CHEMISTRY & BIODIVERSITY

Accepted Article

Title: Review
Balkans' Asteraceae species as a source of biologically active compounds

for pharmaceutical and food industry

Authors: Aleksandar Ž. Kostić, Peđa Janaćković, Stefan M Kolašinac, and Zora P Dajić-Stevanović

To be cited as: *Chem. Biodiversity* 10.1002/cbdv.202000097

Link to VoR: https://doi.org/10.1002/cbdv.202000097

www.cb.wiley.com

WILEY-VHCA

 10.1002/cbdv.202000097

Chem. Biodiversity

Review

Balkans' Asteraceae species as a source of biologically active compounds for pharmaceutical and food industry

Aleksandar Ž. Kostić,[a*] Peđa Janaćković,[b] Stefan M. Kolašinac[c] and Zora P. Dajić Stevanović[c]

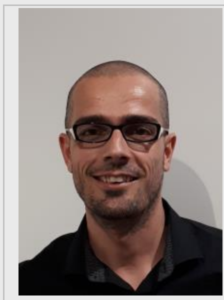
[a*] University of Belgrade, Faculty of Agriculture, Chair of Chemistry and Biochemistry, Nemanjina 6, 11080 Belgrade, Serbia; corresponding author e-mail: akostic@agrif.bg.ac.rs

[b] University of Belgrade, Faculty of Biology, Chair of Morphology and Systematics of Plants, Studentski Trg 16, 11000 Belgrade, Serbia

[c] University of Belgrade, Faculty of Agriculture, Chair of Agrobotany, Nemanjina 6, 11080 Belgrade, Serbia

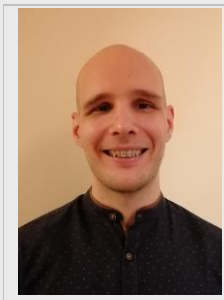
Herbal drugs are a useful source of different bioactive compounds. Asteraceae species, as the most widespread vascular plants can be used both as food and as medicine due to the great diversity of recorded chemical components – different phenolic compounds, terpenes, carotenoids, vitamins, alkaloids, etc. The Balkan Peninsula is characterized by great diversity of plants from Asteraceae family, including presence of rare and endemic species. In this review, results of the survey of chemical composition and biological activity, mainly focusing on antioxidant, antimicrobial and anticancer effects of selected Balkans' Asteraceae species were provided. In addition, information on edible plants from Asteraceae family is presented, due to growing interest for the so-called "healthy diet" and possible application of Balkans' Asteraceae species as food of high nutritional value or as a source of functional food ingredients.

Keywords: Asteraceae • Bioactive compounds • Balkans • Food industry • Pharmaceutics

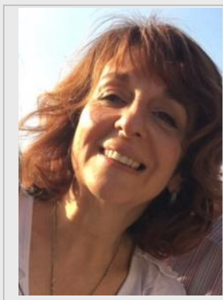


Dr Aleksandar Ž. Kostić is Assistant professor at the Chair of Chemistry and Biochemistry, Faculty of Agriculture, University of Belgrade, teaching in different Chemistry courses. His research area is focused on phytochemistry (with special emphasis on pollen chemistry and nutrition and bioactive compounds in plant materials), food chemistry, water chemistry, health risk assessment for humans expressed through food and water consumption and polyacrylic hydrogels. Until now, he has been the author and co-author of more than a hundred scientific papers in total (thirty-four peer-reviewed articles), two university textbooks and two student handbooks. His articles have been cited more than 200 times, h-index is 10 (Google Scholar). He has reviewed more than 100 articles for top International Journals.

Dr Peđa Janaćković is Full professor at Chair of Plant Morphology and Systematics, Faculty of Biology, University of Belgrade, teaching in different Botany courses at bachelor, master and doctoral studies (e.g. Systematics of higher plants, Phytochemistry practicum, History of Botany, Ethnobotany, Systematics and phylogeny of the Asteraceae). He was the supervisor of 3 completed PhD theses, and currently he is the supervisor of 2 PhD students. His research area is focused on plant systematics especially of Asteraceae as well as phytochemistry and ethnobotany (with special emphasis on medicinal plants and bioactive compounds in plant). Until now, he has been the author and co-author of more than one hundred and thirty scientific papers in total (fifty four peer-reviewed articles), one chapter in international monograph and five university textbooks. His articles have been cited more than 444 times (excluding self citations), h-index is 13 (Scopus). He has reviewed more than 30 articles for top International Scientific Journals. Prof. Janaćković is a board member of two international journals.



M.S. Stefan M. Kolašinac, is a forth year Ph.D. student at the Faculty of Agriculture, University of Belgrade Chair of Agrobotany. During the bachelor studies, he was awarded as one of the best students. Until now, he has published 7 scientific papers. Currently, he is included in one national project and one bilateral cooperation. Stefan is a demonstrator on courses Agriculture Botany and Systematics of flowering plants. His main interests are based on plant chemistry and chemometrics.



Dr Zora P. Dajić Stevanović is the Head of Department of Agricultural Botany at Faculty of Agriculture, University of Belgrade. She is Full professor teaching several modules in the field of Plant sciences at bachelor, master and doctoral studies; she was a supervisor of 8 completed PhD theses, currently supervisor of 3 PhD students; team leader of research group interested in biodiversity, ethnobotany, morpho-anatomy, phytochemistry, bioactivity of plant metabolites and Raman spectroscopy. She published more than 300 papers, nearly 70 in international peer reviewed journals and 11 chapters in international monographs. Her papers were cited 875 times, h-index 15 (ResearchGate). Prof. Dajic Stevanovic is a reviewer of papers in international journals and a board member in 4 international journals. She is the president of Association for Medicinal and Aromatic Plants of Southeast European Countries (AMAPSEEC) and a member of working groups for medicinal and aromatic plants in international organizations (FAO, ECPGR, IUCN).

10.1002/cbdv.202000097

1. Introduction

Plants have been essential resources for human health from ancient times to the present day. According to the World Health Organization (WHO), the majority of the world's population still depends on traditional medicine for primary health care needs. More than 35 000 plant species are used in herbal medicine and as spices, most of which are of local importance due to traditional use. The flora of the Balkan Peninsula is among the most diverse in Europe, comprising more than 8 000 species of vascular plants, among which 2 600-2 700 are known as endemic species.[1] The Balkans and Rhodope Mountains are recognized as global Centers of Plant Diversity. The region is also well known for richness in indigenous medicinal and aromatic plant (MAPs) resources and long tradition in use of MAPs and their products. The total number of MAP species in Southeast Europe and the Balkans is very difficult to assess, but it certainly exceeds 1 000 species or even 2 000 upon approximation that one in six species of higher plants is used medicinally.[2] Asteraceae family is the most abundant in the number of genera and species in the Balkans' flora (**Figure 1**), as it is the largest family of vascular plants. Asteraceae (Compositae), daisy or sunflower family, represents the mega-diverse family containing more than 10% (25 000–35 000) of all today's living angiosperms.[3] Members of the Asteraceae are distributed on all continents including Antarctica -two introduced species *Nassauvia magellanica* J. F. Gmel. and *Gamochaeta nivalis* Cabrera, according to Smith and Richardson[4], and occur on almost every type of habitat on planet Earth, having the greatest concentration of species in steppes, prairies, deserts, montanes, and in regions with Mediterranean-like climates.[3] Newly discovered fossils and the latest molecular clock dating, showed that Asteraceae possible originates in the Late Cretaceous: ~83 MYA.[3] The family consists of 13 subfamilies and 47 tribes according to Mandel et al.[3]. Asteraceae as one of the largest, natural families (with a combination of specialized morphological structures e.g., capitula, inferior ovaries and unique fruit – cypsela, and also, with a wide diversity of specialized metabolites) has been researched from many different aspects for centuries. Because of its diversity Asteraceae represents immense plant resources. Asteraceae species have wide economic importance, e.g. as medicinal plants, sources of oil, vegetables, insecticides, and as horticultural and garden ornamentals.[5] Nevertheless, some species of Asteraceae, as noxious weeds, represent a major problem for agriculture.[6] The Balkan Peninsula extends from Central Europe in the north to the Eastern Mediterranean in the south, and is bounded by the Adriatic, Ionian, Aegean and Black Seas.[7] The Balkans or the Balkan Peninsula is in the north limited by the rivers Danube and Sava, in the northwest by the Soča (in Slovenian, or Isonzo in Italian) river, in the east by the Black Sea, in the south by the Aegean and Ionian seas, and in the west by the Adriatic Sea.[8] Although, till today, a complete list of the flora of the Balkan Peninsula has not yet been completed, it can be estimated that the Asteraceae family on the Balkans counts 913-1 081 species (13.52 % of the total) classified in 547 genera[9–13] and represents one of the most important plant resource of the Balkan Peninsula. The exact number of the Balkans' endemic Asteraceae species is unknown, but could be approximately at least between 350-400 species.

10.1002/cbdv.202000097

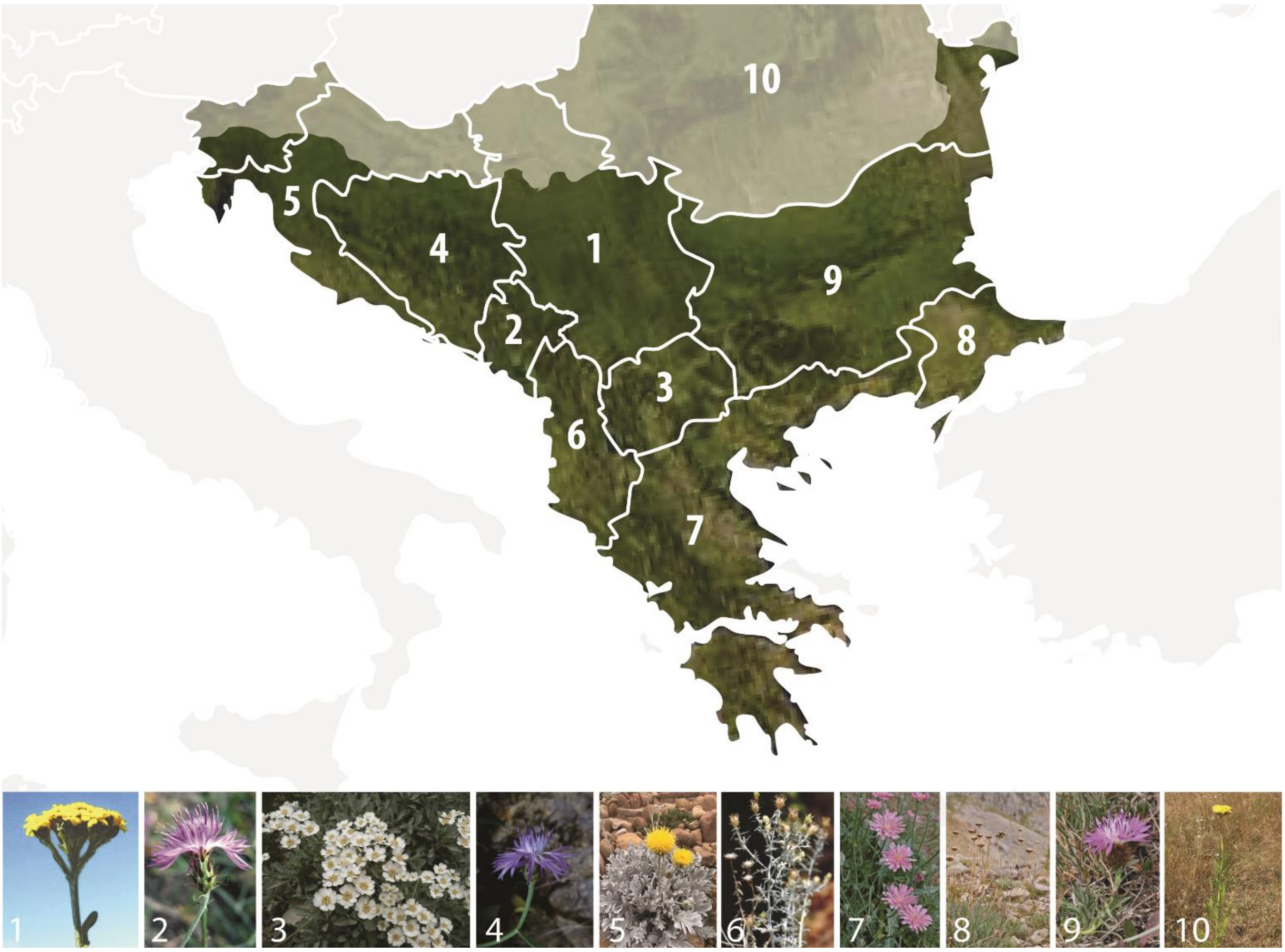


Figure 1. The Balkan Peninsula with usual appearance of some of the Asteraceae species: 1. *Achillea alexandri-regis* Bornm. & Rudsky, 2. *Centaurea scabiosa* L., 3. *Achillea clavennae* L., 4. *Centaurea derventana* Vis. & Pančić, 5. *Centaurea ragusina* L., 6. *Centaurea soskae* Hayek ex Košanin, 7. *Crepis incana* Sm., 8. *Achillea fraasii* Sch.Bip., 9. *Centaurea parilica* Stoj. & Stef., 10. *Achillea thracica* Velen.

Due to great diversity, these species can be used as an excellent source of different bioactive compounds which can improve functional food properties or as a source in drug development for pharmaceutical industry. In that sense, in this review authors tried to make the first detailed cross-section of the current status of phytochemical analyses of different materials that originated from Asteraceae plants grown specifically on the Balkan Peninsula, and their possible biological activities. Therefore, the Balkans' endemic Asteraceae species were especially emphasized in the review. Additionally, importance and potential application of wild growing Asteraceae plants as an edible food source are reviewed upon available ethnobotanical sources for the Balkan region, in order to indicate to the readers the possibility of using them as healthy food for the future. Consequently, since the number of endemics used as wild edible foods is limited, assessment of edible Balkans' Asteraceae plants included all reported species within ethnobotanical data.

2. Chemical composition and biological activity of Balkans' Asteraceae species

2.1. Chemical composition

Plants are a well-known source of different phytochemicals which are recognized as potential antioxidants for animals and humans.[14,15] These compounds are mostly specialized (secondary) plant metabolites which are produced from compounds included in central (primary) metabolic processes such as photosynthesis, plant respiration, etc.[16] There is a great diversity among them but the most important groups of compounds are different phenolics and terpenes, carotenoids, fatty acids, saponins and alkaloids[16] as well as some bioactive vitamins such as vitamins A, C and E.[15] It is a challenging approach to match different phytochemical profiles of different taxa with their phylogenetic, morphological and ecological properties. Such was the case, for instance with *Iris* species of the central Balkans where detailed polyphenols screening was done, and where 9 novel compounds were assessed in such a way.[17] Similarly, phytochemical investigation of endemic species of the western part of the Balkans of genus *Amphoricarpos*, showed presence of a large number of sesquiterpene lactones so called amphoricarpolids (sesquiterpenoids that contain a γ - lactone ring), which are characteristic of this genus, and which are showing: lipophilicity, cytotoxicity[18] and antimicrobial[19] activity as well as protective effect on human lymphocyte DNA,[20] and which are also attributed to a role in enhancing antioxidant activity[19]. Among all known bioactive compounds, the terpenes are commonly basic components of plant essential oils (EOs) which have regularly been analyzed in plants due to their great potential for application in pharmacy, food industry, aromatherapy and well known in

10.1002/cbdv.202000097

traditional medicine. Within phenolic compounds, the class of flavonoids is the most important in terms of diversity, stability and potential as chemophenetic markers.[21] According to Bohm and Stuessy[21] almost all flavonoid subclasses that are known in the plant kingdom can be found in many Asteraceae genera or species. The most represented flavonoid compounds in the family Asteraceae are anthocyanin pigments, chalcones, aurones, flavones, flavanones and flavonols.[21] Among "famous" Asteraceae species, sunflower (*Helianthus annuus* L.) pollen from Serbia has already been defined as a better source of flavonoids[22] compared to some usual vegetables. It makes it suitable for application as a potential food ingredient. Summarized available data regarding the chemical composition of indigenous Balkans' Asteraceae plants are shown in **Table 1**. Here are provided results only for the Balkan endemic species of Asteraceae, illustrating high variability in phytochemical profiles. The main compounds were indicated according to information provided in cited reference, if any.

Chem. Biodiversity

Table 1. Chemical composition (with the main compound(s)) of mostly endemic Balkans' Asteraceae plants.

