



## Research paper

## Medical ethnobotany on the Javor Mountain (Bosnia and Herzegovina)

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## ABSTRACT

**Introduction:** The study provides significant ethnobotanical information on plant resources traditionally used in the Javor Mountain region (eastern Bosnia and Herzegovina), aiming at identifying medicinal plants and collecting information concerning the specific methods of their therapeutic application.

**Methods:** A qualitative anthropological method using a semi-structured questionnaire was used to interview 70 people. The relative importance of wild plant species, as reported by the informants, was assessed by the quantitative methods: use-value (UV), cultural importance value (CIV) and Shannon-Wiener index. Also, the level of homogeneity among information provided by different informants was calculated by the Informants' Consensus Factor (FIC).

**Results:** 73 plant species with medicinal properties were collected, identified and their methods of preparation and uses were recorded. Asteraceae, Lamiaceae and Rosaceae have the greatest species diversity. The most commonly used are *Hypericum perforatum*, *Mentha x piperita*, *Sambucus nigra* and *Achillea millefolium*, with UV over 0.9. The most frequently used plant parts are the aerial part (29%) and the leaf (26%), while infusion being the most common way of preparing herbal remedies (57%). The plant most appreciated by the people interviewed was *Hypericum perforatum* used to treat skin complaints, haemorrhoids, moderate depression, gastrointestinal ailments and respiratory infections. Also, phytotherapeutic use of *Veronica officinalis* rhizome in jaundice treatment, as well as utilization of *Prunus domestica* bark for cavity protection were noted.

**Conclusion:** The results of the current study may be significant in rural development programs in the Javor Mountain region, in aiming to foster community-based strategies of management of natural resources.

## 1. Introduction

The ethnobotanical studies of the Balkan Peninsula, conducted at the beginning of the 21st century, confirmed the widespread use of medicinal plants in the everyday life of the local people [1–6]. Also documented were traditional alternative methods of treatment with herbal remedies, a customs observed in the multi-ethnic state of Bosnia and Herzegovina where the ethnicity of its population bore no relevance to the practice [7–11]. This connection with nature is particularly evident amongst Serbs populating the highland areas of Bosnia and Herzegovina. Since ancient times, as recorded in the local folk tradition, the magical and healing powers of herbs have been revered, while medicinal plants have played an important role in many ancient rituals and customs, and in traditional medicine. Ethnomedicinal studies play an important role in preserving traditional phytotherapeutic knowledge, which are at risk of being lost in the future. For these reasons, a study was carried out on the traditional use of medicinal herbs in the everyday life of the people who inhabit the Javor Mountain

region (eastern Bosnia and Herzegovina) which has not been investigated from the ethnobotanical point of view so far.

Within the general crisis of biodiversity, Cunningham [12] referred to the local traditional knowledge and its enormous relevance to the ecosystem preservation. In this regard, ethnobotanical studies have gained great importance due to the fact that they can provide new directions for nature conservation, sustainable development and proper management of resources [13]. Considering this, the extent of exploitation of locally important resources should be revealed, and the importance of preservation of rare and endangered plant species and their habitats highlighted (such *Picea omorika*, commonly known as Serbian spruce). One of the most common approaches to that effect has been to associate the use of plants with issues of their conservation since the most important species suffer the greatest harvesting pressure.

Hence, the current study opened several issues dealing with the need to identify the most important plant species, frequently used in this region, and also the need to deepen the knowledge about the healing power of plants that could be used when natural disasters strike

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(emergency situations) or medicine and food shortages occur. It was assumed, initially, that this ethnobotanically unexplored region, justified by its historical demography and geographical position, hid underutilized medicinal plants or unusual and unique methods of their application. Searching for a specific and less known use of a particular plant, the study tried to identify more effective herbal remedies and modes of their application in the prevention and treatment of some acute and chronic diseases. From this arose a number of questions, such as those pertaining to a) the existence of local names used in this region is mistakenly attributed to some other plant species, found in other regions of the neighbouring countries, and might lead to confusion and misidentification, b) the reasons for utilizing, or not, the same plant in a similar manner within cultures of different linguistic and geographical backgrounds, and c) the reasons for discontinued use of certain plants.

In line with this, the current research intended to document the valuable traditional knowledge on the medicinal use of wild plants passed down by old generations. In order to preserve this knowledge for the benefit of future generations, the research promises to break free from the oblivion of orally conveyed secrets about medicinal plants and their uses, passed on from one generation to another.

## 2. Methods

### 2.1. Study area

The Javor mountain is located in eastern part of Bosnia and Herzegovina (Republika Srpska) being geographically part of the Dinaric macro-region, with the length extending up to 60 km, and the highest peak Žep (1537 m above sea level). It is administratively located between the municipalities of Vlasenica (on the north-east side), Han Pijesak (south-eastern side) and Kladanj (northwest side, Federation of Bosnia and Herzegovina). The altitude distribution of the mountain massif is between 1000–1537 m above sea level. The direction of mountain expansion is northwest-southeast. According to the annual climate index (Thorntwaite – Matter's method), the whole research area is dominated by a very humid climate type – B4, that is characterized by high forest vegetation [14]. The climate is temperate continental but strongly influenced by mountainous. The average annual temperature reaches 9.9 °C, while the average temperature is 18.5 °C in summer and 0.8 °C in winter. Since the area is situated at a climate turning point at which cold air masses (coming from Mount Javor) and slightly warmer air masses (coming through the Drinjača, Tišča and Jadar valleys) mix, it is very windy, especially in spring and autumn when air movements are most pronounced [15]. The local population is traditionally engaged in rural and agricultural activities, subsistence farming in particular. For example, in the Vlasenica area, arable land covers approximately 8288 ha, while meadows and pastures occupy an area of about 4255 ha. Extensive livestock production is the most developed agricultural sector in this region. The most commonly grown agricultural crops are corn, wheat, potatoes, carrots, onions and beans. Orchards occupy only 670 ha, and mainly plums, apples, pears, walnuts and cherries are cultivated [16].

Javor mountain is dominated by forest vegetation. More than half of the forest area contains a large variety of coniferous species (pine, fir, spruce, juniper and others), while the rest is occupied by deciduous trees (oak, maple, ash, aspen, hazelnut, elm, birch, cornel and others). Aside from Serbian spruce (*Picea omorika* (Pančić) Purk.), downy birch (*Betula pubescens* Ehrh.) has also been identified as a tertiary relic [17]. The regional flora and fauna of Mount Javor have been poorly explored, although its beauty and lushness indicate an area very rich in biodiversity.

### 2.2. Demographic information

Historically, during Roman times, major roads passed through this area, leading from the Adriatic Sea towards the north-eastern parts of

the Roman Empire – Serbia and Romania. In the year 1992, the war in Bosnia and Herzegovina broke out and caused great changes in the demographic image of the area. A new administrative division took place resulting in the establishment of the municipality of Milići thus causing a decrease in population and the size of the municipality, which have nearly been halved. The migration of the Muslim population to the cities of the Federation of Bosnia and Herzegovina happened later, as did the counter migration of the orthodox population to Vlasenica.

The population of the investigated area is multiethnic: the Muslim, Orthodox and Catholic religions and, according to the Agency for Statistics of Bosnia and Herzegovina [18], the official languages are "the languages of the Serbian, Bosnian and Croatian people". Since 1996, due to the stagnant economic development of the region, in urban zones as well as in rural, a decrease in population figures has been registered [18].

