapeseed meal protein isolates prepared by sequential isoelectric focusing. ¹Department of Biochemistry and Molecular Biology, University of Food Technologies; ²Department of Analytical Chemistry and Physicochemistry, University of Food Technologies, 26 Maritsa Blvd., 4002 Plovdiv, Bulgaria; ³Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal

12:00-12:15 – short presentation (**on site**): Stefan Dragoev, Desislav Balev, Desislava Vlahova-Vangelova, Nikolay Kolev, Kamelia Dimova – Improving the meat quality by feed supplementation with distilled rose petals. Department of Meat and Fish Technology, University of Food Technologies, 26 Maritsa Blvd., Plovdiv 4000, Bulgaria

12:15-13:15 – lunch

Moderator – Associate Professor DSc Kiril Mihalev

13:15-13:30 – short presentation (**on site**): Zhana Petkova, Ginka Antova, Maria Angelova-Romova – Fat-soluble biologically active components and physico-chemical characteristics of lupin seed oil (*Lupinus angustifolius* L. cultivar ‘Boregine’), Department of Chemical Technology, University of Plovdiv ‘Paisii Hilendarski’ 24 Tzar Asen Str., 4000 Plovdiv, Bulgaria

13:30-13:45 – short presentation (**on site**): Nenko Nenov – Advanced methods for extraction of valuable compounds from plants and their wastes–liquefied gas and superheated water extraction. Innosolv Ltd. – Plovdiv, Bulgaria

13:45-14:00 – short presentation (**on site**): Rada Dinkova¹, Fabian Weber², Vasil Shikov¹, Alexios Vardakas¹, Maike Passon², Andreas Schieber², Kiril Mihalev¹ – Polyphenols from plant by-products and their role in fruit processing. ¹Department of Food Preservation and Refrigeration Technology, University of Food Technologies, 26 Maritsa Blvd., Plovdiv 4000, Bulgaria; ²Department of Nutritional and Food Sciences, Molecular Food Technology, University of Bonn, Germany

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14:00-14:15 – short presentation (**on site**): Belgin Cosge Senkal¹, Tansu Uskutoglu¹, Hafize Fidan², Stanko Stankov², Hulya Dogan⁴, Albena Stoyanova³ – Essential oil composition and heavy metal content of *Salvia aethiopsis* L. from Turkey. ¹Department of Field crops, Faculty of Agriculture, Yozgat Bozok University, 66900, Yozgat, Turkey; ²Department of Nutrition and Tourism, University of Food Technologies, 26 Maritza Blvd., Plovdiv, Bulgaria; ³Department of Tobacco, Sugar, Vegetable and Essential oils Technology, 26 Maritza Blvd., Plovdiv, Bulgaria; ⁴Department of Plant and Animal Production, Vocational School of Technical Sciences, Yozgat Bozok University, 66200, Yozgat, Turkey

14:15-14:45 – coffee break (posters could be placed)

14:45-15:00 – short presentation (**on site**): Zapryana Denkova¹, Rositsa Denkova-Kostova², Ivelina Vasileva³, Anton Slavov³ – Antimicrobial activity of plant extracts of rose by-products from the essential oil industry against saprophytic and pathogenic microorganisms. ¹Department of Microbiology, ²Department of Biochemistry and Molecular Biology, ³Department of Organic chemistry and Inorganic chemistry, University of Food Technologies, 26 Maritsa Blvd., Plovdiv 4000, Plovdiv, Bulgaria

15:00-15:15 – short presentation (**on site**): Rosen Chochkov¹, Ivelina Vasileva¹, Anton Slavov¹, Dimitar Penkov² – Effect of rose waste (*Rosa damascena* Mill) in quality characteristic of sweet baked bun. ¹University of Food Technology, 26 Maritsa Blvd., Plovdiv 4000, Bulgaria, ²Medical University – Plovdiv, Bulgaria

15:15-15:30 – short presentation (**on site**): Nikoleta Yantcheva, Ivelina Vasileva, Anton Slavov – Obtaining and characterization of water and water-ethanolic extracts from industrial rose wastes. Department of Organic and Inorganic Chemistry, University of Food Technologies, 26 Maritsa Blvd., Plovdiv 4000, Bulgaria

15:30-15:45 – short presentation (**on line**): Hulya Dogan¹, Tansu Uskutoglu², Hafize Fidan³, Stanko Stankov³, Belgin Cosge Senkal², Hatice Bas⁴, Albena Stoyanova⁵ – Production and trade of medicinal aromatic plants in Turkey. ¹Department of Plant and Animal Production, Vocational School of Technical Sciences; ²Department of Field crops, Faculty of Agriculture; ⁴Department of Biology, Faculty of Science and Letters, Yozgat Bozok University, Yozgat, 66100, Turkey; ³Department of Nutrition and Tourism; ⁵Department of Tobacco, Sugar, Vegetable and Essential oils Technology, 26 Maritza Blvd., Plovdiv, Bulgaria

15:45-16:00 – short presentation (**on line**): Nils Haneklaus^{1,2}, Peter Fröhlich², Martin Bertau², Ivelina Vasileva³, Gergana Marovska³, Petya Georgieva⁴, Anton Slavov³ – Potential use of rose petal biowaste for wastewater treatment and energy production in Bulgaria. ¹Td Lab Sustainable Mineral Resources, Danube University Krems, Dr.-Karl-Dorrek-Straße 30, 3500 Krems, Austria; ²Institute of Chemical Technology, Freiberg University of Mining and Technology, Leipziger Straße 29, Freiberg, Germany; ³Department of Organic Chemistry and Inorganic Chemistry, University of Food Technologies, 26 Maritsa Blvd., 4002 Plovdiv, Bulgaria; ⁴Department of Biochemistry and Molecular Biology, University of Food Technologies, 26 Maritsa Blvd., 4002 Plovdiv, Bulgaria

16:00-16:30 – **plenary lecture (on line): Angela M. Fraser** – Prevalence of human noroviruses in U.S. foodservice establishments: The importance of environmental sanitation. Clemson University, Department of Food, Nutrition and Packaging Sciences, Clemson, SC 29634, 206 Poole Agriculture Center, USA

16:45-17:30 – **plenary lecture (on line): Fabian Weber** – Valorization of press residues from the juice and wine industry. Rheinische Friedrich-Wilhelms University of Bonn, Institute of Nutritional and Food Sciences, Molecular Food Technology, 19b Endenicher Str., Bonn 53115, Germany

17:30-18:00 – Closing ceremony and poster session awards

19:00 – Diner – at **Grand Hotel Plovdiv** restaurant

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Friday September 10 2021: Meetings and sightseeing



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ABSTRACTS



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ORAL PRESENTATIONS



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PL1. TURKEY AS A SOURCE FOR MEDICINAL AND AROMATIC PLANTS

Kemal Husnu Can Baser

*Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia,
N. Cyprus, www.khcbaser.com, khcbaser@gmail.com*

Abstract

The rich and diverse flora of Turkey is well documented in 11 volumes (1-3). Thanks to its geographical location with land in Asia and Europe at the junction of three phytogeographic regions (Mediterranean, Euro-Siberian, Irano-Turanian), under the influence of three different climates (Mediterranean, Continental and Oceanic) and its natural diversity blended with cultural richness throughout centuries Turkey enjoys a rich inventory of plants used in medicine, agriculture, food, cosmetics, flavours and fragrances and other related sectors. Important cultivated and wildcrafted plants like opium poppy, oregano, thyme, sage, sideritis, mint, rose, laurel, anise, licorice, gypsophila, salem, etc. which have been used and traded since time immemorial, and essential oils obtained from aromatic plants will be covered in this lecture.

References

- [1] Davis P. H. (Ed.). *Flora of Turkey and the East Aegean Islands*, Vols. 1–9, University Press, Edinburgh (1965–1985).
- [2] Davis P. H., Mill R. R., Tan K. (Eds.). *Flora of Turkey and the East Aegean Islands*, (Supplement), Vol. 10, University Press, Edinburgh (1988).
- [3] Güner A., Özhatay N., Ekim T., Başer K. H. C.. *Flora of Turkey and the East Aegean Islands* (Supplement 2), Vol. 11, University Press, Edinburgh (2000).



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PL2. BIG ABILITIES OF SMALL INSTRUMENTS: PORTABLE NIR AND RAMAN SPECTROSCOPY IN ANALYSIS OF WINE AND NATURAL PRODUCTS

Liudmil Antonov¹, Daniela Nedeltcheva¹, Vera Deneva¹, Kamelia Gechovska¹, Viktor Markuliev¹, Ivan Bakardzhiyski², Krasimir Bambalov², Diana Tsobanova², Valentin Bambalov³

¹*Institute of Organic Chemistry with Centre of Phytochemistry, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria*

²*Department of Technology of Wine and Beer, University of Food Technologies Plovdiv, Plovdiv 4002, Bulgaria*

³*Department of Viticulture, Agricultural University-Plovdiv, Plovdiv 4000, Bulgaria*

Abstract

Green analytical chemistry is a part of the sustainable development concept in science and technology. It is based on a new philosophy for performing routine and R&D analytical work: less waste, less time, less energy, finally less expenses and pollution, more valuable information. Miniaturisation of analytical devices and shortening the time elapsing between performing analysis and obtaining reliable analytical results are among the important aspects in making methods for analysis green. Miniaturization is one of the key elements: the advances in the electronics and optics allow designing the devices smaller and smaller, integrating, at the same time, more and more functions. Starting from the huge benchtop instruments, requiring specific infrastructure and highly qualified personnel (off-line analysis) nowadays the smartphone based personalized analysis (on-line analysis) is not an impossible dream. Miniaturization, as a concept, unavoidably has established the non-destructive measurements as a standard, not only in very sensitive fields like cultural heritage, but in any aspect of our daily life analytics.

