Medicinal plants of the Himalayan Tral region of Kashmir, India: an ethnobotanical study of their diversity, use patterns, and health implications

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Ethnobotany Research and Applications 27:33 (2024) - http://dx.doi.org/10.32859/era.27.33.1-19
Manuscript received: 07/06/2024 – Revised manuscript received: 20/09/2024 - Published: 22/09/2024

Research

Abstract

Background: For the tribal inhabitants of Tral, a location in Indian Kashmir's Pulwama district, medicinal plants constitute a significant source of healthcare. Being underexplored for traditional knowledge and usage of medicinal plants, an ethnobotanical survey was carried out to document the diversity, usage, and cultural significance of medicinal plants in this area.

Methods: The data were collected from 57 informants using group discussions, questionnaires, and interviews. Data was analyzed through use value, fidelity level, and informant consensus factor calculations.

Results: Forty-seven plant species from twenty-seven families were recorded, with roots and leaves being the frequently used plant parts. Decoctions and infusions were the preferred methods for treating various ailments. The highest informant consensus factor of 0.85 was recorded for gut disorders and treated with 25 plant species, whereas the lowest informant consensus factor of 0.36 was observed for skeletomuscular disorders and treated with 10 species. *Ocimum tenuiflorum* showed the highest use value of 0.46, whereas *Phytolacca acinosa* exhibited the lowest use value of 0.05.The highest fidelity value of 100% was found for *Datura stramonium*, *Phytolacca acinosa*, *Sibbaldia cuneata*, *Arisaema jacquemontii*, *Rhododendron campanulatum*, *Bergenia ciliata*, *Salvia hians*, *Valeriana jatamansi* against helminths, beef worms, skin rashes, abscesses, hypersomnia, deep wounds, arthritis and throat pain, respectively. *Rumex acetosa* exhibited the lowest fidelity value of 33% against constipation.

Conclusions: This study presents a comprehensive analysis of the traditional knowledge and use patterns of medicinal plants in the Himalayan Tral region of Kashmir, serving as a foundation for further research in ethnobotany and pharmacology.
Keywords: Ethnomedicine, informant consensus, fidelity value, Kashmir Himalaya

Background

Medicinal plants have been used for centuries as a source of healthcare by various cultures and communities worldwide. India, in particular, has a rich tradition of using indigenous herbs for treating various health disorders (Shi *et al.* 2021).Many modern drugs in the Western system of medicine are derived from or influenced by Indian medicinal plants.In

underdeveloped nations, over 80% of people use medicinal plants for basic healthcare requirements (Farnsworth 2007).The main reasons for this preference are the low cost, accessibility, and minimal side effects of these plants (Croom 1983; Yousuf *et al.* 2012).However, the healthcare system in developing countries faces many challenges and limitations. One is the lack of access to modern medical facilities for a large population segment. This is especially true for remote and hilly areas, where geographical and infrastructural barriers hinder the provision of adequate health services (Kruk *et al.* 2018).One such area is the Tral region in the Pulwama district of South Kashmir, India. This study aims to document medicinal plants' diversity, usage, and cultural significance in the Tral region, a hilly and conflict-hit area in a developing country. We hypothesize that there is a dearth of knowledge of the local medicinal plants in this region and that their documentation can provide valuable insights for improving the healthcare system. Although there have been some studies on ethnomedicinal plants in the Kashmir Himalayan range (Gupta *et al.* 2013; Kanta *et al.* 2018; Kumar *et al.* 2009; Kumari *et al.* 2013; Lone *et al.* 2014; Pala *et al.* 2021; Shah *et al.* 2012; Sharma & Singh 1989; Wagay 2014), little information is available on the explicit plants used in the Tral region. This study aimed to identify the medicinal plants used by the tribal communities in the Tral region and their botanical names, families, parts used, modes of preparation, and ailments treated; assessing the plant-human relationship in this region and how it influences their health beliefs and practices; evaluating the use value (UV), fidelity level (FL), and informant consensus factor (ICF) of the medicinal plants to measure their importance and agreement among the informants; understanding the transmission of knowledge of medicinal plants across generations and assessing the factors affecting its continuity or erosion, and comparing the results found with other studies on ethnomedicinal plants in the Kashmir Himalayan range and other regions of India.

Materials and Methods

Physical and descriptive anthropology of the study site

The study site consisted of Tral meadows and forest range, part of the Pulwama district in the Union Territory of Jammu and Kashmir, India (Fig 1).The geographical coordinates of the site are 33°56'3.18"N 75°64'9.92" E. The site encompasses an area of 160 km and has a moderate climate, with an average temperature of 20-29°C.The site has a diverse and unique flora due to its rocky crevices and hilly terrains. The summer season is moderately hot, with a maximum temperature of 30°C, while the winter season is freezing, with a minimum temperature of -20°C.The site receives an annual precipitation of about 33.85 mm and has about 51 rainy days. The site also experiences heavy snowfall in winter but low rainfall in other seasons. The site is characterized by its green pastures, meadows, dense forests, and snow-capped mountains, attracting locals and visitors. One such forest belt, Shikargah, is especially remarkable for its evergreen vegetation, dominated by tall *Cedrus deodara* and *Pinus wallichiana* trees. The state government has declared Shikargah a wildlife sanctuary for the endangered Kashmiri **Hangul** (Cervus elaphus hanglu), establishing it as a "Hangul Breeding Conservation Centre. “The people living in the site belong to the Gujjar, Shepherd, and Bakerwal communities, who practice Islam as their religion. They speak Pahari, Gujri, and local Kashmiri dialects. They depend on medicinal plants gathered from the meadows and forests for their healthcare needs, as they lack modern knowledge and facilities. They also rear sheep, goats, and cows for meat, cheese, and milk. The site has a pleasant ambiance, enhanced by the bird songs and the flower fragrance.

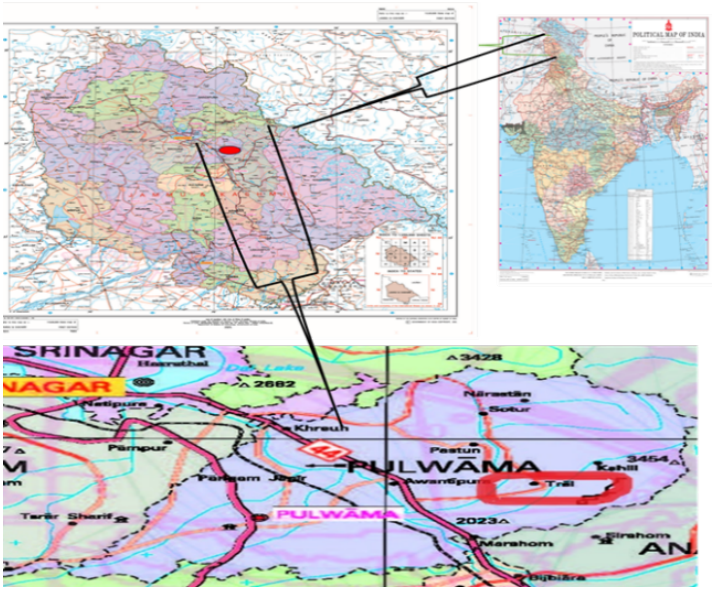

Figure 1. Map showing the study area

Data collection and sampling methods

An ethnobotanical survey was undertaken from June 2022 to July 2023, and fifty-seven informants, including men and women, were chosen to offer information on the ethnomedicinal usage of plants in the research location. We employed a purposive sampling strategy to select 57 respondents known within their communities for their expertise in traditional medicinal plant use. Local community leaders and elders were consulted to identify these knowledgeable individuals. Geographic representation across the 160 km stretch of the study area was ensured. The sample size of 57 was determined based on achieving data saturation, where additional interviews provided no new information. Questionnaires, informal gatherings, field observations, group discussions, and personal interviews were used to collect data. Data was collected through individual interviews with all 57 informants, while a subset of 20 informants participated in group discussions. Questionnaires were administered to gather structured information, and interviews were conducted for in-depth exploration of their knowledge. The data was recorded in the local dialects and then translated into English. The informants agreed to provide knowledge of the local uses of medicinal plants, the symptoms and diseases they treated, the plant parts they used, and the methods of preparation and administration of herbal remedies. The informants also provided the plants' local names, parts used, and specific therapeutic applications. Field walks with the informants enabled the identification, collection, and documentation of the plant species, their habitats, and their availability. The plant specimens underwent herbarium creation and were authenticated by taxonomists at the Center for Plant Taxonomy, University of Kashmir, alongside verification using the herbarium specimens from KASH Herbarium, University of Kashmir. Additionally, the data underwent validation through comparison with relevant literature sources.

