Millennial traditions - Exploration of ethno-medicinal knowledge among different ethnic groups of Northern part Kashmir Himalaya, India

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Abstract

Background: Traditional use of medicinal plants is an important aspect of Himalayan culture, and these approaches have evolved to include the primary health-care purpose and treatment of a wide range of ailments.

Methods: Snowball sampling method was used to interview 300 informants using semi-structured questionnaire to document the uses of indigenous species. Principal component analysis was used to analyze the data using PAST software ver.3.14.

Results: The present study reported a total of 67 medicinal plants belonging to 44 families with Asteraceae as dominant family. The majority of the species were herbaceous (81%) followed by trees (10%) and shrubs (9%). Leaves were the most commonly used plant part accounting for (16%), followed by roots (10%). The medicinal plants were used to cure various ailments, especially intestinal problems, skin diseases, stomach problems, respiratory problems, diabetes, bone and joint problems. The majority of people preferred to prepare herbal medicines on their own rather than obtaining these from traditional health practitioners. 63.11%, 55.15%, 45.61% respondents believed that the medicinal plants were highly effective from the site I, II, III respectively.

Conclusions: According to the findings of the current study, local people have a profound cultural link to the flora, as the use of medicinal plants to treat various illnesses plays an important role in meeting the primary health care needs. Due to urbanization and exploitation, it has become imperative to preserve the traditional medicinal knowledge before it becomes extinct.

Keywords: Health care, Knowledge, Medicinal plants, Traditional therapeutic use

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Background

Traditional medicine is not practiced in the same way all over the world, and it differs according to culture and philosophy of the region (Zidny *et al.* 2020). In the Indian medicinal system (Ayurveda, Unani, and Siddha) plants play a vital role and possess an utmost position, same is seen in Chinese and Tibetan medicine systems (Haq *et al.* 2020; Hassan *et al.* 2021b; Yeshi *et al.* 2019). Traditional medicine is legacy to the modern medical world as varieties of chemical compounds used to treat different diseases have been extracted from plants (Ramawat *et al.* 2009; Hassan *et al.* 2021c). Plants play a vital role in the healthcare and wellbeing regimens of people living in remote Himalayan locations (Yousuf *et al.* 2020; Haq *et al.* 2021). This can be linked to their strong faith in the efficiency of herbal medicines (traditional medicinal system) as well as the lack of contemporary healthcare services (Heinrich *et al.* 2021). Due to urbanizations and habitat loss the indigenous knowledge about the use of medicinal plants is disappearing in many regions, hence it becomes imperative to document the said traditional knowledge before it is lost forever (Rodrigues *et al.* 2020; Wali *et al.* 2021). Ethnobotany is valuable for the development of healthcare and conservation programs in different parts of the globe by preservation and promoting future medicinal plant research for the development of novel medications (Nagan and Hammer 2013).

Plants have always been utilized by humans to improve their bodily and spiritual well-being, and medicinal plants have risen in popularity even in the modern period (Cocks and Moller 2002; Jan *et al.* 2021). This interaction between plants and mankind has always been complex as it is affected by a variety of factors like local categorization systems, language, human cognition, cultural beliefs, religion, social networks, and information access (Brondízio *et al.* 2021; Fernández-Llamazares *et al.* 2021). The side effects and rising cost of allopathic medicine have led to an increase in the use of natural products and further this has led the worldwide researchers to focus on ethno-medicinal flora (Sharma *et al.* 2018; Mir *et al.* 2021).

The Himalaya region (Kashmir) holds more than half India's biodiversity (Dar and Khuroo 2020), with most of the species being rare and endemic, serving as the prime resource for food and medicine (Kumar *et al.* 2021; Singh *et al.* 2020). So far a significant number of ethnobotanical studies have been carried out across the Himalayan mountain range in different countries, including India, and have reported enormous numbers of medicinal and food plants historically being used by the local communities. Particularly the tribal communities like Gujjar, Bakarwal, and Pahari of the region are more dependent on non-timber forest products, as they extract their livelihood from plant derived ingredients which are also playing a crucial role in managing the traditional health care systems. Jammu and Kashmir, a union territory in India, lies in the bosom of the Himalayas. The inhabitants in remote areas of the region mostly depend on the flora to combat a variety of health disorders (Asif *et al.* 2021; Jan *et al.* 2021; Jan *et al.*2021a; Jan *et al.* 2022). Recognizing the loss of ethnomedicine knowledge, the current study aimed to collect and document information on the indigenous use of medicinal plants by the people of District Baramulla for the treatment of ailments for future generations, as well as provide baseline information for pharmacological studies on the discovery of new drugs and molecules.

Material and Methods

Study Area

The Kashmir valley (Fig. 1) constitutes one of the provinces of the Indian Himalayan Union Territory of Jammu and Kashmir (J&K) (http://cgwb.gov.in/AQM/NAQUIM_REPORT/JandK/Kashmir%20Valley.pdf; Haq *et al.* 2020a). The province, situated on the northernmost edge of the Indian Himalaya, is spread over an area of 15,948 km^2 ,(https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr_jandk/sdr_jkch1.pdf) , and falls between 33º 20´ to 34º 54´N latitudes and 73º 55´ to 75º35´ E longitudes. The region shows a highly uneven topography and about 64% of the area is mountainous with altitude ranging from 1600 to 5420 (m.a.s.l). The region possesses remarkable habitat diversity. The present study was conducted in the north Kashmir Baramulla district (Fig. 1). Geographically the district is situated between 34.1980 N and 74.3636 E and has an average elevation of 1750 (m.a.s.l). The climate is predominantly continental temperate with wet and cold winters and relatively dry and mild summers (https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr_jandk/sdr_jkch1.pdf; ul *et al.* 2019).

Study Sites

Site I (Tangmarg): Tangmarg lies in the Baramulla district of union territory of Jammu and Kashmir. Geographically, it lies between 33°.80´ N to 75°.36 ´E, with an average elevation of 2350 m (m a.s.l.). The area known for its cold-water springs, also area receives heavy snowfall during winter. The region is also enriched with lush green alpine forests. Tribal communities inhibited are Gujjar, Bakarwall. Area is mostly rural with limited area in market for trade. Elderly people are mostly illiterate, and the young people are almost well read

Site II (Pattan): Pattan a town lies in the municipal limits of Baramulla of the union territory Jammu and Kashmir, India. Geographically, it lies between 34°.17´ N latitude to 74° 57´E, with an average elevation of 1553 m (m a.s.l.). The area is transition point between Srinagar (City) and famous apple town Sopore. The area is mainly inhibited by Kashmiri people; however, some Gujjar families are also visible who have migrated from the high altitude area Gulmarg.

Site III (Baramulla town): Baramulla town is situated between 34°.19´ N to 74°.36´ E in the union territory of Jammu and Kashmir. It is the administrative headquarters of the district Baramulla. The area is well off in every respect like education, health, transport, economy, and other necessary vitals. The area is mainly inhibited by Kashmiri people. Tribal people like Gujjar use to come in the town to sell item like handle for spade, axe, and other agricultural equipment. Also the Bakarwal, use to come in town on special occasions like Eid, so people can purchase their livestock, like sheep, and goats.

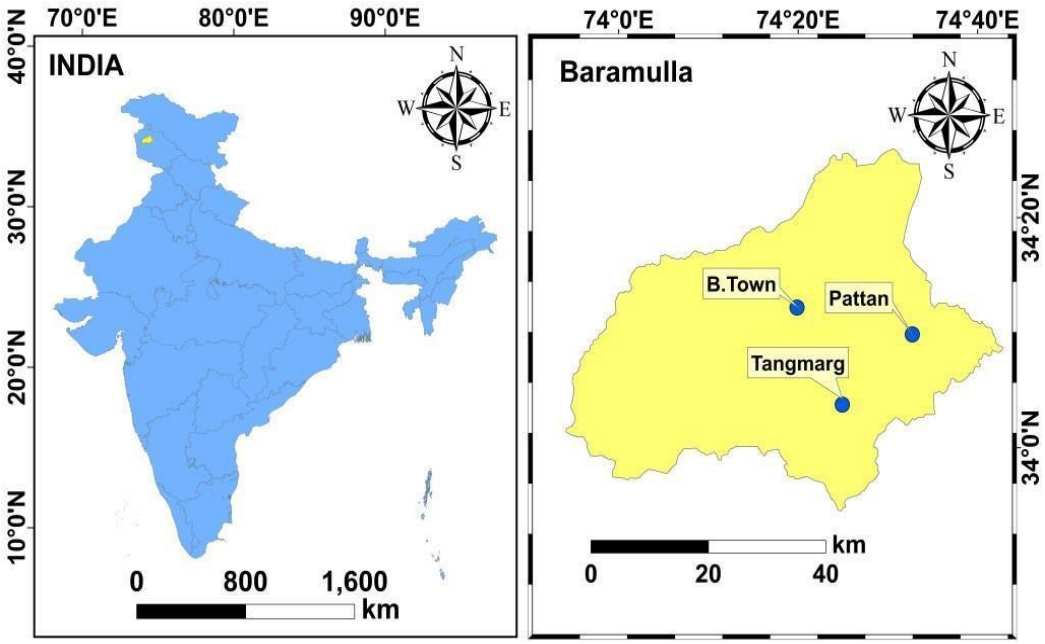

Figure 1. Map of India, Kashmir, and point showing survey sites in the erstwhile UT of Jammu and Kashmir.

Ethnobotanical methodology

A questionnaire was designed to document the traditional knowledge of medicinal plants. The data was collected through field surveys and face-to-face interviews after obtaining oral prior informed consent from all participants (Hassan *et al.* 2021; Haq *et al.* 2021). A total of 300 households were interviewed and the selection of the household was random. Specimens were collected and identified at the Center for Biodiversity and Taxonomy (CBT), Department of Botany, University of Kashmir, where the vouchers have been deposited. The format of the questionnaire is given below (Appendix. 1).

Demographic details of respondents

We conducted interviews with 300 respondents across twenty villages in the study area. The number of men (N=205) was higher than women (N=95). This can be explained by the fact that the people in the study area follow the Islamic faith, and women are prohibited or reluctant to communicate with strange people (Hassan *et al.* 2021a; Haq *et al.* 2020a).The age of respondents ranged between 18-75 years. Most respondents recorded were older (N=121) followed by middle aged (N=109) and young (N=70). Among the respondents more than half were illiterate (N=104), 80 respondents had primary education, 66 with secondary education, and 50 higher education (Table 1).

Table 1. Demographic status of the respondents from study area

Demographic features	Number of people	Percentage
Informants	300	
Gender		
Male	205	68
Female	95	32
Visited villages	20	
Language	Urdu, Kashmiri	
Ethnic group	Gujjar Bakarwal Kashmiri	
Education		
Illiterate	104	35
Primary education	80	27
Secondary education	66	22
Higher education	50	17
Age range		
Young (18-26)	70	23
Middle (27-55)	109	36
Old (56-75+)	121	40
Profession		
Skilled/semi-skilled worker	45	15
Cultivator/agricultural laborer	51	17
Hakeem (Traditional healers)	15	5
Daily wage laborers	72	24
Govt. employees	32	11
Housewives	43	14
Shopkeepers	42	14
Religion	Islam	

Results and Discussion

Medicinal plants used in the study area

The present study identified 67 plant species belonging to 65 genera and 44 families. The usage of all species is presented in Table. 2. Some representative photographs of medicinal plants taken during the survey are shown in photo plate 1. When comparing the number of species documented in the present study it is apparent that a high number of species was being used locally, as e.g., Mir *et al.* (2021) reported 34 plant species; Singhal *et al.* (2020) reported 37 species; Mir *et al.* (2021) reported 32 species; Asif *et al.* (2021) reported 29 species; Mehmood *et al.* (2018) reported 24 species from the Himalayas. Among the documented species 81% were herbaceous, followed by trees (10%) and shrubs (9%) (Table.2). The dominance of herbaceous plants can be ascribed to the fact that herbaceous plants are easier to work with when it comes to herbal preparation and extracting active metabolites than woody plants like shrubs and trees (Mehmood *et al.* 2018; Haq and Singh 2020). Some important species are shown in Appendix 2.

Across the 44 families, the distribution of species was unequal, half of the species belonged to 11 families (Asteraceae, Apiaceae, Brassicaceae, Lamiaceae, and Solanaceae, Berberidaceae, Caprifoliaceae, Euphorbiaceae, Fabaceae, Iridaceae and Malvaceae), while the remaining half belonged to 33 families. A large number of families (N=29) were monotypic, being represented by single species (Fig. 2, Table 2). The predominance of families was also comparable with the investigations carried out in other parts of the Himalayan region which have described Asteraceae as the dominant family (Haq and Singh 2020; Nafeesa *et al.* 2021; Altaf *et al.* 2021). Also, the dominance of Asteraceae may be due to high involvement in the cultivation of the various species of this family for medicinal purposes (Haq *et al.* 2021a). Another plausible explanation for the dominance of family Asteraceae is that this particular family is mostly cosmopolitan, rich in essential oils and is widely used in traditional medicine (Mir *et al.* 2021). Owing to widespread ecological amplitude, the members of the family Asteraceae acclimatize easily and adapt to arid dry habitats rapidly (Haq *et al.* 2021a).

Table 2. Medicinal flora of district Baramulla.

