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The Healing Flora of Konjuh Mountain in Bosnia and Herzegovina

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The mountain of Konjuh is characterized by a landscape of high aesthetic value with significant diversity in biological, geomorphological, and hydrological aspects. This, combined with its cultural-historical heritage, religious and traditional values, provides the foundation for educational, ecotourism, and sports-recreational tourism activities, as well as for visitor enjoyment and the development of economic activities. Located in the northeastern part of Bosnia and Herzegovina, Konjuh, along with Ozren, Javor, and Javornik, forms part of the chain of peripheral (higher) mountains, which, together with Trebavac and Majevica, represent the transition from the Dinaric mountain system to the vast Pannonian plain. The average elevation of the mountain is 1,000 meters. The Tuzla Canton government has passed a law declaring a portion of Konjuh Mountain, covering an area of 8,016 hectares, as a Cultural Heritage site of Bosnia and Herzegovina.
The aim of this study was to systematically inventory medicinal plant species at seven sites on Konjuh Mountain in three municipalities (Kladanj, Živinice, and Banovići) at different altitudes (from 560 to 1,100 meters), classify medicinal plant species based on taxonomic and ecological attributes, and create phytocenological field records.

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During the research, 109 medicinal plant species were identified, including endangered and endemic species. The taxonomic structure of the families of medicinal plants on Konjuh Mountain revealed the presence of 43 families, with the most represented being representatives of the Lamiaceae family at 13.76%, Asteraceae at 11.92%, Fabaceae at 7.33%, and Plantaginaceae at 5.50%. A phytogeographical analysis of the medicinal plant flora identified 11 areal types and groups. An analysis of the biological spectrum of flora in all habitats indicates the presence of six primary life form types, with hemicryptophytes (H) being dominant, accounting for 59 species.

Keywords: Konjuh; medicinal plants; inventory; hemicryptophytes.

1. INTRODUCTION

The medicinal properties of plants are one of their most essential characteristics. Humans have recognized this in the distant past, making plants an accessible means for healing, a tradition that continues to this day [1]. Today, they represent a cost-effective resource in the pharmaceutical industry worldwide.

As far back as 3000 BCE, more than 100 different species of medicinal plants were known, and they were used for treatments, remedies, and poison preparation against enemies. Knowledge gained through experience from the distant past was passed down from generation to generation and kept as a family secret. In Asia Minor, over 5000 years ago, various plant parts, such as flowers, fruits, seeds, and roots, were used for medicinal purposes.

Regarding geomorphological and geological characteristics, medicinal plants can grow on soils specific to their structure. The protected landscape of Konjuh Mountain grows on soils formed due to the dissolution of metamorphic rocks, shales, quartzites, and sandstones. Medicinal plants in this area grow on silicate-dolomite soil, which is fresh, deep, loose, and fertile. In lower areas, the plant cover consists of low shrubs and meadows, which transition to pastures, deciduous, and coniferous forests at higher elevations.

The area of Konjuh Mountain has remained, to this day, partly to completely unknown in the world of science, even though forestry experts have been managing this area for about 100 years. The potential of Mount Konjuh can be assessed based on some floristic and phytocenological studies [2], [3,1,4,5]. Above the village of Brateljevići near Kladanj, subendemic species Micromeria thymifolia acinoshungaricus [6] were found. It was noted that they were found on the left bank of the Oskova River at 340m on serpentine rock. Additionally, a specimen of the species *Calamintha sylvatica* ssp. *sylvatica*, which is common in the area of ZP Konjuh on Konjuh Mountain, was collected in the Mačkovac-Varda area and stored in the herbarium of the National Museum in Sarajevo. The renowned dendrologist and phytocenologist, academician Pavle Fukarek, also stayed in Brateljevići, but besides one specimen of the species *Erica carnea* stored in the mentioned herbarium [7], he left no other written records about the flora and vegetation of this area.

