Cross culture comparison in ethno-pharmacological uses of plants between two geographical regions of Northwest Pakistan

Rishma Batool, Amina Nazar, Muhammad Adnan, Zainab Khursheed, Fakhar Mohsin and Wahid Hussain

Correspondence

Rishma Batool[1], Amina Nazar[1], Muhammad Adnan[1], Zainab Khursheed[1], Fakhar Mohsin[1] and Wahid Hussain[2*]

[1]Department of Botany, Kohat University of Science and Technology, Kohat-26000, Pakistan
[2]Department of Botany, Govt. Post Graduate College Parachinar, 26300, KP, Pakistan

*Corresponding Author: wahidhussain@hed.gkp.pk

Ethnobotany Research and Applications 30:6 (2025) - http://dx.doi.org/10.32859/era.30.6.1-21
Manuscript received: 28/10/2024 – Revised manuscript received: 02/01/2025 - Published: 06/01/2025

Research

Abstract

Background: Medicinal plants and plant-based medicines are extensively used in the healthcare system in developing countries. Present research work was carried out to record and report the ethno-pharmacological comparison of medicinal plant uses of two culturally different geographical regions (Kohat and Parachinar) located in the Khyber Pakhtunkhwa province of Pakistan.

Methodology: The ethno-pharmacological survey was conducted through a semi-structured questionnaire comprised of demographic information and traditional knowledge of medicinal plants of the localities. The survey was based on traditional ethno-medicinal knowledge of local plants. Relative frequency of citation (RFC), informant consensus factor (ICF), and frequency of citation (FC) were among the quantitative tools used to assess the information that was collected.

Results: A total of 103 medicinal plants were reported in two geographical regions, Kohat and Parachinar. Out of these, 62 medicinal plants were reported from District Kurram Parachinar and 41 from District Kohat. In total, 14 medicinal plant species were common based on reported names and traditional knowledge between the two regions. Based on their local names, therapeutic applications, dosage, treatment, and preparation methods, eighty-nine (89) species were determined to be unusual. Among all reported species highest RFC value was reported for *Withania coagulans*. In the case of ICF gastrointestinal diseases marked maximum value 730 use report. Leafs reported that most plant parts were utilized during the survey.

Conclusion: In terms of the components of medicinal plants employed, their local names, and their traditional uses, there was a notable 91.67% difference between the two localities. This suggests that the ethnobotanical knowledge of the two locations differs, reflecting differences in environmental effects and cultural behaviors. These variations show how diverse traditional medicine is in each place and emphasize how crucial it is to record and preserve this distinctive legacy.

Keywords: Ethno-pharmacological uses, medicinal plants, cross-culture, Kohat, Parachinar.

Background

Indigenous knowledge regarding medicinal plants is often utilized by individuals in remote regions to address various health issues. Plants serve multiple purposes, such as enhancing air quality, preventing soil erosion, and facilitating water recycling. A large number of developing countries and many developed countries use medicinal plants and plant-based medicines extensively in their healthcare systems (Haq *et al*. 2020). The world's population receives 80% of its healthcare from plants (Adeniyi *et al*. 2018, Hao and Xiao 2020, Wagh and Jain 2020). The use of medicinal plants is vital for most remedies for ailments, as plant-based remedies can cure a variety of human ailments (Rehman *et al*. 2024).

In the past few decades, medicinal plants have been extensively used for healing purposes all over the world, and many of their healing properties have been proven (Gillani *et al*. 2024). A World Health Organization study estimates that approximately 4 billion people in emerging countries rely on the medicinal properties of plant species and exploit them regularly, an assessment estimates that over 35,000–70,000 plant species are used in traditional medicine around the globe (Qadir *et al*. 2021). The World Health Organization indicates that 60% of the global population depends on traditional medicine, while 80% of people in developing nations utilize conventional therapeutic methods, particularly herbal remedies, to address their main health issues. (WHO, 2023).

In Asia, Pakistan ranks 7th in terms of medicinal plant production (Wanzala *et al*. 2024). Over 75% of the people in Pakistan depend on medicinal herbs for the majority, if not all, of their healthcare requirements. Pakistan has approximately 600 species of plants used as traditional medicine. Medicinal flora is extensively used to make medicines, foods, cosmetics, and dietary supplements (Petrakoua *et al*. 2020). A rich diversity of indigenous medicinal plants (MPs) has been cultivated in Pakistan because of its peculiar climatic conditions (Haq *et al*. 2022, Bano *et al*. 2014, Shinwari *et al*. 2012). There is a remote area of Pakistan where knowledge of traditional herbal medicine helps researchers discover new medicinal plants with valuable pharmacological properties (Jan *et al*. 2022). There are still many rural communities in Pakistan that practice the old traditional system of medicine (Umair *et al*. 2024, Mahmood *et al*. 2011).