The names of the villages and the total number of locals living in them, according to the 2013 population census, are as follows: Turalići (92), Grabovica (380), Mišari (183), Rača (59), Drum (166), Kulina (89), Šadići Gornji (48), Šadići Donji (126), Gradina (425), Bakići (67), Malo polje (61), Nerići (17), Kraljevo polje (439), Rijeke (39), Podžeplje (103), Gerovi (110), Milići (354) and Vitići (31). Of the total population living in the aforementioned villages, 2.51% were interviewed.

### 2.3. Ethnobotanical study and data collection

The ethnobotanical study was carried out during the vegetation period in 2015 and 2016, in 18 mountain villages namely: Turalići, Grabovica, Mišari, Rača, Drum, Kulina, Šadići Gornji, Šadići Donji, Gradina, Bakići, Malo polje, Nerići, Kraljevo polje, Rijeke, Podžeplje, Gerovi, Milići and Vitići (Fig. 1). The interviewed locals mostly dealt with agriculture. Semi-structured interviews, conducted in the Serbian language, were used to collect data. The majority of households in the research area were recommended by a local guide. One participant per household (usually the head of the household or the oldest male member, or a family member who had the most knowledge and experience in the traditional use of medicinal plants) was invited to take part in the interview. In each village, available households with residents who were willing to converse and owned traditional knowledge, were selected. It was not possible to find an adequate participants for the interview in each of the selected rural houses, as some of them were dilapidated and abandoned, or used mainly for holidays.

A total of 70 people voluntarily participated of which 92% were older than 50 years, where 57 (82%) were women and 13 (18%) were men. Everyone was asked about the utilizations of medicinal herbs, either wild growing, uncontrollably sprouted or purpose-grown in gardens. The most important interview data were obtained from old women and, to a lesser extent, from old men, as they are considered experts on local herbs. Some people refused to be interviewed or, occasionally, a house scheduled for a visit was unoccupied. The interview was focused on the informants' knowledge about the local medicinal plants used in everyday life and prevention and treatment of health problems. Depending on their responses, more specific questions concerning plant species utilization gradually followed. All participants were classified into four age categories (Category I: 30–45 years old; Category II: 46–60 years old; Category III: 61–75 years old; Category IV: 76 and above) and the level of their education was also registered. As part of the interviews, a "guided tour" technique was employed. It consisted of walks through forests and meadows with one participant in order to observe *in loco* the plants cited, or to find some rare plant species and to collect samples which were dried and pressed to send to an expert for subsequent botanical identification [19,20]. Numerous plant photographs were taken and the participant's observations were recorded.

The medicinal plants collected were determined by botanists from the Department of Agrobotany, Faculty of Agriculture, University of

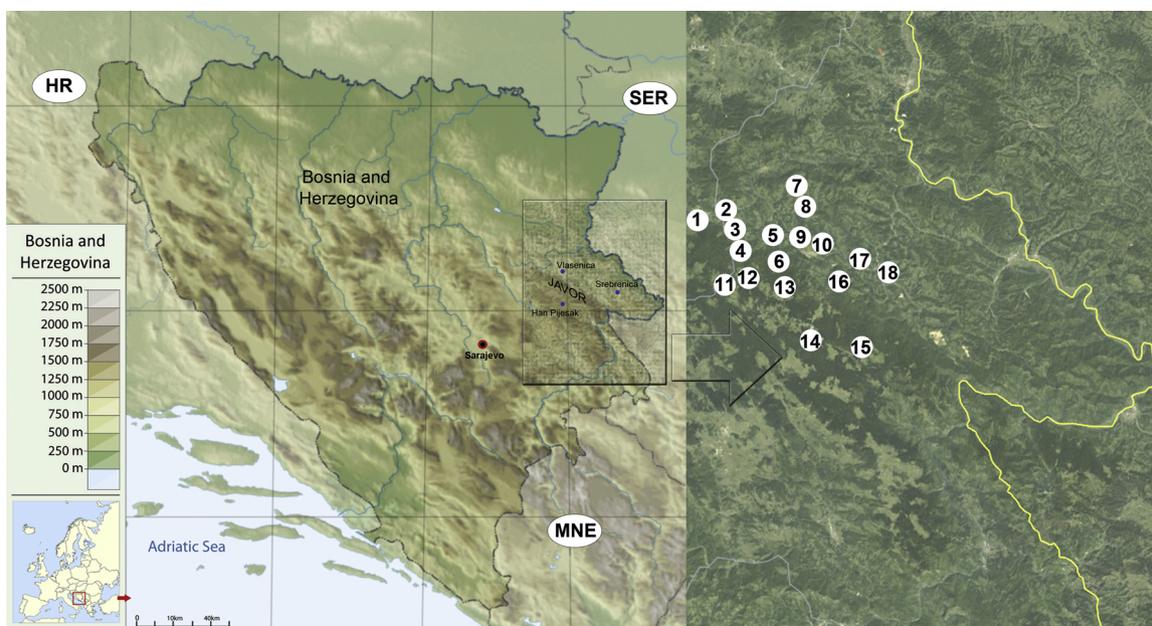


Fig. 1. Map of study area. Investigated localities: 1. Turalići; 2. Grabovica; 3. Mišari; 4. Rača; 5. Drum; 6. Kulina; 7. Šadići Gornji; 8. Šadići Donji; 9. Gradina; 10. Bakići; 11. Malo polje; 12. Nerići; 13. Kraljevo polje; 14. Rijeke; 15. Podžeplje; 16. Gerovi; 17. Milići; 18. Vitići.

Belgrade using professional literature [21–23]. The plants were collected in a sustainable manner that meets the plant survey goals and provides useful information for ethnobotanical analysis. Herbarium specimens with the corresponding reference number for every taxon, as well as the original notes, questionnaire data and other documented materials obtained during the field survey, are deposited at the Department of Agrobobotany. Each voucher specimen was accompanied with the data relating to species, genus and family information, collection date, a plant's locality, name of the collector and collector's notes about the plant abundance, habitat and plant condition (presence of flowers or mature fruits, or absence of both, are included thus offering information as to when plants and their parts can be used for medicinal purposes, or if necessary as food). Protected or rare species were identified on site, and samples, if any, were taken from the local people for a more thorough clarification. Some of the species were identified with the help of book images or authentic descriptions of plants obtained by the participants. Plant material, not immediately recognizable, was appropriately stored pending future examination. The study also included certain poisonous species, or those used in magic and religious rituals and ceremonies, and special methods of their application.

The emic approach [24] was applied to describe the ways the local people explain relevant issues, the ways they perceive and classify diseases, their attitudes to plant treatments and the influence plants have on their everyday life. A great deal of information from a large number of people was gathered through semi-structured interviews in a relatively short period of time, allowing the interviewees to comment or answer the questions more easily. Data analysis was based exclusively on useful plants that are known locally.

The ethnobotanical research and related activities, including collecting of plants, compiling databases, images, audio or video recordings, gathering information on the uses of traditional knowledge or other elements of biocultural heritage found in the study area, were undertaken in compliance with the International Society of Ethnobiology (ISE) code of ethics [25]. No harmful consequences (biological or cultural) for the local people and local communities arose from this research and its related activities. Each original recipe pertaining to medicinal utilization of certain plants has been recorded with the approval of the participants. A written consent was obtained from some of them in order to facilitate future scientific data processing of

the gathered information. During research, all principles of the code of ethics [25] were adhered to including intellectual property rights and support to the development of local people's cultures.

