



The Balkan Botanical Congress is an international meeting that has been held nearly every three years, since 1997. It brings together botanists from around the world who perform research on plants in the widest sense, as well as scientists who are engaged in the plant sciences and their applications. We were honored to host such an extraordinary scientific event this year in Serbia.

The 7th Balkan Botanical Congress – 7BBC 2018 took place in Novi Sad from September 10th to 14th 2018. The Congress was organized by the University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology and the “Andreas Wolny” Botanical Society, along with the great help of 7 co-organizers and more than 30 supporters and sponsors. It truly was not possible to happen without exceptional help of our co-organizer - the Institute for Nature Conservation of Vojvodina Province who made this congress not only possible, but totally awesome.

7BBC 2018 placed a special emphasis on plants of the Balkan Peninsula and covered various research fields. The Congress was organized into ten sessions: Plant Anatomy and Physiology, Plant Taxonomy and Systematics, Plant Molecular Biology and Genetics, Floristics, Vegetation and Phytogeography, Conservation Botany and Plant Invasions, Phytochemistry and Plant Resources, Agronomy and Forestry, Botanical Collections and History, Ethnobotany and Cryptogam Biology. These topics were elaborated through five plenary lectures given by eminent scientists, as well as in the form of introductory lectures, oral and poster presentations. With an overall number of 387 abstracts presented on the very latest of botanical science, we shared knowledge, expertise and novel ideas. We welcomed nearly 400 scientists to Novi Sad, and we believe that we succeeded in our joint endeavor to make new networks and new connections among botanists. We hope that we contributed to advancements in the wide and beautiful field of botany, ranging from fundamental botanical research to applied botany.

It is our great pleasure to publish this Abstract Book in Botanica Serbica, in the same year that this international journal, a renamed continuation of the Bulletin of the Institute of Botany and Botanical Garden Belgrade, celebrates its 90 year jubilee. On behalf of the Scientific and Organizing committee of 7BBC 2018 we would like to express our gratitude to all contributors, colleagues and sponsors for taking part in the 7th Balkan Botanical Congress, as well as for their efforts and contributions to it's successful realization.

Goran Anačkov and Lana Zorić,
Co-presidents of the Scientific Committee of the 7 BBC
and guest editors of Botanica Serbica 42 (supplement 1).

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Sessions:

The 7th Balkan Botanical Congress consists of plenary lectures, introductory lectures of each session, as well as oral and poster presentations on the following topics:

Sessions 1. Plant Anatomy and Physiology

Sessions 2. Plant Taxonomy and Systematics

Sessions 3. Plant Molecular Biology and Genetics

Sessions 4. Floristics, Vegetation and Phytogeography

Sessions 5. Conservation Botany and Plant Invasion

Sessions 6. Phytochemistry and Plant Resources

Sessions 7. Agronomy and Forestry

Sessions 8. Botanical Collections and History

Sessions 9. Ethnobotany

Sessions 10. Cryptogam Biology

Oral presentation 05 06 39

PHYTOCHEMICAL SCREENING AND EVALUATION OF ST. JOHN'S WORT (*HYPERICI HERBA*, *HYPERICUM PERFORATUM*, HYPERICACEAE) BIOLOGICAL POTENTIAL – THE IMPORTANCE OF CRUDE DRUG QUALITY CONTROL

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St John's wort is a medicinal plant widely used in traditional, as well in conventional medicine. Considering the rising market demand for *Hyperici herba* as a result of its medical potential, quality control of crude drug is of high importance. The aim of this study was chemical profiling of *Hyperici herba* samples as a part of quality assessment, followed by evaluation of biological potential. Chemical profiling of *Hyperici herba* samples obtained at local markets, pharmacies and health food stores of Balkan Peninsula countries, Austria and Turkey was performed by HPLC-DAD. Furthermore, the water alcoholic extracts of the collected samples were evaluated in the aspect of antioxidant potential, as well as for the ability to inhibit biologically important enzymes such as acetylcholinesterase (AChE), monoamine oxidases A and B (MAO-A, MAO-B), α-amylase and α-glucosidase. High variability in the amounts of hypericin, hyperforin, rutin, quercetin, gallic, chlorogenic, caffeic and *p*-hydroxybenzoic acid within samples was noticed. Generally, the extracts exhibited significant potential to inhibit MAO-A and α-glucosidase, which supports the proved antidepressant potential of this drug, but also points toward a possibility of its use in diabetes type 2 treatment. The results of antioxidant potential evaluation suggest strong potential to neutralize hydroxyl and nitroso radicals, but moderate inhibition potential of lipid peroxidation process. Overall, the conducted study emphasizes the importance of crude drug quality control and identifies some of the primary factors which significantly affect the tested parameters.

