

ETHNOBOTANICAL KNOWLEDGE AND TRADITIONAL PRACTICE IN THE FRAME OF URBAN ECOSYSTEM SERVICES ON THE EXAMPLE OF THE CITY OF KRAGUJEVAC (SERBIA)

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ABSTRACT. The ethnobotanical studies provide a generalized survey of ethnobotanical knowledge, traditional practices, and plant species utilization using by humans a range of provisioning ecosystem services, referring dominantly to rural and less to urban settlements. This study aims to answer the question of whether traditional ethnobotanical knowledge is applied in urban areas in the context of the selection and utilization of medicinal, aromatic, and wild edible plant species. The research was conducted in the urban area of the city of Kragujevac (central Serbia) in the period from May to October 2021. Data collection was performed “in situ” using semi-structured ethnobotanical face-to-face interviews with 43 respondents. The total number of finally selected plant species reported by respondents was 24. They were classified according to their purpose of use as medicinal, food, and ornamental. Herein, the analyzed urban population mostly utilized plant species for edible purposes.

Keywords: ethnobotany, urban ecosystem services, useful plants, Central Serbia.

INTRODUCTION

In the modern urban environment, ecosystem services provide multiple benefits, from economic and social to ecological and health ones. (GÓMEZ-BAGGETHUN *et al.*, 2013). Provisioning ecosystem services includes all the material products obtained from ecosystems. As such according to BOLUND and HUNHAMMAR (1999) are the most recognizable seven different urban ecosystems: street trees (ST); lawns/parks (P); urban forests (UF); cultivated land (CL); wetlands (WL); lakes/sea (L); and streams (S). Ethnobotanical knowledge and practices could be applied in the range of ecosystem services in the urban surrounding.

Ethnobotanical studies are generally focused on rural areas and indigenous communities. These studies attempt to recover and revive almost forgotten traditional knowledge and traditional practices neglected under the pressures of globalization (LEITÃO *et al.*, 2009). Although some cultures are still nurturing and transmitting ethnobotanical knowledge, especially African folks, or grounded their medicine the herbalist practices (e.g., Chinese, Ayurvedic, or Tibetan), western ethnobotany is slowly becoming extinct (PRANSKUNIENE *et al.*, 2018). The important ethnobotanical studies conducted in Balkan countries strongly support numerous initiatives in this region, mainly in terms of sustainable and peaceful rural development (PIERONI and QUAVE, 2014). The largest number of ethnobotanical studies in the Balkans is focused on medicinal use and health-related properties of wild and cultivated plants in rural and mountainous areas (ŠARIĆ-KUNDALIĆ *et al.*, 2010; DAJIĆ STEVANOVIĆ *et al.*, 2014).

Ethnobotanical studies of urban areas have been sporadically conducted in the urban areas over the last decade, aiming at knowledge preservation by the local population and local herbal healers who perform folk herbal medicine (PRANSKUNIENE *et al.*, 2018). Traditional botanical knowledge and practices transmission recording in urban areas is needed for ethnobotanical research on plant species composition in urban residential home gardens, particularly focusing on surveying biodiversity richness (HURRELL, 2014; PRADEICZUK *et al.*, 2017). In general, ethnobotanical reports for urban areas are scarce.

In the Republic of Serbia, ethnobotanical studies mainly concentrate on the diversity of medicinal plant use, as well as the use of medicinal plants in the treatment of some disorders (ŠAVIKIN *et al.*, 2013; JARIĆ *et al.*, 2015; JANAČKOVIĆ *et al.*, 2019). However, these studies were conducted in a limited geographical area. Therefore, it should be noted that comprehensive ethnobotanical studies have not been carried out so far and studies on larger spatial scales are welcome.

Urban ecosystem services refer to benefits that humans obtain from ecosystem functions, or as a direct or indirect contributions to human well-being. Worldwide there is a number of reports on ethnobotany and ethnomedicine in urban surrounding with a focus on vegetation-based urban ecosystem services, traditional knowledge flow, small-scale growing medicinal plants, local herbal shops, or cataloged ethnomedicinal practice in an urban environment (BALICK and LEE, 2001; DUTTA *et al.*, 2022; STROUD *et al.*, 2022). Except for the several studies dealing with the local botany, primarily the quantitative-qualitative representation of plants causing allergies in the urban area of the city of Kragujevac (ĐELIĆ *et al.*, 2021) or ruderal flora of the city of Kragujevac (PAVLOVIĆ-MURATSPAHIĆ *et al.*, 2010), the comprehensive urban ethnobotanical studies have not been considered yet in the study area, nor wider Serbia.

