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RESEARCH ARTICLE

Ethnobotanical exploration of traditional medicinal plants among the rural inhabitants of district Muzaffarabad, Kashmir Himalayan Region

Syed Waseem Gillani[1], Mushtaq Ahmad[1]*, Muhammad Zafar[1], Muhammad Manzoor[1]*, Ghulam Mujtaba Shah[2]*, Hamayun Shaheen[3], Wajid Zaman[4], Shazia Sultana[5], Bibi Sadia[1] & Khaydarova Khilola Khishlatovna[6]

[1]Department of Plant Sciences, Quaid-i-Azam University, Islamabad 45320, Pakistan
[2]Department of Botany, Hazara University, Mansehra 21120, Pakistan
[3]Department of Botany, University of Azad Jammu & Kashmir, Muzafarabad 13100, Pakistan
[4]Department of Life Sciences, Yeungnam University 38541, South Korea
[5]College of Life Sciences, Neijiang Normal University Sichuan 641100, China
[6] Department of Sociology, National University of Uzbekistan, Tashkent 100174, Uzbekistan

*Email: mushtaq@qau.edu.pk, mmanzoor@bs.qau.edu.pk, gmujtabashah@hu.edu.pk

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Abstract

Indigenous knowledge provides insights into the therapeutic properties of medicinal plants used in local communities for basic healthcare. This research focuses on documenting the medical knowledge of rural communities that rely on medicinal plants in their traditional healthcare practices in the district of Muzaffarabad, Kashmir Himalayas. A field survey was carried out in 2022 and 2023 to collect data on wild medicinal plants. Informants were selected at random to learn about indigenous medical practices through semi-structured interviews and group discussions with 95 informants. The ethnomedicinal data were quantitatively analyzed using indices of use value (UV) and relative frequency citation (RFC). The study area documented 56 medicinal plants from 34 different families. Polygonaceae was the most dominant family, contributing 14.03% to medicinal plants, followed by Lamiaceae (10.52%) and Rosaceae (7.01%). Among medicinal plants, communities predominantly used herbs (64.91%) and leaves (29.09%) to treat several health problems. *Mentha longifolia* had the highest reported use value (1.71), and *Bergenia ciliata* had the highest recorded RFC value (0.72). Rural inhabitants continue to rely on wild medicinal plants as their primary source of medication. The transmission of indigenous knowledge to descendants is steadily declining and is primarily limited to healthcare practitioners and the elderly. These communities have kept important indigenous knowledge, which must be preserved for sustainable resource management and conservation. A more extensive field exploration is required to discover all of the indigenous knowledge in rural areas of Kashmir.

Keywords

conservation; ethnobotany; medicinal; rural communities; traditional knowledge

Introduction

Ethnobotany and traditional knowledge explorations have frequently proven relevant and demonstrating. The emphasis has frequently been on developing a thorough inventory that includes information about plants, indigenous names, and the local benefits associated with them (1). Traditional medicine is used to prevent, cure, and diagnose physical and mental illnesses, as well as to preserve overall health, and it draws on a

wide range of concepts, techniques, and beliefs from various cultural backgrounds (2). In addition, traditional knowledge continues to decline on a global scale. In the age of globalization, it is critical to record traditional knowledge to defend the rights of local communities (3). Recent ethnobotanical research helps to preserve traditional knowledge about medicinal plants (4). The vast biodiversity of natural plant resources in numerous regions aids in the identification of innovative drugs. This provides rapid, cost-effective, and diverse local healthcare options (5). A vital facet of preserving traditional plant knowledge is identifying plant classifications and identifying individuals within a society who hold them, particularly in the context of therapeutic herb use. As a result, the importance of interactions between humans and plants in the preservation of biodiversity has grown. This has resulted in the rise of quantitative methodologies that concentrate on many factors that influence traditional knowledge (6, 7).

Despite the advances in modern healthcare, traditional medications continue to play an important but sometimes underappreciated role in solving today's healthcare concerns (6). There is an increasing need for services related to traditional medicine, and herbal traditions are widespread throughout the world. When compared to synthetic pharmaceuticals, folk treatments are of higher quality, safer, more effective, and biocompatible. This has led to an increase in interest in them (8). Plants have been used by humans for thousands of years for a wide range of reasons. Over time, they have developed a wide range of techniques for the treatment of different diseases (9). Exploring the various relationships and interactions between humans and plants, ethnobotany is a thriving interdisciplinary scientific field (10). The ancient system of herbal treatments, which has its origins in the use of plants by native tribes, has been passed down from elders to younger generations over many decades (11). The traditional medical system uses whole plants or parts of plants as decoctions, infusions, and in powdered form (12-14). Pakistan is located in Asia, and about 6000 species have been recorded in the region. Notably, 60% of the population, particularly in small communities, uses 12% of the reported flora species for medicinal purposes (15). Approximately 80% of Pakistan's native flora are found only in the northern and western Himalayan region (16).

The Himalayan region is considered an important plant diversity hub, featuring a broad range of medicinal and food plants (17-24). The native communities within this specific geographic area, in particular, rely substantially on non-timber forest resources. Their sustenance is obtained from plant-based ingredients, which serve an important role in the preservation of traditional healthcare techniques (25, 26). Plants play an important part in the survival of indigenous tribes living in the Himalayan Mountains, providing key supplies of nourishment and healing through their dual roles as food and medicinal resources (27, 28). The increasing globalization and modernization processes have generated discussion among contemporary ethno biologists about traditional knowledge. According to research, the major cultural shifts that have accompanied these achievements have resulted in a reduction, and in some cases, the entire extinction, of traditional knowledge (29).

It is critical to record traditional knowledge to preserve and facilitate future studies on the safety and efficacy of medicinal plants. This material helps to validate the traditional use of certain plants through study (30). Traditional medicinal wisdom is primarily passed down through verbal communication, with elderly individuals and hakims playing an important role in this process (31). Urbanization advances in healthcare, and generational disparities all contribute to rising concerns about knowledge loss (32, 33). Preserving culture, progressing pharmacological research, and managing natural resources all depend on the documentation of traditional indigenous healing knowledge. The traditional medicinal uses of plants by local communities in various parts of Azad Jammu and Kashmir have been recorded by numerous studies (34-42). This research looked into how this knowledge may be used practically for local healthcare in the rural areas of Muzaffarabad. Few studies have been conducted in the Muzaffarabad district to document local communities' traditional knowledge about fundamental healthcare practices (43-46). The primary objective of this research was to document the traditional knowledge owned by local communities, with a particular emphasis on emphasizing the need to share this indigenous knowledge as well as preserving the community's traditional practices in rural areas of Muzaffarabad, Kashmir Himalayas.

