

Ethnobotanical and statistical analysis of early spring medicinal plants in the Zagatala-Balakan region

Fatmakhanim K. Nabiyeva¹, Farah F. Amrahova, Gulnara Sh. Shiraliyeva, Samira F. Khudaverdiyeva, Ulkar M. Mammadova, Hasrat Kh. Mammadova, Turana A. Hasanli

Institute of Botany Public Legal Entity, Ministry of Science and Education of the Republic of Azerbaijan, A. Abbaszade str., entr. 99, AZ1073, Baku, Azerbaijan

Gulmira F. Rzayeva

Zagatala State Nature Reserve, Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, E. Agayev, str., 6, AZ6200, Zagatala, Azerbaijan

¹Corresponding author (e-mail: fatmakhanyim_58@mail.ru)

Abstract: This research was conducted in the Zagatala-Balakan region to investigate early spring medicinal plants and their traditional uses by the Avar and Tsakhur ethnic groups from an ethnobotanical perspective. Fieldwork was primarily carried out in Mazingara, Garakli, Katekh, and Chaygarishan villages, where plant specimens were collected, herbaria were prepared, and the GPS coordinates of the localities were recorded. A total of 23 medicinal plant species traditionally used by these communities were identified, which are mainly utilized in the treatment of skin, gastrointestinal, and respiratory diseases. Furthermore, 22 ethnobotanical interviews were conducted with local inhabitants across various age groups. To analyze the collected data statistically, Use Value (UV) and Relative Frequency of Citation (RFC) indices were employed. The results demonstrate the richness of local ethnomedicinal knowledge and its significance from both scientific and cultural perspectives. The systematic documentation and preservation of this knowledge are essential for its transmission to future generations.

Keywords: *avars, ethnobotanical indices, medicinal plants, relative frequency of citation, use value*

INTRODUCTION

Ethnobotany is a multidisciplinary scientific field that explores the interactions between plants and human societies, specifically focusing on the traditional uses of plants [Martin, 1995; Ansari et al., 2023; Malik et al., 2021; Ozturk et al., 2020, 2023, 2024 a,b,c; Mekonnen

et al., 2022; Singh, Saxena, 2026]. This field is of significant importance for documenting the use of medicinal plants by various communities along with the conservation of biodiversity [Cotton, 1996]. Since traditional botanical knowledge is often transmitted orally from generation to generation, preventing its loss remains a critical and timely scientific challenge [Pieroni, Vandebroek, 2007; Ishtiaq et al., 2024]. The Zagatala-Balakan is one of Azerbaijan's regions characterized by rich floristic diversity [Grossheim, 1948]. The Zagatala State Nature Reserve (ZSNR) is located in this area and stands out for its high biodiversity, where a large number of medicinal plants are naturally distributed. The flora of Azerbaijan is ethnobotanically diverse and has been widely evaluated by the local communities across different regions, being used for traditional purposes throughout the country [Ibadullayeva, 2013]. The Avar and Tsakhur ethnic communities living in Zagatala-Balakan region have been utilizing the local plants for various purposes over years. However, information regarding their ethnobotanical characteristics especially those which grow during the early spring. An evaluation of these plants by local communities has not been studied much.

MATERIALS AND METHODS

Study area. It is located on the southern slopes of the Greater Caucasus range within the Ganikh-Ayrichay valley; bordered by Georgia to the south, Dagestan (Russian Federation) to the north, and Balakan and Gakh districts to the west and east. The relief is predominantly mountainous in the northeastern parts of the district, while plains prevail in the southern and southwestern regions. The complex topography and the climatic condition have lead to the development of a rich floristic diversity. The Zagatala State Nature Reserve (ZSNR) has been established in 1929 and covers an area of 47,349 hectares. The landscape is characterized by mountains and highlands intersected by deep valleys and rocky riverbanks. The sharp-peaked northern cliffs remain under snow cover for most of the year, while the dome-shaped mountains in the southern part are covered with alpine meadows. The lower and middle

