Traditional healing practices in Kiwai, Balakot: Insights from ethnobotanical research in Kaghan Valley, Pakistan

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Research

Abstract

Background: Using plants for traditional medicinal purposes has consistently held a significant position and has become increasingly important. Due to the underdeveloped healthcare system in Pakistan, the region is particularly intrigued by ethnobotanical and ethnomedicinal investigations. The present study aims to investigate the floral diversity of therapeutic plants in a remote region of Pakistan with a focus on therapeutic plants.

Methods: The research was conducted between March 2023 to April 2024 in Thubi Village of Kiwai, Kaghan Valley. Semi-structured interviews were used to gather data. Health Organization Family of International Classifications, approved by the World Health Organization Family of International Classifications, used to group therapeutic uses into 14 disease categories. The data was evaluated through ethnobotanical indices like Use Value (UV), Relative Frequency of Citation (RFC) and Consensus Index (CI %).

Results: The study reported 69 plants from 39 different plant families. Out of 69, 40 plant species (57.9%) were herbaceous with Rosaceae being the most (9, 13%) prevalent species. *Hedera helix* L. has the highest use value of 0.92. For *Solanum tuberosum* L., the highest relative citation frequency was documented (0.94). The consensus index for *Prunus armeniaca* L. was the greatest (94%). The conservation status of species was detected according to the IUCN Red List showing 30 species (43.48%) were endangered, 23 (33.33%) were vulnerable, 10 (14.49%) were of least concern and 6 plant species (8.7%) were not threatened.

Conclusions: Some unexpected uses of medicinal plants were revealed by the ethnobotanical study conducted in Kiwai Valley. Members of the local community and traditional healers participated in the survey. They contributed important data about medicinal plants that will aid in future studies and the development of new drugs.

Keywords: Ethnobotany; Traditional knowledge, Conservation; ICPC, Consensus Index

Background

Traditional medical knowledge of medicinal plants and indigenous people's use of them is important for preservation and drug formulations. Throughout the world, traditional medicines form a significant component of healthcare. The World Health Organization (WHO) states that 80% of the world's inhabitants rely on traditional medicine. Before the development of contemporary medicine, people around the globe used herbs for the treatment of a variety of illnesses. The native

individual's know-how regarding preparing and utilizing plants for traditional medication is a crucial element (Tahir *et al*. 2023). With a focus on the traditional knowledge of plants and the natural world, ethnobotany is an integrative, multidisciplinary discipline that includes languages, botany, and ethnography (Sagıroglu *et al*. 2023). Around 250 to 300 thousand plant species are currently recognized for therapeutic aims. Globally 70,000 plant species are currently used by humans, including 7000 crop species for food and medicine. Meanwhile, 90% of the world's nutritional demands are satisfied by just 30 plants (Selvi *et al*. 2022). The Rigveda (4500–1600 BC) and the Ayurveda (2500–600 BC) contain the first descriptions of ethnomedicinal plants. The ethnobotanical assessment of Fateh Pur Thakyala, Azad Jammu and Kashmir, Pakistan, records and conserves local medicinal plant knowledge and practices. Asteraceae is the most prevalent family in the regions examined, with 135 species of medicinally significant plants (Sabir *et al*. 2024). Local populations in mountainous areas rely on therapeutic plants to treat various illnesses because of the remote locations and lack of medical services. New plant species that could be made into extracts or drugs to treat a range of diseases can be found with the help of ethnobotanical research (Gillani *et al*. 2024). Ethnobotanical study in Swat, Pakistan highlights the threats to medicinal plant diversity and the need for their conservation (Shah *et al.* 2024). However, local communities work together to maintain, protect, and promote the species of local crops while also gathering and consuming plant-based foods for daily nourishment (Bhandari *et al*. 2023). Pakistan has various topographical climate zones (Zeeshan *et al*. 2023). Pakistan is a region in the temperate zone with four distinct seasons because of its geography and climate. Much of the Pakistani populace (60%) relies on therapeutic plants to heal their minor and sometimes major diseases and wounds (Jabeen *et al*. 2021). Kiwai is a union council in Tehsil Balakot, District Mansehra, KPK, region of northern Pakistan. The terrain is rugged, high in elevation in the vicinity of range as less than 100 miles and up to 100 altitudes, from 18,000 feet to Godwin Austin (K-2), the second-highest peak in the world at 8611 meters. It is also abundant in many types of plant species. The rural populations in Kiwai village, district Mansehra, largely rely on and prefer using medicinal plants to treat their problems because there aren't any contemporary medical facilities in the study region. The traditional healthcare system is preferred because it is affordable and easily accessible (Shah *et al*. 2024). To the best of our knowledge, this is the first report on the ethnobotanical study of Thubi village, Kiwai. This study focuses on exploring indigenous knowledge of the use of therapeutic plants. The study aimed:

1. To study the medicinal flora of the Kiwai village

2. To document traditional knowledge regarding the application of medicinal plants, used parts, medicine formulation, and administration methods

3. To incorporate the categorization of the medicinal plants based on ICPC-2

Materials and Methods

Study area

Kaghan Valley is a popular tourist destination due to its natural beauty and diverse flora and fauna. The valley is home to various wildlife, including snow leopards, brown bears, musk deer, and Himalayan ibex. The valley is also known for its alpine meadows. The valley is home to several hot springs and is a popular attraction for tourists. Other notable settlements in the valley comprise Mahandri, Naran, Kaghan, and Paras. Spanning an area of 945 km^2, the valley stretches approximately 24 km in width and 96 km in length. The valley land is used for agriculture (2.6%), forestry (24.6%), and grazing (55%). The studied area is located between coordinates 34°43.24′ N, 073°30.822′ E likewise 34°30.979′ N, 073°38.740′ E (Fig. 1). The terrain of the valley is diverse, featuring steep sections and flat zones. The valley experiences an average of 2500 mm of rainfall throughout the summer, winter, and monsoon. Snowfall typically begins late and lasts through the end of February, often resulting in snowy mountains for a few months. The region is between 1200 and 3500 meters above sea level. The valley reaches its highest point at Malika Parbat, standing at 5291 m, where the Kunhar River originates (Ullah *et al*. 2021).