Quantitative data analyses

Quantitative ethnobotanical analyses help study the significance of plant species for treating different diseases; three indices analyzed the collected information.

Fidelity level value (FL)

The fidelity level is determined by gaining valuable information on the percentage of informants who suggested using a specific plant species to treat the same disease; formula for FL calculation is:

$$FL\ (\%) = N_p / N \times 100$$

Where NP is the informant number that asserts the use of plant species to treat a particular ailment, and N is the total number of questioned informants.

Information Consensus Factor (ICF)

This index shows which plant species are strenuously used and helps select plant species for ethnopharmacological and phytochemical studies' was determined by using the following formula:

$$ICF = N_{ur} - N_t / N_{ur} - 1$$

N_{ur} is the total number of individual suggestions of plant use for a specific illness category, and N_t is the total number of medicinal plant species used by all informants in a given illness category. If the informants are determined to share their expertise, this variable's value is 1; otherwise, it is 0.

Use value calculation (UV)

The use value determines the most frequently used plant species. The UV was calculated using a formula.

$$UV = \sum^u / N$$

U is the number of uses for a plant species each informant mentions, and N is the total number of informants who cited this species.

Results

Demographic characteristics of informants

The data on the ethnomedicinal usage of plant species were collected from 57 informants knowledgeable about the local plants and their therapeutic uses in the Tral forest and meadows area of Pulwama, Jammu, and Kashmir. The informants

ranged in age from 24 to 80 years, with 38 males and 19 females. The males had more experience and knowledge about the ethnomedicinal plants than the females. Most informants were illiterate, while a few had higher education (Table 1). Detailed information on the selection process and data collection methods are discussed in the methodology section. Regular contact was maintained with the informants throughout the study to obtain the maximum possible information about different ethnomedicinal plants of the site under consideration.

Table 1. Interviewer's demographic characteristics

Variable	Total	Percentage
Gender		
Male	38	67%
Female	19	33%
Age group (years)		
24-30	11	19%
35-48	22	39%
55-67	16	28%
67-80	8	14%
Occupation		
Farmers/Housewives	26	46%
Herbal doctors/Vaid	4	7%
Students/teachers	15	26%
Shopkeepers and jobholders	12	21%

Diversity of ethnomedicinal plants

Forty-seven plant species from 27 families and 42 genera were used as ethnomedicinal plants by the locals of the study area (Fig 2).The details of the recorded plant species, including their botanical name, vernacular name, family name, location coordinates, plant part used, disease treated, mode of use, and ethnomedicinal use, are presented in Table 2.The most represented family in this study was Lamiaceae with 8 species (17%), followed by Asteraceae with 5 species (11%), Rosaceae with 4 species (9%), Polygonaceae with 3 species (6%), Boraginaceae, Liliaceae, Apiaceae, and Solanaceae with 2 species each (4%), and the other 19 families with 1 species each. Herbs accounted for 85%, shrubs for 11%, and trees and creepers for 2% each, of the identified plant species (Fig 3). The local communities relied on herbal medicines for their health care needs, as they lacked access to modern medical facilities due to poor road connectivity. They also preferred herbal medicines due to their low cost, accessibility, and minimal adverse effects.

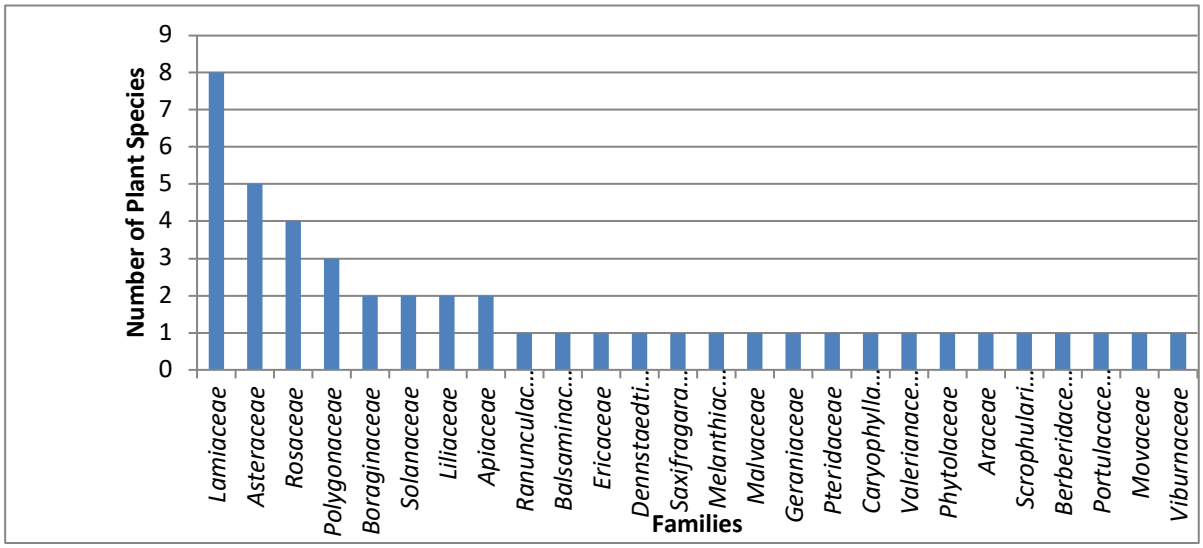

Figure 2. Chart depicting the contribution of plant species of medicinal plants by different families

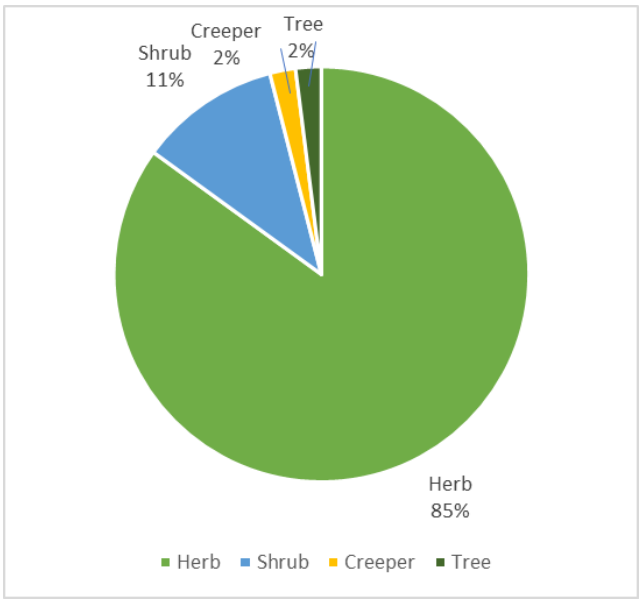

Figure 3. Life form percentage of documented plant species

Plant parts used, their formation, and direction of use

The results indicate that the leaf (43%) was the most frequently used plant part for preparing herbal remedies, followed by the root (33%), fruit (6%), whole plant (5%), seed (3%), rhizome (3%), flower (4%), stem (2%), and bulb (1%) (Fig. 4).The results also reveal that both the roots and the shoots of the plants are essential for the preparation of herbal remedies in the Tral region of Pulwama. The informants used various methods to prepare herbal therapies, such as decoction (30%), infusion (21%), paste (18%), powder (14%), cooked (11%), and juice (6%) (Fig. 5).A total of 14 ailments were identified and treated with herbal medicines, among which gut disorders were the most common, followed by body detoxification. The locals believe the herbal medicinal plants collected from the meadows and forest belt of Tral have many therapeutic properties that can cure various diseases.