#### 2.4. Data analysis

The use-value technique, has been widely applied in the ethnobotanical research in order to highlight the plants that are considered most important by a local population [26,27]. The UV index proposed by Phillips and Gentry [28] and modified by Rossato et al. [29] and Silva and Albuquerque [30], a quantitative method that demonstrates the relative importance of species known locally, was calculated as follows:  $UV = \sum U_i / n$ , where  $U_i$  = the number of uses mentioned by each informant for a given species,  $n$  = the total number of informants. Values will be high (near 1) if there is a lot of user reports for a plant, implying that the plant is important, and near 0 if there are few reports related to its use. As such, the use-value index for a given plant is determined by the number of uses locally attributed to it in relation to the number of informants. The use-value index does not determine whether a plant has a single or multi-purpose use. Also, the frequency of quotation for each species was analyzed.

The Informants' Consensus Factor (FIC) [31] describing the level of homogeneity among information provided by different informants was calculated by using the formula:  $FIC = Nur - Nt / (Nur - 1)$ , where,  $Nur$  = number of use reports from informants for a particular plant-use category;  $Nt$  = number of taxa or species that are used for that plant use category for all informants. FIC values range between 0 and 1, where '1' indicates the highest level of informant consent.

Cultural Value Index [32], was calculated by formula:  $CV_e = UC_e * Ic_e * IUc_e$ , where  $e$  = ethnospecies (medicinal plants);  $UC_e$  = number of uses reported (through free listing) for an ethnospecies divided by the total number of use categories;  $Ic_e$  = number of participants who listed a species as useful divided by total number of participants;  $\sum IUc_e$  = number of participants who mentioned each use (category) for the ethnospecies divided by the total number of participants. The index values range from zero (0 - the condition where there is no mention of the plant being useful) to UI.

The calculation of the Shannon-Wiener index was made through the formula  $H = -\sum_{i=1}^u p_i \log p_i$ , (both base  $e$  and 10), where  $p_i$  is the proportion of individuals of the  $i^{th}$  species (here the number of citations

**Table 1**  
Wild and domesticated medicinal plants on Javor mountain (eastern Bosnia and Herzegovina).

Family	Botanical taxa and voucher specimens	Local common name	Used plant part	Preparation form	Ailment category medical use	Frequency of quotation	Use value	Cultural Value Index	Shannon–Weaver index
Adoxaceae	<i>Sambucus ebulus</i> L. JAV-Ado-01	Aptika	root	infusion	SM E: rheumatism;	6	0.08	0.082	0.026
	<i>Sambucus nigra</i> L. JAV-Ado-02	Zova	flower	juice, syrup, infusion	R I: fever and cold; high temperature;	64	0.91	2.798	0.062
	<i>Allium sativum</i> L. JAV-Ama-01	Beli luk	bulb	fresh	C I: high blood pressure; GI I: parasites; EMN I: high levels of triglycerides and cholesterol in the blood	61	0.87	3.566	0.077
Apiaceae	<i>Allium ursinum</i> L. JAV-Ama-02	Medvedji luk	leaf; flower bud	fresh fresh	C I: high blood pressure; GI I: digestive problems; EMN I: high levels of triglycerides and cholesterol in the blood	31	0.44	1.803	0.077
	<i>Angelica sylvestris</i> L. JAV-Api-01	Gospina trava; Anđelika	fruit	infusion	GI I: digestive disorders; spasms; gastritis;	62	0.89	2.736	0.062
Araliaceae	<i>Hedera helix</i> L. JAV-Ara-01	Bršljan	leaf	infusion	N I: nervous system disorders;	6	0.08	0.082	0.026
	<i>Achillea millefolium</i> L. JAV-Ast-01	Kunica, hajdučka trava	aerial part	infusion	G I: menstrual disorders; GI I: gastritis;	64	0.91	2.798	0.062
Asteraceae	<i>Arcium lappa</i> L. JAV-Ast-02	Čičak	rhizome leaf	infusion infusion	D E: eczema; acne; hair loss; U I: bladder sand;	47	0.67	3.433	0.091
	<i>Bellis perennis</i> L. JAV-Ast-03	Bela rada	flower	infusion	EMN I: hyperglycemia; G I: menstrual problems; chronic mastitis and other female reproductive system disorders;	8	0.11	0.338	0.062
Asteraceae	<i>Calendula officinalis</i> L. JAV-Ast-04	Neven	flower	ointment, infusion	D E: skin complaints; burns and wounds; C E, I: hemorrhoids and varicose veins;	51	0.73	3.741	0.091
	<i>Centaurea cyanus</i> L. JAV-Ast-05	Različak	flower	infusion	GI I: liver ailments; S E: eye inflammation;	6	0.09	0.184	0.045
Asteraceae	<i>Cichorium intybus</i> L. JAV-Ast-06	Cikorija	root aerial part, flower	decoction infusion	GI I: hepatoprotective activity; treatment of liver disorders; purification of biliary tract; GI I: diarrhea;	15	0.21	0.013	0.062
	<i>Matricaria chamomilla</i> L. JAV-Ast-07	Kamilica	flower	infusion decoction (with milk)	R I: cold; GI I: stomach disorders; N I: insomnia; anxiety; D E: face and eye disinfectant; S E: conjunctivitis; GI I: anthelmintic;	45	0.64	4.591	0.116
Asteraceae	<i>Tanacetum vulgare</i> L. JAV-Ast-08	Povratič	flower, leaf	raw	D I: eczema; acne and wounds; EMN I: anemia;	12	0.17	0.174	0.026
	<i>Taraxacum officinalis</i> Weber	Maslačak	flower leaf	syrup raw	C I: cardiac insufficiency;	27	0.38	1.558	0.077
Betulaceae	<i>Tussilago farfara</i> L. JAV-Ast-09	Podbjel	leaf	infusion	C I: cardiac insufficiency;	17	0.24	0.246	0.026
	<i>Betula pendula</i> Roth. JAV-Bet-01	Obična breza	bark extract leaf	fresh juice “sap” infusion	EMN I: spring anemia; U I: nephritis; urinary tract infection; D E: hair loss; U I: nephritis; urinary tract infection; D E: hair loss;	10	0.14	0.574	0.077
Boraginaceae	<i>Symphytum officinale</i> L. JAV-Bor-01	Gavez crni	rhizome	decoction (with milk)	SM E: bone fractures; sprains and swellings;	53	0.76	2.337	0.062
Brassicaceae	<i>Capsella bursa-pastoris</i> (L.) Medik. JAV-Bra-01	Srčanič, hoću-neću	aerial part	infusion	C I: heart failure;	15	0.21	0.215	0.026

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Table 1 (continued)