Scientific name	Family	Local name	Growth form	Part used	Preparation form	Diseases treated	Ethnic groups
Acorus calamus L.	Acoraceae	Vai	Herb	Rhizome	Decoction	Stomach troubles Skin diseases Anthelmintic	Kashmiri
Allium cepa L.	Alliaceae	Gande Pyaaz	Herb	Bulb	Cooked	For increasing appetite	Gujjar, Bakarwal kashmiri
Celosia argentea L.	Amaranthaceae	Mawal	Herb	Seeds	Cooked	Jaundice Diarrhea Fever	Kashmiri
Coriandrum sativum L.	Apiaceae	Danival	Herb	Leaves	Raw	Blood pressure Headache	Gujjar, Bakarwal, Kashmiri
Foeniculum vulgare Mill.	Apiaceae	Badiyaan	Herb	Seeds	Raw	Urinary infection Constipation	Gujjar, Bakarwal, Kashmiri
Heracleum canescens Lindl.	Apiaceae	Heracleum	Herb	Fruit Leaf Root	Raw	Aphrodisiac	Gujjar, Bakarwal
Arctium lappa L.	Asteraceae	Phughood	Herb	Leaves Root	Decoction	Skin disease Boils Body pain	Gujjar, Bakarwal
Artemisia absinthium L.	Asteraceae	Tethwan	Herb	Leaves	Decoction	Obesity Diabetes Liver issues.	Gujjar, Bakarwal, Kashmiri
Cotula anthemoides L.	Asteraceae	Bobul	Herb	Flowers	Raw	Rheumatism	Kashmiri
Eclipta prostrata L.	Asteraceae	Babriboul	Herb	Seeds	Infusion	Urinary infection	Gujjar, Bakarwal, Kashmiri
Inula racemosa Hook. f.	Asteraceae	Puskarmool	Herb	Dried rhizomes Roots	Decoction	Weakness Expectorant Inflammation	Gujjar, Bakarwal
Saussurea costus (Falc.) Lipsch	Asteraceae	Kouth	Herb	Rhizome	Decoction	Joint pain Cough Asthma	Kashmiri
Taraxacum officinale F.H. Wigg.	Asteraceae	Hand	Herb	Leaves	Cooked	Back pain Fractures	Gujjar, Bakarwal, Kashmiri

						Delivery problems	
Berberis lycium Royle	Berberidaceae	Kawdach	Shrub	Roots Fresh fruit	Decoction	Indigestion Constipation.	Kashmiri
Sinopodophyllum hexandrum Royle	Berberidaceae	Banwangun	Herb	Leaves Roots	Raw	Skin diseases Gastric problems	Gujjar, Bakarwal, Kashmiri
Betula utilis D. Don	Betulaceae	Bhuz	Tree	Bark	Infusion	Antiseptic	Gujjar
Arnebia benthamii (Wall. ex G. Don) I.M. Johnst.	Boraginaceae	Kahzaban	Herb	Leaves Flowers	Decoction	Fever	Gujjar, Bakarwal, Kashmiri
Brassica rapa L.	Brassicaceae	Telgogul	Herb	Seeds	Oil	Hair fall Dandruff	Gujjar, Bakarwal, Kashmiri
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	Kralmond	Herb	Leaves	Infusion	Gastrointestinal disorders Chronic diarrhea	Kashmiri
Raphanus sativus L.	Brassicaceae	Mujh	Herb	Roots	Raw	Appetite issue Urinary infection Chronic constipation.	Gujjar, Bakarwal, Kashmiri
Cannabis sativa L.	Cannabinnaceae	Bhang	Herb	Leaves Seeds Stem	Decoction	Ear-ache Blood purifier Scabies Piles	Gujjar, Bakarwal, Kashmiri
Dipsacus inermis Wall.	Caprifoliaceae	Wapalhakh	Herb	Leaves	Decoction	Cough Body weakness Pain Swelling	Kashmiri
Valeriana jatamansi (D. Don) Wall.	Caprifoliaceae	Mushkibala	Herb	Dried roots Rhizome	Decoction	Eye diseases Blood issues Livers diseases	Gujjar, Bakarwal, Kashmiri
Viburnum grandiflorum Wall. ex DC.	Caprifoliaceae	Kulmanch	Shrub	Seeds	Raw	Typhoid Whooping cough	Gujjar, Bakarwal, Kashmiri
Juniperus communis L.	Cupressaceae	Bithur	Shrub	Leaves	Cooked	Rheumatism	Gujjar, Bakarwal
Cuscuta reflexa Roxb.	Cuscutaceae	Kokliporte	Herb	Whole plant	Decoction	Urination disorders Muscle pain Cough Blood purifier	Kashmiri

Dioscorea deltoidea Wall. ex Griseb.	Dioscoreaceae	Kraeth	Herb	Leaves	Decoction	Ophthalmic infections Urinary infections	Gujjar, Bakarwal, Kashmiri
Equisetum arvense L.	Equisetaceae	Gundam Gund	Herb	Stem Leaves	Raw	Bleeding Ulcers Wounds	Gujjar, Bakarwal, Kashmiri
Euphorbia helioscopia L.	Euphorbiaceae	Gurisochol Gandibooti	Herb	Seeds Roots Latex	Raw	Abdominal cramps Cholera and Eruptions	Gujjar, Bakarwal
Euphorbia wallichiana Boiss.	Euphorbiaceae	Guridud / Harbi	Herb	Stem Leaves Latex	Raw	Skin diseases Asthma	Gujjar, Bakarwal, Kashmiri
Glycyrrhiza glabra L.	Fabaceae	Shanger	Shrub	Root	Decoction	Cough Cold	Kashmiri
Mentha longifolia L.	Fabaceae	Meth	Herb	Leaves	Raw	Diabetes Heart issue Liver problems Stomach problems	Gujjar, Bakarwal, Kashmiri
Fumaria indica (Hausskn.) Pugsley	Fumariaceae	Pugsley / Shahtaur	Herb	Whole plant	Infusion	Dyspepsia Rheumatism	Gujjar, Bakarwal
Crocus sativus L.	Iridaceae	Zafran	Herb	Flower (stigma)	Raw	Antioxidant Mood elevator	Gujjar, Bakarwal, Kashmiri
Iris kashmiriana Baker	Iridaceae	Mazarmund	Herb	Whole plant	Infusion	Joint pains	Kashmiri
Juglans regia L.	Juglandaceae	Doonkul	Tree	Bark	Raw	Cleaning teeth	Gujjar, Bakarwal, Kashmiri
Lavandula officinalis Chaix	Lamiaceae	Lavender	Shrub	Leaves Stem Flowers	Infusion	Anxiety Depression Headache	Kashmiri
Mentha arvensis L.	Lamiaceae	Pudni	Herb	Leaves	Raw	Appetite problem.	Gujjar, Bakarwal, Kashmiri
Prunella vulgaris L.	Lamiaceae	Kalwiyuth	Herb	Flowers	Cooked	Wounds Headache Memory issue	Kashmiri
Allium sativum L.	Liliaceae	Rohan	Herb	Bulb	Raw	Hair fall Toothache Cholesterol issue	Gujjar, Bakarwal, Kashmiri

Lavatera cachemiriana Cambess.	Malvaceae	Sazposh	Herb	Root	Infusion	Skin irritation in pregnant women Mumps	Kashmiri
Malva sylvestris L.	Malvaceae	Sochal	Herb	Leaves	Infusion	Eyesight problems Tonic Laxative	Gujjar, Bakarwal, Kashmiri
Ficus carica L.	Moraceae	Anjeer	Herb	Fruits	Raw	Infertility	Gujjar, Bakarwal, Kashmiri
Peganum harmala L.	Nitrariaceae	Izband	Herb	Roots Seeds	Decoction	Body pain Lice problems	Kashmiri
Olea europaea L.	Oleaceae	Zytoon	Herb	Fruits	Infusion	Bone & joint problems	Gujjar, Bakarwal, Kashmiri
Dactylorhiza hatagirea (D. Don) Soó	Orchidaceae	Salem Panja	Herb	Whole plant	Decoction	Dysentery Diarrhea Chronic fever	Gujjar, Bakarwal
Papaver somniferum L.	Papaveraceae	Kashkhas	Herb	Fruits	Infusion	Dry cough Diarrhea	
Phytolacca acinosa Roxb.	Phytolaccaceae	Brand	Herb	Root	Decoction	Used as sedative to extract wounds.	Gujjar, Bakarwal, Kashmiri
Abies pindrow (Royle ex D. Don) Royle	Pinaceae	Sal/ Baddul	Tree	Bark	Infusion	Rheumatism	Gujjar, Bakarwal, Kashmiri
Cedrus deodara (Roxb. ex D. Don) G. Don	Pinaceae	Divdar	Tree	Stem Bark	Oil	Skin rashes External ulcers.	Gujjar, Bakarwal, Kashmiri
Picrorhiza kurrooa Royle ex Benth.	Plantaginaceae	Kutki	Herb	Root Rhizome	Decoction	Liver disorders Upper respiratory tract issues	Gujjar, Bakarwal
Plantago lanceolata L.	Plantaginaceae	Gull	Herb	Leaves	Cooked	Cough	Gujjar, Bakarwal, Kashmiri
Fagopyrum esculentum Moench	Polygonaceae	Chaeersaban	Herb	Leaves Shoots	Decoction	Blood pressure Gout	Gujjar, Bakarwal, Kashmiri
Rheum webbianum Royle	Polygonaceae	Pamchalan	Herb	Roots Leaves	Decoction	Renal function disorders	Kashmiri
Portulaca oleracea L.	Portulacaceae	Nunar	Herb	Whole plant	Cooked	Acting as a febrifuge Used as vermifuge.	Gujjar, Bakarwal, Kashmiri
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	Paewakh/ Patrees, Atees/	Herb	Root	Decoction	Antidote for snake bites	Gujjar, Bakarwal

Anemone obtusiloba D. Don	Ranunculaceae	Kawashud	Herb	Root	Cooked	Joint pains.	Gujjar, Bakarwal, Kashmiri
Prunus persica (L.) Batsch	Rosaceae	Chenun	Tree	Fruits Leaves	Raw	Abdominal pain	Gujjar, Bakarwal, Kashmiri
Citrus limon (L.) Osbeck	Rutaceae	Leom	Herb	Fruits	Raw	Weight loss	Gujjar, Bakarwal, Kashmiri
Salix alba L.	Salicaceae	Miswak	Tree	Stem Twigs	Raw	Cleaning teeth	Gujjar, Bakarwal, Kashmiri
Sambucus wightiana Wall. ex Wight & Arn.	Sambucaceae	Kown	Shrub	Roots Leaves Fruits	Decoction	Diuretic Purgative	Gujjar, Bakarwal, Kashmiri
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae	Palfoot	Herb	Root	Decoction	Joint pains	Kashmiri
Atropa acumniata Royle ex Lindl.	Solanaceae	Chellalubbar	Herb	Roots Leaves	Infusion	Cough Spasmodic problems	Bakarwal
Datura stramonium L.	Solanaceae	Datur	Herb	Fruits	Raw	Dandruff Rheumatic pain	Kashmiri
Hyoscyamus niger L.	Solanaceae	Bazarbang	Herb	Seeds	Decoction	Tooth ache	Gujjar, Bakarwal, Kashmiri
Taxus baccata L.	Taxaceae	Birmi	Tree	Whole plant	Infusion	Spasmodic pain Cardio-tonic Diaphoretic Emmenagogue Expectorant Purgative	Gujjar, Bakarwal, Kashmiri
Trapa natans L.	Trapaceae	Gaerkul	Herb	Fruits	Infusion	Stomach problems Kidney issues Spleen diseases	Gujjar, Bakarwal, Kashmiri
Urtica dioica L.	Urticaceae	Soi	Herb	Leaves Roots	Cooked	Dandruff Wounds	Kashmiri

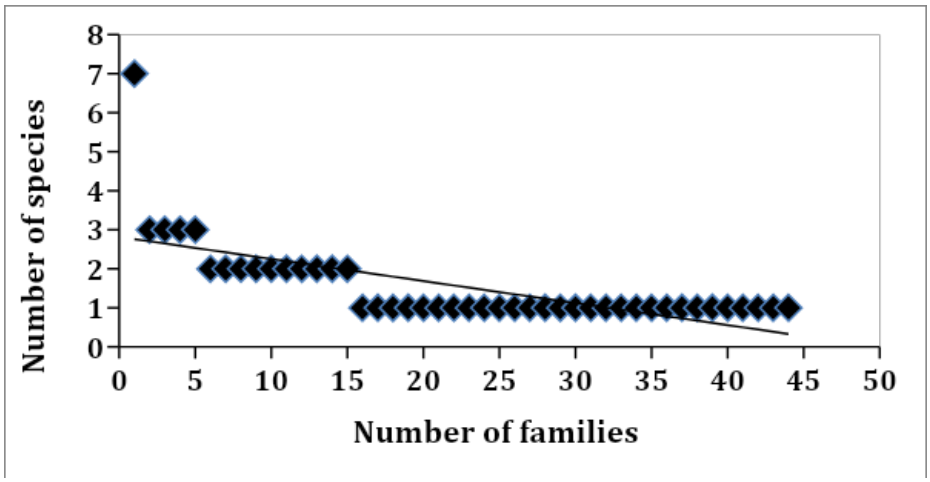

Figure 2. Species family relationship of documented medicinal flora of the study area

Part used

Different plant parts were documented for indigenous use, with a significant variance in their usage ($\chi 2 = 87.876$, $df=9$, $p<0.001$). Leaves were the most commonly used plant part accounting for 16%, followed by roots (10%), seeds (9%), fruits (9%), whole plant (9%), bark (5%), rhizome & bulb (3% each) **(**Fig. 3). The maximum usage of the leaves can be explained by the fact that they are easy to collect and are locally believed to be rich in the constituents with medicinal attribution. Leaves are directly involved in photosynthesis, creating a variety of active substances and acting as sinks for secondary metabolites, all of which have great medical potential. (Yousuf *et al.* 2020) Similarly, Haq and Singh (2020) from District Reasi, J&K, reported the predominant utilization of leaves of medicinal plants in herbal medicines.