Materials and Methods

The current study has been conducted in nine different villages of rural areas of Muzaffarabad district, Azad Jammu & Kashmir. These villages are Narri Syedan, Narri Gujran, Khoajy Trar, Pathyali, Pir Chanasi, Pir Hasimaaar, Jabsar, Magri, and Thora (Fig. 1). Azad Jammu and Kashmir (AJK) is described by the geographic coordinates 33°54′-34° 44 North latitude and 73° 31-74° 50 East longitude (18, 47, 48). The area is dominated by steep mountains, deep ravines, and rocky landscapes with undulating topography. It is bounded to the south by the Punjab Province's Gujrat district, to the east by the occupied Jammu and Kashmir Region, and to the west by the districts of Kahota, Murree Region, and KPK (18). The climate in the area ranges from subtropical to moderately humid. During the winter months, high temperatures typically range between 25 and 34 degrees Celsius, while low temperatures typically range between 4 and 10 degrees Celsius (49-51). In addition to Urdu, the people of Azad Jammu and Kashmir come from many cultural origins and converse in a variety of regional or local languages, including Kashmiri, Gojri, Pahari, and Hindko (18).

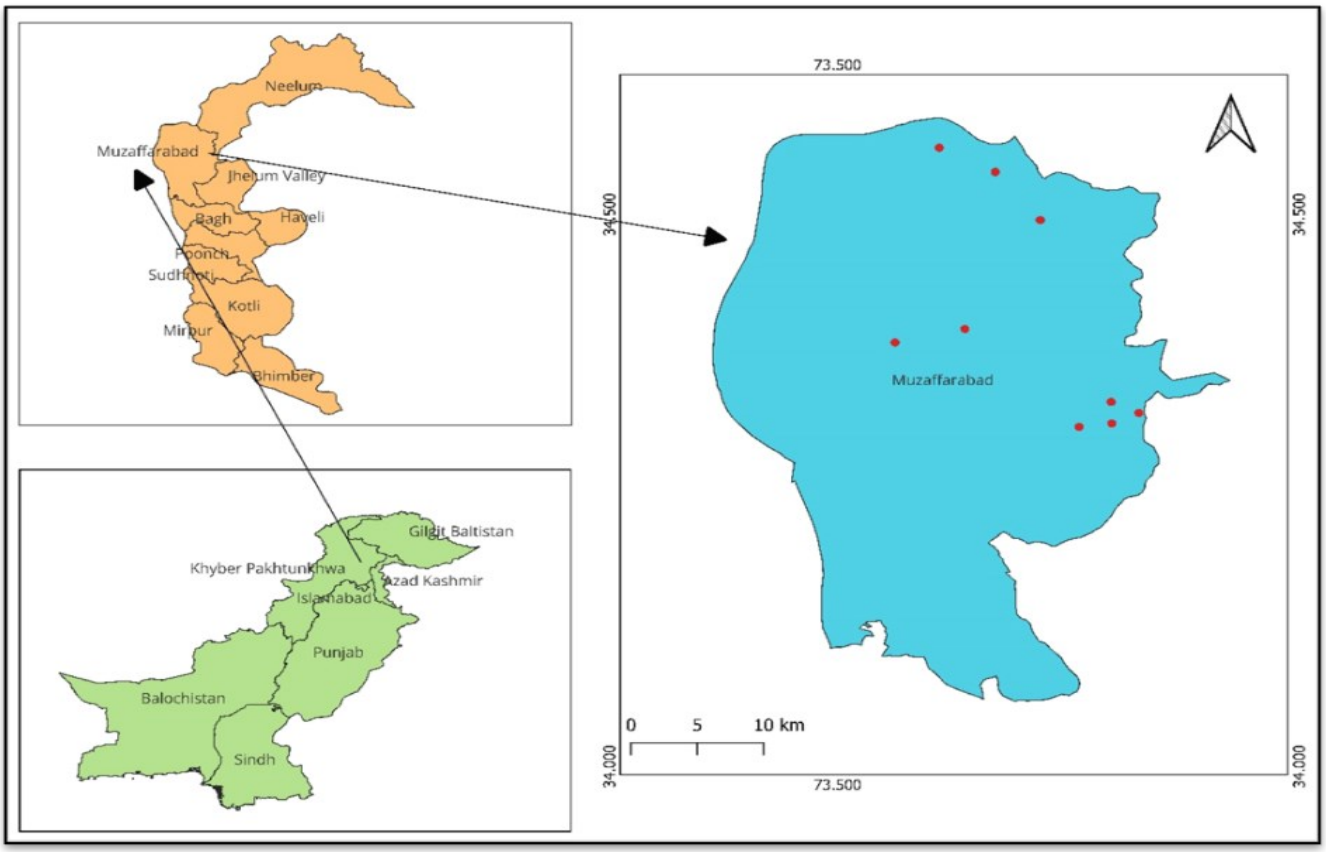

Fig. 1. Study area map.

Data collection

Ethnobotanical data was collected in nine different villages in the Muzaffarabad area using a questionnaire and group discussion technique (Table 1). In total, 95 people took part in the survey as informants. The majority of these were above the age of 35, including 72 males, and 23 women. Before collecting ethnobotanical data, each participant was given extensive information about the research's goal and objectives. This was done to ensure their participation in following ethical rules (52). To improve communication throughout the field survey, group discussions were conducted in the inhabitants' native languages, which include Pahri, Gojri, and Hindko.

Table 1. Demographic information of study area.

Demographic Features	Number of Persons	Percentage
Gender		
Male	72	75.78
Female	23	24.21
Informant category		
Indigenous people	86	90.52
Hakims	9	7.36
Age of Informants		
25-40 years	14	14.73
41-55 years	26	27.36
56-70 years	34	35.78
71 and above	21	22.10
Educational background		
Illiterate	46	48.42
Elementary School level	18	18.94
Secondary School level	11	11.57
High School level	13	13.68
Higher education	7	7.36
Marital Status		
Married	76	80
Unmarried	13	13.68
Widowed	6	6.31
Employment Status		
Employed	22	23.15
Farmer	49	51.57
Unemployed	14	14.73

Ethnographic and socio-economic variables

Indigenous communities' financial status varied significantly, although they tended to be modest overall. The area displayed a heterogeneous ethnography that included a range of ethnic groups, including the Chaudhary, Syed, Raja, Maliks, Mughals, Khwaja, Abbasi, Awan, and Butt (18, 48). The region has very few sources of income other than forestry, agriculture, and a few other occupations. A significant number of people live in rural areas where they mostly rely on farming, harvesting medicinal plants, and rearing livestock to meet their needs. The agricultural economies of these regions, where rice, potatoes, maize, and wheat are the main crops grown, are significantly influenced by precipitation (34). Tourism has played an important role in improving the local population's economic and social well-being by creating employment opportunities (42, 53).

