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RESEARCH

Quantitative ethnobotanical investigation in Northern District of Lesser Himalayas of Azad Jammu and Kashmir, Pakistan

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Background: The present study provides valuable insights into the traditional uses of medicinal plants by the inhabitants of the Northern District of the lesser Himalayas in Azad Jammu and Kashmir, Pakistan. The study likely focuses on documenting and preserving the region's indigenous knowledge and practices related to medicinal plants. Ethnobotanical data were collected by interviewing 72 local informants including practitioners, farmers, teachers, and laborers from different localities of District Jhelum Valley. Different quantitative tools were used for the analysis of ethnobotanical data including relative frequency of citation, use value, informant consensus factor, fidelity level, cultural value, practical value, consensus value for plant part, rank order priority, percentage respondent knowledge, economic value and their total value were calculated. Jaccard's index (JI) was used to compare the present knowledge with the previous studies in the same or surrounding areas.
Results: A total of 129 species belonging to 111 genera and 63 families were documented along with their ethnobotanical uses. Dominant families based on the number of species include Rosaceae contributing 12 species followed by Asteraceae and Saxifragaceae with 8 species each. The comparative study of the novelty of species and their uses by the JI revealed 13 novel plant species which were not reported earlier from this region.
Conclusions: This information is not only important for scientific and ethnobotanical purposes but also for the sustainable management of medicinal plant resources and the potential discovery of new natural medicine. Such studies can help to bridge the gap between traditional and modern medicines and collaboration between traditional healers and health care practitioners.

Keywords: indigenous knowledge, Lesser Himalayas, medicinal plants, traditional uses, treatment

Introduction

The utilization of medicinal plants for the prevention and treatment of various diseases is an age-old practice that has been passed down through generations (Rehman et al. 2023a, b). In rural areas of Pakistan about 80% of local peoples dependent on medicinal plants (Khan et al. 2021; Sadeghi and Mahmood 2014). Due to the lack of basic health facilities traditional medicinal plants are excellent source of primary health care in developing countries (Hu et al. 2020). The indigenous people have been making medicines from the medicinal plants that are readily available, many of which are used to cure the ailments that affect women. Due to its efficiency, the lack of basic healthcare facilities, and cultural preferences, indigenous people rely on plants for medicine (Khattak et al. 2015). The rich repository of traditional knowledge has contributed significantly to the development of modern medicines. Approximately 25% of herbal pharmaceuticals used in current medicine come from plants (Tufail et al. 2020). Among different communities, qualitative data reveals the diverse values attributed to the use of plants as medicine for treating various disorders (Vandebroek and Balick 2012). Ethnobotany is a multidisciplinary field that explores the relationships between people and plants, particularly focusing on how different cultures use plants for various purposes.

One aspect of ethnobotanical research involves collecting data on cultural features associated with plants, such as their flavor, medicinal properties or ceremonial uses (Ahmad et al. 2017; Hussain et al. 2012). Ethnobotanical data are valuable in enhancing our understanding of the importance of plants in various contexts, have emphasized the significance of ethnobotanical data by employing methods of documentation, collection (Rashid et al. 2018). Adopted quantitative methods to make it easier to quantify and cross-verify data from ethno botanical sources. Many diverse characteristics, including social standing, age, education, gender, occupation, management of natural resources, roles in the home and community, and economic status, affect how much value is placed on plant resources (Petrakou et al. 2020). The Himalayan region, located in south Asia, encompasses several countries including Afghanistan, Bangladesh, Bhutan, Nepal, China, Myanmar, India, and Pakistan. It is widely recognized as a hotspot of biodiversity, particularly for its abundant medicinal plants species (Narscia and Borgognini-Tarli 2006; Pieroni 2001). In Pakistan, traditional medicine plays a crucial role in health care; around 600 different species of plants are utilized as traditional medicine. These species are known for their medicinal properties and used to prepare remedies and treatment (Pieroni 2001). The Kashmir Himalaya region is known for its rich biodiversity, including a wide variety of medicinal plants. The region's unique geographical features, such as its high altitude, diverse climate, and pristine natural environment, contribute to the abundance of medicinal flora found there (Dar and Naqshi 2001). It remained a popular location for the neighborhood hakims to practice the Unani system of herbal medicine, which offered numerous opportunities to further this approach. Traditional medical practices in Azad Kashmir are often based on local ethnobotanical knowledge. Numerous qualitative research projects focusing on the medicinal flora of the Azad Kashmir Himalaya have been conducted by (Ahmad et al. 2012; Habib et al. 2013). But just a few papers dealt with the quantitative data gathering and interpretation in various parts of ethnobotany, such as informant consensus factor (ICF), fidelity level (FL), percentage respondent knowledge (PRK), relative frequency of citation (RFC), relative importance (Amjad et al. 2017b; Ishtiaq et al. 2012). The Jhelum Valley is identified as an unexplored area in terms of ethnobotanical research. This means that little or no scientific research has been conducted to document the traditional knowledge of plants used by the local communities in this region. There are two main challenges that have hindered ethnobotanical research in this area. First the topography of the region which is hilly with steep slopes, making it difficult for researchers to access and study the plants. Second, cultural and religious restrictions are said to limit researchers' access to the local communities and their ethnobotanical knowledge. We hypothesized that because of the remoteness of the area and the challenges mentioned, the ethnobotanical knowledge in Jhelum Valley will differ significantly from other regions in Pakistan. In other words, we expect to find unique and distinctive plant uses in this area. Therefore, the primary objective of this study was to document the indigenous knowledge about medicinal plants. Specifically, how these plants are used for primary health care. This includes not only identifying plants but also understating the methods of preparation administration of herbal remedies. The data was further analyzed by using various numerical indices and compared with previous studies to determine the novelty of work (Fig. 1).

Materials and Methods

Study area

This study was conducted in Jhelum Valley of Azad Jammu and Kashmir, Pakistan, which lies between 34°14–34°17 N latitude and 73°26–73°56 E longitude with elevations range 830 to 4,200 mask, with area of about 854 km^2. The valley earns it name due to river Jhelum. Topographically, it is mountainous zone situated in Western Himalayan. While geoclimatically the area falls within subtropical, moist temperate, subalpine to alpine zone where climate is controlled by various factors of latitude, altitude, summer, monsoon and winter snowfall. The cultural configuration of valley is quite diverse with tribes as Awan, Gujjars, Raja, Mughals, Abbasi, Khawaja, Syed, and Malik. Primary local languages spoken in the area were Hindko, Gojjari, Pahari, and Kashmiri. The three selected villages Lowasi, Kimanja, and Pathyali were located at the distance of 1 km, 25 km, and 55 km respectively from main Muzaffarabad Srinagar-highway (Fig. 2).

Plant collection and identification

The survey was conducted from December 2021 to September 2022 in the winter, spring and summer season along with local participants. Indigenous knowledge and ethnobotanical data were collected through semi-structured questionnaires, interviews and direct observations. Prior rural appraisal approach was adopted according to Kyoto practice. Data documentation consisted information about disease name, parts name, remedial preparation, and route of administration. The voucher specimens of collected plant species were authenticated using flora of Pakistan (Al-Adhroey et al. 2010; Andrade-Cetto 2009) and cross-checked by the plant list and deposited at the AKASH herbarium in University of Azad Jammu and Kashmir, Muzaffarabad for future reference.

Ethnobotanical indices

The recorded values analyzed with various tools used in

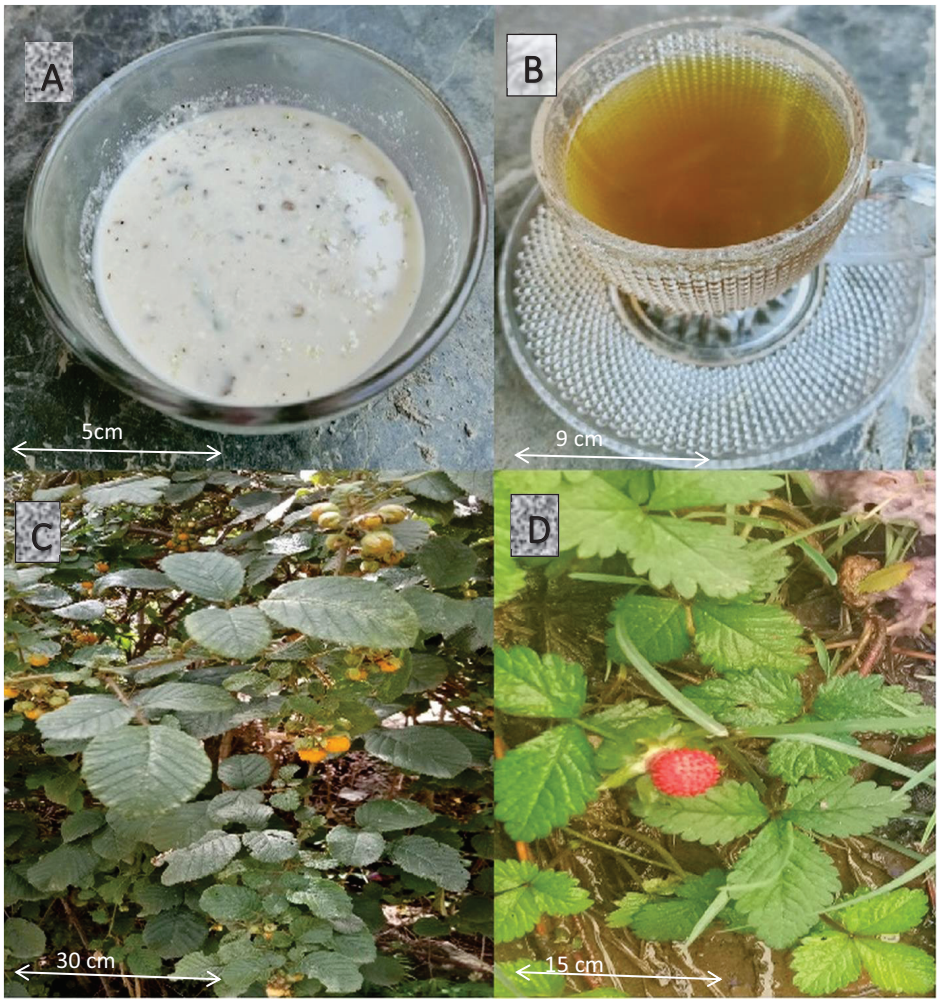

Fig. 1 Traditional uses of wild plants in lesser western Himalayas of Azad Kahmir. (A) *Juglans regia* seeds mixture in yogurt are used as chutney. (B) *Mentha longifolia* leaves are used as Kawa (herbal tea). (C, D) *Rubus ellipticus* and *Duchesnea indica* are consumed as wild fruits.

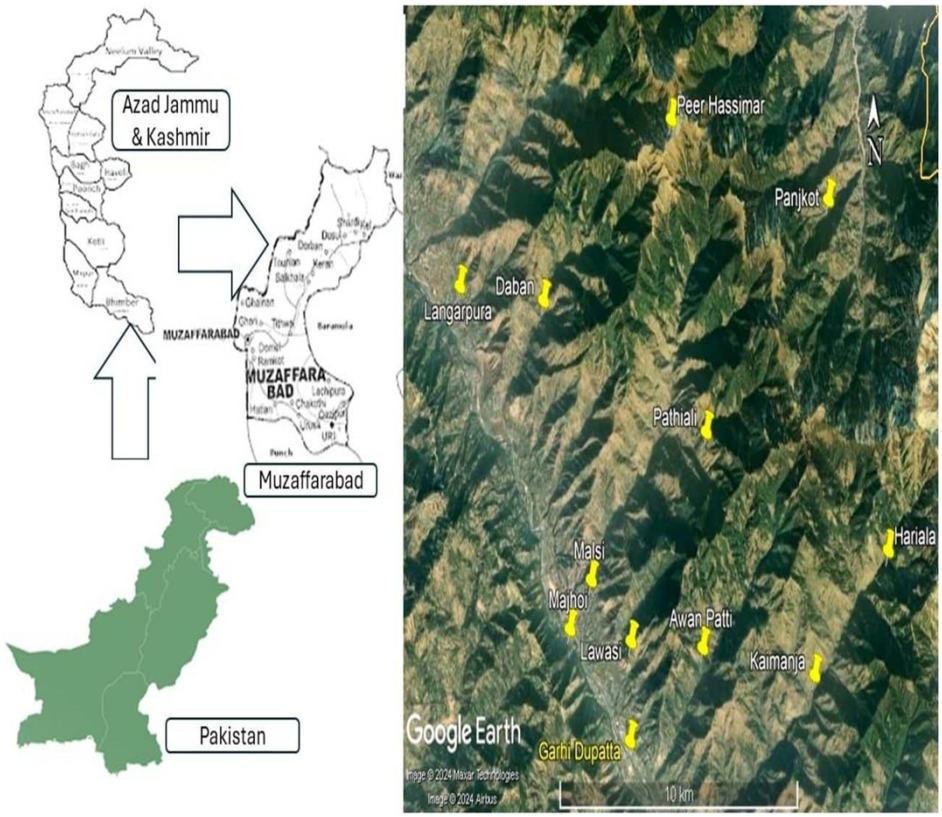

Fig. 2 Map of the Azad Jammu and Kashmir and study area.

quantitative documentation of plants. These indices help to understand the used pattern of medicinal species among the communities of studied areas in Jhelum Valley. Different statistical measuring tools were used as:

Family importance value

Family importance value (FIV) = FC / N ×100

FC is total participants who mention species, N is sum of all the plant families mention by participants.