Scientific species name	Distribution	Part of plants	Analyzed fraction and / or general chemical composition and reference source	Type of extract (s)	Applied technique(s)	The main compound(s)	Remarks
Achillea abrotanoides (Vis.) Vis. [g]	Alb, BiH, Cro, Grc, Mkd, Mne, Srb[a]	Aerial parts	EOs[a]; sesquiterpene lactones[23]	Chloroform	Silica gel column chromatography; ^{1}H NMR spectroscopy	desacetoxymatricarin (202 mg)	-3 new lactones (desacetoxymatricarin, desacetylmatricarin and 1β, 10β-epoxydesacetoxymatricarin) and one flavonoid (centaureidin) were isolated.
			- EOs; terpenes[24]	Hydrodistillation	GC-MS	α-tujone (34.5%) and 1,8-cineole (8.5 - 10.9%)	- 97 terpene and non-terpene compounds were isolated. 50 compounds were reported for the first time in *Achillea genus*.
			- EOs; terpenes[25]	Hydrodistillation	GC; GC-MS	β-thujone (16,8%), pinocarvone (15.6%) and 1,8-cineole (11.3%)	-In total, 36 components (monoterpenes and sesquiterpenes) were identified and quantified.
A. ageratifolia subsp. *serbica* (Nyman) Heimerl[g]	Alb, BiH, Srb	Aerial parts	- Sesquiterpene lactones[26]	Petrol-ether/Ether/ MeOH (1:1:1)	Column chromatography	No data	- 6 guaianolides were obtained from the extract with 4 new identified compounds.
			- EOs[27]	Hydrodistillation	GC-FID; GC-MS; ^{1}H NMR spectroscopy	Sabinyl-acetate (30.8 - 37.9%) and *trans*-sabinol (5.0 - 6.3%)	- 300 components were identified. Sabinyl derivatives were predominant in EOs.
A. alexandri-regis Bornm. & Rudsky[g]	Srb	Aerial parts	- Flavonoids, phenolic acids, triterpenoids[28,29]	75% MeOH[e]	HPLC	Apigenin-7-*O*-glycoside (EtOAc[c] fraction) and caffeic acid (BuOH[d] fraction)	- Polyphenols were the main components.
			- Triterpenic derivatives and phenolics[30]	Combined hloroform/EtOAc i.e. MeOH/50% MeOH	Silica gel column chromatography; ^{1}H NMR spectroscopy and	No data	- In total 15 triterpenic (chloroform/EtOAc) and 4 phenolic compounds (MeOH)

					^{13}C NMR spectroscopy; GC-MS		were identified.
			- EOs[31]	Hydrodistillation	GC; GC-MS	α-pinene (14.4 - 15.7%), isopinocamphone (5.4 - 23.5%), α-phellandrene epoxide (5.0 - 19.0%) , borneol (3..6 - 7.7%) and spathulenol (1.4 - 9.7%)	- In total 24 volatile compounds were identified.
A. holosericea Sm.[g]	Alb, Grc, Mkd, Srb	Aerial parts	- EOs[32–34]	Hydrodistillation	GC-MS	Camphor (14.8% i.e. 20.9%), borneol (16.3 i.e. 30.2%), *cis* / *trans* farnesyl acetate (9.6%)[32,33] and 1,8-cineole (47.4%)[34]	- Ninety five, [32] twelve[33] i.e. sixteen [34] compounds were identified belonging to monoterpenes or sesquiterpenoids classes.
A. baldaccii Degen[g]	Alb, Srb	Leaves	- Flavonoids[35]	Acetone	TLC	No data	- 5 derivatives (3 in small amounts and 2 as traces) of scutellarein, kaempferol and quercetagetin were isolated and identified.
A. chrysocoma Friv. [g]	Alb, Bul, Grc, Mkd, Srb	Aerial parts	- EOs[36,37]	Hydrodistillation	HPLC/GC/GC-MS	1,8-cineole (17%) and β-caryophyllene (6.3%)[36] i.e. borneol (10.1%), terpinen-4-ol (9.2%) and *cis* / *trans* menth-2-en-1-ol (7.9 - 8.2%)[37]	- 48[36] i.e. 28 compounds[37] were identified.
A. chrysocoma Friv. [g]	Alb, Bul, Grc, Mkd, Srb	Flowers and leaves	- Sesquiterpene lactones[38]	Chloroform	Silica gel column chromatography	Rupicolin A (10 mg)	- In total 22 lactones were identified in the chloroform extract. Lack of germacranolides as well as guaianolide derivates of matricarin and achillin was observed.
A. clavennae L.	Mkd, Srb	Aerial parts	- Alkanes, fatty acids, monoterpenes, guaiane sesquiterpenes and flavonoids[39]	Ether/Hexane/MeOH (1:1:1)	Silica gel column chromatography, GC-MS, NMR spectroscopy	No data	- 1 flavonoid (centaureidin) and 3 terpenes (1,8-cineole, camphor and caryophyllene oxide) were predominant.
			- EOs[34]	Hydrodistillation	GC-MS	Camphor (46.9%) and 1,8-cineole (43.9%)	12 compounds were identified.

A. fraasii Sch.Bip. [g]	Alb, Grc, Mne, Mkd, Srb, Tur	Aerial parts	- EOs[32]	Hydrodistillation	GC-MS	Camphor (16.3%) and 1,8-cineole (11.9%)	- 14 compounds were identified.
A. taygetea Boiss. & Heldr. [g]	Grc	Aerial parts	- EOs[32]	Hydrodistillation	GC-MS	1,8-cineole (26.6%) and camphor (25.7%)	- 13 compounds were identified.
A. thracica Velen. [g]	Bul, Rou	Fresh, *in vitro* and *ex-vitro* grown ground parts	- EOs[40]	Hydrodistillation	GC-MS	1,8-cineole (35.7%) and germacrene D (33.8%) - *in vitro* Santolina alcohol (41.2%) and β-eudesmol (12.4%) - *in situ* Santolina alcohol (26.4%) and β-eudesmol (11.5%) - *ex vitro*	- Fresh and *ex-vitro* grown plants EOs differ from EO of *in vitro* grown plant.
			- Monoterpenes, irregular terpenes, esters and flavonoids[41]	Acetone	GC-FID; GC-MS; HPLC	**Volatile compounds:** Santolina alcohol (31.1%) - natural plant Yomogi alcohol (21.66%) - *in vitro* plant Santolina alcohol (28.1%) - *ex vitro* plant **Flavonoids**: *O,O*-dimethyl quercetin (65.7%) - natural plant *O,O*-dimethyl quercetin (29.7%) and *O*-methyl quercetin (28.4%) - *in vitro* plant *O,O*-dimethyl quercetin (38.5%) and *O*-methyl quercetin (38.1%) - *ex vitro* plant	- Among volatile compounds 16 irregular monoterpenes were identified and quantified. In acetonic extracts 4 different flavonoids were identified and quantified.
A. depressa Janka	Bul, Grc,Mkd, Rou, Srb	Roots	- Sesquiterpene-coumarin ethers[42]	Petrol ether/ether (2:1)	TLC; ^{1}H NMR spectroscopy	Acetyldeparnol (7 mg) and farnochrol (6.5 mg)	- 11 compounds were identified with 3 new sesquiterpene-isofraxidin ethers: albartol (bicycilic derivate), deparnol and acetyldeparnol (monocyclic

							derivatives).
		Leaves	- Monoterpenes, sesquiterpene lactones and flavonoids[43]	Chloroform	Silica gel column chromatography; ^{1}H NMR spectroscopy	Camphor (150 mg)	- 5 monoterpnes were isolated (camphor, borneol, bornyl acetate, sabinol and sabynil acetate), as well as 3 flavonoids (salvigenin, tambulin and 6-methoxy-genkwanin) and 2 well known guaianolides: achillin and β-1,10-epoxyachillin.
		Aerial Parts	- Sesquiterpene and flavonoids[44,45]	Chloroform[44]; Petrol ether/ether/MeOH (1:1:1) [44]	Silica gel column chromatography; TLC; ^{1}H NMR spectroscopy[44]	No data[44,45]	- 2 monoterpenes (tanaparthin-α-peroxide and 8α-hydroxy-tanaparthin-α-peroxide), sesquiterpenes (reynosin, ridentin, acrifolide and spirodepressolide[44] 3 flavonoids (cirsimaritin, salvigenin penduletin) and 2 unidentified lactones were isolated from aerial parts of this plant[45].
			- Terpenoids[46]	Chloroform	Column chromatography; ^{1}H NMR spectroscopy	No data	Five acyclic terpenoids were isolated (as minor components) and identified. Three of them were new natural compounds.
A. umbellata Sibth. & Sm. [g]	Grc	Aerial parts	- EOs[47]	Hydrodistillation	GC; GC-MS	β-thujone (62.8%) and camphor (8.7%)	- In total, 66 components were isolated and identified from EO. Predominant class of compounds was oxygen-containing monoterpenes.
			- EOs[48]	Hydrodistillation	GC-MS	Fragranol and fragranyl acetate (in total make 74.6% of EO)	- 51 compounds were quantified from plant EO. In addition, 14 fragranol esters were identified with 6 compounds identified for the first time from a plant.
Amphoricarpos autariatus subsp.	Alb, Grc, Mne, Srb	Leaves	- Polyphenols and	MeOH	UV-Vis spectroscopy	No data	- Dry MeOH[e] extract

10.1002/cbdv.202000097

bertisceus Blečić & E.Mayer[g]			flavonoids[19]				contained the highest quantity of total phenolics and flavonoids.
A. autariatus Blečić & Mayer subsp. *autariatus*[g]	BiH, Mne, Srb	Leaves	- n-alkanes, sesquiterpene lactones[49]	Dichloromethane	GC; GC-MS; LC-ESI MS[h]; ^{1}H NMR spectroscopy	C_{29} alkanes (29.7%) in the non-polar fraction, amphoricarpolide 13 (48.7%) in the more polar fraction	- The non-polar fraction contained C_{27}, C_{29} and C_{31} alkanes as predominant, while 13 sesquiterpene lactones were identified in the more polar fraction.
			- Polyphenols and flavonoids[19]	MeOH	UV-Vis spectroscopy	No data	- Among the examined *Amphoricarpos* species, extracts of this plant had the highest total phenolic and flavonoid content.
A. neumayerianus (Vis.) Greuter[g]	Cro, BiH, Mne	Leaves	- Polyphenols and flavonoids[19]	MeOH	UV-Vis spectroscopy	No data	- Dry MeOH extract contained the highest quantity of total phenolics and flavonoids.
Anthemis auriculata Boiss. [g]	Bul, Grc, Mkd, Tur	No data	- EOs[50]	Hydrodistillation	GC-MS	α-eudesmol (14.5%), *trans*-caryophyllene (11.1%), and germacrene-D (9.5%)	- Terpenoids consisted of the main class in EO.
A. macedonica Boiss. & Orph. [g]	Bul, Grc, Mkd, Srb	Aerial parts	- Sesquiterpene lactones[51]	Chloroform	Column chromatography; ^{1}H NMR spectroscopy	Parthenolide and stizolin	- 9 compounds (6 germacranolides and 3 eudesmanolides) were identified.
A. stribrnyi subsp.tracica Velen. [g]	Bul, Grc	Aerial parts	- Sesquiterpene lactones[51,52]	Chloroform	Column chromatography; ^{1}H NMR spectroscopy	Isospiciformin	- In total, 4 germacranolides were isolated and identified. One of them (lactone form) was recorded for the first time.
A. rumelica (Velen.) Stoj. & Acht. [g]	Bul	Aerial parts	- Sesquiterpene lactones,[53]	Chloroform	Silica gel column chromatography; ^{1}H NMR spectroscopy	No data	- 6 compounds were identified: tanacin, hanphyllin, two guaianolides, centaureidin and santin.
Artemisia arborescens (Vaill.) L.	Grc	Aerial parts	- EOs[54]	Hydrodistillation	GC-MS	Camphor (30.5%), *trans*-thujone (18.4%)	- 41 compounds were identified in EO.
A. inculta Delile	Grc	Aerial parts	- EOs[54]	Hydrodistillation	GC-MS	1,8-cineole (28.1%), *cis*-thujone (17.5%)	- 37 compounds were identified in EO.
Aster albanicus (Degen) Degen [g]	Alb, Srb	Aerial parts	- EOs[55]	Hydrodistillation	GC/GC-MS	Germacrene D (34.7%), β-	- Chemical analysis of plant

						pinene (11.9%), Caryophyllene E (10.9%)	EO revealed presence of 111 components (sesquiterpenes and monoterpene hydrocarbons were the main ones).
Carduus candicans subsp. *globifer* (Velen.) Kazmi[g]	Bul. Rou, Srb, Tur	No data	- Water soluble polyphenols and flavonoids[56]	EtOH	UV-Vis spectroscopy	No data	- Among the examined species, it was the second one based on total phenolic and flavonoid content.
		Flower heads	- EOs[57]	Hydrodistillation	GC-MS	Benzaldehyde (22.1%), palmitic acid (8.1%)	- 50 compounds were identified during EO analysis.
C. kerneri subsp. *austro-orientalis* Franco[g]	Alb, Bul, Grc, Mkd, Mne, Srb	No data	- Water soluble polyphenols and flavonoids[56]	EtOH	UV-Vis spectroscopy	No data	- EtOH extract of this plant possessed the lowest content of water-soluble polyphenols and flavonoids.
Centaurea achaia Boiss. & Heldr. [g]	Grc	Aerial parts	- Sesquiterpene lactones[58]	Cyclohexane/ether/MeOH (1:1:1)	Column chromatography; TLC; ^{1}H NMR spectroscopy	No data	- 15 compounds (9 germacranolides, 2 elemanolides, 2 eudesmanolides, and 2 hydroxyesters derivatives) were isolated and identified.
C. attica Nym subsp. *attica*[g]	Grc	Aerial parts	- Sesquiterpene lactones[59]	Cyclohexane/ether/MeOH (1:1:1)	Column chromatography; HPLC	Cnicin (101.1 mg)	- 2 germacranolides and 2 elemanolides were isolated and identified from the extract.
C. melanocephala Pančić[g]	Alb, Srb	Capitula	- Monoterpenes and sesquiterpenes[60]	Dichloromethane	GC; GC-MS	β-caryophyllene (9.0%), caryophyllene oxide (8.1%)	- In total, 61 compounds (monoterpenes and sesquiterpenes) were identified. About 30% of the compounds belonged to monterpenes. High content of oxigenated sesquterpenes was also observed.
C. chrysolepis Vis. [g]	BiH, Bul, Mne, Srb	Capitula	- Monoterpenes and sesquiterpenes[60]	Dichloromethane	GC; GC-MS	Hexaconsane (14.1%), β-caryophyllene (12.8%)	- 59 components were recorded in EO with monoterpenes as a minor fraction.
C. grisebachii (Nyman) Heldr. subsp. *grisebachii*[g]	Alb, Bul, Grc, Mkd, Srb	Aerial parts	- Sesquiterpene lactones, flavonoid aglycons,	Cyclohexane/ether/MeOH (1:1:1) and MeOH/aqueous	Silica gel column chromatography/HPLC;	4-*epi*-malacitenolide	- 10 sesquterpene lactones, 5 flavonoids, 2 lignans and 1

Chem. Biodiversity

			lignans and sterol[61]	(5:1)	^{1}H NMR spectroscopy		sterol were identified. None of the guaianolides were detected which is a chemotaxonomic characteristic of this plant.
C. galicicae Micevski[g]	Mkd	Aerial parts	- Sesquiterpene lactones and flavonoids[62]	Pethrol ether/ether/MeOH (1:1:1)	^{1}H and ^{13}C NMR spectroscopy; LC-ESI-MS	Santaflavone	- Lactone (cnicin) was quantified and 6 flavonoids (apigenin, isokaempferide, hispidulin, eupatorin, santoflavone and salvigenin) were identified.
		Fruits	- Fatty acids[63]	2-propanol	GC-FID; GC-MS	Palmitic acid (32.5% i.e. 4.4 g/100 g)	- 11 fatty acids were identified.
C. gracilenta Velen. [g]	Bul	Aerial parts	- EOs[64]	Hydrodistillation	GC; GC-MS	β-eudesmol (12.8%), nonacosane (11.8%)	- Plant EO (45 identified compounds) constituted mostly sesquiterpenoids, different hydrocarbons and carbonylic compounds (in total, 4 compounds).
C. gloriosa ssp. *multiflora* Radić	Cro	Aerial parts	- EOs and total polyphenols[65]	n-hexane, EtOH, aqueous	GC-MS	Caryophyllene oxide (16.9%) and torilenol (12.4%)	- Total phenolic content of aqueous plant extract was the highest compared to *n*-hexane and EtOH[f] extracts.
C. derventana Vis. & Pančić[g]	BiH, Mne, Srb	Aerial parts	- Sesquiterpene lactones, triterpenes sterols and flavonoids[66]	No data	Silica column gel chromatography	Cnicin (607 mg)	- 4 germacranolides were quantified. In addition, 2 triterpenes (α and β-amyrin), 2 flavonoids (apigenin and eupatillin) and 2 sterols (stigmasterol and β-sitosterol) were also isolated
C. davidovii Urum. [g]	Bul	Aerial parts	- EOs[67]	Hydrodistillation	GC; GC-MS	β-eudesmol (13.9%), spathulenol (13.3%)	- In total, 62 compounds were identified and quantified.
		Fresh, *in* vitro and *ex*-vivo grown leaves	- Total phenolics and flavonoids, sesquiterpene lactones[68]	80% MeOH (for phenolics); Chloroform (for sesquiterpene lactones)	UV-Vis; HPLC	8α-(5'-hydroxyangeloyl)-salonitenolide (56.2 mg/g in *ex vitro* plant)	- The content of total phenolics and flavonoids was higher in fresh leaves compared to those grown under controlled conditions (*in vitro* and *ex-vivo*).
C.euxina Velen. [g]	Bul	Aerial parts	- EOs[69]	Hydrodistillation	GC-MS	Hexadecanoic acid (20.3%),	- 58 volatile components were

