



Ethnomedicinal potential of the Gohar region of Mandi district, Himachal Pradesh, India

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Ethnobotany Research and Applications 34:45 (2026) - doi: 10.32859/era.34.45.1-26

Manuscript received: 31/01/2026 - Revised manuscript received: 20/06/2026 - Published: 21/06/2026

Research

Abstract

Background: Traditional therapeutic knowledge has been diminishing at an increasingly rapid pace, making its documentation crucial. Keeping this fact in mind, the current study was conducted on the therapeutic plants of the Gohar region in Mandi district, Himachal Pradesh, India.

Methods: Ethno-medicinal information was collected by conducting interviews and group discussions with 145 local informants by using a semi-structured questionnaire between March, 2023 and March, 2025. Descriptive and inferential statistical tests such as ANOVA, Chi square test and post-hoc tests were applied on demographical data to determine the relationship between the number of plant species reported by the participants and age, gender and education level. Quantitative indices like Use Value (UV), Fidelity Level (FL) and Informant Consensus Factor (ICF) were applied on medicinal plants data to show its cultural importance and informant consensus in the indigenous healthcare system.

Results: The uses of 62 plants of medicinal importance were documented in the study area. The older and illiterate people and males had slightly higher scores and possessed majority of the knowledge in this study. Of the total plant species, herbs were frequently used (42%) in preparing the plant-based drugs followed by trees (39%), shrubs (13%) and climbers (6%). The highest number of plants were recorded from the Rosaceae family while leaves were used most frequently among all the plant parts (28%). Of the documented plants, one species (*Taxus contorta*) was endangered (EN) and one was in the near threatened (NT) (*Aegle marmelos*) category of IUCN red list, while three species were endangered in H.P. The UV value ranged between 0.10 and 0.43, with 28 plant species exhibiting a FL of 100%. The ICF value varied from 0.96 (fever, ear problems) to 1.00 (eye problems), representing a high level of consensus among the respondents.

Conclusions: The people of the Gohar region have a significant knowledge of usage of plants around them and frequently utilize herbal medicine to treat various diseases irrespective of the availability of modern health care. This study will help in finding herbal cure for diseases, in promoting future research and preservation of valuable ethnomedicinal knowledge.

Keywords: Indigenous healthcare, Herbal medicine, Plant-based drugs, Therapeutic, Traditional knowledge.

Background

From the beginning of human refinement, living resources have been explored and exploited for their utility (Martin 2001). The basic needs of humans, for instance, clothing, food, medicine and shelter, have been met with plants (Kumar *et al.* 2025). Plants serve as crucial reservoirs of land biodiversity, and also an integral part of customs, ceremonies and rituals in different cultures. This significantly affects the traditional, socio-ecological and livelihood practices of societies residing in forest land or connected with forests (Thapa *et al.* 2025). Plants also play a crucial role in sustaining the human health and curing countless diseases (Chaudhary *et al.* 2025). About 80% of world's population relies on traditional plant-based medicine due to their easy availability and affordability (Anjum *et al.* 2024, Kaundal & Kumar 2025).

Ethnomedicine pertains to a traditional healthcare system that involves the use of natural resources for the treatment and management of diseases within different ethnic communities (Anshari 2024, Mondal *et al.* 2025). The practice of traditional medicine is as ancient as humanity itself; its understanding and application have continued to expand despite the prominent impact of allopathic and modern medicine. This may be due to its accessibility, cultural significance and recognized therapeutic efficacy (Yusuf *et al.* 2025). These plant-based drugs have been used since ages as a part of culture; and considered non-toxic and safe, with few reports of adversities (Dangwal *et al.* 2025). Herbal medicinal formulations and skills have been conveyed down to successive descendants by elderly people, albeit with little alterations occurring with each generation (Laldingliani *et al.* 2022). This treasured knowledge has been diminishing as it is not conveyed or preserved aptly to next generation (Horackova *et al.* 2023). This valuable information will pave the path for future researches and sustenance in plant medicinal field (Agidew 2022).

India possesses all three major components i.e., ethnic diversity, floristic diversity and rich tradition, that enhances an area's ethno-medicinal wealth (Jain 1994, Thakur *et al.* 2024). India has been at the forefront of documenting traditional and folk activities in a systematic way (Rajasekharan 2013). The traditional medicinal knowledge has its roots in the Ayurveda and Siddha systems of Indian medicine (Abat *et al.* 2017). The study of therapeutic plants together with their indigenous uses has drawn more attention over the past few decades across various regions of India and also in the western world (Ayyanar & Ignacimuthu 2011).

Himachal Pradesh is a hilly state and is a part of North-western Himalayas in the Indian Himalayan Region. Mandi district lies at the center of the state and is divided into 12 sub-divisions and 17 tehsils. Some ethnobotanical studies have been carried out earlier in this district. For instance, Gaur and Singh (1993) have studied the ethnomedicinal plants from the Mandi district; and Singh (2018) has written the Flora of Mandi district. Sood and Thakur (2004) have studied the ethnobotany of Rewalsar region. However, ethnomedicinal studies in the current study area is still not documented. A dedicated study of the Gohar region was necessary because earlier ethnobotanical surveys in Mandi district were broad in scope and did not adequately document the unique floristic composition and traditional knowledge systems of Gohar. Additionally, there is limited recent documentation and much of the available literature is outdated, highlighting the need for updated field-based documentation.

This study aims to systematically document plants of ethnomedicinal importance from the Gohar region of Mandi district, Himachal Pradesh, while identifying and assessing the usage patterns of different medicinal species among local informants. It further seeks to determine the degree of agreement among respondents regarding the usage of plants for various categories of ailments, as well as to examine the distribution of ethnomedicinal knowledge across various demographic groups using suitable statistical tests. By integrating ethnobotanical indices such as Use Value (UV), Fidelity Level (FL) and Informant Consensus Factor (ICF), this study also intends to emphasize the culturally significant medicinal plants. It will also contribute in finding phyto-therapeutic agents for curing diseases, in promoting future research in phytochemistry and pharmacology by identification of potential plants, in drug-discovery and preservation of valuable ethnomedicinal knowledge.

Materials and Methods

Study area

Himachal Pradesh lies in the western Himalayas, between 75°77' to 79°07' East longitude and 30°38' to 33°13' North latitude. The region has an altitude range from 350 to 7,000 m above mean sea level and receives an average of 152 cm rainfall annually. The Mandi district is situated between 76°37'20" to 77°23'15" East longitude and 31°13'50" to 32°04'30" North latitude. It is bounded by the districts of Bilaspur, Hamirpur, Kangra, Kullu, Shimla and Solan. The region features a

rugged landscape, which also has some fertile valleys near Balh and Chauotra; and is drained by the Beas and Satluj rivers (Balokhra 1999).

The study area 'Gohar' lies in the Chachyot tehsil and is also one of the sub-divisions of district Mandi (Figure 1). It is bordered by the tehsils of Balh, Bali Chowki, Mandi Sadar, Nihri, Sundarnagar and Thunag. The area is surrounded by the Shivalik mountain range. Its lower region comprises the mid-mountainous area; and the upper regions are part of the Dhauladhar range. The terrain is mountainous with steep valleys; and has relatively inclined and flat regions close to the foothills. The Jiuni Khad and Bakhli Khad, which are tributaries of river Beas, drain this region. The study area exhibits an altitudinal range from 800 to 3,000 m above mean sea level, resulting in distinct vegetation belts. Lower elevations (up to about 1,950 m) are dominated by chir pine (*Pinus roxburghii*); while mid-altitudes support forests of deodar (*Cedrus deodara*) and blue pine (*Pinus wallichiana*). The higher elevations are characterized by pindrow fir (*Abies pindrow*) and oak (*Quercus* spp.) forests. The climate ranges from subtropical to temperate. The area houses the famous Dev Kamrunaag temple and lake which attracts numerous devotees throughout the year. The use of land is dominated by terraced agriculture, forest land and grazing areas. The crops such as maize, wheat and pulses are traditionally cultivated, while horticulture (apple, apricot, peach and plum) has expanded in recent decades due to market integration and evolving livelihood strategies. The study area is rich in culture and ethno-medicinal knowledge, with diverse ethnic and religious communities such as Buddhists, Gaddis, Gujjars and Hindus residing in this area. These native people have accumulated this knowledge through generations of experience and it is now a crucial part of their lifestyle. The local inhabitants have consistently tried to conserve and safeguard these plants in order to meet their daily requirements, as many of them have several ethnomedicinal uses.