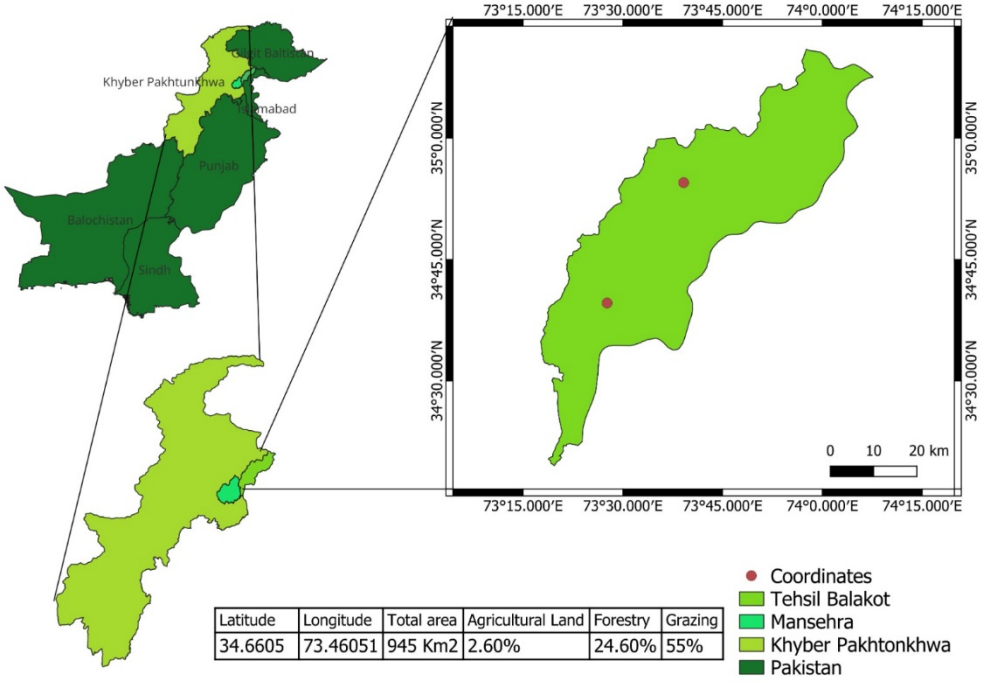
Data collection

Indigenous ethnomedicinal knowledge in the village of Thubi, Kiwai, took place from March 2023 to April 2024. A total of 50 key informants of both genders were randomly selected for the study. Professionally they were farmers, healers, teachers, and community leaders (Table 1). Data was collected through a semi-structured questionnaire. Qualitative and quantitative data was gathered via focus group discussions, interviews, and participant observation. The plant taxonomist helped identify these specimens. They were also cross-checked using World Online Flora and the Flora of Pakistan as a guide. Some specimens were identified using references of botanical data reported from the area in various botanical research. The study also documented the cultural and ecological significance of medicinal plants in the local community and their role in maintaining biodiversity and ecological balance. It highlighted the importance of integrating this knowledge into conservation efforts and sustainable practices. By doing so, it would be possible to not only preserve biodiversity but also promote the well-being of both the indigenous population and the environment. All the interviews took place in the local

Pahari language.

The World Health Organization's Family of International Classifications (WHO-FIC), has been slightly modified and is the most widely used international classification system for methodically gathering and organizing clinical information in primary care. The collected information was categorized into 14 ailment groups using the International Classification of Primary Care (ICPC-2) (World Health Organization 2021, Ginko *et al*. 2023) incorporating a separate infectious disorders category. The 14 groups

are 1) General and Unspecified (comprising parasites) 2) Infectious illnesses; 3) Blood, blood-making organs, lymphatics as well as spleen; 4) Digestive; 5) Ear; 6) Cardiovascular; 7) Musculoskeletal; 8) Neurological; 9) Respiratory; 10) Skin; 11) Endocrine, metabolic along with nutritional; 12) Urology; 13) Pregnancy plus family planning; 14) Female genital system (Table 2).



Latitude	Longitude	Total area	Agricultural Land	Forestry	Grazing
34.6605	73.46051	945 Km2	2.60%	24.60%	55%

Figure 1. The climatic zone of the area was studied along with the area map.

Conservation status

Field observations, locals' knowledge, and previous collectors' reports on the local flora can all be used to identify vulnerable plant species. The categories are: 0) Not Evaluated, 1) Data Deficient, 2) Least Concern, 3) Near Threatened, 4) Vulnerable, 5) Endangered, 6) Critically Endangered, 7) Collapsed (Jamal 2009). IUCN guidelines were followed in listing the conservation status of medicinal plants (Walter & Gillett 1998).

Data analysis

The data obtained was analyzed statistically by using quantitative ethnobotanical indices of Use Value (UV), Relative Frequency of Citation (RFC), and consensus index (CI %).

Use value (UV)

$$UV = UVi/Ni$$

(where 'UVi' is the incidence of citations for species via all respondents and 'Ni' is the sum of respondents) (Shah *et al*. 2023).

Relative Frequency of Citation (RFC)

The degree of agreement among informants about the use of therapeutic herbs is measured using RFC. This index, which is calculated, implies the importance of numerous medicinal plant species in the studied area. The formula used to calculate it is as follows:

$$RFC = FC/N$$

(where FC denotes the sum of informants mentioning indigenous consumption of plant species and N is the total number of study area informants that were interviewed) (Liaqat *et al*. 2023).

Consensus index (CI %)

The consensus index (CI %) was used to determine the ratio of local informants who were knowledgeable about therapeutic plants that were utilized to cure ailments. The following formula was employed:

$$CI = n/N \times 100$$

(where n is the total number of informants mentioning species of therapeutic plants and N denotes the total number of participants during the survey) (Rehman *et al*. 2022).

Results

Demography of the study area

In the present survey (Fig. 2), a total of 50 key informants including 39 males and 11 females of different demography were interviewed. The demography of 50 informants was placed education-wise in 5 categories (Illiterate, 10, 12, 14, and 16 years of education) belonging to 4 professions (hakims, teachers, shopkeepers, and farmers) and age groups in 3 categories (below 30 years of age, 30-50, 50-70 years) (Table 1). The maximum knowledge about the use of medicinal plants was shared by informants between 50-70 years of age.

Figure. 2 Panoramic views of the collection site and plant species with the most usage among locals.

Table 1. Demographic features of informants, gender ratio, education level and socio credentials.