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mountain belts (800–2200 m) are covered with beech (*Fagus* L.), hornbeam (*Carpinus* L.), and oak (*Quercus* L.) forests. As elevation increases, these are replaced by subalpine woodlands, followed by subalpine meadows (up to 2400 m), alpine meadows (up to 3200 m) and finally, subnival and nival belts. The region is traversed by the high-discharge Mazimchay, Balakanchay and Katekhchay rivers, which originate in the Greater Caucasus. The specimens were collected from the areas located as: 41.770730 N, 46.372110 E, 41.770010 N, 46.370990 E, 41.770500 N, 46.371740 E, 41.676350 N, 46.465600 E, 41.770010 N, 46.465600 E in ZNSR.

Field work and sample collection. Field research was conducted in March 2026 across Mazimgara, Garakli, Katekh and Chaygarishan areas of ZNSR. The plant species found in the early spring period were recorded, the photographs taken and GPS coordinates for all localities recorded and herbarium materials were prepared (Fig. 1). A semi-structured interview method [Martin, 2014] was employed to record the ethnobotanical data from local population.

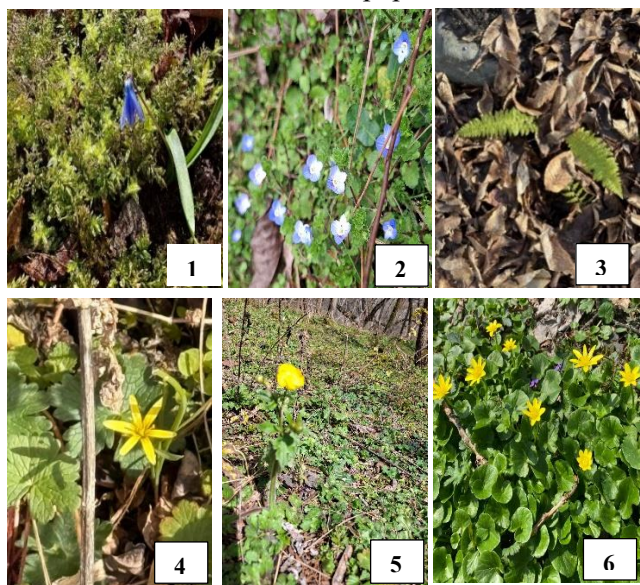


Figure 1. GPS coordinates and locality data of the studied sites: 1 - *Scilla sibirica* Andrews; 2 - *Veronica macrocarpa* Vahl; 3 - *Dryopteris wallichiana* subsp. *wallichiana*; 4 - *Gagea lutea* (L.) Ker Gawl.; 5 - *Ranunculus ficarioides* Bory & Chaub.; 6 - *R. ficaria* L.

Quantitative ethnobotanical analysis. The traditional botanical knowledge of the informants was systematically documented, providing details on the local names of medicinal plants, their intended uses, and the specific disease categories they are applied

for treatment [Ozturk et al. 2023; 2024 a, b, c.]. Both qualitative as well as quantitative evaluations were used and indices like “Use Value (UV)” and the “Relative Frequency of Citation (RFC)” applied. These indicators allowed an assessment of the utilization intensity of plant species by local communities, their frequency of citation, and their level of association with specific therapeutic purposes. The Relative Frequency of Citation (RFC) index was calculated to determine the frequency of which each plant species as mentioned by the informants and RFC was calculated according to the following formula:

$$RFC = FC / N$$

FC (Frequency of Citation) is the number of informants who independently mentioned the use of a specific species, N represents the total number of informants (N=22) participating in the study. The Use Value (UV) index was applied to determine the relative importance of each plant species based on its use frequency among the informants. This index indicates the average number of uses for a specific plant as reported by each respondent. The UV was calculated using the following formula:

$$UV = \sum \frac{U_i}{N}$$

where U_i is the total number of distinct uses mentioned by all informants for a given species, N is the total number of informants involved in the study.