As a consequence, in recent years, great efforts were made in the development of accurate and fast analytical techniques, which require no sample preparation. Special attention is given to the use of vibrational techniques for food and beverages authenticity control, process control of pharmaceuticals and natural products due to their rapid, automated, low cost and non-destructive character. In addition, the progress made in the field of chemometric methods increased the versatility and application of vibrational techniques (IR or Raman) in the related industries. Unfortunately, the main disadvantage of IR spectroscopy is the limitation for the water-rich samples assessment (e.g. wine), due to the strong absorption bands of water. In the contrary, Raman spectroscopy appears to be more suitable for the vibrational assessment of water containing samples, due to the relatively weak water signals in the vibrational fingerprint range.

The miniaturization of the IR and Raman instruments makes them powerful analytical devices. In the present lectures the capabilities of portable near IR (NIR) and Raman spectroscopy for on-line monitoring will be demonstrated by number of cases: polyphenols in Bulgarian wines; active components (phenolic acids, flavonoids, and sesquiterpene lactones) in Arnicae flos; ethanol content in Bulgarian rose oil.

Acknowledgements: The financial support from Bulgarian Science Fund (Project DCOST01/5/2018) is gratefully acknowledged. We thank the COST Action CA16215 (PortASAP) „European Network for the promotion of portable, affordable and simple analytical platforms“ for the ideas and knowledge exchange.



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PL3. PREVALENCE OF HUMAN NOROVIRUSES IN U.S. FOODSERVICE ESTABLISHMENTS: THE IMPORTANCE OF ENVIRONMENTAL SANITATION

Angela M. Fraser

*Department of Food, Nutrition, and Packaging Sciences, Clemson University, Clemson,
SC 29634 USA*

Abstract

Globally, norovirus is the most common cause of acute gastroenteritis. The most common modes of transmission are person-to-person, followed by food, then environmental surfaces. Although transmission of human norovirus in food establishments is commonly attributed to consumption of contaminated food, transmission via contaminated environmental surfaces, such as those in bathrooms, may also play a role. Our aim was to determine the prevalence of human noroviruses on bathroom surfaces in commercial food establishments in three U.S. states under non-outbreak conditions. Food establishments (751) were randomly selected from nine counties in each state. Four surfaces (underside of toilet seat, flush handle of toilet, inner door handle of stall or outer door, and sink faucet handle) were swabbed in male and female bathrooms using premoistened macrofoam swabs. A checklist was used to collect information about the characteristics, objects, and materials in bathrooms. In total, 61 (1.5%) of 4,163 swabs tested were presumptively positive for human norovirus, 9 of which were confirmed by sequencing. Some factors associated with the presence of human norovirus included being a chain establishment (OR, 1.9; 95% CI, 1.1 to 3.3; $P < 0.05$), being a unisex bathroom (versus male: OR, 2.0; 95% CI, 0.9 to 4.1; $0.05 < P < 0.10$; versus female: OR, 2.6; 95% CI, 1.2 to 5.7; $P < 0.05$), having a touchless outer door handle (OR, 3.3; 95% CI, 0.79 to 13.63; $0.05 < P < 0.10$), and having an automatic flush toilet (OR, 2.5, 95% CI, 1.1 to 5.3; $0.05 < P < 0.10$). Our findings confirm it is difficult to detect human noroviruses under non-outbreak conditions. Therefore, routine implementation of good environmental sanitation practices, including procedures for cleaning up bodily fluids (e.g., vomitus), is critical to preventing norovirus outbreaks.



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PL4. VALORIZATION OF PRESS RESIDUES FROM THE JUICE AND WINE INDUSTRY

Fabian Weber

*Institute of Nutritional and Food Sciences, Molecular Food Technology,
University of Bonn – Germany*

Abstract

During berry juice processing and winemaking, a considerable part of the fruits is lost as the pomace, which contributes up to 20-25% of the fruits' weight. Because of the extremely large amounts and its susceptibility to spoilage, these residues are a considerable ecological and economical issue for the beverage industry. However, grape pomace contains a large number of valuable components. The recovery of phenolic compounds from pomace as biological active compounds has a long history of research regarding their antimicrobial, antioxidant, coloring properties. More recently, dietary fiber also contained in the pomace has come into the focus of researchers. These polysaccharides consist of not only hemicellulose and cellulose but contain also a fraction called non-extractable polyphenols. These polyphenols are strongly associated with cell wall polysaccharides and proteins and cannot easily be extracted. Therefore, the term "antioxidant dietary fiber" has been coined and studies suggest that the polyphenols impart health benefits after release in the colon and metabolism by gut bacteria. Eventually, the seeds of the fruits might contain valuable oil that might also be recovered.

But despite a lot of research into the utilization of these side-streams, an integrative concept that allows companies to select processes for the recovery of valuable compounds according to their needs is missing.



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SP1. ICP-MS and MP-AES investigation of the essential and trace element content in green and red algae from coastal waters of the Bulgarian Black Sea area

Nicole Parapanova¹, Sofia Dimova¹, Ivelina Koicheva¹, Kuril Simitchiev¹, Ginka Antova²,
Galya Toncheva³

¹*Department of Analytical Chemistry and Computer Chemistry, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria*

²*Department of Chemical Technology, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria*

³*Department of General and Inorganic Chemistry, University of Plovdiv, 24 Tsar Assen St., 4000 Plovdiv, Bulgaria*

Abstract

This work presents a summary of the research related to the element content in green (*Ulva lactuca*, *Bryopsis plumosa*) and red algae (*Callithamnion corymbosum*, *Polysiphonia sp.*) from the coastal waters of the Bulgarian Black Sea area. Samples from three habitats were studied. Essential elements in algae (Ca, Na, K, Mg) were examined by MP-AES. The results obtained for the trace elements content (Ni, Cu, Zn, Mn, As, Pb, Hg) tested by ICP-MS were compared with commercially purchased marine samples.

Trace element content in dry samples seawater algae species were 40.2-62.3 mg/g for calcium, 3.1-10.3 mg/g for magnesium, 13.0-30.8 mg/g for potassium, 5.8-28.1 mg/g for sodium, 0.2-1.1 mg/g for iron, 21.2-75.7 µg/g for zinc, 6.8-10.4 µg/g for copper, 28.4-88.7 µg/g for manganese, 0.2-0.7 µg/g for nickel. The concentration ranges of some contaminants have also been determined: 2.0-20.2 µg/g for arsenic, 0.2-4.1 µg/g for lead and less than 0.07 µg/g for mercury. While calcium was the highest macro element concentration, manganese was the highest trace element in samples. The data on the content of fiber, carbohydrates and proteins are commented. Most of the analyzed samples were edible.

Keywords: seawater algae, ICP-MS, MP-AES, trace elements, essential elements

Acknowledgements: This work was supported by the Plovdiv University Scientific Fund (grant No SP21-HF004).



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SP2. INFLUENCE OF THE POLYPHENOL EXTRACT FROM ROSE (*ROSA DAMASCENA* MILL.) PETALS ON THE GROWTH AND ACTIVITY OF PROBIOTIC BACTERIA IN YOGURT

Milena Dimitrova¹, Ivelina Ivanova², Galin Ivanov¹, Kiril Mihalev³

¹*University of Food Technologies, Technological Faculty, Department of Milk and Dairy Products Technology, 26 Maritza Blvd. Plovdiv 4002, Bulgaria*

²*University of Food Technologies, Technological Faculty, Department of Analytical Chemistry, 26 Maritza Blvd. Plovdiv 4002, Bulgaria.*

³*University of Food Technologies, Technological Faculty, Department of Food Preservation and Refrigeration Technology, 26 Maritza Blvd. Plovdiv 4002, Bulgaria*

Abstract

The objective of the present study was to characterize polyphenol-enriched extract from industrial plant by-products (distilled rose petals) and to investigate the effect of the addition of this extract in milk on the growth and activity of yogurt starter culture. Polyphenol-enriched extract from distilled rose petals (RPE) was obtained by adsorption technology and characterized by high-performance liquid chromatography-electrospray ionization mass spectrometry (HPLC-ESI-MS). Among the 24 major compounds analyzed, only kaempferol and quercetin glycosides were detected. The total polyphenol content of the extract and the antioxidant activity of yogurt samples were studied. The total antioxidant capacity was evaluated using DPPH- (2,2-diphenyl-1-picrylhydrazyl-hydrate) radical and FRAP- (ferric reducing antioxidant power) assays. The RPE was characterized by high total polyphenol content: $47283.3 \pm 19.96 \text{ mgGAE} \cdot 100\text{g}^{-1}$ of dry extract and high antioxidant activity: DPPH = $3013 \pm 3.60 \text{ } \mu\text{molTE} \cdot \text{g}^{-1}$ and FRAP = $3625 \pm 7.30 \text{ } \mu\text{molTE} \cdot \text{g}^{-1}$. The growth and acidification activity of the probiotic lactic acid bacteria were slightly affected by the enrichment of milk with polyphenol extract. The results reported in the present study indicated that polyphenol-enriched extract from industrial plant by-products (distilled rose petals) can be considered as a relevant source of bioactive compounds. They also proved to be an interesting choice for improving the functional characteristics of probiotic yogurts.

Keywords: LC-MS, polyphenols, probiotic bacteria, rose petals, yogurt.

Acknowledgments: This work was supported by the Bulgarian Ministry of Education and Science under the National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" approved by DCM # 577 / 17.08.2018".