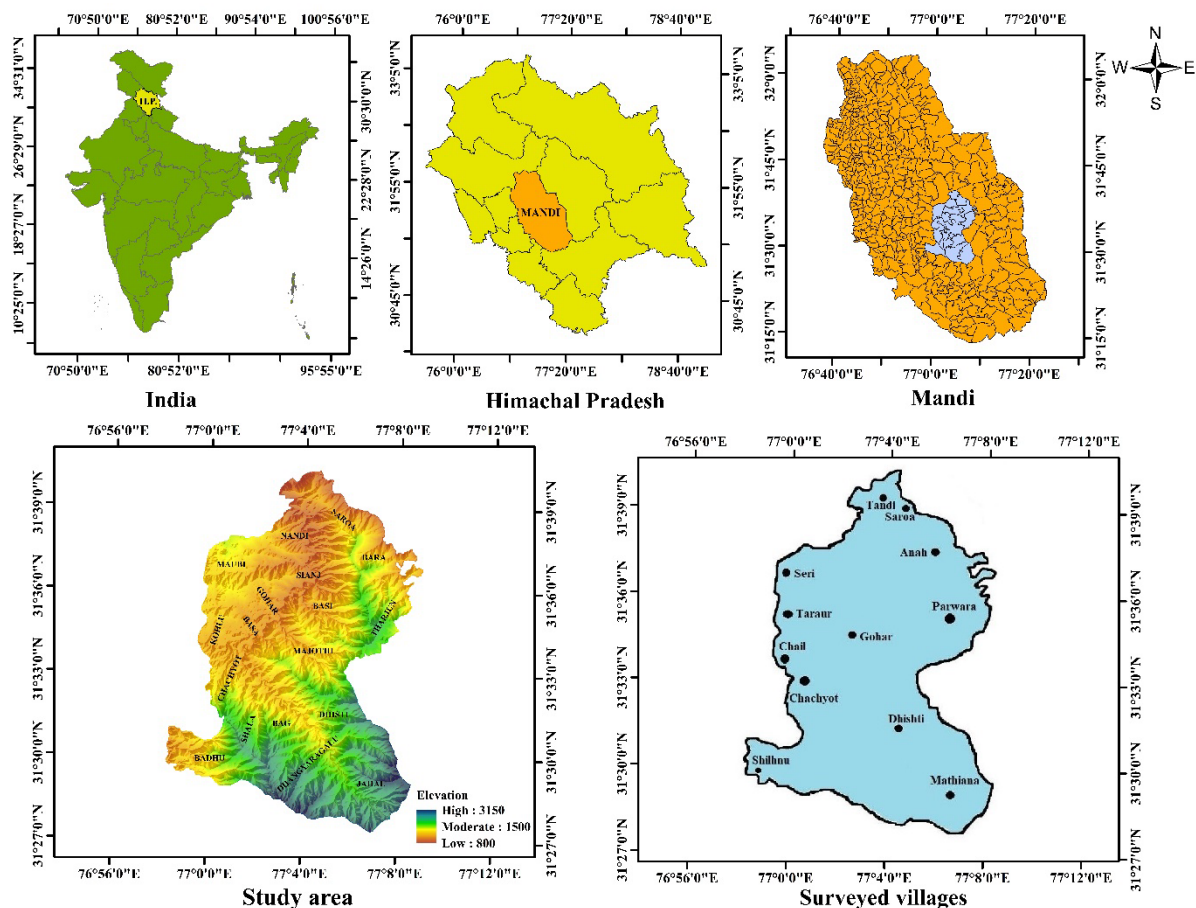


Figure 1. Geographical location and map of the study area

Methodology

Extensive field surveys were conducted in the study area between the period of March, 2023 and March, 2025 to record the seasonal diversity of plant resources, to document the traditional practices and to verify the ethnomedicinal information through repeated interactions with informants. The difficult terrain and climatic conditions in the study area also limited the year-round accessibility, requiring multiple field visits. Informants were selected using snowball sampling method for the key informants (n=9) and random sampling for other informants (n=136). A number of interviews, group discussions and guided

field walks were conducted; and different questions were asked from the 145 informants on the basis of semi-structured questionnaire as prescribed by Jain and Goel (1995). The participants were informed about the purpose of the research and the participation was entirely voluntary. The consent of informants was also obtained to take part in the study in either oral or written form, depending on their preference and literacy level, as per the ISE Code of Ethics (2008). Interviews were conducted in Hindi language and local dialect (Mandiyali) to document the accurate data. Information was recorded on the field notebook and only that information was considered valid, which was confirmed from at least three informants. Plants were shown to the local informants on various occasions to confirm the identity of the plants and their described usage. Herbarium specimens were also prepared according to standard methods (Jain & Rao 2016) and deposited in the herbarium section of Department of Bio-sciences, Himachal Pradesh University, Shimla. Identification of plant species was done initially by the local informants through local names and field guidance; and then from the regional and Indian floras (Chauhan 1999, Chowdhery & Wadhwa 1984, Collett 1902, Polunin & Stainton 1984). The herbarium specimens housed at the herbaria of Botanical Survey of India (BSI) and Forest Research Institute (FRI), Dehradun, and Himalayan Forest Research Institute (HFRI), Shimla were also consulted for identification of plant species. The botanical names and families were validated from the online database 'The World Flora Online'. Author citations follow the International Code of Nomenclature for algae, fungi and plants (ICN); and family classification was based on the Angiosperm Phylogeny Group IV (APG IV) classification system. The conservation status of plants was also verified from the IUCN website (for global status) and ENVIS Centre on Medicinal Plants (for regional status).

Data Analysis

The data were analyzed using the descriptive and inferential statistics and ethnobotanical indices. Ethnobotanical data was organized using the Microsoft Excel spreadsheets.

Ethnobotanical Indices

Use Value (UV)

The use value (UV) evaluates each medicinal plant's significance based on the respective utilization by the informants (Lal *et al.* 2023). It was determined for every species using the formula described by Phillips *et al.* (1994) with slight modification.

$$UV = \frac{\sum U_i}{N}$$

where 'U_i' is the number of use reports mentioned by each informant and 'N' is the total number of informants.

Fidelity level (FL)

The fidelity level depicts the percentage (%age) of respondents affirming any use of a specific plant species for same primary purpose or areas and the overall count of frequently mentioned usages or ailments. It was determined according to the given formula of Friedman *et al.* (1986):

$$FL(\%) = \frac{N_p}{N} \times 100$$

where 'N_p' depicts the number of informants who claimed the same or specific use of a plant species and 'N' means the total number of informants/interviewees reporting any medicinal use of a species.

Informant Consensus Factor (ICF)

The ICF is measured according to the formula given by Trotter and Logan (1986) as follows:

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

where 'N_{ur}' refers to the number of use reports for a disease category and 'N_t' is the total number of plant species used as remedy for the disease category.

Statistical Analysis

The statistical analysis of demographic data of the informants was done using Microsoft Excel, JASP (version 0.95.4.0) and RStudio (version 2026.04.0+526) software; and the data was evaluated using descriptive and inferential statistics. The distribution of the number of plants reported by the participants was explained by descriptive statistics. A one-way Analysis of Variance (ANOVA) was conducted to analyze the relationship between age, gender and education level to identify trends

in awareness across different groups and to determine whether these factors influence the understanding of traditional knowledge. Levene's test was applied to assess the homogeneity of variances across these groups. When the assumption of equal variances was satisfied, Tukey's HSD post-hoc test was applied to identify pairwise group differences. In cases where Levene's test indicated significant heterogeneity of variances, Welch's ANOVA was utilized as a robust alternative to the standard ANOVA. Where significant differences were observed, Games-Howell post-hoc tests were applied as a robust alternative to Tukey's HSD because they are appropriate under unequal variance conditions (Games & Howell 1976). Furthermore, Chi-square (χ^2) test of independence was used for determining the relationship between variables such as age, education, gender and knowledge level; and its significance was assessed by comparing observed and expected frequencies. Finally, Pearson correlation and a simple linear regression analysis was performed to assess the predictive effect of participants' age on the number of plants reported by them. To determine the statistical significance, a significance level of 0.05 was used for all tests.

Results

Demography of informants

A total of 145 informants (76 females and 69 males) were interviewed. The informants interviewed were between the age of 26 and 87 years; and majority of them were females. Most informants have attended the higher school. The 10.53% female informants were without formal education whereas only 4.35% of the male informants were illiterate (Table 1).

Table 1. Demographic description of informants

Category	Female	Male	Total
Informants	76 (52.41%)	69 (47.59%)	145 (100.00%)
Age group			
≤30	7 (9.21%)	8 (11.59%)	15 (10.35%)
31-45	29 (38.16%)	13 (18.84%)	42 (28.96%)
46-60	21 (27.63%)	19 (27.54%)	40 (27.59%)
≥60	19 (25.00%)	29 (42.03%)	48 (33.10%)
Education level			
Never attended a school	8 (10.53%)	3 (4.35%)	11 (7.59%)
Attended school for 1-5 (primary) classes	5 (6.58%)	6 (8.69%)	11 (7.59%)
Attended school for 6-10 (secondary) classes	18 (23.68%)	13 (18.84%)	31 (21.38%)
Intermediate (12 th class)	23 (30.26%)	19 (27.54%)	42 (28.96%)
Graduate	20 (26.32%)	23 (33.33%)	43 (29.65%)
Post-graduate	2 (2.63%)	5 (7.25%)	7 (4.83%)

A one-way ANOVA was conducted to examine the differences in the number of medicinal plant species reported by the demographic groups in order to identify variation in traditional medicinal plant knowledge among the participants. The analysis revealed a significant effect of age on the number of plant species reported, $F(3,141)=247.10$, $p<0.001$, $\eta^2=0.84$, indicating substantial variance across age groups. Descriptive statistics showed that participants aged ≥ 60 years ($n=48$) described the highest number of medicinal plant species, whereas those aged ≤ 30 years ($n=15$) reported the lowest number of species. Levene's test indicated that the assumption of homogeneity of variances was not violated, $F(3,141)=2.03$, $p=0.112$. Therefore, standard ANOVA results were considered appropriate for interpretation. Tukey's post hoc test revealed significant differences among nearly all age groups. In particular, the ≥ 60 age group reported significantly more medicinal plant species than the younger age groups, whereas the ≤ 30 group described significantly fewer species than the 31-45 and 46-59 age groups ($p<0.001$ for most comparisons). Pearson correlation ($r=0.944$, $p<0.001$) and simple linear regression analysis ($R^2=0.891$, $p<0.001$) further demonstrated that age was a strong positive predictor of the reported number of medicinal plant species (standardized $\beta=0.944$, $p<0.001$), explaining a substantial proportion of the observed variation. These findings indicate that older respondents generally possessed greater medicinal plant knowledge than younger participants (Figure 2).