Informants	Demographic Information	Total	Percentages (%)
Gender	Male	39	78
	Female	11	22
Traditional healers	Male	8	16
Informant's education	Illiterate	16	32
	10 years of education	13	26
	12 years of education	10	20
	14 years of education	8	16
	16 years of education	3	6
Informant's professions	Farmers	7	14
	Hakims	22	44
	Teachers	9	18
	Shopkeepers	12	24
informant's age groups	Below 30	10	20
	30-50	11	22
	50-70	29	58

Growth Forms and Families of Medicinal Plants

Overall, 69 plant species out of 39 families have been recognized. However, the most encountered medicinal plant family was Rosaceae (9, 13% species). Between taxa, herbs were denoted by 40 (57.9%) plant species followed by shrubs 11(15.9%), and trees 18(26%). Among the noted families maximum contribution was Rosaceae (9, 13% species), Fabaceae (7, 10.1% species), Pinaceae, and Asteraceae (4, 5.7 % species both), whereas the remaining families varied in having 3 or fewer species (Fig. 3). Between taxa, herbs were denoted by 40 (57.9%) plant species followed by shrubs 11(15.9%), and trees 18(26%) (Fig. 4).

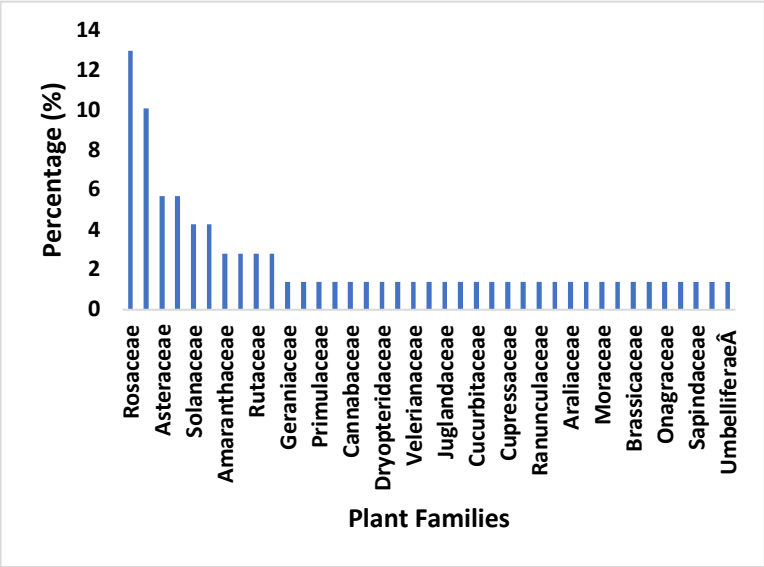


Figure 3. Significant plant families along with the frequency in the research region.

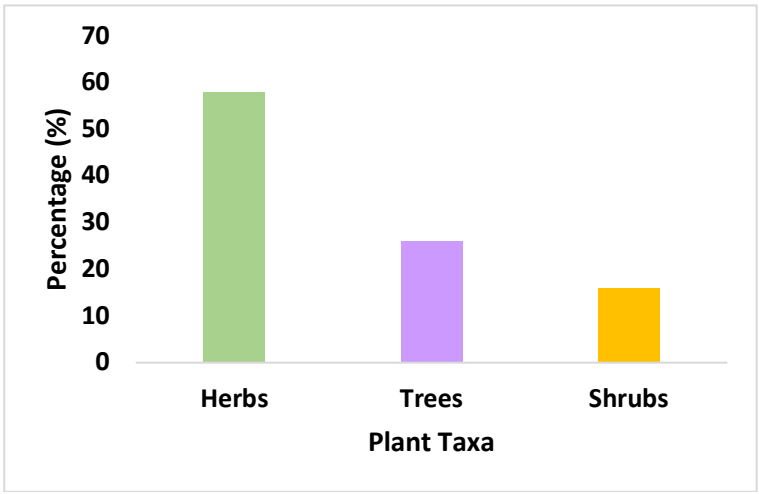


Figure 4. Frequency of plants based on their taxa.

Used Parts and Types of Medicinal Plants

The parts that were most frequently used were leaves (40%), fruit (12.1%), whole plant, and roots (9.5% each) (Fig. 5). While the minimum used parts were bulb and rhizome with the same frequency of 1.7% each. Three major plant types angiosperms, gymnosperms, and pteridophytes were observed in our study. The majority of the plant species were angiosperms (94.2%), gymnosperms (5.70%), and pteridophytes (1.40%) (Fig. 6).

ICPC-2 and Conservation Status

The informants provided a list of seventy medicinal applications for the indicated plants, which could be categorized into fourteen ICPC-2 disease categories. This highlights the significance of the different categories for the individuals (Table 1). Among 69 ethnomedicinally important medicinal plants, about 30 (43.48%) species were reported as endangered, 23 (33.33%) plant species were vulnerable, 10 (14.49%) species were of least concern (Fig. 7) and 6 (8.7%) plant species were not threatened (Table 2).

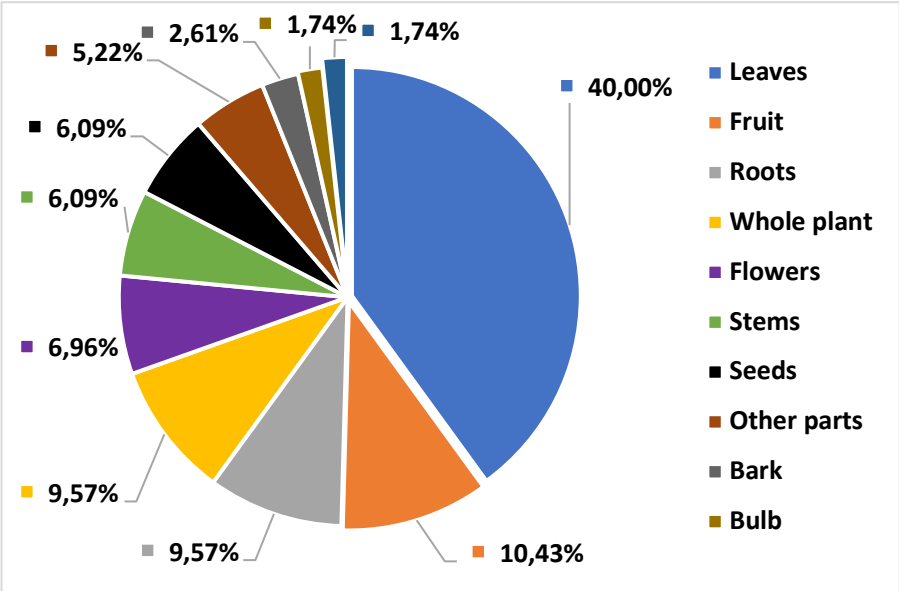


Figure 5. Organ use of plant species for therapeutic purposes.