The novelty of this study lies in the fact that this is the first attempt of recording ethnobotanical knowledge and traditional herbalistic practices in the frame of urban ecosystem services in Kragujevac city. The research aims of the current study are to gather ethnobotanical knowledge in urban ecosystems and examine the diversity of species use and record the existing practices.

MATERIALS AND METHODS

Study area

The field research was carried out in urban and suburban zones of the city of Kragujevac, positioned in the central part of the Republic of Serbia. The city of Kragujevac is located in the middle part of the Šumadija region, bordered by the slopes of Šumadija's mountain Rudnik at the north, Gledičke mountains at the west, and Bešnjaja at the south. The researched area is situated between 40° 02' N and 22° 50' E. Kragujevac covers an area of 452 km² and occupies

7.4% of the total Šumadija's land area (PAVLOVIĆ-MURATSPAHIĆ *et al.*, 2010). The vegetated areas, capacity of provisioning ecosystem services, recreational spaces and local population circulation in this areas was used as the criteria for research site selection.

The ethnobotanical interviews were performed in the three main selected parts of Kragujevac: Memorial Park Šumarice with a wider area, Košutnjak park/forest, Grošnica suburb and area along the Lepenica river (Fig. 1) respecting the variety of urban ecosystems as proposed by BOLUND and HUNHAMMAR (1999) and adjusted to the study area.