KEYWORDS: *Hyperici herba*, Hypericaceae, quality control, HPLC-DAD, enzyme inhibition, antioxidant

Oral presentation 06 06 47

CYPSELAE FATTY ACID COMPOSITION OF TWO SUBSPECIES OF BALKAN AMPHORICARPOS AUTARIATUS BLEČIĆ & MAYER (COMPOSITAE)

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The genus *Amphoricarpos* Vis. (Compositae-Cardueae-Carduinae) belongs to the *Xeranthemum* group, which, based on plastid and nuclear analysis, represents a natural group, well characterized on molecular and morphological features. *Amphoricarpos* species are heterocarpic perennial chasmophytic plants, mountain endemics in the eastern Mediterranean (the Balkans, Anatolia and the Caucasus). Taxonomy of the genus *Amphoricarpos* is complex and ambiguous. According to Blečić and Mayer there are three taxa distributed on the Balkan Peninsula: *A. neumayerianus* (Vis.) Greuter (*A. neumayeri* Vis.), *A. autariatus* ssp. *autariatus* Blečić & Mayer and *A. autariatus* ssp. *bertisceus* Blečić & Mayer. Some authors have suggested that all the Balkan populations should be treated as a single species – *A. neumayerianus* (Vis.) Greuter. We analyzed fatty acid composition of central and outer cypselae of two subspecies of *A. autariatus*, using gas chromatography coupled with flame ionization detector (GC-FID). Out of 8 fatty acids detected, 6 were identified, ranging from palmitoleic (C16:0) to stearic (C18:0) acids. Linoleic acid was dominant in the central, as well as in the outer cypselae of both studied taxa, ranging from 31.8 to 57.67%. Unsaturated fatty acids were predominant, ranging from 62.43 to 81.58%. Fatty acids profile differs among studied taxa, as well as between central and outer cypselae of the same taxon. As cypselae fatty acids composition may be valuable as taxonomic marker at infraspecific level, our results demand further examination of all Balkan *Amphoricarpos* taxa from a phytochemical and chemotaxonomic point of view. Moreover, the rest of the *Amphoricarpos* taxa from Georgia and Turkey should be included in the analysis, with the main goal of contribute to the phylogeny of this small, but very complex genus.

KEYWORDS: *Amphoricarpos*, Asteraceae, fatty acids, phytochemistry

Oral presentation 07 06 31

THE INFLUENCE OF SATUREJA KITAIBELII WIERZB. EX HEUFF. ADDITION ON THE OXIDATIVE STABILITY OF SUNFLOWER AND OLIVE OIL DURING STORAGE

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Oxidative stability is an important parameter of edible oils quality. Autoxidation of oils results in production of various products which significantly affect the sensory characteristics of oil, as well as their nutritional value. Antioxidants have the ability to slow down the oxidation process, while currently the preference is given to those obtained from natural sources. The aim of the research was time-dependent monitoring of parameters of oxidative degradation in sunflower and olive oil with the addition of *Satureja kitaibelii* by chemical and physical methods. The content of primary oxidation products was determined by peroxide value method and evaluation of conjugated dienes and trienes, while the content of secondary oxidation products was determined by evaluation of thiobarbituric acid reactive substances (TBARS). The obtained results indicated that peroxide values and levels of thiobarbituric acid reactive substances were lower in samples with added *Satureja kitaibelii*, while the levels of conjugated dienes and trienes were not affected by the addition of herb. Addition of *Satureja kitaibelii* significantly slows the lipid oxidation process in olive and sunflower oil samples during storage time. Also, *Satureja kitaibelii* might represent a potential source of natural antioxidants for aromatization of edible vegetable oils in the future.