Plant collection and identification

Several field trips were conducted in 2022 and 2023 to get plant specimens and traditional ethnomedical knowledge. Throughout the collection procedure, every plant was given a proper label and recognized using its local name. Plant sample pressing, drying, and mounting on herbarium sheets were done with precision. Using the "Flora of Pakistan" as a guide and following the instructions provided by Stewart (54), in addition to using several internet sites, made it easier to identify these specimens. Every plant name was checked by looking up the information in the World Online Flora.

Quantitative data analysis

The first step was compiling a comprehensive list of plants for further evaluation. This included information on the different plants used in phytoremediation as well as any potential therapeutic benefits. Then, specific indices were calculated:

Use value (UV)

Use value (UV) is the local identification and citation of plants to assess their value within a certain area. The use value is calculated using a specific methodology (46, 55). It was calculated by the following method:

$$UV = \sum Ui/N$$

Where 'N' indicates the overall number of informants that were involved in the study, whereas 'Ui' stands for the use of reports about that particular species.

Frequency of citation (FC)

The use citation frequency (FC) was used to identify the plant species most widely used by the local community in the region which coincides with the observations reported by Tardo and Pardo-de-Santayana (56).

$$FC = \frac{\text{Number of times a particular species was mentioned}}{\text{total no of times that all species were mentioned}} \times 100$$

Relative frequency citation (RFC)

It highlights the significance of each species and is determined using the method developed by Tardio and Pardo-de-Santayana (56), which is based on the frequency of citation (FC) and the number of informants who mention the use of a certain species.

The FC value is calculated by dividing the total number of survey participants (N) by the disease categories. Its value varies from "0" to "1".

$$RFC = FC/N$$

Results and Discussion

Demography of the Informants

The demographic features of participants were documented and studied during group discussions and personal interactions. The interviews included 95 individuals, of whom 23 women and 72 men took part. The majority of informants (75.78%) were male due to restrictions on women's interactions with strangers and external community members in the research location. Women are often restricted from attending markets, cities, or ceremonial sites, resulting in a lower level of female involvement in the current study. According to research, those who are older have a better understanding of the healing powers of plants. Those with excellent educational backgrounds are generally unaware of the traditional use of medicinal plants. A large proportion of survey respondents believe that the transmission of ancestral wisdom from one generation to the next is inefficient, owing to a lack of interest among younger people in learning and implementing such knowledge. The introduction of modern healthcare services is mostly to blame for the decline in traditional knowledge among Muzaffarabad's rural population. Our findings are consistent with previous studies in the same region, demonstrating a consistency in plant use among ethnically different communities in Kashmir with diverse cultural backgrounds (46, 48).

Medicinal plant diversity

A survey in Muzaffarabad revealed 57 plant species classified into 49 genera and 34 plant families (Fig. 2). Herbaceous plants were the most common, accounting for 64.91% of the identified ethnobotanical species in the study area. Shrubs and trees accounted for 14.04% each, while ferns and climbers accounted for 5.26% and 1.75%, respectively (Fig. 3). The Polygonaceae family was the most common, with 8 species, followed by the Lamiaceae family, which had 6 species. Our finding of medicinal plant diversity is consistent with prior studies conducted in the comparable vegetation zones of AJ&K and Pakistan, which feature varying numbers of plant species, according to studies (35, 41, 46, 57). Furthermore, the study found that older people were more aware of the health advantages of plants than younger individuals. Furthermore, when literacy rates climbed, respondents' ethno-medical knowledge decreased, as shown in Table 1. This tendency may be linked to educated people preferring modern healthcare systems over traditional ones, which is consistent with prior research findings (15, 57, 58).

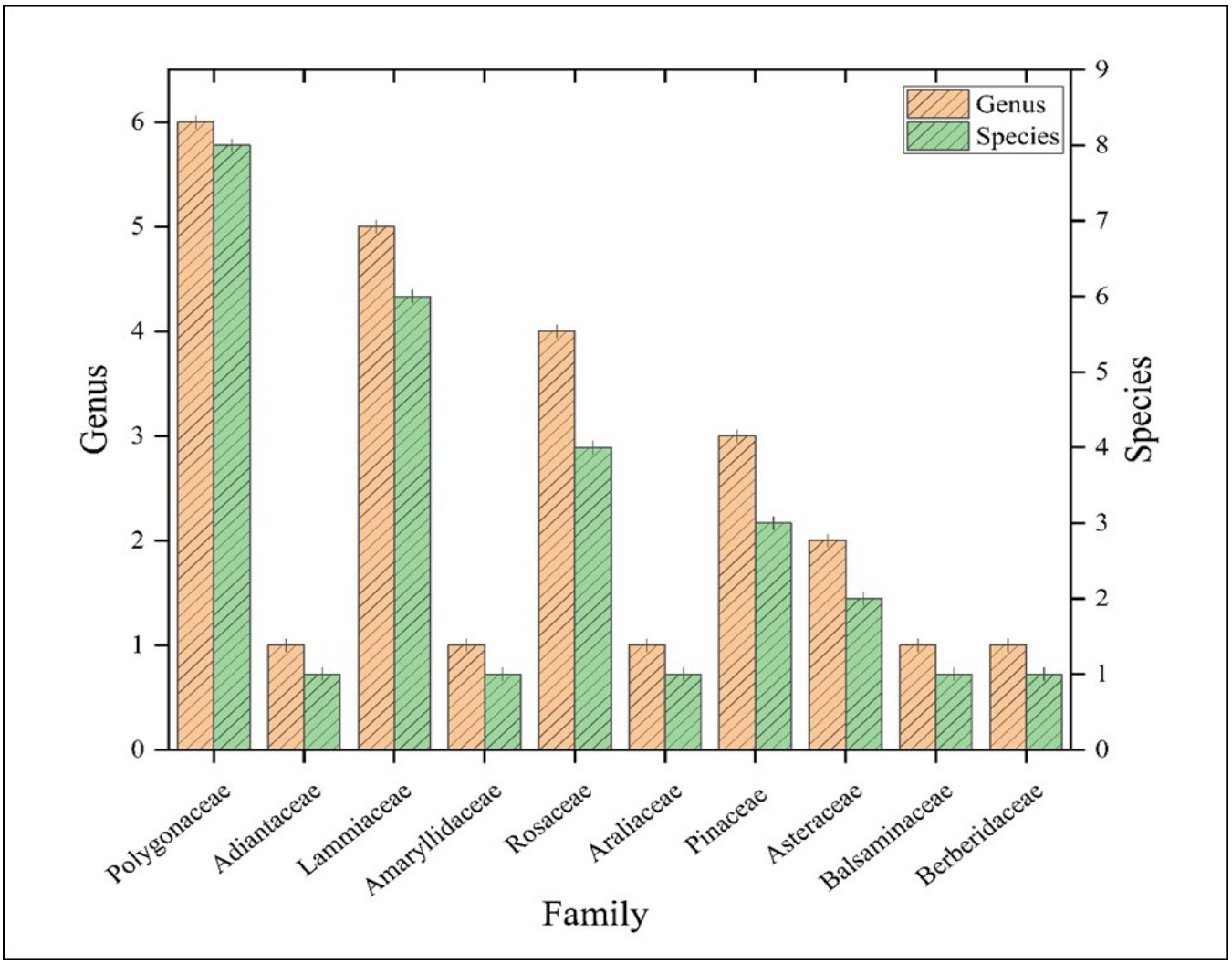

Fig. 2. Proportion of dominated Plant Families and Genera recorded from the study area.