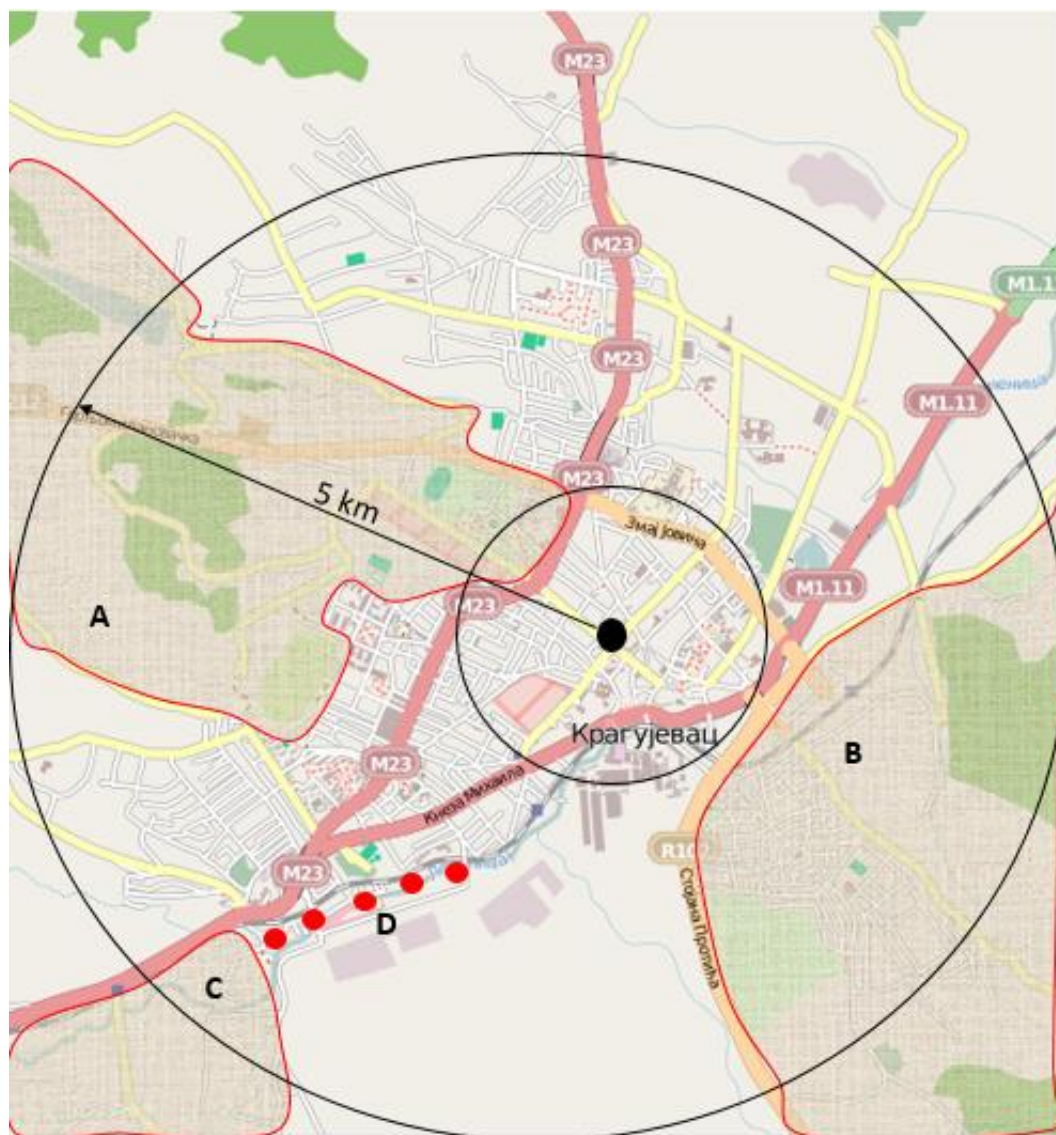


Figure 1. The map of the researched area (Kragujevac city – urban and sub-urban region up to 5 km from the center; Areas marked in red: A – City Park and monument complex Šumarice; B – Košutnjak; C – Grošnica; Red points, partially explored area: D – Ljubine Livade.) (<http://www.openstreetmap.org> modified by author).

Data collection

Data collection was performed using standardized semi-structured ethnobotanical questionnaires in the period from May to October 2021. A total of 43 respondents (7 males and 36 females), selected in accordance with the random sampling method (HÖFT *et al.* 1999), participated in the research. The interview questions were designed to obtain as detailed as possible information from respondents about their interests, knowledge, purpose of plant

species collection, and particular practice on collected species utilization. The interviewed respondents mainly belong to the following three occupational groups: retired people, middle-aged housewives, and naturalists. The collected information referred to folk/local species names, the purpose of collection from the wild and related use (e.g., medicinal, food, ornamental etc.), and the plant part which is used. The listed plant samples were collected, determined using standard botanical keys (JOSIFOVIĆ, 1970-1977; JAVORKA and CSAPODY, 1975) and stored as herbarium vouchers specimens at the Gastronomic laboratory, Faculty of Hotel Management and Tourism in Vrnjačka Banja (labeled 26/21 to 79/21).

Data analysis

The collected ethnobotanical data were classified and stored in excel databases for further analyses. Several quantitative ethnobotanical parameters were analyzed, such as: 1. Number of Use Reports (UR), 2. Relative Frequency of Citation (RFC), and Use value (UV) with intermediate equations according to SHAHEEN *et al.* (2017).

The Use Reports (UR) included three parameters: 1. Respondents/informants “*i*”, 2. Cited use of the plant species “*s*” in the determined use-category “*u*” and 3. Use-category “*u*”, described by the following equation:

$$UR_s = \sum_{u=1}^{u_{NC}} \sum_{i=1}^{i_N} UR_{sui} \quad (1)$$

where NC signifies the individual species (*s*₁, *s*₂,..., *s*_{NC}) within a total number of use categories NC (*u*₁, *u*₂,..., *u*_{NC}); N informants (*i*₁, *i*₂,..., *i*_N); *UR_{sui}* (0-1).

The Relative Frequency of Citation (RFC) represents the number of citations of particular species by respondents:

$$RFC = FC/N \quad (2)$$

where FC is the frequency of citation and N is a total number of respondents.

The Use Value (UV) demonstrates the relative importance of plants for local community:

$$UV = \sum U_i/N \quad (3)$$

where *U_i* is the number of uses mentioned by each respondent for a given species and N is the total number of respondents.