Family	Botanical taxa and voucher specimens	Local common name	Used plant part	Preparation form	Aliment category medical use	Frequency of quotation	Use value	Cultural Value Index	Shannon–Weaver index
Chenopodiaceae	<i>Atriplex hortensis</i> L. JAV-Che-01	Loboda	leaf	decoction	EMN I: anemia;	5	0.07	0.072	0.026
Comaceae	<i>Cornus mas</i> L. JAV-Cor-01	Dren	fruit	juice, jam	C I: heart failure; EMN I: anemia; S E: earache;	52	0.74	1.517	0.045
Crassulaceae	<i>Sempervivum tectorum</i> L. JAV-Cra-01	Čuvarkuća	leaf	fresh juice		33	0.47	0.482	0.0262
Cupressaceae	<i>Juniperus communis</i> L. JAV-Cup-01	Kleka	cone	infusion, tincture	C I: blood purification; GI I: stomach ailments; gall bladder stones ; R I: cold; cough; tuberculosis; SM rheumatism ; U I: urinary tract inflammations; GI I: anthelmintic;	25	0.36	2.952	0.127
Dryopteridaceae	<i>Dryopteris filix-mas</i> L. Schott	Navala	leaf, rhizome	infusion		19	0.27	0.277	0.026
Equisetaceae	<i>Equisetum arvense</i> L. JAV-Dry-01	Preslica	aerial part	infusion	U I: sand in the bladder and kidney;	50	0.71	1.455	0.045
Ericaceae	<i>Vaccinium myrtillus</i> L. JAV-Equ-01 JAV-Eri-01	Borovnica	leaf fruit	infusion juice, jam, medical vine	EMN I: hyperglycemia; EMN I: anemia;	51	0.73	1.496	0.045
Fabaceae	<i>Ononis spinosa</i> L. JAV-Fab-01	Gladišijka, zečiji trn	aerial part	infusion	SM I: rheumatic pain; U I: bladder sand;	11	0.16	0.328	0.045
Fagaceae	<i>Trifolium pratense</i> L. JAV-Fab-02 <i>Quercus cerris</i> L. JAV-Fag-01 <i>Quercus petraea</i> Matt. Liebl.	Crvena detelina Hrast cer Hrast medunac	aerial part bark bark	infusion infusion, decoction infusion, decoction	G I: ailments of female reproductive tract; problems in menopause; GI I: against poisoning; diarrhea; C E: hemorrhoids; GI I: against poisoning; diarrhea; C E: hemorrhoids;	4 12 12	0.06 0.17 0.17	0.123 0.523 0.697	0.045 0.062 0.077
Geraniaceae	<i>Geranium macrorrhizum</i> L. JAV-Ger-01	Zdravac	aerial part	infusion	R I: throat inflammations; GI I: gastrointestinal ailments;	18	0.26	0.266	0.026
Hypericaceae	<i>Hypericum perforatum</i> L. JAV-Hyp-01	Gorac, kantarion	aerial part	infusion oil	N I: moderate depression; GI I: gastrointestinal ailments; R I: respiratory infections; D E: skin complaints; wounds and burns; C E: hemorrhoids; GI I: gastrointestinal ailments;	65	0.93	6.672	0.116
Iridaceae	<i>Iris sp.</i> JAV-Iri-01	Sabica, perumika	rhizome	infusion		2	0.03	0.031	0.026
Juglandaceae	<i>Juglans regia</i> L. JAV-Jug-01	Orah	green fruit	tincture	EMN I: hypothyroidism; C I: cardiac insufficiency;	15	0.21	0.430	0.045
Lamiaceae	<i>Hyssopus officinalis</i> L. JAV-Lam-01 <i>Marrubium vulgare</i> L. JAV-Lam-02 <i>Melissa officinalis</i> L. JAV-Lam-03	Miloduh Macina trava Matčnjak	aerial part flower aerial part	infusion infusion infusion	R I: cough; asthma; bronchitis; G I: ailments of female reproductive tract; polymenorrhea, sterility; N I: insomnia; GI I: digestive disorders; spasms; R I: respiratory infections;	11 30 55	0.16 0.43 0.78	0.492 1.322 3.198	0.062 0.062 0.077
	<i>Mentha longifolia</i> L. JAV-Lam-04	Divlja nana	aerial part	infusion	G I: myomas in the female reproductive tract; GI I: digestive disorders; spasms and diarrhea; R I: fever and cold;	57	0.81	4.981	0.104

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Table 1 (continued)

Family	Botanical taxa and voucher specimens	Local common name	Used plant part	Preparation form	Aliment category medical use	Frequency of quotation	Use value	Cultural Value Index	Shannon–Weaver index
	<i>Mentha x piperita</i> L. JAV-Lam-05	Pitoma nana	aerial part	infusion	GI I: stomach disorders; N I: anxiety; insomnia; R I: respiratory infections; fever and cold; D E: mouthwash;	65	0.93	6.672	0.116
	<i>Ocimum basilicum</i> L. JAV-Lam-06	Bosiljak	aerial part	infusion, spice	N I: anxiety; insomnia; R I: respiratory infections; fever and cold; D E: mouthwash;	60	0.86	3.525	0.077
	<i>Origanum vulgare</i> L. JAV-Lam-07	Roza gospina trava; vranilovka	aerial part	infusion	N I: anxiety; insomnia; R I: fever; cough; R I: fever and cold;	41	0.58	1.188	0.045
	<i>Teucrium chamaedrys</i> L. JAV-Lam-08	Podtubica	aerial part	infusion	GI I: digestive complaints; diarrhea;	55	0.78	1.598	0.045
	<i>Teucrium montanum</i> L. JAV-Lam-09	Trava iva	aerial part	infusion	GI I: digestive complaints;	25	0.36	0.369	0.026
	<i>Thymus</i> sp. JAV-Lam-10	Majčina dušica	aerial part	infusion	GI I: gastrointestinal disorders; R I: respiratory disorders;	63	0.90	1.845	0.045
Loranthaceae	<i>Viscum album</i> L. JAV-Lor-01	Imela	leaf	infusion	C I: high blood pressure;	6	0.08	0.082	0.026
Lycopodiaceae	<i>Lycopodium clavatum</i> L. JAV-Lyc-01	Bradavica trava, prečica	aerial part	compress	D E: wart removal;	13	0.19	0.195	0.026
Lythraceae	<i>Lythrum salicaria</i> L. JAV-Lyt-01	Metvica, potočnjak	aerial part	infusion	GI I: diarrhea; C blood circulation disorders;	36	0.51	1.045	0.045
Malvaceae	<i>Althaea officinalis</i> L. JAV-Mal-01	Bijeli slez	rhizome	macerate	R I: cough;	41	0.58	0.594	0.026
	<i>Malva sylvestris</i> L. JAV-Mal-02	Crni slez	leaf	fresh, infusion	EMN I: anemia;	27	0.38	0.389	0.026
Oenotheraceae	<i>Epitobium parviflorum</i> Schreber JAV-Oen-01	Trava za prostatu	aerial part	infusion	GI I: prostatic diseases; prostate cancer;	11	0.16	0.328	0.045
Papaveraceae	<i>Chelidonium majus</i> L. JAV-Pap-01	Rusa	fresh juice	juice	D E: wart removal S E: cataract	21	0.30	0.615	0.045
	<i>Papaver somniferum</i> L. JAV-Pap-02	Mak	fruit	infusion	N I: nerve excitability;	10	0.14	0.143	0.026
Pinaceae	<i>Abies alba</i> Mill. JAV-Pin-01	Jela	resin	decoction	D E: wounds; infections;	6	0.08	0.164	0.045
	<i>Pinus sylvestris</i> L. JAV-Pin-02	Crni bor	leaf bud resin	syrup decoction	R I: cough and bronchitis; D E: wounds; infections;	15	0.21	0.861	0.077
Plantaginaceae	<i>Plantago lanceolata</i> L. JAV-Pla-01	Muška bokvica	leaf	infusion compress	R I: cough and bronchitis; D E: wounds; cuts and ulcers; skin inflammation;	44	0.63	3.874	0.104
	<i>Plantago major</i> L. JAV-Pla-02	Ženska bokvica	leaf	infusion compress	R I: cough and bronchitis; D E: wounds; cuts and ulcers; skin inflammation;	41	0.58	3.566	0.104
	<i>Veronica officinalis</i> L. Jav-Pla-03	Zvončiči; čestoslavica	rhizome	fresh juice	D E: wounds; cuts and ulcers; skin inflammation; GI I: jaundice;	1	0.01	0.010	0.026
Poaceae	<i>Agropyron repens</i> L.P. Beauv. JAV-Poa-01	Pirika, pirovina	aerial part	infusion	SM I: rheumatism;	9	0.13	0.133	0.026
Polygonaceae	<i>Rumex crispus</i> L. JAV-Pol-01	Štavelj seed	leaf seed	fresh infusion	EMN I: anemia; in nutrition; GI I: diarrhea;	3	0.04	0.123	0.062
Primulaceae	<i>Primula vulgaris</i> Huds. JAV-Pri-01	Jagorčevina rhizome leaf	flower, rhizome leaf	infusion, decoction fresh	R I: cough and bronchitis ; EMN I: anemia; in nutrition;	45	0.64	2.624	0.077