Use value

Use value (UV) = ∑u / n

∑u = total uses of species "n" sum of all informants participate in free listing.

Relative frequency of citation

RFC = (FC) / (N)

FC is number of participants mention plant where N is sum of all informants.

Fidelity level

FL = NP / N × 100

NP is number of participants mention ethno species, N is sum of all informants (Hoffman and Gallaher 2007).

Rank order priority

Rank order priority (ROP) = FL × RPL

FL is fidelity level and RPL is relative popularity level (Hoffman and Gallaher 2007).

Percentage respondent knowledge

PRK = (n / N) ×100

n = number of individual participated and N= sum of people interviewed (Hoffman and Gallaher 2007).

Informant consensus factor

ICF = NUr – NT / NT – 1

NUr is the number of uses reported and NT is sum of plants mention by the informants (Collins et al. 2006).

Cultural value

CV = UC × IC × IUc

CV is cultural value, UC is total use category mention by informants, IC is sum of individuals, and IUc is total individuals who cited ethno species divided by the sum of individuals participate in study (Ghorbani et al. 2011).

Practical value

PV = UP × IP × DUP

PV is practical value, UP is sum of uses reported divided by the 14 potential categories of diseases, and IP is expresses the number of times ethno species brought to house divided by the total number of informants participating in scan observations. DUP is duration of each use (Godoy et al. 2009).

Economic value

EV = OE × PE

EV is the economic value, OE is sum of ethnomedicinal observation, and PE is village price of the ethno species (Godoy et al. 2009).

Total value

TV = (CV+ PV + EV)

where TV is total value, CV is cultural value, PV is practical, and EV is economic value (Reyes-García et al. 2007).

Jaccard's index

The main goal is to assess the similarity of knowledge across various communities. The comparison is made by examining the findings of the current study and comparing them with 21 published peer-reviewed papers at regional and national levels. The Jaccard's index (JI) is applied as a metric for measuring similarity. The JI is commonly used to compare the similarity and dissimilarity between two sets. These includes 10 studies from Azad Jammu and Kashmir, 6 from Khyber Paktunkhawa, 2 from Gilgit Baltastan and 2 from Punjab Pakistan are included in this list. The studies conducted on the areas with similar, vegetation, climatic condition, and culture was considered for comparison. In accordance with (Amjad et al. 2020) the JI was computed using the following formula:

JI = c × 100/ (a + b) – c

Results

Demographic data of participants

During free listing, seventy-two (24 from each site) local informants were interviewed from study area. Demographic data of the participant's occupation was classified into 4 groups based on age as: 16–30 year, 31–45 year, 46–60 year, and above 60 years. The numbers of male and female respondents were equal, maximum information were given by old people above 45 years. More than half of the respondents were literate (62.2%) in Lowasi, 50% in Kimanja and 33.33% in village Pathyali, as compared to 37.5% in Lowasi, 50% in Kimanja and 66.66% in Pathyali of illiterate respondents. The local informants were laborers, soldier, traditional health practioners, homemaker, farmers, shopkeeper, teachers and foresters (Table 1).

Floristic diversity of medicinal plants

In present study, 129 medicinally important plants species were reported dispersed in 111 genera and 63 families. The dominating family was Rosaceae (n = 12) in all of studied areas followed by family Asteraceae and Lamiaceae (n = 8, each). In present data, there were small variations found in the usage of medicinal plants of different families. In Lowasi, 104 plants species of 57 families were recorded (Table 2).

Informant consensus factor

The ICF value of 0.52 was obtained for diseases related to gastrointestinal disorder in village Kimanja and Pathyali while in Lowasi, the ICF of gastrointestinal disorder was 0.51 which is less than the other two villages. In present study, the most common disease category treated by using plant species was gastrointestinal disorder followed by respiratory disorder. The least ICF (0.1) was found for hepatic disorder, central nervous system disorder and hepatic disorder (Table 3).

Cultural, practical, economic, and total value

Cultural, practical, and EVs of three different localities were calculated to check the valuation of species with reference to their distribution in different ecological zones. The Lowasi and Kimanja were situated in sub trophic while the village Pathyali located in temperate zone. The TV of ethno species varied between 0.01 to 36.32 in Lowasi, 0.85 to 40.13 in Kimanja, and 0.09 to 41 in Pathyali. The ethno species classified into three groups (Table 4). About 34 plants species in Lowasi, 23 in Kimanja and 23 in Pathyali had very low TV (0.02 to 0.1), 23% in Lowasi, 26% in Kimanja and 15% in Pathyali had a low value (from 0.1 to 1), 34% in Lowasi, 40% in Kimanja and 47 % in Pathyali, had a high value (from 1 to 10), and 9% in Lowasi, 12 % in Kimanja, 15% in Pathyali had very high value higher than 10. The species *Ranunculus laetus*, *Morchela esculenta*,

Table 1 Demographic information and literacy level percentage of informants

Demographic information	Lowasi		Kimanja		Pathyali	
	Individuals	Response percentage	Individuals	Response percentage	Individuals	Response percentage
Age groups						
16–30	6	8.41	6	10.11	6	9.36
31–45	6	18.46	6	16.91	6	18.5
46–60	6	31.59	6	33.21	6	32.96
Above 60	6	41.54	6	39.77	6	39.77
Sex						
Male	12	50	12	50	12	50
Female	12	50	12	50	12	50
Literacy level						
Illiterate	9	37.5	12	50	16	66.7
Primary	5	20.8	5	20.8	3	12.5
Middle	4	16.7	3	12.5	3	12.5
Secondary	3	12.5	3	12.5	1	4.2
University	3	12.5	1	4.2	1	4.2
Occupation						
Farmer	3	12.5	6	25.1	8	33.3
Teacher	3	12.5	1	4.2	1	4.2
Labourer	3	12.5	3	16.7	3	12.5
Private job	4	16.7	2	8.3	1	4.2
Housewife	7	29.2	8	33.3	9	37.5
Soldier	1	4.2	1	4.2	-	-
Devoid	1	4.2	1	4.2	1	4.2
Forester	1	4.2	-	-	-	-
Shopkeeper	1	4.2	1	4.2	1	4.2
Health practioners	-	-	1	4.2	-	-

Table 2 Uses of plants, local name, family, habit, mode of use, route of use, diseases cure and ethnobotanical recipes of plants recorded at Jhelum Valley villages (Lowasi, Kimanja, Pathyali) Azad Jammu and Kashmir (add reference with ethnomedicinal uses)