10.1002/cbdv.202000097

						and spathulenol (10.8%)	identified and quantified.
C. formanekii Halácsy[g]	Bul, Grc, Mkd	Aerial parts	- EOs[70]	Hydrodistillation	GC-MS	Hexadecanoic acid (13.6%), and δ-elemene (9.1%)	- 64 compounds were determined in EO.
C. kosaninii Hayek [g]	Alb, Mkd, Srb	Aerial parts	- Sesquiterpene lactones, triterpenes sterols and flavonoids[66]	No data	Silica column gel chromatography	Mixture of sterols (stigmasterol and β-sitosterol) and triterpenes (α and β-amyrin)	- None of the lactones or flavonoids were isolated from extract of this plant.
C. moesiaca Urum. & J.Wagner[g]	Bul, Srb	Aerial parts	- Sesquiterpene lactones, flavonoids and lignan[71]	Chloroform	Silica gel column chromatography	Cnicin, 4'-acetylcnicin	- In total, 21 components were isolated from chloroform extract: eleven sesquiterpene lactones, nine flavonoids (derivatives of 6-methoxyflavones and 6-methoxyflanonols) and one lignan (trachelogenin).
C. orphanidea Heldr. & Sart. ex Boiss. subsp. *thessala* (Hausskn.) Dostál[g]	Grc	Aerial parts	- EOs[70]	Hydrodistillation	GC-MS	γ-elemene (26.1%), and caryophyllene oxide (13.2%)	- 41 components were identified and quantified.
		Capitula		Hydrodistillation	GC-MS	hexadecanoic acid (33.5%), and heptacosane (6.3%)	- 41 components were identified and quantified.
		Roots		Hydrodistillation	GC-MS	Methyl hexadecanoate (22%), and α-chamigrene (14%)	- 41 components were identified and quantified.
C. thessala Hausskn. subsp. *drakiensis* (Freyn & Sint.) T.Georgiadis [g]	Grc	Aerial parts	- EOs[72]	Hydrodistillation	GC-MS	Hexacosane (22.6%), and caryophyllene oxide (7.8%)	- In total 43 EO components were identified.
C. parilica Stoj. & Stef. [g]	Grc, Bul	Aerial parts	- EOs[60]	Hydrodistillation	GC; GC-MS	Hexadecanoic acid (39.2%), and (Z,Z)-9,12-octadecadienoic acid (11.9%)	- 28 identified compounds.
C. pelia DC. [g]	Grc	Aerial parts	- EOs[72]	Hydrodistillation	GC-MS	Heptacosane (5.7%), and caryophyllene oxide (4.3%)	- In total 80 EO components were identified.
C. ragusina L. [g]	Cro	Flowers	- EOs[73]	Hydrodistillation	GC; GC-MS	Germacrene D (17.1%), and γ-muurolene (9.1%)	- 62 different compounds (sesquiterpenes, hydrocarbons, aldehydes, etc.) were identified and quantified.
			- Sesquiterpene lactones, organic acids and phenolics[74]	Aqueous (hot water)	HPLC-ESI-MS	Quinic acid, and citric acid	- Aqueous extracts was characterized with the presence of different lactones, organic acids as well as some

							phenolic compounds.
		Leaves	- EOs[73]	Hydrodistillation	GC; GC-MS	Cycloocta-1,3-diene (13.6%), octadec-9-enoic acid (10.6%), and acetophenone (10.3%)	- In total, 61 different compounds (sesquiterpenes, hydrocarbons, acids, ketones etc.) were identified and quantified.
		Herbal parts	- Sesquiterpene lactones, organic acids and phenolics[74]	Aqueous (hot water)	HPLC-ESI-MS	Solstitialin A-3,13-diaceate, epoxyrepdiolide and quinic acid	- Aqueous extract did not contain polyphenol compounds.
C. raphanina subsp. *mixta* (DC.) Runemark[g]	Grc	Aerial parts	- EOs[75]	Hydrodistillation	GC-MS	Caryophyllene oxide (10.3%), and *epi*-bicyclosesquiphellandrene (6.9%)	- EO of aerial plant parts contained 74 different compounds.
C. spinosa L.[g]	Grc	Aerial parts	- Sesquiterpene lactones and flavonoids[76]	Cyclohexane/ether/MeOH (1:1:1)	Column chromatography; HPLC; ^{1}H NMR and UV spectroscopy	4'-acetylcnicin (354 mg)	- 10 sesquiterpene lactones (two were new natural products) and 9 flavonoids were isolated and identified in plant extract.
C. spruneri Boiss. & Heldr.	Alb, Grc	Aerial parts	- EOs[75]	Hydrodistillation	GC-MS	β-elemene (27.7%)	- 50 compounds were isolated from the plant.
C. sibthorpii Halácsy[g]	Grc	Aerial parts	- EOs[77]	Hydrodistillation	GC; GC-MS	Hexadecanoic acid (18.6%), and 9,12-octadecadinoic acid (12.2%)	- The obtained plant EO consisted of 63 different compounds. Fatty acids and sesquiterpenes were predominant classes of compounds.
C. soskae Hayek ex Košanin[g]	Alb, Mkd	Aerial parts	- Sesquiterpene lactones and flavonoids[62]	Pethrol ether/ether/MeOH (1:1:1)	^{1}H and ^{13}C NMR spectroscopy; LC-ESI-MS	Santoflavone	- 1 lactone (cnicin) was quantified and 6 flavonoids (apigenin, isokaempferide, hispidulin, eupatorin, santoflavone and salvigenin) were identified.
C. tuberosa Vis. [g]	Alb, BiH, Bul, Cro, Grc, Mkd, Mne, Srb	Aerial parts	- EOs[78]	Hydrodistillation	GC	Caryophyllene-oxide (27.8%), and β-caryophyllene (11.1%)	- 32 compounds were registered in the obtained oil.
C. tomorosii Micevski[g]	Mkd	Aerial parts	- Sesquiterpene lactones and flavonoids[62]	Pethrol ether/ether/MeOH (1:1:1)	^{1}H and ^{13}C NMR spectroscopy; LC-ESI-MS	Santoflavone	- 1 lactone (cnicin) was quantified and 7 flavonoids (apigenin, isokaempferide,

							hispidulin, eupatorin, santoflavone, cirsimaritin and salvigenin) were identified.
		Fruits	- Fatty acids[63]	2-propanol	GC-MS	Linolelaidic acid (48.8% i.e. 2.6 g/100g)	- Only 5 fatty acids were identified.
C. vlachorum Hartvig	Alb, Grc	Aerial parts	- EOs[79]	Hydrodistillation	GC-MS	Caryophyllene-oxide (11.9 - 26.7%), and spathulenol (9.5 - 15.6%)	- The leaves, flowers and stems of examined plants were characterized with prevalence of oxygenated sesquiterpenes. The following components were accompanying: E-nerolidol and humulene epoxide II in leaves, *n*-heneicosane and methyl-linoleate in flowers i.e. 13-epi-malooloxide and *n*-heneicosane in examined stems.
		Seeds	- Lignans and alcaloids[80]	No data	^{1}H NMR spectroscopy	No data	- The first report about 2 lignans (matairesinol and arctiin) and 2 alcaloids (N-*p*-coumaroyl-serotonin and moschamine) in seeds of this plant has been made.
C. zuccariniana DC. [g]	Alb, Grc	Aerial parts	- EOs[72]	Hydrodistillation)	GC-MS	Hexadecanoic acid (6.5%), and caryoplhyllene oxide (6.2%)	- In total 74 EO components were identified.
Crepis incana Sm. [g]	Grc	Aerial parts	- Sesquiterpene lactones and flavonoids[81]	Cyclohexane/ether/water (1:1:1) followed by MeOH/water (5:1)	TLC; ^{1}H NMR spectroscopy	Ghroseimin and 1-*O*-β-D-glucopyranosyl ester of taraxinic acid	- 5 different lactones (ghroseimin, crepiside E, crepiside D, taraxinic acid and its ester with glucose) and 3 flavonoids (luteolin and its glucoside and 3-*O*-glucoside of quercetin) as well as 1 nor-preonid (loliolide) were isolated for the first time in case of this species.
		Roots	- Triterpenoids[81]	Cyclohexane/ether/water	TLC; ^{1}H NMR	No data	- 2 triterpeonids (lupeol and

10.1002/cbdv.202000097

				(1:1:1)	spectroscopy		oleanolic acid) were identified.
Hieracium orieni A.Kern.	Alb, Bul, Cro, Grc, Mne, Mkd, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Chlorogenic acid (18.8 mg/g), luteolin-7-*O*-glucuronide (17.7 mg/g), luteolin-7-*O*-glucoside (17.5 mg/g), and luteolin 7-*O*-glucoxyloside (16.8 mg/g)	- 16 compounds (12 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones [83]	MeOH	LC-MS	None	- 2 guaianolide lactones were quantified but as traces.
H. durmitoricum (Rohlena & Zahn) Niketić[g]	Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin-7-*O*-glucoside (34.0 mg/g), ,luteolin 7-*O*-glucoxyloside (16.4 mg/g), and chlorogenic acid (13.5 mg/g)	- 22 compounds (18 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (5.5 mg/g), and guaianolide glucoside (4.7 mg/g)	- 4 lactones were quantified.
H. guentheri-beckii Zahn[g]	Alb, BiH, Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin-7-*O*-glucuronide (40.3 mg/g), chlorogenic acid (19.8 mg/g), Luteolin-7-*O*-glucoside (15.2 mg/g), and 3,5-dicaffeoylquinic acid (14.5 mg/g)	- 21 compounds (17 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Guaianolide glucoside (11.1 mg/g), and crepiside E (10.4 mg/g)	- 3 lactones were quantified.
H. mirificissimum Rohlena & Zahn[g]	BiH, Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin-7-*O*-glucuronide (74.5 mg/g),, chlorogenic acid (30.3 mg/g), luteolin-7-*O*-glucoside (16.95 mg/g), and luteolin 7-*O*-glucoxyloside (14.5 mg/g)	- 14 compounds (10 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (10.1 mg/g), and guaianolide glucoside (2.4 mg/g)	- 3 lactones were quantified.

10.1002/cbdv.202000097

H. mokragorae (Nägeli & Peter) Nägeli & Peter [g]	Alb, BiH, Bul, Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin-7-*O*-glucuronide (18.5 mg/g), 3,5-dicaffeoylquinic acid (12.8 mg/g), and chlorogenic acid (12.7 mg/g)	- 11 compounds (7 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (0.3 mg/g)	- Guaianolide glucoside and calophyllamine A were quantified in traces.
H. albopellitum (Zahn) Niketić [g]	Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin-7-*O*-glucuronide (26.4 mg/g), luteolin-7-*O*-glucoside (16.3 mg/g), chlorogenic acid (14.6 mg/g), and 3,5-dicaffeoylquinic acid (9.8 mg/g)	- 16 compounds (12 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (0.5 mg/g)	- Guaianolide glucoside, calophyllamine A and B were quantified in traces.
H. naegelianum Pančić	Mkd, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin 7-*O*-glucoside (49.2 mg/g), luteolin hexosylpentoside (40.8 mg/g), and luteolin 7-*O*-glucoxyloside (34.8 mg/g)	- 15 compounds (11 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (7.9 mg/g), and guaianolide glucoside (3.7 mg/g)	- 3 lactones were quantified.
H. macrodontoides (Zahn) Zahn	Alb, Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	3,5-dicaffeoylquinic acid (28.6 mg/g), luteolin-7-*O*-glucuronide (26.9 mg/g), chlorogenic acid (24.8 mg/g), and luteolin 7-O-glucoside (21.0 mg/g)	- 12 compounds (8 flavonoids and 4 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	None	- Only 1 lactone (eudesmanolide type i.e. calophyllamine B) was above the limit of quantification.
H. tommasinianum K.Malý	Alb, Bul, Cro, Grc, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	3,5-dicaffeoylquinic acid (28.6 mg/g), luteolin 7-O-	- 12 compounds (8 flavonoids and 4 phenolic acids) were

						glucoxyloside (16.1 mg/g), chlorogenic acid (15.7 mg/g), and luteolin-7-*O*-glucuronide (15.3 mg/g),	quantified. It was one of the species where phenolic acids were predominant components compared to flavonoids.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	None	- Only 1 lactone (crepiside E) was present, but in low quantity (below 1 mg/g).
H.bupleuroides subsp. *pseudoschenkii* Rohlena & Zahn	BiH, Mne	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Chlorogenic acid (22.3 mg/g), 3,5-dicaffeoylquinic acid (22.3 mg/g), and luteolin 7-O-glucoxyloside (16.7 mg/g)	- 17 different components (13 flavonoids and 4 phenolic acids) were recorded in the extracts.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Guaianolide glucoside (10.4 mg/g) and calophyllamine A (5.1 mg/g)	- 3 lactones were quantified.
H. waldsteinii subsp. *plumulosum* (A.Kern.) Freyn	BiH, Mne	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin 7-O-glucuronide (35.9 mg/g), chlorogenic acid (17.8 mg/g), luteolin 7-*O*-glucoside (14.7 mg/g), and 3,5-dicaffeoylquinic acid (9.5 mg/g)	- 13compounds (8 flavonoids and 5 phenolic acids) were quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (7.5 mg/g)	- 3 lactones were quantified.
H. coloriscapum Rohlena & Zahn	Alb, Grc, Mne	Aerial parts	- Flavonoids and phenolic acids [82]	Dichloromethane followed by MeOH	LC-MS	Luteolin 7-O-glucuronide (23.7 mg/g), luteolin-7-*O*-glucoside (23.0 mg/g), chlorogenic acid (21.0 mg/g), and luteolin 7-O-glucoxyloside (15.3 mg/g)	- 18 different components (13 flavonoids and 5 phenolic acids) were isolated and quantified.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (10.1 mg/g)	- 4 lactones were quantified.
H. gymnocephalum Griseb. ex Pant.	Alb, BiH, Grc, Mne, Srb	Aerial parts	- Flavonoids and phenolic acids[82]	Dichloromethane followed by MeOH	LC-MS	Luteolin 7-O-glucoxyloside (25.1 mg/g), luteolin 7-O-	- 18 compounds (14 flavonoids and 4 phenolic

 10.1002/cbdv.202000097

						glucoside (20.2 mg/g), chlorogenic acid (15.3 mg/g), and luteolin 7-O-glucuronide (11.9 mg/g)	acids) were recorded.
			- Sesquiterpene lactones[83]	MeOH	LC-MS	Crepiside E (14.2 mg/g) and guaianolide glucoside (8.2 mg/g)	- 3 lactones were quantified.
Jurinea tzar-ferdinandii Davidov [g]	Bul, Rou	Aerial parts	- Terpenoids, sesquiterpene lactones, and flavonoids[84]	*n*-hexane Chloroform	Column chromatography; GC-MS; ^{1}H NMR spectroscopy	8-(4'-hydroxymethacryloyloxy)-15-oxo-helianga-1(10),4,11 (13)-trien-6,12-olide (6.3 mg)	- In total 22 compounds were isolated and identified.
Onopordum laconicum Heldr. & Sart. ex Rouy[g]	Grc	Aerial parts	- Flavonoids[85]	*n*-hexane MeOH	Column chromatography; TLC; ^{1}H NMR and UV spectroscopy	Chrysoeriol-7-*O*-β-glucoside (15 mg), and acacetin (15 mg)	- 12 flavonoids and derivatives were isolated and identified.
Senecio macedonicus Griseb. [g]	Bul, Grc, Mkd	Leaves	- Sesquiterpene lactones[86]	Chloroform	Column chromatography; ^{1}H NMR spectroscopy	No data	- 4 sesquiterpene lactones were identified. Two of them were new C-8 epimeric secomacrotolides.
		Roots	- Alkaloids[87]	EtOH	Column chromatography; GC-MS; ^{1}H and ^{13}C NMR spectroscopy	No data	- 6 alkaloids were identified in plant root ethanolic extract.
Tanacetum corymbosum (L.) Sch.Bip.	BiH, Bul, Grc, Cro, Mne, Mkd, Srb, Tur	Whole plant	- Sesquiterpene lactones[26]	Chloroform	No data	None	- None of the lactones were identified. This plant is well known as a poor source of these lactones[26].
T. larvatum (Pant.) Hayek[g]	Alb, Mne, Srb	Aerial parts	- Parthenolide - sesquiterpene lactone[88]	Pethrol ether/ether/MeOH (1:1:1)	Silica gel column chromatography/dry-column flash chromatography	Parthenolide (35 mg) and douglanine (21 mg)	- 2 lactones (germacranolide parthenolide and eudesmanolide douglanine) and 1 flavone (tricin) were isolated and identified.
			- EOs[89]	Hydrodistillation	GC	*trans*-sabinyl acetate (51.2 - 69.7%), β–pinene (4.3 - 7.7%), and camphor (4.3 - 6.3%)	- 47 compounds were isolated and identified. Among them, monoterpenes were the predominant class.