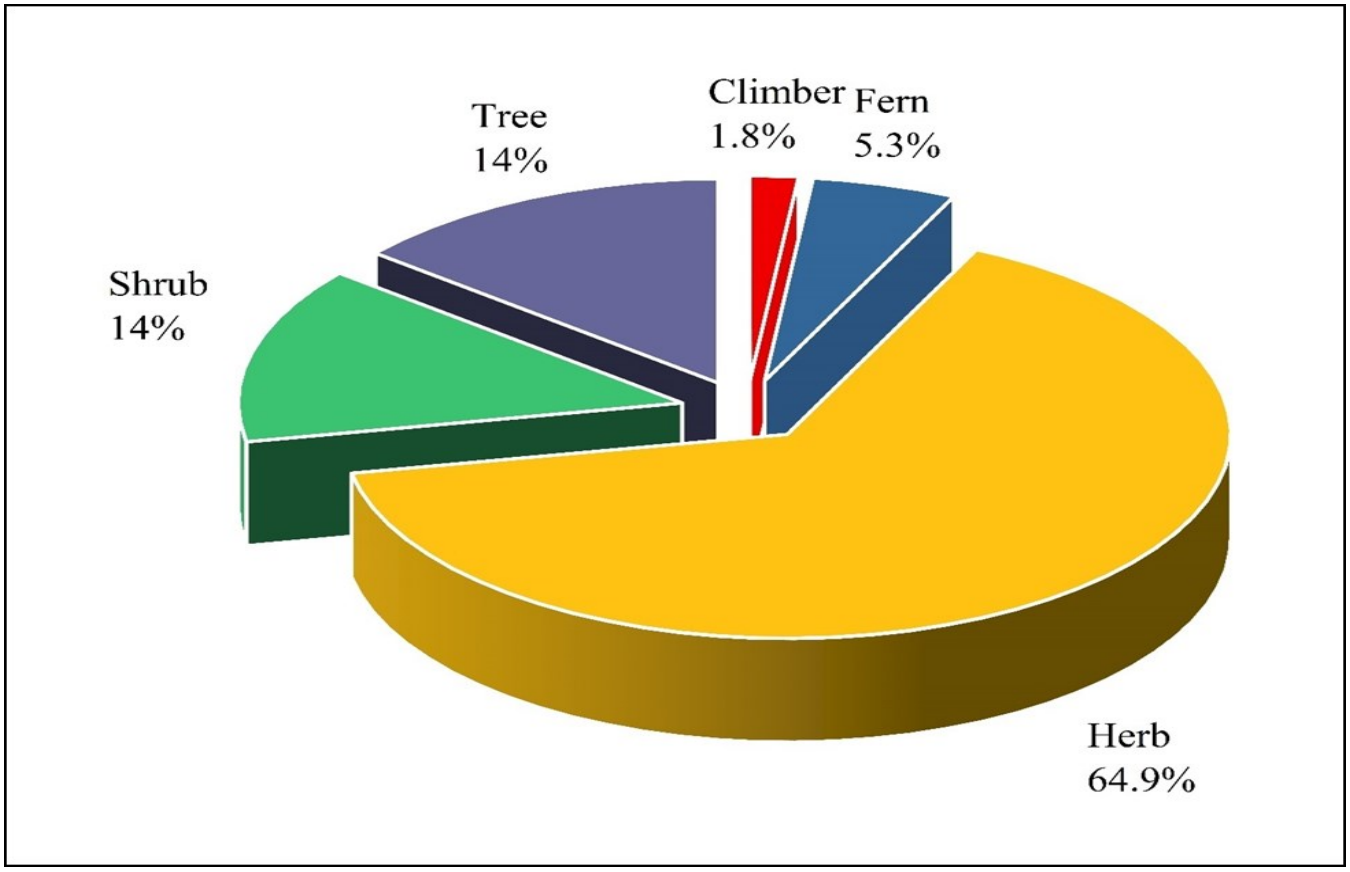

Fig. 3. Classification of medicinal plants on the basis of habit.

Plant parts used

Several plant parts were recorded for their medicinal properties in the present investigation (Fig. 4). With 32 reports, leaves were the most commonly used plant part, followed by the entire plant with 15 reports. Following that, below-ground parts of plants, notably the roots, were documented in 11 reports. Residents also used flowers from 10 different species, seeds from 8 different species, rhizomes and fruits from 6 different species each, latex and resins from 3 different species each, and bark, bulb, gum, oil, and stem from a single species. Because of their high concentration of secondary components, leaves are frequently used in herbal preparations. The aerial parts of plants, particularly the leaves, are thought to have a higher concentration of extractable phytochemicals, crude medicines, and other active molecules with potential applications in Phytotherapy. Field research conducted in various parts of Pakistan backs up this claim (12, 28, 32, 59). Roots are usually considered critical elements because they have a higher concentration of bioactive chemicals than other portions of plants in many cases (60). In these areas, the most widely used whole plants are herbaceous. It is critical to use only complete herbaceous plants because extracting roots may threaten the plant's survival and renewal capacity. As a result, when working with endangered or rare plant species, root utilization should be limited. The leaves are the most commonly used plant portion in medicinal applications, and it is best to avoid using complete plants, or roots or relying too much on fruits or seeds. Such activities may harm plant growth and population, potentially leading to a significant decrease in the number of medicinal plants in their natural habitats (60-62).

Use categories

The ethnic flora was divided into 10 use categories: medicinal, vegetable, fruit, fuel, spice, drink, furniture, fodder, tea, and miscellaneous. The most widely used category was medicinal, which included 57 plant species. Following that, there were 23 species of vegetables, 12 species of fuel, 6 species of fruit, 5 species of furniture, and 4 species of drink, fodder, tea, and miscellaneous. It's worth noting that only one species was used as a spice (Fig. 5). The range of uses was particularly prominent in two plant species, *Taxus wallichiana* and *Viburnum grandiflorum*, which were associated with six and four distinct usage categories, respectively. In addition, four plant species displayed utilization across four use categories, while eleven plant species were identified as having applicability in three use categories. A total of 24 plants were discovered to be used in two use categories, whereas 17 species were exclusively linked to a single-use category. The frequency of citations in the recent study correlates with previous research conducted in Kashmir's Himalayan region (38, 46).