Endemic species of the Balkans [8,9] recorded in the area of Konjuh Mountain include: *Centaurea nigrescens* ssp. *smolinensis*, *Centaurea stenolepis* ssp. *bosniaca*, *Cerastium malyi* ssp. *serpentinii*, *Edraianthus jugoslavicus*, *Euphorbia montenegrina*, *Halacsya sendtneri*, *Iris bosniaca*, *Knautia dinarica*, *Knautia sarajevensis*, *Peucedanum aegopodioides*, *Sesleria latifolia*, *Sesleria serbica*, *Stachys recta* ssp. *baldacc*ii, *Thymus jankae*, and *Viola beckiana*. The number of endemics is undoubtedly much greater, as it is necessary to include *Lilium bosniacum* and *Micromeria thymifolia*, as well as numerous other endemic plants that are potentially present and for which it is necessary to cover the late spring and summer development aspects of vegetation. These plant species represent the most significant value of ZP "Konjuh," making it recognizable in a broader international context. So far, only *Iris bosniacum and Lilium bosniacum* have been recognized as important in official reports and on the official website, so further promotion of this area is necessary because some of the mentioned plants are equally attractive and all deserve special attention and protection in the territory of the Protected Landscape. Subendemic Balkan plant species are also of great significance, with their distribution center in the Balkan Peninsula but with some disjunctions beyond the Balkan borders. Such plants are generally considered (sub)endemics and are important for the preservation of the overall genetic heritage of our country and the neighboring countries in a joint effort to preserve the nature of Europe. Among them, the following stand out: *Dianthus petraeus*,

Micromeria thymifolia (not confirmed by our research but certainly present in the canyon in Drinjače near Brateljevići based on herbarium material from the National Museum of BiH), *Dianthus croaticus*, *Cytisus pseudoprocumbens*, *Hieracium pavichii*, and *Scabiosa leucophylla.*

In addition to the species mentioned above, particular attention should be given to plants that have a suitable degree of endangerment in the territory of the Federation of Bosnia and Herzegovina. According to the current Red List of the flora of the Federation of Bosnia and Herzegovina [10], in ZP "Konjuh," almost endangered (NT) species have been found (marked in red if they are not endemic): *Viola beckiana*, *Halacsya sendtneri*, *Edraianthus jugoslavicus*, and Narcissus radiiflorus; vulnerable (VU): *Asplenium cuneifolium*, *Hepatica nobilis*, *Daphne blagayana*, *Euphorbia montenegrina*, *Centaurea smolinensis*, and *Ruscu shypoglossum*; endangered (EN): *Notholaena marantae*, *Daphne laureola*, and *Echium russicum*. Unconfirmed species that are also listed as vulnerable include *Taxus baccata* and Ilex aquifolium, as well as endangered *Gentiana lutea*.

1.1 Overview of Previous Research

Konjuh Mountain and, by extension, the Konjuh Protected Landscape (ZP "Konjuh"), is an area that has been very poorly researched, not only in terms of flora but also fauna and fungi. The research conducted during the first half of the previous century was unsystematic because researchers collected plants along known routes and did not explore less accessible locations.

The first data on the plant world of ZP "Konjuh" in the 1950s is associated with the name of Hilda Ritter-Studnička. In her extensive work, she points out the presence of Downy Birch (*Betula pubescens*) from the summit of Konjuh [11]. Given that this area is atypical for this plant species, it is assumed that the seeds came from the immediate vicinity. This was the reason for her to visit Konjuh Mountain again a few years later, specifically the location known as Jezero, located north of Zidine, where, in addition to birch, she mentions a few herbaceous plants: Wild Angelica (*Angelica sylvestris*), Meadowsweet (*Filipendula ulmaria*), Greater Tussock Sedge (*Carex paniculata*), Tufted Hairgrass (*Deschampsia caespitosa*), and False-brome (*Brachypodium sylvaticum*) [12], which are widely distributed throughout the entire ZP "Konjuh." The presence of almost all plant species and typical plant communities was confirmed during further research.