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Abies pindrow Royle	Tung	Pinaceae	WT	Tea	Bark	Orally	Cough, asthma	The inner portion of bark boiled in water ads some sugar then used the patient for children ½ tsp in day for two days for adults, half cup for four days.
Acacia modesta Wall.	Phulaai	Mimosaceae	WT	Powder	Bark	Orally	Leucorrhoea, sexual disability	Fresh bark powder used for the treatment of sexual debility and leucorrhoea children not allows, for adults 1tsp for 7 days.
Acacia nilotica L.	Kikaar	Mimosaceae	WT	Powder	Whole plant	Orally	Gleet, leucorrhoea, sexual debility, diarrhea, dysentery, tuberculosis, cough, asthma, and phlegm	1 kg of dry pods used for the treatments of mention disorder for 7 days child not allow. ½ kg of dried leaves, dried flowers, and dried pods ground, powder used for 7 days.
Achillea millefolium L.	Dand Jari	Asteraceae	WH	Powder	Root	Orally	Toothache	Dry roots grounded for 10 minutes make powder the powder store in bottle and given to patient suffering from toothache powder rub on teeth for 6–7 minutes.
Achyranthes aspera L.	Putkhanda	Amranthaceae	WH	Ash, decoction	Whole plant	Orally	Cough asthma, kidney stone, and kidney pain	Dried fruit powder used for the treatments of asthma and cough for child ½ tbs for adults, 1 tbs of ash powder for 8 days. (b) Fresh decoctions used for Kidney problems for adults ½ cups for 4-day child not allow.
Aconitum chasmanthum Stapf.ex Holmes	Mori	Ranunculaceae	WH	Paste	Flower	Orally	Cough rheumatism, asthma, and snakebite	Fresh flower gullkand used for the cure of asthma, rheumatism, snake bite, and cough 1 tsp used for 4 days.
Aconitum heterophyllum Wall.ex Royle	Patrees	Ranunculaceae	WH	Powder	Roots	Orally	Diabetes and earache	Dry root powder given to patient suffering from diabetes and earache orally for children ½ tbs for 3–4 days for adults 1 tbs for 5–6 days.
Adiantum capillus-veneris L.	Kakawa Kakapi	Adiantaceae	WH	Decoction	Whole plant	Orally	Chest pain, measles, rashes, and fever	Fresh plant decoction given the patient for chest pain, measles, rashes, and fever for children, ½ cup of decoction given for 5 days for adults, 1 cup given 6 days.
Aesculus indica Wall ex.camb.	Bankhor	Hippo-dastenaceae	WT	Powder	Fruit	Orally	Diabetes	½ kg of dry fruit powder given to patient of diabetes for 3 tbs with for 10 days.
Ailanthus altissimus (Mill.) Swingle	Daravaya	Simaroubaceae	CT	Extract	Leaves	Orally	Dysentery, diarrhea	Fresh leaves are grounded this extract of leaves gives the patient of diarrhea and dysentery with one cup of water 2 time in a day for 5–6 days.
Ajuga bracteosa Wall., ex Benth	Janeadam	Lamiaceae	WH	Infusion	Whole plant	Orally	Blood purification, earache, throat pain, blood purification, body inflammation, eye pain and skin lesions	Fresh plant material ground added water then filtered and use for the treatments of theses disorder.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Allium cepa L.	Piyaz	Alliaceae	CT	Juice	Bulb	Orally, Dermal	Diarrhea, dysentery, skin lesions, cholera	Bulb ground and this juice given to patients scales slightly dipped in oil and placed on infected skin for 5–6 days.
Allium sativum L.	Thoom	Alliaceae	CT	Cooked, oil	Corm	Ear, dermally	Earache, pimples, hypertension, and flue	Fried bulblets oil used for earache one fresh bulblet cut in middle and applied directly on pimples for 3 minutes twice daily for 6 day 2 fresh bulblets directly cooked on fire for 1 minute then given to patient for flue and hypertension when needed.
Aloe vera L.	Kowargandal	Liliaceae	WH	Pulp	Leaves	Orally, dermally	Weakness, indigestion, backache, lesion, pimple, muscle pain, and inflammations	The sweet meal used to cure diseases used for 4 days. (b) The fresh pulp used directly on the skin for pimple, lesion, and inflammation.
Amaranthus viridis L.	Ganayar	Amaranthaceae	WH	Powder, cooked	Seed, leaves	Orally	Vision disorder and constipation	Dried seeds and 3 tbs sugar mixed and ground together used for 12–15 days. Cooke leaves as vegetables and eat for cure of constipation.
Anethum graveolens L.	Soya	Apiaceae	CH	Cooked	Whole plant	Orally	Indigestion, diuretic, gastric problems and eye pain	Fresh plant material cooked in oil add some salt for 14 minutes then eat for digestive and gastric problems and seed boiled in water then filtered the material and given to patient for cure of diuretic problem and eye pain for children ½ cup for adults 1 cup for 6 days.
Arisaema utile Hook.f.ex Schott	Sanp-boti, sorganda	Araceae	WH	Powder	Tubers seed	Orally, dermally	Gastritis, asthma, skin (pimples) and skin lesion	Powder of tubers used for 3 days fresh tuber applied on skin for lesion and pimple. 2–3 seeds orally eaten daily for 3 days for the treatments of gastritis and asthma child no allow.
Arnebia benthamii (Wall. ex G. Don)	Gao zaban	Boraginaceae	WH	Tea	Root, leaves	Orally	Liver problem, gastritis, and fever	Tea of root used to cure liver problem and gastritis, fever and liver disorder for children 2 tsp and for adults 1 cup for a week.
Artemisia vulgaris L.	Chaow	Asteraceae	WH	Infusion	Leaves	Ear	Earache	Fresh leaves ground with one cup of water for 10 minutes then filtered with piece of cloth. The infusion use to cure the disease of earache for children 1 drops of infusion for 3 days for adult 2 drops for 6–7 days.
Berberis lycium Royle in Trans. L.	Sumbal	Bereridaceae	WS	Decoction, extract, powder	Whole plant	Orally, dermally	Pimple, mouth sores, throat pains, back pain, stomach disorder, liver disorder, wound healing and purify blood, jaundice, rheumatism, dental disorder, ear problem	(a) Fresh leaves extract used for 8 days. (b) Bark filtered extract for 6 days. (c) Dried bark powder sprinkled on injuries or wounds for 5 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Bergenia ciliata (Haw.) Sternb.	Butpawa	Saxifragaceae	WH	Powder, paste	Rhizome	Orally	Stomach ulcer, back pain, mouth sore, mouth ulcer, piles, dysentery, and wounds healing stomache	Dried rhizome powder given for 7 days. (b) Dried rhizome ground and make (halwa) given for 8 days.
Bistorta amplexicaulis (D. Don)	Masloon	Polygonaceae	WH	Tea	Roots	Orally	Rheumatism gastritis and cold	Domestic tea used in cold, gastritis, and joints pain.
Boerhavia procumbens Banks ex Roxb.	Itsit	Nyctaginaceae	WS	Decoction	Whole plant	Orally	Jaundice and constipation	Fresh plant material boiled and given for 6–7 days.
Brassica rapa L.	Sarson	Brassicaceae	CH	Oil, powder	Pods + seed	Orally, dermally	Leucorrhoea, menstrual disorder, muscular pain, dry skin and dandruff	Fresh pods powder used for menstrual disorder, leucorrhoea, and muscular pain for children, not used for adults, 1–2 tsp given with for 10 days. (b) Brassica seed oil used for the treatment of dry skin gently applies on skin and message head for treatment of dry hairs.
Calotropis procera (Wild) R. Br.	Auk	Asclepidaceae	WT	Milk, powder	Leaves	Orally, dermally	Snake bite, dog bite, insect sting, asthma, and cough	(a) Fresh milk (latex) applied over the affected parts of snakebite, dog bite, and insect sting until the patient feels relief. (b) The leaves powder given to patients suffering from asthma and cough for children, not used for adults for 10 days.
Cannabis sativa L.	Bang	Cannabinaceae	WH	Decoction	Leaves	Orally	Intoxication and loss of appetite	Fresh or dried leaves with ads some sugar boiled and filtered then drinks by the age of 25–50 year man for intoxication.
Cedrela toona Roxb.ex Willd.	Neem	Meliaceae	WT	Powder	Leaves	Orally	Blood disorder, pimple, hepatic disorder, and stomach problem	Dried leaves powder used for adults, 2–3 tsp for 15 days.
Cedrus deodara (Roxb. ex D. Don)	Deodar	Pinaceae	WT	Resin	Arial part	Dermally	Fracture bone and cracked skin	The resin dermally used on cracked skin and on fractured bone.
Cestrum nocturnum L	Rat Ki Rani	Solanaceae	CH	Extract	Leaves	Orally	Epilepsy	Leaves extract used for epilepsy for children 2–3 tsp for 5–6 days for adults 3 tsp for 7 days.
Chenopodium ambrosioides L.	Bathwaa	Chenopodiaceae	WH	Decoction	Leaves	Orally	Gastritis, piles, stomachache and indigestion	Half kg of fresh leaves boiled and used child not used for adults; ½ cup of decoction for 4–5 days.
Cichorium intybus L.	Kasni Booti	Asteraceae	WH	Decoction	Whole plant	Orally	Fever, jaundice, gas trouble and diabetes	Fresh plant with 3 tbs sugar boiled and used for 6 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Citrus aurantium Var.Dulcis L.	Malta	Rutaceae	CS	Raw, powder	Fruit	Orally, dermally	Jaundice and achne	Fruit eaten as a raw form to treat the disease of jaundice and half kg of dry pericarp of citrus in powder form mix in ½ cup of water then directly apply on face one time in a day child no use.
Citrus limon (L.) Burm.	Limo	Rutaceaea	CS	Juice	Fruit	Orally	Hypertension, vomiting, cholera, fever and skin tonic	(a) Fresh fruit juice used for 2–3 days green tea boiled add lemon juice and used for 8–10 days.
Citrus maxima (Burman) Merrill	Chakootra	Rutaceae	CT	Raw	Fruit	Orally	Heart disease, diabetes	Fruit eaten by the patient in a raw form for the treatment of heart and diabetes problems.
Coriandrum sativum L.	Dania	Apiaceae	CH	Paste	Leaves	Orally	Diuretic, gastritis, stomache, and indigestion	Fresh leaves orally eaten for the cure of gastric problems, diuretic, stomache, and indigestion for children and adults ½ plate for 6 days (b) The root eaten in raw form against jaundice and improves eyesight. (c) The juice obtaining by grinding the root use both children and adults drink the juice.
Cotinus coggyria Scop.	Pahan	Anacardiaceae	WH	Paste	Leaves	Orally	Fever, anemia and pimple	Paste of leaves and flowers used in skin diseases and orally used for the treatment of fever and anemia for children ½ tsp of paste for adults 1 tsp of paste for 5 days.
Cucumis sativus L.	Kheera	Cucurbitaceae	CH	Raw	Fruit	Orally, dermally	Indigestion, skin problems (achne), tonic and diuretic	(a) The fresh fruit cut into pieces and eat as raw for the cure of dyspepsia, tonic, and diuretic problem. (b) The pieces of fresh fruit dermally applied for the treatment of skin problems like achne.
Curcuma longa L.	Haldi	Zingiberaceae	CH	Powder	Rhizome	Orally, dermally	Inflammation,dysentery,wound healing, insect sting, fractured bone, skin tonic and menstrual pain	(a) Dry rhizome powder use orally for children 1 tsp for adults 2 tsp for 4–5 days 3 tsp of curcuma mixed half cup of gram grain (basen) and half cup of curd mixed together paste apply on skin for skin completion. For children not allow. For adults for 4–5 days. (d) For menstrual pain 1 tsp of curcuma powder in one fried egg eaten for the treatment of pain in women.
Cuscuta reflexa Roxb.	Neela Tari	Cuscutaceae	WH	Infusion	Arial part	Orally	Jaundice	The infusion of plant used by patient of jaundice, for one week The extract of the plant use to get rid of dandruff.
Cynodon dactylon (L.) Pers	Gass	Poaceae	WH	Paste	Whole plant	Dermally	Wound healing, control bleeding	Plant paste applied for control bleeding and wound healing for 5 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Cyperus rotundus L.	Muthroon	Cyperaceae	WH	Powder Paste	Rhizome	Orally, dermally	Piles, sexual debility, wound healing, toothache	(a) A mixture of dried stolon and sugar (halwa) used. (b) Fresh rhizome paste directly applies on wound for 3 days. (c) Fresh rhizome paste applies on tooth for cure of toothache 3–4 time in a day for 3–4 days.
Datura innoxia Miller	Datura	Solanaceae	WH	Powder	Leave, seeds	Orally	Cough, asthma	½ kg dried leaves, half cup dried seeds used for 8–12 days.
Daucus carota L.	Gajor	Apiaceae	CV	Juice, raw	Root	Orally	Weak eyesight, jaundice, skin tonic	The root eaten in a raw form against jaundice and improves eyesight.
Dodonaea viscosa L.	Sanatha	Sapindaceae	WS	Paste, decoction	Leaves	Orally, dermally	Rheumatism intestinal worm	(a) Fresh leaves boiled the decoction used by patient (b) Fresh leaves boiled used for intestinal worms for children used for 3–4 days.
Duchesnea indica (Andrews) Focke	Budi Mava	Rosaceae	WH	Raw	Fruit, Leaves	Orally	Stomach ulcers, liver disorder, diarrhea	Fruit edible and has a very pleasant strawberry flavor. The fruit used to treat stomach ulcers and liver disorder.
Eriobotrya japonica (Thunb.) Lindl	Lokat	Rosaceae	CH	Juice	Fruit	Orally	Diabetes	½ kg of fruit pulp juice and use orally twice a day to treat diabetes and obesity for children ½ cup for 8 days for adults 1 cup once in a day for 10 days.
Euphorbia helioscopia L.	Doodal	Euphorbiaceae	WH	Powder	Whole plant	Dermally	Wound healing, control bleeding, remove pus from ulcer	Powder of plant use for the cure of wound healing, control bleeding, and remove puss from wound used for 5 days.
Ficus carica Forssk.	Pughwara	Moraceae	WH	Milk, raw	Leaves and fruit	Orally, dermally	Remove prickle, constipation	Milk latex used as prickle easily drawn fresh fruits eaten by both children and adults to cure constipation.
Foeniculum vulgar Mill	Sonaf	Apiaceae	CH	Infusion	Seed	Orally	Constipation, gastritis	Dried seeds infusion used for 5–8 days.
Fragaria nubicola Landle ex Lacaita	Tatar Mava	Rosaceae	WH	Tea	Root	Orally	Liver inflammation	Fresh roots tea for 5 days.
Fumaria indica (Hausskn.) Pugsley	Papraa	Fumariaceae	WH	Decoction	Whole plant	Orally	Skin infection achne, constipation, blood purification	Fresh plant material used for 5 days.
Galium aparine L.	Bora Jarri	Rubiaceae	WH	Extract	Whole plant	Orally	Diuretic, kidney pain	Plant material extract given for 5 days.
Geranium wallichianum D. Don	Ratnaa	Gereniaceae	WH	Extract	Roots, flower	Orally	Jaundice, kidney pain, week eye side, blood purification and eye pain	Floral extract used for vision problem and blood purification. Root powder with *Daucus carota* also used for jaundice, kidney, and spleen problems.
Hedera nepalensis K. Koch, Hort.	Buldi	Araliaceae	WH	Chewed	Leaves	Orally	Diabetes	Fresh leaves chewed for the treatment of toothache and sore gum.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Impatiens edgeworthii Hook.	Bantill	Balsaminaceae	WH	Chewed	Leaves	Orally	Toothache, sore gum	The roots decoction used for 3 days. Bandage o root paste applied and chewed for abdominal pain.
Indigofera heterantha Wall. ex Baker	Khanthi	Papilionaceae	WS	Chewed, paste, decoction	Roots	Orally, dermally	Abdominal pain and cracked body	The roots decoction used for 3 days. Bandage o root paste applied and chewed for abdominal pain.
Ipomea nil (L.) Roth	Eldi	Convolvulaceae	Wc	Powder	Seeds	Orally	Constipation, intestinal worm	Dried seeds powder used for 7 days.
Isodon rugosus Wall. ex	Pemar	Lamiaceae	WS	Leaves	Extract	Dermally	Antilice	Leaves grounded for 10 minutes the extract used to wash hair for removal of lice's.
Juglans regia L.	Akhroot	Juglandaceae	CT	Raw, miswak	Bark seed	Orally	Physical weakness, toothache, bad tooth, cholesterol	Kernels eaten as remedy for physical health and for cholesterol control bark or fresh branches used for toothache. Bark cut with a knife daily and used as a toothbrush (miswak) for toothache and bad tooth.