Education level also had a significant association with the number of medicinal plant species reported. Participants with no formal education described the highest mean number of plant species, while post-graduates reported the lowest number of species. One-way ANOVA indicated significant differences among educational groups, $F(5,139)=74.60$, $P<0.001$, $\eta^2=0.729$. However, Levene's test confirmed unequal variances among groups, $F(5,139)=8.531$, $p<0.001$. Therefore, Welch's ANOVA

was performed, which confirmed a significant effect of education level on the reported number of plant species, $F(5,37)=186.69$, $p<0.001$. Because the assumption of equal variances was violated, Games-Howell post hoc comparisons were conducted. The results showed that participants with lower formal education, particularly illiterate participants ($n=11$) and participants with primary education ($n=11$) reported significantly more medicinal plant species than graduates ($n=43$), intermediates ($n=42$), post-graduates ($n=7$) and individuals with secondary education ($n=31$) ($p<0.001$ for most comparisons). Consistent with these findings, a chi-square test showed that a significant association existed between education level and knowledge category, $\chi^2(10)=120.50$, $p<0.001$, with high knowledge concentrated in the illiterate, primary and secondary groups, and low knowledge predominated in graduates and post-graduates.

The difference in knowledge was significant between genders. One-way ANOVA revealed that males ($n=69$) had reported significantly more medicinal plant species than females ($n=76$), $F(1,143)=9.093$, $p=0.003$, $\eta^2=0.06$. Levene's test identified unequal variances between the two groups, $F(1,143)=6.149$, $p=0.014$. Therefore, Welch's ANOVA was additionally performed, which confirmed the robustness of this result, $F(1,143)=9.19$, $p=0.003$, $\eta^2=0.06$. Since only two gender groups were compared, no post hoc analysis was required.

Together, these results demonstrated statistically significant associations of age, education level and gender with the number of medicinal plant species reported by the respondents, with age showing the most pronounced effect.

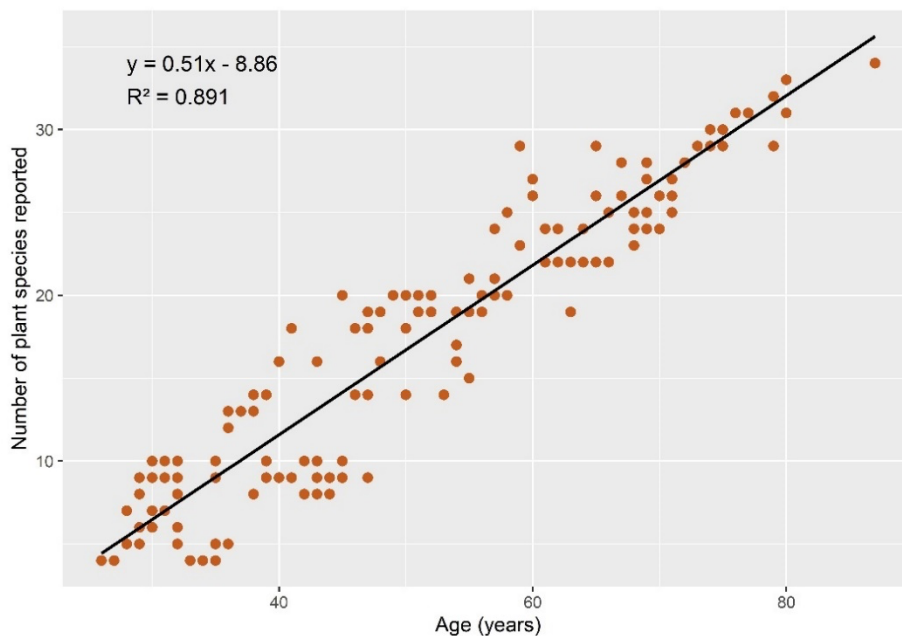


Figure 2. Linear regression between age of participants and number of plants reported by them

Ethnomedicinal Information

In total, 62 ethnomedicinal plant species that belong to 39 different families were documented from the study region (Table 2).

Rosaceae (7 species) was the most frequently used medicinal family, followed by Fabaceae (5 species), Rutaceae (4 species), Amaranthaceae, Lamiaceae, Moraceae (3 species each), Asteraceae, Lythraceae, Polygonaceae, Zingiberaceae (2 species each), Araceae, Anacardiaceae, Apiaceae, Asparagaceae, Bambucaceae, Berberidaceae, Bombacaceae, Cannabaceae, Caryophyllaceae, Convulvulaceae, Dioscoriaceae, Ericaceae, Euphorbiaceae, Juglandaceae, Malvaceae, Meliaceae, Menispermaceae, Myricaceae, Myrtaceae, Phyllanthaceae, Plantaginaceae, Portulacaceae, Salicaceae, Saxifragaceae, Solanaceae, Taxaceae, Urticaceae, Valerianaceae and Violaceae (1 species each) (Figure 3). Herbs (42%) were the most frequently used life-forms of plants followed by trees (39%), shrubs (13%) and climbers (6%) (Figure 4). The most frequently utilized plant part was leaves (28%), followed by the usage of fruits and seeds (21%), roots, rhizome and tuber (14%), bark (12%), flowers and floral buds (8%), stem, culm and twigs (5%), whole plant (4%), latex (4%), aerial parts (3%) and galls (1%) (Figure 5).

Table 2. Ethnomedicinal plants utilized by the inhabitants of Gohar region

Plant Name	Voucher No.	IUCN Status	Family	Local Name	Habit	Part Used	Ethnobotanical Uses	Use Reports	UV
<i>Achyranthes aspera</i> L.	HPU-EL-SR-0311	NE	Amaranthaceae	Latjeera, Puthkanda, Umalkudi	Herb	Aerial parts, Roots	Decoction of aerial parts with black pepper (5 mL) is used to cure cough. Paste of powdered roots is applied on acne.	60	0.41
<i>Acorus calamus</i> L.	HPU-EL-SR-0331	LC	Araceae	Bach, Bare, Barya	Herb	Rhizome	Pieces of rhizome are chewed to cure cold, cough and headache, and to reduce inflammation.	57	0.39
<i>Aegle marmelos</i> (L.) Corrêa	HPU-EL-SR-0362	NT	Rutaceae	Bel	Tree	Fruits	<i>Murabba</i> prepared from fresh fruit pulp and ripe fruits are consumed to improve digestion.	55	0.38
<i>Ajuga integrifolia</i> Buch.-Ham. ex D.Don	HPU-EL-SR-0340	NE	Lamiaceae	Dhaluchha, Nilkanthi	Herb	Leaves, Roots	Paste of leaves is applied on hair to kill lice. Decoction of roots is used to cure dysentery and earache.	61	0.42
<i>Albizia lebeck</i> (L.) Benth.	HPU-EL-SR-0324	LC	Fabaceae	Sirin, Suran	Tree	Bark, Leaves	Decoction of bark is used to treat cough and asthma. Paste of leaves is applied on eczema.	45	0.31
<i>Amaranthus viridis</i> L.	HPU-EL-SR-0349	NE	Amaranthaceae	Bithua	Herb	Leaves	Leaf infusion (2-3 drops) is used for treating eye disorders and to relieve pain.	32	0.22
<i>Artemisia absinthium</i> L.	HPU-EL-SR-0356	LC	Asteraceae	Chhaember, Kubsh	Herb	Leaves	Poultice of leaves is used to cure bone fracture and to reduce inflammation.	56	0.39
<i>Asparagus adscendens</i> Roxb.	HPU-EL-SR-0339	NE	Asparagaceae	Sansarpali	Shrub	Roots	Roots are used for treating nosebleed, menstrual complaints and urinary infection.	60	0.41
<i>Bambusa nutans</i> Wall. ex Munro	HPU-EL-SR-0354	NE	Bambucaceae	Bainjh	Herb	Culm exudate	<i>Banslochan</i> obtained from its culm is taken with milk for reducing inflammation in the body.	42	0.29
<i>Bauhinia variegata</i> L.	HPU-EL-SR-0312	LC	Fabaceae	Karyale	Tree	Bark	Decoction of bark is taken to cure piles.	39	0.27

<i>Berberis aristata</i> DC.	HPU- EL-SR- 0330	LC	Berberidaceae	Kashmale	Shrub	Fruits	Fruits (3-4) are eaten with honey to cure stomach infection and jaundice.	59	0.41
<i>Bergenia ciliata</i> (Haw.) Sternb.	HPU- EL-SR- 0355	LC	Saxifragaceae	Pashanbhed	Herb	Rhizome	Rhizome powder is consumed to treat kidney stones.	45	0.31
<i>Bergera koenigii</i> L.	HPU- EL-SR- 0320	LC	Rutaceae	Gandhela, Karripatta	Shrub	Branches, Leaves	Branches are used as toothbrush for preventing oral problems. Paste of leaves is used to cure piles. Fresh leaves are crushed and applied on fresh cuts and wounds.	59	0.41
<i>Bombax ceiba</i> L.	HPU- EL-SR- 0323	LC	Bombacaceae	Simbal, Simal	Tree	Bark	Powdered bark (3-4 gram, twice a day) is useful in controlling excessive bleeding and dysentery.	34	0.23
<i>Butea monosperma</i> (Lam.) Kuntze	HPU- EL-SR- 0338	LC	Fabaceae	Plah	Tree	Leaves	Paste of leaves is applied on boils and pimples.	37	0.25
<i>Cannabis sativa</i> L.	HPU- EL-SR- 0301	NE	Cannabaceae	Bhang, Magholu	Herb	Leaves	Paste of leaves is applied on skin to get relief from irritation caused by the <i>Urtica dioica</i> plant.	59	0.41
<i>Cassia fistula</i> L.	HPU- EL-SR- 0353	LC	Fabaceae	Amaltas	Tree	Fruits	Fruits are given to children in dysentery, constipation and stomachache.	45	0.31
<i>Centella asiatica</i> (L.) Urb.	HPU- EL-SR- 0309	LC	Apiaceae	Brahmi, Handumalu	Herb	Leaves	Leaves are eaten to enhance the memory. Paste of leaves is applied on acne.	58	0.40
<i>Chenopodium album</i> L.	HPU- EL-SR- 0350	NE	Amaranthaceae	Kadaun	Herb	Leaves	Vegetable cooked from young leaves aid in digestion and getting relief from jaundice.	37	0.25
<i>Citrus medica</i> L.	HPU- EL-SR- 0313	LC	Rutaceae	Naboa	Tree	Fruit, Leaves	Fruit juice is refreshing and taken orally for indigestion. Dried pulp is mixed with honey to cure cough. Leaves are used to brush the teeth to prevent dental caries.	52	0.36
<i>Curcuma longa</i> L.	HPU- EL-SR- 0310	DD	Zingiberaceae	Haldar	Herb	Rhizome	Fresh rhizome or dried powder paste is applied on cuts, wounds and acne. Powdered fresh rhizome (2-3 gm with milk) is taken orally to heal up internal wounds.	61	0.42