[a] Alb- Albania; BiH- Bosnia and Herzegovina; Bul- Bulgaria; Cro- Croatia; Grc- Greece; Mkd- North Macedonia; Mne- Montenegro; Srb- Serbia; Tur - Turkey; Rou- Romania[b] EOs/EO - essential oils/ essential oil; [c] EtOAc - ethyl-acetate; [d] BuOH - buthanol; [e] MeOH - methanol; [f] EtOH – ethanol [g] Balkans' endemic taxa; [h] LC ESI MS - Liquid Chromatography-Electrospray Ionization-Mass Spectrometry

It is obvious that there is great diversity regarding the chemical composition of studied plant species from the Balkan Peninsula. As expected, the main classes of chemical compounds of EOs, mainly different mono- and sesquiterpenes were similar to those reported for other taxa belonging to Asteraceae.[21,90] In addition, in surveyed Balkans' Asteraceae taxa, the flavonoids were the main phenolic subclass as already reported for large families of vascular plants.[21,90] The chemical structures of some of the representative bioactive compounds determined in different extracts of Balkans' Asteraceae species are given in **Figure 2 (see suplementary file)**.

As shown in **Table 1**, the literature search included 63 species of Asteraceae typical for the Balkan Peninsula for which some phytochemical records already exist. The highest number of species belongs to the genus *Centaurea* (25), followed by genera *Achillea* and *Hieracium* (13 each), *Artemisia*, *Carduus*, *anacetum* (2 each), Aster and *Crepis* (1 each). The bioactive and potentially bioactive specialized metabolites from these taxa belong to different classes: EOs (10 oxygenated monoterpenes, 3 monoterpene hydrocarbons and 1 oxygenated sesquiterpene were presented in significant quantities (above 20%) in all Balkans' *Achillea* species),[91] esters, flavonoids, phenolic acids, sesquiterpene lactones, triterpenoids (from *Achillea* taxa); flavonoids and other polyphenols, n-alkanes, sesquiterpene lactones-amphoricarpolides (from *Amphoricarpos* taxa); EOs (from *Aster albanicus*) and EOs, water soluble phenolic compounds (from *Carduus* taxa); EOs, fatty acids, flavonoids, lignans, monoterpenes, organic acids, phenolics, sesquiterpenes, sesquiterpene lactones, sterols, triterpenes, triterpene sterols (from *Centaurea* taxa); flavonoids, sesquiterpene lactones,triterpenoids (from *Crepis incana*); flavonoids, phenolic acids, sesquiterpene lactones (from *Hieracium* taxa) and EOs and parthenolide - sesquiterpene lactone (from *Tanacetum* taxa). In addition, some organic acids, lignans and alkaloids were recorded in several Balkans' Asteraceae species. A range of specialized metabolites, including some specific components, such as some flavonoids, sesquiterpene lactones and rare fatty acids (γ-linoleic acid, *trans*, epoxy and hydroxy forms) might be of chemophenetic relevance. For instance, several germacranolides are principal components of *Anthemis macedonica*[52] In addition, linear irregular lactones could be considered as chemophenetic markers for two Asteraceae genera: *Anthemis* and *Maruta*.[52] Todorova et al.[92] determined the presence of seven new irregular sesquiterpene dilactones in the flower of *Anthemis auriculata* Boiss. from Bulgaria. Same authors[44] reported the presence of one unusual bis-norsesquiterpene lactone (proposed name is spirodepressolide) in aerial parts of *Achillea depressa* Janka. Regarding some characteristic flavonoids, literature data reported the presence of pectolinarigenin, eupatilin and jaceosidin for the first time in *J. tzar-ferdinandii* Davidov.[84] These compounds possibly make a biogenetic relationship between *Jurinea* genus and two other Asteraceae genera: *Onopordon* and *Centaurea.*[84] Many of the examined Balkans' Asteraceae species are endemic (**Table 1**), and are not used in traditional or official medicine. However, some of Balkan endemics might be of further research interest upon preliminary information on the phytochemical composition and related biological activity (**Table 2**). It should be emphasized that endemic Asteraceae species are mostly composed of small populations with limited distribution. Therefore, it is necessary to implement a range of *in situ* and *ex situ* conservation measures for their possible commercial use.

2.2. Biological activity

Nowadays, the importance of biologically active substances acting as antioxidants is based upon their ability to prevent cell and macromolecule damages caused by free radicals, reactive oxygen (ROS) and nitrogen (RNS) species.[93] Ability of different compounds to perform as antioxidants is established on the positive redox potential during reaction with different prooxidants allowing them to inhibit "oxidative stress" (OS). The number of articles dealing with antioxidant properties / abilities of different plant foods or food ingredients has become immense during the last few decades.[94–96] Due to the importance of antioxidants in human diet, there are several antioxidant tests developed for assessment of biological behavior of whole plant extracts and individual components.[97] The main differences among these assays are related either to the way of performance - *in vitro* and *in vivo*[93,98] or the principal chemical reaction mechanism. In that sense we can distinguish so-called "hydrogen atom transfer-based" (HAT), "single electron transfer-based" (SET) or mixed assays.[93,99] Currently, there are 19 *in vitro* and 10 *in vivo* tests used to establish antioxidant potential of plant material.[100] Among all plant metabolites, polyphenols, carotenoids and vitamins are considered as the most prominent antioxidants[101,102] as well as valuable antimicrobial agents.[103] Application of plant extracts and individual components as effective agents against different microorganisms is still in progress and will be even more applied due to known resistance to standard antibiotics.[103] In **Table 2** available literature sources for antimicrobial activity and *in vitro* and *in vivo* antioxidant effects of selected Balkans' Asteraceae plants are summarized.

Table 2. Biological activity assays of selected Balkans' Asteraceae plants.

Scientific species name	**Part of plant**	**Biological activity assays**[b]	**Remarks**[c]
Achillea alexandri-regis Bornm & Rudsky	Aerial parts	- Anti-inflammatory and anti-ulcer activity[28]	- All applied MeOH[a] extracts were successful as anti-inflammatory agents in doses below the dose necessary for the anti-ulcer effect
		- Antioxidant activity[29]	- Both plant extracts (50% EtOH[b] and EtOAc[c]) were successful in hydroxyl and superoxide radicals neutralization
		- Antioxidant and cytotoxic activity[30]	- MeOH[c] extract exhibited the highest DPPH activity while combined chloroform and EtOAc extracts showed significant ability to act against adenocarcinoma cells (HeLa)
A. holosericea Sm.	Aerial parts	- Antimicrobial activity[32]	- EO's[d] obtained from this plant were completely inactive against examined bacteria and fungi species
		- Antimicrobial activity[39]	- Plant extract possessed low but measurable activity against 5 bacteria and 2 fungi
A. clavennae L.	Aerial parts	- Antimicrobial activity[39]	- Plant extract exhibited significant antimicrobial activity against 5 bacteria and 2 fungi species
A. chrysocoma Friv.	Aerial parts	- Antibacterial activity[37]	- EO showed significant activity against 2 gram-negative bacteria
A. fraasii Sch.Bip.	Aerial parts	- Antimicrobial activity[32]	- Extract presented a significant activity against gram negative bacteria
A. taygetea Boiss & Heldr.	Aerial parts	- Antimicrobial activity[32]	- Extract presented a moderate activity against gram negative bacteria and pathogenic fungi
A. thracica Velen.	Fresh, in vivo and ex-vitro grown plant parts	- Antibacterial activity[41]	- Acetonic extract of naturally obtained plants showed very weak antibacterial activity while the other two extracts can be characterized as moderate antibacterial agents against five bacterial strains
A. umbellata Sm.	Aerial parts	- Antimicrobial activity[48]	- The highest inhibitor activity was recorded against *Staphylococcus aureus* while *Pseudomonas aeruginosa*

			was resistant to EO treatment
		- *in vivo* toxicity and locomotor activity[48]	- The first case of mortality between treated mice was recorded at EO dose of 600 mg/kg. Compared to standard drug (diazepam) plant EO exhibited significant activity
Amphoricarpos autariatus subsp. *bertisceus* Blečić & E.Mayer	Leaves	- Antimicrobial activity	- Examined extracts possessed a significant antimicrobial potential
		- Antioxidant activity[19]	- Dry MeOH plant extract showed a higher DPPH activity compared to liquid MeOH and aqueous extracts
A. autariatus Blečić & Mayer subsp. *autariatus*	Leaves	- Antifungal activity[49]	- Lactone fraction possessed a significant activity against eight examined fungi
		- Antimicrobial and antioxidant activity[19]	- Examined extracts possessed a significant antimicrobial potential. Dry MeOH plant extract showed a higher DPPH activity compared to liquid MeOH and aqueous extracts
A. neumayerianus (Vis.) Greuter	Leaves	- Antimicrobial and antioxidant activity[19]	- Examined extracts possessed a significant antimicrobial potential. Dry MeOH plant extract showed a higher DPPH activity compared to liquid MeOH and aqueous extracts
Artemisia. arborescens (Vaill.) L.	Aerial parts	- Antioxidant activity[54]	- DPPH test proved that EO of *A. arborescens* possessed 40 times higher antioxidant activity compared to EO of *A. inculta* mostly due to absence of chamazulene in EO of *A. inculta*
A. inculta Delile	Aerial parts	-Antioxidant activity[54]	
Carduus candicans subsp. *globifer* (Velen.) Kazmi	No data	- Antioxidant activity[56]	- EtOH plant extracts exhibited significant ability to quench DPPH and ABTS free radicals as well as to reduce Fe^{3+} ions during FRAP assay. In addition, compared to BHT, plant extracts had higher ability to prevent lipid peroxidation
C. kerneri subsp. *austro-orientalis* Franco	No data	- Antioxidant activity[56]	
Centaurea achaia Boiss. & Heldr.	Aerial parts	- Antifungal activity[58]	- Several compounds, extracted and isolated from plant extract, showed strong antifungal activity against nine tested fungi: *A. niger*, *A. ochraceus*, *A. versicolor*, *A. flavus*, A. alternata, C. cladosporioides, P. *ochrochloron*, *P. funiculosum*, and *T. viride*. MIC values were in range 0.1 - 3.0 nmol/L while MFC values were between 0.75 and 6.0 nmol/L except in case of 4-*epi*-carmanin.
C. gloriosa var. *multiflora* Radić	Aerial parts	- Antioxidant activity[65]	- Three different tests were applied: DPPH, ABTS and ORAC. Aqueous plant extract showed significant ability to quench DPPH and ABTS radicals while ORAC test proved that the extracts of this plant can act both as oxidant and prooxidant which is controlled by free radical source
			- Disc diffusion method proved a low antimicrobial activity

		- Antimicrobial activity[65]	of plant extract with *Candida* spp. and *Pseudomonas* spp. as the most sensitive microbes
C. ragusina L.	Flowers and leaves	- Antimicrobial activity[73]	- Based on the results of two *in vitro* applied methods (disc diffusion and microdilution) the plant extract showed significant antibacterial and antifungal activity at mass concentration of 250 µg/mL. The investigation included 4 gram-positive and 4 gram-negative bacteria as well as 2 fungal strains
	Herba and flowers	- *in vitro* cytotoxic activity[74]	- Examination of aqueous plant extract on 1 bladder and 1 glioblastoma cell lines proved good cytotoxic activity
C. spinosa L.	Aerial parts	- Antibacterial activity; *in vitro* cytotoxic activity[76]	- All lactones, isolated from plant extract, were inactive against selected Gram-negative bacteria while they exhibited some inhibitory effect against three Gram-positive bacteria (*S. aureus*, *B. Cereus*, *M. flavus*). Elemanolide was the most active compound against tasted human cell lines (DLD1, SF268, H460, OVCAR3) especially in the case of OVCAR3 line with significant cell growth inhibition at concentration below 5 µM.
C. sibthorpii Halácsy	Aerial parts	- Antibacterial activity[77]	- There was no any activity of plant EO against 10 examined bacteria
C. vlachorum Hartvig	Seeds	- Antioxidant activity[80]	- DPPH assay revealed good antioxidant properties for all isolated components (N-*p*-coumaroyl-serotonin, matairesinol and moschamine) except in case of arctiin. During lipid peroxidation inhibition test N-*p*-coumaroyl-serotonin and arctiin showed high antilipid peroxidation activity
		-Inhibitor activity[80]	- Matairesinol and moschamine possessed good inhibition properties against soybean lypoxygenase enzyme
Hieracium spp. (14) [e]	Aerial parts	- Antioxidant activity[82]	- All extracts exhibited promising antioxidant properties in all applied assays (FRAP, DPPH and 2-deoxyribose assay). The obtained results correlated with the results for phenolic compounds content in plant extracts
Jurinea tzar-ferdinandii Davidov	Aerial parts	Anti-lipase activity[84]	- IC_{50} values of chloroform extract against two lipase enzymes were 29 -i.e. 39 µg/mL for *Candida rugosa* lipase (CRL) and porcine pancreas lipase (PPL) respectively. Among tested isolated compounds onopordopicrin was the most prominent with IC_{50} values at 32 (CRL) and 36 µg/mL (PPL)

Tanacetum corymbosum subsp. *cinereum* (Griseb.) Bornm.	Flowers	- *in vivo* antifeedant activity[104]	- MeOH flower extract exhibited significant antifeedant effect against larvae of *S. littoralis*
T. larvatum (Pant.) Hayelk	Aerial parts	- Antioxidant activity[105]	- *in vitro* DPPH assay revealed remarkable antioxidant capacity of plant extracts
		- Anti-inflammatory activity, gastroprotective effects[106]	- combined *in vivo* application of chloroform plant extracts with indomethacin on rats showed improved anti-inflammatory effect with reduced gastric lesions
Senecio macedonicus Griseb.	Roots	- *in vitro* cytotoxic activity[87]	- 9-angeloylplatynecine and mixture of sarracine and neosarracine (1:3 w/w), alkaloids isolated from plant roots extract, possessed promising immunomodulatory activity applied to normal murine spleen lymphocytes and P3U1 mouse myeloma cells.