RESULTS AND DISCUSSION

Our studies lead to a documentation of many medicinal plant species. According to the results, *Cardamine uliginosa* M. Bieb., *Caltha polypetala* Hochst. ex Lorent., *Rumex alpinus* L., and *Potentilla erecta* (L.) Raeusch. were found to be widely distributed throughout the study area. Furthermore, species such as *Colchicum raddeanum* (Alboff) Pobed., *Corylus avellana* L., *Viola tricolor* L., *Amygdalus communis* L., *Senecio vernalis* Waldst. & Kit, *Tussilago farfara* L. and *Lamium amplexicaule* L. were recorded during the early spring season. The phenological observations revealed that the flowering phase for certain species initiates as early as January–February; but more than 35 species start flowering during March and April, while the remaining bloom during April–May period. The data indicates that the region possesses high biodiversity in

terms of its early spring flora and ethnobotanically a total of 23 medicinal plant species were documented as being utilized by the local communities for various therapeutic purposes.

The flowering of approximately 37 plant species was recorded within the ZSNR in Zagatala–Balakan region during the early spring period. Ethnobotanical surveys revealed that 23 of these species possess significant ethnobotanical value. Early phenological observations indicated that certain species initiate flowering in January and February, while the majority bloom between March and April. The remaining species survive in their vegetative and generative phases during April–May; thereby confirming a high biological diversity of the region's early spring flora. In all 23 medicinal plant species are utilized by the avar and sakhr communities. These are primarily employed in the treatment of digestive, respiratory, and dermatological diseases [Malik et al. 2021]. Most of these plants serve dual purposes as both medicine and food. Specifically, *Foeniculum vulgare* Mill., *Anethum graveolens* L., *Allium ursinum* L., *Malva sylvestris* L. and *Ficus carica* L. exhibited high frequencies of use. Among plants used strictly for medicinal purposes, *Hypericum perforatum* L., *Plantago major* L. and *Sambucus nigra* L. were found to be predominant.

Quantitative analysis using Use Value (UV) and Relative Frequency of Citation (RFC) indices demonstrate a significant variation in utilization

intensity among the species (Table 1). The highest values were observed for *Anethum graveolens*, *Foeniculum vulgare* Mill. and *Castanea sativa* Mill., whereas *Rosa canina* L., *Tilia cordata* Mill., *Rumex acetosa* L. and *Mespilus germanica* L. showed moderate use values. The species like *Chelidonium majus* L., *Quercus robur* L. and *Potentilla erecta* (L.) Raeusch., have shown a lower utilization intensity with limited ethnobotanical knowledge. Furthermore, the findings confirm that traditional botanical knowledge remains actively preserved and is transmitted across generations within the local community.

Most of the identified species are medicinal plants with abundant reserves. Under mild weather conditions, some species begin flowering in January–February. Generally, early spring plants start flowering in March, whereas late-flowering species bloom in April–May. However, due to the mild weather conditions in February of this year, premature flowering was observed in several species (Table 2). During the expedition a total of 37 species belonging to 27 genera and 21 families were collected from the study area. Herbarium specimens were identified and analyzed based on their life forms (Fig. 2). These early spring plants are distributed across forests, meadow ecosystems, fields, and pastures. They form temporary clusters characterized by the shifting of phenological phases and seasonal aspects.

Life forms of plants. The analysis of the flora according to life forms is of great importance for studying the