One of the leading botanists in Bosnia and Herzegovina who also explored the Konjuh area is Čedomil Šilić. Above the village of Brateljevići near Kladanj, he mentions the subendemic species *Micromeria thymifolia and Acinos hungaricus*, which he found on the left bank of the Oskova River at 340 meters on serpentine rock. Additionally, he observed a specimen of the species *Calamintha sylvatica* subsp. *sylvatica*, which was present at the Mačkovac-Varda site.

The renowned academic Pavle Fukarek stayed near the village of Brateljevići but, apart from a sample of the species *Erica carnea* stored in the National Museum in Sarajevo [7], he left no other written records about the flora of this area. Vladimir Beus is an academic who, in his doctoral dissertation (1986), studied the forests in the immediate vicinity of the present-day area of ZP "Konjuh." Four phytocenological surveys were conducted near the southern boundary of ZP "Konjuh." During his work, he analyzed the floristic composition of the forests, and his results were confirmed by further research.

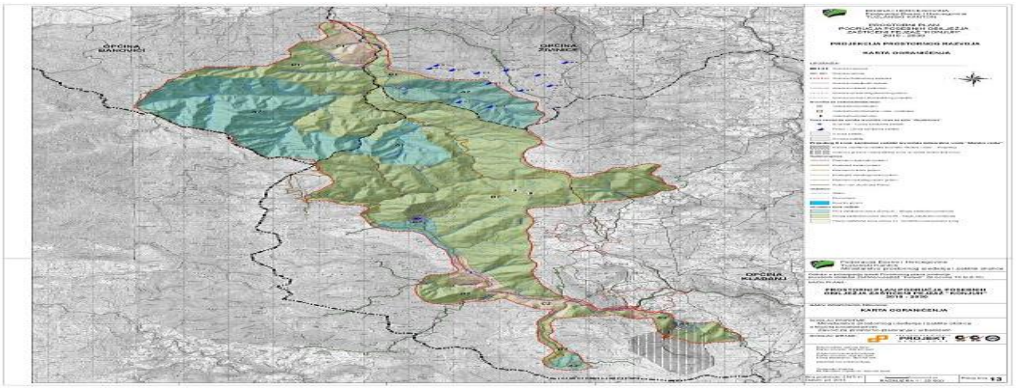

Image 1. Map of the Konjuh Protected Landscape

1.2 Spatial and Ecological Characteristics of the Researched Areaa

Konjuh Mountain is located in the northeastern part of Bosnia and Herzegovina. The mountain is bordered by the following rivers: Seona, Turija, Litva, and Oskova to the north, the Gostelja River and the main road connecting Tuzla and Sarajevo to the northeast, and the Krivaja River to the south and west. Along with Ozren, Javor, and Javornik, Konjuh is part of a chain of peripheral (higher) mountains that, along with Trebavac and Majevica, represent the transition from the Dinaric mountain system to the vast Pannonian lowland. The average elevation of the mountain is 1,000 meters. Above this elevation, there are peaks such as Šuplji Javor (1157 m), Vina Kruška (1088 m), Suho Drvlje (1206 m), Zidine (1180 m), Brezina (1120 m), Vrh Konjuha (1328 m), Bandijerka, the peak of Javor (1261 m), Bijeli Vrh (1272 m), and Zečiji Rat (1275 m) on the southwestern Smolin ridge. The Government of the Tuzla Canton has passed a law declaring a portion of Konjuh Mountain, covering an area of 8,016 hectares, as the Konjuh Protected Landscape (ZP "Konjuh"), placing this area on the list of cultural heritage in Bosnia and Herzegovina.