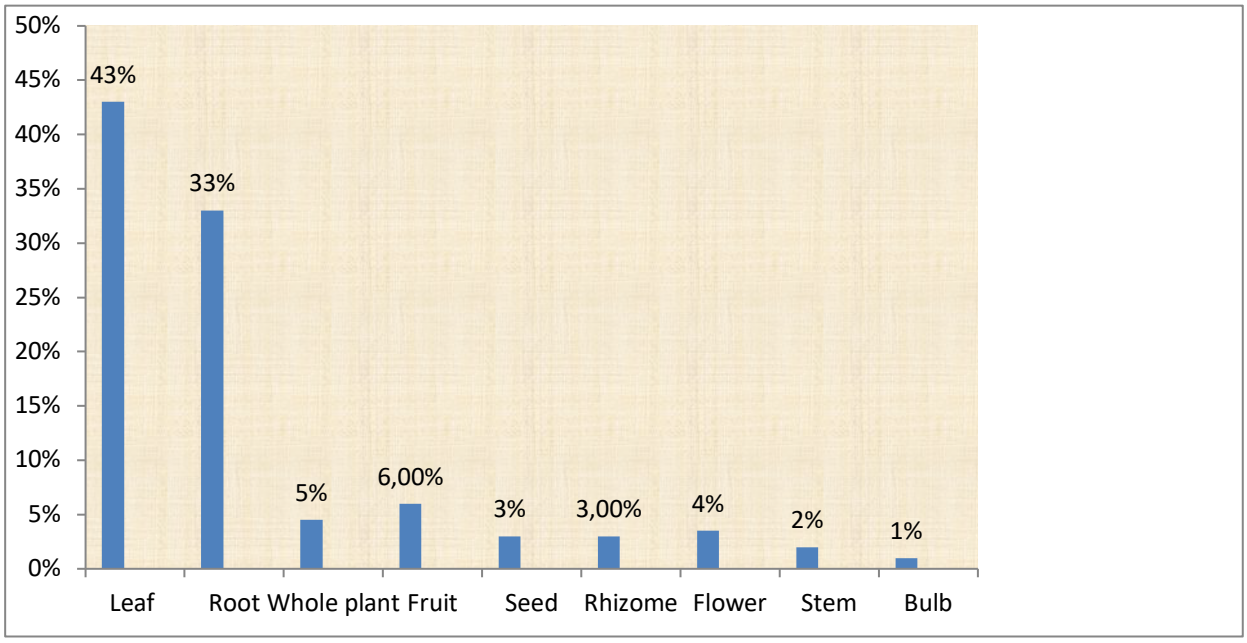

Figure 4. Percentage contribution of plant part used

Table 2: Medicinal plant species used by the locals, including their family, botanical name, local name, location coordinates, plant part used, disease treated, mode of use, total number of citations, and use value.

Family	Botanical Name with Voucher No.	Local Name	Coordinates	Site	Habit	Part/Parts Used	Ethnobotanical Preparation	Ethnomedicinal Uses	Total No of Citations	Use Valve
Apiaceae	*Angelica glauca* Edgew. 9475-KASH	Choora	34°00′43″N 75°10′16″E	Lokut Panchal (Meadow)	Herb	Root	Decoction Paste Powder	GD: Abdominal pain, GD: Anthelminthic, DC: Removes plaques, DC: Teeth whitening	11	0.19
Apiaceae	*Foeniculum vulgare* Mill. 9474-KASH	Badiyan	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Fruit Fruit Whole Plant	Infusion Paste Decoction	CD: Blood purifier, GUA: Kidney problems, GH: Anemia GD: Stomachache GD: Constipation.	19	0.33
Araceae	*Arisaema jacquemontii* Blume. 9465-KASH	Sorim-gand	33°59′38″N 75°11′43″E	Badrewath (Forest)	Herb	Root	Powder Paste	DD: Remove the puss of abscess. DD: Rupture the abscess to release the puss	16	0.28
Asteraceae	*Artemisia absinthium* L. 9485-KASH	Tethwen	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Leaf Leaf	Decoction Paste	CD: Blood pressure ED: Diabetes LP: Jaundice GD: Stomachache	24	0.42
Asteraceae	*Saussurea bracteate* (Schrenk) Sch.Bip. 9487-KASH	Bal-e-koath	33°56'52"N 75°14'13"E	Shumny (Meadow)	Herb	Root	Decoction	NSD: Headache FVR: Fever, RSD: Cough	7	0.12

Asteraceae	*Saussurea costus* (Falc.) Lipsch. 9486-KASH	Koath	33°56'52"N 75°14'13"E	Shumny (Meadow)	Herb	Root Root	Decoction Powder	SMD: Body pain, LP: Jaundice, CD: lipoatrophy GD: Stomach disorders	13	0.23
Asteraceae	*Senecio chrysanthemoides* DC. 9483-KASH	Bagoo	33°59'38"N 75°11'43"E	Badrewath (Forest)	Herb	Flower Leaf Root Root	Paste Paste Powder Powder	GD: Abdominal pain RSD: Cough, Cold, FVR: Antipyretic, SMD: Body pain	12	0.21
Asteraceae	*Taraxacum officinale* F.H.Wigg. 9484-KASH	Jungli haund	33°59'29"N 75°11'07"E	Achalgand (Forest)	Herb	Leaf Leaf	Decoction Cooked	LP: Jaundice CD: Hematinic, NSD: Postpartum depression	18	0.32
Balsaminaceae	*Impatiens edgeworthii* Hook.f. 9468-KASH	Khatdi	33°59′29″N 75°13′10″E	Panchal (Meadow)	Herb	Leaf	Decoction Infusion	SMD: Osteopenia, SMD: Rheumatism. GD: Improves gut health	11	0.19
Berberidaceae	*Podophyllum hexandrum* Royle ex Hook.f. & Thomson 9435-KASH	Wan-Wangun	34°00′26″N 75°11′22″E	Shikargah (Forest)	Herb	Fruit	Juice	LP: Jaundice, GD: Constipation, FVR: Antipyretic.	10	0.18
Boraginaceae	*Arnebia benthamii* (Wall. ex G.Don) I.M.Johnst. 9477-KASH	Kahzaban	34°00'50"N 75°14'50"E	Gandi-Pathri (Meadow)	Herb	Root Root	Decoction Paste	RSD: Cough, Asthma, FVR: Antipyretic, GD: Gastric problems DD: Inflammation, DD: Herpes zoster	13	0.23
Boraginaceae	*Arnebia euchroma* (Royle ex Benth.) I.M.Johnst. 9476-KASH	-	34°00'50"N 75°14'50"E	Gandi-Pathri (Meadow)	Herb	Root	Decoction	CD: Blood purifier, DD: Wound healing, LP: Liver detoxification.	5	0.09

