

# Ethnomedicinal knowledge of the rural communities of Gulmarg, Jammu and Kashmir, India

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**Abstract.** Ji A, Hamid A, Andrabi SAH. 2023. Ethnomedicinal knowledge of the rural communities of Gulmarg, Jammu and Kashmir, India. *Asian J Ethnobiol* 6: 58-64. In the current study, 60 medicinal plants have been collected from Gulmarg, Jammu and Kashmir (India), belonging to 34 families. The plant parts used were dominated by roots (36%), and the collection of roots has depleted the population of certain plant and may endanger the survival of the rare and slowly reproducing medicinal plants. It was found that the old people possessed a good wealth of traditional information as compared to younger generation Therefore, it is imperative to document the medicinal plants and associated information and to require necessary measures for the conservation of those resources. Herbs dominated all other life forms (49 species). The most typical way to consume the medications was by decoction, 32% (22 species). According to the current study the most prevalent disease addressed by the medicinal plants included was gastrointestinal disorders (25 species). *Artemisia absinthium* L. had the highest Use Value (UV), i.e., 0.58, while *Viscum album* L. had the lowest UV (0.17). Locals continue to value herbal treatments as a trustworthy means of curing a variety of ailments.

**Keywords:** Ethnomedicine, Gulmarg, medicinal plants, traditional knowledge

## INTRODUCTION

A rich source of therapeutic compounds for illness prevention, medicinal plants have a long history dating back thousands of years. Herbal medicine is essential for the treatment of illnesses. Many local groups in impoverished nations still use plant-based medicines today, and modern healthcare systems rely on plant-based components. Plants have been a crucial component of human civilization since humans learned to survive on the earth. Since the beginning of time, mankind has relied on plants to provide for all of their essential requirements. Approximately 70% of the recognized medicinal plants in the Indian Himalayas are subject to opportunistic harvesting (Dhar et al. 2000) 80% of the world's population still relies on conventional medicinal plants today (Dar et al. 2001). The usage of herbal medicine, especially in rural areas where many locally made international medications are still utilised as home cures for a variety of illnesses, continues to be significant (Az-Zahra et al. 2021).

Kashmir Himalayas are home to a vast collection of medicinal plants (Singh et al. 2019). Due to their significance for social, cultural, and economic survival, forests play a significant role in the viability and survival of indigenous households in India (Phondani et al. 2010). The use of these plants' resources for medicine, fuelwood, food, housing, agriculture, timber, furniture, fodder, and religious rituals is the subject of ethnobotanical surveys (Khan et al. 2003). Kashmir is no exception. Rural inhabitants in the Himalayan region, particularly those living close to forested areas, rely more heavily on the use of forest

resources. About 800 plant species are thought to be eaten in India as food and medicine, primarily by the tribal people (Venkatachalapathi and Paulsamy 2017) and there are numerous reports on ethno-botanical and ethno-medical knowledge available in the region by different workers (Abdullah and Andrabi 2021, Asif et al. 2021; Haq et al. 2021b; Hassan et al. 2022; Khoja et al. 2022a).

Ethnobotany has been experimenting with new techniques over the past few decades while continuing the dual objectives of recording and preserving ancient human uses of plants and describing and striving to improve human lifestyle (Mir et al. 2020). Consequently, gathering information on plant applications related to health, especially medical and food uses, though other uses are also relevant, dominates ethnobotanical study. Many drugs have been developed based on their ethnobotanical foundation in light of the significance of folk local knowledge to protect and improve health, including the antiviral oseltamivir and the antimalarial artemisinin, to name just two well-known and recent examples (Abdullah and Andrabi 2021; Haq et al. 2021a). One of the major pillars of the field is ethnopharmacology (Haq et al. 2021b).

Due to increased population and highway construction, medicinal plants are frequently included into new commercial endeavours. Because of modern healthcare facilities, the remoteness of the area and a strong cultural belief in the efficacy of folk medicines, the traditional medicinal system serves as the primary provider of primary healthcare services in the tribal areas (Haq et al. 2023b).

The loss of related traditional knowledge could be caused by the extinction of multiple taxa (Lamsal et al.