The authors would like to express their gratitude to Dr. Maïke Passon, Institute of Nutrition and Food Sciences, University of Bonn, Germany, for the identification of polyphenol compounds.



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**SP3. CURRENT EXPERIENCE AND RESEARCH DIRECTIONS
IN AGROBIOINSTITUTE, RELATED TO SUSTAINABLE
UTILIZATION OF BIO-RESOURCES OF MEDICINAL AND
AROMATIC PLANTS AND VALORIZATION OF AGRO-INDUSTRY
WASTES AND BY-PRODUCTS**

Ivan Atanasov, Krasimir Rusanov, Tzvetelina Zagorcheva, Mila Rusanova, Marina Alexeeva,
Rumyana Velcheva

Agrobiointitute, Agricultural Academy, 8 Dragan Tsankov Blvd., Sofia, Bulgaria

Abstract

Bulgaria is well known with the great biodiversity of medicinal and aromatic plants /MAP/ and long and well established traditions in their utilization. It includes collection of over 700 MAP, regularly harvesting of natural populations and processing of over 200 MAP and industrial cultivation of smaller set of MAP. The increasing interest in using natural phytoproducts of various purposes during this century, resulted in higher demands from production of MAP biomass and processed products. Accordingly, there is steadily growing interest from industrial cultivation of larger range of MAP and elevation the efficiency of the currently cultivated MAP. On the other hand, the increased volumes of processed MAP biomass result in generation of larger volumes of by- and waste products, rich of bioactive compounds with high capacity for valorization. Here we present an overview of the research and current experience of AgroBioInstitute /ABI/ in support of cultivation and sustainable utilization of bio-resources of medicinal and aromatic plants and valorization of agro-industry wastes and by-products. Examples from the related ABI research work are pointed out. The methodological challenges and solutions, and further directions of ABI research in these areas are put forward, including planned activities of the currently developed 'Center of competence' project BG05M2OP001-1.002-0012 / "Sustainable utilization of bio-resources and waste of medicinal and aromatic plants for innovative bioactive products"



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SP4. ESSENTIAL OIL ROSES – CURRENT STATUS OF GENOMICS AND METABOLOMICS STUDIES WITH CAPACITY FOR PRACTICAL APPLICATION

Krasimir Rusanov¹, Ivan Atanassov¹, Natasha Kovacheva²

¹ *AgroBioInstitute, Agricultural Academy, 8 Dragan Tsankov Blvd., 1164, Sofia, Bulgaria*

² *Rosa Select Ltd*

Abstract

Essential oil roses have been grown for more than 300 years in Bulgaria for production of essential oil, rose water, rose concrete and absolute. In spite of the long tradition, essential oil roses have been vegetatively propagated and breeding has been mostly limited to clonal selection. Improvement based on cross-pollination has been generally avoided. During the last 15 years our knowledge for the two main species *Rosa damascena* Mill. and *Rosa alba* L. has grown considerably. Here we review the current status on essential oil roses research based on the application of modern molecular marker techniques for genotyping and marker assisted selection as well as the application of high-throughput profiling of volatiles in essential oils and flower extracts for evaluation and improvement of the agricultural practices. We draw the perspectives for enlarging the genetic resources of essential oil roses in Bulgaria as well as for valorization of the agri-wastes from the essential oil industry.



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SP5. TEM ANALYSIS ON MORPHOLOGY AND PHASE COMPOSITION OF SILVER NANOPARTICLES, OBTAINED BY A “GREEN” METHOD

Biliana Georgieva¹, Daniela Karashanova¹, Radoslav Angelov¹, Ivelina Vasileva², Totka Dodevska², Anton Slavov²

¹ *Institute of Optical Materials and Technologies “Acad. J. Malinowski”, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 109, 1113 Sofia, Bulgaria*

² *Department of Organic Chemistry and Inorganic Chemistry, Technological Faculty, University of Food Technologies, 26 Maritza Blvd., Plovdiv 4002, Bulgaria*

Abstract

In this study we present “green” synthesis of Ag nanoparticles (NPs), obtained by reduction of silver salt (AgNO_3), using water extract of solid waste from *Rosa damascena* Mill. petals, pasteurized and live beer yeasts and combinations thereof. The morphology, microstructure and phase composition of Ag NPs are investigated by High Resolution Transmission Electron Microscopy (HRTEM) and Selected Area Electron Diffraction (SAED). Histograms of nanoparticles distributed by their diameters are constructed using the data acquired with Image J computer program.

The TEM analysis of silver nanoparticles synthesized by the “green” method, found that the smallest particle sizes were obtained by reduction of AgNO_3 with pasteurized beer yeast. The average particles diameters in this case are below 5 nm, due to the formation of AgNPs in polyphenol-poor media where fewer silver atoms are produced. These particles crystallize only in the cubic face centered silver phase. In other experiments, extracts rich in polyphenols (*Rosa damascena* aqueous solution, live beer yeast, and the combinations) are applied as reducing agents. These experimental conditions favor the formation of much larger silver nanoparticles with average diameters up to 25 nm. The indexing of SAED patterns reveals the presence of both cubic and hexagonal silver phases.

Acknowledgment: The authors are grateful to the financial support of National Science Fund of Bulgaria; project DN 17/22 “Valorization and application of essential oil industry wastes for “green” synthesis of metal nanoparticles”.

Research equipment of distributed research infrastructure INFRAMAT (part of Bulgarian National roadmap for research infrastructures) supported by Bulgarian Ministry of Education and Science under contract D01-284/17.12.2019 was used in this investigation.



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SP6. ADVANCES IN MINIMAL PROCESSING OF HIGH ACID AND LOW ACID INGREDIENTS AND PRODUCTS FOR FOOD, COSMETIC AND MEDICAL APPLICATIONS

David Lewis

*Director, Foodstream Pty Ltd Australia, Member of the Australian
Institute of Foodscience and Technology*

*Foodstream Pty Ltd Australia is a group of Professional Engineers,
Technologists and Scientists working in the commercial food industry around the world*

www.foodstream.com.au

Abstract

Foodstream has been conducting research and development and applied for patents for products and processes that utilize minimal processing to improve organic ingredient and product quality.

Products produced using these processes have the following qualities:

1. comply with international standards for safety
2. extended shelf life
3. minimal change to the; active ingredients, colour, flavour, aroma, texture

The processes vary depending if the products are low acid or high acid.

Low acid products are processed close to harvest and require a continuous cold chain distribution.

High acid products are processed close to harvest and are thermally processed in a retort so may be chilled or ambient shelf stable products.

Products produced are closer to fresh and have a standout point of difference in the marketplace. This means that the products are Premium and can command a higher value than existing products. The extended shelf life allows the Premium Products to be Exported to Premium Markets maximising returns for the producer and processor.

The author will present photographs of some products produced utilizing Foodstream Technology.



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SP7. ENHANCED SOLUBILITY OF RAPESEED MEAL PROTEIN ISOLATES PREPARED BY SEQUENTIAL ISOELECTRIC FOCUSING

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Abstract

The solubility of plant protein isolates is a key determinant of their functional properties and potential application. Two protein isolates from ethanol-treated industrial rapeseed meal, PI_{10.5-2.5} and PI_{2.5-8.5}, were prepared by sequential isoelectric focusing of alkali-extracted proteins (pH 12) starting from pH 10.5 to 2.5 or from pH 2.5 to 8.5, respectively. Biochemical analyses revealed that PI_{2.5-8.5} contained a higher amount of crude protein (72.84%) than PI_{10.5-2.5} (68.67%). In the same protein isolate, PI_{2.5-8.5}, the level of total phenols (0.71%) was almost 2-fold higher than that in PI_{10.5-2.5} (0.42%). No glucosinolates were established in both protein isolates. SDS-PAGE analysis demonstrated that PI_{10.5-2.5} contained a larger amount of 10 to 15 kDa protein fractions, while the PI_{2.5-8.5} was enriched in 18 to 29 kDa protein fractions. The PI_{10.5-2.5} exhibited high solubility varying from 41.74% at pH 4.5 to 65.13% at pH 6.5, while PI_{2.5-8.5} was almost two-fold less soluble under the same conditions. Up to pH 5.5, the addition of NaCl at 0.03 and 0.25 M diminished the solubility of PI_{2.5-8.5}, while the solubility of PI_{10.5-2.5} was increased. The supplementation of PI_{10.5-2.5} with 0.25M NaCl enhanced the protein solubility to 56.11% at pH 4.5 and 94.26% at pH 6.5. The addition of 0.03 M NaCl also increased the solubility of this protein isolate but at a lower extension. Overall, the chosen approach for sequential precipitation of proteins influenced the biochemical characterization, fractional profile and solubility of the isolates, and could be used to prepare protein-rich products with desired nutritive and functional properties.

Acknowledgements: This study was financially supported by Bulgarian Ministry of Education and Science under the National Research Programme “Healthy Foods for a Strong Bio-Economy and Quality of life“, DCM № 577/17.08.2019 and National Science Fund, project № KII-06-H37/21 “An integrated approach for efficient utilization of by-products of vegetable oil producing industry: Sunflower and rapeseed meals”.