[a] MeOH – methanol; [b] EtOH – ethanol; [c] EtOAc – ethyl-acetate; [d] EOs – essential oils; [e] the given results are related for fourteen Balkans' endemic species

Essential oils are one of the most powerful natural antimicrobial agents.[107] Similarly, some plant metabolites can act as biopesticides as it can be seen in the case of *Tanacetum corymbosum* subsp. *cinereum* (Griseb.) Bornm.[90] Since plants produced some specific molecules in order to protect themselves from herbivores in this case effectiveness of methanolic plant extract against larvae of *Spodoptera littoralis* can be linked to the presence of several active compounds belonging to germacranolide, eudesmanolide, cumarin, and flavonol subclasses.[90] Although synthetic antioxidants (such as butylated hydroxytoluene (BHT) and hydroxyanisole (BHA)) are still predominantly used in the food industry due to rising concerns about consumers' safety and healthy diet, there are great opportunities for "back to the nature" by applying natural antioxidants. Among 35 surveyed Asteraceae taxa, some of them showed promising antioxidant properties proved by several assays (DPPH, ABTS, ORAC, FRAP, mainly referring to *Tanacetum larvatum*, *Centaurea gloriosa* var. *multiflora* and several *Hieracium* species) (**Table 2**). Some authors pointed out the correlation between antioxidant ability and the content of polyphenols in Asteraceae taxa.[82] In addition to antimicrobial effects, some phenolic compounds of Asteraceae species exhibited antiviral and anti-helminths activity, as reported for caffeic acids and tannins isolated from tarragon (*Artemisia dracunculus*).[103] *Hieracium* species from the Balkan Peninsula were characterized as good sources of different luteolin derivates and phenolic acids[82] which might be of further interest for the testing of their possible antimicrobial activity. It had already been shown that: 3,5-di-*O*-caffeoylquinic acid, luteolin, 4-coumaric acid and quercetin pentosides isolated from the aqueous extract of dandelion (*Taraxacum mongolicum* Hand.-Mazz.) exhibit good antifungal activity against *Candida albicans*.[108] Additionally, different phenolic compounds (e.g. caffeic acids, tannins, quercetin, chrysin, myricetin and some other flavonoids) were tested for anti-HIV activity.[103] Due to the presence of several bioactive compounds (curcumin, and different polyphenolic compounds such as flavonoids and tannins) which can neutralize free radicals, medicinal plants can act as natural anti-inflammatory agents.[109] In this way, these compounds prevent gastric ulcer since free radicals can react with some inflammatory molecules responsible for disease development[109] such as nitric oxide, nitric oxide synthase and interleukins-1. The observed anti-inflammatory and anti-ulcer activities of *Achillea alexandri-regis* Bornm & Rudsky extract[28] is mostly related to the presence of sesquiterpene lactones and, probably, some flavonoids[28]. Similar effect was observed in the case of *Tanacetum larvatum* chloroform extract[92] since it significantly reduced ulcerogenic effect of the standard drug, indomethacin, used for gastric ulcer treatment. Authors suggested that this important ability is mostly connected to the inhibition of activity NF-κB protein complex responsible for the transcription process. It is probably caused by some of the active ingredients originated from plant extract[92]. This is important since modern pharmacy is seeking for alternative sources of anti-ulcer agents to replace synthetic drugs which have some unpleasant side effects such as: nausea, abdominal pain, constipation, etc.[110] Anti-cancer activity of plant-derived molecules has been recognized and used in order to replace some standard synthetic anti-cancer drugs.[111] Among examined species cytotoxic activity of *Centaurea spinosa* L. extract is connected with one of the elemanolides' active ingredients. This compound belongs to sesquiterpene lactones and its activity against OVCAR3 cell line probably originated from the presence of aldehyde group.[76] On the other side, *in vitro* cytotoxic activity of the extract obtained from *Senecio macedonicus Griseb.* roots[87] is probably caused by the presence of several pyrrolizidine alkaloids which is in accordance with literature data about alkaloids' anti-cancer activity.[111] Since all Asteraceae plants are a possible good source of phenolic acids and flavonoids, different biological activities of their extracts and of related compounds should be further researched.

3. Balkans' Asteracae species as food source – review from ethnobotanical data

3.1. Historical background

Due to historical, political and biological factors, the Southeast Europe, i.e. the Balkan region is a hotspot of biocultural diversity in Europe.[112] Traditional use of plants in the Balkans is very complex and interesting, considering the rich cultural and historical past and influences coming from the East and West, due to geographical position of the region. The curative and prophylactic use of medicinal herbs in the Balkan peninsula has a long tradition, starting from the first reports of Theophrastus and Dioscorides and several medieval manuscripts, such as Slavic manuscript found in Sinai monastery St Ekaterina (anonymous, XI century, Bulgaria), "Canon Prayer to St. Ivan Rilski and Medical Text" (anonymous, 1845, Bulgaria), "Herbarium" (by Peter Melius Juhasz, 1578, Romania), "Hodosh Codex" (anonymous, XIV century, Serbia), "Chilandar Medical Codex, No 517 (anonymous, XV century, Serbia) as well as some others. There is an important historical background on traditional knowledge of edible plants from the Balkan region. Some recent reports have addressed the use of wild edible plants in the Southeast Europe which is still ongoing in the rural areas.[113–118] It is thought that nearly 30% of the world flora have edible parts and therefore are used in traditional nutrition.[119] Many wild herbaceous plants are still collected by local people in the rural areas for their own use or for sale at the local markets.[114,120] It is important to preserve the knowledge about traditional use of wild edible plants as a source of important nutrients, mainly vitamins, minerals and antioxidants.[113] The interest in wild leafy vegetables is increasing due to documented health benefits of these herbs in human diet.[121–124] Many of the wild edible plants belong to Asteraceae family, where preference for their use could be attributed to their satisfying sensory properties, resulting in domestication and cultivation of a range of species of this family for human consumption.[125] Species of the Asteraceae family (exceeding 80 species) are widely used in the Mediterranean region and the Balkans as edible plants,[116,117,126,127] (**Table 3**).

3.2. Edible green vegetables

Among the most used wild Asteraceae are: dandelion (*Taraxacum officinale* (L.) Weber ex F.H.Wigg.) and chicory (*Cichorium intybus* L.), readily eaten in fresh, mixed and garnish salads.[121] There are several reports on nutritive and phytochemical composition of these species, addressing the high content of potassium, calcium, manganese, iron, beta-carotene, dietary fibers and vitamin B6.[123,125,128] The high content of Β-sitosterol, quercetin glycosides, monocaffeoyltartaric acid and sesquiterpene lactones (taraxinic acid βD glucopyranoside) was determined in dandelion leaves,[123] whereas flavonoids and hydroxycinnamic acids, with isomers of chicoric acid, chlorogenic acid, caftaric acid, and luteolin hexoside were dominant compounds in the leaves of chicory.[122] Besides dandelion and chicory, the other frequently used edible Asteraceae in the Balkans are: yarrow (*Achillea millefolium* agg.), daisy (*Bellis perennis* L.), hawkbits (*Leontodon tuberosum* Batt.), Jerusalem artichoke (*Helianthus tuberosus* L.), stemless carline thistle (*Carlina acaulis*), common golden thistle (*Scolymus hispanicus* L.), common sow thistle (*Sonchus oleraceus* (L.) L.), and some other thistle plants (usually belonging to the tribe Cardueae), especially of genera *Carduus*, *Cirsium* and *Onopordum*. Edible thistles are known to have edible basal leaves and the midribs of the basal leaves, like in *Silybum*, *Cynara*, *Scolymus*, *Onopordum* and *Arctium*.[129] The highest number of identified edible Asteraceae in the Balkans region is used as green vegetables, either raw as a salad, or as cooked vegetables (**Table 3**). This is in agreement with the data of Hadjichambis et al.[126] showing that leaves are the most used plant parts, followed by shoots and other plant parts. It has already been reported that edible leafy vegetable Asteraceae species contain valuable dietary phytochemicals, mainly carotenoids, tocopherols and high content of ascorbic acid,[121,130] in addition to various phenolic compounds and sesquiterpene lactones.[131] Therefore, wild fresh leafy vegetables might constitute significant functional food components.[132] It is known that in southern Europe and the Balkans, many bitter-tasting Asteraceae species are still used as a food in rural communities (e.g. *Cichorium, Hypochaeris, Sonchus, Leontodon, Arctium*), while being neglected in the northern Europe, due to replacement with species of less bitter taste, such as *Urtica, Chenopodium, Aegopodium* and some others.[119] Bitter taste of leafy Asteraceae species is related to the presence of sesquiterpene lactones, exhibiting putative health-promoting effects.[133]

3.3. Edible roots

Nearly 30 species of Asteraceae family with edible underground parts were recorded (**Table 3**), of which the following have the roots as the only plant part used: *Carlina acaulis* L., *Chondrilla juncea* L., *Inula helenium* L., *Picnomon acarna* (L.) Cass. and *Scorzonera hispanica* L. Roots of many edible Asteraceae plants are characterized by high content of fibers and inulin, a complex carbohydrate of sweet taste upon cooking, because of partial breakdown into fructose.[119] The most used edible roots of Asteraceae species in the Balkans are dandelion, chicory and stemless carline thistle. Dandelion roots are known for the presence of carbohydrates, mainly inulin, mucilage, pectin and simple sugars (glucose, fructose and sucrose), carotenoids (lutein), as well as different phenolic compounds, mainly phenolic acids (chicoric acid, caffeic, chlorogenic acid), taraxasterol, chrysoeriol, luteoline glucoside and some other compounds.[123] It has been reported that inulin accounts for up to 70% of the total root carbohydrates in chicory and that together with the Jerusalem artichoke (*Heliantus tuberosus* L.), it is the most important source of inulin for the industry uses.[128] The root is also rich in hydroxycinnamic acids, such as ferulic, caffeic and chicoric acid, which are together with the inulin, responsible for the antidiabetic activity.[134] Roots of *Carlina acaulis* L. are also very rich in inulin, in addition to high content of flavonoids and 1–2% of essential oil, with carlina oxide as the main component.[135]

3.4. Edible flowers

Edible flowers contribute to the taste, appearance, aesthetic value and aroma of food, simultaneously expressing valuable nutrition and low calorie characteristics.[136] Edible flowers are usually used to bring fragrance, flavor and color to main courses, salads, soups, entrees and drinks.[137] Frequently used edible flowers of the Asteraceae species are: *Calendula officinalis* L., *Carthamus tinctorius* L., *Centaurea cyanus* L., *Chrysanthemum morifolium* Ramat., *Cichorium intybus* L.,[138] *Bellis perennis* L., *Taraxacum officinale* (L.) Weber ex F.H.Wigg.,[124] *Scolymus hispanicus* L. and the cultivated *Carthamus tinctorius* L:, both used as saffron substitutes, as well as flowers of *Cynara humilis* L. and *Cynara cardunculus* L. used for making the local cheese varieties.[129] It was demonstrated that edible flowers of Asteraceae contain different phenolic compounds, mainly phenolic acids, flavonols and anthocyanins, all exhibiting strong antioxidant effects.[139,140] Edible flowers are not much used in the Balkans cuisine. Nevertheless, there are few notes on edible flowers used either raw, in the salads, as reported for *Bellis perennis* L., *Taraxacum officinale* (L.) Weber ex F.H.Wigg.[118] and *Cichorium intybus* L.,[141] or for seasoning, as in the case of *Achillea millefolium* L., *Artemisia absinthium* L., *Chamomilla recutita* (L.) Rauschert, *Eupatorium cannabinum* L.,[118] *Calendula officinalis* L. and *Helianthus tuberosus* L..[142] Finally, it should be added that the flowers of many Asteraceae species are readily used in the Balkans for preparing herbal teas, which are used not only as a remedy in prophylaxis, but often as a hot beverage. The most used species in the herbal teas are: *Chamomilla recutita* (L.) Rauschert, *Achillea millefolium* L., *Calendula officinalis* L., *Taraxacum officinale* (L.) Weber ex F.H.Wigg, *Cichorium intybus* L., *Matricaria suaveolens* Koch, *Xanthium spinosum* L., *Cirsium vulgare* (Savi) Ten., *Tusssilago farfara* L., *Artemisia absinthium* L., *Arnica montana* L., *Centaurea jacea* L., *Helichrysum italicum* (Roth) G. Don, *Helichrysum plicatum* DC., and some others.[115–117,143–145] Instead of a conclusion it is worth to mention some less common uses of wild Asteraceae in the Balkans, such as for preparation of sweet syrup, called "dandelion's honey" as in the case of *Taraxacum*,[146] and *Arctium* species[147]; use of chicory and dandelion roots as coffee surrogate[143] or use of aerial parts of *Arctium lappa* L., *Artemisia absinthium* L., *Cyanus segetum* Hill, *Tanacetum vulgare* L. and *Taraxacum* spp. for fermented beverages, such as wine and beer.[145] Finally, apart from the vegetative plant parts and flowers, rarely, some other plant parts of Asteraceae species might be used, such as cypsela or pollen, as in the case of sunflower,

 10.1002/cbdv.202000097

where its pollen was assigned to have much higher flavonoid content and better nutritive features than many other commonly used crops which makes it a possible functional food ingredient.[22,148]

Table 3. Balkans' Asteraceae plants as food source.

Species	**Plant part used**	**Preparation**	**Country/Sub-region**	**Reference**
Achillea millefolium. aggr.	Young shoots	Green vegetable, condiment	BiH[a]	[149,150]
	Flowers	Seasoning	Mkd	[118]
Arctium L. spp.	Young shoots	Salad, soup	WB	[147]
	Root	Sweet syrup, flavor, cooked	WB	
		Vegetable, coffee supplement	WB	
Arctium lappa L.	Leaves	Salad	Bul	[144]
	Root	Flour, soup, baked vegetable		
Arctium nemorosum Lej.	Root	Mush	BiH	[149]
	Young leaves	Green vegetable		
Artemisia absinthium L.	Flowers	Seasoning	Mkd	[118]
Artemisia vulgaris L.,	Young shoot	Cooked vegetable, condiment	BiH	[149,150]
Bellis perennis L.	Leaf	Green vegetable	Tur	[120]
		Salad	Bul	[144]
	Young shoot	Salad, green vegetable	WB	[147]
	Flowers	Raw	Mkd	[118]
Bellis sylvestris Cirillo	Leaves	Salad	BiH	[151]
Calendula arvensis (Vaill.) L.	Leaves	Cooked vegetable	Grc	[126]
Calendula officinalis L.	Flowers	Seasoning, decoration, cooked	Bul	[142]
Carduus L. spp.	Young shoots	Salad	Cro	[152]
Carduus acanthoides L.	Young shoots	Salad	WB	[153]
	Root	Cooked vegetable		
Carduus argentatus L.	Young stem	Cooked vegetable	Grc	[154]
Carthamus lanatus L.	Young leaves	Cooked vegetable	WB-Med	[153]
Carlina acaulis L.	Root	Fresh, salad	BiH	[149,150]
		Beverage	BiH	
		Cooked vegetable	Srb	[143]
Carlina involucrata Poir.	Young stems	Cooked vegetable	Grc	[154]
Centaurea calcitrapa L.	Young stems	Cooked vegetable	Grc	[154]
Centaurea jacea L.	Leaves	Cooked vegetable	BiH	[151]
Centaurea hyalolepis Boiss.	Young stems	Cooked vegetable	Grc	[154]
Centaurea scabiosa L.	Young leaves	Green vegetable	WB	[153]
Chondrilla juncea L.	Root	Cooked vegetable	WB	[153]
Cichorium intybus L.	Leaves	Salad, green vegetable	Cro	[127]
.			Grc	[126]
		Sweets, soups, green vegetable	Mne	[128]
		Soup, salad, green vegetable	WB	[147]
		Cooked vegetable, coffee surrogate	BiH	[149]
	Root	Coffee surrogate	Srb	[143]
	Flowers	Raw	Srb	[141]
Cichorium pumilium Jacq.	Leaves	Green vegetable	Grc	[126]
Cicerbita alpina (L.) Wallr.	Young shoots	Cooked vegetable	BiH	[149]
(Syn. *Lactuca alpina* (L.) A. Gray)	Leaves	Salad	WB	[153]
Cirsium arvense (L.) Scop.	Leaves	Salad, green vegetable	Cro	[127]
Cirsium oleraceum (L.) Scop.	Young shoots	Cooked vegetable Salad	BiH	[151]
			WB	[153]
Cirsium lanceolatum (L.) Scop. (Syn. *Cirsium vulgare* (Savi) Ten.)	Young shoots	Cooked vegetable	WB	[153]
Chamomilla recutita (L.) Rausch. (Syn. *Matricaria chamomilla* L.)	Flowers	Seasoning	Mkd	[118]
Crepis biennis L.	Leaves	Salad, green vegetable	Cro	[127]