Jurinea dolomiaea Boiss	Google Toop	Asteraceae	WH	Powder, decoction	Roots	Orally	Back pain, gastritis	A decoction of root used as back pain and gastritis.
Justicia adhatoda L.	Baker	Acanthaceae	WS	Powder, ash	Whole plant	Orally	Cough asthma, bronchitis, dysentery diarrhea, phlegm, jaundice, diabetes, mouth sores, toothaches, tuberculosis and purify blood	Dried leaves powder for 5 days for adults, 1 tbs for 8 days A sweet preserve used for 10–15 days.
Lycopersicon esculentum Mill	Tamater	Solanaceae	CS	Juice, raw	Fruit	Orally, dermally	Liver disorder, skin lesions, achne	Eating fully-grown tomato for liver problems fresh tomato juice used directly on skin to sure skin diseases.
Mallotus philippensis (Lam.) Muell. Arg.	Kamiila	Euphorbiaceae	WT	Powder	Seeds	Orally	Constipation, intestinal worm	Dried seeds powder given to patients suffering from constipation and intestinal worms for children, ½ tsp for 2 days for adults 1 tsp for 6 days.
Malva parviflora L.	Sonchal	Lamiaceae	WH	Cooked	Leaves	Orally	Constipation, diabetes, cough	Fresh leaves cooked and given to patient suffering from constipation, cough, and diabetes for 3 days.
Melia azedarach L.	Daraak	Meliaceae	WT	Decoction, paste	Leaves	Dermally, orally	Eye disease, blood purification, diabetes, malaria fever, headache	Leaves decoction used for eye diseases, blood purification, diabetes, and malarial fever for children, 1 tsp and for adults, 2 tbs of for 8–10 days. Fresh leaves paste used for headaches and body swelling due to injury.
Mentha longifolia (L.) huds	Barina	Lamiaceae	WH	Tea, powder	Leaves	Orally	Vomiting, diarrhea, gastritis, acidity, indigestion, nausea cholera dysentery and stomache	(a) Fresh leaves tea for 4 days. (b) Dried leaves powder given to patient suffering from indigestion and vomiting for children ½ tbs for 2 days for adults 1 tbs of powder for 3 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Mentha royleana Benth.	Podina	Lamiaceae	WH	Tea, powder	Leaves	Orally	Vomiting, diarrhea gastritis, acidity, indigestion, cholera, dysentery, stomache, nausea and loss of appetite	(a) Fresh leaves adds in water and make tea and given to patients suffering from vomiting, diarrhea, gastritis, acidity, cholera, stomache, nausea, dysentery, and indigestion for 5 days. (b) Dried leaves powder given to patient suffering from indigestion and vomiting for children ½ tbs for 2 days for adults 1 tbs of powder for 3 days.
Momordica charantia L.	Kerala	Cucurbitaceae	CH	Juice, cooked	Fruit	Orally	Diabetes, earache	The fruit grinded and given to patient for children 2–3 tsp in ½ cup 6 days for adults 3–4 tsp for 10–15 days. Cooked *Momordica charantia* also use to cure these problems
Morchela esculenta L.	Guchi	Helviliaceae	F	Powder	Whole plant	Dermally	Wound healing	Dry morchela ground and make a powder the powder poured on wound for.
Morus alba L.	Toot	Moraceae	WT	Juice	Fruit	Orally	Throat problems, toothache	Fresh fruits juice given to the patient suffering from throat problem and toothache twice a day for two weeks both children and adults dried fruit eaten for the treatment of throat problem and anemia for children 3–4 fruit grain eaten with ½ cup of water for adults, 4–5 fruit grain for 5 days.
Morus nigra L.	Shah Toot	Moraceae	WT	Juice	Fruit	Orally	Throat problem, anemia	Fresh fruits crushed and given to the patient suffering from throat problem and toothache twice a day for two weeks both children and adults.
Myrsine africana L.	Khukun	Myrsinaceae	WS	Powder	Fruit	Orally	Jaundice	Dry fruits powder given to patient suffering from jaundice day for 5 days.
Nigella sativa L.	Kalvangi	Nigellaceae	CH	Raw, tea	Seed	Orally	Hypertension, heart disease	Seeds eaten in empty stomach at morning to cure hypertension heart patients given its extract/tea with juice as domestic therapy.
Ocimum basilicum L.	Babri	Lamiaceae	CH	Soaked	Seeds	Orally	Diarrhea, nausea, indigestion, stomache	2 tsp of Ocimum seeds soaked and given to patient suffering from diarrhea, indigestion stomache and nausea for adults 1 glass for 3–4 day for children 3–4 tsp 3–4 days.
Oenthera rosea L.	Aazta	Onagraceae	WH	Extract	Seed	Orally	Diabetes, snake bite, dog bite	Fresh plant material grounded for 10–15 minutes then added some water the bitter extract given patient of diabetes and on the attack of snake and dog bite.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Olea ferruginea Royle	Koi, Koh	Oleaceae	WT	Decoction, miswak, chewed	Leaves, twigs	Orally	Mouth sore, sore throat, bad tooth and mouth ulcer	Fresh leaves boiled and given to patients suffering from mouth sore, mouth ulcer, and throat sore for 4 days. For bad tooth, 6-inch young twigs cut with a knife daily and used as a toothbrush (miswak) for mouth sores and bad tooth.
Origanum vulgare L.	Benjamin	Lamiaceae	WH	Cooked	Leaves	Orally	Stomache, indigestion	Leaves cooked as vegetable and used raw as a salad. Leaves used to treat digestive problems.
Oxalis corniculata L.	Khatti Meethi	Oxalidaceae	WH	Extract	Whole plant	Orally, dermally	Stomache, liver inflammation, wound healing, and stop bleeding	Fresh plant material ground and used for 10 days Fresh material ground and then the paste applied to stop bleeding.
Paeonia emodi Wall. ex Royle	Mamakh	Paeoniaceae	WH	Paste	Tubers	Orally	Rheumatism, backaches	Dried tubers powder cooked in desighee used to cure rheumatism and backaches for 5 days.
Pinus roxburghii Sargent	Cheer	Pinaceae	WT	Infusion	Leaves	Orally	Chicken pox, tuberculosis	Fresh leaves ground and used for 5 days. Set under the tree for half hours and breathe in the air for the treatment of tuberculosis.
Pinus wallichiana A.B. Jackson	Biyar	Pinaceae	WT	Resin	Arial part	Orally	Intestinal worms	Resin mixed eaten, which useful for the expulsion of worms for children up to 7 days.
Pistacia chinensis (J.L. Stewart)	Kanger	Anacardiaceae	WT	Powder	Fruits	Orally	Cough	Dried fruit the powdered drug for 10 days.
Plantago lanceolata L.	Chamchi Patter	Plantaginaceae	WH	Paste	Leaves	Orally	Dysentery, phlegm	The leaves crushed and mixed with brown sugar that to cure dysentery and phlegm treatment.
Plantago ovata Forssk.	Chamchi Patter	Plantaginaceae	WH	Soaked	Seeds	Orally	Dysentery, phlegm	3 tbs of died seeds (soaked) used for 10–14 days.
Polygonum aviculare L.	Tarobra	Polygonaceae	WH	Powder	Leaves	Orally	Stomache, wound healing, piles	The powder of seeds used for the treatment dysentery. The decoctions of plant used for the treatment of wounds, bleeding, and piles. The juice of plant used externally to stop nose bleeding and sore throat.
Prunus amygdalus Batsch	Badam	Rosaceae	CT	Oil, raw	Seed	Orally, dermally	Baldness, poor memory	For hair loss, place a little almond oil on the skin of head and massage for 5–6 minutes 3–4 seeds eaten daily for treatment of poor memory.
Prunus armeniaca L.	Khobani	Rosaceae	CT	Soaked	Seed	Orally	Typhoid fever	Kernels of seeds put in water overnight at morning given to patient suffering from typhoid fever.
Prunus persica (L.) Batsch	Aroo	Rosaceae	CT	Extract	Leaves	Orally	Remove intestinal worm	Fresh leaves ground and given to patient for explosion of intestinal worms for adults not used.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Psidium guajava L.	Amrood	Myrtaceae	Cultivated tree	Raw	Fruit	Orally	Indigestion, constipation	Fresh fruit eaten as raw to cure the stomach problems and constipation both children and adults eat 1 fruit in a day for 5–6 days.
Pteridium aquilinum (L.) Kuhn	Kuta Kunji, Or Braken Fern	Pteridaceae	WH	Decoction	Rhizome	Orally	Diarrhea, sore throat, mouth sores, vomiting, dysentery, muscular pain, earache	Fresh rhizomes boiled used for 3 days.
Punica granatum L.	Daroon	Punicaceae	WS	Decoction, powder	Fruit	Orally	Diarrhea, dysentery, piles, diabetes intestinal worms, fever, whooping cough, indigestion stomach disorder, jaundice, vomiting, sore gums, toothache, purify blood and liver disorder	(a) Dried powder used for 8–10 days for sore gums and toothache, 1 tsp of powdered drug rubbed on teeth 2–3 times per day for 8–10 days. For whooping cough and sore gums, 1 tsp of powdered drug or dried rind crushed under teeth once daily at bedtime for 3–4 days.
Pyrus communis L.	Nashpati	Rosaceae	WT	Powder	Fruit	Orally	Cough	Dry fruit grounded and make powder the powder given to patient suffering from cough for children 1 tsp of powder 1 time in a day for adults 2–3 tsp in a day for 4–5 days.
Pyrus malus L.	Sabe	Rosaceae	CT	Juice	Fruit, flower	Orally	Deficiency of iron, anemia, heart problems	(a) Fruit ground for 5 minutes with 1 tbs of sugar the juice given to patient to fulfill the need of iron in blood and anemia eat raw apple in a day fresh flower petals gullkand for heart problem for 15–10 days.
Pyrus pashia Buch.-Ham. ex D. Don	Batangi	Rosaceae	WT	Raw	Fruit	Orally	Constipation	Fruit eaten as raw for the treatment of constipation.
Quercus incana Roxb.	Rein	Fagaceae	WT	Powder, paste	Bark, fruit	Dermally, orally	Dysentery, diarrhea, wound healing, broken bones, leucorrhea	(a) Dried bark in milk form paste used (b) Powder mixed with flour placed externally on wounds, and eats for dysentery, leucorrhea, and diarrhea.
Ranunculus laetus Wall.ex Hook. F.& Thoms	Chambel Booti	Ranunculaceae	WH	Paste	Leaves	Dermally	Eczema	Fresh leaves ground (malum) applied on infected parts and wounds for 3 days.
Raphanus raphanistrum L.	Moli	Brassicaceae	CH	Raw	Root	Orally	Jaundice	The fresh root eaten in a raw from for the treatment of jaundice.
Rheum australe D. Don	Chotiyal	Polygonaceae	WH	Powder	Root	Orally	Piles, asthma, stomache, gastritis	The root powder used for the treatment of piles, gastritis, and asthma and stomache for children 1 tsp in a day for adults 2 tsp in a day for 5 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Rosa chinensis Jacq.	Gulaab	Rosaceae	Cultivated shrub	Paste, infusion	Flower	Orally, eye	Constipation, eye diseases, leucorrhoea, heart problem	(a) Fresh flower petals gullkand prepared from constipation, leucorrhoea, and heart problem for 15–20 days. (b) Fresh petals of Rosa boiled in water then filter with filtration pot the rose water used to cure eye pain day for 5 days.
Rubus niveus thumb	Garachaa	Rosaceae	WS	Infusion	Root	Orally	Cough, sore throat	Dry root boiled in water then the infusion used for the treatment of cough and sore throat.
Rumex dentatus L.	Khatimbal	Polygonaceae	WH	Decoction	Whole plant	Orally, dermally	Cough, fever, asthma, wound healing, hepatitis b, wound cleaning	(a) Fresh roots sweet meal (halwa) given to patients suffering from cough, asthma, hepatitis-B and fever for children, 2 tsp of drug given for 3 days for adults, 5 tsp for 10 days. (b) Fresh plant material ground the paste applies on wound for healing and cleaning wounds.
Rumex hastatus D. Don, Prodr.	Hola	Polygonaceae	WH	Cooked, extract	Leaves	Orally, dermally	Constipation, remove prickle, wound healing, wound cleaning	Fresh leaves cook for 30 minutes eaten by patient suffering from constipation. Fresh leaves on the skin that affect form prickle for 5 minutes. Fresh leaves grounded for 5 minutes the extract of leaves use for cleaning wounds while the paste applies on wound for healing.
Sapindus mukorossi Gaertn.	Rantha	Sapindaceae	WT	Infusion	Fruit, seed	Dermally, orally	Dandruff, stomache, leucorrhea	Leaves grounded aqueous extract of leaves used for fever and gastritis problems for 3 days. Seed powder used for stomached.
Sarcococca saligna (D. Don)	Ban Sutra	Buxaceae	WH	Extract	Leaves	Orally	Fever, gastritis	Leaves grounded aqueous extract of leaves used for fever and gastritis problems for 3 days.
Saussurea costus (Falc.) Lipsch	Kuth	Asteraceae	WH	Powder	Root	Orally	Cough, toothache asthma	Dry roots grounded powder the powder use to backache, cure cough and asthma for children ½ tsp with 1 cup of water for 5 days for adults 1 tsp with one cup of water for 5 days.
Senecio chrysanthernoldes D. C	Bagoon	Asteraceae	WH	Extract	Leaves	Orally	Rashes, stomache cholera	Whole plant used in stomach disorders the extract of leaf mixed into water and employed on skin diseases and stomache in infants, and it good reliever against cholera too.
Sibbaldia procumbens L	Matri	Rosaceae	WH	Infusion	Whole plant	Orally	Gastritis, stomache	Fresh plant material boiled and given to patient suffering from gastritis and stomache for children ½ cup for adults 1 cup in day for 3–4 days.
Skimmia laureola (DC.) Sieb.	Naraa	Rutaceae	WH	Decoction	Leaves	Orally	Kidney pain, asthasms, stomache	Fresh leaves boiled and used for 6–7 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Solanum melongena L.	Bangan	Solanaceae	CH	Cooked	Fruit	Orally	Cholesterol	Fruit cooked in an oil with some sat added the take twice a day to lower the cholesterol level.
Solanum nigrum L.	Kachmach	Solanaceae	WH	Decoction	Leaves	Orally, dermally	Mouth sore, clean wounds, constipation	Fresh leaves boiled, then it filtered and use to clean wounds, mouth sores, and constipation. Half a cup of decoction applied 3–4 times per day for 6–7 days for mouth sores.
Spinacia oleracea L.	Palaak	Amaranthaceae	CH	Cooked, paste	Leaves	Orally	Blood purification, ANEMIA	The fresh leaves paste used orally with water for blood purification and Anemia the cooked Spinacia also used.
Syzygium aromaticum L.	Longe	Myrtaceae	CT	Raw	Seed	Orally	Toothache	1 dried cloves leave above the cavity around the damaged tooth.
Syzygium cumminii L.	Jamun	Myrtaceae	CT	Powder	Seed, fruits	Orally	Diabetes	Dried seeds ground for 5 minutes make powder the powder store in bottle and given to patient suffering from diabetes for children ½ tbs for adults 1tbs 2 times in a day for 10–15 days.
Taraxacum officinale Weber	Hand	Asteraceae	WH	Decoction	Rhizome	Orally	Jaundice, diabetes	Dried rhizomes boiled in water given to patients for 10–12 days.
Thlaspi arvense L.	Jangli	Brassicaceae	WH	Powder	Seed	Orally	Rheumatism	Seeds grounded for 10 minutes the powder for 3 days.
Thymus linearis Benth.	Chekal	Lamiaceae	WH	Powder	Flower	Orally	Gastrirus, menstrual pain	Dry flower grounded for 10 minutes the powder used for 3 days.
Trachyspermum ammi (L.)	Ajwain	Apiaceae	CH	Powder, tea	Seeds	Orally	Kidney stone, indigestion, cough, appetizers, gastric problems	Seeds dry leaves of *Mentha longifolia*, ground together make a powder given to patient suffering from stomache, appetizer, cough, kidney stone, and gastric problems and for appetizers. For children ½ tbs for 2 days for adults 1 tbs of powder with one day for 3 days.
Triticum aestivum L.	Ghandam	Poaceae	CH	Powder	Seeds	Orally	Stomach pain, lose motion	Wheat grains powdery mass called nashashta given to patient suffering from stomach pain and loss motion.
Viburnum grandiflorum Wall.ex DC.	Guch	Caprifoliaceae	WS	Juice	Fruit	Orally	Stomache, blood purification	Fruit juice for the treatment of stomache and blood purification for children ½ cup in a day for 3 days for adults 1 cup in a day for 4–5 days.