RESULTS AND DISCUSSION

According to ethnobotanical interviews collected from 43 respondents regardless of their socio-demographic characteristics (age, gender, economic status, how long their ancestors belong to Kragujevac population, education, etc.), a total of 54 species was cited, of which 24 expressed the RFC index above 0.3 (Table 1). For each plant species mentioned by respondents, the local name(s) and use pattern were indicated. Upon primary utilization recorded plant species were classified into one of the following groups: 1. Medicinal (Med), 2. Food (fresh and processed food, supplements, and spices), and 3. Other (ornamental, ritual, craft, etc.). Among all mentioned species, 11 were classified into only one group (they are used exclusively as medicine, food, or other), 10 belong to two groups, while only three species corresponded with three different groups. Besides plant species, edible mushrooms were often cited by respondents – three species were mostly mentioned: *Lactifluus piperatus* (L.) Pers., *Cantharellus cibarius* Fr., and *Macrolepiota procera* (Scop. ex Fr.) Sing.

Table 1. Diversity (quantitative and descriptive ethnobotanical data) of used species in Kragujevac urban ecosystem services based on ethnobotanical interviews collected from 43 respondents in 2021.

Code	Species (latin and common name)	Serbian common name	Ethnobotanical indices					Descriptive data		
			UR	FC	NU	RFC	UV	PPU	PoU	UES
AM	<i>Achillea millefolium</i> L.– yarrow	hajdučka trava	26	16	1	0.37	0.56	H	T	M
CS	<i>Castanea sativa</i> Mill. – sweet chestnut	kesten	29	26	3	0.60	0.72	F	FD	P, ST
CR	<i>Chamomilla recutita</i> L. – chamomile	kamilica	17	14	2	0.33	0.44	H	T, D	L
CI	<i>Cichorium intybus</i> L. – chicory	plavocvet, vodopija	23	19	2	0.44	0.49	H	T, D	L, M
CM	<i>Crataegus monogyna</i> Jacq. – haw	glog	24	20	2	0.47	0.60	F	FD, D	UF
EM	Edible mushrooms	pečurke	34	32	1	0.74	0.88	F	FD	UF
FV	<i>Fragaria vesca</i> L. – wild strawberry	šumska jagoda	39	37	2	0.86	0.93	F	FD, T	M
GC	<i>Galium cruciate</i> L. – Smooth bedstraw	đurđevak	40	39	1	0.91	0.95	H	D	M
GU	<i>Geum urbanum</i> L. – wood avens, herb bennet	zečja stopa	16	13	1	0.30	0.42	H	T	M
GH	<i>Glechoma hederacea</i> L. – ground-ivy	dobričica	24	20	2	0.47	0.65	H	FD, T	M
HP	<i>Hypericum perforatum</i> – St. John's wort	kantarion	16	14	1	0.33	0.40	H	T	L
JR	<i>Juglans regia</i> L. – walnut	orah	40	38	1	0.88	0.93	F	FD	UF
MS	<i>Malva sylvestris</i> L. – mallow	crni slez	15	13	1	0.30	0.93	H	T	M
M	<i>Mentha</i> sp. – mint	nana	37	35	2	0.81	0.88	L, H	T, J	M
MN	<i>Morus nigra</i> L. – black mulberry	crni dud	28	24	1	0.56	0.67	F	FD	UF, S
MA	<i>Myosotis arvensis</i> (L.) Hill – forget-me-not plant	spomenak	15	13	1	0.30	0.40	H	D	M
PL	<i>Plantago lanceolata</i> L. – ribwort plantain	muška bokvica	18	16	1	0.37	0.47	L	C	M, L
PM	<i>Plantago major</i> L. – broadleaf plantain	ženska bokvica	19	17	1	0.40	0.53	L	C	M, L
PS	<i>Prunus spinosa</i> L. – blackthorn	trnjina	30	27	2	0.63	0.79	F	FD, T	UF
RC	<i>Rosa canina</i> L. – pomegranate	šipurak	31	29	3	0.67	0.77	F	T	M, L
RF	<i>Rubus fruticosus</i> L. – blackberry	kupina	33	31	2	0.72	0.88	F	FD, T	M, UF
RC	<i>Rumex crispus</i> L. - greens	Zelje	37	34	2	0.79	0.91	L	FD	L
TO	<i>Taraxacum officinale</i> Web. – dandelion	Maslačak	28	26	3	0.60	0.86	L, Fl, R	FD, T	M, L
UD	<i>Urtica dioica</i> L. – nettle	Kopriva	39	38	2	0.88	0.93	L	FD, T	L