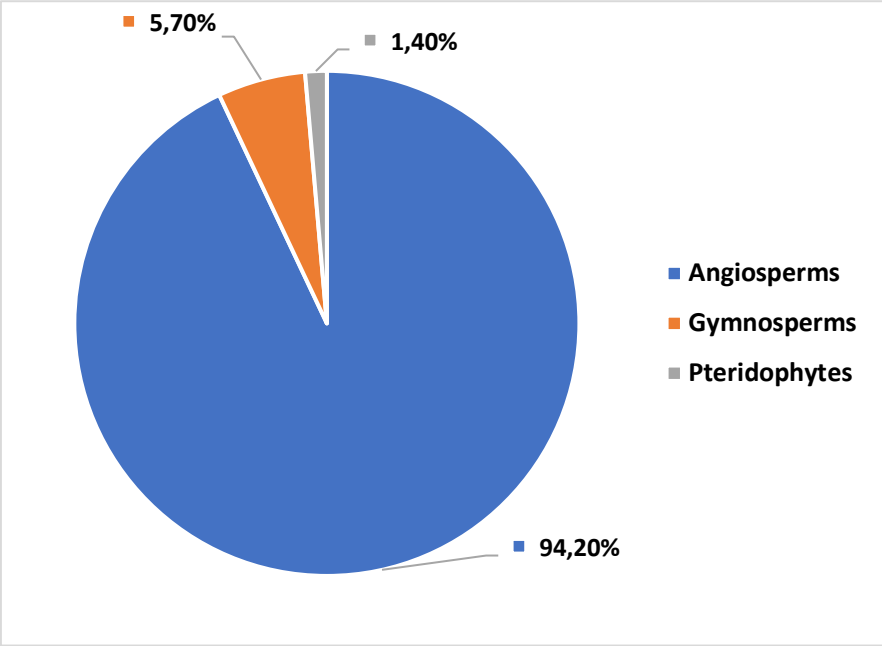


Figure 6. Percentage distribution of plant families by plant type.

Ethnobotanical Indices

Use Value (UV)

In this study, quantitative value indices were created to analyze the ethno-medical data.

The use value is between 0.08 and 0.92. *Hedera helix* L. had the highest UV of 0.92, while *Solanum tuberosum* L., *Pisum sativum* L., and *Prunus persica* (L) Batsch tied for second place. *Senegalia modesta* had the lowest UV of 0.08 (Table 2).

Relative Frequency Citation (RFC)

Citation frequency relative ranges from 0.04 to 0.94. The plant *Solanum tuberosum* L. (0.94) had the most proportional citation frequency, which it shared with *Pinus wallichiana* A.B Jackson (0.92), *Prunus armeniaca* L. (0.88), and *Androsace rotundifolia* (0.88). As indicated in Table 2, the least number of citations were made for *Cannabis sativa* L. (0.08), *Crataegus monogyna* Jacq (0.08) and *Cedrus deodara* (Roxb. ex D Don) G. Don (0.04).

Consensus Index (CI)

Prunus armeniaca L. had the highest consensus index (CI) (96%), followed by *Malus domestica* Borkh (94%) and *Solanum tuberosum* L. (94%) As indicated in Table 2, *Angelica glauca* Edgew (12%) and *Cannabis sativa* L. (10%) had the lowest CI index values.

Table 2. Listed plants with scientific names, common names, habits, family, parts utilized, Medicinal use, and ICPC-2.

Species name & Plant Family	Native name	Plant portion utilized	Reported plant use	Medicinal use	ICPC-2 category	CI%	UV	RFC
Abies pindrow Royle. (Pinaceae)	Kachal	Leaves, shoots	>10	Asthma	Respiratory	46	0.12	0.18
Achyranthes aspera L. (Amaranthaceae)	Phutkanda	Leaves	>10	Cough	Respiratory	62	0.1	0.08
Aesculus indica Wall. ex Camb. (Sapindaceae)	Banakhor	Leaves, roots	1	Migraine	Neurological	34	0.26	0.26
Alkanna tinctoria (L.) Tausch (Geraniaceae)	Ratan jot	Leaves, roots	>20	Back pain, arthritis, inflammation & body aches	Musculoskeletal	16	0.22	0.18
Allium cepa L. (Amaryllidaceae)	Piyaaz	Bulb, leaves	>20	Kidney, stomach & hypertension	Urology, Digestive, Cardiovascular	40	0.44	0.52
Androsace rotundifolia Hardwick in Asiat. (Primulaceae)	Golpattipho ol	Leaves, flowers	2	Menstrual problems	Female Genital	68	0.28	0.88
Angelica glauca Edgew. (Apiaceae)	Chora	Roots, rhizome	>10	Gastric problems	Digestive	12	0.16	0.08
Arisaema flavum (Forssk.) Schott (Araceae)	Sanpbooti	Seeds, bulb	5	Asthma	Respiratory	16	0.14	0.18
Berberis lyceum Royle. (Berberidaceae)	Sumbul	Leaves, Roots & bark	>20	Anti-tumor, wound healing, edema development, intestinal colic, & ocular conditions	Immune mechanism, Skin, Digestive	32	0.36	0.72
Bergenia ciliata (Haw.) Sternb (Saxifragaceae)	Butpewa	Leaves, roots	>10	Dysentery & kidney stones	Digestive, urology	44	0.56	0.6
Brassica campestris L. (Brassicaceae)	Sarson	Leaves, seeds	>20	Weakness	General	92	0.76	0.64
Broussonetia papyrifera (L.) Herit ex. Vent (Moraceae)	Jangli toot	Fruit, leaves	5	Stomach pain	Digestive	14	0.2	0.16
Bupleurum canaliculatum Diels (Apiaceae)	Methijar	Leaves	0	Depression	Psychological	32	0.34	0.28
Cannabis sativa L. (Cannabaceae)	Bhang	Leaves, flowers	>20	Analgesic & stomach problems	Digestive	10	0.26	0.08
Cedrus deodara (Roxb. ex D. Don) G. Don (Pinaceae)	Diyar	Leaves	>20	Carminative, asthma, pulmonary disorder	Digestive, Respiratory	42	0.14	0.04
Chaerophyllum reflexum Lindl. (Umbelliferae)	Dudkai	Whole plant	>10	Jaundice	Digestive	42	0.14	0.04
Chenopodium album L. (Amaranthaceae)	Bathwaa	Whole plant	>10	Toothache & laxative	General	66	0.42	0.48
Cichorium intybus L. (Asteraceae)	Kasni	Flowers, leaves, stem	>10	Fever	General	16	0.5	0.12