Caryophyllaceae	*Stellaria media* (L.) Vill. 9462-KASH	Laloori	34°00′03″N 75°11′43″E	Cheni-pathri (Meadow)	Herb	Leaf	Infusion Decoction	NSD: Nervous stimulant. GH: Anemia, LP: Jaundice	7	0.12
Dennstaedtiaceae	*Pteridium revolutum* (Desv. ex Poir.) Kuhn 9466-KASH	Zatij	33°59′38″N 75°11′43″E	Badrewath (Forest)	Herb	Leaf Whole Plant	Cooked Cooked	GUA: Prostrate, GD: Gastritis. GD: Bloating, NSD: Remove nerve weakness.	14	0.25
Ericaceae	*Rhododendron campanulatum* D.Don 9469-KASH	Yoam	33°56′37″N 75°11′16″E	Karmulla (village near forest)	Shrub	Leaf	Flower	RSD: Coomon Cold, Flu, NSD: Hypersomia	4	0.07
Geraniaceae	*Geranium pratense* L. 9433-KASH	Ratanjog	33°59′29″N 75°13′10″E	Panchal (Meadow)	Herb	Root	Powder	GH: Removing the weakness of nursing mothers, SMD: Rheumatism, SMD: Joint pain.	15	0.26
Irideaceae	*Iris hookeriana* Falc. 9434-KASH	Neer poash	33°54′00″N 75°06′09″E	Tarsar-Marsar (Alpine)	Herb	Root	Paste Decoction	ENT: Sore throat, ENT: Throat ache. CD: Blood purifier.	6	0.11
Lamiaceae	*Isodon rugosus* (Wall. ex Benth.) Codds 9455-KASH	Soleh	34°08'02"N 75°04'16"E	Nagberan (Meadow)	Shrub	Leaf Leaf Stem	Paste Paste Powder	DD: Wound healing DD: Skin allergy GD: Abdominal pain	7	0.12
Lamiaceae	*Ocimum tenuiflorum* L. 9456-KASH	Babri-beoul	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Seed Seed Seed Leaf Leaf Seed	Paste Infusion Infusion Infusion Infusion Infusion	RSD: Sinusitis GD: Constipation CD: Blood purifier RSD: Asthma ED: Malaria GUA: Kidney disorders	26	0.46
Lamiaceae	*Phlomis bracteosa* Royle ex Benth. 9451-KASH	Shilli	33°59'29"N 75°11'07"E	Achalgand (Forest)	Herb	Root	Powder Oil	SMD: Arthritis SMD: Analgesic	9	0.16

Lamiaceae	*Phlomis spectabilis* Fisch. & C.A.Mey. 9452-KASH	Kala Zeer type	33°59'38"N 75°11'43"E	Badrewath (Forest)	Herb	Root Leaf Leaf Root	Decoction Powder Infusion Infusion	DD: Inflammation DD: Acaricide ED: Diabetes GD: Stomach disorders	11	0.19
Lamiaceae	*Prunella vulgaris* L. 9482-KASH	Kali veouth	33°59'38"N 75°11'43"E	Badrewath (Forest)	Herb	Leaf Leaf Leaf	Paste Infusion Decoction	DD: *Herpes zoster* ED: Diabetes CVS:Atherosclerosis	9	0.16
Lamiaceae	*Salvia hians* Royle ex Benth. 9454-KASH	Kala zeer type 2	33°59'29"N 75°13'10"E	Panchal (Meadow)	Herb	Root Stem Stem	Powder Infusion Infusion	SMD: Arthritis, LP: Jaundice, GD: Stomach cleaning	8	0.14
Lamiaceae	*Stachys affins* Benth. 9481-KASH	Mathran type	33°59'29"N 75°13'10"E	Panchal (Meadow)	Herb	Leaf Leaf Root	Paste Decoction Infusion	DD: Wounds, Swelling GD: Stomach cleaning RSD: Cold, Flu, pneumonia	10	0.18
Lamiaceae	*Thymus linearis* Benth. 9490-KASH	Jungli ajwan	33°59'29"N 75°11'07"E	Achalgand (Forest)	Herb	Leaf Leaf Leaf Leaf	Infusion Decoction Decoction Decoction	DC: Toothache RSD: Cold, Flu FVR: Fever SMD: Muscle pain, body strain	12	0.21
Liliaceae	*Fritillaria imperialis* L. 9473-KASH	Jungli gand	34°00'50"N 75°14'50"E	Gandi-Pathri (Meadow)	Herb	Bulb	Paste Decoction	DD: Herpes zoster, DD: Abscesses. RSD: Asthma, FVR: Antipyretic.	12	0.21
Liliaceae	*Fritillaria roylei* Hook.f. 9472-KASH	Sheethkar	34°00'43"N 75°14'16"E	Lokut Panchal (Meadow)	Herb	Root	Paste Decoction	DD: Herpes zoster, DD: Burns. ENT: Eyesight, RSD: Asthma.	9	0.16

Malvaceae	*Malva neglecta* Wallr. 9432-KASH	Jungli sochal	33°56′11″N 75°15′05″E	Hapat Mazar (Meadow)	Herb	Leaf	Cooked	GH: Body weakness, GH: Anemia, GD: Diarrhoea, CD: Blood purifier.	22	0.39
Melanthiaceae	*Trillium govanianum* Wall. 9431-KASH	Triparti	33°58′54″N 75°04′12″E	Naundi-Kean (Meadow)	Herb	Root Leaf	Paste Raw	SMD: Rheumatism SMD: Body pain. BD: Mastitis.	13	0.23
Moraceae	*Ficus carica* L. 9436-KASH	Anjeer	33°56′37″N 75°11′16″E	Karmulla (village near forest)	Tree	Fruit	Infusion Raw	GH: Anemia CD: Blood pressure GD: Improves gut health CD: High cholesterol. DD: Blisters.	19	0.33
Phytolaccaceae	*Phytolacca acinose* Roxb. 9464-KASH	Lubad	34°08′02″N 75°04′16″E	Nagberan (Meadow)	Shrub	Leaf	Powder Straw	BD: Paramphistomiasis. BD: Strengthen muscles	3	0.05
Polygonaceae	*Rheum emodi* Wall.ex Meisn. 9459-KASH	Pambchalan	34°03'05"N 75°12'55"E	Munwarsar (Meadow)	Herb	Rhizome Leaf	Paste Cooked	SMD: Hair-like bone fractures, BD: Mastitis, SMD: Muscle pain. GUA: Diuretic, LP: liver detoxification	17	0.30
Polygonaceae	*Rumex acetosa* L. 9479-KASH	Obuj	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Root Root Leaf	Paste Decoction Cooked	DD: Abscesses DD: Boils. ED: Diabetes, CD: High Cholesterol, GUA: Diuretic, GD: Constipation	15	0.26
Polygonaceae	*Rumex nepalensis* Spreng. 9458-KASH	Mam Ram	33°59'38"N 75°11'43"E	Badrewath (Forest)	Herb	Root Leaf	Decoction	SMD: Rheumatism, GD: Gastritis. GD: Appetizer, LP: Mild-liver infection	14	0.25

Portulacaceae	*Portulaca oleracea* L. 9437-KASH	Nunur	33°56′37″N 75°11′16″E	Karmulla (village near forest)	Herb	Leaf	Cooked	GUA: Diuretic, DD: Inflammation, GUA: Kidney problems, GH: Liver tonic, CD: Body detoxification.	16	0.28
Pteridaceae	*Adiantum venustum* D. Don. 9461-KASH	Kakwa	34°00′50″N 75°14′50″E	Gandi-Pathri (Meadow)	Herb	Leaf	Decocton Infusion	LP: Jaundice. NSD: Nausea, GD: Gastritis, GD: Vomiting, ENT: Improves eyesight	11	0.19
Ranunculaceae	*Aconitum heterophyllum* Wall.ex Royle 9467-KASH	Patris	34°00′01″N 75°14′29″E	Banhal margi (Meadow)	Herb	Root Leaf	Decoction Powder	RSD: Tuberculosis and other lung disorders. GD: Acute gastritis.	7	0.12
Rosaceae	*Geum elatum* Wall.ex G.Don 9457-KASH	Gogjihaakh mool	33°53'26"N 75°09'22"E	Shikargah (Forest)	Herb	Root	Decoction	ENT: Throat infection, ENT: Eye ailments, GD: Diarrhoea	10	0.18
Rosaceae	*Potentilla argyrophylla* Wall. ex Lehm. 9481-KASH	Meawa	33°58'54"N 75°04'12"E	Naundi-Kean (Meadow)	Herb	Leaf	Decoction	GD: Anthelminthic, GD: Gastric pain, Acidity	11	0.19
Rosaceae	*Rubus niveus* Thunb. 9488-KASH	Daansh	33°53'26"N 75°09'22"E	Shikargah (Forest)	Shrub	Fruit	Juice	NSD: Insomonia, DD: Skin acne, DD: Skin pigmentation, CD: Hematinic	10	0.18
Rosaceae	*Sibbaldia cuneata* Edgew. 9453-KASH	Mathran	33°59'29"N 75°11'07"E	Achalgand (Forest)	Creeper	Root Leaf	Paste Paste	DD: Skin rashes DD: Skin itching	7	0.12
Saxifragaceae	*Bergenia ciliata* (Haw.) Sternb. 9430-KASH	Pushaand	33°59′29″N 75°13′10″E	Panchal (Meadow)	Herb	Root	Paste	DD: Deep wound healing, DD: Abscesses, DD: Inflammation.	9	0.16