<i>Cuscuta reflexa</i> Roxb.	HPU-EL-SR-0329	LC	Convulvulaceae	Amarbel, Kashbel	Climber	Whole plant	Plant paste is used to cure skin diseases. Its decoction with oil is used for massage to get relief from joint pain.	56	0.39
<i>Dioscorea deltoidea</i> Wall. ex Griseb.	HPU-EL-SR-0336	DD	Dioscoriaceae	Shingli-Mingli, Tardi	Climber	Tuber	Vegetable cooked from its tubers reduces inflammation in the body.	59	0.41
<i>Eucalyptus tereticornis</i> Sm.	HPU-EL-SR-0302	LC	Myrtaceae	Safeda	Tree	Leaves	Infusion of leaves is inhaled in cough and cold.	42	0.29
<i>Euphorbia helioscopia</i> L.	HPU-EL-SR-0347	NE	Euphorbiaceae	Dudhali	Herb	Latex	The milky latex is applied on acne, boils, pimples and fresh cuts to stop bleeding.	37	0.25
<i>Fagopyrum esculentum</i> Moench	HPU-EL-SR-0352	NE	Polygonaceae	Kathu, Oghal	Herb	Flowers, leaves	Tea made from its flowers and leaves is drunk to regulate blood pressure.	34	0.23
<i>Ficus auriculata</i> Lour.	HPU-EL-SR-0322	LC	Moraceae	Taryambal	Tree	Latex	Latex is applied to treat cuts and wounds.	51	0.35
<i>Ficus palmata</i> Forssk.	HPU-EL-SR-0341	LC	Moraceae	Fegda	Tree	Latex	Latex is used to cure warts and thorn pricks.	33	0.23
<i>Grewia optiva</i> J.R. Drumm. ex Burret	HPU-EL-SR-0328	LC	Malvaceae	Bihul	Tree	Bark	Decoction of bark is taken to cure fever.	46	0.32
<i>Hedychium spicatum</i> Buch.-Ham. ex Sm.	HPU-EL-SR-0337	LC	Zingiberaceae	Ban Haldi, Kachoor	Herb	Rhizome	Powdered rhizome (1 teaspoon) with milk is prescribed for joint pain.	50	0.34
<i>Juglans regia</i> L.	HPU-EL-SR-0314	LC	Juglandaceae	Khod	Tree	Bark	Scouring of mouth is done with bark (called <i>Dundas</i>) for preventing oral problems.	56	0.39
<i>Lathyrus aphaca</i> L.	HPU-EL-SR-0348	LC	Fabaceae	Bhuaaphh	Herb	Leaves	Tea prepared from the leaves is drunk to treat urinary problems.	35	0.24

<i>Melia azedarach</i> L.	HPU- EL-SR- 0303	LC	Meliaceae	Darek	Tree	Bark	Paste prepared from its powdered bark is applied on scalp to kill lice.	45	0.31
<i>Morus nigra</i> L.	HPU- EL-SR- 0308	DD	Moraceae	Chimu	Tree	Fruits	Fruits are eaten for treating mouth ulcers and sore throat.	47	0.32
<i>Myrica esculenta</i> Buch.-Ham. ex D.Don	HPU- EL-SR- 0325	NE	Myricaceae	Kaphal	Tree	Bark, Fruits	Bark powder is taken with honey to treat cough and asthma. Fruits are eaten to improve digestion.	56	0.39
<i>Ocimum basilicum</i> L.	HPU- EL-SR- 0306	NE	Lamiaceae	Bhabri	Herb	Seeds	Seeds kept overnight in water are used to cure sore throat, earache, urinary tract infection and wounds.	52	0.36
<i>Origanum vulgare</i> L.	HPU- EL-SR- 0357	LC	Lamiaceae	Ban Tulsi	Herb	Leaves	Decoction or tea made from the leaves is used to treat cold, cough, fever and influenza.	45	0.31
<i>Phyllanthus emblica</i> L.	HPU- EL-SR- 0307	LC	Phyllanthaceae	Aamla, Aambla	Tree	Fruits	Fruits are eaten for improving digestion and boosting immunity.	54	0.37
<i>Pistacia chinensis</i> subsp. <i>integerrima</i> (J.L. Stewart) Rech.f.	HPU- EL-SR- 0335	LC	Anacardiaceae	Kakade	Tree	Galls	Galls (<i>Kakadsingi</i>) are used to cure cough and vomiting.	47	0.32
<i>Plantago major</i> L.	HPU- EL-SR- 0342	LC	Plantaginaceae	Gandhabgol	Herb	Leaves	Leaves are crushed and applied on wounds.	36	0.25
<i>Portulaca oleracea</i> L.	HPU- EL-SR- 0360	LC	Portulacaceae	Nalyara	Herb	Aerial parts	Decoction of aerial parts is drunk to cure diarrhoea and dysentery.	29	0.20
<i>Potentilla indica</i> (Andrews) Th.Wolf	HPU- EL-SR- 0321	NE	Rosaceae	Ghumphal	Herb	Fruits	Ripe fruits aid in digestion.	58	0.40
<i>Prinsepia utilis</i> Royle	HPU- EL-SR- 0346	NE	Rosaceae	Bhekhal	Shrub	Seeds	Oil obtained from its seeds is applied on skin to get relief from joint pain.	47	0.32

<i>Prunus armeniaca</i> L.	HPU- EL-SR- 0315	DD	Rosaceae	Shada, Shadi	Tree	Fruits	Fruits are preserved as sundried fruit (called 'Shdoi' or 'Chilori'), which are eaten to improve digestion.	32	0.22
<i>Prunus campanulata</i> Maxim.	HPU- EL-SR- 0351	LC	Rosaceae	Paaja	Tree	Flowers, Fruits	Decoction of flowers is taken to cure cough and sore throat. Ripe fruits are edible and aid in digestion.	52	0.36
<i>Punica granatum</i> L.	HPU- EL-SR- 0305	LC	Lythraceae	Darhu, Jungli Anar	Tree	Seeds	Dried seeds are used to prepare 'Anardaana' for making chutney to cure dysentery.	33	0.23
<i>Pyrus pashia</i> Buch.- Ham. ex D.Don	HPU- EL-SR- 0334	LC	Rosaceae	Shegal, Kainth	Tree	Fruits	Unripe fruits are used to treat mouth sores and throat infection. Fruit pulp with black pepper is eaten twice a day to treat dysentery.	47	0.32
<i>Rhododendron arboreum</i> Sm.	HPU- EL-SR- 0326	LC	Ericaceae	Buraah	Tree	Flowers	Flowers are considered coolant and eaten raw or in the form of chutney to cure nose bleeding and menstrual disorders.	59	0.41
<i>Rosa brunonii</i> Lindl.	HPU- EL-SR- 0319	NE	Rosaceae	Jungli Gulab, Kuje Kande	Climber	Flowers	Paste of flowers is applied on burns as coolant.	43	0.29
<i>Rubus ellipticus</i> Sm.	HPU- EL-SR- 0316	LC	Rosaceae	Aakhe	Shrub	Fruits, Roots	Fruits are edible and aid in digestion. The juice of roots is used in the treatment of fever and gastric troubles.	57	0.39
<i>Rumex nepalensis</i> Spreng.	HPU- EL-SR- 0345	NE	Polygonaceae	Jungli Palak, Marla	Herb	Leaves	Leaves are rubbed against the skin to get relief from irritation caused by bichhoobooti (<i>Urtica dioica</i>).	44	0.30
<i>Salix tetrasperma</i> Roxb.	HPU- EL-SR- 0358	LC	Salicaceae	Beuns, Bhashal	Tree	Bark, Twigs	Decoction of bark is drunk to cure fever. Twigs are used as toothbrush to cure oral problems.	35	0.24
<i>Solanum nigrum</i> L.	HPU- EL-SR- 0343	NE	Solanaceae	Ghyayin, Jangli Tamatar	Shrub	Fruits, Roots	Consuming fruits provide relief from menstruation cramps. Juice from its roots is used for curing cough and cold.	41	0.28
<i>Stellaria media</i> (L.) Vill.	HPU- EL-SR- 0361	LC	Caryophyllaceae	Badyala	Herb	Leaves	Paste of leaves is applied on wounds caused by burns.	38	0.26