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SP8. IMPROVING THE MEAT QUALITY BY FEED SUPPLEMENTATION WITH DISTILLED ROSE PETALS

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Abstract

The increasing of meat nutritional value by feed supplementation in order to obtain functional meat and meat products is a challenge and innovation. The distilled rose petals are an interesting by-product, a waste material in rose oil and rose water production (*Rosa Damascena* Mill.) containing a wide range of antioxidant components - flavonoids with synergistic, antioxidative and antibacterial effect. The use of distilled dried rose petals (DDRP) as a supplement in broilers feed increased the tocopherols content by 37%. The poly unsaturated fatty acid content in enriched chicken drumstick was three times higher than controls. The DDRP feed supplementation in laying guinea (*Numida meleagris*) lead to three weeks earlier first laying intensity period and had positive effect on eggs essential amino acids content and poly unsaturated fatty acid content. In pork, the DDRP feed supplementation increased with 5% the content of poly unsaturated fatty acids (m. Semimembranosus, m. L. dorsi and fat). The use of DDRP enriched meat is appropriate for manufacturing of functional sausages with half added nitrites due to the stabilizing effect on colour characteristics (L^* , a^* , b^*), the decreasing of TBARS and increasing of the product shelf life.



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SP9. FAT-SOLUBLE BIOLOGICALLY ACTIVE COMPONENTS AND PHYSICO-CHEMICAL CHARACTERISTICS OF LUPIN SEED OIL (*LUPINUS ANGUSTIFOLIUS* L. CULTIVAR 'BOREGINE')

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Abstract

Fat-soluble biologically active components and physico-chemical characteristics of lupin seed oil (*Lupinus angustifolius* L. cultivar 'Boregine') have been examined. The seeds were with German origin but introduced in Bulgaria. Their oil content was found to be 7.4%. Nineteen fatty acids were detected in the lupin seed oil and the major one was linoleic (41.0%), followed by oleic (32.9%) and palmitic acid (11.9%). Unsaturated fatty acids (79.6%) predominated in the lipid fraction and the amount of the polyunsaturated fatty acids (46.1%) was higher than monounsaturated ones (33.5%). Unsaponifiable matters in the oil were 3.0% and total sterols – 1.0%, in which β – sitosterol (71.3%) was the main component. Total tocopherol content of the oil was significantly high (1585 mg/kg) and γ – tocopherol (92.2%) was the major compound. The content of the total carotenoids was 2068 mg/kg. Total phospholipids in the oil were 5.5% and the main component was phosphatidylinositol (33.8%), followed by phosphatidylcholine (21.2%). The fatty acid composition of the main phospholipid classes of lupin seed oil (*Lupinus angustifolius* L. cultivar 'Boregine') were determined for the first time and the main fatty acid was found to be oleic (43.1 – 48.3%), followed by linoleic (23.8 – 30.6%), and palmitic (13.6 – 20.1%) acids. There were no significant differences between the fatty acid composition of the triacylglycerols and these of the main phospholipids. The physico-chemical characteristics (such as peroxide, iodine and saponification values, relative density and refractive index) of lupin seed oil were in the range of the recommended limits for crude oils, apart from the acid value which was slightly higher. The oxidative stability of the oil was over 100 h which depicted the longer shelf life of the lupin seed oil.

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SP10. ADVANCED METHODS FOR EXTRACTION OF VALUABLE COMPOUNDS FROM PLANTS AND THEIR WASTES – LIQUEFIED GAS AND SUPERHEATED WATER EXTRACTION

Nenko Nenov

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Abstract

Sub-critical extraction method using liquefied food grade gas has been developed by the author in recent years as effective tool for production of valuable compounds from natural resources like herbs, spices, hemp, etc. It offers a number of technological advantages like excellent target selectivity, soft extraction parameters, solvent safety, low capital and operational cost. The produced extracts are thin to dense colored liquids featuring strong typical smell of raw material or high content of targeted molecules with application in food, cosmetic and medicinal products. The method is patented and highly commercialized worldwide in industrial scale by own design and production equipment.

Superheated water extraction method is another tool for medicinal plants extraction developed by the author. It is still in laboratory stage researches and offers promising perspectives for “green” extraction. It uses as solvent only water even for non-polar compound avoiding any organic solvents.



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SP11. POLYPHENOLS FROM PLANT BY-PRODUCTS AND THEIR ROLE IN FRUIT PROCESSING

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Abstract

The focus of this study was on developing of new enzyme-assisted processes for the recovery of polyphenols from plant by-products and their applications for polyphenol enrichment of fruit-based products. Our study was based on local plants, namely bilberry (*Vaccinium myrtillus* L.) from the region of the Rhodopa Mountain and Bulgarian oil-bearing rose (*Rosa damascena* Mill.).

A novel process, comprising of partial dejuicing of the mash followed by enzymatic maceration, was developed for the extraction of a polyphenol-rich bilberry juice.

Following a minimal processing strategy in order to keep the sensory profile as natural as possible, freshly pressed strawberry and bilberry juices were obtained for preparing functional beverages by addition of rose petal extract.

Further, the polyphenol enrichment of strawberry spread was shown to be worthwhile, enhancing both the antioxidant capacity and color quality.

The results obtained demonstrate an improved storage stability of anthocyanins, enzymatically released from the bilberry skin matrix. Moreover, applying enzyme-assisted juice extraction technology may be very helpful, allowing both enhanced contents of bioactive compounds and extended microbiological shelf-life. This polyphenol fortification is also worthwhile from a sensory quality point of view, enhancing colour intensity, thus meeting the growing consumer demand for substitution of synthetic food additives by natural alternatives.



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SP12. ESSENTIAL OIL COMPOSITION AND HEAVY METAL CONTENT OF *SALVIA AETHIOPIS* L. FROM TURKEY

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Abstract

Mediterranean sage (*Salvia aethiopis* L.) is a common species in Turkey belonging to the family Lamiaceae and could be used as tea, ointment or for treatment of various diseases *etc.* *S. aethiopis* was collected from the Yozgat Bozok University Erdoğan Akdağ Campus area, in June 2017. The essential oil was isolated from leaves by hydrodistillation and analyzed by means of GC and GC/MS. Among the 22 components identified in this essential oil (yield 0.15%), aromadendrene (18.03%), *trans*- α -bisabolene (5.72%), caryophyllene oxide (30.11%), α -humulene epoxide (5.78%) were found to be the major constituents. Concentrations of potentially harmful heavy metals (Al, Cd, Co, Cr, Ni) were below its respective toxic levels. *Salvia aethiopis* essential oil could be considered as a prime potential additive or ingredient for application in the food and cosmetic industries.

Key words: *Salvia aethiopis*, essential oil, heavy metal



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SP13. ANTIMICROBIAL ACTIVITY OF PLANT EXTRACTS OF ROSE BY-PRODUCTS FROM THE ESSENTIAL OIL INDUSTRY AGAINST SAPROPHYTIC AND PATHOGENIC MICROORGANISMS

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Abstract

In a series of experiments, the inhibitory effect of plant extracts derived from waste raw materials from the essential oil industry (roses, white yarn, lavender, chamomile, Melissa and salvia) against pathogenic microorganisms, causing food toxicoinfection and intoxication, and saprophytic bacteria, yeasts and fungi, causing food spoilage, were determined. The lowest antimicrobial activity was established for aqueous extracts of the roses waste material while the highest antimicrobial activity was demonstrated by the water-alcoholic (70%) extracts. The latter inhibited the growth of the test-pathogenic bacteria and yeast to varying degrees, with MICs ranging from 6 ppm to 600 ppm. In determining the effect of the extracts on saprophytic microorganisms, all the extracts were found to inhibit the growth of spore-forming bacteria *B.subtilis*, yeast *C.utilis* and fungi *R.arrhizus*. The growth of the remaining fungi in the study was suppressed only by the 70% alcoholic extracts, with a MIC = 600 ppm for all. Lesser inhibitory activity was determined in the extracts of waste raw materials from white yarn, lavender, chamomile, melissa and salvia, with MICs being between 60 ppm and 600 ppm. The antimicrobial effect of the 70% alcohol extracts from these waste raw materials on the growth of all pathogenic microorganisms included in the study was significant. The extracts from the waste materials from white yarn, lavender, chamomile, melissa and salvia inhibited the growth of *Bacillus subtilis* and yeast *Candida utilis*. Only the 70% water-alcohol extracts affected fungal growth with a MIC of 600 ppm. Gram-positive bacteria were more sensitive to the plant extracts tested (IZ=8-22.5 mm), with a minimum inhibitory concentration of 60 ppm. The Gram-negative bacteria tested were less sensitive (IZ=8-12.5 mm) with a minimum bactericidal concentration of 600 ppm. This was due to the difference in the structure and composition of the cell wall of the two bacterial groups. The results show that bioactive ingredients that can be extracted with various agents remain in the rose oil waste products. Many of them have antimicrobial activity against pathogenic and saprophytic microorganisms. Therefore, alone or in combination with other extracts, they can be used for the biopreservation of food and beverages.

Acknowledgements: The experimental work in the present study was funded by project DN 17/22 of the BNSF "Valorization and application of essential oil industry wastes for "green" synthesis of metal nanoparticles".



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SP14. EFFECT OF ROSE WASTE (*ROSA DAMASCENA* MILL.) IN QUALITY CHARACTERISTIC OF SWEET BAKED BUN

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Abstract

In recent years, there has been an increasing emphasis on the introduction of technologies, including in the food industry, that have led to a reduction in the quantity of waste produced and a more efficient waste using. The objective of this study was to determine the quality characteristics of sweet baked bun with the addition of rose oil industry waste (*Rosa damascena* Mill.) in quantities of 2.5, 5.0, 7.5 and 10.0 %. The results of the study showed that low added quantities of rose waste lead to a decrease in the volume, respectively, specific volume of samples. Higher quantities (7.5 and 10.0 %) sharply reduce the volume and specific volume of products. The quantities of added rose waste do not significantly effect on products mass. Sensory evaluation of samples with rose oil waste was performed by 25 panelists. It was found that with increasing quantities of rose waste, the crust color was very intense. The crumb color, appearance and porosity, intensity increased with the addition of high quantities of rose waste. The chewing score of all samples was slightly lower than that of the control sample. The aroma and taste of the samples were pleasant and specific to the added functional component. The addition of 10 % rose oil waste revealed that the products have a pronounced residual taste (aftertaste). As a result of the research carried out, it was found that the best quality characteristic of enriched sweet baked bun was obtained by the addition of 2.5 and 5.0 % of rose oil waste.