KEYWORDS: *Satureja kitaibelii*, oxidative stability, sunflower oil, olive oil

Oral presentation 08 06 59

POTENTIAL OF MELISSA OFFICINALIS POSTDISTILLATION WASTE EXTRACTS - PHARMACODYNAMIC STUDIES

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Lemon balm (*Melissa officinalis* L., Lamiaceae) leaf is mainly used for isolation of essential oil which has numerous phar-

macological activities. Since essential oil is present in low amounts in the leaf, large quantity of plant material remains unused. Recently, investigation of various lemon balm leaf extracts has been given a great attention. In this study, chemically well characterised ethanol extracts of lemon balm leaf, before and after hydrodistillation, were evaluated for their antioxidant and anticholinesterase activity *in vitro* and potential anxiolytic and antidepressive activity, influence on motor coordination and memory on experimental animals, as well as possible interaction with applied conventional drugs. *In vitro* experiments were conducted spectrophotometrically on several antioxidant tests and following Ellman method for evaluation of influence on acetylcholinesterase activity. Pharmacodynamic studies were performed using rotarod performance, tail suspension, elevated plus maze and novel object recognition tests on Swiss Albino male mice. Both examined extracts expressed notable antioxidant and anticholinesterase activity. None of examined extracts exhibited influence on motor activity nor antidepressive effect. Both standard and deodorised leaves extracts of lemon balm showed significant anxiolytic effect, but in applied dosing regimen influence on memory of experimental animals was not recorded. Moreover, there was no interactions with applied antidepressive, anxiolytic and sedative drugs. These findings indicate that postdistillation waste remaining after hydrodistillation of essential oil of lemon balm could be used as a potential source for pharmaceutical industry due to its anxiolytic and anticholinesterase activity.

KEYWORDS: lemon balm, postdistillation waste, antioxidant, acetylcholinesterase, anxiolytic effect, antidepressive activity, motor activity, memory

Poster presentation 09 06 58

ANATOMY AND COMPOSITION OF THE ESSENTIAL OIL OF LARIX DECIDUA L. (PINACEAE)

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Larix decidua L. is a deciduous coniferous native to the mountains of central Europe, in the Alps and Carpathians. The aim was to investigate anatomy and the chemical composition of the essential oils of needles, stems and strobilus of *L. decidua*. The samples were collected from larch trees from cultivated conditions (Belgrade, Serbia.) and from natural habitat (Alps, Austria). Needles of *L. decidua*, on cross section are more or less elliptically shaped. Two small secretory canals are in the mesophyll of the needles, on their lateral sides, just below the epidermis. The young stem (primary structures) have canals

in cortex, some are just below the epidermis and many, that are in forming phase above the phloem. The older stem (perennial stem) has many secretory canals in the parenchyma of cortex and in the xylem of secondary wood. The essential oils were obtained by hydrodistillation and qualitative and quantitative analysis was performed by GC-FID and GC-MS. Small amounts of essential oils were extracted from the needles (0.06-0.41%), stems (0.31-0.54%) and strobilus (0.16 % and 0.19 %) of *L. decidua*. The monoterpene (28.70-50.40%) and sesquiterpene compounds (41.80-67.20%) dominated in the essential oil of needles, monoterpenes (80.50-91.70%) in the oil of stems, diterpenes (46.50% and 40.50%) and monoterpenes (24.20% and 22.20%) in the oil of strobilus. Main compounds in the essential oil of needles represented germacrene D (15.2-46.9%), δ -3-carene (4.6-24.6%) and α -pinene (6.3-14.1%), in the oil of stems α -pinene (12.8-21.8%), δ -3-carene (8.6-14.3%) and sabinene (0.5-10.3%), while in the oil of strobilus diterpene of abietane type (4.1-10.2%) and nor-abietatriene (3.9-9.2%) were the most abundant. The larch needles and stem essential oils from cultivated and natural habitats were quite similar in qualitative composition. However, the essential oil of needles from natural habitat contained higher content of germacrene D and α -pinene and the oil of stem α -pinene and trans-verbenaol. The oil of larch strobilus from natural habitat was characterized by manool and 3- α -acetoxy-manool, diterpenes that were not present in the oil of cultivated sample.