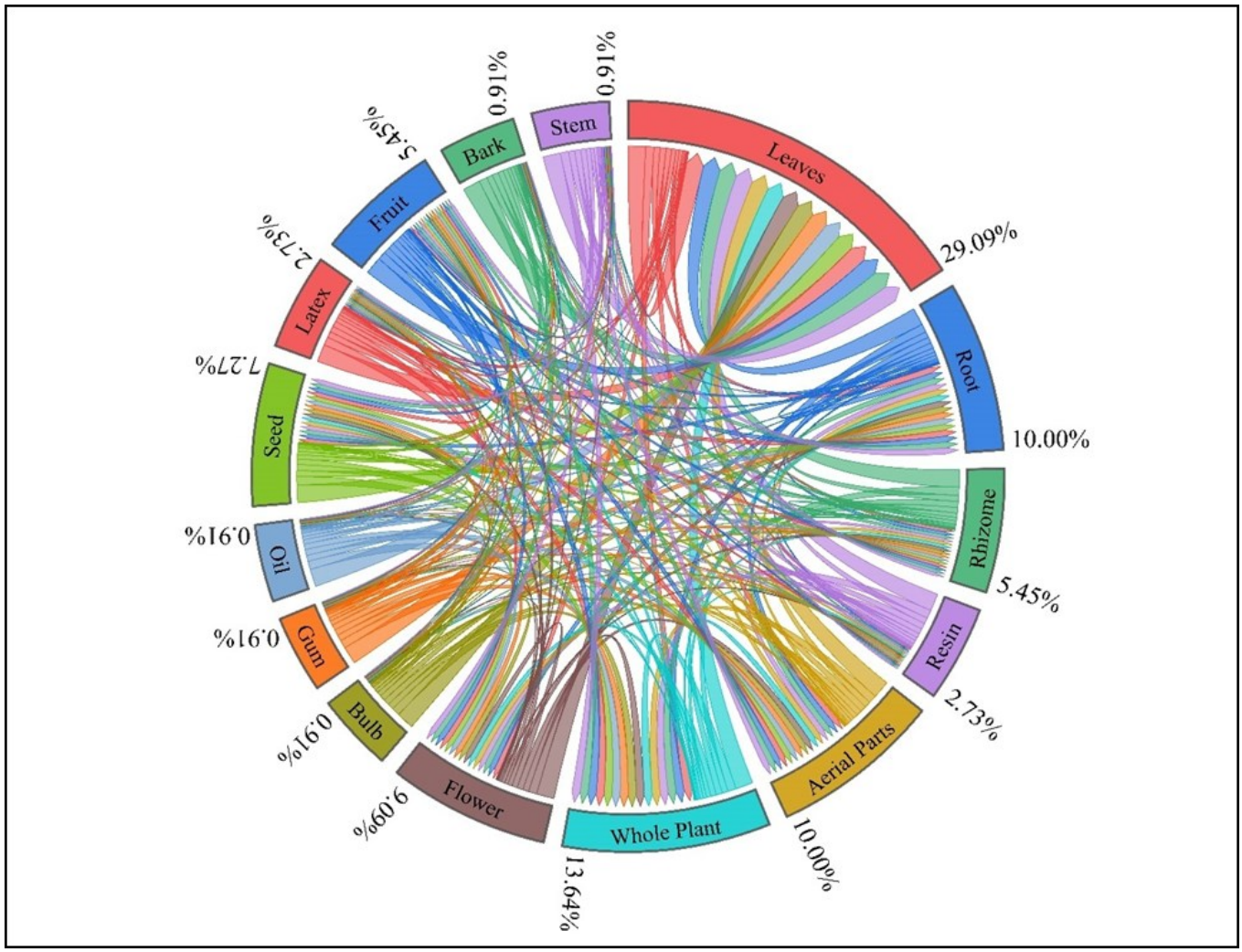

Fig. 4. Proportion of plant parts used by medicinal plants for remedies.

Table 2. Medicinal plant diversity, families, used part and folk methods of preparation.

Sr. No.	Plant Species/ Voucher No.	Family	Local Name	Habit	Parts Used	Use Category	Folk methods of preparation/uses	UV	RFC
1	*Achillea millefolium* L. K-2011	Asteraceae	Dand Jari	H	L, R, F	Med, Veg, Fod	Toothache, antiseptic, mouth ulcers, tooth pain relief	0.92	0.34
2	*Adiantum incisum* Forsk. K-2012	Adiantaceae	Kaakwa	H	L	Med	An infusion prepared with water is administered orally to treat various ailments	0.40	0.16
3	*Aesculus indica* (Colebr. ex Cambess.) Hook. K-2013	Hippocastanaceae	Ban Khor	T	L	Med, Fod, Fur, Fue	Fresh and dry leaves are given to animals to help them overcome their weakness	0.06	0.06
4	*Ajuga bracteosa* Wallich ex Benth K-2014	Lammiaceae	Jan-e-adam	H	Wp	Med	Decoction is used to treat typhoid, malaria, skin conditions, blood purification, and stomach burning. An infusion of the entire plant is used to cure rheumatism and sore throats	1.01	0.45
5	*Allium humile* Kunth K-2015	Amaryllidaceae	Prhe Piaz	H	WP, Bu	Med, Veg, Spi	Used as an accompaniment to salads and flavoring in several traditional recipes, vegetables in indigestion, gas problems, cold and cough	1.29	0.50
6	*Amaranthus viridius* L. K-2016	Chenopodiaceae	Ganhiar	H	Ap, Se, L	Med, Veg	Leaf paste or juice is used for leucorrhoea, eye pain, constipation, cough, and asthma; vegetables, seeds, and other medicinal plants are given as treatments for backache, joint pain, and burning in the stomach	1.40	0.58
7	*Berberis lyceum* Royle. K-2017	Berberidaceae	Sumbal	S	R, F, L	Med, Veg, Fue, Mis	Fruit is used to stimulate blood production, while the young leaves are consumed as a vegetable. Joint pains, skin illnesses, pimples and scabies, stomach ulcers, backaches, and fractures can also be cured	1.52	0.48
8	*Bergenia ciliata* Sternb. K-2018	Saxifragaceae	Batpywa	H	R, Ap, L	Med	Used to stop the wound from bleeding. Bark paste is used to treat wounds and skin problems. It is also used to treat gastrointestinal issues and ulcers	1.53	0.72
9	*Bistorta amplexicaulis* Greene K-2019	Polygonaceae	Masloonr	H	Rh, F, L	Med	Rhizome is used to treat general animal weakness. Urinary disorders, flu, fever, cough, joint pain, and sore throats are all treated with rhizome powder. Rhizome tea is used to cure gastrointestinal issues as well as general body weakness	0.92	0.52
10	*Canabas sativa* L. K-2020	Cannabaceae	Bhang	H	AP, L, F, Se	Med	Leaf paste is used for constipation, dysentery, and asthma; seed juice is used for worminess, sedative, intoxicant, a diuretic and insomnia	0.15	0.07
11	*Capsella bursa-pastoris* (L.) Medikus K-2021	Bracicaceae	Pan Pencha	H	Ap, L	Med, Veg	Arial parts are cooked as a vegetable to treat stomach problems. Fresh leaf decoction is both astringent and stimulating as well	0.65	0.27
12	*Cedrus deodara* L. K-2022	Pinaceae	Dewdar	T	W, Gu, O, Re,	Med, Fur, Fue	Oil is used to treat rheumatism and scabies	0.93	0.42
13	*Chenopodium album* L. K-2023	Chenopodiaceae	Bathwa	H	L, Se, F, Wp	Med, Veg	Arial parts cooked as vegetable for rheumatic pain, cough, and constipation	0.05	0.06
14	*Caltha alba*Jacq.ex Cart. K-2024	Ranunculaceae	Kakari Patra	H	Ap, Wp	Med	Juice from the aerial parts has antispasmodic properties	0.45	0.29
15	*Diospyros lotus* L. K-2025	Ebenaceae	Amlook	T	Fr	Med, Fr, Fue	Fruits are sedative and digestive	0.65	0.18
16	*Dryopteris stewartii* Fraser-Jenk. K-20226	Dryopteridaceae	Kunji	F	Ap, L	Med, Veg	Vegetable to treat stomach problems	0.69	0.29