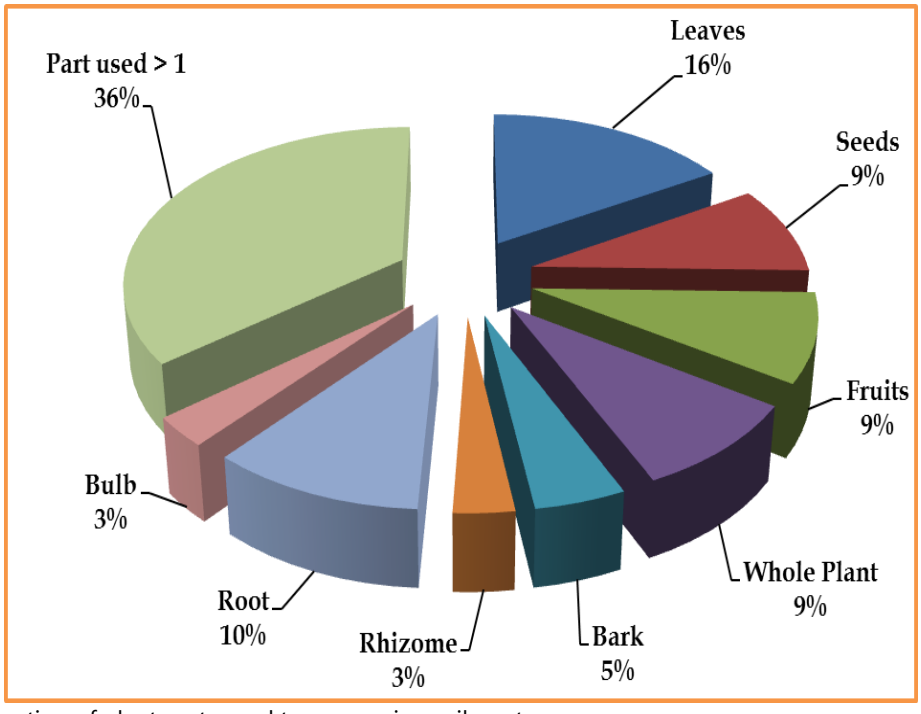

Figure 3. Proportion of plant parts used to cure various ailments.

Preparation form

The present study documented decoctions (34%) as most commonly used preparation, as the local population believed that said preparation had higher efficacy than any other preparation form (Fig. 4). It is believed that the water from the Himalayans alps used for the decoction do possess the healing potential, leading to a synergistic effect.;). Haq *et al.*2021 while evaluating the use of plants across different communities in Ladakh revealed that decoction was the most used preparation form.. Koduru *et al.* 2007 reported the maximum usage of decoction

while investigating the medicinal uses of plants for the treatment of cancer. Other researchers also reported the maximum usage of decoction (Asif *et al.* 2021; Mir *et al.* 2021; Rahmaan *et al.* 2021)

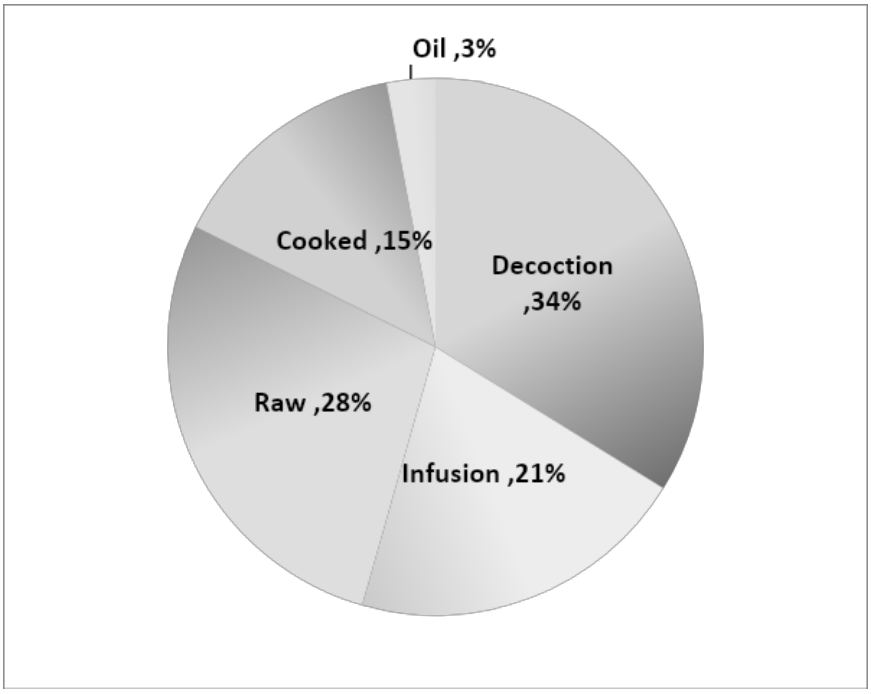

Figure 4. Percentage of preparation mode of usage of documented species.

Ethno-pharmacological relevance

This study presents a brief account of the uses of various ethno-medicinal plants against various diseases like rheumatism, stomach troubles, skin diseases, hair fall, cough and cold, headache, and urinary infection by the local inhabitants in J&K. The use percentage observed from site I, II, III respectively are shown in Table 3. The highest percentage response regarding the use of traditional medicines was found at site I, which may be due to the fact that the inhabited area is rural hence people have an easy access to forests. The results further revealed that most species were used to treat gastrointestinal problems, followed by dermatological diseases, bone and joint and respiratory problems. This was also supported by the PCA (Fig. 5). The gastrointestinal problems, dermatological diseases were outlined in groups. Our results are in accordance with previous studies e.g., Sher *et al.* (2021) from Pakistan. Gastrointestinal problems were common diseases treated by traditional therapies were also reported by Arya *et al.* (2021) & Chetry *et al.* (2018) in western Himalaya & Eastern Himalaya respectively.

Table 3. Percentage response regarding the preference of traditional medicines used for curing various diseases

Diseases	Site I	Site II	Site III	Mean
Gastro-intestinal problem	27.11%	16.23%	18.73%	**20.69%**
Dermatological problem	10.32%	13.22%	10.16%	**11.23%**
Stomach problems	13.76%	12.91%	17.67%	**14.78%**
Respiration problems	8.57%	10.23%	14.18%	**10.99%**
Bone and Joint problems	15.04%	16.31%	17.29%	**16.21%**
Diabetes	3.23%	7.45%	8.45%	**6.37%**
Cancer	1.45%	0%	0%	**0.48%**
Fever	8.04%	7.32%	8.18%	**7.84%**
Cough and Cold	9.36%	9.11%	3.22%	**7.23%**
Tooth problems	3.12%	7.22%	2.12%	**4.15%**

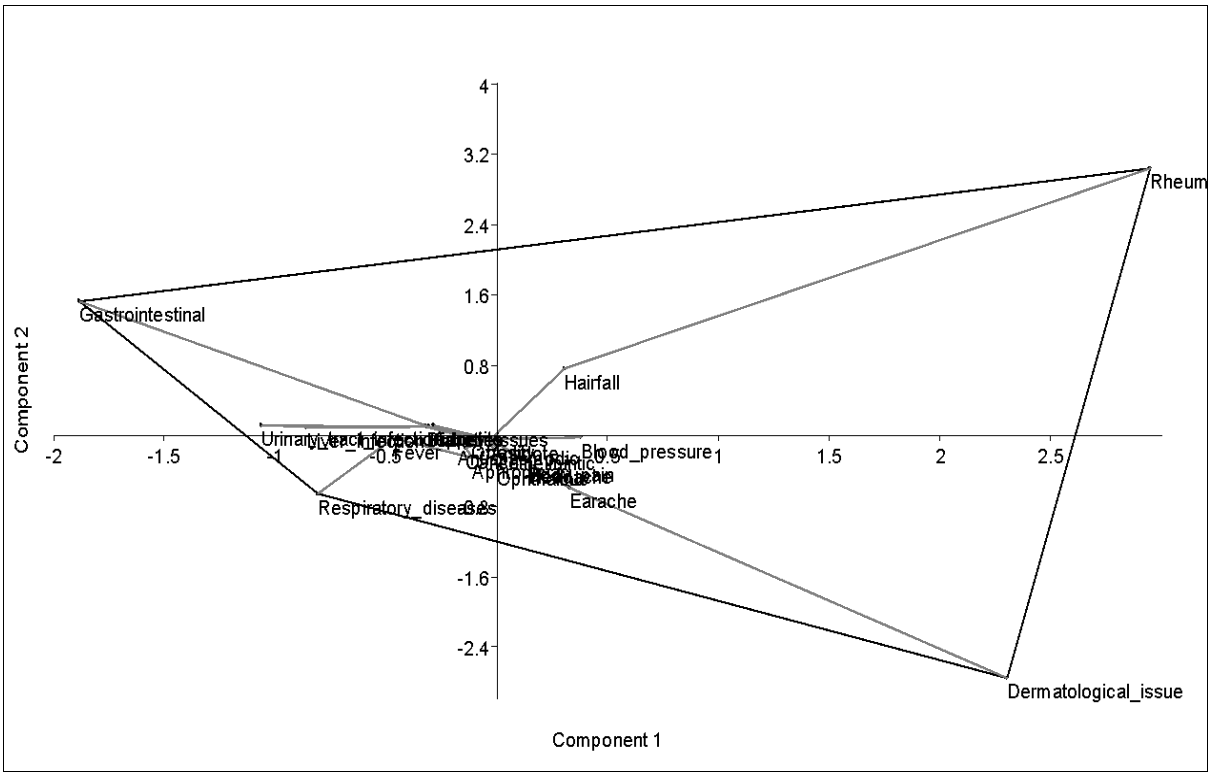

Figure 5. PCA showing variation of the diseases treated by plants in the study area.

During the present study we also came to know that preparation of traditional herbal therapies mostly occurred in the homes of participants, instead of consulting traditional medicinal practitioners (Hakims) (Table 3). Only a small percentage of informants, i.e., 28.25% from site I, 32.15% from site II and 35.76% from site III obtained medicinal plants from hakims (Fig. 6).The reason may be due to the fact that people prefer to save money, so they like to prepare their own herbal medicines rather than purchasing from Hakims (Rahmaan *et al.* 2021)..

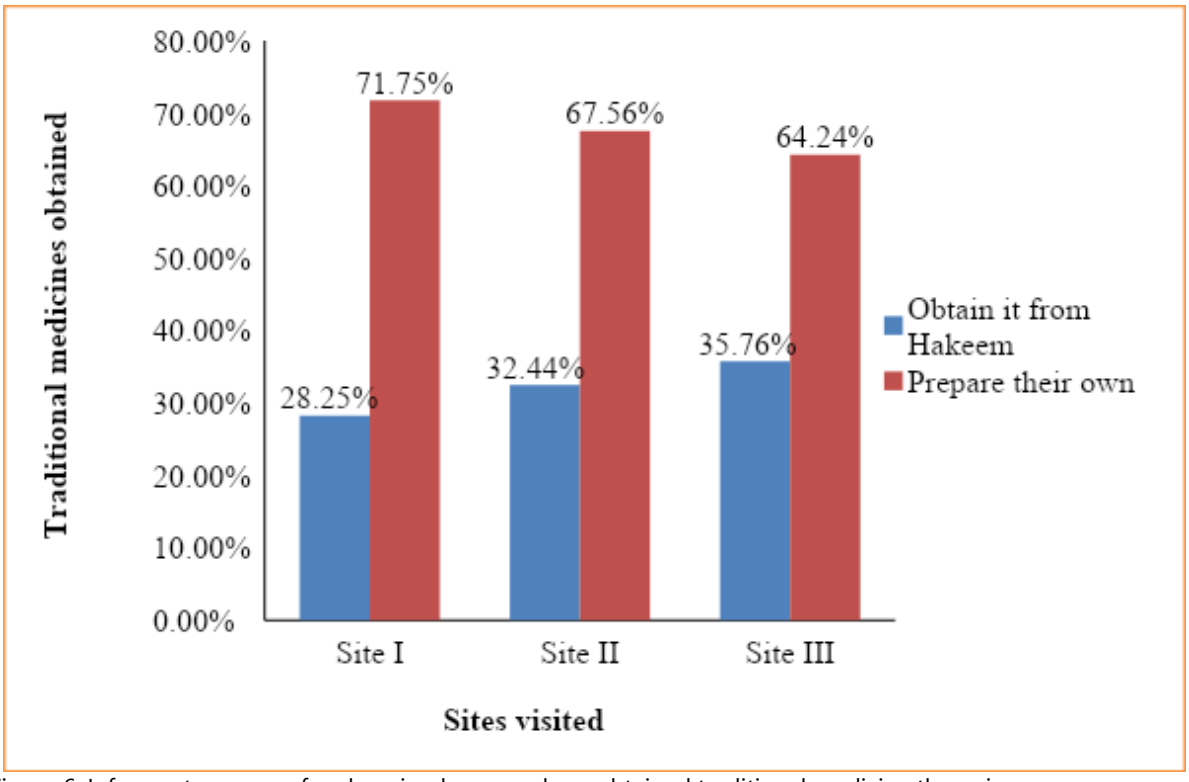

Figure 6. Informant response for choosing homemade or obtained traditional medicine therapies

Perceived efficacy of traditional medicinal plants

Overall 63.11%, 55.15%, 45.61% believed that the medicinal plants are highly effective from the site I, II, III respectively (Fig. 7). The percentages of households that indicated that medicinal plants were moderately effective were 28.25%, 34.19%, and 33.51% respectively. The percentages of households that believed they were somewhat effective were 7.51%, 8.33%, 8.35% and for counter effectiveness it was 1.77% from site III only (Fig. 7). Percentages of respondents who believed that medicinal plants were not effective were 1.13%, 2.33%, 6.17% respectively from the sites I, II, III. The highest percentage response regarding the high efficiency of traditional medicinal plants from the site I may be due to the fact that people from this site were well aware of the usage of medicinal plants and had been using them since time immemorial. Similar findings were reported by Asif *et al.* (2021) from tribal communities of District Kupwara, Kashmir. The least percentage from site III may be due to urbanization which is a main cause for the eroding of traditional ethno-knowledge (Hassan *et al.* 2021).