Table 2 Continued

Plant name	Local name	Family	Habit	Mode of use	Part used	Route of use	Diseases cure	Ethnomedicinal uses
Viola canescens Wall.ex Roxb.	Gullnaksh	Violaceae	WH	Infusion	Whole plant	Orally	Cold, cough, asthma, jaundice, headache, sore throat, toothache	Infusion of plant material used 4–5 days.
Vitex negundo L.	Marvani	Verbinaceae	WT	Powder	Seeds	Orally	Gas trouble, cholera stomache	Dried seeds powder used for 4 days.
Vitis vinifera L.	Anghor (Monaka)	Vitaceae	Cultivated climber	Raw	Fruit	Orally	Pneumonia	Dry fruit eaten as raw for the treatment of pneumonia for children 1 fruit in one time a day for 3–4 days for adults 2–3 fruit in a day for 4–5 days.
Woodfordia fruticosa (L.) S. Kurz	Thavii	Lythraceae	WH	Powder	Flower	Orally	Diarrhea, vomiting, wound healing, menstrual disturbance, leucorrhea	Powder given used for 4 days. Dried flowers powder with sugar make halwa in ghee used for 3 days.
Xanthium strumarium L.	Mota Kanda	Asteraceae	WH	Powder	Seeds	Orally	Asthma	Dry seeds of powder used for 7–8 days.
Zanthoxylum armatum DC, Prodr.	Timber	Rutaceaea	WS	Powder, miswak	Fruit, twig	Orally	Gastritis, cholera, bad tooth, indigestion, mouth sore, toothache, mouth ulcer and stomache	(a) Dried fruit ground for 8 minutes. The powder used for 5 days. (b) For mouth sores, bad tooth, and toothache, 6-inch young twigs cut with a knife daily and used as a toothbrush (miswak).
Zea mays L.	Maaki	Poaceae	CH	Decoction, powder	Flower	Orally, dermally	Kidney pain, kidney stone, urinary disorder, and remove pus from wound	Decoction of stigma used for 3 days. (b) Old resident stem (koli) rubbing on stone the powder directly apply on skin (phora) to remove pus form them.
Zingiber officinale Roscoe	Adrak	Zingiberaceae	CH	Tea	Rhizome	Orally	Cold, cough, nausea	A tea is prepared by pouring boiling water over of the coarsely powdered ginger and stained taken to prevent vomiting, cough, and nausea.
Zizyphus numalaria L.	Bari	Rhamnaceae	WS	Powder	Fruit	Orally	Constipation	Dried fruit is ground into powder and given for 3 days.
Zizyphus oxyphylla Edgew.	Pithni	Rhamnaceae	WS	Decoction	Roots	Orally	Mouth sore, skin disease (lesion), earache, high blood pressure	Fresh roots boiled given to patients suffering from mouth sores, skin lesions, earache, and high blood pressure for children, 1–2 tbs o for 4–5 days for adults 3–4 tsp for 8–10 days.

WT: wild tree; WH: wild herb; CT: cultivated tree; CH: cultivated herb; WS: wild shrub; CV: cultivated vegetables; Wc: wild clumber; CS: cultivated shrub.

Table 3 Informant consensus factor of frequently reported diseases categories in village Lowasi, Kimanja, and Pathyali of Jhelum Valley

Disease categories	Lowasi			Kimanja			Pathyali		
	Nur	NT	ICF	NUr	NT	ICF	NUr	NT	ICF
Digestive disorder	104	51	0.51	107	52	0.52	105	51	0.52
Respiratory disorder	35	20	0.44	34	24	0.3	33	23	0.31
Cardiovascular disorder	13	11	0.17	18	15	0.18	14	12	0.15
CNS disorder	2	2	0.0	2	2	0.0	1	1	0.0
Musculoskeletal disorder	16	12	0.27	19	14	0.28	20	15	0.26
Urinogenital disorder	24	15	0.39	28	17	0.41	23	15	0.36
Anti-dot disorder	6	4	0.4	6	4	0.4	6	5	0.2
Hepatic disorder	13	12	0.1	20	17	0.1	17	17	0.0
Opthalmentic disorder	8	7	0.14	9	7	0.25	11	8	0.3
Hyperglycemia disorder	24	20	0.14	16	15	0.07	15	14	0.07
ENT disorder	15	13	0.14	14	11	0.23	13	11	0.17
Dental disorder	12	9	0.27	10	8	0.22	12	9	0.27
Skin disorder	33	24	0.28	31	23	0.27	28	21	0.26
Others disorder	29	22	0.25	29	23	0.21	28	20	0.3

Nur: total of usage reports; NT: number of taxa used for disease category; ICF: informant consensus factor; CNS: central nervous system; ENT: eye nose throat.

Table 4 Fidelity level of medicinal plants, plants reported frequently for major diseases treatment of Jhelum Valley

Major disease treated	Lowasi			Kimanja			Pathyali		
	Ethnomedicinal plants	N	FL	Ethnomedicinal plants	N	FL	Ethnomedicinal plants	N	FL
Digestive disorder	*Mentha royleana*	24	100	*Mentha royleana*	24	100	*Mentha royleana*	24	100
Respiratory disorder	*Justicia adhatoda*	17	71	*Trachyspermum ammi*	19	79	*Viola canescens*	18	75
Cardiovascular disorder	*Justicia adhatoda*	19	79	*Pyrus malus*	19	79	*Pyrus malus*	19	79
CNS disorder	*Prunus amygdalus*	18	75	*Prunus amygdalus*	16	67	*Prunus amygdalus*	16	67
Musculoskeletal disorder	*Brassica rapa*	16	67	*Berberis lyceum*	17	71	*Berberis lycium*	19	79
Urinogenital disorder	*Cucumis sativus*	15	63	*Zea mays*	17	71	*Geranium wallichianum*	20	83
Anti-dot disorder	*Ficus carica*	17	71	*Ficus carica*	17	71	*Rumex dentatus*	18	75
Hepatic disorder	*Raphanus sativus*	17	71	*Raphanus sativus*	17	71	*Berberis lycium*	17	71
Hyperglycemia disorder	*Citrus limon*	19	79	*Citrus limon*	19	79	*Citrus limon*	20	83
ENT disorder	*Artemisia vulgaris*	18	75	*Artemisia vulgaris*	18	75	*Artemisia vulgaris*	18	75
Dental disorder	*Olea ferrugine*	19	79	Olea ferruginea	19	79	*Juglans regia*	20	83
Skin disorder	*Curcuma longa*	16	67	*Curcuma longa* L.	16	67	*Brassica rapa*	16	67
Others disorder	*Rumex hastatus*	16	67	*Cannabis sativa*	17	71	*Pinus wallichiana*	17	71
Opthalmentic disorder	*Rosa chinensis*	18	75	*Rosa chinensis*	18	75	*Geranium wallichianum*	17	71

N: number of respondent; FL: fidelity level; CNS: central nervous system; ENT: eye nose throat.

Pyrus communis, *Datura anoxia*, *Paeonia emodi*, *Aconitum chasmanthum*, etc. recorded in all studied areas had lowest TV. The species *R. laetus*, only recorded in Lowasi and have only one use report for the treatment of Eczema (chambel), *A. chasmanthum* display low CV, PV and EV in Kimanja they had CV but shown less economic and TV due to PV. In village Pathyali *A. chasmanthum,* displayed diminutive CV and PV but they display EV (4) and so have moderate TV (4.17). *Pyrus communis* represented low practical, economic, and TV as they had low CV only recorded for the treatment of cough (Fig. 3).

Route of administration and mode of utilization of plant

Modes of utilization were grouped into seventeen different well defined categories. Powder (43 reports) was the leading mode of remedial preparation in all three localities followed by decoction (20 reports), paste and raw used (15 reports each). Infusion (10 reports), juice (10 reports), extract (11 reports), tea (9) were also the mode of usage recorded from Jhelum Valley. Remaining mode of remedial preparation oil, chewed, milk, pulp, resin, miswak, ash, cooked, soaked and milk were shared by three or less than three plants (Fig. 4).

Quantitative ethno botanical data

A total of 129, ethno medicinal species were used to cure 89 different diseases. The 73 plant species were reported from Pathyali, 71 from Kimanja, and 58 from Lowasi. Forty-three species reported during studies showed 1 use, twenty-nine species showed 2 uses, twenty-one species 3 uses, and twelve species showed more than three use reports.

Fig. 3 Wild plants used traditional vegetable in study area. (A) *Mentha longifolia* leaves used as paste (chutney), (B) *Ficus palmate* leaves cooked as curry, (C) *Buhunia variegata* flowers and leaves cooked as vegetable and (D) *Nasturtium officinale* cooked as vegetable (neeli sabzi).

Family importance value

The collected data showed Lamiaceaea and Saxifragaceae were dominant families with 100% FIV value while Lythraceae (33.33%), Myrsinaceae (37.50%) and Buxaceae (37.50%) showed least FIV value in all of studied areas of Jhelum Valley (Table 5).

Consensus values for plant part

The values of consensus values for plant part (CPP) range from 0.01 to 0.25. Total fourteen plant parts such as leaves, roots, fruit, twigs, rhizome, bark, bulb, flowers, seeds, corms, arial parts, pods, tubers, and whole plant that were used as ethno medicinal. Leaves were the dominant plant part with 0.23 CPP values followed by fruit (0.22). The remaining parts twig, pods, Arial part, corm; bulb denotes denoted low CPP value. In three, different localities of study areas were representing little bit alteration in values (Table 6).

Relative frequency of citation

In present study, the value of frequency citation was found in the range between 0.3–1. Maximum value of RFC verified for *Mentha royleana* (1.00) followed in *Brassica rapa*, *Citrus limon*, *Zanthoxylum armatum*, *Bergenia ciliata,* and *Mentha longifolia*. The least vale of RFC in all studied areas of Jhelum Valley recorded for *Woodfordia fruticosa*, *Acacia modesta* (0.38 each), *Myrsine africana*, and *Sarcococca saligna* (0.4 each) (Table 7).

Jaccard's index

The results described in this our research were associated with 21 previous studies conducted in different surrounding areas of Azad Jammu and Kashmir, Gilgit Baltastan and Pakistan (Table 8). The data showed that across 129 species of plants, similarity index of the data 51.28 to 7.93 whereas the variation fraction varies from 21.53 to 4.76. The maximum level of similarity such as 54.51%, 52.33%, 47.50%, and 44.16% was found with studies by Amjad et al. (2020), Hussain et al. (2018b), Aftab et al. (2023), and Niyaz et al. (2023), respectively. The highest degree of similarity index was found in the study of Amjad et al. (2020), which revealed the same ethnic values and the same type of vegetation and topography of both areas. Moreover, there may have been historical cultural contact between the indigenous populations and this is why the ethnobotanical results of both areas are comparable (Amjad et al. 2020). *Achyranthes aspera*, *Justicia adhatoda*, *Malva parviflora*, and *Pistacia chinensis*from various Districts of Azad Jammu and Kashmir were reported with similar uses. This was a reflection of the similar climates