Crataegus monogyna Jacq. (Rosaceae)	Sinjli	Leaves, flowers, fruit	>10	Chest pain, diabetes & cardiac problems	Cardiovascular, Metabolic	42	0.54	0.08
Cucumis callosus (Rottb.) Cogn. (Cucurbitaceae)	Jangli kakrii	Fruit, seeds	3	Antioxidant, anti-diabetic & anti-hyperlipidemic	Endocrine/ Metabolic, Nutritional	32	0.44	0.66
Daphne mucronata Royle. (Thymelaeaceae)	Kutaylal	Leaves, stems	>10	Wound healing	Skin	28	0.52	0.48
Datura stramonium L. (Solanaceae)	Datura	Whole plant	>10	Stomach, fever & antibacterial	Digestive, General	26	0.22	0.14
Desmodium triflorum (L.) DC. (Fabaceae)	Chamkath	Leaves	>10	Fever	General	34	0.48	0.44
Dryopteris serrato-dentata (Bedd.) Hayatai (Dryopteridaceae)	Kunjii	Leaves, roots	0	Fever	General	56	0.32	0.2
Eucalyptus globulus Labill. (Myrtaceae)	Gond	Leaves, stem	>20	Diabetes	Metabolic, Nutritional	44	0.36	0.32
Euphorbia helioscopia L. (Euphorbiaceae)	Dodal	Leaves, stems	>10	Abdominal pain	Digestive	32	0.28	0.22
Hedera helix L. (Araliaceae)	Aribumbal	Leaves, berries,	>10	Skin issues, sore throat & cough	General, Skin	84	0.92	0.44
Helianthus annuus L. (Asteraceae)	Gul mukhi	Leaves, flowers	>20	Malarial fever	General	46	0.54	0.86
Indigofera heterantha Wall. ex. Brand (Fabaceae)	Kainthii	Whole plant	0	Jaundice & Wound treatment	Skin, Digestive	28	0.12	0.18
Isodon rugosus (Schrad. ex Benth.) Spach (Lamiaceae)	Chitboota	Leaves	1	Irritation & itchiness	Skin, Digestive	50	0.44	0.22
Juglans regia L. (Juglandaceae)	Akhrot	Leaves, fruit	>20	Reduced risk of heart disease and cancer, anti-inflammatory	Cardiovascular, Anti-cancer, Skin	88	0.58	0.14
Justicia adhatoda L. (Acanthaceae)	Beikarh	Leaves, flowers, roots	>10	Asthma, cold, tuberculosis	Respiratory	20	0.14	0.14
Lycopersicon esculentum (*Mill*.) (Solanaceae)	Timatar	Leaves, fruit	>20	Sunburns	Skin	52	0.64	0.42
Malus domestica Borkh (Rosaceae)	Saib	Leaves, fruit	>20	Anemia	Blood	94	0.8	0.54
Malva neglecta Wall. (Malvaceae)	Sonchal	Whole plant	>10	Hepatitis & Headache	Neurological, Digestive	38	0.26	0.04
Mentha longifolia (L.) Huds. (Lamiaceae)	Jangli podina	Leaves	>20	Vomiting, fever & constipation	Digestive, General	28	0.5	0.2
Oenothera rosea L Her. ex Aiton (Onagraceae)	Jangli gulab	Leaves	3	Liver pain	Digestive	42	0.42	0.36
Otostegia limbata (Benth.) Boiss. (Lamiaceae)	Chiti booti	Leaves	>20	Antibacterial & anti-inflammatory	General	62	0.64	0.7
Oxalis corniculata L. (Oxalidaceae)	Khatkurla	Whole plant	>20	Jaundice, & wound healing	Digestive, General	82	0.44	0.52

Paeonia emodi Wall. Ex HK. (Paeoniaceae)	Mamaikh	Roots	10	Backache, body pains & epilepsy	Neurological, Musculoskeletal	50	0.38	0.1
Parthenium hysterophorus L. (Asteraceae)	Gandibooti	Whole plant	>10	Diarrhea & urinary tract infection	Digestive, Urology	80	0.28	0.08
Perideridia gairdneri (Hook. & Arn.) Mathias (Apiaceae)	Karwya	Roots	>10	Ophthalmic	Eye	44	0.18	0.12
Phaseolus vulgaris L. (Fabaceae)	Lobia	Leaves, seeds	>20	Anemia	Blood	44	0.56	0.38
Pinus roxburghii Sarg. (Pinaceae)	Chirh	Leaves, cone	>10	Stomachache, stimulant & diuretic	Digestive	68	0.44	0.38
Pinus wallichiana A.B. Jackson (Pinaceae)	Biyaar	Stem	5	Wounds, sores & burns	Skin	82	0.66	0.92
Pisum sativum (Fabaceae)	Matar	Leaves, seeds	>20	Digestion	Digestive	70	0.74	0.8
Populus ciliata L. (Salicaceae)	Safaida	Stem	>10	Rheumatism	Musculoskeletal	70	0.6	0.36
Potentilla hebiichigo (Rosaceae)	Jangli berry	Fruit	>20	Anticoagulant	Blood	14	0.12	0.22
Potentilla indica (Andrews) Th. Wolf (Rosaceae)	Strawberry	Leaves, fruit	>20	Eczema & insect bites	Skin	22	0.46	0.26
Prunus armeniaca L. (Rosaceae)	Zarcha	Seeds, fruit	>20	Blood clotting, brain memory improvement	Blood, Neurological	96	0.62	0.88
Prunus persica (L) Batsch (Rosaceae)	Aaruu	Fruit	>20	Constipation & pulmonary diseases	Digestive, Respiratory	84	0.68	0.78
Pyrus pashia Ham. ex D. Don. (Rosaceae)	Nashpatti	Leaves, fruit	>20	Reduce constipation & cholesterol	Digestive, Cardiovascular	86	0.64	0.54
Pyrus pashia Ham. ExD. Don. (Rosaceae)	Batang	Leaves, fruit	>20	Abdominal pain	Digestive	42	0.5	0.24
Ranunculus muricatus L. (Ranunculaceae)	Makhanboo ti	Whole plant	>20	Asthma	Respiratory	28	0.46	0.34
Rheum australe D. Don. (Polygonaceae)	Chattiyal	Leaves, rhizome	10	stomach ulcer, kidney stone, & wound healing	Urology, Skin, Digestive	62	0.4	0.76
Robinia pseudo-acacia L. (Fabaceae)	Kikar	Leaves	>20	Digestion	Digestive	28	0.32	0.26
Rosa damascene Mill. (Rosaceae)	Gulab	Leaves, flowers	>20	Anti-bacterial & antiseptic	General	42	0.4	0.48
Saussurea lappa (Dcne.) C.B. Clarke. (Asteraceae)	Kuth	Roots	0	Dysentery & cholera	Digestive	20	0.4	0.22
Senegalia modesta (Wall.) P.J.H Hurter (Fabaceae)	Phulai	Leaves	0	Wound healing, bacterial infection, cough, dysentery	Skin, Pulmonary, Digestive	30	0.08	0.22
Skimmia laureola (DC.) Osbeck (Rutaceae)	Nehra	Leaves	2	Insect repellant	Skin	16	0.34	0.42
Solanum tuberosum L. (Solanaceae)	Aloo	Leaves, tuber	>20	Tranquilizer & antispasmodic agent	Musculoskeletal	94	0.88	0.94