Scrophulariaceae	*Picrorhiza kurroa* Royle ex Benth. 9460-KASH	Koawd	34°00′03″N 75°11′43″E	Cheni-pathri (Meadow)	Herb	Root	Decoction Infusion	RSD: Asthma, ED: Diabetes. LP: Hepatic steatosis, GD: Stomach ache.	8	0.14
Solanaceae	*Datura stramonium* L. 9478-KASH	Datur	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Leaf Seed	Decoction Paste	GD: Stomach pain, GD: Anthelminthic.DD: Inflammation	4	0.07
Solanaceae	*Hyoscyamus niger* L. 9480-KASH	Brarigas	33°56'37"N 75°11'16"E	Karmullah (Forest)	Herb	Whole Plant Leaf	Decoction Powder	GD: Vomiting, GD: Stomach ache DC: Teeth whitening	6	0.11
Valerianaceae	*Valeriana jatamansi* Jones ex Roxb. 9463-KASH	Thandi jadi	33°59'29"N 75°13'10"E	Panchal (Meadow)	Herb	Root Leaf	Paste Infusion	ENT: Sore Throat. ENT: Throat pain.	4	0.07
Viburnaceae	*Viburnum grandiflorum* Wall. ex DC. 9471-KASH	Kul-maash	34°00′26″N 75°11′22″E	Shikargah (Forest)	Shrub	Fruit	Juice	GH: Anemia, CD: Lowers hypercholesterolemia, GD: Abdominal pain, GUA: Diuretic	11	0.19

Ailment categories: GD: Gut disorders; CD: Circulatory disorders; RSD: Respiratory system disorders; FVR: Fever; GUA: Genito-urinary disorders; BD: Bovine disorders; NSD: Nervous system disorders; GH: General health; DC: Dental care; DD: Dermatological disorders; SMD: Skeletomuscular disorders; ED: Endocrinal disorders; LP: Liver problems; ENT: Ear, nose and throat).The coordinates and site information indicate the primary locations where the plant species were observed and collected. While some species may occur in multiple locations, the provided coordinates represent significant collection points, offering context for geographic distribution and environmental conditions associated with each species

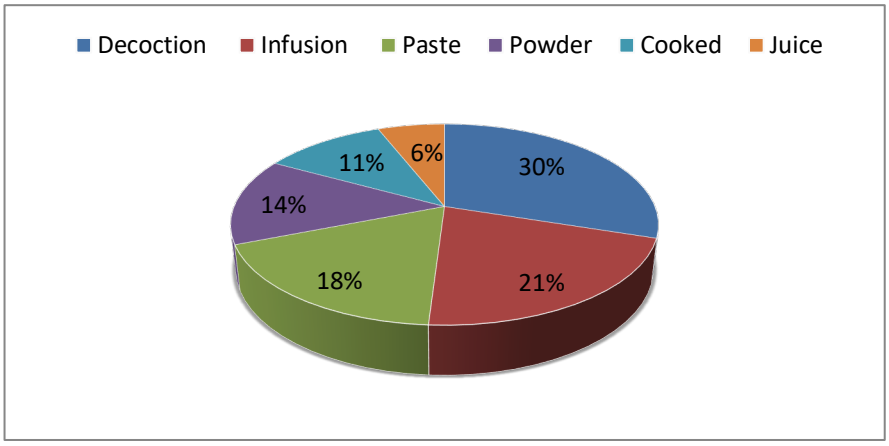

Figure 5. Percentage contribution of the method or preparation used as an herbal remedy

Informant consensus factor (ICF)

The survey revealed 14 different ailments that were treated with various herbal medicines. The ICF reflects the agreement among the informants on the use of ethnomedicinal plant species for ethnopharmacological and cultural purposes. The highest ICF was recorded for gut disorders (ICF=0.85), treated with 25 plant species, and cited 157 times by the informants. Some of the most commonly used plants for this ailment category were *Isodon rugosus*, *Ocimum tenuiflorum*, *Senecio chrysanthemoids*, *Artemisia absinthim*, *Potentilla argyrophylla*, *Geum elatum*, *Rumex nepalensis*, *Hyoscyamus niger*, *Arnebia benthamii*, *Foeniculum vulgare*, *Adiantum venustum*, *Pteridium revolutum*, *Rumex acetosa*, and *Saussurea costus*.The dental care and respiratory system disorders had the second highest ICF (0.83), with 3 plant species and 13 use reports for dental care, 11 plant species, and 59 use reports for respiratory system disorders.Some of the plants used for respiratory system disorders were *Saussurea bracteata*, *Rhododendron campanulatum*, *Aconitum heterophyllum*, *Picrorhiza kurroa*, and some of the plants used for dental care were *Thymus linearis* and *Angelica glauca*. The third highest ICF (0.82) was reported for dermatological diseases, treated with 16 plant species and cited 88 times by the informants. Some of the frequently used plants for this ailment category were *Phlomis spectabilis*, *Sibbaldia cuneata*, *Stachys affins*, *Fritillaria roylei*, *Fritillaria imperialis*, *Arisaema jacquemontic*, *Bergenia ciliata*, *Ficus carica*, *Portulaca oleracea*, *Datura stramonium*, *Prunella vulgaris*.The lowest ICF (0.36) was observed for skeletomuscular disorders treated with 10 plant species and 15 use reports. *Geranium pratense* and *Impatiens edgeworthii* were the plants used for this ailment category in the study area (Table 3).A high ICF indicates that the plant species have high ethnopharmacological and cultural significance to the local community, are believed to possess strong medicinal properties, and are trusted by the community to cure various ailments. A low ICF suggests that the plant species have low significance within the specific environment.

Table 3. Informant consensus factor of medicinal plants

Disorder category	Use report (Nur)	Taxa (Nt)	ICF
Gut disorders	157	25	0.85
Circulatory disorders	47	13	0.74
Respiratory disorders	59	11	0.83
Fever	24	6	0.78
Genito- urinary ailments	18	7	0.65
Bovine disorders	9	3	0.75
Nervous system disorders	27	7	0.77
General health	16	6	0.67
Dental care	13	3	0.83
Dermatological disorders	88	16	0.82
Skeletomuscular disorders	15	10	0.36
Endocrinal disorders	18	5	0.76
Liver problems	48	11	0.79
ENT	19	5	0.78

Use value (UV)

Use value is a mathematical index often utilized in ethnobotany to assess the utility of different medicinal plants for communities.In the current study, use value ranged from 0.46 to 0.05, as shown in (Table 2). *Ocimum tenuiflorum* (Kidney

disorders) exhibited highest UV of 0.46, followed by *Artemisia absinthium* (Stomach ache) with UV= 0.42, *Malva neglecta* (Body weakness) with UV= O.39, *Ficus carica* (Blood pressure) and *Foeniculum vulgare* (Constipation) with UV= 0.33, *Taraxacum officinale* with UV=0.32, *Rheum emodi* with UV= 0.30,*Arisaema jacquemontii* and *Portulaca oleracea* with UV= 0.28, *Thymus linearis*, *Rumex acetosa* and *Geranium pratense* with UV= 0.26, *Rumex nepalensis* and *Pteridium revolutum* with UV= 0.25 and lowest use value for *Phytolacca acinosa* with UV= 0.05.The results suggested the local communities' frequent use of these medicinal plant species. The highest use value indicates the great range utility of a particular plant species, while the lowest use value suggests the minor importance of plant species.