2. MATERIALS AND METHODS

The research conducted in this study consists of fieldwork and laboratory work.
Fieldwork was carried out in three municipalities within the Tuzla Canton (Kladanj, Živinice, and Banovići), covering seven sites within the Konjuh Protected Landscape (ZP "Konjuh") with a total area of 3000 square meters, ranging in elevation from 560 to 1100 meters. At each site, the following parameters were determined, moving from the lowest to the highest positions: topographic points, elevation, geographic coordinates, slope, and terrain exposure (GPS data), edaphic factors, phytocenological surveys following [13], determination according to the principles of the International Code of Phytosociological Nomenclature [14], and the creation of photo documentation. When collecting plant material from natural habitats, the quantity of harvested material and its sustainability were taken into account. The identification of plant species was carried out following references [15], [16], and [17]. Among the methods used, it is important to highlight the survey method, herbarium preparation, as well as the creation of analytical and synthetic tables. The collected data were statistically processed using relevant software programs.

Phytosociological tables were prepared based on the qualitative and quantitative representation of species in individual plant communities, summarized in a synoptic phytosociological table. The most represented species are listed at the top of the table.

Specimens collected were herbarized following standard procedures [18]. To the herbarium specimens, the Latin name, common name, location where the plant species was collected, and the date of collection were added after taxonomic determination [15].

3. RESULTS AND DISCUSSION

During this research on Konjuh Mountain, 109 medicinal plants were identified. Some plant species are present in specific micro-locations, which may result from climatic or human factors, while certain plant species are present at a large number of sites.

In the investigation of the taxonomic structure of medicinal plant families on Konjuh Mountain, the presence of 43 families was observed, with the most represented family being Lamiaceae at 13.76%. Besides the most represented family, Lamiaceae, there are several other families with a significant number of representatives, including Asteraceae at 11.92%, Fabaceae at 7.33%, and Plantaginaceae at 5.50%. The dominance of the Lamiaceae family in the systematic spectrum of the studied species suggests arid habitats and the influence of a warm continental climate. Similar proportions of systematic affiliation have been observed in some other areas of Bosnia and Herzegovina [2,19], as well as in the Mediterranean region [20,21,22,23].

3.1 Phytosociological Surveys on Konjuh Mountain

Seven phytosociological surveys were conducted in the field to cover various plant communities in order to gather as much data as possible about the presence of medicinal plants on Konjuh Mountain. Phytosociological surveys were carried out at the following locations: Tuholj, Gornja Višća, Katranica, Zlaća, Paučko Lake, Muške Vode, and Brataljevići. Throughout the entire research, the presence of 109 medicinal plants was observed.

Table 1. Representation of the basic life forms and floral elements of medicinal plants on Konjuh Mountain