<i>Tagetes minuta</i> L.	HPU- EL-SR- 0333	NE	Asteraceae	Jangli Genda, Guhii Phool	Herb	Leaves	Juice of leaves (4-5 drops) is effective against gastritis. Leaf paste is applied on skin injuries.	15	0.10
<i>Taxus contorta</i> Griff.	HPU- EL-SR- 0359	EN	Taxaceae	Rakhale	Tree	Leaves	Paste of leaves is applied on wounds.	48	0.33
<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook.f. & Thomson	HPU- EL-SR- 0318	NE	Menispermaceae	Giloe, Gulja	Climber	Whole plant	Plant juice (2-3 mL) is taken to cure joint pain and control uric acid.	51	0.35
<i>Urtica dioica</i> L.	HPU- EL-SR- 0327	LC	Urticaceae	Bichoobooti, Kugashi	Herb	Leaves	Poultice of its leaves is used to treat muscle and joint pain.	57	0.39
<i>Valeriana jatamansi</i> Jones	HPU- EL-SR- 0344	NE	Valerianaceae	Mushkbala	Herb	Rhizome	Decoction of rhizome is drunk for curing stomachache.	42	0.29
<i>Viola pilosa</i> Blume	HPU- EL-SR- 0317	NE	Violaceae	Banaksha	Herb	Flowers	Decoction of flowers is given to cure cold and cough. Powdered flowers (1 teaspoon) with honey are given twice a day to treat cough.	62	0.43
<i>Woodfordia fruticosa</i> Kurz	HPU- EL-SR- 0332	LC	Lythraceae	Dhavae	Shrub	Flowers, Whole plant	Paste of whole plant is applied to treat bone fractures and paste of flowers is applied on cuts, burns and for curing other skin diseases.	38	0.26
<i>Zanthoxylum armatum</i> DC.	HPU- EL-SR- 0304	LC	Rutaceae	Tirmire, Timbare	Shrub	Twigs	Twigs are used as toothbrush and to cure toothache.	40	0.28

EN=Endangered; DD=Data Deficient; LC=Least Concern; NE=Not Evaluated; NT=Near Threatened; VU=Vulnerable

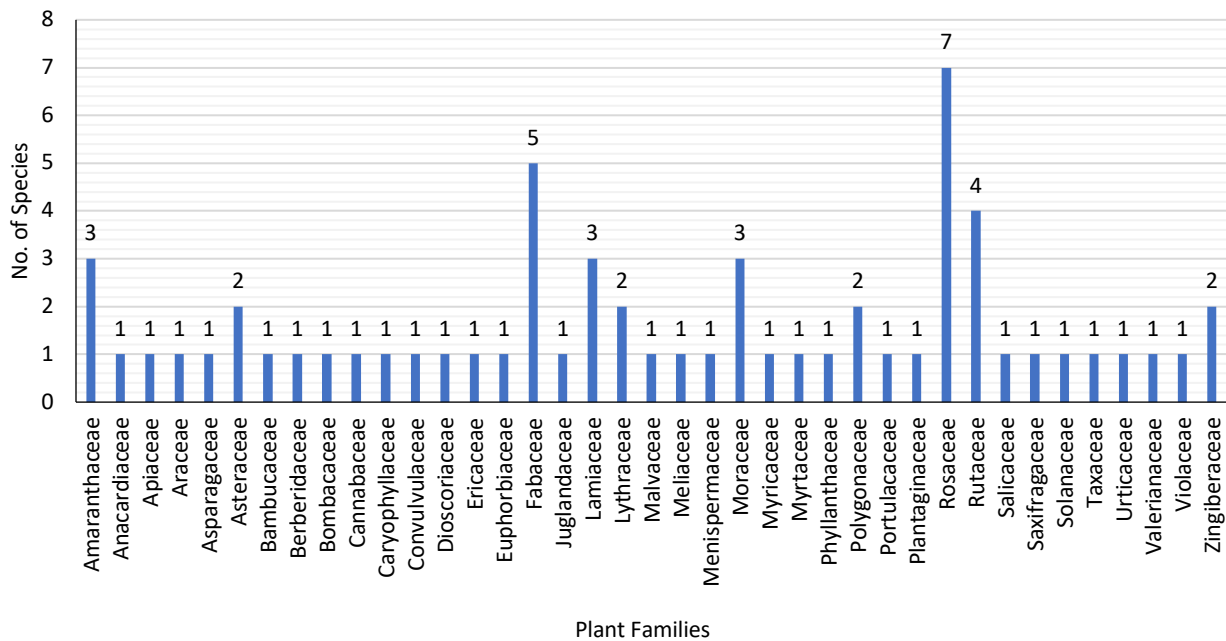


Figure 3. Family-wise representation of ethnomedicinal plant species documented from the Gohar region

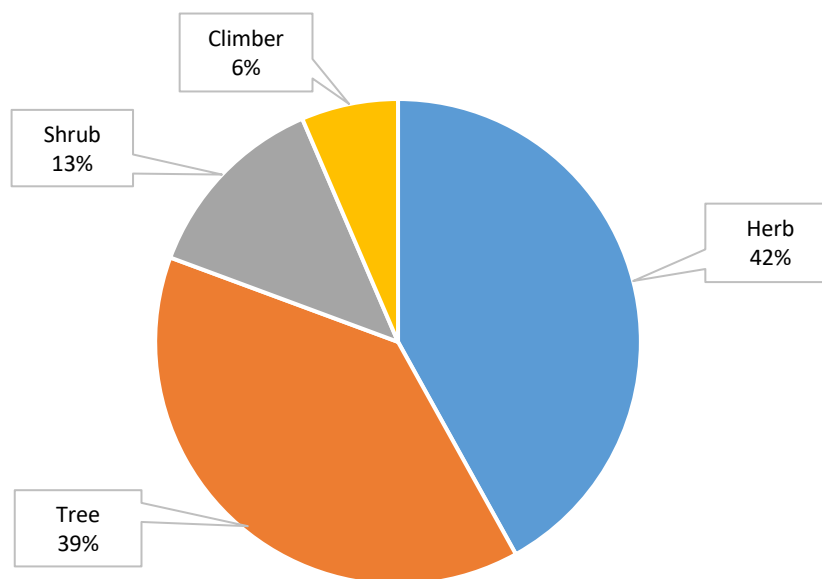


Figure 4. Habit-wise classification of ethnomedicinal plants documented from the study area

Conservation Status of documented plant species

The IUCN red list status of the recorded plants was also checked and it was not much variable. The data of 20 plant species was not evaluated (NE) in the IUCN online database. As for others, 36 plant species were found of least concern (LC), four species were data deficient (DD), one species was endangered (*Taxus contorta*) and one was of near threatened (NT) category (*Aegle marmelos*) in the IUCN red list (IUCN 2026).

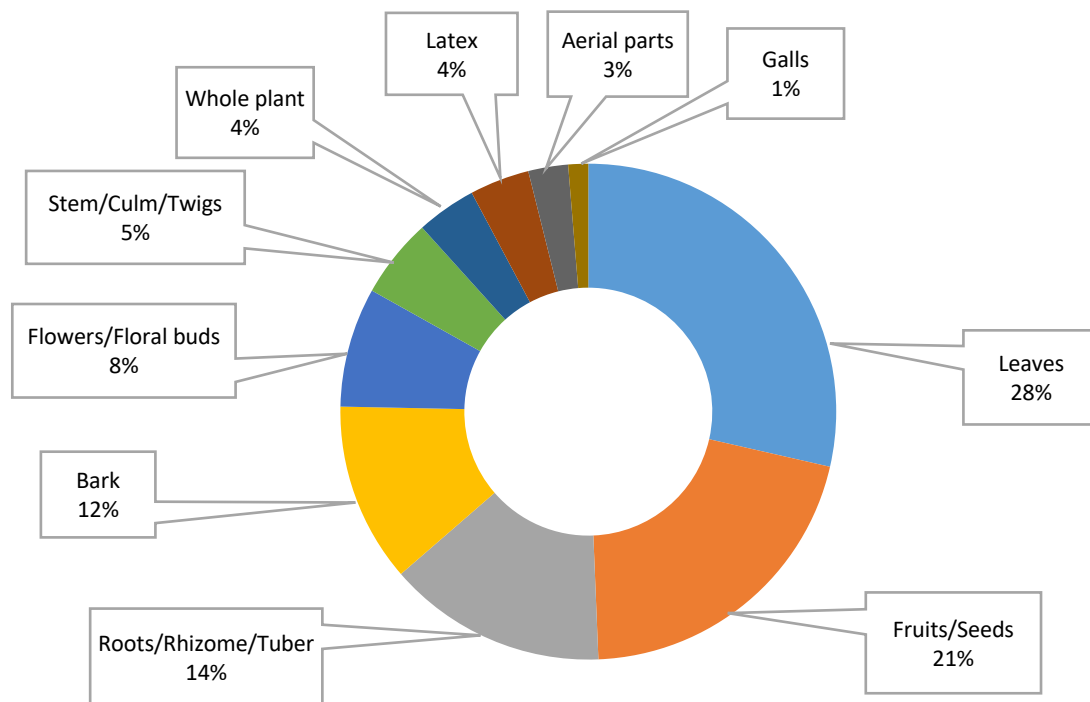


Figure 5. Percentage of different plant parts utilized in traditional remedies by the people of Gohar region

Ethnobotanical Indices

Use reports were calculated for each plant. A use report is counted each time an informant mentions a specific use of a plant species. If a single informant reports multiple uses of the same plant, each distinct use is recorded as an individual use report. The UV was computed for all the plant species from these use reports (Table 2). It was high for *Viola pilosa* (0.43), followed by *Curcuma longa* (0.42), *Ajuga integrifolia* (0.41), *Asparagus adscendens* (0.41), *Berberis aristata* (0.41), *Bergera koenigii* (0.41), *Dioscorea deltoidea* (0.41) and *Rhododendron arboreum* (0.41). The lowest UV was measured at 0.10 for *Tagetes minuta* with only 15 people reporting utility of the species. The FL ranged from 17.31% to 100% in this study (Table 3). In total, 28 species had FL of 100%, viz., *Aegle marmelos*, *Amaranthus viridis*, *Bambusa nutans*, *Bauhinia variegata*, *Berginia ciliata*, *Butea monosperma*, *Cannabis sativa*, *Dioscorea deltoidea*, *Eucalyptus tereticornis*, *Fagopyrum esculentum*, *Ficus auriculata*, *F. palmata*, *Grewia optiva*, *Hedychium spicatum*, *Juglans regia*, *Lathyrus aphaca*, *Melia azedarach*, *Plantago major*, *Potentilla indica*, *Prinsepia utilis*, *Prunus armeniaca*, *Punica granatum*, *Rosa brunonii*, *Rumex nepalensis*, *Stellaria media*, *Taxus contorta*, *Valeriana jatamnasi* and *Zanthoxylum armatum*. The 100% FL of species showed that these were used in a similar manner by the informants. Reported ailments were grouped into ten clinically relevant categories based on the system involvement and symptom similarity for calculating the ICF, which ranged from 0.96 to 1.00 in this study (Table 4). This grouping allowed for meaningful analysis while maintaining clinical relevance and reducing complexity. The 'Others' category included ailments that did not fit into the main groups, such as headache, immunity boosters and memory enhancers, ensuring all reported conditions were captured for analysis. The greatest number of species were employed to cure digestive disorders (23); followed by skin and hair problems (20); cough and respiratory disorders (13); urinary and reproductive diseases (eight); blood and lymphatic system disorders (eight); muscular and joint disorders (seven); fever (three), ear disorders (two) and eye problems (one).