(continued on next page)

Table 1 (continued)

Family	Botanical taxa and voucher specimens	Local common name	Used plant part	Preparation form	Aliment category medical use	Frequency of quotation	Use value	Cultural Value Index	Shannon–Weaver index
Rosaceae	<i>Agromonia eupatoria</i> L. JAV-Ros-01	Petrovac	aerial part	infusion	C I: blood purification; GI I: liver and gall disorders; parasitic induced ailments; SM I: rheumatism; C I: heart failure;	23	0.33	1.691	0.091
	<i>Crataegus monogyna</i> Jacq. JAV-Ros-02	Glog	leaf, flower	infusion	U I: kidney sand; GI I: diarrhea;	29	0.41	0.420	0.026
	<i>Cydonia oblonga</i> L. JAV-Ros-03	Dunja	leaf	infusion	EMN I: in nutrition (source of vitamin C); U I: urinary sand;	10	0.14	0.287	0.045
	<i>Fragaria vesca</i> L. JAV-Ros-04	Šumska jagoda	leaf	infusion	SM E: dental caries; GI I: constipation;	26	0.37	0.758	0.045
	<i>Mespilus germanica</i> L. JAV-Ros-05	Mušmula	fruit	infusion	EMN I: high levels of triglycerides and cholesterol in the blood; anemia; EMN I: hyperglycemia;	9	0.13	0.133	0.026
	<i>Prunus domestica</i> L. JAV-Ros-06	Šjiva	bark	infusion	EMN I: anemia; in nutrition (source of vitamin C); R I: cold; fever;	4	0.06	0.123	0.045
	<i>Prunus spinosa</i> L. JAV-Ros-07	Tranjina	fruit	dry fruit	GI I: diarrhea; EMN I: anemia; in nutrition (source of vitamin C);	30	0.43	1.322	0.062
	<i>Pyrus pyraeaster</i> L. Burgsd. JAV-Ros-08	Divlja kruška	bark	decoction	R I: fever and cold;	5	0.07	0.072	0.026
	<i>Rosa canina</i> L. JAV-Ros-09	Šipak	fruit	infusion, jam	EMN I: anemia; in nutrition (source of vitamin C); R I: cold; fever;	48	0.68	2.787	0.077
	<i>Rubus fruticosus</i> L. JAV-Ros-10	Kupina	leaf	infusion	GI I: diarrhea; EMN I: anemia; in nutrition (source of vitamin C);	45	0.65	1.998	0.062
Tiliaceae	<i>Tilia platyphyllos</i> Scop. JAV-Til-01	Lipa	flower	infusion	R I: fever and cold;	61	0.87	1.783	0.045
Urticaceae	<i>Urtica dioica</i> L. JAV-Urt-01	Kopriva	aerial part; young leaf	infusion, spice	C I: cleansing the blood; hemorrhoids; EMN I: anemia; D I: hair loss;	60	0.86	4.407	0.091
Violaceae	<i>Viola tricolor</i> L. JAV-Vio-01	Žuta ljubičica, dan i noć	aerial part	infusion	SM E: rheumatic pain; D E: eczema; acne; C I: blood purification;	2	0.03	0.092	0.062

Aliment category: GI - gastrointestinal diseases; R - respiratory diseases; D - dermatologic diseases; U - urinary tract ailments; C - problems of the circulatory system; EMN - diseases of endocrine glands, metabolism and nutrition; N - diseases of the nervous system and psyche; SM - skeletal; muscle and connective tissues problems; G - gynecological complications; S - problems of the sensorial system. Methods of application: I - internally; E - externally.

or informants per species) [33]. Shannon-Wiener is an information theory index, based on the idea that diversity in a natural system can be measured as information contained in a message. We used the program A Software Package for Statistical Analysis of Ecological Data “FLORA” [34].

### 3. Results

Information about 73 species of medicinal plants, which people living in the region of the Javor Mountain traditionally use for the treatment of various ailments, were classified by families and listed alphabetically in Table 1.

Percentage of participating informants classified by age categories was as follows: Category I (21%), Category II (49%), Category III (23%) and Category IV (7%). Young people under 30 years of age were not included in the study simply because they expressed no interest in, or knowledge of this field. The participants from the 46–60 age group were most knowledgeable about medicinal plants, and were their most frequent users. Their frequent comment was that a certain plant was “good for any health problems”, as in the case of *Agrimonia eupatoria*, *Hypericum perforatum*, *Mentha longifolia* or *Matricaria chamomilla* that are used to treat a wide range of diseases (Table 1). There is also a folk belief, widely accepted as a truth by most of the locals, that if someone gets sick, the healing herb will “appear” in that person’s garden. It may be observed that people with a very basic level of education tend to use medicinal plants frequently. A small percentage of the interviewed population did not even finish primary school, particularly the female population over 60 years of age (11%). The largest number of the participants finished only primary school (43%), about one-third has high school diplomas, while 16% of them has university degrees. Medicinal plants most frequently used (the highest frequency of quotation) by almost all participants, are as follows: *Hypericum perforatum* (65), *Mentha xpiperita* (65), *Sambucus nigra* (64) and *Achillea millefolium* (64) (Table 1). This is primarily associated with the proven beneficial effects of these plants and their easy accessibility, and in a lesser extent with the most common health problems and plant abundance.

#### 3.1. Quantitative data analysis

Quantitative data related to how many times each species is mentioned (which corresponds to the number of respondents), as well as use value, cultural value index and Shannon-Wiener index are shown in Table 1. The indices are calculated from the responses and degree of consensus among participants, and they were used to establish statistically different parameters to evaluate the knowledge and serve as a qualitative reference.

The highest use value  $\geq 0.90$  in the investigated area was recorded for *Sambucus nigra*, *Achillea millefolium*, *H. perforatum*, *M. xpiperita* and *Thymus* sp., which is in line with the frequency of their mention by the participants (Table 1). Also, the highest Cultural Value Indices were found for *Hypericum perforatum* (6.67), *M. xpiperita* (6.67), *M. longifolia* 4.98, *M. chamomilla* (4.59), *Urtica dioica* (4.41), *Plantago lanceolata* (3.87), *Calendula officinalis* (3.74), *Allium sativum* (3.56) *P. major* (3.56) and *Ocimum basilicum* (3.52). This index best illustrates the link between number of uses reported (through free listing) for an ethnospecies, total number of use categories, number of participants who listed a species as useful, as well as total number of participants.

The Shannon-Wiener index is used to determine the variety of uses of the cited species taking into consideration the relative abundance of citations. *M. chamomilla*, *Juniperus communis*, *H. perforatum*, *M. longifolia*, *M. xpiperita*, *P. lanceolata* and *P. major* have this index values  $> 0.1$ , which means that these species have the highest variety of uses (Table 1).