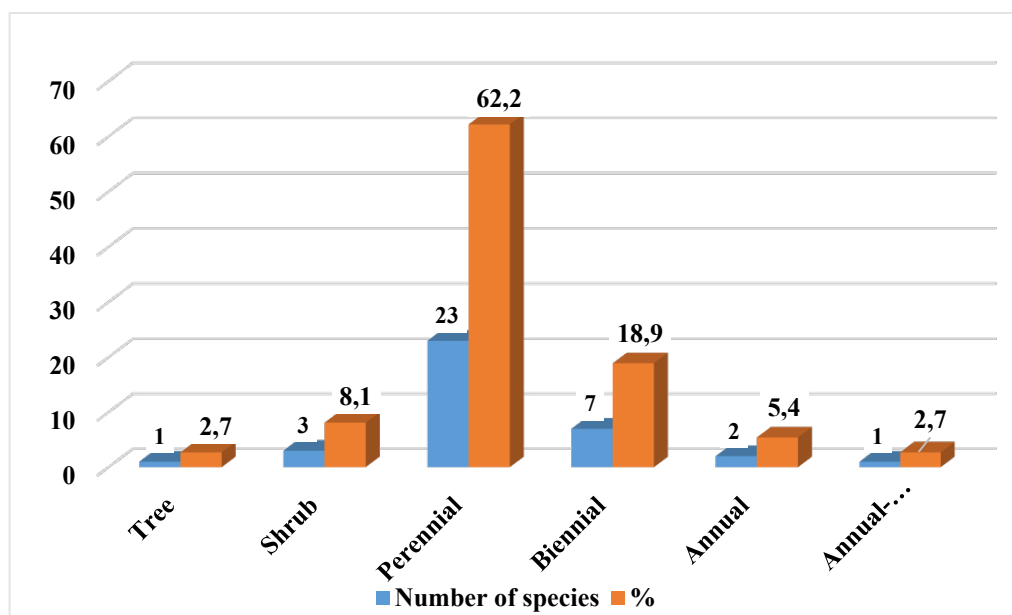


Figure 2. Distribution of life forms among the early spring plant species.

Table 1. Values of RFC and UV indices for the ethnobotanical flora of the Zagatala-Balakan region.

Scientific Name	Use Category	Number of Informants	ΣU_i	UV	RFC
<i>Hypericum perforatum</i> L.	Medicinal	18	9	0.41	0.82
<i>Plantago major</i> L.	Medicinal	13	6	0.27	0.59
<i>Rhus coriaria</i> L.	Medicinal, food	11	4	0.18	0.50
<i>Quercus iberica</i> L.	Medicinal	5	4	0.18	0.23
<i>Viola odorata</i> L.	Medicinal, food	6	6	0.27	0.27
<i>Mespilus germanica</i> L.	Medicinal, food	11	7	0.32	0.50
<i>Rosa canina</i> L.	Medicinal, food	20	11	0.50	0.91
<i>Stellaria media</i> (L.) Vill.	Medicinal, food	14	5	0.23	0.64
<i>Anethum graveolens</i> L.	Medicinal, food	22	21	0.95	1.00
<i>Foeniculum vulgare</i> Mill.	Medicinal, food	22	21	0.95	1.00
<i>Chelidonium majus</i> L.	Medicinal	4	4	0.18	0.18
<i>Ficus carica</i> L.	Medicinal, food	21	8	0.36	0.95
<i>Potentilla erecta</i> (L.) Raeusch.	Medicinal	5	3	0.14	0.23
<i>Malva sylvestris</i> L.	Medicinal, food	9	5	0.23	0.91
<i>Sambucus nigra</i> L.	Medicinal	8	4	0.18	0.36
<i>Tilia cordata</i> Mill.	Medicinal	15	9	0.41	0.68
<i>Arctium lappa</i> L.	Medicinal	11	7	0.32	0.50
<i>Rumex acetosa</i> L.	Medicinal, food	13	8	0.36	0.59
<i>Castanea sativa</i> Mill.	Medicinal, food	22	21	0.95	1.00
<i>Rosmarinus officinalis</i> L.	Medicinal	16	9	0.41	0.73
<i>Carum carvi</i> L.	Medicinal, food	20	7	0.32	0.91
<i>Inula helenium</i> L.	Medicinal	19	11	0.50	0.86
<i>Allium ursinum</i> L.	Medicinal, food	21	14	0.64	0.95

Table 2. Demographic profile and socio-economic characteristics of the informants.

Informants (n=22)	Age group (55-72)	Occupation	Education Level
Male 6	55-64	driver, farmer, forester, ranger huntsman	secondary
Female 16	56-72	retiree, housewife, vendor, teacher, cook	higher, secondary, incomplete secondary

characteristics of phytocenoses; the results are presented in Figure 2.