Table 3. Fidelity Level (%) of plant species utilized for treating different ailments

Plant Species	Ailments	N	Np	FL (%)
<i>Achyranthes aspera</i>	Cough	37	60	61.67
	Skin diseases	23		38.33
<i>Acorus calamus</i>	Headache	10	57	17.54
	Inflammation	19		33.33
	Cough and cold	28		49.12
<i>Aegle marmelos</i>	Digestion	55	55	100

<i>Ajuga integrifolia</i>	Ear disorders	19	61	31.15
	Dysentery	16		26.23
	Hair problems	26		42.62
<i>Albizia lebbek</i>	Cough and asthma	19	45	42.22
	Skin problems	26		57.78
<i>Amaranthus viridis</i>	Eye problems	32	32	100
<i>Artemisia absinthium</i>	Inflammation	32	56	57.14
	Muscular and joint disorders	24		42.86
<i>Asparagus adscendens</i>	Urinary and reproductive diseases	37	60	61.67
	Nosebleed	23		38.33
<i>Bambusa nutans</i>	Inflammation	42	42	100
<i>Bauhinia variegata</i>	Piles	39	39	100
<i>Berberis aristata</i>	Jaundice	25	59	42.37
	Stomach infection	34		57.63
<i>Bergenia ciliata</i>	Kidney stones	45	45	100
<i>Bergera koenigii</i>	Oral problems	31	59	52.54
	Piles	17		28.81
	Healing wounds	21		18.64
<i>Bombax ceiba</i>	Excessive bleeding	13	34	38.23
	Dysentery	21		61.76
<i>Butea monosperma</i>	Skin diseases	37	37	100
<i>Cannabis sativa</i>	Skin irritation	59	59	100
<i>Cassia fistula</i>	Constipation	12	45	26.67
	Dysentery	25		55.56
	Stomachache	8		17.78
<i>Centella asiatica</i>	Skin diseases	21	58	36.21
	Memory enhancement	37		63.79
<i>Chenopodium album</i>	Digestion	23	37	62.16
	Jaundice	14		37.84
<i>Citrus medica</i>	Cough	9	52	17.31
	Indigestion	30		57.69
	Oral problems	13		25.00
<i>Curcuma longa</i>	Skin problems	20	61	32.79
	Healing wounds	41		67.21
<i>Cuscuta reflexa</i>	Joint pain	30	56	53.57
	Skin diseases	26		46.43
<i>Dioscorea deltoidea</i>	Inflammation	59	59	100
<i>Eucalyptus tereticornis</i>	Cough and cold	42	42	100
<i>Euphorbia helioscopia</i>	Skin diseases	15	37	40.54
	Treating wounds	22		59.46
<i>Fagopyrum esculentum</i>	Heart problems	34	34	100
<i>Ficus auriculata</i>	Treating wounds	51	51	100
<i>Ficus palmata</i>	Skin diseases	33	33	100
<i>Grewia optiva</i>	Fever	46	46	100
<i>Hedychium spicatum</i>	Joint pain	50	50	100
<i>Juglans regia</i>	Oral problems	56	56	100
<i>Lathyrus aphaca</i>	Urinary problems	35	35	100
<i>Melia azedarach</i>	Hair problems	45	45	100
<i>Morus nigra</i>	Mouth ulcers	26	47	55.32
	Sore throat	21		44.68
<i>Myrica esculenta</i>	Asthma	11	56	19.64
	Cough	19		33.93
	Digestion	26		46.43

<i>Ocimum basilicum</i>	Ear disorders	9	52	17.31
	Sore throat	27		51.92
	Urinary tract infection	16		30.77
<i>Origanum vulgare</i>	Cough and cold	28	45	62.22
	Fever	17		37.78
<i>Phyllanthus emblica</i>	Digestive disorders	19	54	35.18
	Immunity booster	35		64.82
<i>Pistacia chinensis</i> subsp. <i>integerrima</i>	Cough	31	47	65.96
	Digestive disorders	16		34.04
<i>Plantago major</i>	Treating wounds	36	36	100
<i>Portulaca oleracea</i>	Diarrhoea	18	29	62.07
	Dysentery	11		37.93
<i>Potentilla indica</i>	Digestion	58	58	100
<i>Prinsepia utilis</i>	Joint pain	47	47	100
<i>Prunus armeniaca</i>	Digestion	32	32	100
<i>Prunus campanulata</i>	Cough	8	52	15.38
	Digestion	19		36.54
	Sore throat	25		48.08
<i>Punica granatum</i>	Dysentery	33	33	100
<i>Pyrus pashia</i>	Dysentery	18	47	38.30
	Mouth sores and Throat infection	29		61.70
<i>Rhododendron arboreum</i>	Menstrual problems	28	59	47.46
	Nosebleed	31		52.54
<i>Rosa brunonii</i>	Treating burns	43	43	100
<i>Rubus ellipticus</i>	Digestive disorders	36	57	63.16
	Fever	21		36.84
<i>Rumex nepalensis</i>	Skin irritation	44	44	100
<i>Salix tetrasperma</i>	Oral problems	20	35	57.14
	Fever	15		42.86
<i>Solanum nigrum</i>	Cough and cold	24	41	58.54
	Menstrual problems	17		41.46
<i>Stellaria media</i>	Treating burns	38	38	100
<i>Tagetes minuta</i>	Skin injuries	8	15	53.33
	Digestive disorders	7		46.67
<i>Taxus contorta</i>	Wounds	48	48	100
<i>Tinospora cordifolia</i>	Joint pain	28	51	54.90
	Uric acid control	23		45.10
<i>Urtica dioica</i>	Muscular pain	34	57	59.65
	Joint pain	23		40.35
<i>Valeriana jatamansi</i>	Digestive disorders	42	42	100
<i>Viola pilosa</i>	Cold	34	62	54.84
	Cough	28		45.16
<i>Woodfordia fruticosa</i>	Muscular and joint disorders	20	38	52.63
	Skin problems	18		47.37
<i>Zanthoxylum armatum</i>	Oral problems	40	40	100

Table 4. ICF values of different plant species used for treating various categories of diseases

Ailments Category	Ailments Included	Plants used and number of use reports	Total number of plants used (N _i)	Total use records (N _{ur})	ICF
Blood and lymphatic	Blood pressure, Excessive bleeding, Inflammation,	<i>Acorus calamus</i> (19), <i>Artemisia absinthium</i> (32), <i>Asparagus adscendens</i> (23), <i>Bambusa nutans</i> (42), <i>Bombax ceiba</i> (13), <i>Dioscorea</i>	8	253	0.97