Acknowledgements: This work was supported by the Bulgarian Ministry of Education and Science under the National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" approved by DCM # 577/17.08.2018" and by project DN 17/22 from 12.12.2017 "Valorization and application of essential oil industry wastes for "green" synthesis of metal nanoparticles" funded by the National Science Fund (Ministry of Education and Science) of Bulgaria.



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SP15. OBTAINING AND CHARACTERIZATION OF WATER AND WATER-ETHANOLIC EXTRACTS FROM INDUSTRIAL ROSE WASTES

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Abstract

Oil-bearing roses are an emblematic symbol of Bulgaria, with high economic importance. In their industrial processing significant amount of waste is generated. This waste is most often discarded, used as compost or for animal feed. Recently the industry has been interested in reducing waste from the production of rose oil in order to utilize them from an environmental point of view and reducing the cost of the main product. Hence, the aim of present study was to explore possibility for utilization of wastes for obtaining of polyphenol-rich extracts and characterize them in order to find suitable applications. The industrial rose wastes were resulted from traditional steam-water distillation, CO₂, hexane and freon extraction. They were collected from different distilleries and then were extracted with water, 30% and 70% ethanol solutions, and after filtration aqueous and water-ethanol (30 and 70%) extracts and alcohol insoluble residues (AIR) were obtained. The extracts were characterized for polyphenols, proteins, galacturonic acid and neutral sugars content. By comparing the results it could be concluded that extraction with freon, hexane and CO₂ preserves to a higher extent the polyphenol compounds. The extracts exhibited high antimicrobial activity against *Staphylococcus Aureus* ATCC 25923, *L. monocytogenes* ATCC 19111, *Pr. Vulgaris* ATCC 6380, *Can. albicans* NBIMCC 74 and antisaprophytic activity against *B. subtilis* ATCC 19659 and *C. utilis* ATCC 42402.

Practical applications: The results from the analyses suggested that the rose oil industry wastes are rich source of polyphenols and could be used as source of dietary antioxidants. The extracts could be also utilized as 'green' reducing agents for metal nanoparticle synthesis.

Key words: waste valorization; polyphenols; antioxidant activity; antimicrobial activity

Acknowledgements: This work was supported by the Bulgarian Ministry of Education and Science under the National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" approved by DCM # 577/17.08.2018" and by project DN 17/22 from 12.12.2017 "Valorization and application of essential oil industry wastes for "green" synthesis of metal nanoparticles" funded by the National Science Fund (Ministry of Education and Science) of Bulgaria.



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SP16. PRODUCTION AND TRADE OF MEDICINAL AROMATIC PLANTS IN TURKEY

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Abstract

The trading of medicinal and aromatic plants is usually done in dried form, or as essential oil and fresh plants. About half a million tonnes of dried medicinal and aromatic plants are traded internationally each year worldwide. Besides, a considerable amount of medicinal and aromatic plants are traded in local (national) markets, the quantity of which is not known exactly. Medicinal and aromatic plants are used for many purposes such as food, medicine, and cosmetics from the past to the present. While some of these plants are harvested from nature, some are cultivated and produced. Eighty percent of the population in developing countries uses herbal products for therapeutic purposes. Medicinal plants also play an important role in the lives of rural people in Turkey. It is estimated that at least 1 000 of the species in Turkey are used in various ways and 400 of them are traded. Most of the medicinal and aromatic plants traded in Turkey are collected from nature. In this study, the medicinal and aromatic plant production and trade situation in Turkey will be reviewed by screening the data obtained from the International Trade Statistics Database and Turkish Statistical Institute records.

Key words: Medicinal plant, trade, Turkey.



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SP17. POTENTIAL USE OF ROSE PETAL BIOWASTE FOR WASTEWATER TREATMENT AND ENERGY PRODUCTION IN BULGARIA

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Abstract:

Bulgaria generates some 30,000-40,000 tons of organic waste (old rose petals) every year during rose oil production. The rose petal biowaste is largely disposed improperly now causing bio pollution. Researchers from Danube University Krems (DUK) in Austria, the University of Food Technologies (UFT) in Plovdiv and Freiberg University of Mining and Technology (TU-BAF) in Germany are working on different solutions for sustainable rose petal waste utilization in Bulgaria. This presentation provides an overview of how rose petal biowaste could potentially be used for wastewater purification at a copper processing plant in Bulgaria and energy production through subsequent gasification and combustion of the loaded biosorbents.

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SP. OBTAINING OF NEW AROMATIZED WINES WITH ADDED ROSE-OIL INDUSTRY WASTES

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Abstract

Aromatized wines are wines which organoleptic character is obtained through addition of natural aromatizing substances and/or natural aromatizing compositions and /or herbs and spices, including their extracts, and/or combinations of the above-mentioned. Among the most common aromatizing materials are: wormwood, *Gentianella* (dwarf gentians), mint, cinnamon, cardamom, *Sambucus* (elder), nutmeg, *Coriandrum sativum* (coriander), rosemary, conifer, goatweed (St. John's wort), cloves, vanilla, sweet flag (calamus), pine resin, quinine, etc. Utilization of agricultural or food industry by-products for preparation of aromatized wines is insignificant. For example, St. Raphael aperitif is prepared using peels from bitter oranges (also added cinchona barks, vanilla, cacao beans and aroma plants). Therefore, the aim of the present study was to investigate the possibility for preparation of new aromatized wines with addition of wastes from the rose oil industry by co-fermentation of the grape must and the wastes.

Six variants of aromatized wines (W1-W6) with addition of essential rose oil industry wastes in the course of fermentation of grape must were prepared. During the fermentation the most intensive colors were observed in the variant (W6) with higher amount of added waste due to anthocyanins co-pigmentation. The polyphenol content increased significantly from 355.01 ± 10.14 to 576.08 ± 12.08 $\mu\text{mol GAE L}^{-1}$ for the control and W6, respectively. The major phenolic acids determined were 3,4-dihydroxy benzoic acid and gallic acids. β -Caryophyllene, β -citronellol, phenethyl alcohol, rose oxides, and geraniol content increased significantly compared to control and gave pleasant rose aroma. The results of the sensory tests revealed that most of the panelists preferred W1 and W2. The variants W3 to W6 were characterized with more pronounced rose aftertaste. The results suggested that rose waste successfully could be utilized for preparation of new type aromatized wines.

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SP. DETERMINATION OF PECTIN METHYLESTERASE ACTIVITY OF PRICKLY PEAR (*OPUNTIA FICUS-INDICA* L.) FRUIT AND ITS KINETIC PARAMETERS

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Abstract

The prickly pears (*Opuntia ficus-indica*) belonged to the Cactaceae family are grown in arid and semi-arid regions and harvested in summer to fall season in Mediterranean basin, United states and South America. Besides having pleasure flavor, high betalain pigment, vitamin C, mineral content and amino acid such as proline and taurine are made prickly pear as very useful functional food or food ingredient. In this study, biochemical properties of Pectin Methyl Esterase (PME) enzyme obtained by partial purification from prickly figs such as optimum temperature, optimum pH, maximum reaction rate (V_{max}), substrate specificity (K_m) and thermal stability were investigated. Apple pectin was used as substrate for calculations of crude PME extract activity. It was found that early season prickly pears have higher PME activity than the mid-season fruits. The enzyme has an optimum activity at pH 7.0 and optimum temperature of 40 °C. K_m and V_{max} values of enzyme were calculated as 0.162 mg/ml and 3.0553 unit, respectively. Crude PME extract was found as heat resistant and it was recommended that further purifications of crude enzyme extract are needed.



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SP. ANTIBACTERIAL ACTIVITIES OF *CORIANDRUM SATIVUM* AND *PIMPINELLA ANISUM* SEED EXTRACTS AND ESSENTIAL OILS

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Abstract

The coriander and anise seeds were macerated (3 times each solvent) with hexane, ethyl acetate, and methanol, respectively. Each extract was concentrated under reduced pressure to give a solvent-free residue, and crude hexane (0.85 g for coriander; 2.74 g for anise), ethyl acetate (1.15 g for coriander; 3.67 g for anise), and methanol (13.77 g for coriander; 34.94 g for anise) extracts. Also, essential oils of the seeds were obtained by hydrodistillation method for 3 hours with Clevenger-type apparatus. Essential oil composition of seeds oils were analyzed by means of gas chromatography-mass spectrometry (GC-MS). The main compounds of coriander and anise oils were linalool (60.5%) and (*E*)-anethole (86.0%), respectively. Additionally, antibacterial activities of essential oils and extracts were determined against *Staphylococcus aureus* ATCC 29213, *Bacillus cereus* ATCC 14579, *Enterobacter aerogenes* ATCC 13048 and *Escherichia coli* ATCC 25922 by using broth microdilution and disc diffusion methods. The experiments were started with 8 mg/mL of extracts and oil for microdilution assay and 10 mg/disc of extracts and oil were used for disc diffusion assay. Chloramphenicol was used as positive control for both assays. All experiments were done duplicated.