RB	Plant species	Flora elements	Family	Life forms/shape
1	*Sambucus nigra*	EAz	*Adoxaceae*	P scap
2	*Sambucus ebulus*	EAz		H scap
3	*Asarum europaeum*	EAz	*Aristolochiaceae*	Ch herb rept
4	*Daucus carota*	Hol/ Phol-ptrop	*Apiaceae*	H/T scap
5	*Hedera helix*	SE	*Araliaceae*	S lig
6	*Achillea millefolium*	EAz		H scap
7	*Artemisia absinthium*	EAz		CH suffr caesp
8	*Cichorium intybus*	Kosm		H scap
9	*Cirsium arvense*	EAz		H scap
10	*Sonchus arvensis*	Kosm		H scap
11	*Hieracium pilosella*	EAz/EAz (W)		H ros
12	*Petasites hybridus*	EAz		G rad
13	*Taraxacum officinale*	EAz		H ros
14	*Matricaria chamomilla*	Kosm		T scap
15	*Tussilago farfara*	EAz		G rhiz
16	*Crepis biennis*	Se		T scap
17	*Leucanthemum vulgare*	EAz		H scap
18	*Arctium lappa*	EAz	*Asteraceae*	T/H scap
19	*Allium ursinum*	EAz	*Alliaceae*	G bulb
20	*Convallaria majalis*	Kosm	*Asperagaceae*	G rhiz
21	*Ceterach officinarum*	Kosm	*Aspleniaceae*	H scap
22	*Asplenium scolopendrium*	Kosm		Ch herb caesp
23	*Betula pendula*	Bor	*Betulaceae*	P scap
24	*Corylus avellana*	EAz/Eaz (W)		P scap
25	*Pulmonaria officinalis*	Se	*Boraginaceae*	H scap
26	*Symphytum officinale*	EAz/ EAz(W)		H scap
27	*Myosotis sylvatica*	EAz/EAz(W)		H/T scap
28	*Capsella bursa-pastoris*	Kosm	*Brasicaceae*	T ros
29	*Armoracia rusticana*	kosm		G rhiz
30	*Valeriana officinalis*	EAz	*Caprifoliaceae*	H scap
31	*Knautia arvensis*	EAz/EAz(W)		H scap
32	*Silene vulgaris*	EAz	*Caryophyllaceae*	H scap
33	*Stellaria media*	Kosm		H scap/Rept
34	*Humulus lupulus*	EAz	*Cannabaceae*	H scap
35	*Convolvulus sepium*	Kosm	*Convolvulaceae*	SH herb
36	*Cornus mas*	EAz	*Cornaceae*	T/H scap
37	*Sedum rupestre*	Se	*Crassulaceae*	Ch suffr caesp
38	*Juniperus communis*	Kosm	*Cupressaceae*	P caesp
39	*Pteridium aquilinum*	Kosm	*Dennstadetiaceae*	G rhiz
40	*Dryopteris filix-mas*	Hol	*Dryopteridaceae*	G rhiz
41	*Vaccinium myrtillus*	Bor	*Ericaceae*	Ch suffr caesp
42	*Equisetum arvense*	Hol	*Equisetaceae*	G rhiz
43	*Lotus corniculatus*	Hol	*Fabaceae*	H scap
44	*Melilotus officinalis*	EAz		T/H scap
45	*Trifolium repens*	Hol		H rep
46	*Trifolium pratense*	EAz/EAz (W)		H scap
47	*Vicia cracca*	EAz		H scap SH herb
48	*Anthyllis vulneraria*	EAz/ EAZ(W)		H scap
49	*Vicia grandiflora*	EAz/Se-med-pont		H scap/ SH herb
50	*Ononis spinosa*	EAz/ Se-med	*Fabaceae*	CH suffr caesp
51	*Quercus petraea*	Se	*Fagaceae*	P scap
52	*Tilia chordata*	Se	*Tiliaceae*	P scap
53	*Gentiana lutea*	EAzP	*Gentianaceae*	G rhiz
54	*Centaurium erythraea*	Se		H scap
55	*Hypericum perforatum*	EAz	*Hypericaceae*	H scap