Tree: *Celtis caucasica* Willd. Shrubs: *Cornus mas* L., *Berberis integerrima* Bunge, *Prunus spinosa* L., perennial – *Lathraea squamaria* L., *Dryopteris wallichiana* subsp. *wallichiana*, *Viola odorata* L., *V. tricolor* L., *Viscum album* L., *Ficaria vernalis* L., *Calthia polypetal* Hochst. *Ranunculus ficarioides* Bory & Chaub., *R. ficaria* L., *Nonea lutea* (Desr.) DC., *Corydalis caucasica* DC., *C. cava* subsp.

marschalliana, *Anemone caucasica* (Rupr.) Holub. *Chelidonium majus* L., *Scilla siberica* Andrews, *Primula vulgaris* Huds., *Rumex alpinus* L., *Potentilla erecta* (L.) Raeusch., *Colchicum raddeanum* (Regel) K. Perss., *Tussilago farfara* L., *Veronica macrocarpa* Vahl, *Allium paradoxum* (M.Bieb.) G.Don, *Allium ursinum* L., biennial – *Euphorbia helioscopia* L., *Valeriana rimosa* (Bastard) Christenh. & Byng, *Valerianella uncinata* (M. Bieb.) Dufr., *V. dentata* (L.) All, *V. carinata*, *Cardamine uliginosa* L., *Holosteum glutinosum* (M. Bieb.) Fisch. et

C. A. Mey., annual – *Senecio vernalis* Waldst. & Kit., *Barbarea arcuata*.

These species serve as highly effective ornamental and medicinal plants, representing a significant natural resource for our republic. The rational utilization and conservation of this resource remain a matter of great relevance. It was noted that the local population extensively utilizes various beneficial plants from the regional flora as fodder, food, medicine, essential oils, vitamins, and for ornamental purposes [Ansari et al. 2023]. Many of these plant species possess abundant natural reserves. Ethnobotanical surveys conducted among local inhabitants revealed that species such as stinging nettle (*Urtica dioica* L.), mountain fennel (*Foeniculum vulgare* Mill.), and wild garlic (*Allium ursinum* L.) are widely used in traditional nutrition and

folk medicine. The fresh leaves of these plants are used in the preparation of traditional fermented products and various salads (Fig. 3, 4).

Ethnomedicinal beliefs and therapeutic applications. During the interviews, informants described the species as a “remedy for numerous ailments” and reported its widespread use in traditional medicine. According to local knowledge, the plant is believed to support kidney function and promote urinary tract health.

A notable element of local folklore indicates that bears consume this plant immediately after emerging from winter hibernation in order to cleanse their digestive system and purify their blood. This traditional belief is closely associated with the vernacular name of the species and further supports its perceived detoxifying properties within the local ethnomedicinal tradition.



Figure 3. Traditional market presentation of wild *Allium ursinum* L. (wild garlic/ramsons) used in local ethnobotany.

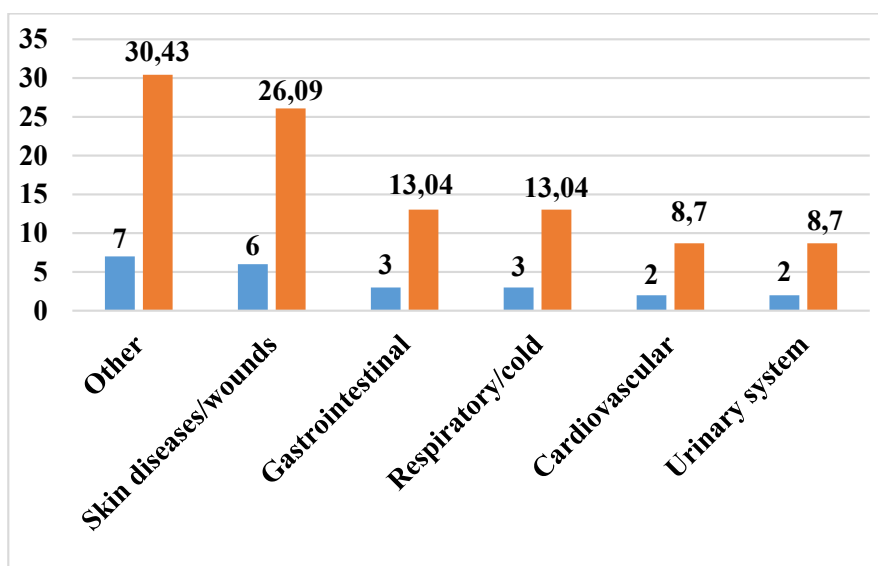


Figure 4. Traditional market presentation of wild *Allium ursinum* L. (wild garlic/ramsons) used in local ethnobotany.