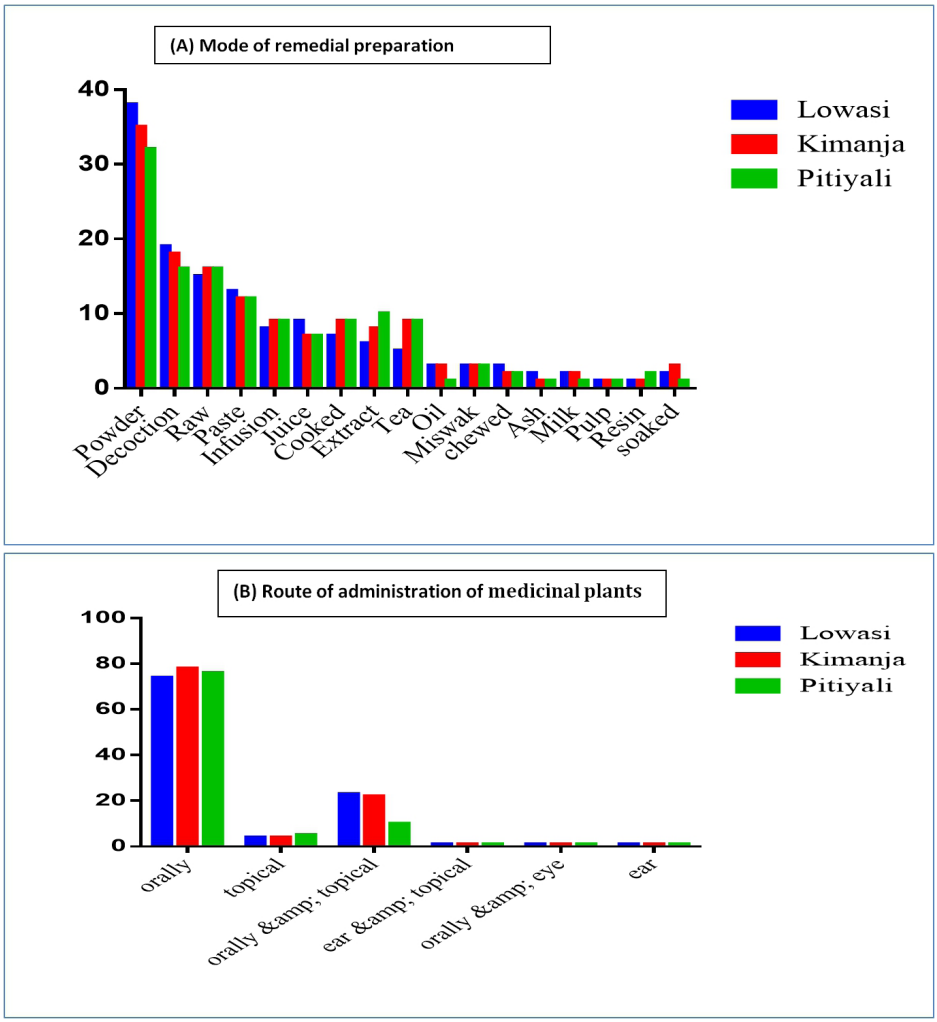

Fig. 4 (A) Mode of remedial preparation, (B) route of administration of medicinal plants.

in the surrounding places as well as the plants' strong flexibility to grow at different elevations and in diverse biological zones (Ahmad and Pieroni 2016). The minimum JI value was recorded for the work conducted by Hussain et al. (2023) (2.17) in western Himalayas Azad Jammu and Kashmir (Islam et al. 2021), in Palas Valley, Indus Kohistan, Pakistan (9.33) (Shuaib et al. 2021), and District Buner, Pakistan (12.32) (Table 8).

Novel uses

The comparative study of current findings with reported research revealed some novel uses which were not reported earlier from this region. These include *Arisaema utile* powder of tubers applied on skin for lesion and pimple. Dried leaves powder of *Cedre latoona*used against blood disorder, pimple, hepatic disorder and stomach problem. Leaves extract of *Cestrum nocturnum* for epilepsy. *Citrus aurantium* fruit eaten as a raw form to treat the jaundice. Fruit of *C. limon* used against hypertension, vomiting, cholera, fever, and skin tonic. Fruit of *Citrus maxima* eaten by the patient in a raw form for the treatment of heart and diabetes problems. *Cotinus coggyria* paste of leaves and flowers used in skin diseases and orally used for the treatment of fever and anemia. *Cucumis sativus* fruit used to treat dyspepsia and diuretic problems. *Ipomea nil* seed powder used to cure constipation and kill intestinal worms. *Raphanus raphanistrum* fresh roots are eaten in a raw form for the treatment of jaundice. *Saussureacostus* dry roots grinded powder use to backache, cure cough and asthma. *Sibbaldia procumbens* fresh plant material is boiled and given to patient suffering from gastritis and stomache. *Woodfordia fruticosa* flower powder used against Diarrhea, vomiting, wound healing, menstrual disturbance.

This discrepancy in ethno botanical knowledge could be caused by an ecological barrier that isolates a species geographically and diversity in vegetation and habitats (Kayani et al. 2015). Researchers have discovered that, in addition to habitat isolation and variations in vegetation type, informant age, sex, educational attainment, and origin all affect how well-versed in ethno botany they are (Beltrán-Rodríguez et al. 2014). These results suggest that geographic isolation among communities has a significant impact on changes in the type of vegetation and the alteration of cultural knowledge, and that this may be the reason why ethno botanical knowledge disappearing.

Table 5 Family importance value of village Lowasi, Kimanja, and Pathyali

Sr. no.	Plant families	Lowasi		Kimanja		Pathyali	
		FC	FIV	FC	FIV	FC	FIV
1	Acanthaceae	17	70.83	-	-	-	-
2	Adiantaceae	12	50.00	13	54.17	14	58.33
3	Alliaceae	15	62.50	16	66.67	17	70.83
4	Anacardiaceae	12	50.00	14	58.33	-	-
5	Araceae	11	45.83	11	45.83	14	58.33
6	Araliaceae	13	54.17	13	54.17	17	70.83
7	Asclepidaceae	12	50.00	12	50.00	-	-
8	Asteraceae	22	91.67	22	91.67	22	91.67
9	Cannabinaceae	15	62.50	17	70.83	-	-
10	Chenopodiaceae	10	41.67	13	54.17	15	62.50
11	Cyperaceae	9	37.50	13	54.17	16	66.67
12	Euphorbiaceae	14	58.33	14	58.33	-	-
13	Fumariaceae	16	66.67	17	70.83	17	70.83
14	Fagaceae	12	50.00	12	50.00	16	66.67
15	Liliaceae	16	66.67	12	50.00	12	50.00
16	Lythraceae	8	33.33	-	-	-	-
17	Meliaceae	15	62.50	16	66.67	14	58.33
18	Mimosaceae	15	62.50	15	62.50	12	50.00
19	Moraceae	17	70.83	17	70.83	17	70.83
20	Nigellaceae	15	62.50	15	62.50	13	54.17
21	Nyctaginaceae	13	54.17	13	54.17	13	54.17
22	Paeoniaceae	13	54.17	14	58.33	15	62.50
23	Pinaceae	14	58.33	17	70.83	17	70.83
24	Plantaginaceae	16	66.67	16	66.67	17	70.83
25	Poaceae	17	70.83	18	75.00	18	75.00
26	Pteridaceae	13	54.17	14	58.33	18	75.00
27	Punicaceae	18	75.00	15	62.50	-	-
28	Ranunculaceae	9	37.50	15	62.50	17	70.83
29	Rhamnaceae	11	45.83	-	-	-	-
30	Rutaceae	22	91.67	22	91.67	20	83.33
31	Saxifragaceae	17	70.83	23	95.83	24	100
32	Verbinaceae	12	50.00	-	-	-	-
33	Violaceae	14	58.33	19	79.17	20	83.33
34	Amaranthaceae	15	62.50	16	66.67	16	66.67
35	Apiaceae	19	79.17	22	91.67	18	75.00
36	Balsaminaceae	-	-	-	-	15	62.50
37	Bereridaceae	15	62.50	21	87.50	22	91.67
38	Boraginaceae	-	-	14	58.33	14	58.33
39	Brassicaceae	23	95.83	17	70.83	22	91.67
40	Buxaceae	-	-	-	-	9	37.50
41	Caprifoliaceae	-	-	13	54.17	17	70.83
42	Convolvulaceae	11	45.83	12	50.00	14	58.33
43	Cucurbitaceae	15	62.50	16	66.67	16	66.67
44	Gereniaceae	-	-	18	75.00	18	75.00
45	Helviliaceae	10	41.67	13	54.17	15	62.50
46	Hippodastenaceae	11	45.83	16	66.67	17	70.83
47	Juglandaceae	18	75.00	22	91.67	20	83.33
48	Lamiaceae	24	100	24	100	24	100
49	Myrsinaceae	-	-	9	37.50	15	62.50
50	Myrtaceae	18	75.00	18	75.00	18	75.00
51	Oleaceae	19	79.17	19	79.17	17	70.83
52	Oxalidaceae	14	58.33	16	66.67	17	70.83
53	Polygonaceae	16	66.67	17	70.83	17	70.83
54	Rosaceae	19	79.17	19	79.17	19	79.17
55	Rubiaceae	-	-	10	41.67	10	41.67
56	Simaroubaceae	11	45.83	15	62.50	15	62.50
57	Solanaceae	15	62.50	16	66.67	16	66.67
58	Sapindaceae	14	58.33	14	58.33	-	-
59	Vitaceae	14	58.33	15	62.50	15	62.50
60	Zingiberaceae	20	83.33	20	83.33	22	91.67
61	Papilionaceae	14	58.33	15	62.50	17	70.83
62	Onagraceae	-	-	-	-	12	50.00
63	Cuscutaceae			14	58.33	12	50.00

Apply statistical tools on data.
FC: total number of respondents mention the family; FIV: family importance value.

Table 6 Consensus values for plant part in all study areas of Jhelum Valley

Sr. no.	Plants parts	Lowasi		Kimanja		Pathyali	
		PX	CPP	PX	CPP	PX	CPP
1	Leave	26	0.23	29	0.25	29	0.25
2	Fruit	25	0.22	23	0.19	19	0.16
3	Root	8	0.07	13	0.11	12	0.10
4	Flower	5	0.04	5	0.04	5	0.04
5	Bark	3	0.03	4	0.03	2	0.02
6	Seed	15	0.13	15	0.13	16	0.14
7	Rhizome	6	0.05	6	0.05	6	0.05
8	Bulb	1	0.01	1	0.01	1	0.01
9	Corm	1	0.01	1	0.01	1	0.01
10	Arial part	1	0.01	2	0.02	3	0.03
11	Tubers	2	0.02	2	0.02	2	0.02
12	Pods	1	0.01	1	0.01	1	0.01
13	Whole plant	16	0.14	15	0.13	16	0.14
14	Twig	1	0.01	2	0.02	2	0.02

PX: total time plant part cited; CPP: consensus values for plant part.

Discussion

Semi-structured discussions with 72 informants provided base line data, with equal ratio of male and female informants (Chaudhary et al. 2001; Enyew et al. 2014; Friedman et al. 1986). The informants gained this knowledge from their dynasties and others family members (Ghorbani 2005). This study showed illiteracy triggered excessive damaged ethnobotanical flora of region. Rosaceae was dominating family followed by Moraceae, Euphorbiaceae, Mimosaceae, Pinaceae, and Rhamnaceae. Similar findings were reported by (Ghorbani et al. 2011; Giday et al. 2010). The flora was dominating by herbaceous species followed by trees, shrubs, fungi and climber as easily collected from fields. Godoy et al. (2002, 2006), Giday et al. (2009, 2010) reported comparable data as herbaceous species used more frequently. The mode was the oral route of administration, which in agreement with previous ethnobotanical studies (Godoy et al. 2002). The medicinal species widely used as traditional medicine in these regions for treating skin diseases, kidney and urinary system, hyperglycemia, digestive system including stomach and intestinal pain and inflammation, liver diseases, respiratory system and coughing, cardiovascular disorder and for muscular problems were recorded in all three sites. The present studies publicized that *Xanthium strumarium*, *Prunus persica*, *A. utile*, *R. laetus* used under the direction of homoeopaths otherwise; they may cause serious effect or damage. For example the seed powder, of *X. strumarium*, use to cure asthma, however varied concentrations and dosage can cause serious problems.

The study directed by Khan et al. (2018) highest value of family importance was recorded for Asclepidaceae followed by Punicaceae and least value documented for Papilionaceae, Myrtaceae, and Lamiaceae. The current data result was contrary as quantitative data shown fluctuation due to different climatic zones (Khan et al. 2015). Different parts of plants were recorded through which leaves most frequently used individually (Lee et al. [2008], Mahmood and Mahmood [2012], and Khan et al. [2015] also reported comparable results). The preference of leaves make sure the plant sustainability and to prevent extinction (Mahmood et al. 2012; Monteiro et al. 2006).

UV ranged from 5.92–0.38 of the 129-reported ethnomedicinal species, were identified with UV greater than (5.00) *M. longifolia*, *Berberis lyceum*, *Rheum australe*, *Zanthoxylum alatum*, *Pteridium aquilinum*, *Geranium wallichianum*, and *R. laetus*. Similar result establish by (Mahmood and Mahmood 2012) UV greater than (0.55), recorded for *Foeniculum vulgare*, *Ajuga bracteosa*, *M. longifolia*, *Artemisia vulgaris*, *Solanum nigrum*, *Z. alatum*, *Hedera nepalensis*, *Fumaria indica*, *Olea ferruginea*, and *B. lyceum*. Related data also composed by (Reyes-García et al. 2006). The RFC value ranged from 1.00–0.33. The maximum RFC value calculated for *M. longifolia*, *Z. alatum*, *Juglans regia*, and *Taraxacum officinale* in three different localities. Khan et al. (2018) reported maximum RFC for *A. asper* and *Calatropis procera*. It gives an idea about which plants should be taken for detailed study in future for the photochemistry of important medical compounds (Shaheen et al. 2015).