2017). Because of this, it is crucial to comprehend the ecological behavior of these therapeutic plants, such as their flowering phenology, in order to comprehend their reproductive success (Liu et al. 2021).

Ethno-medicinal plants have significantly aided in the development of innovative treatments for diseases like cancer. Studies on natural products have recently regained popularity due to their biological significance and the role that their structural variety plays in these products (Khoja et al. 2022b). Within the Kashmiri tribal areas, forest resources serve as a source of livelihood, employment, housing, food, fuel, vegetables, medicine, fertiliser, etc. Less research has been done on Gulmarg potential for ethnomedicine. Therefore, an effort has been undertaken to archive the ethnobotanical information of Gulmarg therapeutic plants with the help of the locals, including herbalists, shepherds, and knowledgeable elders.

## MATERIALS AND METHODS

### Study area

The Gulmarg is home to ethnic groups including the Gujjars and Bakerwals (India), who have a long history of traditional knowledge, particularly connected to medicinal plants. The Gulmarg also has a rich heritage of traditional medicinal plants. It extends between 74°.17' and 74°.79' N latitude and 34°.55' to 34°.60' E longitude, at an altitude of 2400-4300 m, and drops 26 kilometers southwest of District Baramulla. It is divided into 20 compartments, numbered from 31 to 41 and 50 to 58. Although it had been suggested in 1981 to be designated as a Biosphere Reserve, it became a Wildlife Sanctuary in 1987. (Notified vide S.R.O.147, Dated: 14-03-1987). The Ferozpur Nallah top watershed and the woodlands encircling the Gulmarg Bowl are all included in the 180 km<sup>2</sup> that make up the Gulmarg Wildlife Sanctuary (GWLS). Additionally, the region is bordered by the Jhelum Valley Forest Division-Baramulla in the north and the Forest Divisions of Poonch and Pir-Panjal in the south. Village of Drang and Badrakoot forests of Special Forest Division - Tangmarg border the east, and Baba Reshi and Special Forest Division Tangmarg border the west. For their subsistence, the locals of the GWLS depend on raising cattle and gathering non-timber forest products from the surrounding areas. For a variety of ethnic groups, including the Gujjars and Bakerwal, who have a rich heritage of traditional knowledge, particularly regarding the use of plants for human and animal health care, and who transmitted this knowledge orally from time immemorial, the Gulmarg is a paradise, the area is known as the Himalayas of India. However, such priceless wisdom is now only available to the elderly due to ignorance, industrialisation, and urbanisation. Documenting this knowledge now, before it is lost, is therefore imperative.

### Data collection

The information on medicinal plants was gathered using the following method: field surveys, ethnobotanical knowledge obtained from informants, photography and inventory, preservation and taxonomic verification of

specimens, botanical identification, and quantitative ethnobotanical analysis. Between May 2020 and August 2021, information was gathered from informants about Gulmarg's traditional knowledge of its therapeutic herbs. One hundred twenty-nine informants in all were questioned (90 male and 39 females). To gather the traditional knowledge of the locals regarding medicinal plants, field conversations, questionnaires, and personal interviews were done. The informants provided information about the applications, plant parts used, diseases treated, preparations, and administration methods of medicinal plants. To confirm identification, the most information possible was gathered, and the data provided by the local informants during initial field visits were double checked, routine field surveys were conducted during the majority of the medicinal plants' flowering seasons. The veracity of the information gathered was verified throughout the course of several visits and interviews with the informants.

The snowball sampling approach was used to pick 129 knowledgeable individuals to learn more about the utilisation of medicinal plants in Gulmarg, Jammu and Kashmir (Table 1). From 20 to 85 years old, these volunteers represented various age groups. In terms of information sharing, the selected male participants (N=90) had more experience than the selected female participants (N=39). The majority of the volunteers that were chosen were illiterate (N=63), and just a tiny proportion had schooling above the upper secondary level (N=12). Due to their extensive knowledge of ethnomedicine, participants were chosen. Continuous communication with the local population was maintained throughout the study to ensure the reliability of traditional knowledge.