 10.1002/cbdv.202000097

		Salad, cooked and baked vegetable	BiH	[150]
		Coffee surrogate		
	Root		BiH	[150]
Crepis cappilaris (L.) Wallr.	Leaves	Salad, green vegetable	BiH	[150]
	Root	Coffee surrogate	BiH	[150]
Crepis sancta (L.) Bomm.	Leaves	Salad, green vegetable	Cro	[127]
Crepis zacintha (L.) Loisel.	Leaves	Salad, green vegetable	Cro	[114]
Cynara cardunculus L.	Young stems	Cooked vegetable	Grc	[154]
Cynara cornigera Lindl.	Young shoots	Cooked and baked vegetable	Grc	[126]
Cynara scolymus L.	Young stems	Cooked vegetable	Grc	[154]
			WB-Med	[153]
Echinops spinosissimus Turra	Young stems	Cooked vegetable	Grc	[154]
Echinops ritro L.	Young leaves	Cooked vegetable	WB-Med	[153]
Eupatorium cannabinum L.	Root	Salad	Mkd	[118]
	Flowers	Seasoning	Mkd	[118]
Gundelia tournefortii L.	Young stems	Cooked vegetable	Grc	[154]
Inula helenium L.	Root	Mush, bread	BiH	[151]
Helianthus tuberosus L.	Tubers	Cooked vegetable	Srb	[143]
		Consumed raw as snack	Srb	[117]
	Flowers	Seasoning, decoration, cooked	Bul	[142]
Hypochoeris radicata L.	Leaves	Green vegetable	WB	[153]
Hypochoeris maculata L.	Leaves	Green vegetable	WB	[153]
Hyoseris scabra L.	Leaves	Salad	WB	[153]
Lactuca seriola L.	Leaves	Salad, green vegetable	Cro	[152]
Lactuca perennis L.	Leaves	Salad, green vegetable	Cro	[127]
Lapsana communis L.	Leaves	Salad, green vegetable	Srb	[143]
			Bul	[144]
Leucanthemum vulgare Lam.	Young shoots, leaves	Salad, soups, green vegetable	Balkan	[147]
Leontodon autumnalis L.	Leaves	Salad, cooked vegetable	BiH	[150]
(Syn. *Scorzoneroides autumnalis* (L.) Moench)	Root	Coffee surrogate	BiH	[150]
Leontodon hispidus L.	Young leaves	Salad	Bul	[144]
Leontodon taraxacoides (Vill.) Mérat (Syn. *Leontodon saxatilis* Lam.)		Salad, green vegetable	Cro	[114]
Leontodon tuberosum L.	Leaves	Salad, green vegetable	Cro	[127]
	Shoots	Cooked vegetable	Grc	[126]
	Tubers	Cooked vegetable	WB	[147]
Mycelis muralis (L.) Dum. (Syn. *Lactuca muralis* (L.) Gaertn.)	Leaves	Salad	WB	[153]
Notobasis syriaca (L.) Cass	Young shoots	Cooked vegetable	Grc	[126]
Onopordum acanthium L.	Young shoot	Green vegetable	WB	[153]
	Root	Salad, cooked vegetable, beverage	BiH	[150]
Onopordum bracteatum Boiss & Heldr.	Young stems	Cooked vegetable	Grc	[154]
Onopordum cyprium Eig.	Young stems	Cooked vegetable	Grc	[154]
Petasites albus (L.) Gaertn.	Young leaves	Cooked vegetables	BiH	[149]
Petasites hybridus (L.) Gaertn. & al.	Young leaves	Cooked vegetable, Beverage, Substitute for tobacco	BiH	[150,151]
Picnomon acarna (L.) Cass.	Root	Cooked vegetable	WB-Med	[153]
Picris echioides L.	Leaves	Salad, green vegetable	Cro	[152]
(Syn. *Helminthotheca echioides* (L.) Holub)			Grc	[126]
Picris hieracioides L.	Young leaves	Cooked vegetable	WB	[153]
Reichardia picroides (L.) Roth	Leaves	Salad, green vegetable	Cro	[127]
			Grc	[126]
Scolymus hispanicus L.	Root	Cooked vegetable	WB-Med	[153]
	Young stems	Cooked vegetable	Grc	[154]

	Rhizome	Cooked vegetable	Grc	[126]
Scolymus maculatus L.	Young stems	Cooked vegetable	Grc	[154]
Scorzonera laciniata L. (Syn. *Podospermum laciniatum* (L.) DC.)	Leaves	Salad, green vegetable	Cro	[114]
Scorzonera hispanica L.	Root	Cooked vegetable, salad	WB	[153]
Scorzonera villosa Scop.	Leaves	Salad, green vegetable	Cro	[114]
Scorzonera rosea L.	Leaves	Salad	WB	[147]
(Syn. *Podospermum roseum* (Waldst. & Kit.) Gemeinholzer & Greuter)	Root	Cooked vegetable	WB	[151]
Serratula tinctoria L.	Young shoot	Green vegetable	WB	[153]
Sonchus asper (L.) Hill	Leaves	Salad, green vegetable	Cro	[152]
			Grc	[126]
Sonchus arvensis L.	Leaves	Salad	Bul	[144]
Sonchus oleraceus L.	Leaves	Salad, green vegetable	WB	[147]
			Grc	[126]
	Shoot	Cooked vegetable	BiH	[151]
Silybum marianum (L.) Gaertn.	Young leaves, involucrum	Cooked vegetable	WB-Med	[153]
	Young stems	Cooked vegetable	Grc	[154]
Tagetes erecta L.	Flowers	Seasoning, decoration	Bul	[142]
Taraxacum F.H. Wigg spp.	Leaves	Salad, stew	Bul	[144]
	Root	Salad, cooked vegetable	WB	[147]
	Flowers	Raw	Alb	[116]
			Mkd	[118]
Taraxacum campylodes G.E. Haglund;	Flowers	Syrup, "honey"	Rou	[146]
Taraxacum cyprium H. Lindb.	Leaves	Salad	Grc	[154]
Taraxacum megalorrhizon Hand.-Mazz.	Leaves	Salad, green vegetable	Cro	[127]
			Srb	[143]
	Root	Coffee surrogate	Srb	[143]
Taraxacum officinale Weber	Leaves	Salad, green vegetable	WB	[147]
(Syn. *Taraxacum* sect. *Taraxacum* F. H. Wigg)	Flowers	Syrup , "honey"	Srb	[141]
	Root	Sweets, coffee	BiH	[149]
Telekia speciosa (Schreb.) Baumg.	Young shoots	Cooked vegetable	BiH	[149]
Tragopogon orientalis L. (Syn. *Tragopogon pratensis* subsp. orientalis (L.) Čelak.)	Leaves	Salad	BiH	[151]
Tragopogon pratensis L.	Leaves	Salad, green vegetable	WB	[147]
	Root	Cooked vegetable	WB	
	Shoot	Green vegetable	Tur	[120]
Tragopogon sinuatus Avi.-Lall. (Syn. *Tragopogon porrifolius* L.)	Shoots	Cooked vegetable	Grc	[126]
Tussilago farfara L.	Shoot	Cooked vegetable	Tur	[120]
	Leaves	Cooked vegetable instead cabbage	BiH	
				[150]
Urospermum picroides (L.) Scop. ex F.W.Schmidt	Leaves	Salad, green vegetable	Cro	[127]

[a] Alb- Albania; BiH- Bosnia and Herzegovina; Bul- Bulgaria; Cro- Croatia; Grc- Greece; Mkd- North Macedonia; Med- Mediterranean; Mne- Montenegro; Romania- Rou; Srb- Serbia; Tur – Turkey; WB- Western Balkans.

Concluding remarks

Indigenous species of Asteraceae family are valuable sources of bioactive plant compounds, referring to components of essential oils, sesquiterpene lactones, different flavonoids, anthocyanins and other phenolic compounds, as well as complex carbohydrates such as inulin. Southeast Europe, i.e. the Balkan Peninsula is known for traditional uses of plants, both in ethnomedicine and as foods. Very high species diversity also reflects on high variability of specialized metabolites and complex phytochemical profiles which should be further studied using metabolomic and nutrigenomic approaches. High rate of endemism and related high number of endemic species of the Asteraceae family in the Balkans, represent a starting point for future research on highly efficient bioactive compounds and novel phytochemicals to be used as pharmaceuticals or nutraceuticals and components of functional food. Nevertheless, the final message should address the necessity for conservation of such valuable bioresources and further research of their *ex situ* conservation, *in vitro* propagation and sustainable exploitation.

Acknowledgements

This study was supported by the Ministry of Education, Science and Technological Development of the Republic Serbia through Project Nos. TR31069 and 451-03-68/2020-14/ 200178. Authors would like to thank to Miloš Dobrijević for technical support during graphical abstract preparation and Nebojša Banjac for technical support during preparation of chemical formulas.

Author Contribution Statement

A.Ž.K, P.J. and Z.P.D.S. conceptualized Manuscript idea. All authors have conducted literature search and participated in writing of the first Manuscript draft. S.M.K. and A. Ž.K prepared graphical abstract. A.Ž.K., P.J. and Z.P.D.S. have reviewed and finalized Manuscript. All authors approved final version of Manuscript.

[1] V. Stevanović, K. Tan, A. Petrova, 'Mapping the endemic flora of the Balkans-a progress report', *Bocconea* **2007**, *21*, 131–137.

[2] U. Schippmann, D. Leaman, A. B. Cunningham in 'Medicinal and Aromatic Plants: Agricultural, Commercial, Ecological, Legal, Pharmacological and Social Aspects', Ed. R. Bogers, L. Craker and D. Lange, Springer Nature, Berlin, 2006, Vol. 17, p.75-95.

[3] J. R. Mandel, R. B. Dikow, C. M. Siniscalchi, R. Thapa, L. E. Watson, V. A. Funk, 'A fully resolved backbone phylogeny reveals numerous dispersals and explosive diversifications throughout the history of Asteraceae', *Proc. Natl. Acad. Sci.* **2019**, *116*, 14083–14088.

[4] R. I. Lewis Smith, M. Richardson, 'Fuegian plants in Antarctica: natural or anthropogenically assisted immigrants?', *Biol. Invasions* **2011**, *13*, 1–5.

[5] B. B. Simpson, in 'Systematics, Evolution, and Biogeography of Compositae', Ed. V.A. Funk, A. Susanna, T.F. Stuessy, R.J. Bayer, IAPT, Vienna, 2009, Vol. 1., p. 45.

[6] R. Labrada, in 'FAO Consultation on Weed Risk Assessment - Report', Ed. Labrada, Madrid, 2002, p.1.

[7] J. M. Reed, B. Kryštufek, W. J. Eastwood, in 'Balkan Biodiversity', Ed. H.I. Griffiths, B. Kryštufek, J.M. Reed, Springer, Dordrecht, 2004, Vol. 2, p. 9.

[8] S. Vuksanović, G. Tomović, M. Niketić, V. Stevanović, 'Balkan endemic vascular plants of Montenegro — critical inventory with chorological and life-form analyses', *Willdenowia* **2016**, *46*, 387.

[9] Z. Barina, G. Somogyi, D. Pifko, M. Rakaj, 'Checklist of vascular plants of Albania', *Phytotaxa* **2018**, *378*, 1.

[10] M. Gajić, 'Flora Srbije VII', Srpska akademija nauke i umetnosti, Beograd, 1970.

[11] https://hirc.botanic.hr/fcd/ShowResults.aspx?hash=-2023810786; Accessed, November 25, 2019.

[12] http://portal.cybertaxonomy.org/flora-greece; Accessed, November 25, 2019.

[13] J. Velenovsky, 'Flora Bulgarica, Descriptio et enumeratio systematica plantarum vascularium in principatu Bulgariae sponte nascentium', Řivnáč, Pragae, 1891.

[14] Z. Xu, in 'Analysis of Antioxidant-Rich Phytochemicals', Ed. Z. Xu, R.L. Howard, JohnWiley-Blackwell Publication, West Sussex, 2012, Vol. 1, p. 1.

[15] F. Shahidi, in 'Handbook of Antioxidants for Food Preservation', Ed. F. Shahidi, Elsevier Ltd., Amsterdam, 2015, Vol. 1, p. 1.

[16] D. S. Seigler, 'Plant Secondary Metabolism', Springer, Boston, 1998.

[17] A. Ž. Kostić, U. M. Gašić, M. B. Pešić, S. P. Stanojević, M. B. Barać, M. P. Mačukanović-Jocić, S. N. Avramov, Ž. L. Tešić, 'Phytochemical Analysis and Total Antioxidant Capacity of Rhizome, Above-Ground Vegetative Parts and Flower of Three *Iris* Species', *Chem. Biodivers.* **2019**, *16*, e1800565.

[18] A. A. B. Atrrog, M. Natić, T. Tosti, D. Milojković-Opsenica, I. Đorđević, V. Tešević, M. Jadranin, S. Milosavljević, M. Lazić, S. Radulović, Z. Tešić, 'Lipophilicity of some guaianolides isolated from two endemic subspecies of *Amphoricarpos neumayeri* (Asteraceae) from Montenegro', *Biomed. Chromatogr.* **2009**, *23*, 250–256.

[19] M. Gavrilović, M. Soković, M. Stanković, P. Marin, Z. Dajić-Stevanović, P. Janaćković, 'Antimicrobial and antioxidative activity

of various leaf extracts of *Amphoricarpos* vis. (Asteraceae) taxa', *Arch. Biol. Sci.* **2016**, *68*, 803–810.

[20] M. Cvetković, I. Djordjević, M. Jadranin, M. Stanković, B. Mandić, S. Milosavljević, L. Vujisić, 'Leaf-surface guaianolides from *Amphoricarpos neumaeyri* showing protective effect on human lymphocytes DNA', *Nat. Prod. Res.* **2019**, 33, 1–9.

[21] B. A. Bohm, T. F. Stuessy, 'Flavonoids of the Sunflower Family (Asteraceae)', Springer, Vienna, 2001.

[22] A. Ž. Kostić, D. D. Milinčić, U. M. Gašić, N. Nedić, S. P. Stanojević, Ž. L. Tešić, M. B. Pešić, 'Polyphenolic profile and antioxidant properties of bee-collected pollen from sunflower (*Helianthus annuus* L.) plant', *LWT* **2019**, *112*, 108244.

[23] M. Stefanović, V. Djermanović, M. Gorunvić, M. Djermanović, S. Macura, S. Milosavljević, 'Sesquiterpene lactones from *Achillea abrotanoides*', *Phytochemistry* **1989**, *28*, 1765–1767.

[24] E. Hanlidou, S. Kokkini, E. Kokkalou, 'Volatile constituents of *Achillea abrotanoides* in relation to their infrageneric variation', *Biochem. Syst. Ecol.* **1992**, *20*, 33–40.

[25] J. C. Chalchat, S. D. Petrovic, Z. A. Maksimovic, M. S. Gorunovic, 'Aromatic plants of yugoslavia. III. Chemical composition of essential oils of *Achillea abrotanoides* (Vis.) Vis., *A. clypeolata* Sibth. & Sm., *A. depressa* Janka and *A. stricta* Schleicher et Koch', *J. Essent. Oil Res.* **2005**, *17*, 549–552.

[26] S. Milosavljević, V. Bulatović, M. Stefanović, 'Sesquiterpene lactones from the Yugoslavian wild growing plant families Asteraceae and Apiaceae', *J. Serbian Chem. Soc.* **1999**, *64*, 397–442.

[27] M. Z. Mladenović, N. S. Radulović, 'The essential oil of *Achillea ageratifolia* (Sm.) Boiss. subsp. *serbica* (Nyman) Heimerl (Asteraceae) revisited: the stereochemical nomenclature issues, structural elucidation and synthesis of (new) sabinyl esters', *Flavour Fragr. J.* **2017**, *32*, 5–23.

[28] T. Kundaković, S. Dobric, D. Bokonjić, V. Dragojević-Simić, V. Kilibarda, N. Kovacević, 'Anti-inflammatory and anti-ulcer activity of *Achillea alexandri-regis*', *Pharmazie* **2000**, *55*, 866–867.

[29] T. Kundaković, N. Mimica Dukić, N. Kovačević, 'Free radical scavenging activity of *Achillea alexandri-regis* extracts', *Fitoterapia* **2005**, *76*, 574–576.

[30] T. Kundaković, N. Fokialakis, P. Magiatis, N. Kovacević, I. Chinou, 'Triterpenic derivatives of *Achillea alexandri-regis* Bornm. & Rudski', *Chem. Pharm. Bull.* **2004**, *52*, 1462–1465.

[31] N. Kovačević, M. Ristić, S.Tasić, N. Menković, D. Grubišić, D. Doković, 'Comparative study of essential oil of three *Achillea* species from serbia', *J. Essent. Oil Res.* **2005**, *17*, 57–60.

[32] P. Magiatis, A. L. Skaltsounis, I. Chinou, S. A. Haroutounian, 'Chemical composition and in-vitro antimicrobial activity of the essential oils of three Greek *Achillea* species', *Z. Naturforsch.* **2002**, *57c*, 287-290.

[33] G. Stojanović, Y. Asakawa, R. Palić, N. Radulović, 'Composition and antimicrobial activity of *Achillea clavennae* and *Achillea holosericea* essential oils', *Flavour Fragr. J.* **2005**, *20*, 86–88.