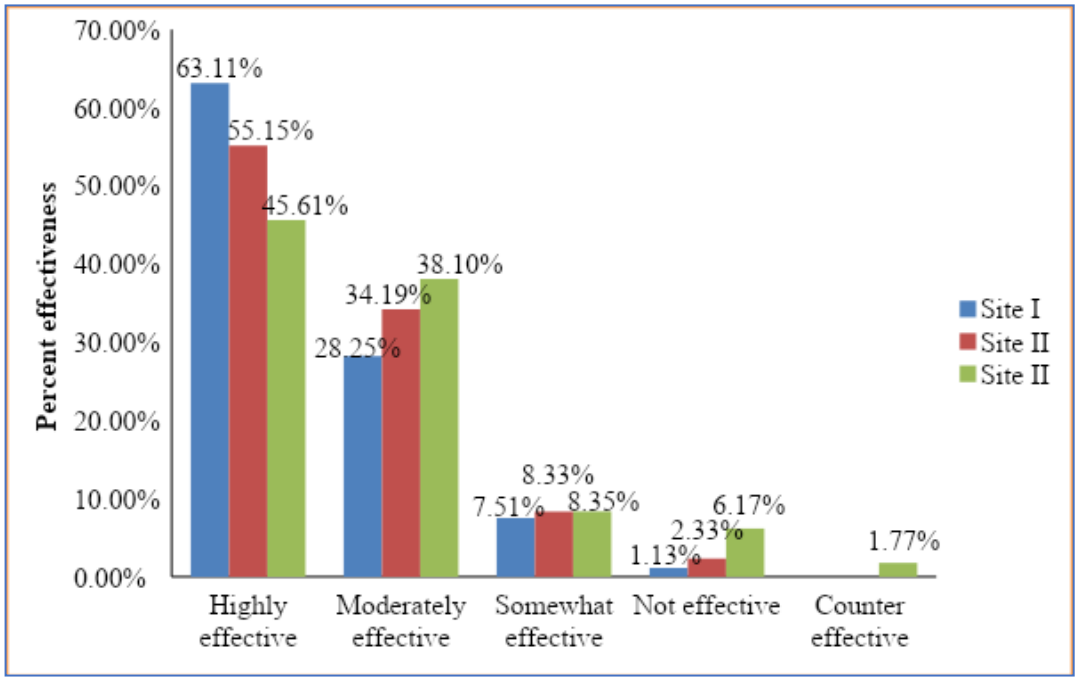

Figure 7. Informant response regarding the efficiency of traditional medicinal plants

Rationality of ethno-medicinal usage

While interpreting the documented results, it was found that the percentage of people who believed that medicinal plants had no side effects was 27.54% from site I, 38.67% for site II and 40.18% for site III. People who used medicinal plants because of cost effectiveness were 29.12%, 25.45%, 23.39% for I, II and III sites respectively (Table. 6; Fig.8). Studies which are in line with our results are Chen *et al.* 2016; Haq *et al.* 2021.

Conclusions

The present study reported the ethnopharmacological relevance of 67 plant species belonging to 65 genera and 44 families from Baramulla of Kashmir Himalaya. The study found that the highest number of plant species used were herbaceous plants (81% of all species), followed by trees (10%). Asteraceae, followed by Apiaceae were the dominant families in the studied area. The present study also observed that most species were used to treat gastrointestinal problems, skin diseases, bone and joint and respiratory problems. Most respondents believed that medicinal plants were highly effective to treat different ailments. The local people also believed that medicinal plants had no side effects and were available free of cost. Given the high cost and adverse effects of allopathic medicine, the use of medicinal plants to treat a variety of illnesses plays an essential role in the study area residents' primary health care needs. As a result, retaining traditional knowledge is more important than ever, and might aid in the development of new treatments and herbal blends.

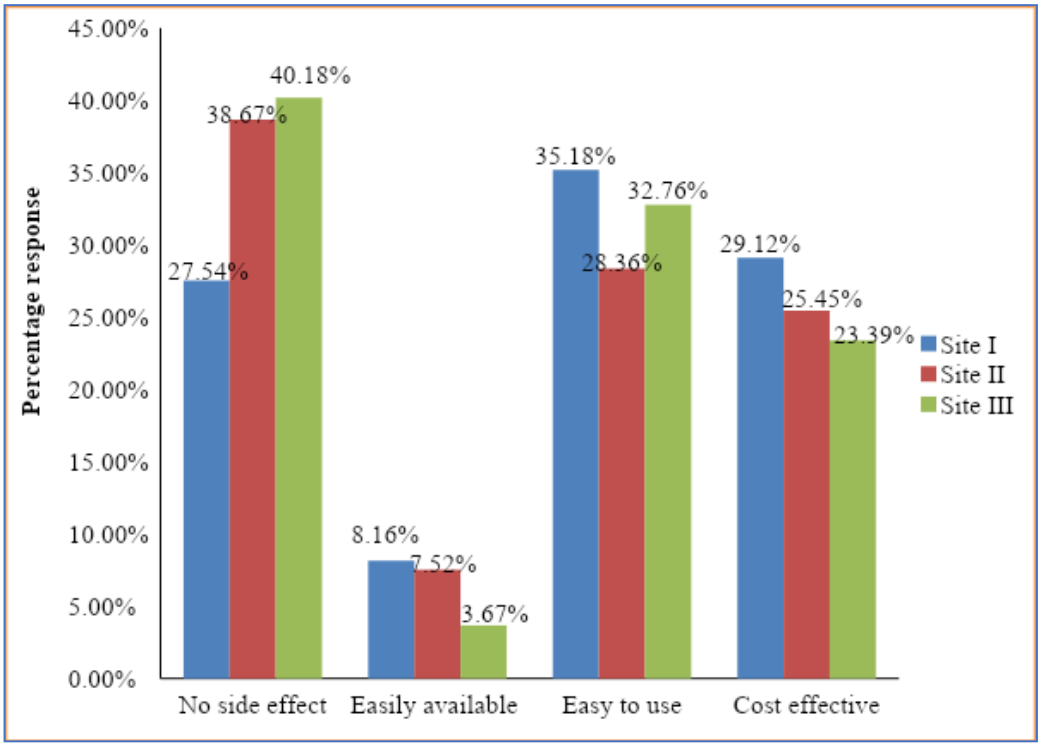

Figure 8. Reasons for using traditional medicinal plant

Declarations

Ethics approval and consent to participate: All the participants provided prior informed consent before the interviews.

Availability of data and materials: Data is available from the first author.

Competing interest: The authors declare that they have no competing interests.

Funding: The research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions: SF collected the field data. SMH analyzed and interpreted the data. MUH, SMH, AG and RWB wrote and revised the manuscript. All the authors read and approved the final manuscript for submission.

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Annex

Questionnaire:

Why are you using traditional medicine?

- No side effects
- Easily available
- Easy to use

Do you believe that commercial use of the local medicinal plants can boost your economy?

- Yes
- No
- Can't say

The number of medicinal plants in your locality is:

- Increasing
- Decreasing
- Unchanged
- Can't say

Questionnaire format used in the present study

Household profile	Administrative District	Specific location			
	Name of the head of the family				
	Primary occupation		Land ownership		
	Family size		Level of Education		
	Annual income		Economic Category	APL (Above poverty line)	BPL (Below poverty line**)**
Usage of medicinal plants	Yes/No				
Part of the medicinal plant used	Leaves	Stem		Root / Rhizome	Other
Form in which plant is used	Cooked	Crushed		Extracted	Other
Effectiveness of treatment	Highly Effective	Moderately effective	Somewhat effective	Not effective	Counter effective
Time since using the product	Few months	1 year	2 years	5 years	More than 5 years
Source of the product knowledge	Folklore	Radio Tv		Accidently	
	Hakeem (Traditional healers)		Books		Other
Side effects (if any)	Stomach upsets	Intestinal disturbances			Nausea
	Kidney disorders	Dermatological effects			Eye/Ear

Appendix 2

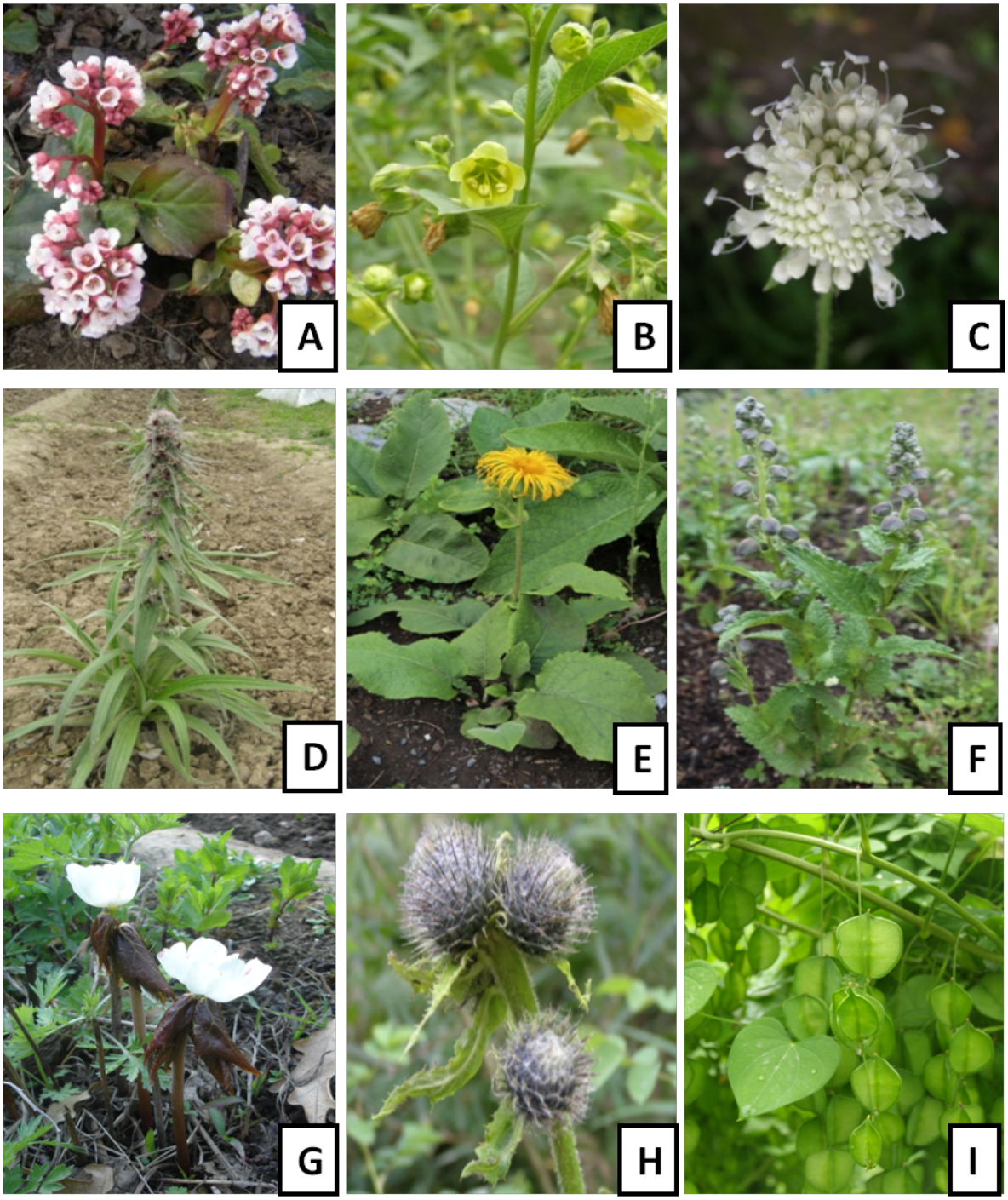

Photo plate 1. Some representative photographs of medicinal plants documented during survey **(A)** *Bergenia ciliata*, **(B)** *Atropa acuminata,* **(C)** *Dipsacus inermis,* **(D)** *Arnebia benthamii,***(E)** *Inula royleana,* **(F)** *Aconitum heterophyllum,* **(G)** *Sinopodophyllum hexandrum,* **(H)** *Saussurea costus,* **(I)** *Dioscorea deltoidea* **(**Photograph credit: *Maroof Hamid*).