### Demographic status of Informants:

A total of 90 informants from three ethnic groups (Gujjar, Bakarwal and Kashmiri) were selected, most of whom were males (58 males and 32 women). The dominance of male informants in the study was due to the cultural limitations (young females are reluctant to meet unknown male due to religious obligations) which can be ascribed to the possible bias of the current study. The selected informants were categorised into different professional groups, age groups, and the education status. Younger individuals have higher levels of education than older ones (Table 1). Urdu, Kashmiri, Phari and Gujri are the four different types of languages spoken in the study area.

**Table 1.** Demography of respondents from the study area

Variable	Demographic category	No. of informants	Percentages
Gender	Male	90	69.77
	Female	39	30.23
Age	20-40	29	22.48
	41-60	40	31.01
	60 and above	60	46.51
Education	Illiterate	63	48.84
	Primary	35	27.13
	Middle	19	14.73
	Higher	12	9.30

**Data analysis**

Utilizing quantitative indicator, the Use Value (UV), indicating the relative importance of locally recognised species, was calculated with the following formula (Phillips et al. 1994):

$$UV = \Sigma U/n$$

Where: "n" denotes the total number of informants and "U" denotes the total number of reports referenced by each informant for a particular plant species. Use value increases with the number of use reports for a plant, showing the significance of the plant species. However, the UV does not differentiate between a plant's single or numerous uses (Khoja et al. 2022c).

**RESULTS AND DISCUSSION**

**Floristic characteristics of medicinal plants**

A total of 60 medicinal plant species belonging from 34 different families, have been gathered from the study area. The majority of them are members of the Asteraceae family (9 species), which is followed by the Lamiaceae (N=4), Apiaceae, Berberidaceae, and Polygonaceae families (3 species each), and the Boraginaceae, Amaranthaceae, Geraniaceae, Malvaceae, Plantaginaceae, Ranunculaceae, and Solanaceae families (2 species each). For the other 22 families, each contributes just one species (Figure 1). The family Asteraceae is dominant because its members are noted for their fragrant qualities and are widely distributed across nature. Its herbaceous life form, widespread distribution, and abundance in the research area may also have a role (Abdullah and Andrabi 2021; Asif et al. 2021). Asteraceae family members adapt to arid, dry environments quickly and easily due to their vast ecological amplitude (Haq et al. 2021b).

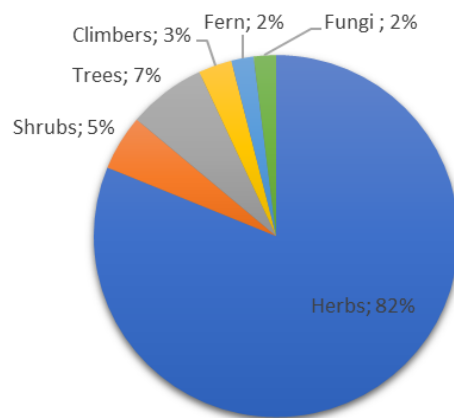
**Life form**

Herbs (N=49 species, 82%) are the most common type of plant life in the current study, followed by shrubs (N=3, 5%), trees (N=4, 7%), climbers (N=2, 3%), ferns, and fungus (N=1, 1, 2% each) (Figure 2). Depending on the

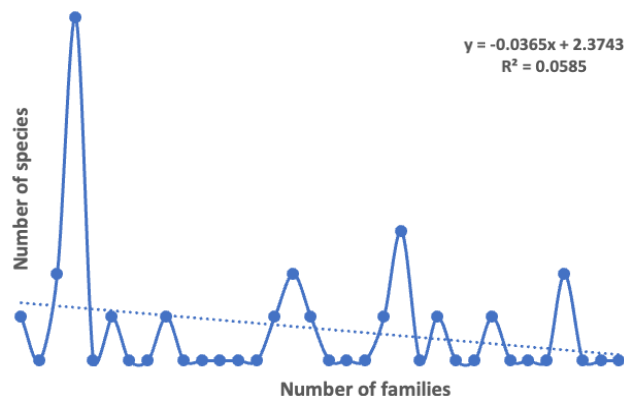
ailment being treated, the plants obtained from the study region were applied topically or orally to affected body parts. The ease with which they may be collected, their greater quantity, and their superior efficiency in treating illnesses when compared to other life-forms may account for the higher use of herbs for therapeutic purposes in the studied region (Adnan et al. 2012; Haq et al. 2023a).