Symphoricarpos albus (L.) S.F. Blake (Caprifoliaceae)	Snowberry	Fruit	>10	Wound healing	Skin	24	0.18	0.24
Thuja orientalis L. (Cupressaceae)	Challai	Leaves, roots	>20	Cough, fever & throat infection	General	88	0.46	0.42
Trifolium hybridum L. (Fabaceae)	Shekhawsha	Leaves	>10	Analgesic	General	18	0.22	0.64
Trifolium repens L. (Fabaceae)	Shautal	Leaves	>10	Pimples	Skin	62	0.3	0.42
Valeriana jatamansi (Jones ex runb) DC (Velerianaceae)	Mushq bala	Whole plant	>10	Pulmonary diseases & hypertension	Cardiovascular, Respiratory	44	0.54	0.64
Viola odorata L. (Violaceae)	Banafsha	Whole plant	>20	Sore throat & cough	General	28	0.44	0.52
Zanthoxylum armatum DC. (Rutaceae)	Timber	Leaves, seeds	>20	Stomach pain	Digestive	52	0.24	0.28
Zea mays L. (Poaceae)	Makai	Leaves, grain	>20	Tonic & Abdominal pain	Digestive	64	0.58	0.6

*ICPC: International classification of primary care; CI: Consensus index; UV: Use value; RFC: Relative frequency citation.

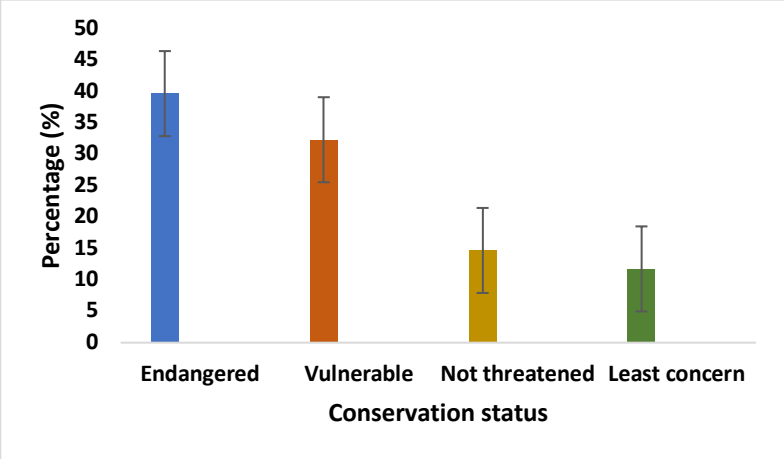


Figure 7. Percentage of plant species based on their conservation status.

Discussion

Medicinal plants have always been a major component of the traditional system of healing in developing countries (Sharma *et al*. 2020). In today's world, people are becoming more and more interested in plant-based medications as natural substitutes for synthetic ones. Additionally, research on medicinal plants and their traditional uses has attracted more attention (Sukumaran *et al*. 2021). Medicinal plants serve as the primary source of healthcare for nearly 80% of the underdeveloped world, catering to their essential healthcare needs (Kacholi & Amir 2022).

People in Pakistan depend on gathering food and utilizing herbal remedies to address a diverse range of ailments. In underdeveloped nations, a significant proportion of the population, ranging from 60-80%, relies on plant-based remedies as their primary source of healthcare. This reliance stems from limited access to allopathic medicines, which are often scarce or unavailable in these regions. (Ayoub *et al*. 2023). The Himalayan mountains exhibit a diverse terrain characterized by remarkable variations in climate and topography (Parvez *et al*. 2023).

The outcomes of our investigation closely correspond with the investigation done by (Jamal 2017) in diverse regions of Pakistan. The families Rosaceae, Fabaceae, and Pinaceae were found to encompass most medicinal plants, as indicated by the findings of this study. Our findings concur with those of (Ahmed *et al*. 2019, Nadaf *et al*. 2023, Karakose *et al*. 2022). They also disclosed that the Asteraceae, Fabaceae, Rutaceae, and Rosaceae families had the greatest number of medicinal plants examined. This could be because of the families' greater diversity and richness in the study area. Leaves, fruits and roots were the two most commonly used elements of therapeutic plants in traditional medicine. Our results are supported by (Abbasi *et al*. 2010, Chaachouay *et al*. 2022, Ssenku *et al*. 2022, Julung *et al*. 2023) who stated that leaves were the most often used plant portion, followed by fruits and seeds.

According to the present research, the listed plant species were frequently consumed to treat a variety of illnesses, like antidepressants, anemia, ulcers, wounds, sore throats, diabetes, gas, gastrointestinal disorders, and indigestion. Among the plant species in the ICPC-2 category, digestive (40.5%) is the most significant group. Similarly, after digestive problems followed by skin disorders (18.8%) and respiratory (13%). The importance of these three categories is due to the relatively high proportion of informants who include these categories in their indications. Our findings are confirmed by (Yebouk *et al*. 2023, Hein *et al*. 2023, Al-Fatimi 2023) who reported digestive, skin, respiratory and general categories were mostly mentioned by the informants.

In the Kaghan Valley (Irfan *et al*. 2018) 88 plant species from 46 families were identified as being utilized by locals to treat gas, constipation, ulcers, nausea, diarrhea, stomach burning, and indigestion. Prominent plant species included *Berberis lyceum* Royle, *Buxus wallichiana* Baill, *Buddleja asiatica* Lour, *Isodon rugosus* (Wall. ex benth.) Codd, *Justicia adhatoda* L., *Rosa damascena* Mill., *Skimmia laureola* (DC.) Siebold & Zucc. ex Walp., *Zanthoxylum armatum* DC. (Hussain & Ghani 2008) reported using *Paeonia emodi* wall. ex Royle dried leaves as a treatment for convulsions or neurological issues (Jamal *et al*. 2021) also reported decoction of *Valeriana wallichii* DC. is useful for respiratory problems.