Fidelity level (FL)

Fidelity level provides the reliability with which a specific cultural indigenous group utilizes a particular plant species for medication. The fidelity level ranged from 33% to 100%.The 100% (highest) fidelity level value was achieved by *Datura stramonium* (Anthelmithic), *Phytolacca acinosa* (Paramphistomisasis), *Sibbaldia cuneata* (Skin rashes), *Arisaema jacquemontii* (abscesses),*Rhododendron campanulatum* (Hypersomnia), *Bergenia ciliata* (Deep wounds), *Salvia hians* (Arthritis), *Valeriana jatamansi* (Throat pain), followed by91% for *Phlomis spectabilis* (Diabetes), 89%for *Prunella vugaris* (Herpes zoster) and *Fritillaria roylei* (Herpes zoster), 87.5% for *Portulaca oleraceae* (Diuretic), 86% for *Pteridium revolutum* (Prostrate) and *Aconitum heterophyllum* (Tuberculosis), 85% for *Arnebia benthamii* (Herpes zoster), 83% for *Fritillaria imperialis* (abscess) and *Iris hookeriana* (Sorethroat),80% for *Stachys affins* (cold) and *Geum elatum* (Diarrhoea), 79% for *Foeniculum vulgare* (Constipation) and *Rumex nepalensis* (Rheumatism),78% *Phlomis bracteosa* (Arthritis),76% *Rheum emodi* (Mastitis), and the other species recorded less than 76% fidelity level value. The lowest fidelity value (33%) was recorded for *Rumex acetosa* (Constipation) (Table 4).The high-fidelity level specifies exclusive use of the plant species for specific medication within one particular cultural context, and the low fidelity level suggests that a plant species may have a broader range of uses. Moreover, a single medicinal plant species was recommended to have a dynamic role in treating more than one disease.

Table 4. Fidelity level values for medicinal plant species often used by local communities to treat various diseases

Ailment Category	Most Important Plant Species	Disease Treated	Number of Citations	Fidelity Level
Gut disorders	*Isodon rugosus*	Abdominal pain	5	71
	Artemisia absinthium	Gastric pain	16	67
	Geum elatum	Diarrhoea	8	80
	Rumex acetosa	Constipation	5	33
	Hyoscyamus niger	Vomiting	4	67
	Datura stramonium	Anthelminthic	4	100
	Foeniculum vulgare	Constipation	15	79
	Adiantum venustum	Gastritis	8	73
Circulatory disorders	*Ocimum tenuiflorum*	Blood purifier	14	54
	Saussurea costus	Lipoatrophy	9	69
Respiratory system disorders	*Stachys affinis*	Cold	8	80
	Aconitum heterophyllum	Tuberculosis	6	86
	Saussurea bracteata	Cough	5	71
Fever	*Senecio chrysanthemoids*	Antipyretic	7	58
Genito-urinary ailments	*Viburnum grandiflorum*	Diuretic	6	55
	Pteridium revolutum	Prostate	12	86
	Portulaca oleraceae	Diuretic	14	87.5
Bovine disorders	*Rheum emodi*	Mastitis	13	76
	Phytolacca acinosa	Paramphistomiasis	3	100
Nervous system disorders	*Stellaria media*	Nervous stimulant	5	71

Ailment Category	Most Important Plant Species	Disease Treated	Number of Citations	Fidelity Level
	Rhododendron campanulatum	Hypersomnia	4	100
General health	*Geranium pratense*	Weakness of nursing mothers	6	40
Dermatological disorders	*Sibbaldia cuneata*	Skin rashes	7	100
	Prunella vulgaris	Herpes zoster	8	89
	Rubus niveus	Skin ach	6	60
	Arnebia benthamii	Herpes zoster	11	85
	Arnebia euchroma	Wound healing	3	60
	Fritillaria imperialis	Abscesses	10	83
	Fritillaria roylei	Herpes zoster	8	89
	Bergenia ciliata	Deep wound healing	9	100
	Arisaema jacquemontii	Removes puss of abscess	10	62.5
Skeletomuscular disorders	*Phlomis bracteosa*	Arthritis	7	78
	Salvia hians	Arthritis	8	100
	Rumex nepalensis	Rheumatism	11	79
	Impatiens edgeworthii	Osteopenia	4	36
Endocrinal disorders	*Phlomis spectabilis*	Diabetes	10	91
Liver problems	*Taraxacum officinale*	Jaundice	13	72
	Picrorhiza kurroa	Hepatic steatosis	5	62.5
Dental care	*Angelica glauca*	Teeth whitening	8	73
	Thymus linearis	Toothache	9	75
Ear Nose Tongue	*Valeriana jatamansi*	Throat pain	4	100
	Iris hookeriana	Sore throat	5	83

Discussion

This study investigated the demographic knowledge and usage of medicinal plants by respondents aged 24 to 80 years. The younger generation, aged 22-29, had minimal required ethnomedicinal information. This finding is consistent with most ethnomedicinal literature, which indicates that urbanization has endangered this folk knowledge and created a knowledge gap between the elders and the youth (Arjona-García *et al.* 2021).Most people and traditional therapists acquired their traditional knowledge about therapeutic plants from their ancestors. Additionally, results indicated that illiterate people had more knowledge of medicinal plants than educated ones. This disparity can be attributed to the reliance of illiterate individuals on traditional practices and oral knowledge transmission within their communities. Their daily interactions with the local environment and medicinal plants for healthcare needs contribute to their extensive practical knowledge.

The dominant plant family in the surveyed area was Lamiaceae (8 species); this family was followed by Asteraceae (5 species), Rosaceae, Polygonaceae (3 species), Solanaceae, Boraginaceae, Apiceae and Liliaceae (2 species each), and 19 other families with 1 species each, representing a similar contribution of families in other studies (Jan *et al.* 2023; Kumar *et al.* 2021; Sari *et al.* 2012; Uritu *et al.* 2018).The dominance of Lamiaceae was attributed to its herbaceous nature, large distribution area, and species richness. The collected medicinal plants were classified into herbs (85%), shrubs (11%), and trees and creepers (2%) each, based on their nature.

The results indicate that leaf (43%) was the most frequently used plant part as traditional medicine, followed by root (33%), fruit (6%), whole plant (5%), seed (3%), rhizome (3%), flower (4%), stem (2%), and bulb (1%).The preference for leaf is attributed to its easy collection and coincides with other studies (Amjad *et al.* 2020; Mir *et al.* 2022; Padalia *et al.* 2023; Rahman *et al.* 2023).The informants used various methods to prepare herbal remedies, such as decoction (30%), infusion (21%), paste (18%), powder (14%), cooked (11%), and juice (6%).Decoction is the dominant method because of its simplicity

and effectiveness in extracting the medicinal properties of plants by mixing them with water or other solvents. The informants also apply topical herbal remedies for external ailments, such as dermatological disorders, wound healing, and joint pain. This practice is similar to other studies (Abubakar & Haque 2020; Bhatia *et al.* 2014; Jan *et al.* 2023; Malik *et al.* 2019; Rokaya *et al.* 2010; Shaheen *et al.* 2023).