**Plant part used**

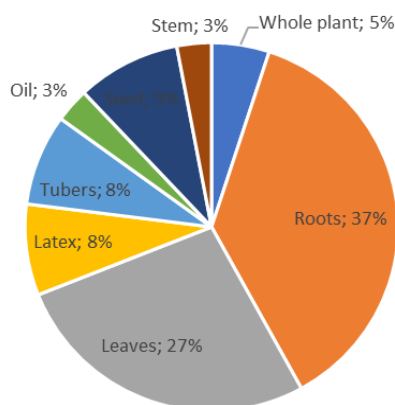
For the preparation of medicinal recipes, the locals most frequently use roots (N=22, 36%), followed by leaves (N=16, 26%), seeds, latex and tubers (N=5, 8%), whole plants (N=3, 5% each), and stem and oil (N=2, 3% each). The remaining ingredients include bark, flowers, fruits and fruiting bodies, which each contribute (N=1, 2%) (Figure 3). The most typical techniques of preparation for the use of medicinal plants are drying the live plants and crushing them into powder or using them raw to produce tea, extract juice, paste, infusion, decoction, or vegetables. In a large portion of the world where herbs are used as medicines, grinding, crushing, and boiling are the most popular and efficient techniques of extracting active ingredients (Singh et al. 2019), and this method is also most popular among the locals in the research area. Previous studies that were conducted reported findings that were similar (Abdullah and Andrabi 2021; Asif et al. 2021).



**Figure 2.** Percentage of life form of medicinal plants used



**Figure 1.** Species contribution of different families



**Figure 3.** Percentage contribution of various plant parts used in the ethnomedicinal preparations

**Plant preparations**

Seven categories were used to categorise the medicinal plants used in herbal remedies (Figure 4). Decoction (N=22, 34%), Raw (N=11, 17%), Infusion (N=9, 14%), Paste (N=10, 15%), Poultice (N=8, 12%), Vegetable (N=3, 5%), and Oil (N=2, 3%) were the most popular ways to prepare herbal treatments. Khoja et al. (2022a,b,c) indicated that the same outcomes were obtained and that the majority of plants were used in decoctions, followed by juice and powder. Because they are simple to manufacture, decoctions are commonly cited as the primary types of preparation in ethnopharmacological investigations Haq et al. 2023a). The paste is made by blending fresh or dried plant parts with oil or water, and the powder is made by crushing plant parts after drying them in the shade (Khoja et al. 2022a,b,c). A considerable amount of components are produced during extraction, making it one of the main forms of ethnobotanical techniques since they can be employed to quickly treat illnesses (Haq et al. 2023b).

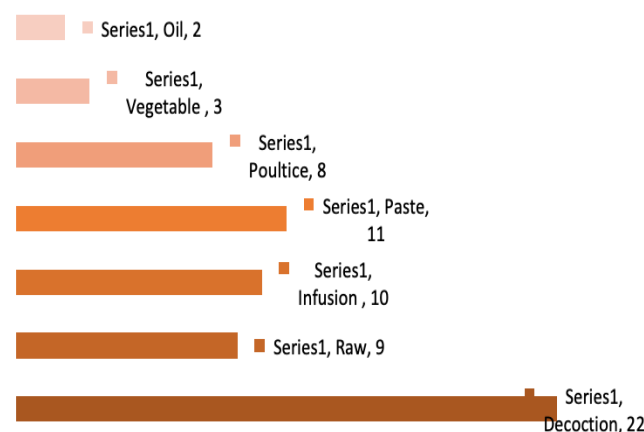
**Diseases treated**

Based on information provided by informants, gastrointestinal illnesses were treated by the greatest number of species (25 species), followed by bone and joint diseases (MSDs) (21 species), and urinary diseases by the least number of species (Figure 5). This distribution of applications is consistent with another research, such as those by (Kaur et al. 1997, Miya et al. 2020, and Monigatti et al. 2013). The most frequently mentioned plants by the informants for the treatment of gastrointestinal disorders were *A. absinthium*, *L. jacquemontiana*, *A. heterophyllum*, *A. parviflora*, *T. linearis*, *F. roylei*, *U. dioica*, *P. major*, *M. neglecta*, and *A. calamus*.