Several studies have been conducted on Ethno-medicinal practices in the area under study (Hussain *et al*. 2023, Mussarat *et al*. 2021). East Asia has a long history of using herbal treatments (Kang *et al*. 2020). Additionally, these plants are thought to have minimal side effects and a high degree of effectiveness (Eddouks et al. 2014, Malik et al. 2014). The key medicinal species cultivated in Pakistan include *Viola pilosa*, *Diospyros lotus*, *Morchella esculenta*, and *Trillium govanianum* (Sher et al. 2014). In many instances, knowledge regarding medicinal plant species has been transmitted orally from one generation to the next (Gillani *et al.* 2024).
The utilization of medicinal species is primarily influenced by cultural practices and the biodiversity of the area (Mwangi et al. 2017). Based on their research, scientists can leverage ethnomedicine to create natural remedies using native plant species (Aziz *et al.* 2018, Hussain *et al.* 2018). In Pakistan, local markets called "Pansar" specialize in medicinal species and export large quantities of plants to other countries (Rashid *et al*. 2018, Sulaiman *et al*. 2018). The use of plants for medicinal purposes ranges from 4 to 20% in different countries, with approximately 2500 species being traded worldwide (Malik et al. 2019). In Pakistan, there are roughly 50,000 Ayurvedic practitioners, Unani medicine specialists known as tabibs, and numerous unregistered healthcare providers who work in both remote mountainous areas and urban settings, often using about 200 plant species to prepare herbal treatments (Ullah *et al*. 2023, Umair *et al*. 2019).

The objectives of the current study are to investigate and analyze the medicinal plants used by local communities for the treatment of various diseases, and to compare the efficacy of these plants across cultures the selected region for cross-cultural comparison is Kohat and Parachinar.

Materials and Methods

Study Area

Kohat is situated in the Khyber Pakhtunkhwa province of Pakistan, positioned at a latitude of 33° 35’ 13” North and a longitude of 71° 26’ 32” East, at an elevation of 508 meters and covering a total area of 2,545 square kilometers (Figure 1). The district has a mountainous landscape, experiencing a peak temperature of 40°C and an average yearly rainfall of approximately 638mm. Compared to other Tehsils, Kohat Tensile has a relatively high population and more developed agricultural infrastructure. Kohat is renowned for its agricultural products and traditional handmade Kohati chappal. The region's agricultural outputs include wheat, maize, barley, guava, and citrus fruits. Additionally, poultry and local cattle breeds contribute significantly to the livelihoods of the residents in Kohat (Hussain *et al*. 2023).

Kurram, a newly established district in Khyber Pakhtunkhwa, Pakistan, is a tribal agency. The Kurram District lies between latitudes 33°20′ north and longitudes 69°50′ and 70°50′ east (Figure 1). The district got its name from the Kurram River, which flows through the valley. The name Kurram is mentioned in "rag Vide" and may have come from the word Karma, but it could also have come from the word Kirram, which means silk because the locals used to keep silkworms for a living. Kurram District has a total area of 3,380 square kilometers and a maximum length of 115 km. There are four distinct seasons in the area; during the winter, snowfall is frequent and temperatures can drop as low as -10°C and as high as 35°C during the summer. The region is covered with semi-evergreen, alpine, and dry temperate coniferous forests. Landscape areas in the local area are commonly characterized by dwarf palm, mulberry, poplar, willow, pine, cedar, and oak trees (Abbas *et al*. 2020).