Table 2 lists the types of ailments with consensus on their treatment (Informant consensus factor = IFC). A total of 10 main groups of diseases were documented based on FIC data (Fig. 4). The highest FIC

**Table 2**  
Types of ailments with consensus on their treatment.

Ailments category	Description of ailments	ICF	No. of species	No. of UR	% of total UR
Diseases of the gastrointestinal system	Spasms; gastritis; liver ailments, purification of biliary tract, diarrhea, anthelmintic, gallbladder stones, jaundice, parasitic induced ailments, constipation	0.26	30	40	19.70
Diseases of the respiratory system	Fever and cold, high temperature, tuberculosis, throat inflammations, respiratory infections, cough and bronchitis	0.49	19	36	17.73
Diseases of the dermatologic system	Eczema, acne, burns and wounds, cuts and ulcers; skin inflammation, infections, wart removal, mouthwash, hair loss	0.44	15	34	16.75
Diseases of the urinary tract	Nephritis, urinary tract infection, urinary tract inflammations, sand in the bladder and kidneys	0.27	9	12	5.91
Diseases of the circulatory system	High blood pressure, blood purification, hemorrhoids and varicose veins, cardiac insufficiency, heart failure	0.11	17	19	9.36
Diseases of endocrine glands, metabolism and nutrition;	High levels of triglycerides and cholesterol in the blood, anemia, spring anemia, hyperglycemia, hypothyroidism, in nutrition (source of vitamin C)	0.28	19	26	12.81
Diseases of the nervous system and psyche;	Insomnia, anxiety, moderate depression, nerve excitability	0.33	7	10	4.91
Skeletal; muscle and connective tissues problems;	Rheumatic pain, bone fractures, sprains and swellings, dental caries	0.44	6	10	4.91
Gynecological complications	Menstrual problems, chronic mastitis, problems in menopause, myomas in the female reproductive tract	0.55	6	12	5.91
Problems of the sensorial system	Eye inflammation, conjunctivitis, earache, cataract	0.00	4	4	1.97

value (0.55) was obtained for gynecological complications, then for respiratory system diseases (0.49), dermatological diseases and disorders of skeletal muscles and connective tissues (0.44). The FIC values show the profile of diseases and can possibly help as a base for health care programs in the research area.

### 3.2. The most used plants in the research area

The high utilization value of *Hypericum perforatum* (UV = 0.93) in the study area is expressed in internal administration in the form of infusion, in treating moderate depression, gastrointestinal ailments and respiratory infections, while externally is applied as an oil for the treatment of skin complaints (wounds and burns) and hemorrhoids. The current study has shown the use of *Mentha xpiperita* (UV = 0.93) in the investigated area as follows: in the treatment of stomach disorders, anxiety, insomnia, respiratory infections, fever and cold and for mouthwash. *Sambucus nigra* is a highly regarded species in the traditional medicine of the Javor Mountain region (UV = 0.91), where the juice (syrup) and infusion made from flowers are mainly used in the treatment of respiratory infections (fever, cold, high temperature). The aerial parts, most often leaves and flowers (fresh or dried), of *Achillea millefolium* are also widely used in the investigated area (UV = 0.91), mainly in the treatment of gynecological (menstrual problems), gastrointestinal (gastritis) and urinary (bladder sand) disorders. For these health problems, fresh juice extracted is used internally, while an infusion and tincture are applied locally externally for treating purulent wounds, ulcers, and cervical wounds, or as an astringent to stop bleeding.

### 3.3. Other commonly used plants

High UV indices were also found for *Thymus* sp. (0.90), *Angelica sylvestris* (0.89), *Tilia platyphyllos* (0.87), *Ocimum basilicum* (0.86), *Urtica dioica* (0.86) and *Mentha longifolia* (0.81), while the lowest were registered for *Viola tricolor* (0.03) and *Veronica officinalis* (0.01).

Informants expressed remarkable concern and awareness regarding plants preservation; for example, they never use combs for picking blueberries. Most beautiful and luxuriant individual plants are not harvested in order to find more of them next year. Moreover, some rarely found useful plants such as *Symphytum officinale*, *Teucrium montanum* and *Marrubium vulgare* are even transplanted into the gardens because people want them always near cultivated species such as *Allium sativum*, *Ocimum basilicum*, *Calendula officinalis* and *M. xpiperita*, in case they are urgently needed.

### 3.4. The modes of plant preparation and application in ethnomedicine

Sometimes, in the herbal medicine of this region, boundary between edible plants and herbs used to treat or alleviate a certain medical condition was not clearly defined. In this respect, it was noticed that daily use of garlic ingested to possibly reduce cholesterol and blood pressure, or treat fungal infections and cold, is a presumable one of the reasons elderly people have lower rates of cardiovascular disorders.

Medicinal plants in the research area are primarily consumed as a herbal infusion, and a lot less as decoction, juice or fresh (Fig. 3), not only for curative but preventive purposes as well. There is a belief that the daily use of, for example, chamomile infusion that have disease-preventive effect (for upset stomach, indigestion and colic) is one of the best ways to take advantage of the healing power of this herb.

The most frequently used plants come from the family Asteraceae, Lamiaceae and Rosaceae. The main plant part used in herbal preparations by local people in the villages of the Javor Mountain region was found to be herb (refers to the leafy green or flowering upper plant parts) both fresh and dried (29%) (Fig. 2).

Most of the local plants that grow in the area of the Javor Mountain are used for the treatment of gastrointestinal (17.3%) and respiratory

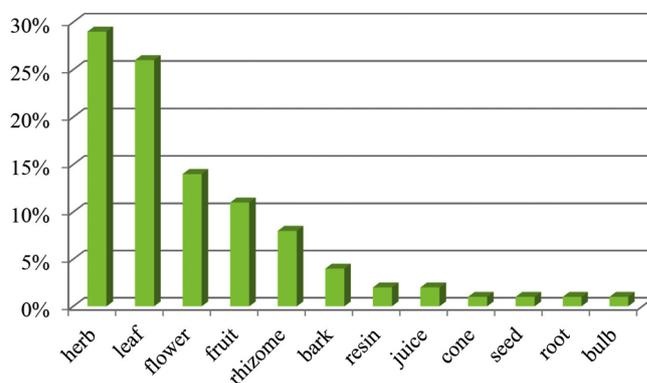


Fig. 2. Percentage contribution of plant parts or products that are the most commonly used for herbal preparations in the investigated region.

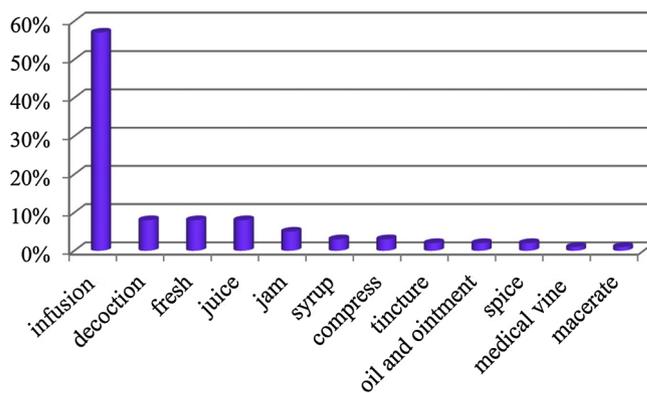


Fig. 3. Application frequency of used preparations.