[34] Z. Bošković, N. Radulović, G. Stojanović, 'Essential oil composition of four *Achillea* species from the Balkans and its chemotaxonomic significance', *Chem. Nat. Compd.* **2005**, *41*, 674–678.

[35] K. M. Valant-Vetschera, E. Wollenweber, 'Comparative analysis of leaf exudate flavonoids in *Achillea* subsect. Filipendulinae', *Biochem. Syst. Ecol.* **1996**, *24*, 435–446.

[36] S. Tasić, M. Ristić, N. Menković, N. Kovačević, D. Grubišić, D. Djoković, 'Endemic plant species of Sara mountain. Part VI. Essential oil of *Achillea chrysocoma*', *J. Essent. Oil Res.* **1998**, *10*, 329–332.

[37] N. Simić, R. Palić, V. Vajs, S. Milosavljević, D. Djoković, 'Composition and antibacterial activity of *Achillea chrysocoma* essential oil', *J. Essent. Oil Res.* **2000**, *12*, 784–787.

[38] M. Todorova, E. Tsankova, 'Sesquiterpene lactones from *Achillea chrysocoma* and *Achillea coarctata*', *Z. Naturforsch.* **2001**, *56c*, 957-960.

[39] G. Stojanović, N. Radulović, T. Hashimoto, R. Palić, 'In vitro antimicrobial activity of extracts of four *Achillea* species: The composition of *Achillea clavennae* L. (Asteraceae) extract', *J. Ethnopharmacol.* **2005**, *101*, 185–190.

[40] Z. P. Yordanova, M. A. Rogova, M. K. Zhiponova, M. I. Georgiev, V. M. Kapchina-Toteva, 'Comparative determination of the essential oil composition in Bulgarian endemic plant *Achillea thracica* Velen. during the process of *ex situ* conservation', *Phytochem. Lett.* **2017**, *20*, 456–461.

[41] G. S. Stojanović, V. Kapchina-Toteva, M. A. Rogova, S. C. Jovanović, Z. Yordanova, B. K. Zlatković, 'Chemical composition and

antibacterial activity of the Bulgarian endemic species *Achillea thracica* from its natural habitat, and *in vitro* propagated and *ex vitro* established plants', *Nat. Prod. Commun.* **2017**, *12*, 291–292.

[42] O. Hofer, H. Greger, 'Naturally occurring sesquiterpene-coumarin ethers, VI. New sesquiterpene-isofraxidin ethers from *Achillea depressa*', *Monatsh. Chem.* **1984**, *115*, 477–483.

[43] E. Tsankova, I. Ognyanov, 'Chemical constituents of *Achillea depressa*', *Plant. Med.* **1985**, *51*, 180.

[44] M. N. Todorova, E. T. Tsankova, E. I. Mustakerova, 'Spirodepressolide: An unusual bis-norsesquiterpene lactone from *Achillea depressa* Janka', *Nat. Prod. Res.* **2004**, *18*, 461–464.

[45] S. Trifunović, I. Aljančić, V. Vajs, S. Macura, S. Milosavljević, 'Sesquiterpene lactones and flavonoids of *Achillea depressa*', *Biochem. Syst. Ecol.* **2005**, *33*, 317–322.

[46] E. Tsankova, E. Mustakerova, M. Todorova, 'Acyclic Terpenoids from *Achillea depressa* Janka', *Comptes Rendus l'Academie Bulg. des Sci.* **2003**, *56*, 51–55.

[47] O. Tzakou, A. Loukis, 'Chemical composition of the essential oil of *Achillea umbellata* growing in Greece', *Nat. Prod. Res.* **2009**, *23*, 264–270.

[48] N. S. Radulović, M. S. Dekić, P. J. Randelović, N. M. Stojanović, A. R. Zarubica, Z. Z. Stojanović-Radić, 'Toxic essential oils: Anxiolytic, antinociceptive and antimicrobial properties of the yarrow *Achillea umbellata* Sibth. et Sm. (Asteraceae) volatiles', *Food Chem. Toxicol.* **2012**, *50*, 2016–2026.

[49] M. Jadranin, I. Djordjević, V. Tešević, V. Vajs, N. R. Menković, M. Soković, J. Glamočlija, S. Milosavljević, 'Sesquiterpene lactones of *Amphoricarpos autariatus ssp. autariatus* from montenegro - Antifungal leaf - Surface constituents', *Rec. Nat. Prod.* **2013**, *7*, 234–238.

[50] V. Saroglou, N. Dorizas, Z. Kypriotakis, H. D. Skaltsa, 'Analysis of the essential oil composition of eight *Anthemis* species from Greece', *J. Chromatogr. A* **2006**, *1104*, 313–322.

[51] J. Staneva, M. Todorova, L. Evstatieva, D. Dimitrov, 'Sesquiterpene lactones in two endemic *Anthemis* species', *Comptes Rendus l'Academie Bulg. des Sci.* **2006**, *59*, 1159–1162.

[52] J. D. Staneva, M. N. Todorova, L. N. Evstatieva, 'Sesquiterpene lactones as chemotaxonomic markers in genus *Anthemis*', *Phytochemistry* **2008**, *69*, 607–618.

[53] M. Todorova, A. Trendafilova, K. Danova, D. Dimitrov, 'Phytochemical study of *Anthemis rumelica* (Velen.) Stoj. & Acht.', *Biochem. Syst. Ecol.* **2011**, *39*, 868–871.

[54] E. Shehata, S. Loupassaki, D. P. Makris, 'Essential oil composition and antiradical activity of two *Artemisia* species endemic to the island of Crete', *Am. J. Essental Oils Nat. Prod.* **2016**, *4*, 32–35.

[55] N. Rajčević, P. D. Marin, L. Vujisić, Z. Krivošej, V. Vajs, P. Janaćković, 'Chemical composition of *Aster albanicus* Deg. (Asteraceae) essential oil: Taxonomical implications', *Arch. Biol. Sci.* **2015**, *67*, 1055–1061.

[56] D. Zheleva-Dimitrova, I. Zhelev, I. Dimitrova-Dyulgerova, 'Antioxidant Activity of Some *Carduus* Species Growing in Bulgaria', *Free Radical. Antioxidant.* **2011**, *1*, 15–20.

[57] I. Zhelev, I. Dimitrova-Dyulgerova, P. Merdzhanov, A. Stoyanova, 'Chemical Composition of *Carduus candicans* ssp. *globifer* and *Carduus thoermeri* Essential Oils', *J. Essent. Oil-Bearing Plants* **2014**, *17*, 196–202.

[58] H. Skaltsa, D. Lazari, B. Garcia, J. R. Pedro, M. Soković, T. Constantinidis, 'Sesquiterpene Lactones from *Centaurea achaia*, a Greek Endemic Species: Antifungal Activity', *Zeitschrift für Naturforsch. C* **2000**, *55*, 534–539.

[59] H. Skaltsa, D. Lazari, E. Georgiadou, S. Kakavas, T. Coristantinidis, 'Sesquiterpene lactones from *Centaurea* Species: *C. thessala subsp. drakiensis* and *C. attica subsp. attica*', *Planta Med.* **1999**, *65*, 393.

[60] J. Novaković, N. Rajčević, N. Garcia-Jacas, A. Susanna, P. D. Marin, P. Janaćković, 'Capitula essential oil composition of seven *Centaurea* species (sect. Acrocentron, Asteraceae) – Taxonomic implication and ecological significance', *Biochem. Syst. Ecol.* **2019**, *83*, 83–90.

[61] S. Djeddi, C. Argyropoulou, H. Skaltsa, 'Secondary metabolites from *Centaurea grisebachii ssp. grisebachii*', *Biochem. Syst. Ecol.*

2008, *36*, 336–339.

[62] V. Tešević, I. Aljančic, S. Milosavljevic, V. Vajs, I. Dorbević, M. Jadranin, N. Menkovic, V. Matevski, 'Secondary metabolites of three endemic *Centaurea* L. Species', *J. Serb. Chem. Soc.* **2014**, *79*, 1355–1362.

[63] P. Janaćković, M. Gavrilović, L. Vujisić, V. Matevski, P. D. Marin, 'Fatty acid composition of the cypselae of two endemic *Centaurea* species (Asteraceae)', *Bot. Serbica* **2017**, *41*, 3–9.

[64] C. Formisano, F. Senatore, S. Bancheva, M. Bruno, A. Maggio, S. Rosselli, 'Volatile Components of *Centaurea bracteata* and *C. pannonica* subsp. *pannonica* growing wild in Croatia', N*at. Prod. Commun.* **2010**, *5*, 1649-1654.

[65] S. Cavar, M. Maksimovic, M. E. Solic, ' Biological Activity and Essential Oil Analysis of Endemic *Centaurea gloriosa* var. *multiflora* Radic ', *Anal. Chem. Lett.* **2011**, *1*, 173–180.

[66] V. Tešević, V. Vajs, P. Janaćković, N. Todorovic, D. Djoković, P. Marin, S. Milosavljevic, 'Sesquiterpene lactones from *Centaurea* species: *C. derventana* and *C. kosaninii*', *Planta Med.* **1998**, *64*, 488.

[67] A. Maggio, L. Riccobono, S. Bancheva, M. Bruno, F. Senatore, 'Chemical composition of the essential oil of the local endemics *Centaurea davidovii* and *C. parilica* (Asteraceae, sect. Lepteranthus) from Bulgaria', *Nat. Prod. Commun.* **2014**, *9*, 1373–1376.

[68] A. Trendafilova, M. Jadranin, R. Gorgorov, M. Stanilova, 'Bioactive Compounds in Wild, In vitro Obtained, Ex vitro Adapted, and Acclimated Plants of Centaurea davidovii (Asteraceae)', *Nat. Prod. Commun.* **2015**, *10*, 839–841.

[69] S. Rosselli, M. Bruno, A. Maggio, R. A. Raccuglia, S. Bancheva, F. Senatore, C. Formisano, 'Essential oils from the aerial parts of Centaurea cuneifolia Sibth. & Sm. and C. euxina Velen., two species growing wild in Bulgaria', *Biochem. Syst. Ecol.* **2009**, *37*, 426–431.

[70] M. Ben Jemia, C. Formisano, S. Bancheva, M. Bruno, F. Senatore, 'Chemical composition of the essential oils of *Centaurea formanekii* and *C. orphanidea* ssp. *thessala*, growing wild in Greece', *Nat. Prod. Commun.* **2012**, *7*, 1083–1086.

[71] A. Trendafilova, M. Todorova, S. Bancheva, 'Secondary metabolites from *Centaurea moesiaca*', *Biochem. Syst. Ecol.* **2007**, *35*, 544–548.

[72] D. M. Lazari, H. D. Skaltsa, T. Constantinidis, 'Volatile constituents of *Centaurea pelia* DC., C. *thessala* Hausskn. subsp. *drakiensis* (Freyn and Sint.) Georg. and *C. zuccariniana* DC. from Greece', *Flavour Fragr. J.* **2000**, *15*, 7–11.

[73] O. Politeo, M. Skocibusic, I. Carev, F. Burcul, I. Jerković, M. Sarolić, M. Milos, 'Phytochemical profiles of volatile constituents from *Centaurea ragusina* leaves and flowers and their antimicrobial effects', *Nat. Prod. Commun.* **2012**, *7*, 1087–1090.

[74] M. Radan, I. Carev, V. Tešević, O. Politeo, V. Č. Čulić, 'Qualitative HPLC-DAD/ESI-TOF-MS Analysis, Cytotoxic, and Apoptotic Effects of Croatian Endemic *Centaurea ragusina* L. Aqueous Extracts', *Chem. Biodivers.* **2017**, *14*, e1700099.

[75] D. M. Lazari, H. D. Skaltsa, T. Constantinidis, 'Volatile constituents of *Centaurea raphanina* Sm. subsp. *mixta* (DC.) Runemark and *C. spruneri* Boiss. and Heldr. (Asteraceae), growing wild in Greece', *Flavour Fragr. J.* **1999**, *14*, 415–418.

[76] V. Saroglou, A. Karioti, C. Demetzos, K. Dimas, H. Skaltsa, 'Sesquiterpene Lactones from *Centaurea spinosa* and Their Antibacterial and Cytotoxic Activities', *J. Nat. Prod.* **2005**, *68*, 1404–1407.

[77] C. Formisano, E. Mignola, F. Senatore, S. Bancheva, M. Bruno, S. Rosselli, 'Volatile constituents of aerial parts of *Centaurea sibthorpii* (Sect. Carduiformes, Asteraceae) from Greece and their biological activity', *Nat. Prod. Res.* **2008**, *22*, 840–845.

[78] M. Nazlic, A. M. Ostric, M. Ruscic, N. Vuletic, V. Dunkic, 'Volatile Compounds of the Endemic Croatian Species *Centaurea tuberosa*', *Chem. Nat. Compd.* **2019**, *55*, 745–747.

[79] E. Hodaj, D. Lazari, L. Shuka, 'Volatiles Constituents From the Leaves , Flowers and Stems of *Centaurea Vlachorum* Hartvig (Asteraceae), Growing Wild in Albania', *J. Hyg. Eng. Des.* **2015**, *13*, 7–9.

[80] E. Hodaj, O. Tsiftsoglou, S. Abazi, D. Hadjipavlou-Litina, D. Lazari, 'Lignans and indole alkaloids from the seeds of *Centaurea vlachorum* Hartvig (Asteraceae), growing wild in Albania and their biological activity', *Nat. Prod. Res.* **2017**, *31*, 1195–1200.

[81] C. Barda, A. Ciric, M. Soković, M. Tsoukalas, H. Skaltsa, 'Phytochemical investigation of *Crepis incana* Sm. (Asteraceae) endemic to southern Greece', *Biochem. Syst. Ecol.* **2018**, *80*, 59–62.

[82] V. Milutinović, M. Niketić, L. Ušjak, D. Nikolić, A. Krunić, C. Zidorn, S. Petrović, 'Methanol Extracts of 28 *Hieracium* Species from the Balkan Peninsula – Comparative LC–MS Analysis, Chemosystematic Evaluation of their Flavonoid and Phenolic Acid Profiles and Antioxidant Potentials', *Phytochem. Anal.* **2018**, *29*, 30–47.

[83] V. Milutinović, M. Niketić, A. Krunić, D. Nikolić, M. Petković, L. Ušjak, S. Petrović, 'Sesquiterpene lactones from the methanol extracts of twenty-eight *Hieracium* species from the Balkan Peninsula and their chemosystematic significance', *Phytochemistry* **2018**, *154*, 19–30.

[84] A. Trendafilova, M. Todorova, N. Kutova, M. Guncheva, 'Phytochemical Profile and Anti-lipase Activity of Balkan Endemic *Jurinea tzar-ferdinandii*', *Nat. Prod. Commun.* **2018**, *13*, 1017-1020.

[85] D. Lazari, H. Skaltsa, C. Harvala, 'Flavonoids of *Onopordum sibthorpianum* and *Onopordum laconicum*', *Biochem. Syst. Ecol.* **1998**, *26*, 105–107.

[86] A. B. Trendafilova, E. T. Tsankova, L. N. Evstatieva, 'Seco-eremophilanolides from *Senecio macedonicus*', *Phytochemistry* **1995**, *40*, 329–330.

[87] V. Christov, B. Mikhova, R. Alexandrova, D. Dimitrova, E. Nikolova, L. Evstatieva, 'Alkaloids from the Roots of *Senecio macedonicus* Griseb', *Z. Naturforsch. C* **2002**, *57*, 780–784.

[88] I. Aljančić, V. Vajs, V. Bulatović, N. Menković, S. Milosavljević, 'Parthenolide from the aerial parts of *Tanacetum larvatum*', *Biochem. Syst. Ecol.* **2001**, *29*, 655–657.

[89] V. M. Bulatović, V. E. Vajs, I. T. Aljančić, S. M. Milosavljević, D. D. Djoković, S. D. Petrović, 'Chemical composition of *Tanacetum larvatum* essential oil', *J. Essent. Oil Res.* **2006**, *18*, 126–128.

[90] T. Getahun, V. Sharma, N. Gupta, 'The genus *Laggera* (Asteraceae) – Ethnobotanical and Ethnopharmacological Information, Chemical Composition as well as Biological Activities of Its Essential Oils and Extracts: A Review', *Chem. Biodivers.* **2019**, *16*, e1900131.

[91] N. Radulović, B. Zlatković, R. Palić, G. Stojanović, 'Chemotaxonomic Significance of the Balkan *Achillea* Volatiles', *Nat. Prod. Commun.* **2007**, *2*, 453-474.

[92] M. Todorova, J. Staneva, P. Denkova, L. Evstatieva, 'Irregular linear sesquiterpene dilactones from *Anthemis auriculata* Boiss.', *Nat. Prod. Res.* **2008**, *22*, 907–914.