Abbreviations: UR – Use report; FC – frequency of citation; NU – number of use categories; RFC – relative frequency of citation; UV – Use value; PPU – plant part use: H – herb, F – fruits, L – leaves, Fl – flowers, R – root; PoU – purpose of use: T – tea, FD – food, D – decoration, C – compress, J – juice; UES – urban ecosystems: ST – street trees, P – lawns/parks, UF – urban forests, S – stream, M – urban meadows, L – leaf, abandoned, along the roads.

The most frequently mentioned plant species belong to the *Rosaceae* family (25%), followed by *Asteraceae* (16%), *Lamiaceae* (16.6%) and *Plantaginaceae* (8.3%) while the rest of them belong to the other plant families (*Brassicaceae*, *Rubiaceae*, *Fagaceae*, *Juglandaceae*, *Malvaceae*, *Moraceae*, *Boraginaceae*, *Polygonaceae* and *Urticaceae*) – each with only one representative. This agrees with the results previously reported by Mullačija *et al.* (2021), who highlighted three families (*Rosaceae*, *Asteraceae* and *Lamiaceae*) as the most frequently used by urban and rural Serbs and Albanians of the Anadrini region (Kosovo and Metohija), for medicine or food.

Generally, Urban Ethnobotany is a relatively new ethnobotany discipline with scarce data collected by sporadically conducted studies. Regardless that these studies were conducted in Brazil, North Africa and India, the most frequently used plants were from the same families – *Asteraceae*, *Lamiaceae*, *Apiaceae* and *Fabaceae* (LEITÃO *et al.*, 2009; MALLIC *et al.*, 2014; ALQETHAMI *et al.*, 2017; KUMAR *et al.*, 2018). To the authors' knowledge, the data of national ethnobotanical studies conducted on the urban ecosystem are very rare. Mainly national ethnobotanical studies (ŠAVIKIN *et al.*, 2013; JARIĆ *et al.*, 2015; JANAČKOVIĆ *et al.*, 2019) were conducted and focused only on the rural ecosystems in different geographical regions of the Republic of Serbia (Zlatibor district, Eastern Serbia – Negotin district, and Southern Serbia – Pčinja district), where the most frequently locally reported plant families were also the *Rosaceae*, *Asteraceae* and *Lamiaceae*.

Despite the greater diversity of species in rural areas, the same species are mentioned in rural as well as urban regions, which is also confirmed by a study conducted by OCVIRK *et al.*, 2013. If we compare data obtained for the use value of individual wild plant species in the analyzed urban region (Kragujevac district) vs. previously reported data for a rural region (e.g. Zlatibor district, Eastern Serbia – Negotin district, and Southern Serbia – Pčinja district), it is obvious that wild plant species such as *Achillea millefolium*, *Hypericum perforatum*, *Matricaria chamomilla* and *Mentha piperita* in researched rural and mountain areas have higher use value than in the urban region. Furthermore, the results of this study show that the edible species (berries – *Rubus fruticosus*, *Rosa canina*, *Fragaria vesca*; tree fruits – *Juglans regia*, *Morus nigra*, *Castanea sativa*, edible plants – *Rumex crispus*, *Urtica dioica*; mushrooms) have high use reports in urban ecosystems. This urban-rural comparison doesn't mean that edible species are not important for rural areas. Oppositely, they have a significant economic role (MATKOVSKI *et al.*, 2019). Comparing the use value of berries for the urban population of Kragujevac with Serbs from the Anadrini region (Kosovo), it can be concluded that *R. canina* has the high use value for rural and urban Serbs (UV 0.3, 0.6, respectively), while *F. vesca* only for urban Serbs (UV 0.1) in the Anadrini region. In our research, *Morus nigra* is not a highly ranked food for the urban population of Kragujevac city. Opposite to our research, *Morus nigra* has highly use value as food for urban and rural Albanian in Anadrini region (Kosovo), but not for Serbs in same region (MULLALIJA *et al.* 2021). In terms of the rural vs. the urban ethnobotany, the example of *J. regia* is very interesting, since the rural population shows small interest (RFC=0.09) for this species according to JANAČKOVIĆ *et al.* (2019), while the urban one is very interested in this plant which is confirmed by the RFC=0.88. This plant is also interesting for urban Serbs, but not for rural Serbs from the Anadrini region. Interestingly, of a total of 72 reported taxa in the study of MULLALIJA *et al.* (2021), urban Serbs reported 42 taxa, while rural Serbs reported 28 taxa. Having in mind that the Anadrini region has sub-urban character there are different influences on traditional herbal knowledge and practices. Ethnobotany in urban environment shows less level of traditional knowledge transmission, mainly influenced by modern media and social relationships which leads to „hybrid ethnobotany“ (FONTEFRANCESCO and PIERONI, 2020; MULLALIJA *et al.*, 2021). Evident differences in urban/rural ethnobotany possibly come from the purpose of the research (mainly based on the examination of traditional medicinal knowledge) and research area size. A smaller