RB	Plant species	Flora elements	Family	Life forms/shape
56	*Crocus vernus*	EAz	*Iridaceae*	G tub
57	*Ajuga reptans*	EAz/ Se-med	*Lamiaceae*	H rept
58	*Stachys officinalis*	EAz/EAz(W)		H scap
59	*Mentha arvensis*	Hol		H scap
60	*Melissa officinalis*	MSM		H scap
61	*Prunella vulgaris*	EAz/EAz(W)		H scap
62	*Urtica dioica*	Hol		T/H scap
63	*Teucrium montanum*	EAz/ EAz(W)		CH suffr caesp
64	*Thymus serpyllum*	Se		CH herb rept
65	*Marrubium vulgare*	Se		H scap
66	*Glechoma hederacea*	EAz		H rept
67	*Salvia glutinosa*	EAz		H scap
68	*Origanum vulgare*	EAz		H scap
69	*Lycopus europaeus*	EAz/EAz(W)	*Lamiaceae*	H scap
70	*Mentha aquatica*	Hol		H scap
71	*Mentha pulegium*	EAz		H scap
72	*Malva sylvestris*	EAz	*Malvaceae*	H scap
73	*Chelidonium majus*	EAz/EAz(W)	*Papaveraceae*	H scap
74	*Abies alba*	Se	*Pinaceae*	P scap
75	*Pinus sylvestris*	EAz		P scap
76	*Digitalis glomerata*	EAz	*Plantaginaceae*	H caesp
77	*Plantago major*	Kosm		H/T ros bienn
78	*Plantago lanceolata*	EAz		H ros
79	*Veronica officinalis*	Hol		Ch herb rept
80	*Veronica chamaedrys*	EAz		H scap
81	*Plantago media*	EAz	*Plantaginaceae*	H ros
82	*Rumex crispus*	Hol	*Polygonaceae*	H scap
83	*Polygonum aviculare*	Kosm		T rept
84	*Polypodium vulgare*	Hol	*Polypodiaceae*	Ch herb caesp
85	*Lysimachia nummularia*	Se	*Primulaceae*	Ch herb rept
86	*Primula vulgaris*	Hol		H ros
87	*Primula veris ssp.columnae*	EAz		H ros
88	*Ranunculus repens*	EAz	*Ranunculaceae*	H rept
89	*Aruncus dioicus*	Hol	*Rosaceae*	H scap/G rhiz
90	*Crataegus monogyna*	Se		P caesp
91	*Filipendula hexapetala*	EAz		H scap
92	*Fragaria vesca*	Kosm		H rept
93	*Sangusorba minor*	EAz/Eaz(W)		H scap
94	*Malus sylvestris*	EAz/EAz (W)		P scap
95	*Rosa canina*	EAz/EAz(W)		P scap
96	*Prunus spinosa*	EAz/ EAz(W)		P scap
97	*Sorbus aucuparia*	EAz(W)		P scap
98	*Rubus idaeus*	Hol		NP rept
99	*Rubus fruticosus*	Se		NP rept
100	*Crataegus oxyacantha*	Se		P scap
101	*Filipendula ulmaria*	EAz		H scap
102	*Agrimonia eupatoria*	EAz		H scap
103	*Asperula odorata*	EAz/ Se-med	*Rubiaceae*	H scap
104	*Galium verum*	EAz		H scap
105	*Viscum album*	Eaz	*Santalaceae*	P scap
106	*Linaria vulgaris*	EAz/EAz(W)	*Scrophulariaceae*	H scap
107	*Salix alba*	EAz	*Salicaceae*	P scap
108	*Viola tricolor*	EAz	*Violaceae*	T caesp
109	*Viola odorata*	EAz/EAZ(W)		H semiros-rept

EAz- Eurasian, EAZ(W) - European-West Asian, EAz/ Se-med - Central European-Mediterranean, Se - Central European, EAz/ EAz(W)-European-West Asian, Hol-Holarctic, Kosm - Cosmopolitan, Hol/ Phol- ptrop –paleoholarctic-paleotropic, EAz/ Se-med-pont- Central European-Mediterranean-Pontic-South Siberian

3.1.1 Life forms

Considering that the research was conducted in an area with a moderately continental climate, this resulted in the presence of all categories of life forms.

By analyzing the structure of hemicryptophytes on Konjuh Mountain (Table 2), it is observed that the majority are stem hemicryptophytes (H scap), accounting for 40 species or 67.79% of the total number of hemicryptophytes. If stem forms are combined with stem hemicryptophyte-geophytes (H scap/G rhiz) and other transitional forms (H scap/SH herb), it can be concluded that stem forms make up 72.88% of the hemicryptophytic flora, or 39.44% of the total analyzed flora of Konjuh Mountain.

The life form Therophytes (T) is represented by 5 plant species. In addition to typical therophytes, the flora of Konjuh Mountain also includes 4 species of a transitional nature, which are essentially therophytes but can survive under unfavorable conditions as hemicryptophytes (T/H). Analysis of the structure of therophytes reveals that stem forms are the most prevalent.

The life form Geophytes (G) is represented by 10 plant species. This life form includes plants whose above-ground parts completely die off in unfavorable conditions, while their rhizomes (G rhiz), stems, or tuberous roots (G tub), bulbs (G bulb), or root buds (G rad) survive in the soil. In the flora of Konjuh Mountain, the most prevalent plant species are those that overwinter with the help of rhizomes (G rhiz), accounting for 70%.

Woody plant species, phanerophytes (P), constitute 14.67% of the flora of Konjuh Mountain. Among the 16 woody plant species, the majority are stem forms (P scap) with 14 plant species, followed by shrub forms (P caesp) with 2 representatives.