KEYWORDS: *Larix decidua*, anatomy, needles, stem, strobilus, essential oil

Poster presentation 10 06 53

PIMPINELLA TRAGIUM VILL. (APIACEAE) – ANATOMY AND ESSENTIAL OIL COMPOSITION

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Pimpinella tragi Vill. is a perennial, herbaceous plant inhabiting dry grasslands, limestone rocky areas and screes of wide sense Mediterranean area, east European lowlands and Caucasus. This study explores the anatomical structure, content and composition of the essential oil of the vegetative organs and fruit of this species. The plant material was collected on two localities: the village Izvor (Bosilegrad, Serbia) and Mt. Galičica (FYR Macedonia). The anatomical studies were conducted on permanent slides obtained by standard

method of preparation for viewing under a light microscope. The essential oils obtained by hydrodistillation from roots (collected during flowering and fruiting period), aerial parts with inflorescences, and fruits, were analysed by GC-FID and GC-MS. The anatomical analysis revealed a secondary structure of root and primary structure of stem with closed collateral vascular bundles. Leaves are isobilateral, amphistomatic; petiole is with arched vascular bundles and the fruit (mericarp) is semi-circular and lightly ribbed in cross section. Non-glandular unicellular and bicellular cuneate trichomes are sparsely distributed on the stem, leaves and petiole, but very dense on the fruit. Secretory channels are present in all organs: in the parenchyma of the root and stem cortex, stem pith, in the phloem of root and vascular bundles of stem and petiole, by the leaf vascular bundles and in the fruit pericarp. Essential oil yields from different parts of *P. tragi* ranged from 0.2-1.1% (v/w). The main compounds in the oils from roots (in both stages, from both localities), as well as from aerial parts and fruits from Mt. Galičica are C-12 norsesquiterpenes (trinorsesquiterpenes): pregeijerene (29.0-56.2%) and gejerene (14.1-22.9%), whereas those from aerial parts and fruits from village Izvor are β -bisabolene (19.1-57.2%) and a phenylpropanoid epoxy-pseudoisoeugenyl-2-methoxybutyrate (17.4-22.2%). Trinorsesquiterpenes, which were also found to be characteristic constituents in some other *Pimpinella* species oils, are the most dominant constituents in all investigated oils, except in the oil of fruit from village Izvor. In addition, phenylpropanoids of pseudoisoeugenol type are present in all oils confirming them as chemical markers of *Pimpinella* species analysed so far.

KEYWORDS: *Pimpinella tragi*, anatomy, secretory canals, essential oil, C-12 norsesquiterpenes, phenylpropanoids

Poster presentation 11 06 29

CHEMOSYSTEMATIC EVALUATION OF THE COMPOSITION OF LEAF AND FLOWER ESSENTIAL OILS OF EIGHT HERACLEUM L. TAXA FROM SOUTHEASTERN EUROPE

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The genus *Heracleum* L. (Apiaceae) is represented by a dozen of native sub(species) in Southeastern Europe. In this study, the composition of the essential oils obtained from the leaves and the flowers of eight taxa of this genus, collected in Serbia, Montenegro, Macedonia and Slovenia, was statistically analyzed to evaluate its chemosystematic significance. Investigated taxa included *H. orphanidis* Boiss. and the representatives of *H. sphondylium* group: *H. sphondylium* L., *H. sibiricum* L., *H. montanum* Schlecht. ex Gaudin, *H. ternatum* Velen., *H. pyrenaicum* subsp. *pollinianum* (Bertol.) F. Pedrotti & Pignatti

ti, *H. pyrenaicum* subsp. *orsinii* (Guss.) F. Pedrotti & Pignatti and *H. verticillatum* Pančić. Essential oils were hydrodistilled using Clevenger-type apparatus and analyzed by GC-FID and GC-MS. Chemosystematic significance of their components was evaluated using multivariate statistics: principal component analysis (PCA), non-metric multidimensional scaling (nMDS) and unweighted pair-group arithmetic averages clustering (UPGMA). The analyses included our previously published data on the oils of eight samples of the leaves and three of the flowers, as well as additionally analyzed oils of eight samples of the leaves and five of the flowers. Leaf and flower oils of investigated members of *H. sphondylium* group were dominated by various sesquiterpenes [(*E*)-caryophyllene, (*E*)-nerolidol, (*E*)- β -farnesene, α -trans-bergamotene, germacrene D, β -bisabolene and/or β -sesquiphellandrene], phenylpropanoids [apiol, methyl eugenol, elemicin and/or (*Z*)-isoelemicin], and/or monoterpene limonene. On the other hand, leaf and flower oils of *H. orphanidis* were rich in aliphatic esters, mostly octyl acetate. Separate statistical analyses of the compositions of the leaf oils and the flower oils demonstrated segregation of *H. orphanidis* from investigated representatives of *H. sphondylium* group, and grouping of the subspecies of *H. pyrenaicum* within this group. Morphologically related species *H. sibiricum* and *H. ternatum* were closely located in PCA and nMDS, and in UPGMA even shared the same cluster. PCA showed that some of both aforementioned dominant constituents and those present in lower amounts influenced the separation of investigated taxa. It can be concluded that applied multivariate statistical methods demonstrated the grouping of investigated *Heracleum* taxa according to their current systematics, and justify further similar study on the essential oils of more species of this genus.