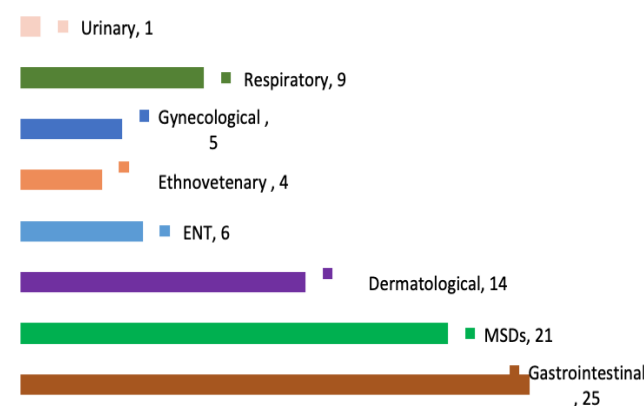
**Use Value (UV)**

A species' importance to the informants and the regional ethnomedicinal system is shown by its Use Value (UV). The primary species in the current study's Table 2 had the greatest UV reported for *A. absinthium* (0.58) and the lowest UV reported for *V. album* (0.17). The other important species with high UV values were *A. calamus* (UV=0.50), *A. heterophyllum* (0.57), *S. costa* (0.47), *G.*

*wallichianum* (0.54), and *R. webbianum* (0.53). Due to their widespread distribution and widespread knowledge of their therapeutic applications by the local population, medicinal plant species in the study region have high UV levels (Rahman et al. 2016). From *A. absinthium*, several phytochemicals have been extracted and reported, including sesquiterpene lactones, a class of natural compounds with several proven medicinal effects, guanolide dimmers such as absinthin and its isomers anabsin, artabsin, and absintholide (Beauhaire et al. 1984), germacrene type such as artabin (Akhmedov et al. 1970), (Perez-Souto et al. 1992). These phytochemical components have been linked to a variety of plant properties, including hypersecretory activity (Blumberger and Glatzel 1966), neuroprotective activity (Wake et al. 2000), anthelmintic activity (Abdullah and Andrabi 2021), neurotoxic activity (Donald 1981), antiprotozoal activity (Valdes et al. 2008), antifungal activity (Kordali et al. 2005).