number of studies emphasize ethnobotanical knowledge for the purpose of local gastronomy. Comparing the use value of berries, fruits, and edible species in our research with the results of studies by DAJIĆ STEVANOVIĆ et al. (2014) and LUKOVIĆ et al. (2021), it can be concluded that berries, fruits, and edible species have a smaller use value in our research.

The most used plant parts by our study are whole herbs (42%), followed by fruits (38%), then leaves (25%), and flowers (4%), what is in contrast to other studies. Generally, the urban ethnobotany is mostly based on edible plant parts such as herba and fruits. Thus, ŠAVIKIN *et al.* (2013) found that the selected plant parts with the specific purpose of use were most commonly used. Roots, a part of plants, are rarely used, which is only mentioned in *Taraxacum officinale* in our research. Although *T. officinale* is a cosmopolitan species, the practice of not removing the root of the plant is important from the conservation perspective of some other possibly endangered species. By avoiding the use of roots the extractive impact is minimized and thus the plant is preserved (LEITÃO *et al.*, 2009).

The human urban population generally does not utilize the entire potential of plants. Many of the mentioned species have multiple uses, e.g., *F. vesca* in addition to edible fruits also has medicinal properties which are not recognized in urban ethnobotany. Medicinal species were more frequently cited by the respondents than the traditionally edible ones. Out of the total of listed plants, 17 species have medicinal properties which are confirmed and well-known. However, their Use Report is lower than that of edible plants (Figure 2). Also, 15 species are cited in the food category, while six species are cited as used for another purpose (ornamental, decorative...). Three species – *T. officinale*, *R. canina*, and *C. sativa*, found their place in all selected categories. The possible reason could be the long tradition of using these species, especially the urban tradition of using sweet chestnuts. Similar urban ethnobotanical studies also show multiple uses of some species, e.g., *Rosmarinus officinalis*, because of long historical and cultural importance (BENNETT and PRANCE, 2000).