Millennial traditions - Exploration of ethno-medicinal knowledge among different ethnic groups of Northern part Kashmir Himalaya, India

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Databases and Inventories

Abstract

Background: Traditional use of medicinal plants is an important aspect of Himalayan culture, and these approaches have evolved to include the primary health-care purpose and treatment of a wide range of ailments.

Methods: Snowball sampling method was used to interview 300 informants using semi-structured questionnaire to document the uses of indigenous species. Principal component analysis was used to analyze the data using PAST software ver.3.14.

Results: The present study reported a total of 67 medicinal plants belonging to 44 families with Asteraceae as dominant family. The majority of the species were herbaceous (81%) followed by trees (10%) and shrubs (9%). Leaves were the most commonly used plant part accounting for (16%), followed by roots (10%). The medicinal plants were used to cure various ailments, especially intestinal problems, skin diseases, stomach problems, respiratory problems, diabetes, bone and joint problems. The majority of people preferred to prepare herbal medicines on their own rather than obtaining these from traditional health practitioners. 63.11%, 55.15%, 45.61% respondents believed that the medicinal plants were highly effective from the site I, II, III respectively.

Conclusions: According to the findings of the current study, local people have a profound cultural link to the flora, as the use of medicinal plants to treat various illnesses plays an important role in meeting the primary health care needs. Due to urbanization and exploitation, it has become imperative to preserve the traditional medicinal knowledge before it becomes extinct.

Keywords: Health care, Knowledge, Medicinal plants, Traditional therapeutic use

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Background

Traditional medicine is not practiced in the same way all over the world, and it differs according to culture and philosophy of the region (Zidny *et al.* 2020). In the Indian medicinal system (Ayurveda, Unani, and Siddha) plants play a vital role and possess an utmost position, same is seen in Chinese and Tibetan medicine systems (Haq *et al.* 2020; Hassan *et al.* 2021b; Yeshi *et al.* 2019). Traditional medicine is legacy to the modern medical world as varieties of chemical compounds used to treat different diseases have been extracted from plants (Ramawat *et al.* 2009; Hassan *et al.* 2021c). Plants play a vital role in the healthcare and wellbeing regimens of people living in remote Himalayan locations (Yousuf *et al.* 2020; Haq *et al.* 2021). This can be linked to their strong faith in the efficiency of herbal medicines (traditional medicinal system) as well as the lack of contemporary healthcare services (Heinrich *et al.* 2021). Due to urbanizations and habitat loss the indigenous knowledge about the use of medicinal plants is disappearing in many regions, hence it becomes imperative to document the said traditional knowledge before it is lost forever (Rodrigues *et al.* 2020; Wali *et al.* 2021). Ethnobotany is valuable for the development of healthcare and conservation programs in different parts of the globe by preservation and promoting future medicinal plant research for the development of novel medications (Nagan and Hammer 2013).

Plants have always been utilized by humans to improve their bodily and spiritual well-being, and medicinal plants have risen in popularity even in the modern period (Cocks and Moller 2002; Jan *et al.* 2021). This interaction between plants and mankind has always been complex as it is affected by a variety of factors like local categorization systems, language, human cognition, cultural beliefs, religion, social networks, and information access (Brondízio *et al.* 2021; Fernández-Llamazares *et al.* 2021). The side effects and rising cost of allopathic medicine have led to an increase in the use of natural products and further this has led the worldwide researchers to focus on ethno-medicinal flora (Sharma *et al.* 2018; Mir *et al.* 2021).

The Himalaya region (Kashmir) holds more than half India's biodiversity (Dar and Khuroo 2020), with most of the species being rare and endemic, serving as the prime resource for food and medicine (Kumar *et al.* 2021; Singh *et al.* 2020). So far a significant number of ethnobotanical studies have been carried out across the Himalayan mountain range in different countries, including India, and have reported enormous numbers of medicinal and food plants historically being used by the local communities. Particularly the tribal communities like Gujjar, Bakarwal, and Pahari of the region are more dependent on non-timber forest products, as they extract their livelihood from plant derived ingredients which are also playing a crucial role in managing the traditional health care systems. Jammu and Kashmir, a union territory in India, lies in the bosom of the Himalayas. The inhabitants in remote areas of the region mostly depend on the flora to combat a variety of health disorders (Asif *et al.* 2021; Jan *et al.* 2021; Jan *et al.*2021a; Jan *et al.* 2022). Recognizing the loss of ethnomedicine knowledge, the current study aimed to collect and document information on the indigenous use of medicinal plants by the people of District Baramulla for the treatment of ailments for future generations, as well as provide baseline information for pharmacological studies on the discovery of new drugs and molecules.

Material and Methods

Study Area

The Kashmir valley (Fig. 1) constitutes one of the provinces of the Indian Himalayan Union Territory of Jammu and Kashmir (J&K) (http://cgwb.gov.in/AQM/NAQUIM_REPORT/JandK/Kashmir%20Valley.pdf; Haq *et al.* 2020a). The province, situated on the northernmost edge of the Indian Himalaya, is spread over an area of 15,948 km^2 ,(https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr_jandk/sdr_jkch1.pdf) , and falls between 33º 20´ to 34º 54´N latitudes and 73º 55´ to 75º35´ E longitudes. The region shows a highly uneven topography and about 64% of the area is mountainous with altitude ranging from 1600 to 5420 (m.a.s.l). The region possesses remarkable habitat diversity. The present study was conducted in the north Kashmir Baramulla district (Fig. 1). Geographically the district is situated between 34.1980 N and 74.3636 E and has an average elevation of 1750 (m.a.s.l). The climate is predominantly continental temperate with wet and cold winters and relatively dry and mild summers (https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr_jandk/sdr_jkch1.pdf; ul *et al.* 2019).

Study Sites

Site I (Tangmarg): Tangmarg lies in the Baramulla district of union territory of Jammu and Kashmir. Geographically, it lies between 33°.80´ N to 75°.36 ´E, with an average elevation of 2350 m (m a.s.l.). The area known for its cold-water springs, also area receives heavy snowfall during winter. The region is also enriched with lush green alpine forests. Tribal communities inhibited are Gujjar, Bakarwall. Area is mostly rural with limited area in market for trade. Elderly people are mostly illiterate, and the young people are almost well read

Site II (Pattan): Pattan a town lies in the municipal limits of Baramulla of the union territory Jammu and Kashmir, India. Geographically, it lies between 34°.17´ N latitude to 74° 57´E, with an average elevation of 1553 m (m a.s.l.). The area is transition point between Srinagar (City) and famous apple town Sopore. The area is mainly inhibited by Kashmiri people; however, some Gujjar families are also visible who have migrated from the high altitude area Gulmarg.

Site III (Baramulla town): Baramulla town is situated between 34°.19´ N to 74°.36´ E in the union territory of Jammu and Kashmir. It is the administrative headquarters of the district Baramulla. The area is well off in every respect like education, health, transport, economy, and other necessary vitals. The area is mainly inhibited by Kashmiri people. Tribal people like Gujjar use to come in the town to sell item like handle for spade, axe, and other agricultural equipment. Also the Bakarwal, use to come in town on special occasions like Eid, so people can purchase their livestock, like sheep, and goats.

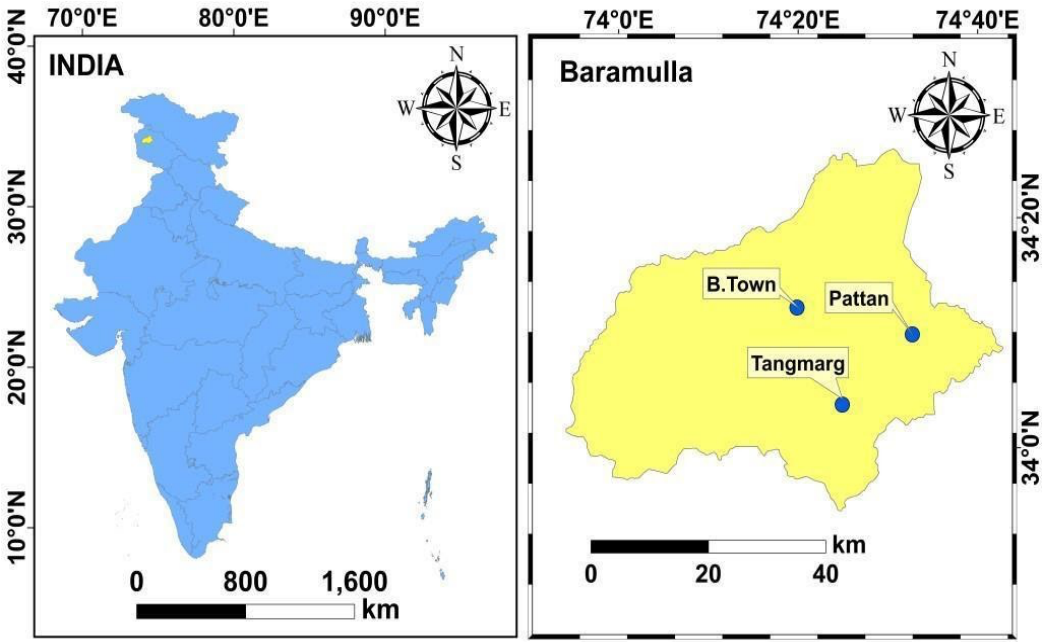

Figure 1. Map of India, Kashmir, and point showing survey sites in the erstwhile UT of Jammu and Kashmir.

Ethnobotanical methodology

A questionnaire was designed to document the traditional knowledge of medicinal plants. The data was collected through field surveys and face-to-face interviews after obtaining oral prior informed consent from all participants (Hassan *et al.* 2021; Haq *et al.* 2021). A total of 300 households were interviewed and the selection of the household was random. Specimens were collected and identified at the Center for Biodiversity and Taxonomy (CBT), Department of Botany, University of Kashmir, where the vouchers have been deposited. The format of the questionnaire is given below (Appendix. 1).

Demographic details of respondents

We conducted interviews with 300 respondents across twenty villages in the study area. The number of men (N=205) was higher than women (N=95). This can be explained by the fact that the people in the study area follow the Islamic faith, and women are prohibited or reluctant to communicate with strange people (Hassan *et al.* 2021a; Haq *et al.* 2020a).The age of respondents ranged between 18-75 years. Most respondents recorded were older (N=121) followed by middle aged (N=109) and young (N=70). Among the respondents more than half were illiterate (N=104), 80 respondents had primary education, 66 with secondary education, and 50 higher education (Table 1).

Table 1. Demographic status of the respondents from study area

Demographic features	Number of people	Percentage
Informants	300	
Gender		
Male	205	68
Female	95	32
Visited villages	20	
Language	Urdu, Kashmiri	
Ethnic group	Gujjar Bakarwal Kashmiri	
Education		
Illiterate	104	35
Primary education	80	27
Secondary education	66	22
Higher education	50	17
Age range		
Young (18-26)	70	23
Middle (27-55)	109	36
Old (56-75+)	121	40
Profession		
Skilled/semi-skilled worker	45	15
Cultivator/agricultural laborer	51	17
Hakeem (Traditional healers)	15	5
Daily wage laborers	72	24
Govt. employees	32	11
Housewives	43	14
Shopkeepers	42	14
Religion	Islam	

Results and Discussion

Medicinal plants used in the study area

The present study identified 67 plant species belonging to 65 genera and 44 families. The usage of all species is presented in Table. 2. Some representative photographs of medicinal plants taken during the survey are shown in photo plate 1. When comparing the number of species documented in the present study it is apparent that a high number of species was being used locally, as e.g., Mir *et al.* (2021) reported 34 plant species; Singhal *et al.* (2020) reported 37 species; Mir *et al.* (2021) reported 32 species; Asif *et al.* (2021) reported 29 species; Mehmood *et al.* (2018) reported 24 species from the Himalayas. Among the documented species 81% were herbaceous, followed by trees (10%) and shrubs (9%) (Table.2). The dominance of herbaceous plants can be ascribed to the fact that herbaceous plants are easier to work with when it comes to herbal preparation and extracting active metabolites than woody plants like shrubs and trees (Mehmood *et al.* 2018; Haq and Singh 2020). Some important species are shown in Appendix 2.

Across the 44 families, the distribution of species was unequal, half of the species belonged to 11 families (Asteraceae, Apiaceae, Brassicaceae, Lamiaceae, and Solanaceae, Berberidaceae, Caprifoliaceae, Euphorbiaceae, Fabaceae, Iridaceae and Malvaceae), while the remaining half belonged to 33 families. A large number of families (N=29) were monotypic, being represented by single species (Fig. 2, Table 2). The predominance of families was also comparable with the investigations carried out in other parts of the Himalayan region which have described Asteraceae as the dominant family (Haq and Singh 2020; Nafeesa *et al.* 2021; Altaf *et al.* 2021). Also, the dominance of Asteraceae may be due to high involvement in the cultivation of the various species of this family for medicinal purposes (Haq *et al.* 2021a). Another plausible explanation for the dominance of family Asteraceae is that this particular family is mostly cosmopolitan, rich in essential oils and is widely used in traditional medicine (Mir *et al.* 2021). Owing to widespread ecological amplitude, the members of the family Asteraceae acclimatize easily and adapt to arid dry habitats rapidly (Haq *et al.* 2021a).

Table 2. Medicinal flora of district Baramulla.

