



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).

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*)-falcariol, 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-

TEPALS OF NATIVE *CROCUS* TAXA AS A PROMISING ANTIOXIDANT BIOMATERIAL RICH IN FLAVONOID KAEMPFEROL

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Most of the pharmacological activities of cultivated *Crocus sativus* have mainly been related to its stigmas (spice saffron) and their major bioactive compounds - carotenoids. Tepals, which are dominant part of *C. sativus* flowers in terms of mass (93% of the flower mass), are still considered as a waste material. In this work we compared, using high-performance liquid chromatography method, qualitative and quantitative composition of flavonoids in tepals, stigmas and stamens of native *Crocus* taxa (*Crocus malyi*, *Crocus vernus* ssp. *albiflorus*, and *Crocus vernus* ssp. *vernus*) water extracts, spectrophotometrically measured antioxidant activities of tepals extracts, and statistically correlated obtained data. The results revealed that *Crocus* tepals contained similar or higher concentration of flavonoid-glycosides than stigmas and stamens. Out of the tested tepal extracts, *C. vernus* ssp. *vernus* from the Botanical Garden Zagreb showed the best biological potential: the highest amount of identified flavonoids (5054.6 mg of identified flavonoid-glycosides/kg dw) and showed the highest antioxidant activity (ABTS - 82%, FRAP - 99.2% , and DPPH - 62.7% of Trolox antioxidant activity). In this taxon we also recorded significantly higher concentration of kaempferol-rutinoside (3581 mg/kg dw) than in other taxa. This flavonoid showed very strong or strong correlation with antioxidant assays results. Therefore, we presume that kaempferol-rutinoside is one of the main antioxidant phenolic component in *Crocus* tepals. High flavonoid content and strong antioxidant activity add value to the, so far, neglected native *C. vernus* ssp. *vernus* taxon. To the best of our knowledge, this is the first study on native Croatian *Crocus* taxa flavonoid content, and their bioactivity at all. The results contribute to the phytochemical description and dietary potential of native *Crocus* taxa.

KEYWORDS: dietary potential, HPLC, phenolics, phytochemical analysis, saffron

ANTIOXIDANT POTENTIAL AND POLYPHENOLIC CONTENT OF THREE MEDICINAL WILD-GROWING SPECIES FROM KOPAONIK MOUNTAIN

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Wild-growing plants are good potential sources of natural substances useful for preventing diseases related to oxidative stress. The food industry is becoming increasingly interested in plants, because of their anti-inflammatory properties and antioxidant activities. In the present investigation, we described the antioxidant potential of acetone extracts of three aromatic species grown on Kopaonik mountain, *Ajuga pyramidalis* L., *Thymus praecox* Opiz and *Vaccinium myrtillus* L. by two methods: 2,2-azinobis(3-ethyl-benzothiazoline-6-sulfonic acid) (ABTS) scavenging and 2,2-diphenyl-1-picryl-hydrazyl (DPPH) radical scavenging assay and their correlations with total phenolics, tannins, flavonoids and proanthocyanidins contents. The total phenolic and tannins content was determined according to the Folin-Ciocalteu method. The total flavonoids were estimated according to the method described by Markham (1989) and proanthocyanidins according to Sun et al. (1998). For ABTS assay, the procedure followed the method of Re et al. (1999) with some modifications. The DPPH assay was done according to the method of Lee et al. (1998). *T. praecox* extract had the almost twice higher phenolics and tannins content compared to *V. myrtillus*, which had twice higher total phenolics and tannins content than *A. pyramidalis*. On the other hand, *A. pyramidalis* had the highest amount of proanthocyanidins, while the content of total flavonoids was the highest in *V. myrtillus*. The highest scavenging activity showed *T. praecox* extract (DPPH: 69,67±0,46 mg trolox/gdw; ABTS: 178,11±0,96 mg trolox/gdw), and the lowest activity showed *A. pyramidalis* extract. Antioxidant capacity was positively correlated with total phenolics, tannins and flavonoids content. From the obtained results it can be concluded that *T. praecox* extract had the greatest antioxidant potential.

KEYWORDS: antioxidant potential, medicinal plants, polyphenolic content

A COMPARATIVE STUDY ON ANTIOXIDANT PROPERTIES OF METHANOL AND WATER EXTRACTS OF *ORIGANUM ONITES* L. (LAMIACEAE) FROM TURKEY

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Origanum onites L. (Lamiaceae), as called Turkish Oregano, is a perennial plant of the east Mediterranean area. It is consumed intensively as a spice especially by the people in the western regions of Anatolia. This work aimed to evaluate the antioxidant activity of methanol and water extracts of wild-grown *O. onites* collected from Fethiye region (Muğla, Turkey), as well as to measure the content of total phenolic compounds of these extracts. The extracts were obtained by ultrasonication method in this study. Total phenolic content present in the extract was also determined by Folin-Ciocalteu assay. Antioxidant activities were investigated by using different assays, including free radical scavenging assays (ABTS and DPPH) reducing power (CUPRAC and FRAP), phosphomolybdenum and metal chelating assays. The total phenolic contents were found to be 86.40 and 111.41 mgGAE/g extract in methanol and water extracts, respectively. Free radical scavenging ability of water extract (432.99 mgTE/g for ABTS and 243.37 mgTE/g for DPPH) was higher than methanol extract (353.68 mgTE/g for ABTS and 193.61 mgTE/g for DPPH). Likewise, the water extract had greater reducing potential in CUPRAC and FRAP assays, as compared to methanol extract. The results of phosphomolybdenum were found to be 2.29 mmolTE/g for methanol and 2.68 mmolTE/g for water. Taken together, the tested water extract had greater antioxidant potential when compared to methanol extract. Based on our findings, *O. onites* could be regarded as a source natural bioactive agent for developing novel functional ingredients.

KEYWORDS: free radical scavenging, *Origanum onites*, total phenolic, natural agents

ANTIOXIDANT AND ENZYME INHIBITORY FUNCTIONS OF THREE SELECTED *FERULA HALOPHILA* (APIACEAE) PEŞMEN EXTRACTS

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Currently, many plant bioactive compounds are considered as excellent alternative candidates to synthetic antioxidants or antimicrobials food additives possessing none side effects in comparison with synthetic additives. In this sense, medicinal plants are seen as an important and feasible alternative, as being used for thousands of years for the treatment and prevention of several health disorders. The genus *Ferula* (Apiaceae) has great potential as a source of traditional drugs in several countries. With this fact, we aimed to determine antioxidant and enzyme inhibitory functions of three solvent extracts (acetone, chloroform and methanol) of *F. halophila*, which is endemic to Turkey. Six complementary assays (DPPH, ABTS, FRAP, CUPRAC, phosphomolybdenum and metal chelating) were performed to obtain full antioxidant picture for the tested extracts. Cholinesterase (acetylcholinesterase (AChE) and butyrylcholinesterase (BChE)), tyrosinase, α -amylase and α -glucosidase were selected as target enzymes. The acetone and methanol extracts had greater antioxidant potential as compared to chloroform extract. Also, these extracts contained considerable levels of phenolics (55.22 mgGAE/g extract for acetone; 48.66 mgGAE/g extract for methanol). However, the chloroform extract was more active on both AChE and BChE than the acetone and methanol extracts. The best tyrosinase inhibitory effect was obtained by the methanol extract. Overall, *F. halophila* could be regarded as a valuable source of novel phyto-pharmaceuticals for designing functional formulations, including food additives or drugs.

KEYWORDS: *Ferula halophila*, tyrosinase, cholinesterase, antioxidant