The dosage of herbal remedies depends on the specific disorder. The informants reported 14 different ailments that they treated with herbal remedies. Gut disorders exhibited the highest ICF of 0.85, followed by respiratory disorders and dental care with ICF of 0.83.The information obtained from the informants is consistent with other studies (Batool *et al.* 2023; Chaachouay *et al.* 2022; Mir *et al.* 2021; Wali *et al.* 2022).A high ICF indicates plant species' ethnopharmacological and cultural importance to the local community and shows its reliability and potent medicinal properties. A low ICF indicates that the plant species has minimal significance in the particular environment. The plant species with high use value in this study were *Ocimum tenuiflorum* (kidney disorders), *Artemisia absinthium* (stomachache), *Malva neglecta* (body weakness), *Ficus carica* (blood pressure), and *Foeniculum vulgare* (constipation).Previous studies have revealed the existence of phytochemicals such as oleanolic acid, eugenol, and rosmarinic acid, in *Ocimum tenuiflorum*, which give it antibacterial, antifungal, antidiarrheal, antioxidant properties and a great potential against Covid-19/pandemic virus (Ara *et al.* 2020; Dailah 2022; Panchal & Parvez 2019; Sharan *et al.* 2019).The high use value displays a plant species' diversity of uses, whereas the low use value indicates a plant species' restricted relevance.

The medicinal plants frequently used and applied by local communities for various diseases have higher fidelity levels than less used ones. The fidelity level in this survey ranged from 33 to 100%.The highest fidelity level (100%) was obtained by *Datura stramonium* (anthelmintic), *Phytolacca acinosa* (paramphistomiasis), *Sibbaldia cuneata* (skin rashes), *Arisaema jacquemontii* (abscesses), *Rhododendron campanulatum* (hypersomnia), *Bergenia ciliata* (deep wounds), *Salvia hians* (arthritis), and *Valeriana jatamansi* (throat pain).Similar results have been reported for these plants in other parts of the world (Charmakar *et al.* 2021; Jan *et al.* 2021; Kour *et al.* 2021; Melkani *et al.* 2011; Tiwari & Pande 2006; Verma *et al.* 2015).The presence of secondary metabolites imparts high therapeutic properties to these plants. Plants with high fidelity levels can be explored for new phytochemicals and drugs with higher efficacy.This study documents the first-hand account of some local tribal communities using these plants for decades. Some of their uses have not been documented or researched before. For example, one of the tribal communities reported that they use the ground bulb of *Fritillaria roylei* (**sheethkar**), an endangered species, for treating herpes zoster, the paste of leaves of *Arisaema jacquemontii* (**sorim gand**) for abscesses, the cooked leaves of *Pteridium revolutum* (**zatij**) for prostrate, and the leaves of *Phytolacca acinosa* (lubad) for paramphistomiasis of domestic ruminants. They claim that they have learned these uses from their forefathers. The facts are based on the locals' first-hand accounts. The respondents did not share any adverse effects of these plants, if any. This survey also shows the significance of these plants for the locals who live near forests and lack access to modern medical facilities. Due to poor or inadequate road connectivity, they do not receive proper health care or treatment. These plants serve as first aid for them in emergencies. The indigenous knowledge of the tribal people can help produce new drugs and advance the medical field. This study also highlights the changing relationship between the locals and the plants due to the modern medical system.

Conclusion

The study documented medicinal plants' diversity, usage, and cultural significance in the Tral region of Kashmir, India. Forty-seven plant species from 27 families were identified, with roots and leaves being the most frequently used parts. Decoctions and infusions were the main methods used to treat various ailments. Gut disorders exhibited the highest informant consensus factor, whereas skeletomuscular disorders exhibited the lowest. Locals of the Tral region employ various medicinal plants for different health problems, and the ethnomedicinal plants in the Tral area have a high-fidelity level and use value and are crucial for the local communities. The identified medicinal plants can be screened for their chemical composition and potential bioactive compounds. The local communities possess indigenous knowledge from their forefathers, and there is a need to register and conserve these valuable resources before they become extinct in the wild. Longitudinal studies can be conducted to know the transmission of knowledge about medicinal plants across generations and the factors influencing their continuity or erosion. Comparative studies can be undertaken to assess the efficacy and safety of traditional plant remedies prepared from the identified plant species, potentially leading to the development of new therapeutic interventions. It is thus important that policymakers and forest/rangeland managers recognize the importance of preserving traditional knowledge and integrating it into formal healthcare practices. Conservation strategies should be developed to protect medicinal plant species and their habitats considering their cultural and therapeutic

significance. Encouraging collaboration between traditional healers and modern healthcare providers can enhance community health outcomes and preserve valuable ethnobotanical knowledge.

Declarations

List of abbreviations: FL (Fidelity Level); ICF (Informant Consensus Factor); UV (Use Value); GD (Gut Disorders); CD (Circulatory Disorders); RSD (Respiratory System Disorders); FVR (Fever); GUA (Genito-Urinary Disorders); BD (Bovine Disorders); NSD (Nervous System Disorders); GH (General Health); DC (Dental Care); DD (Dermatological Disorders); SMD (Skeletomuscular Disorders); ED (Endocrinal Disorders); LP (Liver Problems); and ENT (Ear, Nose, and Throat).

Declaration of competing interest: None

Ethics approval and consent to participate: All informants and respondents were asked for consent, and permission was obtained before interviews and observations were recorded**.**

Consent for publication: Not applicable.

Availability of data and materials: All data are only available to the authors.

Financial Support: Nil

Author contributions: Latif Ahmad Peer: Conceptualization, Methodology, Data curation, Project administration, Writing - original draft. Amir Maqbool Mir: Conceptualization, Methodology, Writing -review and editing. Bilal Ahmad Mir: Conceptualization, Methodology, Writing -review and editing.

Acknowledgements

We want to express our gratitude to the local communities of the Tral region in Kashmir, particularly the informants and respondents who generously participated in our research interviews and other research activities. Additionally, we extend our thanks to the taxonomists at the Center for Plant Taxonomy of the University of Kashmir for their invaluable assistance in plant identification throughout this study.

Literature Cited

Abubakar AR, Haque M. 2020. Preparation of Medicinal Plants: Basic Extraction and Fractionation Procedures for Experimental Purposes. Journal of Pharmacy and Bioallied Sciences 12(1):1-10.

Amjad MS, Zahoor U, Bussmann RW, Altaf M, Gardazi SMH, Abbasi AM. 2020.Ethnobotanical survey of the medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 16(1):65.

Ara I, Maqbool M, Zehravi M, Gani I. 2020. Herbs Boosting Immunity in Covid-19: An Overview. Advanced Journal of Chemistry 3(3):289-94.

Arjona-García C, Blancas J, Beltrán-Rodríguez L, López Binnqüist C, Colín Bahena H, Moreno-Calles AI, Sierra-Huelsz JA, López-Medellín X. 2021. How does urbanization affect perceptions and traditional knowledge of medicinal plants? Journal of Ethnobiology 17(1):1-26.

Batool Z, Singh K, Gairola S. 2023. Medicinal plants traditionally used in the health care practices by the indigenous communities of the Trans-Himalayan region of Ladakh, India. Journal of Ethnopharmacology 317:116837.

Bhatia H, Sharma YP, Manhas RK, Kumar K. 2014.Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India. Journal of Ethnopharmacology 151(2):1005-18.

Chaachouay N, Douira A, Zidane L. 2022. Herbal Medicine Used in the Treatment of Human Diseases in the Rif, Northern Morocco. Arabian Journal for Science and Engineering 47(1):131-153.

Charmakar S, Kunwar RM, Sharma HP, Rimal B, Baral S, Joshi N, Gauli K, Acharya RP, Oli BN. 2021.Production, distribution, use and trade of *Valeriana jatamansi* Jones in Nepal. Genetic and Evolutionary Computation Conference 30:e01792.

Croom EM.1983.Documenting and evaluating herbal remedies. Economic Botany 37(1):13-27.

Dailah HG.2022.The ethnomedicinal evidences pertaining to traditional medicinal herbs used in the treatment of respiratory illnesses and disorders in Saudi Arabia: A review. Saudi Journal of Biological Sciences 29(9):103386.