Scientific name	Family	Local name	Growth form	Part used	Preparation form	Diseases treated	Ethnic groups
Acorus calamus L.	Acoraceae	Vai	Herb	Rhizome	Decoction	Stomach troubles Skin diseases Anthelmintic	Kashmiri
Allium cepa L.	Alliaceae	Gande Pyaaz	Herb	Bulb	Cooked	For increasing appetite	Gujjar, Bakarwal kashmiri
Celosia argentea L.	Amaranthaceae	Mawal	Herb	Seeds	Cooked	Jaundice Diarrhea Fever	Kashmiri
Coriandrum sativum L.	Apiaceae	Danival	Herb	Leaves	Raw	Blood pressure Headache	Gujjar, Bakarwal, Kashmiri
Foeniculum vulgare Mill.	Apiaceae	Badiyaan	Herb	Seeds	Raw	Urinary infection Constipation	Gujjar, Bakarwal, Kashmiri
Heracleum canescens Lindl.	Apiaceae	Heracleum	Herb	Fruit Leaf Root	Raw	Aphrodisiac	Gujjar, Bakarwal
Arctium lappa L.	Asteraceae	Phughood	Herb	Leaves Root	Decoction	Skin disease Boils Body pain	Gujjar, Bakarwal
Artemisia absinthium L.	Asteraceae	Tethwan	Herb	Leaves	Decoction	Obesity Diabetes Liver issues.	Gujjar, Bakarwal, Kashmiri
Cotula anthemoides L.	Asteraceae	Bobul	Herb	Flowers	Raw	Rheumatism	Kashmiri
Eclipta prostrata L.	Asteraceae	Babriboul	Herb	Seeds	Infusion	Urinary infection	Gujjar, Bakarwal, Kashmiri
Inula racemosa Hook. f.	Asteraceae	Puskarmool	Herb	Dried rhizomes Roots	Decoction	Weakness Expectorant Inflammation	Gujjar, Bakarwal
Saussurea costus (Falc.) Lipsch	Asteraceae	Kouth	Herb	Rhizome	Decoction	Joint pain Cough Asthma	Kashmiri
Taraxacum officinale F.H. Wigg.	Asteraceae	Hand	Herb	Leaves	Cooked	Back pain Fractures	Gujjar, Bakarwal, Kashmiri

						Delivery problems	
Berberis lycium Royle	Berberidaceae	Kawdach	Shrub	Roots Fresh fruit	Decoction	Indigestion Constipation.	Kashmiri
Sinopodophyllum hexandrum Royle	Berberidaceae	Banwangun	Herb	Leaves Roots	Raw	Skin diseases Gastric problems	Gujjar, Bakarwal, Kashmiri
Betula utilis D. Don	Betulaceae	Bhuz	Tree	Bark	Infusion	Antiseptic	Gujjar
Arnebia benthamii (Wall. ex G. Don) I.M. Johnst.	Boraginaceae	Kahzaban	Herb	Leaves Flowers	Decoction	Fever	Gujjar, Bakarwal, Kashmiri
Brassica rapa L.	Brassicaceae	Telgogul	Herb	Seeds	Oil	Hair fall Dandruff	Gujjar, Bakarwal, Kashmiri
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	Kralmond	Herb	Leaves	Infusion	Gastrointestinal disorders Chronic diarrhea	Kashmiri
Raphanus sativus L.	Brassicaceae	Mujh	Herb	Roots	Raw	Appetite issue Urinary infection Chronic constipation.	Gujjar, Bakarwal, Kashmiri
Cannabis sativa L.	Cannabinnaceae	Bhang	Herb	Leaves Seeds Stem	Decoction	Ear-ache Blood purifier Scabies Piles	Gujjar, Bakarwal, Kashmiri
Dipsacus inermis Wall.	Caprifoliaceae	Wapalhakh	Herb	Leaves	Decoction	Cough Body weakness Pain Swelling	Kashmiri
Valeriana jatamansi (D. Don) Wall.	Caprifoliaceae	Mushkibala	Herb	Dried roots Rhizome	Decoction	Eye diseases Blood issues Livers diseases	Gujjar, Bakarwal, Kashmiri
Viburnum grandiflorum Wall. ex DC.	Caprifoliaceae	Kulmanch	Shrub	Seeds	Raw	Typhoid Whooping cough	Gujjar, Bakarwal, Kashmiri
Juniperus communis L.	Cupressaceae	Bithur	Shrub	Leaves	Cooked	Rheumatism	Gujjar, Bakarwal
Cuscuta reflexa Roxb.	Cuscutaceae	Kokliporte	Herb	Whole plant	Decoction	Urination disorders Muscle pain Cough Blood purifier	Kashmiri

Dioscorea deltoidea Wall. ex Griseb.	Dioscoreaceae	Kraeth	Herb	Leaves	Decoction	Ophthalmic infections Urinary infections	Gujjar, Bakarwal, Kashmiri
Equisetum arvense L.	Equisetaceae	Gundam Gund	Herb	Stem Leaves	Raw	Bleeding Ulcers Wounds	Gujjar, Bakarwal, Kashmiri
Euphorbia helioscopia L.	Euphorbiaceae	Gurisochol Gandibooti	Herb	Seeds Roots Latex	Raw	Abdominal cramps Cholera and Eruptions	Gujjar, Bakarwal
Euphorbia wallichiana Boiss.	Euphorbiaceae	Guridud / Harbi	Herb	Stem Leaves Latex	Raw	Skin diseases Asthma	Gujjar, Bakarwal, Kashmiri
Glycyrrhiza glabra L.	Fabaceae	Shanger	Shrub	Root	Decoction	Cough Cold	Kashmiri
Mentha longifolia L.	Fabaceae	Meth	Herb	Leaves	Raw	Diabetes Heart issue Liver problems Stomach problems	Gujjar, Bakarwal, Kashmiri
Fumaria indica (Hausskn.) Pugsley	Fumariaceae	Pugsley / Shahtaur	Herb	Whole plant	Infusion	Dyspepsia Rheumatism	Gujjar, Bakarwal
Crocus sativus L.	Iridaceae	Zafran	Herb	Flower (stigma)	Raw	Antioxidant Mood elevator	Gujjar, Bakarwal, Kashmiri
Iris kashmiriana Baker	Iridaceae	Mazarmund	Herb	Whole plant	Infusion	Joint pains	Kashmiri
Juglans regia L.	Juglandaceae	Doonkul	Tree	Bark	Raw	Cleaning teeth	Gujjar, Bakarwal, Kashmiri
Lavandula officinalis Chaix	Lamiaceae	Lavender	Shrub	Leaves Stem Flowers	Infusion	Anxiety Depression Headache	Kashmiri
Mentha arvensis L.	Lamiaceae	Pudni	Herb	Leaves	Raw	Appetite problem.	Gujjar, Bakarwal, Kashmiri
Prunella vulgaris L.	Lamiaceae	Kalwiyuth	Herb	Flowers	Cooked	Wounds Headache Memory issue	Kashmiri
Allium sativum L.	Liliaceae	Rohan	Herb	Bulb	Raw	Hair fall Toothache Cholesterol issue	Gujjar, Bakarwal, Kashmiri

Lavatera cachemiriana Cambess.	Malvaceae	Sazposh	Herb	Root	Infusion	Skin irritation in pregnant women Mumps	Kashmiri
Malva sylvestris L.	Malvaceae	Sochal	Herb	Leaves	Infusion	Eyesight problems Tonic Laxative	Gujjar, Bakarwal, Kashmiri
Ficus carica L.	Moraceae	Anjeer	Herb	Fruits	Raw	Infertility	Gujjar, Bakarwal, Kashmiri
Peganum harmala L.	Nitrariaceae	Izband	Herb	Roots Seeds	Decoction	Body pain Lice problems	Kashmiri
Olea europaea L.	Oleaceae	Zytoon	Herb	Fruits	Infusion	Bone & joint problems	Gujjar, Bakarwal, Kashmiri
Dactylorhiza hatagirea (D. Don) Soó	Orchidaceae	Salem Panja	Herb	Whole plant	Decoction	Dysentery Diarrhea Chronic fever	Gujjar, Bakarwal
Papaver somniferum L.	Papaveraceae	Kashkhas	Herb	Fruits	Infusion	Dry cough Diarrhea	
Phytolacca acinosa Roxb.	Phytolaccaceae	Brand	Herb	Root	Decoction	Used as sedative to extract wounds.	Gujjar, Bakarwal, Kashmiri
Abies pindrow (Royle ex D. Don) Royle	Pinaceae	Sal/ Baddul	Tree	Bark	Infusion	Rheumatism	Gujjar, Bakarwal, Kashmiri
Cedrus deodara (Roxb. ex D. Don) G. Don	Pinaceae	Divdar	Tree	Stem Bark	Oil	Skin rashes External ulcers.	Gujjar, Bakarwal, Kashmiri
Picrorhiza kurrooa Royle ex Benth.	Plantaginaceae	Kutki	Herb	Root Rhizome	Decoction	Liver disorders Upper respiratory tract issues	Gujjar, Bakarwal
Plantago lanceolata L.	Plantaginaceae	Gull	Herb	Leaves	Cooked	Cough	Gujjar, Bakarwal, Kashmiri
Fagopyrum esculentum Moench	Polygonaceae	Chaeersaban	Herb	Leaves Shoots	Decoction	Blood pressure Gout	Gujjar, Bakarwal, Kashmiri
Rheum webbianum Royle	Polygonaceae	Pamchalan	Herb	Roots Leaves	Decoction	Renal function disorders	Kashmiri
Portulaca oleracea L.	Portulacaceae	Nunar	Herb	Whole plant	Cooked	Acting as a febrifuge Used as vermifuge.	Gujjar, Bakarwal, Kashmiri
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	Paewakh/ Patrees, Atees/	Herb	Root	Decoction	Antidote for snake bites	Gujjar, Bakarwal

Anemone obtusiloba D. Don	Ranunculaceae	Kawashud	Herb	Root	Cooked	Joint pains.	Gujjar, Bakarwal, Kashmiri
Prunus persica (L.) Batsch	Rosaceae	Chenun	Tree	Fruits Leaves	Raw	Abdominal pain	Gujjar, Bakarwal, Kashmiri
Citrus limon (L.) Osbeck	Rutaceae	Leom	Herb	Fruits	Raw	Weight loss	Gujjar, Bakarwal, Kashmiri
Salix alba L.	Salicaceae	Miswak	Tree	Stem Twigs	Raw	Cleaning teeth	Gujjar, Bakarwal, Kashmiri
Sambucus wightiana Wall. ex Wight & Arn.	Sambucaceae	Kown	Shrub	Roots Leaves Fruits	Decoction	Diuretic Purgative	Gujjar, Bakarwal, Kashmiri
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae	Palfoot	Herb	Root	Decoction	Joint pains	Kashmiri
Atropa acumniata Royle ex Lindl.	Solanaceae	Chellalubbar	Herb	Roots Leaves	Infusion	Cough Spasmodic problems	Bakarwal
Datura stramonium L.	Solanaceae	Datur	Herb	Fruits	Raw	Dandruff Rheumatic pain	Kashmiri
Hyoscyamus niger L.	Solanaceae	Bazarbang	Herb	Seeds	Decoction	Tooth ache	Gujjar, Bakarwal, Kashmiri
Taxus baccata L.	Taxaceae	Birmi	Tree	Whole plant	Infusion	Spasmodic pain Cardio-tonic Diaphoretic Emmenagogue Expectorant Purgative	Gujjar, Bakarwal, Kashmiri
Trapa natans L.	Trapaceae	Gaerkul	Herb	Fruits	Infusion	Stomach problems Kidney issues Spleen diseases	Gujjar, Bakarwal, Kashmiri
Urtica dioica L.	Urticaceae	Soi	Herb	Leaves Roots	Cooked	Dandruff Wounds	Kashmiri

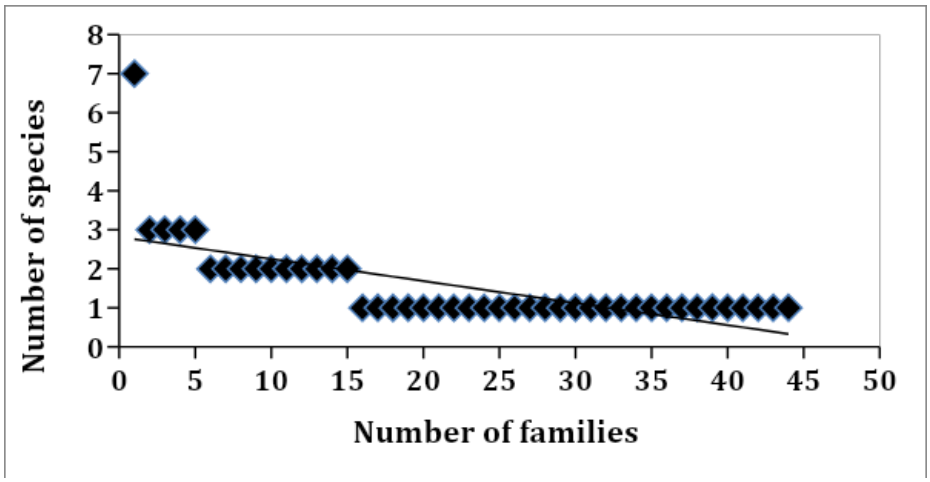

Figure 2. Species family relationship of documented medicinal flora of the study area

Part used

Different plant parts were documented for indigenous use, with a significant variance in their usage ($\chi 2 = 87.876$, $df=9$, $p<0.001$). Leaves were the most commonly used plant part accounting for 16%, followed by roots (10%), seeds (9%), fruits (9%), whole plant (9%), bark (5%), rhizome & bulb (3% each) **(**Fig. 3). The maximum usage of the leaves can be explained by the fact that they are easy to collect and are locally believed to be rich in the constituents with medicinal attribution. Leaves are directly involved in photosynthesis, creating a variety of active substances and acting as sinks for secondary metabolites, all of which have great medical potential. (Yousuf *et al.* 2020) Similarly, Haq and Singh (2020) from District Reasi, J&K, reported the predominant utilization of leaves of medicinal plants in herbal medicines.