KEYWORDS: *Heracleum* taxa, leaf and flower essential oils, GC-FID and GC-MS, PCA, nMDS, UPGMA

Poster presentation 12 06 30

DPPH RADICAL SCAVENGING POTENTIAL OF THE ROOT ESSENTIAL OILS OF FIVE HERACLEUM L. TAXA

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In the Balkan Peninsula, *Heracleum* L. taxa (Apiaceae) were traditionally used for the treatment of various digestive and respiratory diseases, epilepsy, hypertension and sexual weakness. The purpose of this work was to investigate 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging ability of the root essential oils of some of the Balkan *Heracleum* taxa, i.e. *H. sibiricum* L., *H. ternatum* Velen., *H. verticillatum* Pančić,

H. pyrenaicum subsp. *pollinianum* (Bertol.) F. Pedrotti & Pignatti and *H. pyrenaicum* subsp. *orsinii* (Guss.) F. Pedrotti & Pignatti. GC-FID and GC-MS analysis of these oils, obtained by hydrodistillation using Clevenger-type apparatus, revealed the domination of monoterpenes, mostly β -pinene (26.2-47.3%). Additionally, *H. sibiricum* root oil was rich in phenylpropanoids, mainly elemicin (25.6%) and methyl eugenol (22.3%). In colorimetric DPPH assay, the strongest activity was exhibited by *H. sibiricum* oil (SC_{50} =5.19 μ L/mL), followed by *H. pyrenaicum* subsp. *orsinii*, *H. ternatum*, *H. pyrenaicum* subsp. *pollinianum* and *H. verticillatum* oils (SC_{50} =7.85-12.33 μ L/mL). In TLC-DPPH (dot-blot) test, three the most active root oils, i.e. those of *H. sibiricum*, *H. ternatum* and *H. pyrenaicum* subsp. *orsinii* revealed yellow anti-DPPH zones (R_f =0.30-0.42), which were then eluted and analyzed by GC-FID and GC-MS. It was shown that elemicin and methyl eugenol, dominant in *H. sibiricum* oil, were also the most abundant in its anti-DPPH zone (64.5 and 19.5%). β -Pinene and other monoterpene hydrocarbons were not detected in this, and also in the active zones of *H. ternatum* and *H. pyrenaicum* subsp. *orsinii* oils (both contained two closely located anti-DPPH zones, which were eluted together). Anti-DPPH zones of *H. ternatum* oil were dominated by trans-sabinol (21.8%), spathulenol (21.7%) and (*E*)-sesquilandulol (13.1%), and those of *H. pyrenaicum* subsp. *orsinii* oil by (*E*)-sesquilandulol (14.5%) and intermedeol (13.6%). These oxygenated terpenes were detected in *H. ternatum* and *H. pyrenaicum* subsp. *orsinii* oils only in small quantities. Another minor constituent of *H. pyrenaicum* subsp. *orsinii* root oil, (*Z*)-falcarinol, was among the dominant ones in its anti-DPPH zones (11.6%).

KEYWORDS: *Heracleum* taxa, root essential oils, GC-FID and GC-MS, DPPH radical, phenylpropanoids, oxygenated terpenes

Poster presentation 13 06 36

CHEMICAL COMPOSITION OF ESSENTIAL OIL OF ENDEMIC SPECIES ACINOS ORONTIUS FROM BOSNIA AND HERZEGOVINA

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The genus *Acinos* belongs to the family Lamiaceae, and represented by ten species native to southern Europe and western Asia. Its name comes from the Greek word *akinos*, the name of a small aromatic plant. *Acinos orontius* (K. Malý) Šilić is a synonym of *Clinopodium alpinum* subsp. *orontium* (K. Malý) Govaerts, and is endemic species in Bosnia and Herzegovina. The aim of this work was to determine content and composi-