An important parameter in our study is the RFC, which shows how frequently informants cite particular plant species for different reasons. One statistic that emphasizes the significance of different plants in indigenous traditions is the Use Value (UV). Higher UV levels indicate greater significance, and lesser significance is shown by lower values (Khadim *et al*. 2024). *Hedera helix* L. had the highest UV while (Jabeen et al. 2021) reported *Pinus roxburghii* Sarg. as the highest use value. Meanwhile, Myrtus communis had the highest RFC as reported by (Amin et al. 2024). *Prunus armeniaca* L. had the highest consensus index (CI) while (Pandikumar et al. 2011) reported *Pongamia pinnata with the* highest consensus index. Biologic stress harms the conservation status of medicinal plants (Majid 2015, Ali *et al*. 2018) also reported similar results. Special care must be given to plant species that are endangered and vulnerable to prevent their imminent extinction. The area's remoteness, poverty, and lack of modern facilities, food and medicine have a substantial influence on the importance of medicinal plant species. As a result, raising local awareness and preserving these healing herbs are of the utmost significance. Reliance on certain plant species for furniture, food, and fuel reported elevated anthropogenic activities and impaired biodiversity at such an enormous rate. Despite its natural beauty and economic importance, the valley is dealing with several environmental issues, including soil erosion, water pollution, and deforestation. Efforts are underway to address these issues through sustainable tourism practices, reforestation programs, and improved waste management.

Conclusion

The findings of this research highlight the value of traditional knowledge and practices when using these medicinal herbs for a range of health advantages. Through the documentation and examination of local communities' use of these plants, researchers can not only validate the efficacy of traditional medicine but also contribute to the conservation of these valuable resources. The study also emphasizes the necessity of sustainable production and harvesting methods to guarantee the long-term availability of these therapeutic plants. Our findings can contribute to ethnobotanical and ethnomedicinal knowledge and drug research for preexisting and new disorders, with a focus on thorough phytochemical profiling and bioactive potential. The study also serves as a call for healthcare professionals and environmentalists to recognize the importance of preserving traditional knowledge and biodiversity.

Declarations

List of abbreviations: WHO- World Health Organization; WHO-FIC- World Health Organization Family of International Classifications; ICPC- International Classification of Primary Care; IUCN- International Union for Conservation of Nature; UV- Use value; RFC- Relative frequency citation; CI- Consensus index.

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Consent for publication: Not applicable

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Literature cited

Abbasi AM, Khan MA, Ahmad M, Qureshi R, Arshad M, Jahan S, Sultana S. 2010. Ethnobotanical study of wound healing herbs among the tribal communities in Northern Himalaya Ranges District Abbottabad, Pakistan. Pakistan Journal of Botany 42 (6):3747-3753.

Ahmed J, Rahman IU, AbdAllah EF, Ali N, Shah AH, Ijaz F, Khan SM. 2019. Multivariate approaches evaluated in the ethnoecological investigation of Tehsil Oghi, Mansha, Pakistan. Acta Pharmacologica Sinica 39 (6):443-450.

Al-Fatimi M. 2023 Ethnopharmacological survey of endemic plants used in ethnomedicinal knowledge of Soqotra Island. Journal of Ethnopharmacology 304:116033.

Ali A, Badshah L, Hussain F. 2018. Ethnobotanical appraisal and conservation status of medicinal plants in Hindukush Range, District Swat, Pakistan. Journal of Herbs Spices and Medicinal Plants 24 (4):332-355.

Amin M, Aziz MA, Manduzai AK, Pieroni A, Alkahtani J, AbdelGawwad MR, Abbasi AM. 2024. Standard medical ethnobotany of Kohistan, North Pakistan. Journal of Ethnobiology and Ethnomedicine 20 (1):64.

Ayoub M, Saeed S, Ahmed A, Ahmed M. 2023. Ethnobotanical survey and utilization of medicinal and food plants of Panjgur Balochistan, Pakistan. Asian Journal of Ethnobiology 6(1).

Bhandari R, Pandeya B, Ghimire B. 2023. Ethnobotanical study of plant resources in Dhurkot rural municipality, Gulmi district Nepal. Ethnobotany Research and Applications 25:1-19.

Chaachouay N, Benkhnigue O, Zidane L. 2022. Ethnobotanical and ethnomedicinal study of medicinal and aromatic plants used against dermatological diseases by the people of Rif, Morocco. Journal of Herbal Medicine 32:100542.

Gillani SW, Ahmad M, Zafar M, Haq SM, Waheed M, Manzoor M, Makhkamov T. 2024. An insight into indigenous ethnobotanical knowledge of medicinal and aromatic plants from Kashmir Himalayan region. Ethnobotany Research and Applications 28:1-21.

Ginko E, Demirovic EA, Saric Kundalic B. 2023. Ethnobotanical study of traditionally used plants in the municipality of Zavidovici, BiH. Journal of Ethnopharmacology 302:115888.

Hein PP, Arunachalam KFUY, Zaw M, Yang Y, Yang X. 2023. Diversity of medicinal plants and their therapeutic usages of Kachin people (Jinghpaw) in the central part of Kachin State, Myanmar. Journal of Ethnopharmacology 302:115921.

Hussain M, Ghani A. 2008. Disorders In Kaghan Valley, NwFp, Pakistan. Pakistan Journal of Weed Science Research 14 (3-4):169-200.

Irfan M, Nabeela IK, Kamil M, Ullah S, Khan S, Shah M, Jan G. 2018. Ethnobotanical survey of the flora of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa. Journal of Applied Economics and Business Studies 8 (8):1-13.

Jabeen T, Akhtar A, Shah AH, Khan KR, Farooq M. 2021. Qualitative and quantitative ethnobotanical evaluation of plant resources of Kiwai, Kaghan valley, district Mansehra, Pakistan. Indian Journal of Traditional Knowledge 20 (1):141-153.

Jamal Z, Ahmad M, Zafar M, Sultana S, Khan MA, Shah GM. 2012. Medicinal plants used in traditional folk recipes by the local communities of Kaghan valley, Mansehra, Pakistan. Indian Journal of Traditional Knowledge 11 (4):634-639.

Jamal Z, Pervez A, Hussain M, Shah GM, Shah SH, Ahmed M. 2017. Ethnomedicinal plants used for gastrointestinal ailments by the rural communities of Kaghan Valley, Mansehra, Pakistan. Journal of Applied Economics and Business Studies 7 (12):41-48.