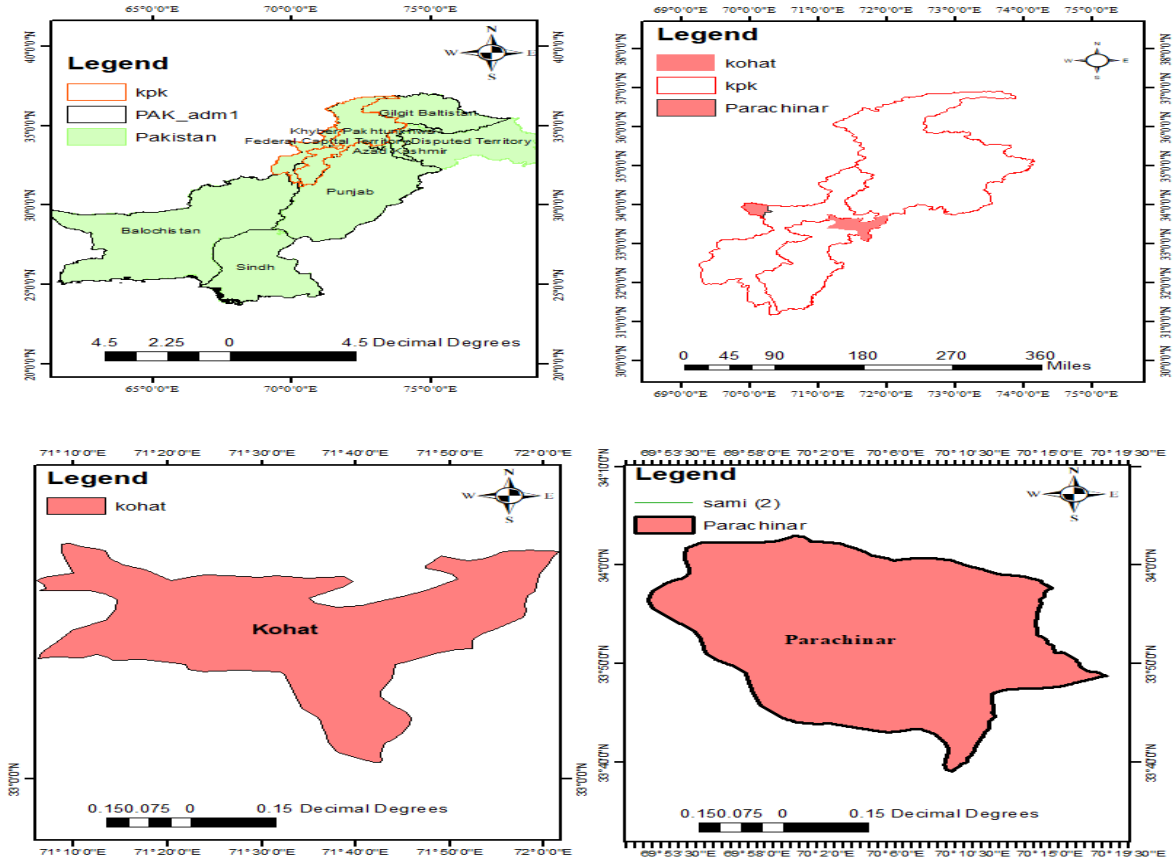

Figure 1. Detail Map of Kohat and Parachinar, Khyber Pakhtunkhwa Province, Pakistan.

Data Collection and Field Survey

Data on ethnomedicinal was collected from March 2019 to March 2021. A convenience sampling method was used to collect information. The data was obtained from people who are born and permanently live in these regions. Data about the local uses of plants as medicinal, fuel wood, timber fodder, etc. was obtained from people from different walks of life but priority was given to the local elderly people because they know well the uses of medicinal plants in folk knowledge. The medicinal plants were studied according to their economic, traditional, local uses, local names, and other related information through interviewing and filling out questionnaires from local people in both areas. The information was gathered in Pashtu (the local language) and subsequently translated into English via a semi-structured questionnaire. It primarily focused on the local name of the medicinal plant, any supplementary components, the preparation of the remedy, the specific parts of the plant utilized, as well as details on how it is administered and the dosage for both children and adults. All the relevant materials were thoroughly studied before going into the fieldwork. The study trips were scheduled according to the blooming period of plants. Several study trips were made to the research stations. The fieldwork was carried out to investigate the traditional knowledge of using medicinal plants and their conservation status. This fieldwork included observation, interviews, and guided field walks. The study participants were recognized for their familiarity with the local flora and ecology and their understanding of medicinal herbs. Rather than traditional healers or experts, the majority of responses to our study were from regular individuals who had learned about local plants verbally from their elders. The International Society of Ethnobiology's (ISE) Code of Ethics was closely adhered to when performing the survey (Nazar *et al*. 2024). Each participant gave their verbal consent before the interview. Every participant was explained the study's goal and content.

Plant Collection and Identification

The survey was conducted through a questionnaire and data was recorded on the same questionnaire. The plant species collected from the research areas were identified with the flora of Pakistan (Ali and Qaiser, 1995-2018), and their botanical names and families were verified with the available literature (Hussain *et al*. 2018, Haq and Badshah, 2021; Haq *et al.* 2023). The voucher specimens were given as mentioned in (Table 2) and then submitted to the Herbarium at the Department of Botany, KUST for future records.

Statistical Data Analysis

Quantitative measures such as informant consensus factor (ICF), relative frequency of citation (RFC), and frequency of citation (FC) were used to assess the gathered data.

Frequency ofcitation (FC)

FC is the number of primary participants who described using each recipe for ethno-medicinal purposes (Alemu *et al*. 2024).

Relative Frequency Citation (RFC)

Relative Frequency Citation (RFC) was used to record the highest therapeutic medicinal flora of the valley, which is consumed for the treatment of numerous ailments.

$$RFC = FC\ N\ (0 < RFC < 1).$$

RFC shows the importance of each species and is given by the frequency of citation FC, the number of respondents (N) in the survey as used by (Haq *et al*. 2023).