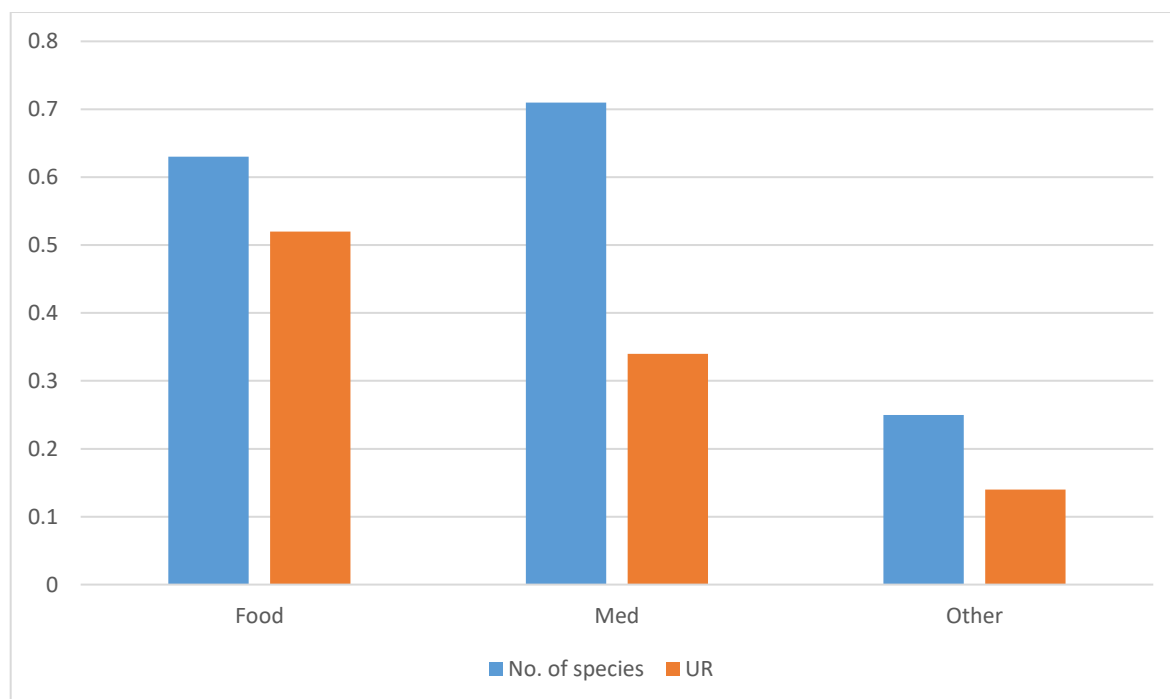


Figure 2. Number of Use Reports (UR) and species in use-categories Food, Med(icinal) and Other based on ethnobotanical interviews collected from 43 respondents in Kragujevac in 2021.

Ecosystem services' accessibility and availability are impacted by global trends of urbanization and land use. In the first line, it makes functional differences in urban/rural environments and their effect on the provision of services. Recent studies indicate that the

importance of provisioning ecosystem (e.g. food) was more characteristic for rural than urban dwellers, while regulating ecosystem (e.g. air quality) or cultural ecosystem services (e.g., recreation) were found as important for urban people (LAPINTE *et al.*, 2019). In that sense urban population is more dependent on limited urban ruderal flora. The availability and diversity of plant resources are important factors affecting traditional plant use (ALQETHAMI *et al.*, 2017).

In addition to the above stated, some studies show that there is a positive correlation between the widespreadness of a plant and the versatility of its use (TARDIO *et al.*, 2008). The versatile species, e.g., *Mentha* sp., *C. intybus*, *U. dioica*, *P. spinosa*, etc., represented in Figure 3, are recognized as useful wild plants – the respondents are aware of their beneficial properties and know how to use them. Almost 80% of mentioned plants species (Tab. 1) are representatives of the widespread ruderal flora of Kragujevac (PAVLOVIĆ-MURATSPAHIĆ *et al.*, 2010). However, their versatility of use still lags the utilization of the same species in rural areas. The potential reason could be the interest of the local urban population for “instant” use, recreation, lack of traditional knowledge transmission, or vicinity and availability of markets and pharmacies. The results of our study show more than half of the cited plants are considered useful in one of the mentioned categories, while the majority of the species, according to PETKEVICIUTE *et al.* (2010), have a diverse usage (e.g., *A. millefolium*) and are frequently mentioned by the respondents because they are easily recognizable.