Ethnobotanical surveys and statistical analysis. A total of 22 informants, representing various age groups, were selected for the study based on purposive sampling [Tongco, 2007; Malik et al. 2021] (Table 2).

The medicinal plants were categorized into several primary health domains based on their traditional therapeutic applications: gastrointestinal: *Anethum graveolens*, *Foeniculum vulgare*, *Carum carvi*, *Rhus coriaria*, *Ficus carica*, *Potentilla erecta*, respiratory : *Tilia cordata*, *Viola odorata*, *Inula helenium*, *Sambucus nigra*, *Malva sylvestris*, skin diseases: *Hypericum perforatum*, *Plantago major*, *Chelidonium majus*, *Arctium lappa*, *Stellaria media*, cardiovascular: *Rosa canina*, *Rosmarinus officinalis*, *Allium ursinum*, *Castanea sativa*, urinary: *Rumex acetosa*, *Quercus iberica*, *Mespilus germanica*.

CONCLUSION

During the expedition period, 37 early spring plant species belonging to 27 genera and 21 families were collected from the study areas. Herbarium specimens were identified and analyzed according to their life forms, and the GPS coordinates of the observed localities were accurately recorded.

The survey revealed that 23 plant species are traditionally utilized by the Avar and Sakhr communities for medicinal and nutritional purposes. A total of 22 ethnobotanical interviews were conducted among local inhabitants representing different age groups. Statistical and analytical processing of the collected data involved the application of ethnobotanical indices, including Use Value (UV) and Relative Frequency of Citation (RFC), in order to quantitatively and qualitatively evaluate traditional ethnobotanical knowledge. The analysis demonstrated that *Foeniculum vulgare*, *Anethum graveolens*, *Castanea sativa*, and *Ficus carica* exhibited relatively high RFC and UV values. In contrast, certain species showed comparatively low UV and RFC indices, indicating a decline in their role within traditional knowledge systems and suggesting a potential risk of disappearance in the future. This trend was particularly evident in less frequently used species such as *Chelidonium majus* and *Potentilla erecta*. These indices provide valuable insight into the intensity of plant use by local communities, the frequency of citation, and the degree of association with specific therapeutic applications.

Overall, the findings indicate that Zagatala–Balakan region possesses a rich ethnobotanical heritage, and the documentation of this knowledge is of considerable

importance for both biodiversity conservation and the preservation of cultural heritage. Future studies are recommended to focus on the pharmacological validation of traditional knowledge and the mechanisms underlying its intergenerational transmission.

The plant resources of Zagatala–Balakan region possess significant ethnobotanical potential, and their sustainable utilization may substantially contribute to regional socio-economic development, biodiversity conservation, and the preservation of traditional knowledge. Therefore, it is essential to monitor the regional flora under both natural and anthropogenic influences, systematize and clarify the floristic composition of the area, determine the conservation status of rare and endangered species, preserve their genetic resources, and conduct comprehensive investigations into their arealogical, floristic-taxonomic, phytogeographical, ecological, and ethnobotanical characteristics in order to better understand their current status and conservation priorities.