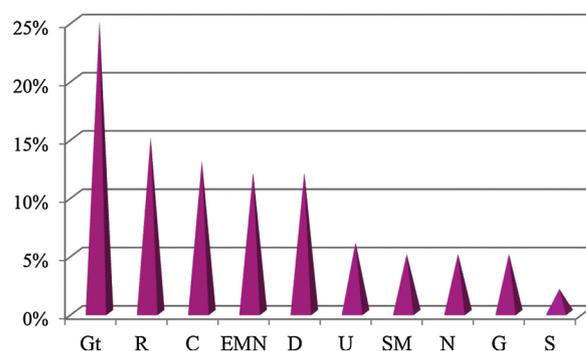


Fig. 4. The frequency of medicinal plant uses in human therapy. GI-gastro-intestinal disorders; R-respiratory diseases; C-problems of circulatory system; EMN-diseases of endocrine glands; D-dermatologic diseases; U-urinary tract infection; SM-skeletal, muscle and connective tissues problems; G-gynaecological ailments; N-diseases of the nervous system; S-problems of the sensorial system.

diseases (15.2%) (Table 1, Fig. 4), particularly from the families Lamiaceae and Asteraceae which are unavoidable in the treatment of these problems, as well as inflammation processes. As far as the utilization of herbal resources for preventive and curative purposes is concerned, the plant most appreciated by the people interviewed is *H. perforatum* used to treat a wide range of health conditions, including skin complaints, wounds and burns, haemorrhoids, moderate depression, gastrointestinal ailments and respiratory infections. In addition, there are species whose characteristics make them more suitable for particular purposes such as *Epilobium parviflorum* which is used for the treatment of prostate cancer, or toxic plants with very restricted use, such as *Tanacetum vulgare*, *Dryopteris filix-mas* (anti-parasitic herbs for tapeworms) and *Chelidonium majus*. The current research presents a

unique case of jaundice treatment on children with the fresh juice made from the rhizome of *Veronica officinalis*. A 63-years old female participant claimed that, during the war, two of her children had jaundice. Not being in a position to provide appropriate medical care and the treatment for them, she prepared the juice every day and gave it to her children. They both recovered quickly. Medical reports after the war did not show any liver damage, or any other adverse effects, in either of them. On the other hand, her oldest child who had the same problem suffered from liver impairment after the exposure to a conventional method of treatment in hospital.

#### 4. Discussion

The present research has shown that the informants in the 46–60 age group were most knowledgeable about medicinal plants, and were their most frequent users. This can be explained by their experience in the children or grandchildren care, but also by concern for their own health, which made them seek treatments based on natural remedies. In reference to the aforementioned, research on traditionally used plants performed in Bulgaria [1] and Bosnia and Herzegovina [10] also confirmed that herb-based treatments are practiced primarily by middle-aged or old women due to experienced maternity and mother's belief in the healing properties of herbs without any harmful side effects on children's health.

Also, the informants from this age group often use the book “Pelagic's national teacher [35] (in Serbian – ‘Pelagićev narodni učitelj’)” for reference, while the older generation (people aged 61 and over) rely on the traditional knowledge of their ancestors. The above-mentioned book covers national experiences in healing and instructions that include all the human needs: air, water, food, exercises, work and rest. What makes it particularly stand out for medical importance is the section including a number of disease definitions, causes and effects, as well as practical advices on the use of medicinal herbs and methods of treatment. As already pointed out elsewhere [36], there is no correlation between gender and education level in the region.

The most frequently used plants come from the Asteraceae, Lamiaceae and Rosaceae, which is not unusual because those plant families contain the largest number of medicinal species in the Balkans [23]. This is compatible with similar ethnobotanical surveys conducted in other Balkan regions, such as those of Bosnia and Herzegovina [3,5,7,9,13,37]. However, according to Serbia's oldest written document about the use of medicinal plants in the Balkans entitled “*Chilandar Medical Codex*”, from 15 to 16 th century, prevailing plants belong to the families Apiaceae (8.1%) and Lamiaceae (8.1%) [38]. Evidently, the use of herbs from the family Apiaceae is decreasing for some reason.

##### 4.1. The most used plants in the research area, the modes of their preparation and application in ethnomedicine

*Hypericum perforatum* has a long history of use in traditional European herbal medicine, whose medical properties are known even back in Hippocrates' time due to its anti-inflammatory and wound/burn healing properties [39]. However, in today's ethnomedicine, this species exhibits great potential to cure many different skin diseases, as well as in the treatment of gastrointestinal, respiratory and nervous system (depression) problems [40]. Bombardelli and Morazzoni [41], Cornara et al. [42] and Yeşilada et al. [43,44] emphasized that the above-ground parts of this species is used traditionally for its anti-inflammatory, antimicrobial and wound-healing properties, and is useful in the topical treatment of dermatitis, sores, rashes, burns, cuts and wounds. The species is very popular in Turkey for wound healing, primarily in the oil form [45,46]. In central Italy, a decoction of leaves is used to rinse wounds and accelerate healing and latex is used for wounds as a vulnerary [47]. This plant is similarly used for medicinal purposes on the Iberian Peninsula (northern Navarra) to treat wounds,

cure burns and infections and for skin hydration [48]. The use of *H. perforatum* as an herbal remedy to treat a variety of internal and external diseases is also popular in the Balkans. The curative properties of this species (the upper portions of mature plant) is best known by the people of eastern, northern and north-eastern Bosnia and Herzegovina [9,10], Serbia [3,5,13,49], Kosovo [50,51], Albania [52], Montenegro [37], Macedonia [2,53] and northwestern Greece [54]. Research have shown that the most commonly is used St. John's wort oil, which is made by macerating the fresh herb in sunlight, usually in sunflower or olive oil for 40 days. In addition, CIV and Shannon-Wiener index show that this species is of extreme importance for the population of the research area.

*Mentha xpiperita* (peppermint or mint) a perennial aromatic plant is a natural hybrid between spearmint (*Mentha spicata* L.) and water mint (*Mentha aquatica* L.) [55,56]. Due to its medicinal properties, *M. xpiperita* has a very diverse application in many countries, as confirmed by numerous ethnobotanical studies. There are data for certain regions of Pakistan [57], Turkey [58], Peru [59], Spain [60] in which *M. xpiperita* is most often used as carminative and as well as for the treatment of stomach and respiratory problems. In ethnobotanical research conducted in the region of the Western Balkans (eastern, northern and north-eastern Bosnia and Herzegovina, south-eastern Romania, Serbia /Kopaonik, Zlatibor, Suva Planina Mountains/, Bulgaria, Macedonia (Sharr Mountain), the use of *M. xpiperita*, is mentioned, most often in the form of infusion for the treatment of stomach problems (digestive disorders, obstipation, flatulence, stomach spasms and diarrhea), kidney inflammation, insomnia, migraine, a headache, influenza and cold, as antiseptic or anesthetic [2,10,13,49,61,62]. The significance of peppermint in the research area of the Javor Mountain is outstanding, as confirmed by UV, CIV and Shannon-Wiener index.

Due to its healing properties, *Sambucus nigra* is very often used in other regions of the Western Balkans, where besides flowers, fruit is also used [2,3,5,9,10,13,37,49,52,61]. In the present study, flowers are used internally in the form of juice, syrup and infusion in the treatment of fewer, cold and high temperature, while in some areas of Serbia, Kosovo and Albania, plant is externally applied, mainly for the treatment of wounds [63].

*Achillea millefolium* (yarrow) is used in traditional medicine worldwide, most often in the treatment of skin disorders, especially inflammation of the skin and mucous membranes, and as a trophic protective agent [64]. Infusion made from leaves, stems and flowers accelerates the healing of rashes, haemorrhoids and skin ulcers [65]. In Chinese [66] and Persian ethnomedicine [67], as well as in Spanish-speaking New Mexico and southern Colorado [68], yarrow has been used to stop bleeding and to treat sores, snakebites, wounds, haemorrhoids, varicose veins, and as an anti-inflammatory and antispasmodic, while in the central part of Italy [47], dried and crushed apical parts are used as a cicatrizant. In the Balkans, *A. millefolium* is a popular plant in the treatment of wounds, gastrointestinal, respiratory and women's ailments, especially in Bosnia and Herzegovina [7], eastern Albania (Gollobordo) [69], eastern (Golak) and western (the Albanian Alps) Kosovo [49,70], Serbia (Mts. Rtanj, Kopaonik, and Suva Planina) [5,13,49] and the Republic of Macedonia (the Sharr Mountain) [2]. Due to its healing properties, the plant is highly appreciated in the study area.