Farnsworth NR.2007.Ethnopharmacology and Drug Development. Ciba Foundation Symposium 185 - Ethnobotany and the Search for New Drugs.p. 42-59.

Gupta SK, Sharma OM, Raina NS, Sehgal S. 2013.Ethno-botanical study of medicinal plants of Paddar Valley of Jammu and Kashmir, India. African Journal of Traditional, Complementary, and Alternative Medicines 10(4):59-65.

Jan HA, Abbasi AM, Bussmann RW, Paniagua-Zambrana NY.2021. *Datura stramonium* L. Solanaceae. Ethnobotany of the Himalayas. Springer. p. 725-733.

Jan M, Mir TA, Ahmad Jan H, Bussmann RW, Aneaus S. 2023. Ethnomedicinal study of plants utilized in pregnancy, childbirth and postpartum healthcare in Kashmir Himalaya. Journal of Herbal Medicine 42:100767.

Kanta C, Sharma IP, Shiekh MA. 2018.Ethnobotanical studies on medicinal plants of Langate area, Kupwara, Jammu and Kashmir, India. Journal of Medicinal Plants Studies 6(2):94-97.

Kour H, Raina R, Verma PK, Khan AM, Bhat MA, Nashiruddullah N. 2021. Evaluation of the wound healing activity of ethanolic extract of *Bergenia ciliata* (Haw.) Sternb. rhizome with excision wound model in Wistar rats. Journal of Ethnopharmacology 281:114527.

Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, Adeyi O, Barker P, Daelmans B, Doubova SV et al. . 2018. High-quality health systems in the Sustainable Development Goals era: time for a revolution. Lancet Global Health 6(11):e1196-e1252.

Kumar M, Paul Y, Anand V. 2009.An ethnobotanical study of medicinal plants used by the locals in Kishtwar, Jammu and Kashmir, India. Ethnobotanical Leaflets 2009(10):5.

Kumar M, Radha, Devi H, Prakash S, Rathore S, Thakur M, Puri S, Pundir A, Bangar SP, Changan S et al. . 2021. Ethnomedicinal Plants Used in the Health Care System: Survey of the Mid Hills of Solan District, Himachal Pradesh, India. Plants (Basel) 10(9):1842.

Kumari S, Batish DR, Singh H, Negi K, Kohli R. 2013.An ethnobotanical survey of medicinal plants used by Gujjar Community of Trikuta Hills in Jammu and Kashmir, India. In: Rahi J, editor. The Gujjars-Vol 04 (Gujjars History & Culture).

Lone PA, Bhardwaj AK, Shah KW, Tabasum S. 2014. Ethnobotanical survey of some threatened medicinal plants of Kashmir Himalaya, India. Journal of Medicinal Plant Research 8(47):1362-73.

Malik K, Ahmad M, Zafar M, Ullah R, Mahmood HM, Parveen B, Rashid N, Sultana S, Shah SN, Lubna.2019.An ethnobotanical study of medicinal plants used to treat skin diseases in northern Pakistan. BMC Complementary and Alternative Medicine 19(1):210.

Melkani AB, Mohan L, Pant CC, Negi A, Dev V. 2011. Terpenoid Composition and Antibacterial Activity of Essential oil from *Salvia hians* Royle ex.Benth. Journal of Essential Oil Bearing Plants 14(6):667-672.

Mir TA, Jan M, Bussmann RW, Bilal T. 2022. Inventory of medicinal herbs utilized for the treatment of musculoskeletal disorders in district Kupwara of Jammu and Kashmir. Ethnobotany Research and Applications 24:1-13.

Mir TA, Jan M, Khare RK. 2021.Ethnomedicinal application of plants in Doodhganga forest range of district Budgam, Jammu and Kashmir, India. European Journal of Integrative Medicine 46:101366.

Padalia H, Rai ID, Pangtey D, Rana K, Khuroo AA, Nandy S, Singh G, Sekar KC, Sharma N, Uniyal SK et al. . 2023. Fine-scale classification and mapping of subalpine-alpine vegetation and their environmental correlates in the Himalayan global biodiversity hotspot. Biodiversity and Conservation 1-37.

Pala NA, Banday M, Islam M, Rashid M, Malik ZA, Bussmann RW. 2021.Ethnobotanical utilization of forest resources in Sindh Forest of Kashmir Himalaya, India. Ethnobotany Research and Applications 21:1-18.

Panchal P, Parvez N. 2019. Phytochemical analysis of medicinal herb (*Ocimum sanctum*). International Journal of Nanomaterials and Molecular Nanotechnology5(2):008-011.

Rahman S, Jan G, Jan FG, Hashmi SJ, Rahim HU. 2023.Exploration of ethnomedicinal plants, diversity and their practices in human healthcare in Tehsil Mandan, District Buner, Khyber Pakhtunkhwa, Pakistan. Acta Ecologica Sinica 44(1):143-154.

Rokaya MB, Munzbergova Z, Timsina B. 2010. Ethnobotanical study of medicinal plants from the Humla district of western Nepal. Journal of Ethnopharmacology 130(3):485-504.

Sari M, Sarri D, Hendel N, Boudjelal A. 2012. Ethnobotanical study of therapeutic plants used to treat arterial hypertension in the Hodna region of Algeria. Global Journal of Medicinal Plants Research 1(9):411.

Shah A, Abass G, Sharma M. 2012. Ethnobotanical study of some medicinal plants from tehsil BudhaL, District Rajouri,(Jammu and Kashmir).International Multidisciplinary Research Journal 2(6):5-6.

Shaheen S, Harun N, Ijaz R, Mukhtar N, Ashfaq M, Bibi F, Ali M, Abbas Z, Khalid Z. 2023.Sustainability Issues in Conservation of Traditional Medicinal Herbs and Their Associated Knowledge: A Case Study of District Lahore, Punjab, Pakistan. Sustainability 15(9):7343.

Sharan S, Sarin NB, Mukhopadhyay K. 2019.Elicitor-mediated enhanced accumulation of ursolic acid and eugenol in hairy root cultures of *Ocimum tenuiflorum* L. is age, dose, and duration dependent. South African Journal of Botany 124:199-210.

Sharma PK, Singh V. 1989.Ethnobotanical studies in northwest and Trans-Himalaya. V. Ethno-veterinary medicinal plants used in Jammu and Kashmir, India. Journal of Ethnopharmacology 27(1-2):63-70.

Shi Y, Zhang C, Li X. 2021.Traditional medicine in India. Journal of Traditional Chinese Medical Sciences 8: 51-55.

Tiwari L, Pande P. 2006. Indigenous veterinary practices of Darma valley of Pithoragarh district, Uttaranchal. Uttaranchal Himalaya. Indian Journal of Traditional Knowledge 5(2):201-206.

Uritu CM, Mihai CT, Stanciu GD, Dodi G, Alexa-Stratulat T, Luca A, Leon-Constantin MM, Stefanescu R, Bild V, Melnic S, Tamba BI. 2018.Medicinal Plants of the Family Lamiaceae in Pain Therapy: A Review. Pain Research & Management 2018:7801543.

Verma H, Lal V, Pant K. 2015. Evaluation of anxiolytic activity in four selected species of *Arisaema*. Journal of Pharmaceutical Research 9:569-572.

Wagay NA. 2014.Medicinal flora and Ethno-botanical knowledge of Baramulla Tehsil in Jammu and Kashmir, India. International Journal of Advanced Biotechnology and Research 5(3):539-546.

Wali R, Khan MF, Mahmood A, Mahmood M, Qureshi R, Ahmad KS, Mashwani ZU.2022.Ethnomedicinal appraisal of plants used for the treatment of gastrointestinal complaints by tribal communities living in Diamir district, Western Himalayas, Pakistan. PLoS One 17(6):e0269445.

Yousuf J, Verma RK, Dar H. 2012. Traditional plant based therapy among rural communities of some villages of Baramulla district (Jammu and Kashmir). Journal of Phytology 4(5):46-49.