The ethyl acetate and methanol extracts of both plants showed inhibitory activity against the tested bacteria in disc diffusion assay. The minimum inhibitory concentration (MIC) values of coriander hexane extract were 2 mg/mL for *S. aureus* and 8 mg/mL for *B. cereus*. The anise essential oil showed inhibitory activity against *E. coli* and *E. aerogenes* with 8 mm inhibition zone diameter in diffusion assay.



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SP. POSSIBILITIES FOR APPLICATION OF ROSE OIL WASTE (*ROSA DAMASCENA* MILL.) IN MUFFINS

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Abstract

It is important to choose the appropriate non-traditional functional component, in order to obtain an enriched quality confectionery product. The objective of this study was to identify the potential application of rose oil industrial waste (*Rosa damascena* Mill.) in different quantities (2.5, 5.0, 7.5 and 10.0 %) in muffins. The results from the analyses showed that the low added quantities of rose waste increase the volume, respectively the specific volume of samples. Higher added quantities reduced the specific volume of all samples. The index H/D of all samples was higher than the control sample except in highest added quantity. Quantitative descriptive sensory analysis was performed. From the data obtained, it was found that with the increase in the quantity of rose waste, the crust of color and crumb was very intense, while the chewiness and softness of the crumb of all the samples was identical to that of the control sample. The aroma and taste were specific for the used raw material. By addition of highest percentage of rose waste to the wheat flour, the muffins had a strong residual taste. Based on the results obtained for protein and ash content, it was found that with increasing the quantities of rose waste, the results were higher in all samples compared to the control. As a result of the research carried out, it was found that the rose waste can be used for direct use in muffins, as a substitute for white wheat flour, in quantities up to 5 %.

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POSTER PRESENTATIONS



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PP1. FUR4SUSTAIN – COST ACTION FOR CHEMICALS FROM BIOREFINERIES

Topic: Waste minimization and valorization of MAEPs processing by-products

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Abstract

The COST Action – FUR4Sustain is about the chemicals and plastics produced from biobased 2,5-furandicarboxylic acid (FDCA). FUR4Sustain project (“European network of FURan based chemicals and materials FOR a Sustainable development”) will realize R&D for the whole value chain of FDCA, involving up to now 28 countries worldwide, and more than 40 institutions (including several industries).

FDCA is an added value chemical, coming out of biorefineries, and holding great promise as a key building block, especially due to its resemblance to the petrochemical terephthalic acid (TPA). In 2004, FDCA has been identified as a key chemical for the future development of the biobased economy in a key study conducted by the US ‘National Renewable Energy Laboratory.



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PP2. KNOWLEDGE, ATTITUDES AND FOOD SAFETY PRACTICES OF FOOD HANDLERS IN CATERING ESTABLISHMENTS IN PLOVDIV, BULGARIA

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Abstract

The globalization of the food chain has posed new challenges and risks to the health and interests of consumers. For example, people from all over the world become ill as a result of the inadequately prepared food they consume every day. Access to safe food is one of the key factors for achieving good health and gaining consumer confidence and to ensure the sustainability of food production. Consequently, this study aimed to assess the knowledge, attitudes and food safety practices of food handlers in catering establishments in Plovdiv, Bulgaria. We surveyed food handlers (n=100), from different age groups (up to 18 – 40 years old) working in catering establishments in Plovdiv, Bulgaria during January 2020. The questionnaire that was compiled and used in the study was developed by taking into consideration the review of the scientific literature and methods used by previous researchers. In order to ensure the reliability of the study, a literature review was done beforehand, followed by an English-language questionnaire which was tested with 15 randomly chosen respondents. These respondents stated that they encountered no difficulties in completing the survey and that the language was easy to understand. Most of the respondents possessed an acceptable understanding of the storage time, proper arrangement and alternation of stored foods, and awareness of compliance with an adequate storage period. Regulations related to sanitizing and cleaning equipment and contact surfaces were followed. More than 41% of the participants had good knowledge, and most had positive attitudes and reported good food safety practices. However, there was a lack of knowledge regarding temperature danger zones, ideal refrigeration measures and temperature control during cooking. Our observations thus confirmed the importance of improving the training programs for food handlers in catering establishments in Plovdiv.

Keywords: food safety; food handlers; food establishment



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PP3. CHEMICAL CHARACTERIZATION OF *ARTEMISIA ANNUA* L. SUBCRITICAL EXTRACT

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Abstract

Aerial parts of *Artemisia annua* L. from Bulgaria have been extracted with 1,1,1,2 tetrafluoroethane. Static two-stage extraction at a pressure of 8 and 12 Bar was used at a relatively low temperature. The extraction yield was 2%.

GC-MS analysis showed that the extract contained the essential oil constituents but in lower concentrations. In total, 28 components were identified, the main ones being artemisia ketone (26.2 %), camphor (10.78 %) and eucalyptol (9.1 %). The presence of artheanin B (3.7 %) and arteannuic acid (3.7 %) were found to be co-metabolites and precursors of artemisinin.

The content of the sesquiterpene lactone artemisinin determined spectrophotometrically was found to be of 1.28 ± 0.10 %. The results revealed that the extract is of interest with the presence of biologically active substances used as a modern anti-malaria agent.



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PP4. GC-MS BASED METABOLITE PROFILING AND FREE RADICAL SCAVENGING ACTIVITY OF *HELICHRYSUM ITALICUM* (ROTH) G. DON. WASTES AFTER DISTILLATION

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Abstract

Distillation waste water, by-products from steam and water distillation as well as untreated flowers used as control of *Helichrysum italicum* were comparative analyzed for content of the biologically active compounds by GC/MS. Acetone exudates, methanolic extracts and ethyl acetate fractions obtained after alkaline hydrolyze of the studied materials were received. The three types of extraction products as well as the distillation waste water were examined for free radical scavenging activity by DPPH radicals.

Phenolic, fatty and organic acids, sterols, triterpenes, sugars and sugar alcohols were identified. Succinic acid and myo-inositol were identified as main components of distillation waste water. Hydroxycinnamic acid, caffeic acid and 4(p)-hydroxybenzoic acid were dominant compounds of the ethyl acetate fractions. Triterpenes and fatty acids are among the main biologically active substances in the methanolic and acetone exudates. The amounts of identified compounds are lower in the by-products compared to the raw material.

The ethyl acetate fractions were found to possess the highest free radical scavenging activity ($IC_{50} < 50 \mu\text{g/mL}$) which is explained by the high content of phenolic acids in them. Methanolic extracts also showed high activity IC_{50} around $50 \mu\text{g/mL}$ whereas exudates displayed the lowest ($IC_{50} > 200 \mu\text{g/mL}$). Significant differences in the activity of treated and untreated materials were not found.

The results show that the by-products of *Helichrysum italicum* contain important biologically active substances and from them extracts with high antioxidant activity can be obtained. Finding application of these waste products will allow a fuller use of the plant raw material of the species.



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PP5. BULGARIAN CONTRIBUTION TO THE INVESTIGATION OF NATURAL AROMATIC PRODUCTS: A BRIEF RETROSPECTIVE REVIEW

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Abstract

Bulgaria is one of the countries with established traditions in the production and processing of aromatic (essential oil bearing) and medicinal plants, as well as in the investigation of the respective plant-derived products. These natural aromatic products (oils, concretes, absolutes, and other extraction concentrates) combine valuable olfactory profiles and beneficial biological and pharmacological activities, which substantiate their use in perfumery, cosmetics, aromatherapy, medicine, food, and many other areas. Therefore, this work presents a brief retrospective review (1900 – 2019 year) of the achievements of Bulgarian researchers in the study of the chemical composition, the antimicrobial, antioxidant and other activities of traditional and contemporary natural aromatic products, obtained from different, indigenous or uncommon to the country, medicinal and aromatic plants. The review does not claim to be exhaustive in terms of Bulgarian research achievements in the indicated timespan, neither has the objective to cover world research on aromatic and medicinal plants.

Keywords: medicinal and aromatic plants; natural aromatic products; biological activity; Bulgaria.



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PP6. BIOSYNTHESIS AND POTENTIAL APPLICATIONS OF SILVER AND GOLD NANOPARTICLES IN ELECTROANALYSIS

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Abstract

Nanotechnology has recently become one of the most active research fields in the areas of material science, chemistry and electrocatalysis. Metal nanoparticles (NPs) have a great scientific interest because of their unique properties. Due to their extremely small size and large specific surface area, metal NPs exhibit unusual physicochemical and electronic properties, compared to that of bulk metals. Nowadays, the development of NPs-based electrochemical sensor devices has great attention in the field of food analysis owing to their attractive performances: high sensitivity and selectivity, fast response and ease of use. Not at least, the electrochemical sensors offer the possibility of miniaturization and potential for development of portable hand-held devices for real time monitoring. In this work, silver and gold nanoparticles (AgNPs and AuNPs) have been synthesized using plant-mediated synthesis as an alternative, efficient, eco-friendly and cost-effective method. Extensive studies have been performed to explore the electrochemical behavior of biosynthesized AgNPs/AuNPs and their potential applications for electrochemical quantitative detection of hydrogen peroxide (H₂O₂), vanillin and nitrite (NO₂⁻) in micromolar levels.



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PP7. A NOVEL PROCESS FOR ENZYME-ASSISTED SUBCRITICAL WATER EXTRACTION OF RICE HUSK POLYPHENOLS

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Abstract

Rice husk (hull) is the main by-product from rice milling industry. This study investigated the potential for utilization of rice husk as a source of polyphenols. A novel process, combining enzyme-assisted and subcritical water extraction, was established on a pilot-plant scale. Recovery rate of total polyphenols (2.97 g GAE/kg rice husk powder) was comparable to those obtained when rice husk was extracted using ethanol. Following green technology approach, the newly developed process may provide an alternative to the conventional organic solvent extraction.