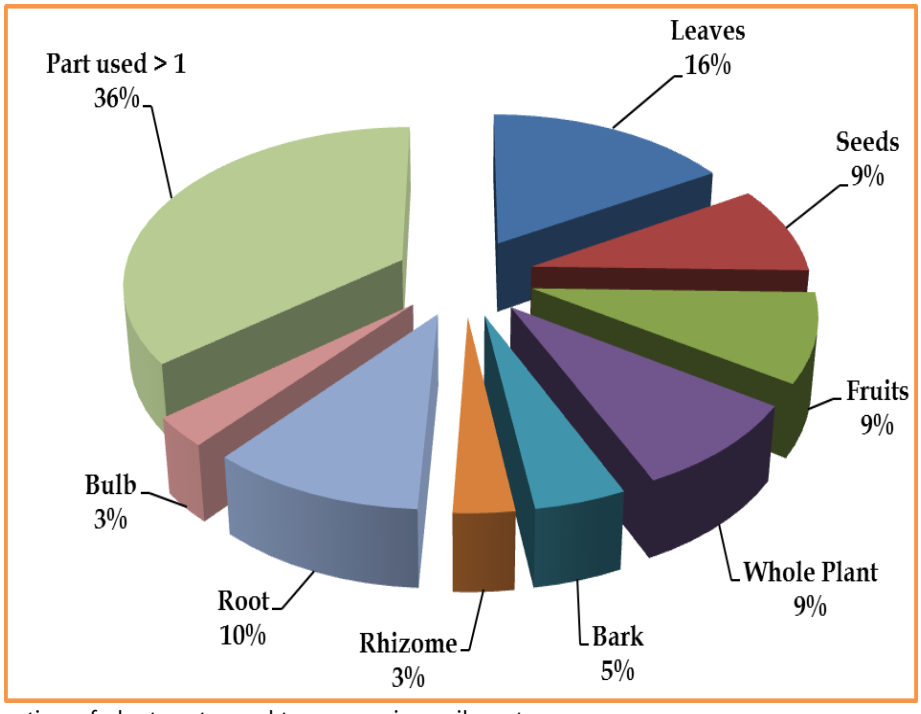

Figure 3. Proportion of plant parts used to cure various ailments.

Preparation form

The present study documented decoctions (34%) as most commonly used preparation, as the local population believed that said preparation had higher efficacy than any other preparation form (Fig. 4). It is believed that the water from the Himalayans alps used for the decoction do possess the healing potential, leading to a synergistic effect.;). Haq *et al.*2021 while evaluating the use of plants across different communities in Ladakh revealed that decoction was the most used preparation form.. Koduru *et al.* 2007 reported the maximum usage of decoction

while investigating the medicinal uses of plants for the treatment of cancer. Other researchers also reported the maximum usage of decoction (Asif *et al.* 2021; Mir *et al.* 2021; Rahmaan *et al.* 2021)

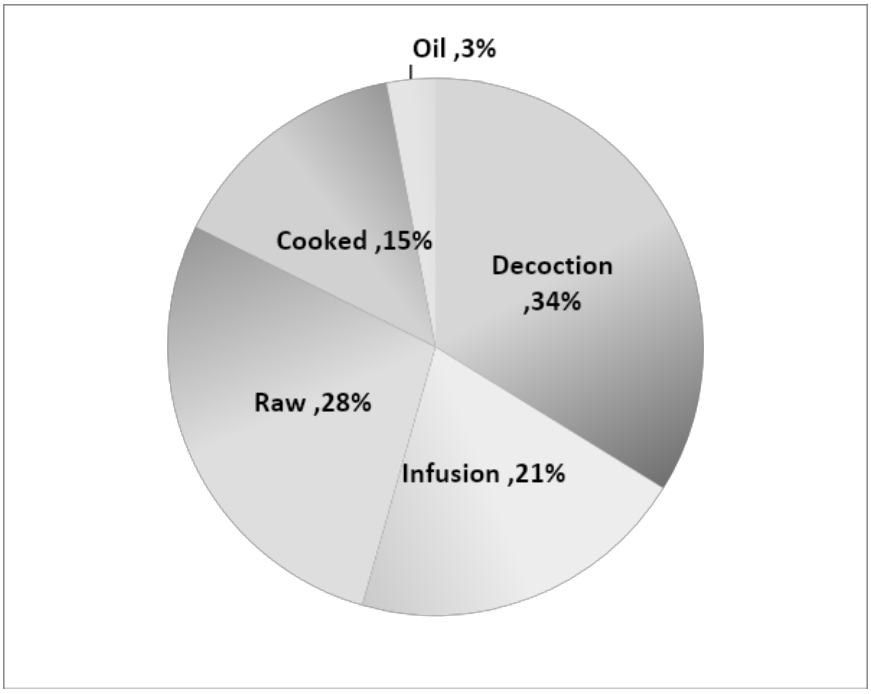

Figure 4. Percentage of preparation mode of usage of documented species.

Ethno-pharmacological relevance

This study presents a brief account of the uses of various ethno-medicinal plants against various diseases like rheumatism, stomach troubles, skin diseases, hair fall, cough and cold, headache, and urinary infection by the local inhabitants in J&K. The use percentage observed from site I, II, III respectively are shown in Table 3. The highest percentage response regarding the use of traditional medicines was found at site I, which may be due to the fact that the inhabited area is rural hence people have an easy access to forests. The results further revealed that most species were used to treat gastrointestinal problems, followed by dermatological diseases, bone and joint and respiratory problems. This was also supported by the PCA (Fig. 5). The gastrointestinal problems, dermatological diseases were outlined in groups. Our results are in accordance with previous studies e.g., Sher *et al.* (2021) from Pakistan. Gastrointestinal problems were common diseases treated by traditional therapies were also reported by Arya *et al.* (2021) & Chetry *et al.* (2018) in western Himalaya & Eastern Himalaya respectively.

Table 3. Percentage response regarding the preference of traditional medicines used for curing various diseases

Diseases	Site I	Site II	Site III	Mean
Gastro-intestinal problem	27.11%	16.23%	18.73%	**20.69%**
Dermatological problem	10.32%	13.22%	10.16%	**11.23%**
Stomach problems	13.76%	12.91%	17.67%	**14.78%**
Respiration problems	8.57%	10.23%	14.18%	**10.99%**
Bone and Joint problems	15.04%	16.31%	17.29%	**16.21%**
Diabetes	3.23%	7.45%	8.45%	**6.37%**
Cancer	1.45%	0%	0%	**0.48%**
Fever	8.04%	7.32%	8.18%	**7.84%**
Cough and Cold	9.36%	9.11%	3.22%	**7.23%**
Tooth problems	3.12%	7.22%	2.12%	**4.15%**

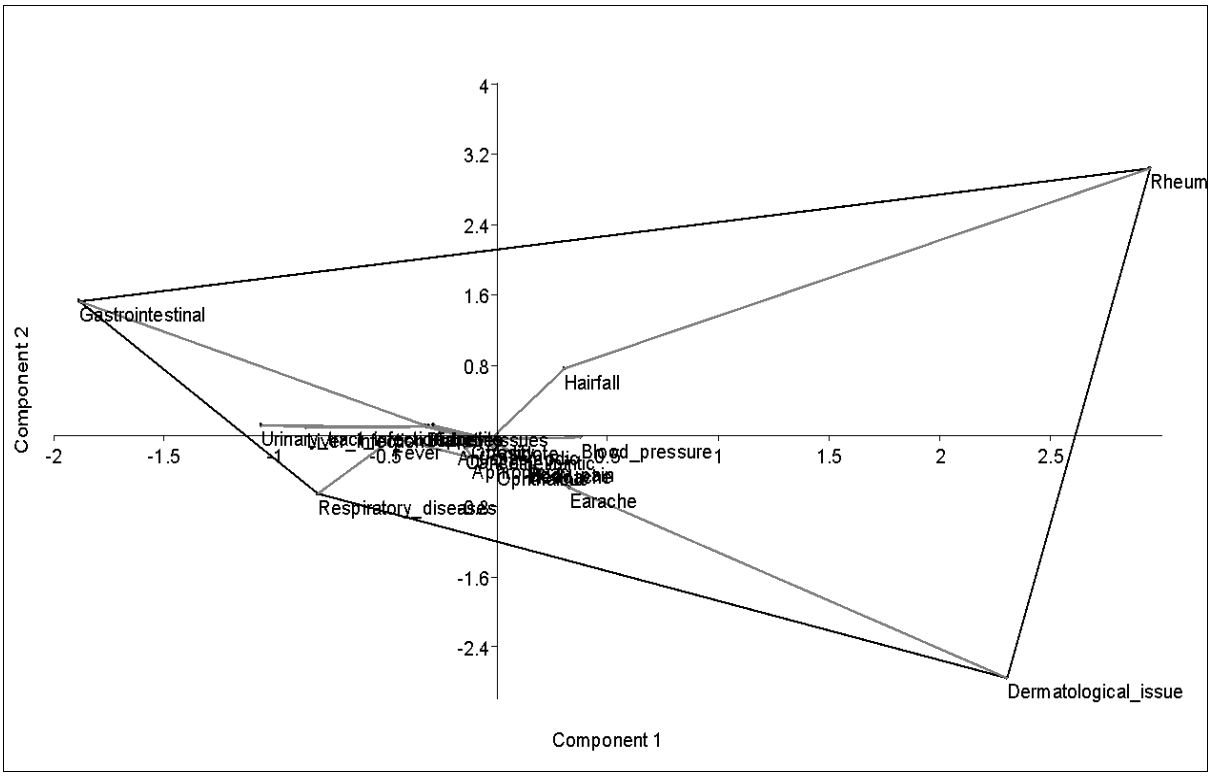

Figure 5. PCA showing variation of the diseases treated by plants in the study area.

During the present study we also came to know that preparation of traditional herbal therapies mostly occurred in the homes of participants, instead of consulting traditional medicinal practitioners (Hakims) (Table 3). Only a small percentage of informants, i.e., 28.25% from site I, 32.15% from site II and 35.76% from site III obtained medicinal plants from hakims (Fig. 6).The reason may be due to the fact that people prefer to save money, so they like to prepare their own herbal medicines rather than purchasing from Hakims (Rahmaan *et al.* 2021)..

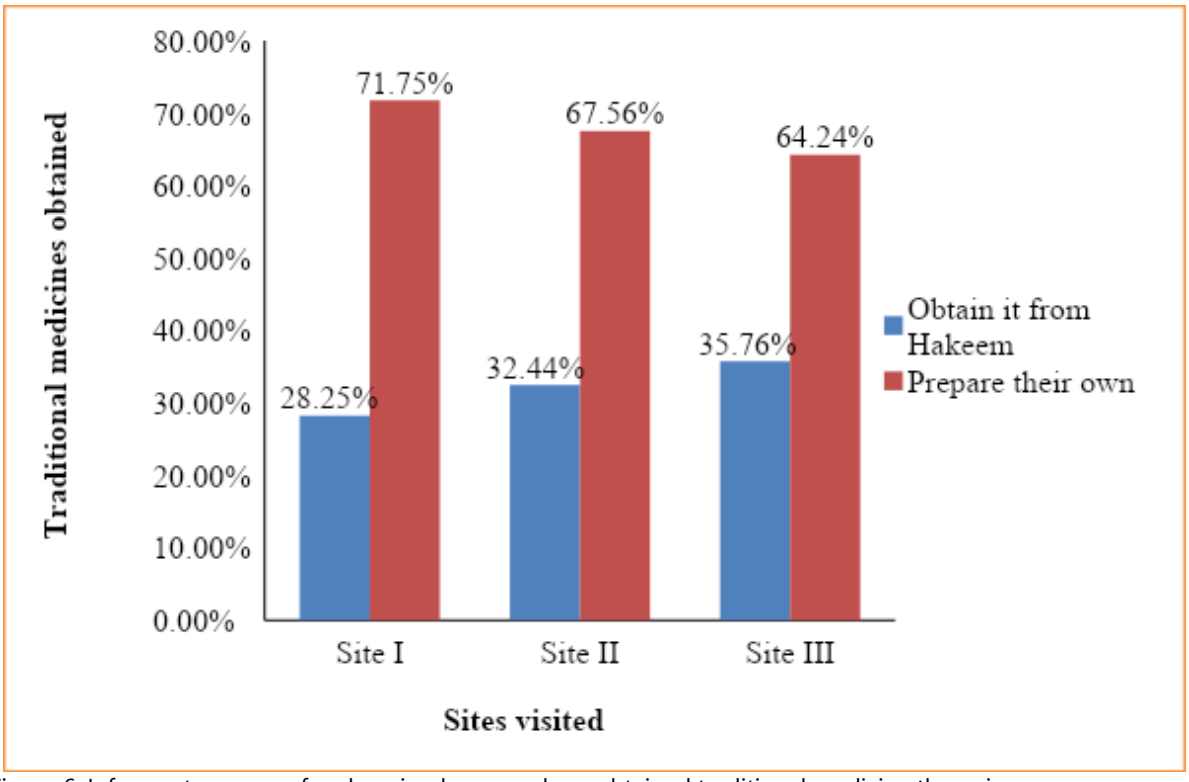

Figure 6. Informant response for choosing homemade or obtained traditional medicine therapies

Perceived efficacy of traditional medicinal plants

Overall 63.11%, 55.15%, 45.61% believed that the medicinal plants are highly effective from the site I, II, III respectively (Fig. 7). The percentages of households that indicated that medicinal plants were moderately effective were 28.25%, 34.19%, and 33.51% respectively. The percentages of households that believed they were somewhat effective were 7.51%, 8.33%, 8.35% and for counter effectiveness it was 1.77% from site III only (Fig. 7). Percentages of respondents who believed that medicinal plants were not effective were 1.13%, 2.33%, 6.17% respectively from the sites I, II, III. The highest percentage response regarding the high efficiency of traditional medicinal plants from the site I may be due to the fact that people from this site were well aware of the usage of medicinal plants and had been using them since time immemorial. Similar findings were reported by Asif *et al.* (2021) from tribal communities of District Kupwara, Kashmir. The least percentage from site III may be due to urbanization which is a main cause for the eroding of traditional ethno-knowledge (Hassan *et al.* 2021).