Jamal Z. 2009. Biodiversity, ethnobotany and conservation status of the flora of Kaghan valley Mansehra, NWFP Pakistan. PhD dissertation, Quaid-i-Azam University Islamabad Pakistan.

Julung H, Supiandi MI, Ege B, Zubaidah S, Mahanal S. 2023. Ethnobotany of medicinal plants in the dayak linoh tribe in sintang district, Indonesia. Biodiversity Journal 24(2).

Kacholi DS, Amir HM. 2022. Ethnobotanical survey of medicinal plants used by traditional healers in managing Gonorrhoea and Syphilis in Urambo District, Tabora Region, Tanzania. Journal of Herbs Spices and Medicinal Plants 28 (2):179-192.

Karakose M. 2022. An ethnobotanical study of medicinal plants in Güce district, north-eastern Turkey. Plant Diversity 44 (6):577-597.

Khadim S, Hyder S, Zuhra T, Abbas H. 2024. Ethnobotanical inventory and indigenous therapeutic applications of wild medicinal plants in Parishing valley, District Astore, Gilgit-Baltistan, Pakistan. Ethnobotany Research and Applications 28:1-26.

Liaqat I, Hussain S, Abid H, Ahmad I, Arif S, Haq MA, Mahmood B. 2023. An Ethnobotanical survey of medicinal plants used for primary health care from Patan Sher Khan and surrounding areas of District Sudhnoti, Azad Jammu and Kashmir, Pakistan. Journal of Applied Research in Plant Sciences 4 (01):518-528.

Majid A. 2015. Distribution pattern and conservation status of plants endemic to Pakistan in Hazara region, PhD dissertation, Hazara University Mansehra.

Nadaf M, Amiri MS, Joharchi MR, Omidipour R, Moazezi M, Mohaddesi B, Mottaghipisheh J. 2023. Ethnobotanical diversity of trees and shrubs of Iran: A comprehensive review. International Journal of Plant Biology 14 (1):120-146.

Pandikumar P, Chellappandian M, Mutheeswaran S, Ignacimuthu S. 2011. Consensus of local knowledge on medicinal plants among traditional healers in Mayiladumparai block of Theni District, Tamil Nadu, India. Journal of Ethnopharmacology 134 (2):354-362.

Parvez I, Ahmad I, Hameed M, Ahmad MSA. 2023. Plasticity in anatomical traits of Cyperus niveus Retz. along elevational gradient of dry sub-Himalayan mountains. Arid Land Research and Management 37 (2):197-221.

Rehman S, Iqbal Z, Qureshi R, Rahman I, Khan MA, Elshaer M, Abu Bakr Elsaid NM. 2022. Ethnogynaecological knowledge of traditional medicinal plants used by the indigenous communities of north Waziristan, Pakistan. Evidence Based Complementary and Alternative Medicine 2022 (1): 6528264.

Sabir S, Raja NI, Qureshi R, Hussain K. 2024. Indigenous traditional knowledge and ethnobotanical flora: a quantitative assessment of medicinal flora of Fateh Pur Thakyala, Azad Jammu, and Kashmir, Pakistan. Journal of Ecology and Environment 48.

Sagıroglu M, Eker I, Semerci AB, Karaduman D. 2023. Ethnobotanical culture of geophytes in Sakarya province, Turkey. Botanical Sciences 101 (1):134-148.

Selvi S, Polat R, Çakilcioglu U, Celep F, Dirmenci T, Ertug, ZF. 2022. An ethnobotanical review on medicinal plants of the Lamiaceae family in Turkey, Turkish Journal of Botany 46 (4):283-332.

Shah IA, Burni T, Badshah L, Uza NU, Bussmann RW. 2023. Quantitative ethnobotanical study and conservation status of herbal flora of Koh-e-Suleman range, Razmak valley, North Waziristan, Pakistan. Ethnobotany Research and Applications 25:1-18.

Shah SHA, Shah GM, Ali N, Alam J, Rehman S, Alia A, Basit A. 2024. Ethnomedicinal survey of medicinal plants traditionally used in Sakhra Valley district Swat, Pakistan. Ethnobotany Research and Applications 29:1-28.

Shah SHA, Shah GM, Ali N, Alam J, Rehman S, Alia A, Basit A. 2024. Ethnomedicinal survey of medicinal plants traditionally used in Sakhra Valley district Swat, Pakistan. Ethnobotany Research and Applications 29:1-28.

Sharma M, Sharma AK, Sharma M. 2020. Ethno-botanical study of medicinal plants from unexplored area of District Ramban (J&K) India. Indian Journal of Agricultural Research 54:1-7.

Ssenku JE, Okurut SA, Namuli A, Kudamba A, Tugume P, Matovu P, Walusansa A. 2022. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda Journal of Tropical Diseases and Medicine 50 (1):39.

Sukumaran S, Sujin RM, Geetha VS, Jeeva S. 2021. Ethnobotanical study of medicinal plants used by the Kani tribes of Pechiparai Hills, Western Ghats, India. Acta Ecologica Sinica 41 (5):365-376.

Tahir M, Asnake H, Beyene T, Van Damme P, Mohammed A. 2023. Ethnobotanical study of medicinal plants in Asagirt District, Northeastern Ethiopia. Tropical Medicine and Health 51 (1):1-13.

Ullah Z, Mahmood S, Iqbal Z, Akhtar N, Khan MF, Said A, Arif M. 2021. Damages to Himalayan White Pine (*Pinus wallichiana*) by Asiatic Black Bear (*Ursus thibetanus*) in Kaghan Valley, Pakistan. Forests 12 (8): 1130.

Walter KS, Gillett HJ. (Eds.). 1998. 1997 “IUCN red list of threatened plants IUCN.” The World Conservation Union, Gland, Switzerland.

World Health Organization (WHO). (2021) International Classification of Primary Care, second ed. ICPC-2). https://www.globalfamilydoctor.com/groups/WorkingPar ties/wicc.aspx. (Accessed 20/10/2023).

Yebouk C, Redouan FZ, El Hachimi H, Merzouki A. 2023. The status and perception of medicinal plants by local population of Adrar province (Northern Mauritania). Ethnobotany Research and Applications 26:1-18.

Zeeshan A, Aslam S, Shaukat S, Nazar A, Akram H, Riaz A. 2023. Ethnobotanical Study of Medicinal Plants of Tehsil Pattoki, Pakistan. GU Journal of Phytosciences 3 (1):14-21.