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PP8. FACTORS AFFECTING THE AMOUNT OF BIOLOGICALLY ACTIVE SUBSTANCES IN EXTRACTS OF PLANTS TYPICAL OF WESTERN RHODOPE

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Abstract

In order to obtain extracts maximally enriched with biologically active substances, it is necessary to study and select suitable conditions for carrying out the extractions.

Five Bulgarian plants were selected that thrive in the Western Rhodopes: fresh flowers (*Onopordum acanthium* and *Crataegus*), flowering stems (*Hypericum perforatum* and *Thyme*), and fruits (*Crataegus* and *Juniperus*).

The effect of the storage of fresh herbs (dried and frozen) on the content of biologically active substances has been investigated. Higher amounts of total phenols and flavonoids were found in the dried raw materials. The highest amount of biologically active compounds from the dried materials was found in the thyme and from the frozen ones - in the *Hypericum perforatum*.

The method of extraction (classical and ultrasonic extraction) has been found to influence the amount of biologically active substances extracted. The results showed that in the classical extraction, the yield of biologically active compounds was almost twice as high as in ultrasonic extraction. Therefore, in the following experiments, aiming at selecting the type and concentration of the extractant (H₂O, 30%, 50%, 70% or 95% C₂H₅OH), extracts of dried *Thyme* and frozen *Hypericum perforatum* were obtained by the classical method.

The analyses performed showed that the type of extractant and the concentration of ethanol affected the amount of extracted biologically active compounds. The most suitable extractant was found to be 70% ethyl alcohol.



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PP9. APPLICATION OF DISTILLED ROSE PETALS EXTRACT IN MEAT MATRIX

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Abstract

An interesting new natural ingredient – dried distilled rose petal extract (DDRPE), a waste material in rose oil and rose water production (*Rosa Damascena* Mill.) was studied as additive during sausage processing. DDRPE is rich of flavonoids and have potential antioxidative and antibacterial effect. The dry distilled rose petals extract (DDRPE) was added in cooked and dry fermented sausages in order to reduce the nitrite or nitrate content. The addition of 1.140 g/kg dry distilled rose petals extract to the filling mass of Bulgarian lukanka type dry fermented sausages with a half-reduction of nitrate content improved the colour characteristics and decreased the primary lipid oxidation compounds, but cannot prevent the outgoing lipolysis and accumulation of secondary lipid oxidation products. The use of 0.03 % or 0.05 % DDRPE preserves the color characteristics in cooked sausages. The DDRPE added at 0.05 % to the filling mass reduced protein oxidation in and decreased formation of secondary products of lipid oxidation in cooked sausages with 50% reduced nitrite content. The rose petal extract can be successfully used as additive for development new functional meat products with halfway reduced amounts of nitrites.



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PP10. A COMPARISON OF TOTAL PHENOLS CONTENT AND ANTIOXIDANT ACTIVITY IN THE EXTRACTS FROM ROSE PETALS (*ROSA DAMASCENA* MILL.) GROWN UNDER ORGANIC AND CONVENTIONAL SYSTEMS

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Abstract

The aim of the current study was to compare the total polyphenols content and the antioxidant activity in 80 % methanol extracts from *Rosa damascena* petals cultivated in organic and conventional systems. Rose flowers were collected from six farms situated in Kazanlak valley, three fields grown conventionally and the other three grown organically. Ultrasound-assisted extraction was performed to obtain the rose petal extracts. The total phenols content, total flavonoids and antioxidant activity (DPPH, ABTS, FRAP and CUPRAC methods) were determined. In general, roses grown in organic agriculture system demonstrated the highest total phenol content in the range of 63.45 to 73.23 mg gallic acid equivalent/g dry weight. The total flavonoids did not exceed 12 mg quercetin equivalents/g dry weight in the samples from both agriculture systems. A strong correlation between antioxidant activity (ABTS, DPPH and CUPRAC methods) and total polyphenol content was found. Principal component analysis (PCA) was performed to gain an overview of the effect of growing conditions on the antioxidant activity and polyphenols content. Therefore, the roses growing under organic systems demonstrated better antioxidant activity. The polyphenols content in their petals was approximately 40 % higher than in the conventionally grown samples. This trend in exceeded levels of secondary metabolites as phenolic compounds could be explained with the natural defense of plants against environmental conditions.

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PP11. PRELIMINARY STUDY ON QUANTIFICATION OF SOME FLAVONOIDS IN *ROSA ALBA* L. AND *ROSA DAMASCENA* MILL. CULTIVATED IN THRACIAN VALLEY

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Abstract

The white rose, *Rosa alba* L., occupies second place in the rose production in Bulgaria. Nowadays its essential oil has two fold higher price than this of *Rosa damascena* Mill., and its plantation area increased continuously. But the plant is not well studied as a source of biologically active substances extracted from the polar fractions, e.g. flavonoids, which have a proven antioxidant potential.

The focus of the present study was the quantification of three major flavonoids – rutin (RU), quercetin (QU) and kaempferol (KA), in *Rosa alba* L. and *Rosa damascena* Mill. cultivated in Thracian Valley, by HPLC-PDA method.

The results demonstrated the largest and the lowest RU content in methanolic extracts from petals of *Rosa alba* L. and petals of *Rosa damascena* Mill. – 43.0 ± 3.7 and 12.1 ± 0.9 mg/g dm, respectively. The highest QU and KA contents were found in the methanolic extract from petals of *Rosa damascena* Mill. – 3.24 ± 0.28 and 0.83 ± 0.07 mg/g dm, and the lowest in the petals of *Rosa alba* L. – 0.40 ± 0.05 and 0.05 ± 0.01 mg/g dm, respectively. This correlates to the coloring – the yellow-brownish quercetin and kaempferol in the petals of the white rose is in small quantities. Despite higher QU and KA concentration levels of *Rosa damascena* Mill., the antioxidant activity of methanolic extracts from flowers of *Rosa alba* L. is stronger – 467 ± 22 and 613 ± 42 mmol TE/g dm, respectively.

The study must be continued and the chemical composition of the polar fraction from flowers of the both plant species must be determined.

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**PP12. INVESTIGATION OF BLUEBERRY CULTIVARS
(*VACCINIUM CORYMBOSUM* L. VAR. BLUEGOLD, VAR. BLUECROP
AND VAR ELLIOTT) AND WILD BLUEBERRY
(*VACCINIUM ULIGINOSUM* L.) GROWN IN BULGARIA AS
POTENTIAL SOURCES OF PENTACYCLIC TRITERPENES**

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Abstract

The blueberries have commonly-recognized with their taste properties they are also a valuable source of health-promoting bioactive compounds. For several decades, blueberries have gained in popularity all over the world, and recent years have seen not only an increase in fresh consumption but also in the importance of blueberries for the processing industry. The 4,4-dimethyl phytosterols and triterpene family show great potential in the fight against various diseases such as inflammation, neurodegenerative disease, cancer, cataract, etc. This work presents results of the investigation of the chemical composition and quantity of triterpenes accumulated in the leaves of blueberry crops (*Vaccinium corymbosum* L. var. Bluegold, var. Bluecrop and var. Elliott) and wild grown blueberry (*Vaccinium uliginosum* L.) from different population – Perelik hill (Rodopi mountain), Cherni hill (Vitocha mountain) and Beklemeto area (Balkan mountain).

In the investigated population and cultivar from blueberry have been identified four pentacyclic triterpenes – oleanolic acid (from 271 to 981 µg/g DW), ursolic acid (from 845 to 1994 µg/g DW), lupeol (from 73 to 331 µg/g DW) and α-amyrin (from 84 to 182 µg/g DW). The ursolic acid is the dominant pentacyclic triterpenes in the investigated berries. In the wild-growing *Vaccinium uliginosum* L. populations only α-amyrin has been not identified. The investigated blueberry species seems to be a potential alternative source of ursolic acid for cosmetics and pharmaceutical industry.

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PP13. COMPARATIVE ANALYSIS OF TRITERPENES PROFILES OF LEAVES OF DIFFERENT WILD POPULATIONS OF BILBERRY (*VACCINIUM MYRTILLUS* L.) AND LINGONBERRY (*VACCINIUM VITIS-IDAEA* L.) GROWN IN BULGARIA

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Abstract:

Worldwide, bilberry (*Vaccinium myrtillus* L.) and lingonberry (*Vaccinium vitis-idaea* L.) are among the most important berry species for the food and pharmacy industries, due to their delicious taste and high content of bioactive substances. Fruits of these species are mostly collected from wild growing plants. Although the number of identified phytochemicals in bilberry and lingonberry is growing, there is still scanty information regarding their triterpenoid content. Wild growing plants such as bilberry and lingonberry are influenced by many abiotic and biotic factors that are a possible reason for the “chemodiversity” observed among plants of the same species growing in different geoclimates. Therefore, the aim of the current study was to identify the main pentacyclic triterpenes in leaves of wild grown bilberries and lingonberries by HPLC-DAD method and to compare their content in populations from different habitats. The content of oleanolic acid in the leaves of bilberry varied between 335.2 µg/g DW and 655.8 µg/g DW, as in the leaves of lingonberry was between 252.1 µg/g DW and 488.7 µg/g DW. Bilberries leaves accumulated ursolic acid between 377.9 µg/g DW and 815.9 µg/g DW, as lingonberries leaves between 355.3 µg/g DW and 1240.2 µg/g DW. Lingonberries leaves biosynthesized significantly higher quantity of lupeol (between 300.5 µg/g DW and 810.2 µg/g DW) and α-amyrin (from 256.5 µg/g DW to 1057.9 µg/g DW) than bilberries leaves. The identified pentacyclic triterpenes in the leaves of lingonberries and bilberries are a prerequisite for their potential application in cosmetic and pharmacy industries.