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Zaqatala-Balakən bölgəsində erkən yaz mövsümündə rast gəlinən dərman bitkilərinin etnobotaniki və statistik təhlili

Fatmaxanım X. Nəbiyeva, Fərah F. Əmrahova, Gülnarə Ş. Şirəliyeva, Samirə F. Xudaverdiyeva, Ülkər M. Məmmədova, Həsərət X. Məmmədova, Turanə A. Həsənli
Botanika İnstitutu Publik Hüquqi Şəxs, Azərbaycan Respublikası Elm və Təhsil Nazirliyi, A. Abbaszadə küç., giriş 99, AZ1073, Azərbaycan

Gülmira F. Rzayeva
Zaqatala Dövlət Təbiət Qoruğu, Azərbaycan Respublikası Ekologiya və Təbii Sərvətlər Nazirliyi, E. Ağayev küç., 6, AZ6200, Zaqatala, Azərbaycan

Bu məqalə Zaqatala-Balakən bölgəsində erkən yaz bitkilərini, onların Avar və Saxur etnik qrupları tərəfindən ənənəvi istifadəsini etnobotaniki baxımdan araşdırmaq məqsədilə aparılmışdır. Sahə işləri əsasən Mazıngara, Qaraqılı, Katex və Çayqarışan kəndlərində həyata keçirilmiş; ilk bahar bitkiləri toplanmış, herbarium nümunələri hazırlanmış və yayılma məntəqələrinin GPS koordinatları qeydə alınmışdır. Həmin icmalar tərəfindən ənənəvi olaraq istifadə edilən ümumilikdə 23 dərman bitkisi müəyyən edilmişdir. Bitkilər əsasən dəri, mədə-bağırsaq və tənəffüs yolları xəstəliklərinin müalicəsində tətbiq olunur. Bundan əlavə, müxtəlif yaş qruplarına mənsub yerli əhali arasında 22 etnobotaniki müsahibə aparılmışdır. Toplanmış məlumatların statistik təhlili üçün İstifadə Dəyəri (UV) və Sitatların Nisbi Tezliyi (RFC) indekslərindən istifadə edilmişdir. Öldə edilən nəticələr yerli etnotibbi biliklərin zənginliyini, eyni zamanda elmi, həm də mədəni baxımdan əhəmiyyətini nümayiş etdirir. Bu biliklərin sistemli şəkildə qorunması və səndəşdirilməsi onların gələcək nəsillərə ötürülməsi üçün zəruri şərt hesab edilir.

Açar sözlər: avarlar, etnobotaniki indekslər, dərman bitkiləri, sitatların nisbi tezliyi, istifadə dəyəri

Этноботанический и статистический анализ ранневесенних лекарственных растений Закатало-Балаканского региона

Фатмаханым Х. Набиева, Фарах Ф. Амрахова, Гюль-нара Ш. Ширалиева, Самира Ф. Худавердиева, Улькер М. Мамедова, Хасрат Х. Мамедова, Турана А. Гасанли
Институт ботаники Публичное Юридическое Лицо, Министерство Науки и Образования Азербайджанской Республики, ул. А. Аббасзаде, подъезд 99, AZ1073, Баку, Азербайджан

Гюльмира Ф. Рзаева
Загатальский государственный природный заповедник, Министерство экологии и природных ресурсов Азербайджанской Республики, ул. Э. Агаева 6, AZ6200, Загатала, Азербайджан

Исследование проведено в Загатала-Балаканской зоне с целью изучения ранневесенних растений и их традиционного использования представителями аварской и цахурской этнических групп в этноботаническом аспекте. Полевые работы проводились преимущественно в сс Мазымгара, Гараклы, Катех и Чайгаришан, где осуществлялся сбор ранневесенних растений, подготовка гербарных образцов и регистрация GPS-координат мест произрастания. В общей сложности было идентифицировано 23 лекарственных растения, традиционно используемых этим населением. Растения применяются преимущественно при лечении кожных, желудочно-кишечных и респираторных заболеваний. Помимо этого, проведено 22 этноботанических интервью у местного населения различных возрастных групп среди. Для статистического анализа собранных данных использовались индексы Ценности Использования (UV) и Относительной Частоты Цитирования (RFC). Полученные результаты демонстрируют богатство местных этномедицинских знаний и их значимость как с научной, так и с культурной точки зрения. Систематическое сохранение и документирование этих знаний признаётся необходимым условием для их передачи будущим поколениям.

Ключевые слова: авары, этноботанические индексы, лекарственные растения, относительная частота цитирования, ценность использования