*Ocimum basilicum* is also highly valued by the local Serbian population. Beside its medicinal significance, the herb also has religious importance and is used in some Eastern Orthodox rituals [71]. Similar UV indices (above 0.90), as registered for the mentioned plants from the north-eastern region of Bosnia and Herzegovina, have been reported by Šarić-Kundalić et al. [10], indicating the most frequently used medicinal plants. However, unlike the current study, these authors emphasize the frequent use of citrus and olive.

The main plant part used in herbal preparations was found to be herb which corresponds to the findings of similar research carried out in the Balkans [3,7,37], but certain differences concerning the use of other

plant parts occurred, nevertheless. For example, in the current study, the herb of *Lythrum salicaria* is used for treating diarrhoea and blood circulation disorders, whereas in other areas of Bosnia and Herzegovina, the same diseases are treated by the plant's root [10]. There is, also, a unique way of utilization of the bark of *Prunus domestica* for cavity protection, although some people expressed fear that the particular preparation can cause male sterility. Unlike this finding, some previous studies indicated only the common use of prunes as a remedy for constipation [3].

Local names of the plants growing in the research area are notably different from their usual common names in the countries of the former Yugoslavia which this and the neighbouring regions once belonged to, as in the case of kantarion (*Hypericum perforatum*) known in this region as *gorac*. Despite the difference between the local names, the uses of plant parts and treatment methods are practically the same. Also, *Origanum vulgare* known elsewhere by the name of *vranilova trava* or *vranilovka* [3,13], in this area is commonly called *roza gospina trava* (pink lady's herb). In this area lady's herb, locally known as *gospina trava*, refers to vulnerable (VU) species *Angelica sylvestris*, while in the north-eastern Bosnia and Herzegovina [9,10] the use of very similar species, *Angelica archangelica*, known as *anđelika*, has been reported. Similarly, the current study records only the uses of fruits of *A. sylvestris*, whereas previous studies also mention the use of rhizome, which also has healing properties. Alongside the application of the plant in the treatment of stomach ailments, Šarić-Kundalić et al. [9] provided information on treatment of high fever, pneumonia and jaundice. *Epilobium parviflorum* does not have a specific common name, but it is known as "the herb for prostate" or "purple flowers" (in Serbian - "trava za prostatu" or "ljubičasto cveće"). The absence of vernacular plant name is rather a consequence of the sporadic use of the plant by local people, encouraged by recent experience and knowledge, for example, under the influence of the book "Health Through God's Pharmacy" written by Treben [72] which has promoted the use of *E. parviflorum*. The plant is not mentioned in older books on phytotherapy that is typical for the Balkans [22,36] or in ethnobotanical research carried out in Bosnia and Herzegovina [7,10] and the rest of the Balkan Peninsula [1,3,5,37,49], with the exception of Mount Kopaonik (Serbia) [13] where the plant is known as "svilovina" and is linked not only to the mentioned treatment of prostate disease but also to the treatment of kidney and urinary tract disorders.

In this research area, medicinal plants are most often prepared and consumed as a herbal infusion, both for preventive and curative health care. Rexhepi et al. [2] explain the excessive drinking of infusion (85%) as the main beverage, linking the practice to the customs of the Ottoman Empire. The participants claimed that mixtures of certain herb extracts exert synergistic effects. Thus, the infusion for strengthening heart is made from equal parts of *Capsella bursa-pastoris* and *Tussilago farfara*. Also, the participants pointed out that during the hunger years (particularly the 1992–1996 war years) wild medicinal plants were used as food mostly, either fresh or stewed, which primarily pertained to *Atriplex hortensis*, *Urtica dioica*, *Primula acaulis* and *Taraxacum officinalis*. It has also been noticed that the treatment of the endocrine glands disorders, as well as those of metabolism and nutrition, is associated mostly with the use of fresh preparations. Similarly, by comparing the ethnobotanical knowledge and practice of two culturally and linguistically distinct groups that share the same ecological landscape, environmental resources and religion in Albania, Quave and Pieroni [6] allege that, during periods of famine, apart from *U. dioica*, some other wild edible species, such as *Rumex* spp. and *Rosa canina* play an important role in ensuring food security as well.

As observed earlier in eastern and north-eastern parts of Bosnia and Herzegovina [10], most of the local plants are used for the treatment of gastrointestinal (17.3%) and respiratory diseases. Menković et al. [73] also confirmed the use of a very large number of medicinal plants in the treatment of gastrointestinal (57.4%) and respiratory diseases (41.5%) in Montenegro, while the results from studies undertaken in other

Balkan countries indicate the largest percentage of plants being used for the treatment of respiratory organs (22%) [74], cardiovascular diseases (13.5%) and skeletal musculature problems (13.5%) [1]. Research carried out in the Italian Alps [75] correspond with our research on the use of herbs for the treatment of digestive (25%) and respiratory disorders (25%). It showed a significantly higher percentage of herbs were being used to treat urogenital problems (23%) and a lower percentage to treat cardiovascular problems (8%). The use of the above-ground part of *Veronica officinalis* is mentioned in relation to the treatment of lung and skin diseases [5,37,74], while no data were found to indicate the use of rhizome in the treatment of jaundice. Studies from the eastern parts of the Balkans confirm its effects in the treatment of skin eczema and wounds. However, in the Western Balkans, its use is reported in the treatment of catarrh of the lungs. As for the central, southern and western parts of Serbia, there is no mention of it at all [3,13,49]. Chemical analysis of *Veronica officinalis* indicates high levels of iridoid glycosides and its anti-inflammatory properties, but its active compounds and their effects are still not fully recognized [76]. Thus, further phytopharmacological studies of certain species are justified and necessary.

## 5. Conclusion

The ethnobotanical research of Javor Mountain area (eastern Bosnia and Herzegovina) provides evidence of extensive use of wild medicinal plants by the local population. The current research produced first pieces of evidence of the traditional use of bio-resources and ethnobotanical information about this area. The study identified 73 plant species which are used in traditional medicine of research area. Asteraceae, Lamiaceae and Rosaceae have the greatest diversity of plant species, and the most commonly use *Hypericum perforatum*, *Mentha x piperita*, *Sambucus nigra* and *Achillea millefolium*. The most frequently used are the aerial parts including leaves, while infusion is the most commonly used way of preparing herbal remedies. The local population of the investigated area emphasizes *H. perforatum* as the most important plant for the treatment of numerous health problems (wounds, burns, hemorrhoids, etc). Additionally, the current study revealed unusual phytotherapeutic use and lesser-known healing power of *Veronica officinalis* rhizome in the treatment of the jaundice, as well as a unique way of utilization of *Prunus domestica* bark for cavity protection.

The questionnaire analysis provided the local population with the opportunity to draw their attention to, and raise their awareness of, issues of sustainable utilization of wild plant resources. The documentation on traditional knowledge about medicinal plants from the Javor Mountain region, ought to be dealt with by official agencies at the national level in order to be preserved from oblivion after its last custodian is gone. There are many valuable plant species here awaiting pharmaceutical and economic evaluations.

## Conflict of interest

All authors gave their final approval for publication and declare that there is no conflict of interest that would prejudice the impartiality of this scientific work.

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