**Figure 4.** Mode of preparation of medicinal plants



**Figure 5.** Percentage of plants used to treatment of various disorders in the study area

**Table 2.** Enumeration of medicinal plants used to treat various diseases in Gulmarg of Jammu and Kashmir, India

Family	Medicinal plant	Common name	Source	Part used	Life form	Preparation	Adm.	Disease treated	No. of use reports	Use value
Amaranthaceae	<i>Amaranthus viridis</i> L.	Ganhar	C	Seeds	H	Cooked	O	Back pain	35	0.27
	<i>Amaranthus caudatus</i> L.	Krey kul	W	Seeds	H	Cooked	O	Constipations	39	0.30
Acoraceae	<i>Acorus calamus</i> L.	Vai	W	Roots	H	Raw	O	Stomach cramps, abdominal pain	65	0.50
Araceae	<i>Arisaema jacquemontii</i> Blume	Hapat-makai	W	Tuber	H	Paste	T	Skin burns	39	0.30
Apiaceae	<i>Coriandrum sativum</i> L.	Dainwal	C	Seeds	H	Paste	T	Abdominal pain	46	0.36
	<i>Angelica glauca</i> Edgew.	Chora	W	Roots	H	Infusion	O	Blot, constipations	58	0.45
Berberidaceae	<i>Eryngium billardieri</i> F. Delaroché	Dawamool	W	Roots	H	Infusion	O	Stomach cramps, jaundice	37	0.29
	<i>Berberis lycium</i> Royle	Chockchrey	W	Roots	S	Decoction	O	Joint pain, Abdominal pain	46	0.36
	<i>Berberis aristata</i> DC.	Sumbal	W	Roots	S	Decoction	O	Joint pain, inflammation	38	0.29
	<i>Podophyllum hexandrum</i> Royle	Wanwagun	W	Roots	H	Infusion	O	Joint pain	40	0.31
Asparagaceae	<i>Polygonatum verticillatum</i> (L.) All	Salapmesri	W	Tuber	H	Raw	O	Gynaecological disorders	45	0.35
Asteraceae	<i>Achillea millefolium</i> L.	Phalgass	W	Leaves	H	Raw	O	Toothache, dysentery	49	0.38
	<i>Artemisia absinthium</i> L.	Tethwan	W	Leaves	H	Infusion	O	Abdominal pain, cramps, diarrhoea, intestinal worms, bone fracture	75	0.58
	<i>Centaurea iberica</i> Trevir. ex Spreng	Krech	W	Leaves	H	Decoction	O	Joint pain, skin diseases	30	0.23
	<i>Cichorium intybus</i> L.	Saz hand	W	Leaves	H	Poultice	T	Bone fracture, gynaecological disorders, diarrhoea	38	0.29
	<i>Inula racemosa</i> Hook. f.		W	Roots	H	Decoction	O	Abdominal pain	28	0.22
	<i>Ligularia jacquemontiana</i> (Decne.)	Musthum	W	Roots	H	Raw	O	Intestinal worms, abdominal pain	42	0.33
	<i>Jurinea dolomiaea</i> Boiss,	Doop	W	Roots	H	Poultice	T	Skin burns, wound healing, stomach cramps	55	0.43
	<i>Saussurea costus</i> (Falc.) Lipsch.	Kuth	W	Roots	H	Decoction	O	Joint pain, back pain	60	0.47
	<i>Taraxacum officinale</i> F.H. Wigg	Heand	W	Leaves	H	Poultice	T	Bone fracture, gynaecological disorders	51	0.40
	Betulaceae	<i>Betula utilis</i> D. Don	Burz	W	Bark	T	Decoction	O	Asthma	41
Boraginaceae	<i>Arnebia benthamii</i> Wall. ex G.Don	Khazaban	W	Roots	H	Decoction	O	Dry throat, fever, joint pain, dysentery	56	0.43
	<i>Cynoglossum glochidiatum</i> Wall. Ex Benth.	Chur	W	Roots	H	Paste	T	Wound healing	32	0.24
Balsaminaceae	<i>Impatiens glandulifera</i> Royle	Truil	W	Leaves	H	Paste	T	Skin burns	29	0.22
Convolvulaceae	<i>Convolvulus arvensis</i> L.	Razgass	W	Whole plant	Cl	Paste	T	Wound healing	45	0.35
Cannabaceae	<i>Cannabis sativa</i> L.	Charas	W	Leaves	H	Infusion	O	Toothache	39	0.30
Dioscoreaceae	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Shingle-mingle	W	Roots	Cl	Decoction	O	Joint pain, diarrhoea	40	0.31
Euphorbiaceae	<i>Euphorbia wallichii</i> Hook.f.	Herib	W	Latex	H	Poultice	T	Warts, skin diseases	42	0.33
Hypericaceae	<i>Hypericum perforatum</i> L.	Chaikul	W	Roots	H	Raw	O	Diarrhoea	29	0.22
Equisetiaceae	<i>Equisetum arvense</i> L.	Gandamgud	W	Whole frond	Fe	Infusion	O	Kidney stones	33	0.26
Liliaceae	<i>Fritillaria roylei</i> Hook.	Sheetkhar	W	Tuber	H	Raw	O	Abdominal pain, abdominal bloating	61	0.47
Gentianaceae	<i>Gentiana khuroo</i> Royle	Khutki	W	Roots	H	Decoction	O	Back pain	51	0.39