system disorders	Nosebleed, Swellings	<i>deltoidea</i> (59), <i>Fagopyrum esculentum</i> (34), <i>Rhododendron arboreum</i> (31)			
Cough and respiratory disorders	Cold, Cough, Sore throat, Throat infection	<i>Achyranthes aspera</i> (37), <i>Acorus calamus</i> (28), <i>Albizia lebeck</i> (19), <i>Citrus medica</i> (9), <i>Eucalyptus tereticornis</i> (42), <i>Myrica esculenta</i> (30), <i>Ocimum basilicum</i> (27), <i>Origanum vulgare</i> (28), <i>Pistacia chinensis</i> subsp. <i>integerrima</i> (31), <i>Prunus campanulata</i> (33), <i>Pyrus pashia</i> (29), <i>Solanum nigrum</i> (24), <i>Viola pilosa</i> (62)	13	399	0.97
Digestive disorders	Appetiser, Constipation, Diarrhoea, Dysentery, Gastric troubles, Gastritis, Indigestion, Jaundice, Oral problems (Dental caries, Mouth sores, Toothache), Stomachache, Stomach infection, Vomiting	<i>Aegle marmelos</i> (55), <i>Ajuga integrifolia</i> (16), <i>Berberis aristata</i> (59), <i>Bergera koenigii</i> (31), <i>Bombax ceiba</i> (21), <i>Cassia fistula</i> (45), <i>Chenopodium album</i> (37), <i>Citrus medica</i> (43), <i>Grewia optiva</i> (46), <i>Juglans regia</i> (56), <i>Morus nigra</i> (47), <i>Myrica esculenta</i> (26), <i>Phyllanthus emblica</i> (19), <i>Pistacia chinensis</i> subsp. <i>integerrima</i> (16), <i>Portulaca oleracea</i> (29), <i>Potentilla indica</i> (58), <i>Prunus armeniaca</i> (32), <i>Punica granatum</i> (33), <i>Pyrus pashia</i> (18), <i>Rubus ellipticus</i> (36), <i>Salix tetrasperma</i> (20), <i>Tagetes minuta</i> (7), <i>Valeriana jatamansi</i> (42), <i>Zanthoxylum armatum</i> (40)	24	832	0.97
Ear disorders	Earache	<i>Ajuga integrifolia</i> (19), <i>Ocimum basilicum</i> (9)	2	28	0.96
Eye problems	Eye pain	<i>Amaranthus viridis</i> (32)	1	32	1
Fever	Fever	<i>Origanum vulgare</i> (17), <i>Rubus ellipticus</i> (21), <i>Salix tetrasperma</i> (15)	3	53	0.96
Muscular and joint disorders	Bone fracture, Joint pain, Muscular pain, Uric acid problems	<i>Artemisia absinthium</i> (24), <i>Cuscuta reflexa</i> (30), <i>Hedychium spicatum</i> (50), <i>Prinsepia utilis</i> (47), <i>Tinospora cordifolia</i> (51), <i>Urtica dioica</i> (57), <i>Woodfordia fruticosa</i> (20)	7	279	0.98
Skin and hair problems	Acne, Boils, Burns (coolant), Cuts and wounds, Lice, Pimples, Skin injuries, Skin irritation, Warts	<i>Achyranthes aspera</i> (23), <i>Ajuga integrifolia</i> (26), <i>Albizia lebeck</i> (26), <i>Bergera koenigii</i> (11), <i>Butea monosperma</i> (37), <i>Cannabis sativa</i> (59), <i>Centella asiatica</i> (21), <i>Curcuma longa</i> (20), <i>Cuscuta reflexa</i> (26), <i>Euphorbia helioscopia</i> (37), <i>Ficus auriculata</i> (51), <i>Ficus palmata</i> (33), <i>Melia azedarach</i> (45), <i>Plantago major</i> (36), <i>Rosa brunonii</i> (43), <i>Rumex nepalensis</i> (44), <i>Stellaria media</i> (38), <i>Tagetes minuta</i> (8), <i>Taxus contorta</i> (48), <i>Woodfordia fruticosa</i> (18)	20	650	0.97
Urinary and reproductive diseases	Kidney stones, Menstrual complaints, Piles, Urinary infection	<i>Asparagus adscendens</i> (37), <i>Bauhinia variegata</i> (39), <i>Bergera ciliata</i> (45), <i>Bergera koenigii</i> (17), <i>Lathyrus aphaca</i> (35), <i>Ocimum basilicum</i> (16), <i>Rhododendron arboreum</i> (28), <i>Solanum nigrum</i> (17)	8	234	0.97
Others	Headache Immunity booster Memory enhancer	<i>Acorus calamus</i> (10), <i>Phyllanthus emblica</i> (36), <i>Centella asiatica</i> (37)	3	83	0.98

Discussion

Demography of informants

Most informants of our study were the women. Ethnobotanical proficiency was generally strong among women as they were frequently involved in recognizing and producing basic household remedies (Karaköse 2022, Priya & Rawat 2024). Women are often the ones in charge of household activities such as collecting firewood, food and fodder; thus, more acquainted with these medicinal plants (Dulal *et al.* 2022). In many Himalayan cultures, women are the primary 'first responders' for managing childhood ailments (such as coughs, diarrhoea), which solidifies their specialized knowledge of herbs found near the homestead, especially in the countries like Nepal and India. However, the higher scores observed among men likely reflect conventional gender roles, in which men are more involved in gathering resources, community health practices and performing spiritual duties, which are primary ways for acquiring traditional knowledge; while cultural norms and taboos often limit women's mobility beyond their households (Misganaw *et al.* 2025). These differences may result from well-established social, cultural or historical influences that affect the distribution of knowledge of therapeutic plants between genders, with such knowledge commonly being inherited by male descendants, particularly sons (Lulesa *et al.* 2025).

Also, it is found that the older and illiterate people had higher scores, possessed majority of the knowledge and were more inclined to utilize plants for therapeutic purposes in this study. It may be due to the practical and experiential knowledge attained by them. Furthermore, the ethnomedicinal wisdom grows with age and the time period of stay in an area (Guimbo *et al.* 2011). Age has a significant impact on knowledge of therapeutic plants, as older people have spent more time to gain experience with medicinal plants for treating various ailments, which they tend to prefer (Dantas *et al.* 2025). The reduced level of medicinal knowledge among younger individuals suggests a decline in inter-generational knowledge transfer, largely influenced by globalization and modernization, along with the reducing interest in traditional practices (Abebe & Teferi 2021).

The individuals with less or no formal education possess more traditional knowledge than the highly-educated people as they are engaged in agricultural activities, extraction of resources and traditional practices (Angmo *et al.* 2024). Modern educational integration often leads to a shift in priorities or a physical move away from forest-dependent livelihoods, thereby reducing the time spent in traditional learning environments and disrupting the inter-generational transmission of indigenous knowledge (Constant & Tshisikhawe 2018). With the increasing emphasis on modern education among younger generations, the interest in traditional medicine is gradually declining, which highlights the urgent need to promote awareness among youth to ensure the preservation of this valuable heritage for future generations (Kalita *et al.* 2024).

Ethnobotanical Indices

The documented data was analysed quantitatively using indices UV, FL and ICF. The high UV value of *V. pilosa* represents its significant usage in the study area for curing cold and cough. This plant is rich in alkaloids, amino acids, flavonoids, glycosides, saponins and terpenes; and it has also shown antioxidant, anti-microbial and antibacterial activities (Kancherla *et al.* 2023, Kaundal *et al.* 2022). The species with the highest UV were the ones which are most frequently collected in the region for medicinal preparations, as they possess multiple uses (Haq *et al.* 2024). The UV remained moderate because most of the documented plants were reported for very specific ailments rather than for multiple uses. For instance, *V. pilosa* was mainly used for the treatment of cold and cough. Although some plant species exhibited lower UV values than others, they are still considered significant in medicine due to their therapeutic potential in treating different diseases (Kalita *et al.* 2024). The low UV values observed for some species may also reflect a gradual decline in their traditional use, potentially driven by generational shifts in preferences, changing patterns of use and the erosion of local ethnobotanical knowledge (Camou-Guerrero 2008).

Some plant species showed 100% FL which revealed that these were utilized in single ailment category and in a similar manner by multiple informants. These high-FL values (ranging from 17.31% to 100%) indicate strong agreement among the reporting informants that the particular species are most preferred for a specific disease (Woldeamanuel *et al.* 2022). These values also represent single medicinal use of plants recorded from the study area. FL of 100% is also reported in some other studies (Amjad *et al.* 2020, Kayani *et al.* 2015, Yabesh *et al.* 2014).

In addition, ICF values between 0.96 and 1.00 indicated a high level of consensus among the participants regarding the use of the listed plants. It may additionally suggest that the extensive and persistent utilization of plants is because they are medicinal in their different divisions. The elevated ICF values across all disease categories indicate shared traditional knowledge among the respondents and a greater agreement on the methods of utilizing the plant species for addressing ailments within a specific category, reflecting intergenerational transmission and reliance on widely recognized medicinal

plants, indicating the efficacy of the reported plant remedies. (Batool *et al.* 2022). Nevertheless, the ICF value equates to one when just one species is utilized in a disease class (for eye diseases in this study), which tends to not represent any sort of consensus. While a mathematically perfect ICF suggests total agreement, in cases with very low use reports (Nur), it may instead reflect a knowledge vacuum or the rarity of the ailment in the study area. The very high ICF values in categories with low use reports also reflect limited reporting associated with rare ailments or restricted knowledge. The most commonly cured ailments, the digestive disorders, suggest that gastrointestinal issues are a central aspect of the traditional healthcare (Valluru *et al.* 2025).

Ethnomedicinal Information

Rosaceae has been reported as dominant medicinal family in this study as well as in some other studies (Abbasi *et al.* 2013, Amjad *et al.* 2020, Malik *et al.* 2015, Rana *et al.* 2020, Samant & Dhar 1997). In this study, Rosaceae was represented by *Potentilla indica*, *Prinsepia utilis*, *Prunus armeniaca*, *Prunus campanulata*, *Pyrus pashia*, *Rosa brunonii* and *Rubus ellipticus* species. This family is representative of about 4,828 species and 81 genera of plant species with cosmopolitan distribution; and has a great reputation for its dietary, economic and therapeutic capabilities; and includes edible fruits, ornamentals, medicinal and timber plant species of great economic value (Ali 2023). The fruits of Rosaceae family also have high phenolic content and therefore, a rich source of antioxidant compounds (Hussain *et al.* 2019).

Herbs were dominantly used in medicinal formulations in our study and similar results have been reported in other medicinal plants' researches (Amjad *et al.* 2020, Ayyanar & Ignacimuthu 2011, Lal *et al.* 2023, Rao *et al.* 2015). The dominance of herbs could be attributed to their abundance in various habitats, easy acquisition and their ecological, medicinal and nutritional value (Thakur *et al.* 2025). Additional factors that influence the need for herbs are the convenience of storage and shipment, as well as their ease of extraction of bioactive substances (Shrestha & Dhillon 2003).