Table 2. Structure of Hemicryptophytes in the Flora of Konjuh Mountain

Life form	Nr.	%	Life form examined in details	Nrt.	%
			H scap	40	67.79
			H caesp	1	1.69
H	53	89.83	H rept	4	6.77
			H ros	6	10.16
			H scap-rept	1	1.69
			H semiros-rept	1	1.69
H/G	1	1.69	H scap/G rhiz	1	1.69
H/SH	2	3.38	H scap/SH herb	2	3.38
H/T	3	5.08	H/T scap	2	3.38
			H/T ros bienn	1	1.69

Table 3. Structure of therophytes in the flora of Konjuh Mountain

Life form	Nr.	%	Life form examined in details	Nr.	%
			T scap	2	22.22
T	5	55.55	T caesp	1	11.11
			T rept	1	11.11
			T ros	1	11.11
T/H	4	44.45	T/H scap	4	44.45

Table 4. Structure of Geophytes in the Flora of Konjuh Mountain

Life form	Nr.	%	Life form examined in details	Nr.	%
			G rhiz	7	70.00
G	10	100.00	G tub	1	10.00
			G bulb	1	10.00
			G rad	1	10.00

Table 5. Structure of Phanerophytes in the Flora of Konjuh Mountain

Life form	Nr.	%	Life form examined in details	Nr.	%
			P scap	14	77.77
P	16	88.88	P caesp	2	11.12
NP	2	11.12	NP rept	2	11.12

Stem phanerophytes are most commonly found in forest vegetation. Characteristic species of stem phanerophytes for specific forest phytocoenoses include *Fagus moesiaca*, *Betula pendula, Salix alba,* and *Salix fragilis*. Shrub phanerophytes are typically the vegetation builders of the Alnetea glutinosae class. This group includes species like *Salix aurita, S. pentandra, S. purpureae*, species of the Rosa genus, and others. Creeping phanerophytes are represented by species of the Rubus genus and the creeping willow *Salix rosmarinifolia*, a characteristic species of heathland thickets [24].

Hemicryptophytes are represented by 11 species, which can be divided into 2 main groups: semi-woody shrubs (Ch suffr) and herbaceous hemicryptophytes (Ch herb). Semi-woody shrubs include 5 species, all of which belong to the typical shrub form (Ch suffr caesp). Herbaceous hemicryptophytes are represented by 6 species (Ch herb). Within this group, there are 4 species with a creeping form (Ch herb rept) and 2 species with a bushy form (Ch herb caesp).).

Scandentophytes, or the life form of vines and climbers, are represented in the flora of Konjuh Mountain by 2 taxa, one of which belongs to scandentophytes with woody stem (S lig), and the other is a perennial scandentophyte with 1 taxon as well.

The analysis of the areal spectrum led to the conclusion that the most abundant presence of species is from the Euroasiatic areal type (EAz) with 39 taxa, or 35.77%. This high representation of Euroasiatic plant species can be explained by the broad ecological valence of these plants, allowing them to inhabit nearly all types of vegetation.

A significant number of species also belong to the European-West Asian areal group (EAz/EAz (W)) with 19 taxa, or 17.43%. The distribution of these species covers a substantial part of Europe, including its Atlantic region, and the western part of Asia, spanning from subarctic or boreal to submeridional or meridional zones. This subgroup includes typical European-West Asian species [2], [24,25]. A notable number of taxa on Konjuh Mountain also belong to the following areal groups: cosmopolitan areal type (Cosm), Central European areal type (Se), and Holarctic areal type (Hol).