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PP14. GC-MS BASED ANALYSIS OF CHEMICAL COMPOSITION OF ESSENTIAL OIL OF DIFFERENT POPULATIONS OF *SATUREJA MONTANA* L. WILD GROWN IN BULGARIA

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Abstract:

Satureja montana L., (winter savory) is widely used as a flavoring agent in food products and also as a traditional herbal medicine. The increasing interest of this plant species in the food and cosmetic industries is associated with its high content of essential oil. The production of the essential oil is greatly influenced by climatic and geographic conditions, growth phase, harvest time and others. Thus, the aim of the present study was to investigate the chemical composition of the essential oil of five wild populations of *S. montana* L. growing in Bulgaria. Provided GC-MS analysis revealed that the five *S. montana* populations differed in the type and relative amount of the biosynthesized volatile compounds. The obtained essential oil from P 1 population (Beledie han, Sofia region), contained 35 components, as the terpene borneol (24.02 % of TIC) was the principal one, followed by p-cymene (18.47% of TIC). In the essential oil of P 2 population (Konyavska planina) 27 components were identified and the major compound was monoterpene carvacrol (68.13% of TIC). The essential oil of the other investigated populations P 3 (Golo Bardo, Studena village), P 4 (Predbalkan, Mitrovci village) and P 5 (Jablyano village, Zemen municipality) consisted of 29 compounds, also with the dominant compound carvacrol (61.54 of TIC, 78,86% of TIC and 72.72% of TIC, respectively). The volatile components in the essential oils of analyzed *S. montana* populations determine their potential application in different food and pharmaceutical products with improved health benefits.



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PP15. ASSESSING THE CAPACITY OF ENDOPHYTIC FUNGI, INDIGENOUS AND COMMON YEAST STRAINS FOR BIOTRANSFORMATION OF PHENOLICS FROM ROSE OIL DISTILLATION WASTEWATER

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Abstract

A collection of 139 endophytic fungi isolated from 20 medicinal and aromatic plant species were tested for their capacity to grow on phenolics-rich wastewater obtained after industrial distillation of rose oil (RODW). The comparative analysis showed a wide variation range of the levels of the RODW sugar and phenolics fermentation for the tested fungi isolates. A sub-set of endophytic fungi isolates with high growth rate following RODW cultivation was selected. The biotransformation capacity of the selected isolates was further assessed following larger scale RODW cultivation. HPLC analysis of resin fraction extracts from RODW showed substantial changes of the RODW phenolics composition. We also tested the phenolics biotransformation capacity of indigenous and common yeast cultivated in phenolics-rich rose oil distillation wastewater. The comparative sequence analysis of internal transcribed spacer (ITS) regions of rRNA genes, amplified from DNA samples isolated from RODW collected from traditional waste deposition place (lagoons) demonstrate that the early RODW fermentation was caused by yeast from the genus *Cyberlindnera*. RODW fermentation capacity of selected set of the characterized indigenous yeast isolates and common yeast strains were assessed based on analysis of RODW sugar and phenolics fermentation. The changes of phenolics composition was determined by HPLC analysis. The results demonstrate that the cultivation of some of the indigenous and common yeast strains on RODW reduces the total phenolics content, as well as the levels of particular phenolic glycosides through depletion and fermentation of their sugar part.



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PP16. GENETIC AND FLOWER VOLATILE DIVERSITY IN NATURAL POPULATIONS OF *ORIGANUM VULGARE* L. SUBSP. *HIRTUM* IN BULGARIA

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Abstract

O. vulgare L. subsp. *hirtum* is a flowering plant from the Lamiaceae family, native to the Mediterranean region, which is widely-used as medicinal plant and as food additive due to its high essential oil content. Two hundred thirty-seven plants from 8 natural populations in Bulgaria, belonging to the two typical for this species regions in Bulgaria – the Kresna Gorge and the Eastern Rhodopes, were analyzed for their genetic as well as flower volatile diversity. Sequencing of the *rbcL*, *trnH-psbA* and *matK* regions from the chloroplast genome revealed the existence of 4 different chlorotypes. The obtained results following analysis with SSR and SRAP markers showed that genetic diversity in *O. v.* subsp. *hirtum* in Bulgaria is largely determined by the two distinct regions specific to this species, and the major part of genetic variation within each region is mainly due to variation within populations and not between populations. Metabolic profiling of volatiles from flower extracts resulted in the identification of 63 compounds. PCA analysis based on volatile abundances showed the existence of two major clusters, which corresponded to samples from the two different regions. Forty-five compounds varied statistically significantly between the regions ($p < 0.05$). However, only 10 of them were compounds above 1 %. Carvacrol was the major compound in all analyzed samples with a mean of 59.3 ± 6.88 in the Kresna region and 55.72 ± 6.1 in the Eastern Rhodopes region. Detailed clustering based on similarity of compound abundances allowed the identification of 6 major clusters and 23 sub-clusters of samples. Seeds from plants from each sub-cluster were collected for development of genetic resources collection based on the observed diversity.



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PP17. RAPESEED MEAL ETHANOL-WASH POWDER AS A SOURCE OF BIOACTIVE COMPOUNDS

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Abstract

Rapeseed oil is one of the most common cooking oils in Europe, so several papers regarding its characteristics have been published. However, the interest in the use of the rapeseed meal, a by-product from the oilseed industry, has been increased during the last years. Rapeseed meal is considered rich in phenolic compounds, which are important because of their antioxidant activity. The rapeseed meal was subjected to a 4-step treatment with a 70% aqueous-ethanol solution. The washing liquids from each step were mixed and freeze-dried to obtain a bioactive prepartate (BE). The BE was prepared as a part of a scheme for complete valorization of rapeseed meal. The aims of this work were to determine the total phenolic compounds (TPC) and the antioxidant capacity (AOA) of BE by using soybean oil as a model system. The TPC and AOA in BE were 222.90 ± 20.55 mg gallic acid/g and 71.09 ± 3.94 mg TE/g. Regarding the oxidative stability, the BE had a positive effect on the lipid oxidation protection reducing it by 20% in comparison to the soybean oil alone. Although BE is a waste of the main process of protein isolate preparation from a rapeseed meal, these findings showed its potential as a natural antioxidant. Further studies should be done in order to obtain a confirmation of the oxidative stability capacity in other oil systems.

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PP18. LACTIC ACID BEVERAGE BASED ON WORT AND MINT (*MENTA PIPERITA* L.)

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Abstract

The influence of mint (*Menta piperita* L.) addition on the antioxidant activity and the phenolic content of lactic acid beverage based on wort was investigated. The mint was added before the fermentation at three doses 0.5 g/L; 1.0 g/L; 1.5 g/L. The fermentation was carried out using three different strains from the *Lactobacillus casei* group – *Lactobacillus paracasei* PX3, *Lactobacillus rhamnosus* LBRC11 and *Lactobacillus rhamnosus* Oly. It was found that the mint addition led to an increase in the antioxidant activity. The radical scavenging activity (DPPH assay) and the ferric reducing antioxidant power (FRAP assay) increased up to 49 % and 59%, respectively. The observed increase was different in the variants with different strains from the *Lactobacillus casei* group and was not proportional of the mint dose changes.

Key words: lactic acid fermentation, wort, mint, antioxidant activity, phenolic compounds.



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PP19. PHYSICO-CHEMICAL CHARACTERISTICS OF POLYSACCHARIDES ISOLATED FROM LAVENDER BY-PRODUCTS

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Abstract

The essential oil industry in addition to the main aroma products: essential oil, water, concrete, etc., results every year large quantities of lignocellulosic undervalorized biomass. Such by-products are obtained from processing of common lavender (*Lavandula angustifolia* Mill.) used industrially in Bulgaria, France, etc., mainly for essential oil and water production. The solid biomass mainly is discarded in locations neighboring distilleries where it spontaneously ferments or used for soil amelioration and fertilization. By this way potentially useful biomass is lost, hence the idea behind the present work was utilization of industrial lavender by-products as a source of polysaccharides. Two industrial solid residues were investigated: the first one obtained after supercritical CO₂ extraction (CO₂-L), and the second: obtained after steam distillation of lavender (SD-L). The by-products were pretreated with 70% ethanol and alcohol insoluble residue (AIR) was obtained. The AIRs were subjected firstly to a dilute acid extraction whereat the CO₂-L and SD-L yielded 6.97±0.14% and 5.95±0.23% acid-soluble polysaccharide, respectively. The monosaccharide profile determined by HPLC revealed presence predominantly of galacturonic acid: 672.44±4.89 µg/mg and 619.17±5.23 µg/mg polysaccharide for CO₂-L and SD-L, respectively. The degree of methoxylation: 53.7±1.5% and 48.9±2.5% and degree of acetylation (DAc) 2.7±0.4% and 2.3±0.1% for CO₂-L and SD-L, respectively, suggested that the isolated polysaccharides were middle esterified with low DAc. The polysaccharides were characterized by infrared spectroscopy. Important physico-chemical parameters, such as: surface tension, kinematic viscosity, foam-forming capability, foam-stabilizing ability and emulsification properties were also investigated. The results of the present study suggested that the lavender by-products from essential oil industry could be successfully valorized and serve as source of pectic type polysaccharides.

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