17	*Dryopteris ramosa* (Hope) C. Chr. K-2027	Dryopteridaceae	langroo	F	Ap, L	Med, Veg	Vegetable to treat gastric ulcer and constipation	0.33	0.25
18	*Dryopteris filix-mas* (L.) Schott K-2028	Dryopteridaceae	Langroo	F	WP	Med, Veg	Leaves are used as vegetables; rhizomes are used for the treatment of cholera and dysentery	0.26	0.23
19	*Fagopyrum esculentum* Moench K-2029	Polygonaceae	Khatkhulda	H	R, L	Med, Veg	Vegetable for constipation and weakness, leaf paste, and root juice are used to treat headaches, fevers, and urinary diseases	0.20	0.16
20	*Ficus palmata* L. K-2030	Moraceae	Phagwaari	T	Fr, Lt, L	Med, Fr, Fue, Veg	Young leaves are used as a traditional vegetable; latex has antibacterial and antiviral qualities; fruits are used for weakness, sour throat, and muscle soreness	0.26	0.08
21	*Euphorbia hirta* L. K-2031	Euphorbiaceae	Budjree	H	Lt	Med	Latex is antibacterial and is used to treat wounds and skin infections	0.25	0.18
22	*Euphorbia wallichii* Hook. F. K-2032	Euphorbiaceae	Hervi	H	Lt	Med	Latex can be externally applied to relieve pain, cure skin diseases, and heal wounds	0.51	0.23
23	*Galium aparine* L. K-2033	Rubiaceae	Jhand	H	Wp	Med	Decoction is used to treat urinary disorders	0.13	0.03
24	*Geranium wallichianum* D. Don K-2034	Geraniaceae	Ratan Jog/ Ratna	H	R, L	Med, Tea	Decoction of leaf used to cure cuts and wounds, skin diseases and menstruation disorders. Root extract used as a tonic after delivery and treat hypertension.	1.07	0.51
25	*Hedera nepalensis* K. Koch (Syn:H.helix L) K-2035	Araliaceae	Baileree	C	Wp	Med	Grinded dried branches and leaves are used as a powder in the morning to treat diabetes with water	0.28	0.13
26	*Hypericum perfotatum* L. K-2036	Hypericaceae	Dudh Jari	H	L	Med	Decoction of leaves is taken in case of anxiety and depression as well to boost up the mood and relaxation	0.33	0.27
27	*Impatiens edgeworthii* Hook. f. K-2037	Balsaminaceae	Bantil	H	WP	Med, Fod	Plant paste is applied externally to treat skin burns	0.22	0.17
28	*Isodon rugosus* Codd K-2038	Lammiaceae	Peemar	S	L	Med	Dried leaves are chewed as a toothache; leaf decoction is applied for wound healing, skin problems, and fever	0.39	0.23
29	*Malva parviflora* L. K-2039	Malvaceae	Dag Sounchal	H	WP, L, Se	Med, Veg	Aerial part decoction applied as a treatment for constipation, fever, gas problems, and sore throat For coughs and ulcers, leaves are utilized as a vegetable	0.49	0.30
30	*Malva sylvestris* L. K-2040	Malvaceae	Sounchal	H	WP, L	Med, Veg	Leaves are used as a vegetable and have laxative and febrifuge effects	0.27	0.25
31	*Mentha longifolia* Hudson K-2041	Lammiaceae	Podeena	H	WP, F	Med, Dri	Vegetable help with indigestion and diarrhoea. Decoction of leaves is used to stop vomiting, as a refrigerant, and as a carminative to treat cholera	1.71	0.58
32	*Mentha arvensis* L. K-2042	Lammiaceae	Podeena	H	L	Med, Tea, Dri	It is used to treat gastroenteritis and respiratory infections; leaf paste is used to treat vomiting, nausea, and diarrhoea; leaves may be eaten as salad; and it is also used as a herbal drink and in traditional Kashmiri Chatni	1.13	0.50
33	*Oxalis corniculata* L. K-2043	Oxalidaceae	Khata	H	L, Wp	Med, Veg	Early pregnancy vomiting can be avoided by eating the leaves of the plant; the entire plant also prevents bleeding and reduces mouth smell	0.47	0.29
34	*Oxyria digyna* (L.) Hill K-2044	Polygonaceae	Khatkulda	H	Ap, L	Med, Veg	A vegetable used to relieve constipation and gastrointestinal issues, as well as to quench extreme thirst when conducting fieldwork in the highlands	0.38	0.21
35	*Phytolacca latbenia* (Moq.) K-2045	Phytolaccaceae	Lubbar	H	Ap, R, L	Med, Veg	used as a vegetable to treat infections of the glandular system	0.34	0.13
36	*Pinus wallichiana* A. B. Jack. K-2046	Pinaceae	Byar	T	Re	Med, Fur, Fue	Resins mixed with soap are applied externally to pus-filled pockets to release pus	0.04	0.02