Table 6. Structure of hemicryptophytes in the flora of Mount Konjuh

Life form	Nr.	%	Life form examined in details	Nr.	%
			Ch suffr caesp	5	45.45
Ch	11	100.00	Ch herb rept	4	36.36
			Ch herb caesp	2	18.18

Table 7. Structure of scandentophytes in the Flora of Konjuh Mountain

Life form	Nr.	%	Life form examined in details	Nr.	%
S	1	50.00	S lig	1	50.00
SH	1	50.00	SH herb	1	50.00

Table 8. Overview of the areal types and areal groups of the flora of Konjuh Mountain

Areal type (group)	**Total taxons**	
	Number	**%**
Euroasian (EAz)	39	35.77
European-Western AsianEAz/EAz(W))	19	17.43
Central European-Mediterranean-Pontic-South Siberian (EAz/Se-med-pont)	1	0.91
Central European-Mediterranean (EAz/Se-med)	3	2.75
Eurasian mountain (EAzP)	1	0.91
Central European (Se)	14	12.84
Boreal (Bor)	2	1.83
Holarctici (Hol)	13	11.92
Paleocholarctic-Paleotropic(Hol/Phol-ptrop)	1	0.91
Cosmopolitan (Cosm)	15	13.76
Mediteranian-Submediteranian (MSM)	1	0.91

4. CONCLUSION

During the research conducted within this study on Konjuh Mountain, the collection and determination of medicinal plants were carried out at 7 different locations. The research was conducted during various periods of vegetation and at varying altitudes, depending on the specific site. A total of 109 medicinal plants were identified during this research, some of which included endangered and endemic species.

Phytocoenological surveys were conducted in the field, and sample herbariums were created. The analysis of the flora of medicinal plants revealed the presence of 109 plant species. The plants were classified into families, with a total of 43 families represented. The most prominent families were Rosaceae with 14 representatives and Lamiaceae with 15 representatives. In addition to these families, the Asteraceae family (13), Fabaceae (8), and others were also notable. Biochemical and pharmacological structures of the identified medicinal plants were conducted and are presented in detail in the tables.

A phytogeographical analysis of the flora of medicinal plants revealed the presence of 11 areal types and groups: Euroasiatic (EAz), European-West Asian (EAz/EAz(W)), Central European-Mediterranean-Pontic-South Siberian (EAz/Se-med-pont), Central European-Mediterranean (EAz/Se-med), Euroasiatic mountain (EAzP), Central European (Se), Boreal (Bor), Holarctic (Hol), Paleoholarctic-paleotropical (Hol/Phol-ptrop), Cosmopolitan (Cosm), and Mediterranean-Submediterranean (MSM).

By analyzing the areal spectrum, it was observed that the core is composed of the Euroasiatic (EAz) type, encompassing 39 species of medicinal plants. The European-West Asian (EAz/EAz(W)) type is represented with slightly fewer species (19), while the Central European-Mediterranean-Pontic-South Siberian (EAz/Se-med-pont) type has one representative. The Central European-Mediterranean (EAz/Se-med) type is represented by three species, the Euroasiatic mountain (EAzP) type by one species, Central European (Se) by 14 species, Boreal (Bor) by two species, Holarctic (Hol) by 13 species, Paleoholarctic-paleotropical (Hol/Phol-ptrop) by one species, Cosmopolitan (Cosm) by 15 species, and Mediterranean-Submediterranean (MSM) by one species.

An analysis of the biological spectrum of the flora from all habitats indicated the presence of six primary life form types. Hemycryptophytes (H) dominated with 59 species, suggesting a moderate and cold climate in these areas. Phanerophytes (P) were the second most abundant group with 18 species, indicating the presence of forest communities. Chamaephytes (Ch) formed the third most abundant group with 11 species, characteristic of mountain and high-mountain meadow flora. Geophytes (G) were the fourth most abundant group with 10 species, indicating the presence of plant species capable of surviving adverse weather conditions by surviving underground. Therophytes (T) were the fifth most abundant group with 9 species, indicating the presence of open and warm habitat vegetation, such as meadows. Scandentophytes (S) formed the sixth group by abundance.

One of the goals of this study was to conduct a survey. A total of 50 respondents of varying ages participated in the survey, and they were from three municipalities (Kladanj, Živinice, and Banovići) that gravitate toward the area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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