Geraniaceae	<i>Geranium pretense</i> L.	Ratanjog	W	Roots	H	Decoction	O	Joint pain, back pain	47	0.36
	<i>Geranium wallichianum</i> Oliv.	Ratanjog	W	Roots	H	Decoction	O	Joint pain, arthritis , bone facture	70	0.54
Juglandaceae	<i>Juglans regia</i> L.	Doon	C	Fruits, bark	T	Paste	T	Foot and mouth disease, toothache	62	0.48
Lamiaceae	<i>Ajuga parviflora</i> L.	Jainadam	W	Leaves	H	Infusion	O	Abdominal pain, fever	69	0.53
	<i>Prunella vulgaris</i> L.	Kalyuth	W	Leaves	H	Decoction	O	Fever, foot fever	58	0.45
	<i>Origanum vulgare</i> L.	Meth	C	Seeds	H	Poultice	T	Bone fracture	46	0.37
	<i>Thymus linearis</i> Benth	Javind	W	Leaves	H	Infusion	O	Abdominal pain, stomach cramps	53	0.41
Malvaceae	<i>Malva neglecta</i> Wall.	Souchal	W	Leaves	H	Raw	O	Stomach cramps, blot	44	0.34
	<i>Lavatera cashmeriana</i> Camb.	Jungle souchal	W	Flowers	H	Infusion	O	Fever, joint pain, Cough and cold	35	0.27
Moraceae	<i>Ficus carica</i> L.	Anjeer	C	Latex	T	Raw	T	Skin disorders, Diarrhoea	49	0.38
Morchellaceae	<i>Morchella esculenta</i> Fr.	Gucchi	W	Fruiting body	F	Cooked	O	Wound healing,	42	0.33
Oxalidaceae	<i>Oxalis acetosella</i> L.	Chokcfrdey	W	Whole plant	H	Decoction	O	gynaecological disorders	39	0.30
Plantaginaceae	<i>Plantago lanceolata</i> L.	Gull	W	Leaves	H	Decoction	O	Abdominal bloating	42	0.33
	<i>Plantago major</i> L.	Bead-gull	W	Leaves	H	Decoction	O	Abdominal bloating	53	0.41
Pinaceae	<i>Cedrus deodara</i> (Roxb.)	Deodar	W	Latex, oil	T	Paste	T	Wound healing, foot and mouth disease	59	0.46
Polygonaceae	<i>Bistorta amplexicaulis</i> (D.Don) Greene	Manchrichai	W	Roots	H	Decoction	O	Fever, cough and cold	49	0.38
	<i>Rheum webbianum</i> Royle	Pambchalan	W	Roots	H	Decoction Poultice	O T	Joint pain, Stomach cramps wound healing	68	0.53
	<i>Rumex nepalensis</i> Spreng.	Abuj	W	Roots	H	Decoction	O	Arthritis, joint pain	60	0.47
Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Dramun	W	Leaves	H	Poultice	T	Skin disorders	45	0.35
Ranunculaceae	<i>Aconitum heterophyllum</i> Wall.	Patrees	W	Tuber	H	Raw	O	Abdominal pain, intestinal worms	73	0.57
	<i>Aconitum chasmanthum</i> Stapf ex Holmes	Mohand	W	Tuber	H	Raw	O	Toothache	56	0.43
Scrophulariaceae	<i>Verbascum thapsus</i> L	Buder-tund	W	Stem	H	Decoction	O	Skin burns	50	0.39
Saxifragaceae	<i>Bergenia ciliata</i> (Haw.) Sternb.	Palfort	W	Roots	H	Decoction Poultice	O T	Joint pain, respiratory disorders, wound healing	63	0.49
Santalaceae	<i>Viscum album</i> L.	Kambaikul	W	Leaves	H	Paste	T	Wound healing	22	0.17
Solanaceae	<i>Atropa acuminata</i> Royle ex Lindl	Brand	W	Leaves	H	Raw	O	Blot	26	0.20
	<i>Datura stramonium</i> L.	Datur	W	Seeds	H	Paste	T	Toothache	37	0.29
Urticaceae	<i>Urtica dioica</i> L	Soi	W	Roots	H	Decoction	O	Arthritis, joint pain	46	0.36
Viburnaceae	<i>Viburnum grandiflorum</i> Wall. ex DC	Kilmich	W	Stem	S	Oil	T	Joint pain	40	0.31
Violaceae	<i>Viola odorata</i> L.	Vanposh	W	Whole plant	H	Decoction	O	Cough and cold	30	0.23

Note: W: Wild, C: Cultivated, S: Shrub, H: Herb, T: Tree, CL: Climber, F: Fungi, Fe: Fern, O: Orally, T: Topical

The study concluded that the rural communities of Gulmarg, Jammu and Kashmir, India, still used many species of plants to treat many health problems. The results of this research further aid in a better understanding of traditional medicines, their relationship to the region's ecological and socioeconomic values, biodiversity protection, and plant resource management techniques for long-term use.

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