37	*Plantago major* L. K-2048	Plantaginaceae	Chemchi Patar	H	F, L, Se	Med, Veg, Dri	Leaves are consumed as a vegetable; a decoction of leaves is given in hypertension; and it is also used as an herbal drink	0.25	0.25
38	*Polygonum aviculare* L. K-2049	Polygonaceae	Trubra	H	Ap	Med, Veg	Aerial parts are used as vegetables and for digestive problems	1.04	0.42
39	*Polygonum plebeium* R.Br. K-2050	Polygonaceae	Trubra	H	Ap, Wp	Med, Veg	Used as a vegetable in cough and stomach disorders	0.74	0.31
40	*Polygonatum verticilatum* All. K-2051	Liliaceae	Peergandal	H	Rh	Med	Rhizome paste is used for gastric problems and wound healing	0.52	0.21
41	*Picea smithiana* (Wall.) Boiss K-2052.	Pinaceae	Chachar	T	Re	Med, Fue, Fur	Resin is applied for blood clotting on fresh cuts	0.38	0.27
42	*Prunella vulgaris* L. K-2053	Lammiaceae	-	H	Wp, Se	Med	Seeds have laxative, diuretic, tonic, and antipyretic properties; a decoction is used to treat inflammation, high fever, and eye sight deficiency.	0.02	0.12
43	*Pyrus pashia* Buch.-Ham. ex D.Don K-2054	Rosaceae	Batangi	T	Fr	Med, Fr, Fue	Fruit is used in the treatment of diarrhoea, dysentery, and gastric problems	0.97	0.35
44	*Rheum webbianum* Royle K-2055	Polygonaceae	Chatyaal	H	L, R, St	Med, Veg	Leaves are eaten as a vegetable, the stem is edible, and the root paste is used to cure internal injuries, cuts, wounds, mumps, headaches, stomach-aches, constipation, diarrhoea, and throat swelling. In dyspepsia, root powder is purgative, astringent, and tonic; stem tuber treats sour eyes and fever, purifies blood, whitens the skin, and is also used to quench thirst	1.49	0.40
45	*Rosa indica* Lour. K-2056	Rosaceae	Gulab	S	F	Med	Flower decoction for pain massage	0.87	0.31
46	*Rubus elipticus* Smith K-2057	Rosaceae	Chal	S	Fr	Med, Fr, Fue	Fruits are used in cases of anaemia and general weakness of the body	0.59	0.34
47	*Rumex hastatus* D.Don. K-2058	Polygonaceae	Kthimbal	S	L	Med, Veg	Leaves are used as a vegetable; the juice of the plant is astringent and used in the treatment of amoebic dysentery	0.27	0.14
48	*Rumex nepalensis* Sprengel K-2059	Polygonaceae	Hola	H	L, Rh	Med, Veg	Leaves are used as a vegetable and for treating skin diseases, coughs, leaf infusions used for stomach-aches, and dysmenorrhea. Rhizome paste is anti-lice. Constipation and lung complaints in animals are treated by rhizome decoction	1.15	0.38
49	*Solanum nigrum* L. K-2060	Solanaceae	Katch Maatch	H	L	Med, Fr	Cooked leaves and fruits are used to treat abdominal swellings and stomach-aches	0.32	0.25
50	*Skimmia laureola* (DC.) Sieb, &Zucc, ex Walp. K-2061	Rutaceae	Nyra	S	L	Med, Mis	A decoction of dried leaves is given to animals as an insect repellent. Coughs are treated using a paste made from the leaves. Leaves are often used to produce aromas in a variety of meals	0.40	0.32
51	*Sinopodophyllum hexandrum* (Royle) T.S.Ying K-2062	Podophyllaceae	Ban Khakkri	H	R, Fr	Med	Root extract is used to treat stomach-aches, liver and bile illnesses, wounds, and skin diseases. Fruit is laxative	0.54	0.24
52	*Sorbaria tomentosa* (Lindl.) Rehder K-2063	Rosaceae	Chalna	S	Wp	Med, Fue	Decoction causes skin contractions, scabies, and stops bleeding from wounds. Fruit smoke is used to treat asthma	0.11	0.16

53	*Taraxecum officinale* Webb K-2064	Asteraceae	Hand	H	R	Med	Root extract is used for headaches and blood purification	0.72	0.40
54	*Taxus wallichiana* Zucc. K-2065	Taxaceae	Barmi	T	L, B, Se	Med, Tea, Fur, Fod, Fue, Mis	Leaves treat respiratory disorders; leaves and seeds are sedative and antiseptic. Bark tea is used to cure asthma, bronchitis, and cough. Bark paste is applied to joints and the head to check for rheumatism and headaches. Bark is also used as an anticancer	0.61	0.30
55	*Thymus linearis* Benth ex Benth K-2066	Lammiaceae	Chikal	H	L, F	Med, Tea	Leaves and flowers Used to cure abdominal pain, chest pain, fever, and obesity, tea is taken to control blood pressure. Suppression of urine, constipation, and shivering. Leaves and flower powder strengthen teeth, gum infections, bleeding gums, are used as a herbal tea, and are used to treat gynaecological problems	1.58	0.61
56	*Viburnum grandiflorum* Wallich ex DC. K-2067	Viburnaceae	Guch	S	Fr	Med, Fr, Fue, Mis	Fresh fruit eaten to cure stomach problems and purify blood	1.21	0.49

Abbreviations: H= Herb, S = Shrub, T = Tree, Med = Medicinal, Dri = Drink, Fue = Fuel, Fr = Fruit, Fod = Fodder, Fur = Furniture, Veg = Vegetable, Mis = Miscellaneous, Spi = Spice, L = Leaves, F = Flower, Se = Seed, B = Bulb, R = Root, Rhi = Rhizome, Wp = Whole Plant, Ae = Aerial Parts, Re = Resin, St = Stem, Lt = Latex, O = Oil, Gu = Gum.