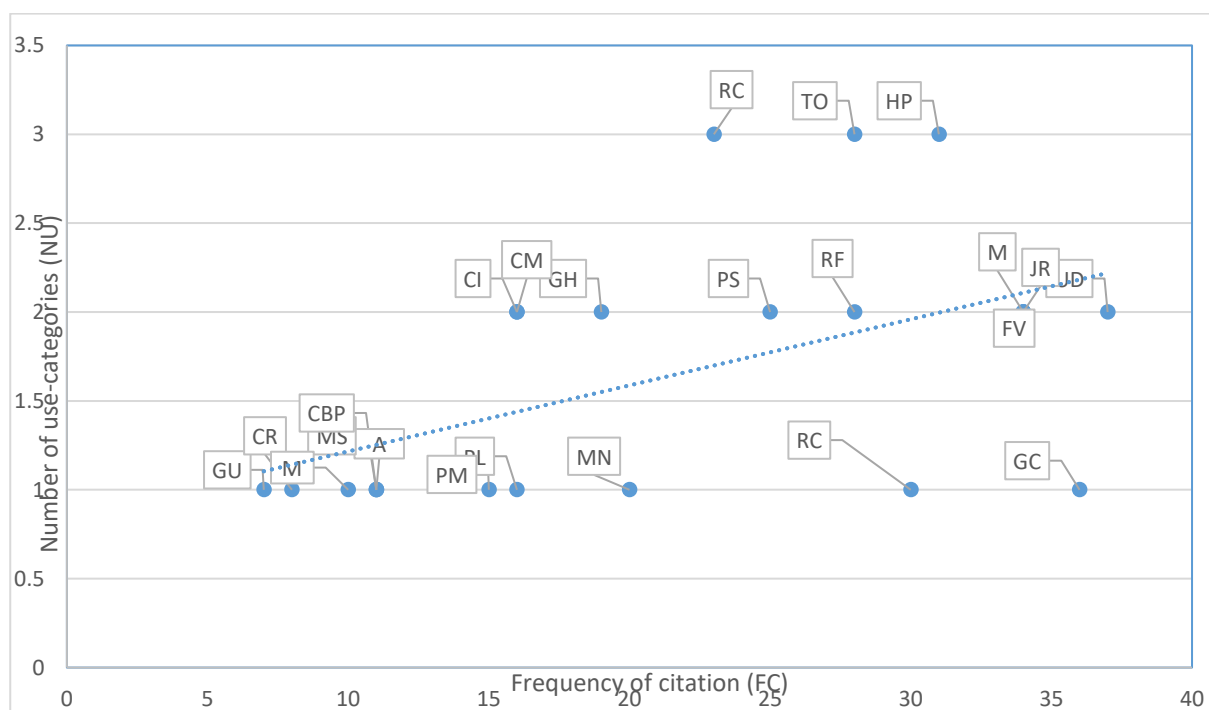


Figure 3. Relationship between the number of use-categories for each plant species (NU) and frequency of citation (FC).

The majority of species' local populations were collected from urban meadows and leas (85%), which indicates the importance of urban greenery, even ruderal. Ruderals represent an important component of urban biodiversity, a source of provisioning ecosystem services and are of great significance for the sustainable development of urban green space (GUO *et al.*, 2018).

In our study, the role of the local urban population as species collectors was examined. However, the results could be more heterogeneous if the open fairs, markets, and local herbalists were included in the research. The urban population recognized a spectrum of species

mostly for edible purposes. The previous studies revealed that the local herbalists make no clear distinction between medicinal, edible, and ritual plants (LEITÃO *et al.*, 2009), because they all are intended for overall well-being. This fact opens possibilities for further research in terms of comparing the average urban population, herbalists, and rural ethnobotanical knowledge and practice. Furthermore, the results of this research could represent the basis for urban ecosystem services investigations, ecological infrastructure conservation, and restoration or transmission of local common ethnobotanical practices and knowledge.

CONCLUSION

The global process of urbanization and population migration from rural to urban areas inevitably leads to the erosion of traditional ethnobotanical knowledge and practices. Consequently, these processes lead to the hybridization of herbalist skills. Ethnobotanical research in urban areas still represents pioneering attempts both in the world and in Serbia. Our research results show a narrow range of plant species used in urban areas in accordance with local diversity. Generally, the same or similar species are mentioned in the notable studies that examine ethnobotanical knowledge and practices in rural Balkan regions, but there is a big difference – the analyzed urban population mostly utilized plant species for edible purposes, while rural populations (literature data) prefer its utilization as medical. Even though this research was limited to local urban plant collectors, this study represents a basis for furthermore comprehensive urban ethnobotanical studies with a wider targeted group (e.g., local herbalists, open-air market) as well as on traditional herbal knowledge and practice transfer from rural to urban settlements.

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