[93] Y. Sun, C. Yang, R. Tsao, in 'Measurement of Antioxidant Activity and Capacity: Recent Trends and Applications', Ed. R. Apak, E. Capanoglu, F. Shahidi, John Wiley & Sons Ltd., Oxford, 2018, Vol. 1, p. 1.

[94] N. Ramarathnam, T. Osawa, H. Ochi, S. Kawakishi, 'The contribution of plant food antioxidants to human health', *Trends Food Sci. Technol.* **1995**, *6*, 75–82.

[95] J.-K. Li, X.-D. Liu, L. Shen, W.-M. Zeng, G.-Z. Qiu, 'Natural plant polyphenols for alleviating oxidative damage in man: Current status and future perspectives', *Trop. J. Pharm. Res.* **2016**, *15*, 1089.

[96] D.-P. Xu, Y. Li, X. Meng, T. Zhou, Y. Zhou, J. Zheng, J.-J. Zhang, H.-B. Li, 'Natural Antioxidants in Foods and Medicinal Plants: Extraction, Assessment and Resources', *Int. J. Mol. Sci.* **2017**, *18*, 96.

[97] R. Apak, E. Capanoglu, F. Shahidi, 'Measurement of Antioxidant Activity and Capacity: Recent Trends and Applications', John Wiley & Sons Ltd., Oxford, 2018.

[98] E. Niki, 'Assessment of Antioxidant Capacity in vitro and in vivo', *Free Radic. Biol. Med.* **2010**, *49*, 503–515.

[99] N. Sahu, J. Saxena, 'Indo American Journal of Pharmaceutical Research Different Methods for Determining Antioxidant Activity: a Review', *Indo Am. J. Pharm. Res.* **2013**, *3*, 7025-7028.

[100] Md. Nur Alam, N.J Birsti, Md. Rafiquzzman, 'Review on *in vivo* and *in vitro* methods evaluation of antioxidant activity', *Saudi Pharm. J.* **2013**, *21*, 143-152.

[101] H. Akbarirard, A. Gohari Ardabili, S.M. Kazemeini, A. Mousavi Khanedhah, 'An overwiew on some of important sources of natural antioxidants', *Int. Food Res. J.* **2016**, *23*, 928-933.

[102] S.C. Lourenço, M. Moldão-Martins, V.D. Alves, 'Antioxidants of natural plant origin: From sources to food industry applications', *Molecules* **2019**, *24*, 4132.

[103] M. M. Cowan, 'Plant Products as Antimicrobial Agents', *Clin. Microbiol. Rev.* **1999**, *12*, 564–582.

[104] H. Susurluk, Z. Çalışkan, O. Gürkan, S. Kırmızıgül, N. Gören, 'Antifeedant activity of some *Tanacetum* species and bioassay guided isolation of the secondary metabolites of *Tanacetum cadmeum* ssp. *cadmeum* (Compositae)', *Ind. Crops Prod.* **2007**, *26*, 220–228.

[105] I. S. Aljancic, V. E. Vajs, S. M. Milosavljevic, N. Todorovic, N. R. Menkovic, D. Godjevac, V. M. Tadic, 'Comparative analysis of parthenolide content in *Tanacetum larvatum*, an endemic species of Montenegro, collected from three different locations', *Chem. Nat. Compd.* **2010**, *46*, 658–660.

[106] S. D. Petrovic, S. Dobric, D. Bokonjic, M. Niketic, A. García-Piñeres, I. Merfort, 'Evaluation of *Tanacetum larvatum* for an anti-inflammatory activity and for the protection against indomethacin-induced ulcerogenesis in rats', *J. Ethnopharmacol.* **2003**, *87*, 109–113.

[107] E. Napoli, L. Siracusa, G. Ruberto, 'New Tricks for Old Guys: Recent Developments in the Chemistry, Biochemistry, Applications and Exploitation of Selected Species from the Lamiaceae Family', *Chem. Biodivers.* **2020**, in press.

[108] Y. Liang, H. Duan, P. Zhang, H. Han, F. Gao, Y. Li, Z. Xu, 'Extraction and isloation of the active ingredients of dandelion and its antifungal activity against *Candida albicans* ', *Mol. Med Rep*. **2019**, *21*, 229-239.

[109] K. Phromnoi, P. Sinchaiyakij, C. Khanaree, P. Nuntaboon, Y. Chanwikrai, T. Chaiwangsri, M. Suttajit, 'Anti-Inflammatory and Antioxidant Activities of Medicinal Plants Used by Traditional Healers for Antiulcer Treatment', *Sci. Pharm.* **2019**, *87*, 22.

[110] T. S. Lakshmi, S. L. Mohana, S. S. . Neelufar, G. R. Koteswara, K. R. Prasanna, 'Medicinal Plants as Anti-Ulcer Agents', *J. Pharmacogn. Phytochem.* **2013**, *2*, 91–97.

[111] M. Fridlender, Y. Kapulnik, H. Koltai, 'Plant derived substances with anti-cancer activity: from folklore to practice', *Front. Plant Sci.* **2015**, *6*, 799.

[112] Ł. Łuczaj, K. Stawarczyk, T. Kosiek, M. Pietras, A. Kujawa, 'Wild food plants and fungi used by Ukrainians in the western part of the Maramureş region in Romania', *Acta Soc Bot Pol.* **2015**, *84*, 339–346.

[113] Ł. Łuczaj, A. Pieroni, J. Tardío, M. Pardo-De-Santayana, R. Sõukand, I. Svanberg, R. Kalle, 'Wild food plant use in 21st century Europe: The disappearance of old traditions and the search for new cuisines involving wild edibles', *Acta Soc. Bot. Pol.* **2012**, *81*, 359–370.

[114] Ł. Łuczaj, M. Končić, T. Miličević, K. Dolina, M. Pandža, 'Wild vegetable mixes sold in the markets of Dalmatia (southern Croatia)', *J. Ethnobiol. Ethnomed.* **2013**, *9*, 2.

[115] Z. Dajić Stevanović, M. Petrović, S. Aćić, in 'Ethnobotany and Biocultural Diversites in the Balkans', Ed. A. Pieroni, C. L. Quave, Springer, New York, 2014, Vol. 14, p. 229.

[116] A. Pieroni, K. Cianfaglione, A. Nedelcheva, A. Hajdari, B. Mustafa, C. L. Quave, 'Resilience at the border: traditional botanical knowledge among Macedonians and Albanians living in Gollobordo, Eastern Albania', *J. Ethnobiol. Ethnomed.* **2014**, *10*, 31.

[117] A. Pieroni, R. Sõukand, C. L. Quave, A. Hajdari, B. Mustafa, 'Traditional food uses of wild plants among the Gorani of South Kosovo', *Appetite* **2017**, *108*, 83–92.

[118] B. Rexhepi, A. Bajrami, B. Mustafa, 'Ethnobotanical Study of Wild Edible Plants in Pelagonia Region (Southwestern Macedonia)', *Int. J. Adv. Sci. Eng. Technol.* **2018**, *6*, 61–65.

[119] N. J. Turner, Ł. J. Łuczaj, P. Migliorini, A. Pieroni, A. L. Dreon, L. E. Sacchetti, M. G. Paoletti, 'Edible and Tended Wild Plants, Traditional Ecological Knowledge and Agroecology', *CRC. Crit. Rev. Plant Sci.* **2011**, *30*, 198–225.

[120] N. S. Üstün, A. Pekşen, S. Bulam, H. Duran, 'Edible wild herbaceous plants consumed in Giresun province', *Acta Biol. Turc.* **2019**, *32*, 84-89.

[121] D. Žnidarčič, D. Ban, H. Šircelj, 'Carotenoid and chlorophyll composition of commonly consumed leafy vegetables in Mediterranean countries', *Food Chem.* **2011**, *129*, 1164–1168.

[122] A. Dalar, I. Konczak, '*Cichorium intybus* from Eastern Anatolia: Phenolic composition, antioxidant and enzyme inhibitory activities', *Ind. Crops Prod.* **2014**, *60*, 79–85.

[123] F. E. Wirngo, M. N. Lambert, P. B. Jeppesen, 'The Physiological Effects of Dandelion (*Taraxacum officinale*) in Type 2 Diabetes', *Rev. Diabet. Stud.* **2016**, *13*, 113–131.

[124] L. Fernandes, S. Casal, J. A. Pereira, J. A. Saraiva, E. Ramalhosa, 'Edible flowers: A review of the nutritional, antioxidant,

antimicrobial properties and effects on human health', *J. Food Compos. Anal.* **2017**, *60*, 38–50.

[125] P. García-Herrera, M. C. Sánchez-Mata, M. Cámara, V. Fernández-Ruiz, C. Díez-Marqués, M. Molina, J. Tardío, 'Nutrient composition of six wild edible Mediterranean Asteraceae plants of dietary interest', *J. Food Compos. Anal.* **2014**, *34*, 163–170.

[126] A. C. Hadjichambis, D. Paraskeva-Hadjichambi, A. Della, M. Elena Giusti, C. De Pasquale, C. Lenzarini, E. Censorii, M. Reyes Gonzales-Tejero, C. Patricia Sanchez-Rojas, J. M. Ramiro-Gutierrez, M. Skoula, C. Johnson, A. Sarpaki, M. Hmamouchi, S. Jorhi, M. El-Demerdash, M. El-Zayat, A. Pieroni, 'Wild and semi-domesticated food plant consumption in seven circum-Mediterranean areas', *Int. J. Food Sci. Nutr.* **2008**, *59*, 383–414.

[127] Ł. Łuczaj, K. Dolina, N. Fressel, S. Perković, in 'Ethnobotany and Biocultural Diversites in the Balkans', Ed. A. Pieroni, C. L. Quave, Springer, New York, 2014, Vol. 8, p. 137.

[128] D. Jančić, Ph.D. Thesis, University of Belgrade at Belgrade, 2017.

[129] D. Sánchez-Mata, R. Morales, in 'Mediterranean Wild Edible Plants', Ed. M. de C. Sánchez-Mata, J. Tardío, Springer, New York, 2016, Vol. 2, p. 15.

[130] P. Morales, I. C. F. R. Ferreira, A. M. Carvalho, M. C. Sánchez-Mata, M. Cámara, V. Fernández-Ruiz, M. Pardo-de-Santayana, J. Tardío, 'Mediterranean non-cultivated vegetables as dietary sources of compounds with antioxidant and biological activity', *LWT - Food Sci. Technol.* **2014**, *55*, 389–396.

[131] M. C. Sánchez-Mata, R. D. Cabrera Loera, P. Morales, V. Fernández-Ruiz, M. Cámara, C. Díez Marqués, M. Pardo-de-Santayana, J. Tardío, 'Wild vegetables of the Mediterranean area as valuable sources of bioactive compounds', *Genet. Resour. Crop Evol.* **2012**, *59*, 431–443.

[132] Q. Su, K. Rowley, C. Itsiopoulos, K. O'Dea, 'Identification and quantitation of major carotenoids in selected components of the Mediterranean diet: green leafy vegetables, figs and olive oil', *Eur. J. Clin. Nutr.* **2002**, *56*, 1149–1154.

[133] E. Giambanelli, L. F. D'Antuono, F. Ferioli, A. G. Frenich, R. Romero-González, 'Sesquiterpene lactones and inositol 4-hydroxyphenylacetic acid derivatives in wild edible leafy vegetables from Central Italy', *J. Food Compos. Anal.* **2018**, *72*, 1–6.

[134] J. Azay-Milhau, K. Ferrare, J. Leroy, J. Aubaterre, M. Tournier, A.-D. Lajoix, D. Tousch, 'Antihyperglycemic effect of a natural chicoric acid extract of chicory (*Cichorium intybus* L.): A comparative in vitro study with the effects of caffeic and ferulic acids', *J. Ethnopharmacol.* **2013**, *150*, 755–760.

[135] S. Djordjević, V. Tadić, S. Petrović, J. Kukić-Marković, S. Dobrić, M. Milenković, N. Hadžifejzović, 'Bioactivity assays on *Carlina acaulis* and *C. acanthifolia* root and herb extracts', *Dig. J. Nanomater. Biostructures* **2012**, *7*, 1213–1222.

[136] H. Rodrigues, D. P. Cielo, C. Goméz-Corona, A. A. S. Silveira, T. A. Marchesan, M. V. Galmarini, N. S. P. S. Richards, 'Eating flowers? Exploring attitudes and consumers' representation of edible flowers', *Food Res. Int.* **2017**, *100*, 227–234.

[137] J. Mlcek, O. Rop, 'Fresh edible flowers of ornamental plants – A new source of nutraceutical foods', *Trends Food Sci. Technol.* **2011**, *22*, 561–569.

[138] T. C. S. P. Pires, L. Barros, C. Santos-Buelga, I. C. F. R. Ferreira, 'Edible flowers: Emerging components in the diet', *Trends Food Sci. Technol.* **2019**, *93*, 244–258.

[139] I. Navarro-González, R. González-Barrio, V. García-Valverde, A. Bautista-Ortín, M. Periago, 'Nutritional Composition and Antioxidant Capacity in Edible Flowers: Characterisation of Phenolic Compounds by HPLC-DAD-ESI/MSn', *Int. J. Mol. Sci.* **2014**, *16*, 805–822.

[140] S. Benvenuti, E. Bortolotti, R. Maggini, 'Antioxidant power, anthocyanin content and organoleptic performance of edible flowers', *Sci. Hortic.* **2016**, *199*, 170–177.

[141] M. Radulović, 'Traditional Use of Wild Plants from Bor District and Surrounding Villages (In Serbian)', Master Thesis, Faculty of Biology, Belgrade, 2019.

[142] I. Petrova, N. Petkova, I. Ivanov, 'Five Edible Flowers – Valuable Source of Antioxidants in Human Nutrition', *Int. J. Pharmacogn. Phytochem. Res.* **2016**, *8*, 604–610.

[143] J. Tucakov, 'Herbs tretment: Phytotherapy (In Serbian)', Rad, Belgrade, 1990.

[144] A. Nedelcheva, 'An ethnobotanical study of wild edible plants in Bulgaria', *EurAsian J. Biosci.* **2013**, *7*, 77–94.

[145] R. Sõukand, A. Pieroni, M. Biró, A. Dénes, Y. Dogan, A. Hajdari, R. Kalle, B. Reade, B. Mustafa, A. Nedelcheva, C. L. Quave, Ł. Łuczaj, 'An ethnobotanical perspective on traditional fermented plant foods and beverages in Eastern Europe', *J. Ethnopharmacol.* **2015**, *170*, 284–296.

[146] R. Sõukand, A. Pieroni, 'The importance of a border: Medical, veterinary, and wild food ethnobotany of the Hutsuls living on the Romanian and Ukrainian sides of Bukovina', *J. Ethnopharmacol.* **2016**, *185*, 17–40.

[147] B. Vračarić, J.Bakić, D. Čolić, V. Lintner, M. Micković, D. Stevanović, M.Uvalin, 'Nutrition in Nature (In Serbian)', Military

publishing institute and People's book, Belgrade, 1977.

[148] A.Ž. Kostić, D.D. Milinčić, M.B. Barać, M. Ali Shariati, Ž.LJ. Tešić, M.B. Pešić, 'The application of pollen as a functional food and feed ingredient – the present and perspectives', *Biomolecules* **2020**, *10*, 84.

[149] S. Redžić, J. Ferrier, in 'Ethnobotany and Biocultural Diversites in the Balkans', Ed. A. Pieroni, C. L. Quave, Springer, New York, 2014, Vol. 10, p. 183.

[150] S. Redžić, 'Use of wild and semi-wild edible plants in nutrition and survival of people in 1430 days of siege of Sarajevo during the war in Bosnia and Herzegovina (1992-1995)', *Coll. Antropol.* **2010**, *34*, 551–570.

[151] S. Redžić, 'Wild Edible Plants and Their Traditional Use in the Human Nutrition in Bosnia- Herzegovina', *Ecol. Food Nutr.* **2006**, *45*, 189–232.

[152] K. Dolina, Ł. Łuczaj, 'Wild food plants used on the Dubrovnik coast (south-eastern Croatia)', *Acta Soc. Bot. Pol.* **2014**, *83*, 175–181.

[153] Lj. Grlić, 'Wild edible plants (In Serbian)', Prosveta, Zagreb, 1980.

[154] A. Della, D. Paraskeva-Hadjichambi, A. C. Hadjichambis, 'An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus.', *J. Ethnobiol. Ethnomed.* **2006**, *2*, 34.

Entry for the Graphical Illustration