Leaves were the most utilized plant parts and these have also been reported as the plant parts with highest number of uses in other studies (Bhatia *et al.* 2014, Khajuria *et al.* 2021, Kumar *et al.* 2015). The greater utilization of leaves than other parts can be attributed to several reasons. The primary reason for using leaves is their accessibility, metabolite synthesis and their ability to participate actively in photosynthesis (Ghorbani 2005). The tender portions of the plant, including the leaves, buds and flowers, are the most abundant reservoir of volatile constituents, exquisite aromatics and active principles (Castellani 1999, Rao *et al.* 2015, Wagh & Jain 2018). Furthermore, the harm caused to medicinal plants by leaf removal is quite small in comparison to other parts of the plant (Araya *et al.* 2015). A small proportion of plants (18%) was being gathered through destructive means such as collection of whole plant, roots and rhizome which poses a threat to the existence of these plants. Gathering roots, rhizomes, bulbs and corms destroys the original plant and poses an enormous danger to the survival of medicinal plants, which are usually rare and regenerate slowly. The plants that are harvested by such means require conservation and sustainable use measures (Kumar *et al.* 2015). The preference for leaves indicates an innate traditional conservation practice among the people of Gohar region, as they prioritize non-destructive harvesting, thus supporting the sustainable resource utilization. Such practices, such as collecting only required plant parts and allowing regeneration, promote sustainable harvesting methods and help in preventing overexploitation, maintaining biodiversity and ensuring long-term availability of plant resources for future generations.

Pharmacological evidence supporting the traditional uses

The documented plants were utilized for the treatment of a wide range of ailments, such as digestive disorders, respiratory infections, inflammation, skin diseases, oral problems, urinary tract infections and cognitive impairments. These ethnomedicinal uses are well supported by the previously reported pharmacological studies, indicating that many of these plants share similar biological activities. The plants employed for digestive and gastrointestinal disorders included species like *Ajuga integrifolia*, *Berberis aristata*, *Cassia fistula* and *Zanthoxylum armatum*. These species share well documented antibacterial, antifungal, anti-inflammatory and antioxidant activities, which support their traditional use in treating gastrointestinal and infectious conditions (Joshi *et al.* 2011, Mwangi *et al.* 2021, Singh *et al.* 2024, Devi & Das 2025, Marchelak *et al.* 2025). Plants such as *Bergenia ciliata*, *Curcuma longa* and *Hedychium spicatum* were found to be effective against inflammatory conditions, pain management and wound healing. These species possess anti-inflammatory, antimicrobial, antioxidant and hepatoprotective activities, validating their traditional application in treating skin disorders, internal injuries, joint pain and infections (Ahmad *et al.* 2018, Singh *et al.* 2023, Iweala *et al.* 2023, Kushwaha & Singh 2024, Tian *et al.* 2025). The traditional use of rhizomes of *Bergenia ciliata* against kidney stones is particularly strengthened by its experimentally proven anti-lithiatic activity (Ahmad *et al.* 2018, Kushwaha & Singh 2024). A number of plants were used for respiratory ailments, infectious diseases and boosting immunity, such as *Phyllanthus emblica*, *Rhododendron arboreum* and *Viola pilosa*. These species possess anti-inflammatory, antimicrobial and antioxidant activities, which may explain their traditional use for

cold, cough, urinary tract infections and general immunity enhancement. (Kumar *et al.* 2019, Ahmad *et al.* 2021, Kaundal *et al.* 2022, Batiha *et al.* 2023). Plants associated with neurological and cognitive improvement included *Centella asiatica* and *Phyllanthus emblica*, which are recognized for antioxidant and neuroprotective properties; and *Centella asiatica* has been specifically reported to improve cognitive function and memory, following supplementation with its extracts (Puttarak *et al.* 2017). Together, these findings indicate that there is a close relationship between traditional ethnomedicinal knowledge and experimentally proven biological activities, supporting the therapeutic relevance of these medicinal plants. Although different species are used for different ailments, many of them share similar biological activities, which explain their broad therapeutic relevance in traditional medicine.

Similar findings were also reported by researchers from other regions of Himachal Pradesh. For instance, the uses of *Berberis aristata* for jaundice and stomach infection; and *Centella asiatica* for memory enhancement were also documented in these studies (Priya & Rawat 2024, Rana *et al.* 2020). *Achranthes aspera* was used for boils and chronic bronchitis and *Cuscuta reflexa* was given for shingles and hair loss in Churah region of Chamba (Rana *et al.* 2020); while these were utilized for cough and acne, and joint pain respectively in the study region. The leaves of *Solanum nigrum* were earlier utilized to cure dysentery (Rana *et al.* 2019), while these were used for cold, cough and menstrual cramps in this study. The plants like *Juglans regia* (bark), *Berberis aristata* (twigs), and *Zanthoxylum armatum* (twigs) were used to treat oral problems in this study and reported also earlier by Surbhi *et al.* (2024). *Acorus calamus* was earlier reported to be used for joint pain, sprain and wounds (Priya & Rawat 2024) and stomach worms of cattle (Rana *et al.* 2020), while it was used for cold, cough, headache and inflammation in the present study. *Stellaria media* was utilized for treating burn wounds, while it was earlier also used for respiratory diseases and dermal infection (Thakur *et al.* 2025).

Endangered plant species

Some endangered plant species were also documented in this study. Among these, *Taxus contorta* was found endangered in the IUCN list and while checking the regional status of these species, three species (*Berberis aristata*, *Dioscorea deltoidea* and *Zanthoxylum armatum*) were found endangered in Himachal Pradesh (ENVIS Centre on Medicinal Plants 2016, Gowthami *et al.* 2021, IUCN 2026).

Harvested plant parts and their associated trade dynamics play a critical role in determining the conservation status and threat intensity of the studied endangered medicinal species. *Taxus contorta* is a highly medicinal Himalayan plant as its bark and leaves are rich in taxanes like paclitaxel, which is a vital compound of taxol utilized in the cancer treatment (Thakur & Kanwal 2024). Its bark is used primarily for extraction, which is a highly destructive practice, often causing the death of the tree, thereby reducing its natural population and regeneration potential. Another medicinal plant is *Berberis aristata*, whose roots are used for digestive, eye and skin problems; because of its isoquinoline alkaloids, mainly berberine, which is present in its bark and roots (Marchelak *et al.* 2025). The main harvested part is the root, which is in high demand due to its commercial trade as it is used in pharmaceutical system and traditional medicine, resulting in unsustainable root extraction and decline in its population. *Dioscorea deltoidea* is another important ethnomedicinal plant, whose tuber is rich in diosgenin, a phyto-steroidal sapogenin used as a precursor in the synthesis of various pharmaceutical steroid hormones such as cortisone and pregnenolone (Naseem *et al.* 2024). High market demand resulted in excessive uprooting of plants, making natural regeneration extremely difficult and placing the species under considerable threat. Another important medicinal plant is *Zanthoxylum armatum*, which is used in traditional medicine to treat toothache, digestive problems, infections, arthritis, asthma, boils and cholera due to its anti-inflammatory, antimicrobial, antinociceptive, antioxidant, carminative and stomachic constituents (Devi & Das 2025). Its fruits and sometimes leaves are used as spices, traded in the herbal industry and traditional medicine. Although harvesting of fruits is comparatively less destructive, increasing commercial demand has led to the unsustainable harvesting practices, including branch cutting and occasional uprooting, which are emerging threats to its populations.

There is a considerable threat to these medicinal plant species due to their overharvesting, habitat degradation, change in land use and increased demand from herbal and pharmaceutical sources. It emphasizes the urgent need for strict regulations of trade, promotion of cultivation practices, sustainable harvesting practices, community-based conservation, incorporation into biodiversity management policies to preserve indigenous knowledge and to ensure long-term conservation of these important medicinal resources in Himachal Pradesh. Educating local communities about the cultivation, conservation and sustainable utilization of these species will definitely aid in improving their population size and preventing the extinction of these species.

Conclusion

The people of Gohar region have a good knowledge of usage of plants around them and frequently utilize them as herbal medicine; reflecting a traditional healthcare system that results in effective management of various diseases in the area through well-structured local understanding of medicinal plant resources, where specific species are consistently associated with particular ailments and treatment practices irrespective of the availability of modern health care. This study enumerated some ethnomedicinal plants which are used for therapeutic purposes by the natives. The study also emphasizes the scientific relevance of integrating ethnobotanical knowledge with modern research approaches. Plants recognized as culturally important through quantitative indices represent promising candidates for further phytochemical and pharmacological investigations. The phytochemistry investigation and pharmacological validation of these plant resources can prove of immense use in developing new eco-friendly products and alternatives for chemical-based medicines, while simultaneously validating indigenous healthcare knowledge. Moreover, the study emphasizes the need for conservation and sustainable management of medicinal plant resources as the depletion of traditional knowledge threatens both cultural heritage and biodiversity. Therefore, systematic documentation, community participation and conservation initiatives are essential to safeguard this valuable ethnomedicinal heritage.

Declarations

List of abbreviations: ANOVA=Analysis of Variance; EN=Endangered; DD=Data Deficient; FL=Fidelity Level; ICF=Informant Consensus Factor; IUCN=International Union for Conservation of Nature; LC=Least Concern; NE=Not Evaluated; NT=Near Threatened; UV=Use Value; VU=Vulnerable.

Ethics approval and consent to participate: All procedures performed in this study followed the ethical standards outlined in the International Society of Ethnobiology (ISE) Code of Ethics and the Prior Informed Consent was obtained from the participants before the interviews.

Consent for publication: Not applicable as the manuscript does not include any identifiable personal data, photographs or individual case information.

Availability of data and materials: The data supporting the findings of this study is included in the article.

Competing interests: The authors declare that there are no competing interests.

Funding: This work was supported by the CSIR-SRF [File No. 09/09/0237(16176)/2023-EMR-I] awarded to Surbhi.

Author contributions: Surbhi collected the data, performed data analysis and wrote the final version of the text. Suman Rawat supervised the work and finalized the manuscript.

Acknowledgements

We express gratitude to the locals of the region whose participation proved of immense use in preparing this research article and the Council of Scientific and Industrial Research (CSIR) for providing fellowship. We sincerely acknowledge the support and assistance provided by the BSI, FRI and HFRI for granting access to their herbarium specimens.

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