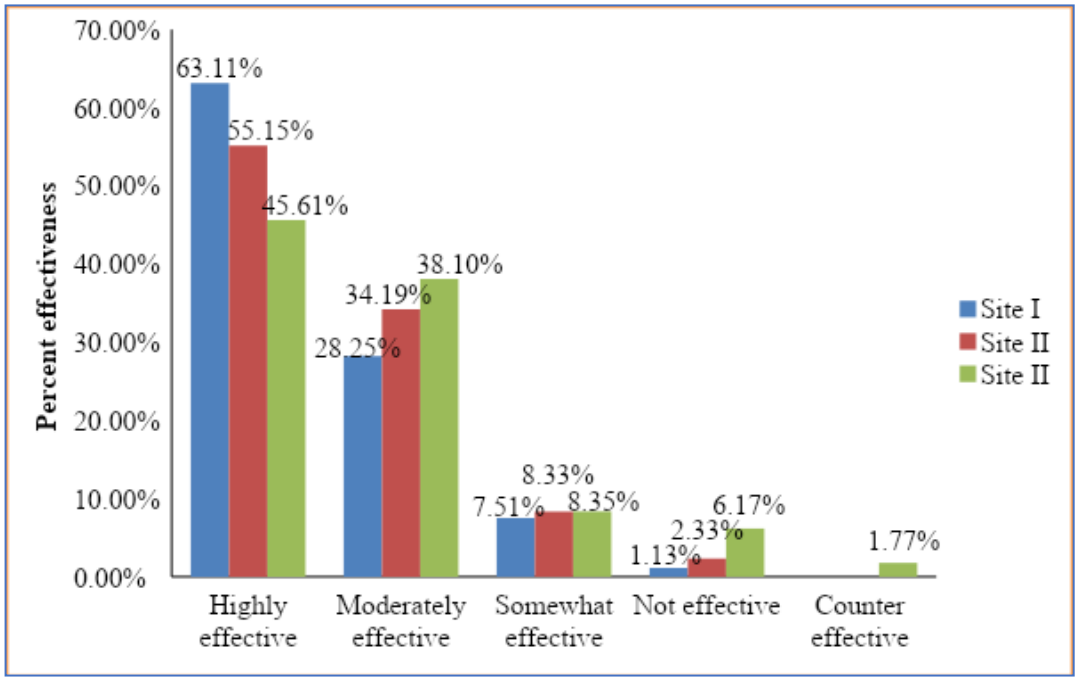

Figure 7. Informant response regarding the efficiency of traditional medicinal plants

Rationality of ethno-medicinal usage

While interpreting the documented results, it was found that the percentage of people who believed that medicinal plants had no side effects was 27.54% from site I, 38.67% for site II and 40.18% for site III. People who used medicinal plants because of cost effectiveness were 29.12%, 25.45%, 23.39% for I, II and III sites respectively (Table. 6; Fig.8). Studies which are in line with our results are Chen *et al.* 2016; Haq *et al.* 2021.

Conclusions

The present study reported the ethnopharmacological relevance of 67 plant species belonging to 65 genera and 44 families from Baramulla of Kashmir Himalaya. The study found that the highest number of plant species used were herbaceous plants (81% of all species), followed by trees (10%). Asteraceae, followed by Apiaceae were the dominant families in the studied area. The present study also observed that most species were used to treat gastrointestinal problems, skin diseases, bone and joint and respiratory problems. Most respondents believed that medicinal plants were highly effective to treat different ailments. The local people also believed that medicinal plants had no side effects and were available free of cost. Given the high cost and adverse effects of allopathic medicine, the use of medicinal plants to treat a variety of illnesses plays an essential role in the study area residents' primary health care needs. As a result, retaining traditional knowledge is more important than ever, and might aid in the development of new treatments and herbal blends.

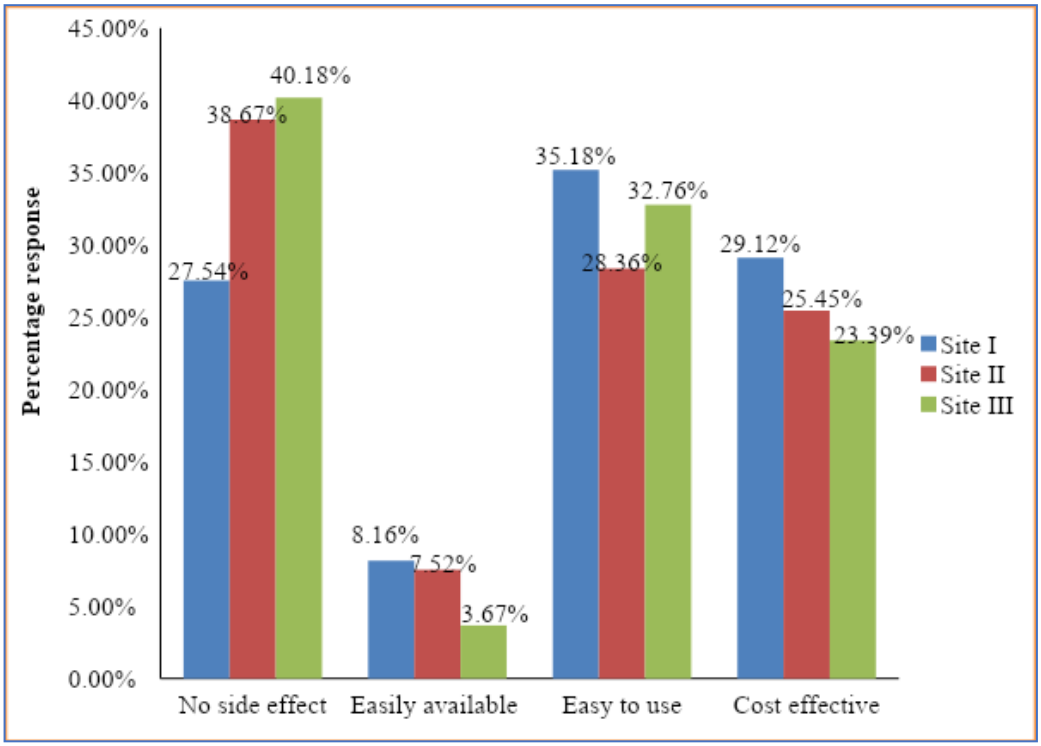

Figure 8. Reasons for using traditional medicinal plant

Declarations

Ethics approval and consent to participate: All the participants provided prior informed consent before the interviews.

Availability of data and materials: Data is available from the first author.

Competing interest: The authors declare that they have no competing interests.

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Author Contributions: SF collected the field data. SMH analyzed and interpreted the data. MUH, SMH, AG and RWB wrote and revised the manuscript. All the authors read and approved the final manuscript for submission.

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Annex

Questionnaire:

Why are you using traditional medicine?

- No side effects
- Easily available
- Easy to use

Do you believe that commercial use of the local medicinal plants can boost your economy?

- Yes
- No
- Can't say

The number of medicinal plants in your locality is:

- Increasing
- Decreasing
- Unchanged
- Can't say

Questionnaire format used in the present study

Household profile	Administrative District	Specific location			
	Name of the head of the family				
	Primary occupation		Land ownership		
	Family size		Level of Education		
	Annual income		Economic Category	APL (Above poverty line)	BPL (Below poverty line**)**
Usage of medicinal plants	Yes/No				
Part of the medicinal plant used	Leaves	Stem		Root / Rhizome	Other
Form in which plant is used	Cooked	Crushed		Extracted	Other
Effectiveness of treatment	Highly Effective	Moderately effective	Somewhat effective	Not effective	Counter effective
Time since using the product	Few months	1 year	2 years	5 years	More than 5 years
Source of the product knowledge	Folklore	Radio Tv		Accidently	
	Hakeem (Traditional healers)		Books		Other
Side effects (if any)	Stomach upsets	Intestinal disturbances			Nausea
	Kidney disorders	Dermatological effects			Eye/Ear

Appendix 2

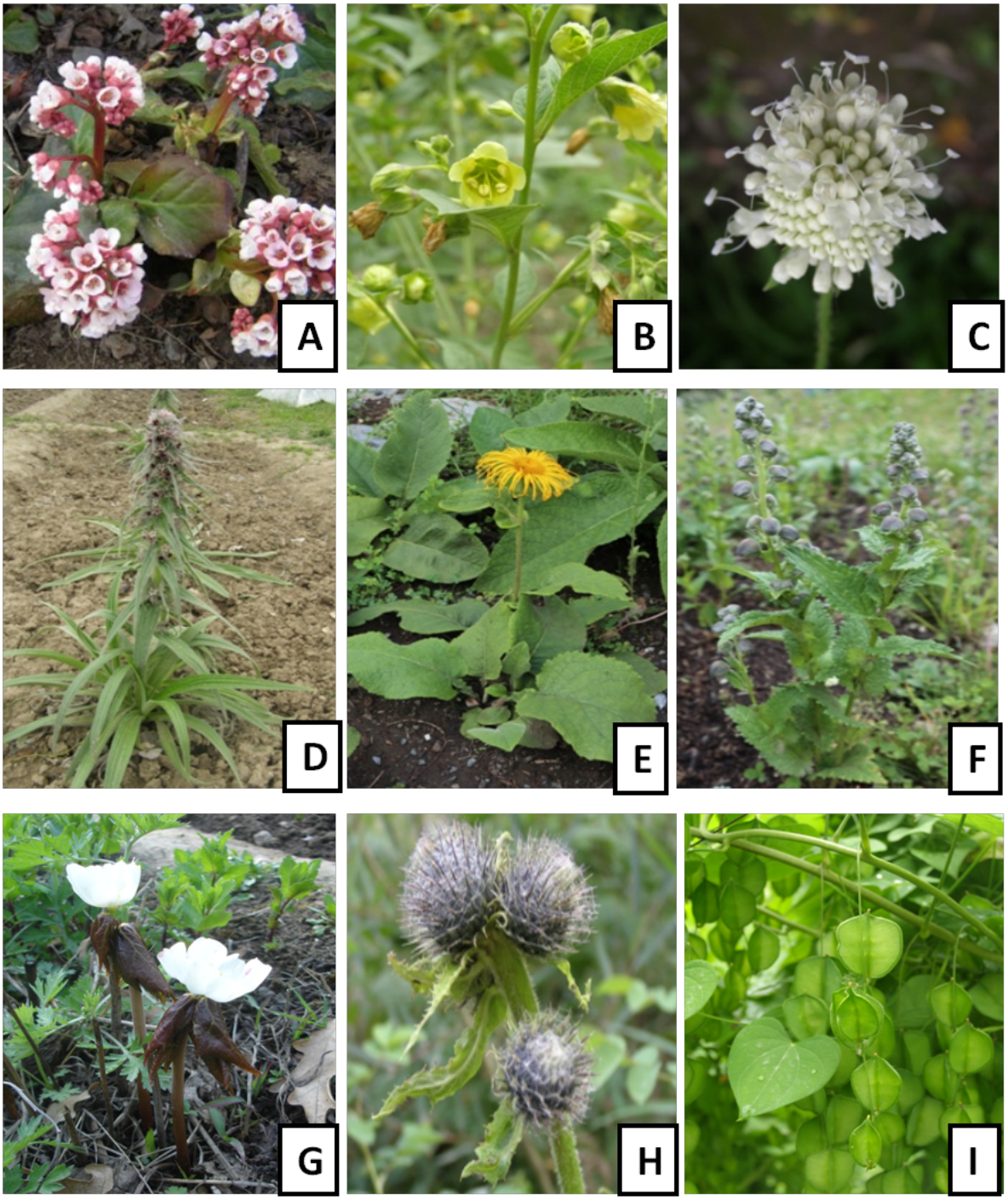

Photo plate 1. Some representative photographs of medicinal plants documented during survey **(A)** *Bergenia ciliata*, **(B)** *Atropa acuminata,* **(C)** *Dipsacus inermis,* **(D)** *Arnebia benthamii,***(E)** *Inula royleana,* **(F)** *Aconitum heterophyllum,* **(G)** *Sinopodophyllum hexandrum,* **(H)** *Saussurea costus,* **(I)** *Dioscorea deltoidea* **(**Photograph credit: *Maroof Hamid*).