Fidelity of species indicates the popularity of specific diseases in the study area. The maximum FL medicinal plant indicates uniqueness to treat certain major disorder of human body (Shil et al. 2014). The FL of plant species for treating specific diseases in the study areas varies (33% to 100%) in all three-study areas. Result shows that *M. royleana* (vomiting) having maximum FL (100%), all studied areas. The recognized plants as more important, as having (80%) FL or more in accordance with FL results (6) plant species in Lowasi, (13 species) in Pathyali (above 80%), (11 species) in Kimanja shown high (FL) percentage mostly

Table 7 Classification of plants on quantitative measures of relative importance

Plants name	Lowasi site					Kimanja site					Pathyali site				
	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK
Abies pindrow Royle	-	-	-	-	-	54	6	0.5	0.5	54	54	11	1.1	0.5	54
Acacia modesta Wall	63	63	1.3	0.3	33	58	19	-	-	-	58	23	-	-	-
Acacia nilotica L.	63	63	4	0.6	63	58	19	1.2	0.6	58	58	23	4	0.5	58
Achillea millefolium L.	58	6	0.6	0.6	58	63	7	0.6	0.6	63	92	9	0.9	0.9	92
Achyranthes aspera L.	50	22	1.8	0.5	50	58	32	2.8	0.6	58	63	31	2.8	0.6	63
Aconitum chasmanthum Stapf.ex Holmes	38	8	0.8	0.4	38	54	18	1.6	0.5	54	67	20	1.8	0.7	67
Aconitum heterophyllum Wall.ex Royle	50	11	1	0.5	50	63	14	1.2	0.6	63	71	14	1.4	0.7	71
Adiantum capillus-veneris L.	50	22	1.8	0.5	50	54	30	2.5	0.5	54	58	29	2.7	0.6	58
Aesculus indica Wall ex.camb.	46	5	0.5	0.5	46	67	15	1.3	0.7	67	71	7	0.7	0.7	71
Ailanthus altissimus (Mill.) Swingle	46	10	0.9	0.5	46	63	14	1.2	0.6	63	63	13	1.2	0.6	63
Ajuga bracteosa Wall., ex Benth	58	45	3.5	0.6	58	58	45	3.9	0.6	58	83	58	4.5	0.8	83
Allium cepa L.	67	30	2.3	0.7	67	67	30	2.3	0.7	67	71	28	2.5	0.7	71
Allium sativum L.	63	28	2.1	0.6	63	63	28	2.3	0.6	63	63	25	2.4	0.6	63
Aloe vera L.	67	59	3.9	0.7	67	50	44	3.9	0.5	50	38	8	0.4	0.8	38
Amaranthus viridis L.	58	19	1.5	0.6	58	67	22	1.9	0.7	67	67	27	2.5	0.7	67
Anethum graveolens L.	54	18	1.5	0.5	54	67	30	2.4	0.7	67	67	27	2.4	0.7	67
Arisaema utile Hook.f.ex Schott	46	20	1.5	0.5	46	46	20	2	0.5	46	58	23	2	0.6	58
Arnebia benthamii (Wall. ex G. Don)	-	-	-	-	-	58	26	2.1	0.6	58	58	18	1.6	0.6	58
Artemisia vulgaris L.	92	10	0.9	0.9	92	75	8	0.8	0.8	75	75	8	0.8	0.8	75
Berberis lycium Royle in Trans. L.	63	63	4.3	0.6	63	88	88	5.3	0.9	88	92	92	5.7	0.9	92
Bergenia ciliata (Haw.) Sternb.	75	50	3.6	0.7	75	96	64	3.9	1	96	100	100	5.7	1	100
Bistorta amplexicaulis (D. Don)	-	-	-	-	-	67	15	1.3	0.7	67	71	21	2	0.7	71
Boerhavia procumbens Banks ex Roxb.	54	12	1	0.5	54	54	12	1	0.5	54	54	11	1.1	0.5	54
Brassica rapa L.	96	53	2.9	1	96	71	47	3.1	0.7	71	92	55	3.4	0.9	92
Calotropis procera (Wild) R. Br.	50	28	2	0.5	50	50	28	2.3	0.5	50	-	-	-	-	-
Cannabis sativa L.	63	14	1.1	0.6	63	71	16	1.3	0.7	71	-	-	-	-	-
Cedrela toona Roxb. ex Willd.	58	32	2.6	0.6	58	58	32	2.6	0.6	58	-	-	-	-	-
Cedrus deodara (Roxb. ex D. Don)	-	-	-	-	-	-	-	-	-	-	63	13	1.3	0.6	63
Cestrum nocturnum L	46	10	0.9	0.5	46	-	-	-	-	-	-	-	-	-	-
Chenopodium ambrosioides L.	42	9	0.8	0.4	42	54	24	2	0.5	54	63	25	2.3	0.6	63
Cichorium intybus L.	54	24	2	0.5	54	-	-	-	-	-	-	-	-	-	-
Citrus aurantium Var. Dulcis L.	63	14	1.1	0.6	63	63	14	1.1	0.6	63	63	13	1.1	0.6	63
Citrus limon (L.) Burm.	92	71	4.2	0.9	92	96	53	3.3	1	96	83	42	3.2	0.8	75

Table 7 Continued

Plants name	Lowasi site					Kimanja site					Pathyali site				
	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK
Citrus maxima (Burman) Merrill	67	22	1.8	0.7	67	67	22	1.9	0.7	67	-	-	-	-	-
Coriandrum sativum L.	63	14	1.2	0.6	63	63	28	2.4	0.6	63	54	16	1.6	0.5	54
Cotinus coggyria Scop.	-	-	-	-	-	46	15	1.4	0.5	46	46	14	1.4	0.5	46
Cucumis sativus L.	63	21	1.8	0.6	63	63	21	1.8	0.6	63	63	19	1.8	0.7	63
Curcuma longa L.	83	56	3.7	0.8	83	83	56	3.7	0.8	83	92	55	3.8	0.9	92
Cuscuta reflexa Roxb.	-	-	-	-	-	50	6	0.5	0.5	50	63	6	0.6	0.6	63
Cynodon dactylon (L.) Pers	54	12	1.1	0.5	54	54	12	1.1	0.5	54	54	11	1.3	0.5	54
Cyperus rotundus L.	38	13	1	0.4	38	54	24	1.9	0.5	54	67	33	2.9	0.7	67
Datura innoxia Miller	50	11	1	0.5	50	54	12	1.1	0.5	54	63	13	1.3	0.6	63
Daucus carota L.	67	22	1.8	0.7	67	67	15	1.2	0.7	67	67	20	1.8	0.7	67
Dodonaea viscosa L.	50	11	1	0.5	50	-	-	-	-	-	-	-	-	-	-
Duchesnea indica (Andrews) Focke	58	19	1.7	0.6	58	58	19	1.7	0.6	58	58	18	1.7	0.7	58
Eriobotrya japonica (Thunb.) Lindl	50	11	1	0.5	50	-	-	-	-	-	-	-	-	-	-
Euphorbia helioscopia L.	58	19	1.8	0.6	58	58	19	1.8	0.6	58	-	-	-	-	-
Ficus carica Forssk.	71	16	1.4	0.7	71	71	16	1.4	0.7	71	71	14	1.3	0.7	71
Foeniculum vulgar Mill	71	16	1.4	0.7	71	71	16	1.4	0.7	71	71	21	1.8	0.7	71
Fragaria nubicola Landle ex Lacaita	-	-	-	-	-	54	6	-	0.5	54	63	6	0.6	0.6	63
Fumaria indica (Hausskn.) Pugsley	67	22	1.9	0.7	67	71	16	-	0.7	71	71	14	1.3	0.7	71
Galium aparine L.	-	-	-	-	-	54	24	2	0.5	54	42	8	0.8	0.4	42
Geranium wallichianum D. Don	-	-	-	-	-	75	50	3.8	0.8	75	83	58	5.1	0.8	83
Hedera nepalensis K. Koch, Hort.	54	6	0.5	0.5	54	54	6	0.6	0.6	54	71	7	0.7	0.7	71
Impatiens edgeworthii Hook.	-	-	-	-	-	-	-	-	-	-	63	13	1.2	0.6	63
Indigofera heterantha Wall. ex Baker	58	13	1.2	0.6	58	63	14	-	0.6	63	71	14	1.3	0.7	71
Ipomea nil (L.) Roth	46	10	0.9	0.5	46	54	12	1.1	0.5	54	58	12	1.1	0.6	58
Isodon rugosus Wall. Ex	-	-	-	-	-	46	5	-	0.5	46	46	5	0.5	0.5	46
Juglans regia L.	75	25	1.9	0.8	75	92	41	-	0.9	92	83	25	2	0.8	83
Jurinea dolomiaea Boiss	-	-	-	-	-	58	13	-	0.6	58	63	13	1.3	0.6	63
Justicia adhatoda L.	71	71	4.7	0.7	71	-	-	-	-	-	-	-	-	-	-
Lycopersicon esculentum Mill	63	21	1.8	0.6	63	67	22	1.8	0.7	67	67	20	1.8	0.7	67
Mallotus philippensis (Lam.) Muell. Arg.	42	9	0.8	0.4	42	-	-	-	-	-	-	-	-	-	-
Malva parviflora L.	42	9	1	0.4	42	54	18	1.4	0.5	54	58	12	1	0.6	58
Melia azedarach L.	63	35	1.3	0.7	63	67	37	2.9	0.7	67	58	12	1.1	0.6	58
Mentha longifolia (L.) huds	92	81	4.7	0.9	92	88	78	5.1	0.9	88	96	77	4.8	1	96

Table 7 Continued

Plants name	Lowasi site					Kimanja site					Pathyali site				
	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK
Mentha royleana Benth.	100	100	5.3	1	100	100	100	5.9	1	100	100	100	5.7	1	100
Momordica charantia L.	63	14	1.3	0.6	63	67	15	1.3	0.7	67	67	20	1.7	0.6	67
Morchela esculenta L.	42	5	0.4	0.4	42	54	6	0.5	0.5	54	63	13	1.2	0.6	63
Morus alba L.	63	14	1.1	0.6	63	-	-	-	-	-	-	-	-	-	-
Morus nigra L.	63	14	0.1	0.5	63	-	-	-	-	-	-	-	-	-	-
Myrsine africana L.	-	-	-	-	-	38	8	0.8	0.4	38	63	6	0.6	0.6	63
Nigella sativa L.	63	14	1.2	0.6	63	63	14	1.2	0.6	63	54	11	1.1	0.5	54
Ocimum basilicum L.	67	15	2.5	0.7	67	63	28	2.4	0.6	63	50	15	1.5	0.5	50
Oenthera rosea L.	-	-	-	-	-	-	-	-	-	-	58	18	-	0.6	58
Olea ferruginea Royle	79	35	2.2	0.8	79	79	35	2.5	0.8	79	71	28	-	0.7	71
Origanum vulgare L.	-	-	-	-	-	50	11	1	0.5	50	46	9	-	0.5	46
Oxalis corniculata L.	58	26	2	0.6	58	67	30	2.4	0.7	67	71	28	2.5	0.7	71
Paeonia emodi Wall. ex Royle	54	12	1	0.5	54	58	13	1.1	0.6	58	63	13	1.2	0.6	63
Pinus roxburghii Sargent	58	6	0.6	0.6	58	71	16	1.2	0.7	71	63	19	1.8	0.6	63
Pinus wallichiana A.B. Jackson	54	6	0.5	0.5	54	63	7	0.6	0.6	63	71	7	0.7	0.7	71
Pistacia chinensis (J.L. Stewart)	50	11	1	0.5	50	58	19	1.7	0.6	58	-	-	-	-	-
Plantago lanceolata L.	-	-	-	-	-	67	15	1.3	0.7	67	71	14	1.4	0.7	71
Plantago ovata Forssk.	67	15	1.3	0.7	67	67	15	1.3	0.7	67	71	14	1.4	0.7	71
Polygonum aviculare L.	-	-	-	-	-	46	5	0.5	0.5	46	42	4	0.4	0.4	42
Prunus amygdalus Batsch	75	17	1.3	0.8	75	67	15	1.3	0.7	67	67	13	1.3	0.7	67
Prunus armeniaca L.	-	-	-	-	-	54	6	0.5	0.5	54	-	-	-	-	-
Prunus persica (L.) Batsch	42	5	0.4	0.4	42	54	6	0.6	0.5	54	54	5	0.5	0.5	54
Psidium guajava L.	75	17	1.4	0.8	75	67	15	1.3	0.7	67	67	7	0.7	0.7	67
Pteridium aquilinum (L.) Kuhn	54	48	3.8	0.5	54	58	52	4.2	0.6	58	75	68	5	0.8	75
Punica granatum L.	75	75	4	0.8	75	63	49	3.9	0.6	63	-	-	-	-	-
Pyrus communis L.	38	4	0.4	0.4	38	54	6	0.5	0.5	54	54	5	0.5	0.5	54
Pyrus malus L.	79	18	1.5	0.8	79	79	26	2.1	0.8	79	79	19	1.5	0.8	79
Pyrus pashia Buch.-Ham. ex D. Don	63	7	0.6	0.6	63	67	7	0.7	0.7	67	67	7	0.7	0.7	67
Quercus incana Roxb.	50	17	1.4	0.5	50	50	28	2.8	0.5	50	67	33	2.8	0.7	67
Ranunculus laetus Wall. ex Hook	38	4	0.4	0.4	38	-	-	-	-	-	-	-	-	-	-
Raphanus raphanistrum L.	71	8	0.7	0.7	71	71	8	0.7	0.7	71	71	7	0.7	0.7	71
Rheum australe D. Don	-	-	-	-	-	54	24	2.2	0.5	54	50	10	0.02	0.5	50