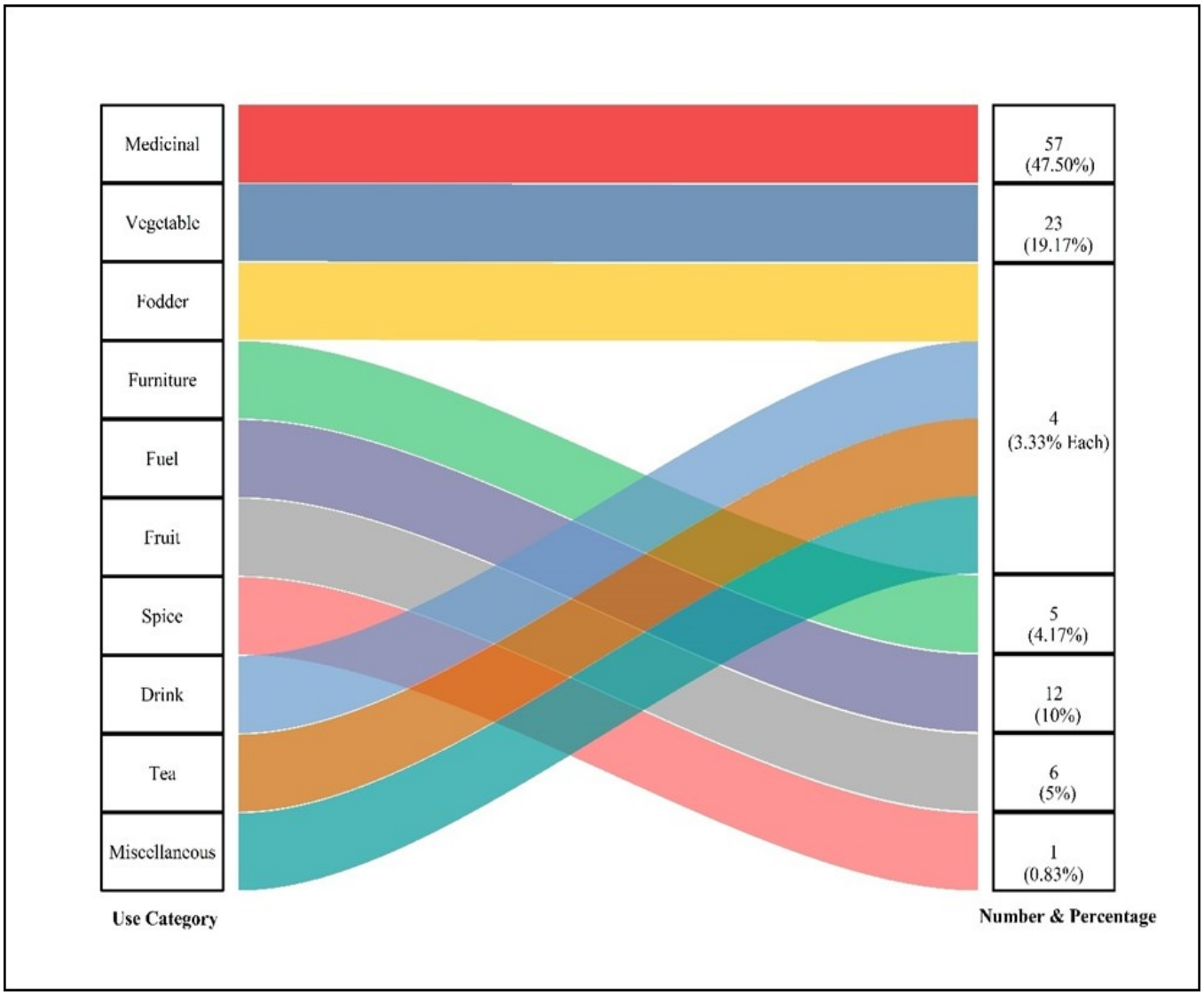

Fig. 5. Percentage distribution of medicinal fora on the basis of use category.

Use value

Use value is an important measure for discovering highly valuable medicinal plants in a certain region, allowing for further in-depth medicinal investigation. The use values in Table 2 ranged from 0.02 to 1.71. The use value of *Mentha longifolia* was 1.71, followed by *Thymus linearis* (1.58), *Bergenia ciliata* (1.53), *Berberis lyceum* (1.52), *Rheum webbianum* (1.49), *Amaranthus viridius* (1.40), and *Allium humile* (1.29). Lower use values were found in *Prunella vulgaris* (0.02), *Pinus wallichiana* (0.04), *Chenopodium album* (0.05), *Aesculus indica* (0.06), and *Galium aparine* (0.13). The widespread use of known medicinal plants demonstrates a strong connection and reliance of the inhabitants on neighboring flora, particularly for treating a variety of health problems. Residents considered these plants as a valuable resource for both food and medicine due to the presence of important biochemical ingredients that are effective in curing diseases (12, 59). The level of utilization reports for an area is directly related to its utility. Medicinal plants with a higher frequency of mentions tend to have a higher usage value (63).

Relative frequency citation

The RFC (Relative Frequency of Citation) is an approach for evaluating the importance of various species in treating different health problems by considering how frequently they are referred to to within their local communities(33). The RFC value ranged between 0.02 and 0.72 (Table 2). *Bergenia ciliata* had the highest reported RFC value (0.72), with *Thymus linearis* following in at 0.61. Other prominent species include *Amaranthus iridius* (0.58), *Bistorta amplexicaulis* (0.52), *Mentha longifolia* (0.58), *Mentha arvensis* (0.50), *Allium humile* (0.50), and *Berberis lyceum* (0.48). The lowest RFC values were found for *Pinus wallichiana* (0.02), *Galium aparine* (0.03), *Chenopodium album* (0.06), *Aesculus indica* (0.06), and *Cannabis sativa* (0.07). The RFC results of the current study are comparable to previous investigations (18, 46, 48). Residents are familiar with a variety of plant species that have high RFC values and are extensively dispersed in the region due to traditional therapeutic usage. These plants have the potential to be useful in medication discovery and commercialization (64-65). High RFCs indicate a deep understanding and widespread use of traditional uses of plant species throughout communities, emphasizing their importance from both indigenous and cultural perspectives. Moreover, high RFC values indicate that a specific species is commonly used to treat diverse diseases, providing a risk of overexploitation and posing an important threat to conservation efforts.

Conclusion

The inhabitants in the rural areas of District Muzaffarabad, Kashmir, are highly knowledgeable about medicinal plants. The recent study has resulted in 57 medicinal plants that the local communities frequently utilize to cure a range of ailments. The Polygonaceae family was the most commonly used herbaceous plant family in this study. Based on plant usage patterns, leaves were mostly used in many medications. *Bergenia ciliata*, *Mentha longifolia*, *Thymus linearis,* and *Taxus wallichiana* are the most important and frequently used plants in the study area. Because of the study area's remoteness and a lack of modern healthcare services, the bulk of the population relies on medicinal plants to cure a variety of diseases. The transmission of indigenous knowledge to descendants is steadily declining and is primarily limited to healthcare practitioners and the elderly. It is important to document the traditional usage of medicinal plants in folklore research to transmit indigenous knowledge globally. Given the issues identified above, we suggest prioritizing sustainable conservation and efficient management of medicinal plants in rural areas of Kashmir. This priority seeks to protect both plant species and traditional knowledge for future generations. A more extensive field exploration is required to discover all of the indigenous knowledge in rural areas of Kashmir.

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Authors' contributions

SWG and MM carried out the field study, and herbarium preparation, participated in the data typing, and drafted the manuscript. HS, GMS, and WZ review the manuscript. BS, KKK, and SS data curation and Analysis. MA and MZ conceptualized and supervised the study.

Compliance with ethical standards

Conflict of interest: The authors declare that there is no conflict of interest.

Ethical issues: None.

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