Table 7 Continued

Plants name	Lowasi site					Kimanja site					Pathyali site				
	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK	FL	ROP	UV	RFC	PRK
Rosa chinensis Jacq.	75	33	2.1	0.8	75	75	33	2.1	0.8	75	42	8	0.8	0.4	42
Rubus niveus thumb	46	10	0.9	0.5	46	58	13	1.2	0.6	58	63	13	1.3	0.7	63
Rumex hastatus D. Don, Prodr.	67	15	2.2	0.6	63	71	24	3	0.6	63	71	28	3	0.6	63
Rumex dentatus L.	63	28	1.3	0.7	67	63	35	1.9	0.7	71	63	31	2.7	0.7	71
Sapindus mukorossi Gaertn.	58	6	0.6	0.6	58	58	13	1	0.6	58	-	-	-	-	-
Sarcococca saligna (D. Don)	-	-	-	-	-	-	-	-	-	-	38	8	0.8	0.4	38
Saussurea costus (Falc.) Lipsch	58	19	1.7	0.6	58	67	22	2	0.7	67	75	23	2.2	0.8	75
Senecio chrysanthernoldes D. C	-	-	-	-	-	-	-	-	-	-	75	23	2.3	0.8	75
Sibbaldia procumbens L.	-	-	-	-	-	-	-	-	-	-	58	18	1.6	0.6	58
Skimmia laureola (DC.) Sieb.	-	-	-	-	-	58	13	1.2	0.6	58	75	23	2.2	0.8	75
Solanum melongena L.	54	6	0.5	0.5	54	54	6	0.5	0.5	54	63	6	0.6	0.6	63
Solanum nigrum L.	54	18	1.6	0.5	54	58	19	1.7	0.6	58	58	18	1.8	0.6	58
Spinacia oleracea L.	63	14	1.3	0.6	63	67	15	1.3	0.7	67	67	7	0.7	0.7	67
Syzygium aromaticum L.	75	8	0.8	0.8	75	75	8	0.8	0.8	75	75	8	0.8	0.8	75
Syzygium cumminii L.	71	8	0.7	0.7	71	75	8	0.6	0.7	75	71	7	0.6	0.7	71
Taraxacum officinale Weber	58	13	1.2	0.6	58	92	20	1.5	0.9	92	63	13	1.2	0.6	63
Thlaspi arvense L.	-	-	-	-	-	-	-	-	-	-	46	5	0.5	0.5	46
Thymus linearis Benth.	58	13	1	0.6	58	83	19	1.3	0.8	83	83	17	1.3	0.8	83
Trachyspermum ammi L.	79	44	3.4	0.8	79	92	61	4.1	0.9	92	83	50	3.4	0.8	83
Triticum aestivum L.	71	16	1.4	0.7	71	75	17	1.5	0.8	75	75	15	1.5	0.8	75
Viburnum grandiflorum Wall. ex DC.	-	-	-	-	-	50	11	1.1	0.5	50	71	14	1.4	0.7	71
Viola canescens Wall. ex Roxb.	58	39	3.1	0.6	58	79	53	3.6	0.8	79	83	50	3.8	0.8	83
Vitex negundo L.	50	17	1.5	0.5	50	-	-	-	-	-	-	-	-	-	-
Vitis vinifera L.	58	13	1.2	0.6	58	63	14	1.3	0.6	63	63	13	1.3	0.6	63
Woodfordia fruticosa (L.) S. Kurz	33	15	1.2	0.3	33	-	-	-	-	-	-	-	-	-	-
Xanthium strumarium L.	63	7	0.6	0.6	63	-	-	-	-	-	-	-	-	-	-
Zanthoxylum armatum DC. Prodr.	75	58	3.8	0.8	75	92	92	5.5	1	92	75	68	5.3	0.9	75
Zea mays L.	58	26	2	0.6	58	71	31	2.5	0.7	71	71	28	2.5	0.7	71
Zingiber officinale Roscoe	67	22	2	0.7	67	67	22	1.8	0.7	67	54	16	1.5	0.5	54
Zizyphus numalaria L.	46	5	0.5	0.5	46	-	-	-	-	-	-	-	-	-	-
Zizyphus oxyphylla Edgew.	46	20	1.8	0.5	46	-	-	-	-	-	-	-	-	-	-

FL: fidelity level; ROP: rank order priority; UV: use-value; RFC: relative frequency citation; PRK: percentage respondent knowledge of ethnomedicinal species of Lowasi, Kimanja, and Pathyali studied village of Jhelum Valley.

Table 8 Jaccard's index comparing the present study with previous articles

Sr. no.	Study area	SY	NRPs	NPSU	NPDU	TSCBA	SEAA	SESA	PPSU	PPDU	JI	Citation
1	Tehsil Khuiratta (Azad Jammu and Kashmir) Pakistan	2023	65	24	14	38	27	91	36.92	21.53	47.5	Aftab et al. (2023)
2	Swat valley, KP, Pakistan	2023	231	29	11	40	191	89	12.55	4.76	16.66	Ali et al. (2023)
3	North Waziristan, Pakistan	2023	69	27	9	36	33	93	39.13	13.04	40	Rehman et al. (2023a)
4	District Budgam, Kashmir Himalaya	2023	50	24	10	34	16	95	48	20	44.16	Niyaz et al. (2023)
5	Rawalpindi, Punjab, Pakistan	2023	169	16	15	31	138	98	9.46	8.87	15.12	Benamar et al. (2023)
6	Azad Jammu and Kashmir, Pakistan	2023	47	9	8	17	30	112	19.14	17.02	13.60	Awan et al. (2023)
7	Azad Jammu and Kashmir, Pakistan	2023	18	0	3	3	15	126	0	16.66	2.17	Hussain et al. (2023)
8	Neelum, Azad Jammu and Kashmir, Pakistan	2022	60	9	11	20	40	109	15	18.33	15.50	Ijaz et al. (2022)
9	Palas Valley, Indus Kohistan, Pakistan	2021	63	5	9	14	49	115	7.93	14.28	9.33	Islam et al. (2021)
10	Kotli, Azad Jammu and Kashmir, Pakistan	2017	126	19	13	32	94	97	15.07	10.31	20.13	Amjad et al. (2017a)
11	District Buner, Pakistan	2020	60	7	10	17	43	112	11.66	16.66	12.32	Jan et al. (2020)
12	Neelum Valley, Azad Jammu and Kashmir, Pakistan	2012	39	20	7	27	12	102	51.28	11.66	31.03	Ahmad et al. (2017)
13	Harighal, Azad Jammu and Kashmir, Pakistan	2020	152	44	14	58	94	71	28.94	9.21	54.21	Amjad et al. (2020)
14	Mohmand Agency, FATA, Pakistan	2018	64	20	8	28	36	101	31.25	12.5	25.69	Aziz et al. (2018)
15	Koh-e-Safaid Range, northern Pakistan	2018	92	33	12	45	47	84	35.86	13.04	52.33	Hussain et al. (2018a)
16	Karakoram-Himalayan range, Pakistan	2014	51	9	7	16	35	113	17.64	13.72	12.12	Bano et al. (2014)
17	Kotli, Azad Jammu and Kashmir, Pakistan	2017	126	39	6	45	81	84	30.95	4.76	37.50	Amjad et al. (2017a)
18	Rawalakot, District Poonch Azad Jammu and Kashmir	2017	136	25	13	38	98	91	18.38	9.55	25.17	Shaheen et al. (2017)
19	Punjab province Pakistan	2019	129	24	11	35	94	94	18.60	8.52	22.88	Umair et al. (2019)
20	Tehsil Kabal, District Swat, KP, Pakistan	2015	45	17	6	23	22	106	37.77	13.33	21.90	Khan et al. (2015)
21	District Gujranwala, Punjab, Pakistan	2018	31	9	6	15	16	114	29.03	19.35	13.04	Noreen et al. (2018)

SY: study year; NRPs: number of reported plant species; NPSU: number of plants with similar uses; NPDU: number of plants with different uses; TSCBA: total species common in both area; SEAA: species enlisted in aligned areas; SESA: species enlisted only in study area; PPSU: percentage of plant with similar uses; PPDU: percentage of plant with different uses; JI: Jaccard's index; KP: Khyberpakhtunkhwa.

cited for gastrointestinal tract disorders. Ssegawa and Kasenene (2007) represents same data the value of FL ranged from 25%–100% the highest fidelity recorded for *Clerodendrum myricoides*, *Ocimum lamiifolium*, *Ficus carica*, and *Verbena officinallis* (100%) and lowermost FL recorded for *Rhus vulgaris* (25%).

The value of ROP ranges from 4–100 in village Lowasi (5–100) in Kimanja, and (4–100) in Pathyali. Similar studies also conducted by Stoffle et al. (1990) the species *Withania somnifera* and *Ranunculus sceleratus* show highest ROP (100 each) and low ROP value recorded for *Tamarix aphylla* (Dar and Naqshi 2001). ROP indicates the preference of species used in study area the highly used specie. *Mentha royleana* in all studied areas and *B. ciliata* in Pathyali was recorded as most frequently used species due to easy access to collect them. In this study, we compared our results with 21 published papers from adjoining and areas with similar vegetation across Pakistan. The highest PRK

value recorded for *M. royleana* (100%) in all studied areas and *B. ciliata* (100%) in village Pathyali this indices also used by (Al-Adhroey et al. 2010). The plant species with greater PRK values were *Eurycoma longifolia* (15.8) values of (PRK) only recorded for anti-malarial plants the present result disagreeing as data recorded only for single disorder while in current investigation fourteen major disorders were presented.

The ICF gives information about the consistency of the informants for the treatment of a certain use-category. In this study, 129 species documented for the treatment of various human disorder these plants used to treat approximately 89 diseases. The present study shown that gastrointestinal ailments in was the most frequent disorder treated by utilizing ethno medicinal plants second highest ICF value recorded for respiratory disorder. The lowermost ICF recorded for hepatic disorder in all of the studied areas. Similarly, Stoffle et al. (1990) recorded ICF value ranged from 0–0.39 the maximum value recorded for gastrointestinal disorder.

The current study also accessed the value of different plant species taking into account the cultural, practical, and EVs. The CVs of 129 ethnospecies range from 0–1.6, PVs range 0–1, and EV range from 0–40.2. Similar studies were also conducted by Bibi et al. (2014) as CV (0–20.3), PV (0–25.2), EV (0–11.64), and TV of ethno species varied (0.004–42.1). The utility and use of plants linked to the importance of them in that area the plants like *M. royleana*, *Z. armatum*, *B. ciliata*, *C. limon* were widely used. This may be associated with the healing potential and their accessibility. In addition, it may be associated with broad-spectrum application and popularization among the communities for the treatment of multiple diseases. EVs were highly contributing in TVs of species (Tardío and Pardo-de-Santayana 2008).

Conclusions

The study likely focuses on documenting and preserving the indigenous knowledge and practices related to medicinal plants in the region. Ethnobotanical data were collected by interviewing 72 local informants includes practitioners, farmers, teachers, and labour from different localities of District Jhelum Valley. The data like demographic characteristics of informants, methods of preparation, life form, modes of application, parts used, and ethnomedicinal uses was documented. Different quantitative tools were used for the analysis of ethnobotanical data. A total of 129 species belonging to 111 genera and 63 families were documented along with their ethnobotanical uses. Dominant families based on the number of species include Rosaceae contributing 12 species followed by Asteraceae and Saxifragaceae with 8 species each. The comparative study of for novelty of species and their uses by JI revealed 13 novel plants species which were not reported earlier from this region. This information is not only important scientific and ethnobotanical purposes but also for the sustainable management of medicinal plant resources and the potential discovery of new natural medicine. Such studies can help to bridge the gap between traditional and modern medicines and collaboration between traditional healers and health care practitioners.

Abbreviations

ICF: Informant consensus factor
FL: Fidelity level
PRK: Percentage respondent knowledge
RFC: Relative frequency of citation
FIV: Family importance value
UV: Use value
ROP: Rank order priority
CV: Cultural value
PV: Practical value
EV: Economic value
TV: Total value
JI: Jaccard's index
CPP: Consensus values for plant part

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Authors' contributions

These authors contributed in the article for publication. TH supervised the research, NQ collected the field data prepared initial draft of the manuscript, SS draw this draft completely, KH and AM and assisted in formatting and proof reading, MSA and TI helped in statistical analysis.

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Availability of data and materials

Data presented in this study will be available on a fair request to the corresponding author.

Ethics approval and consent to participate

The ethical guidelines for the survey of rural and indigenous communities provided by the International Society of Ethnobiology (available online:www.ethnobiology.net/whatwe-do/coreprograms/iseethics-program/code-of-ethics) were carefully followed. Before interviews, formal verbal consent (regarding data collection and publication) of each participant was taken. This study was authorized by the Department of Botany, University of Azad Jammu and Kashmir, Muzafarabad, Pakistan. All participants provided oral prior informed consent.

Consent for publication
Not applicable.

Competing interests
The author declares that they have no competing interests.

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