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) was utilized to assess respondents' agreement on the application of plant species for treating different categories of ailments.

$$FCI = Nt/Nur.$$

Where Nt is the number of species or taxa utilized to treat a given disease category, and Nur is the number of use reports from informers for that disease category treated by a plant species. The range of an ICF value is 0 to 1. In this case, 1 denotes the greatest respondent value, and 0 is the lowest (Hussain *et al*. 2022).

Results

Demographic Information

A total of 326 individuals (130 male and 196 female) participated in gathering traditional knowledge regarding ethnomedicines. They were categorized into various groups based on their age, education, and profession. Most of the respondents were illiterate (90) and were aged 70 years or older. Due to their greater knowledge of traditional medicinal plants and recipes for treating various ailments, females were more engaged in commercial activities compared to males. Among males, the primary participants were predominantly shopkeepers, while females, were mostly housewives. The largest group had completed primary education, followed by the second largest group who had completed middle school (Figure 2).

Families and Ethnobotanical Uses

Results from the current study reveal that a total of 50 families reported during an ethnobotanical survey. Among these families Rosaceae reported as dominant with 31 plant species, Asteraceae ranked second with 20 species and Fabaceae having 18 species. Other families reported with less than 10 species (Figure 3).

The present Ethno-medicinal study provides information about the botanical name, local names, habits, recipes, parts used, doses treatment duration, and toxicity of medicinal plant species (Table 2). Out of these, 41 plant species have been reported from the Kohat region and 62 Plant species from the Parachinar region belonging to 50 different families. Out of the total 103 medicinal plant species, a total of 89 plant species were uncommonly used between the two regions (Table 1). However, 14 medicinal plant species were commonly used in both regions for ethno-medicinal practices (Table 1). The high prevalence of ethnomedicinal plants from the families Rosaceae, Asteraceae, Fabaceae, Solanaceae, and Lamiaceae in the area can be recognized for their widespread presence and the various traditional uses recognized by local informants.

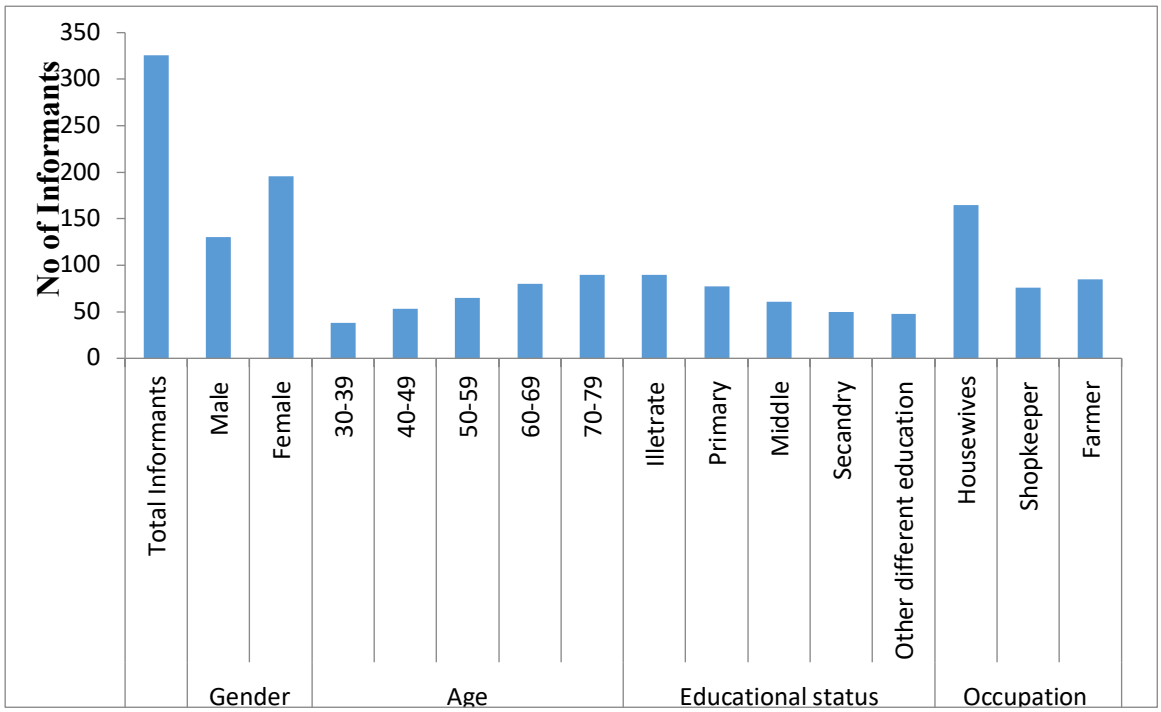

Figure 2. Demographic data of the respondents

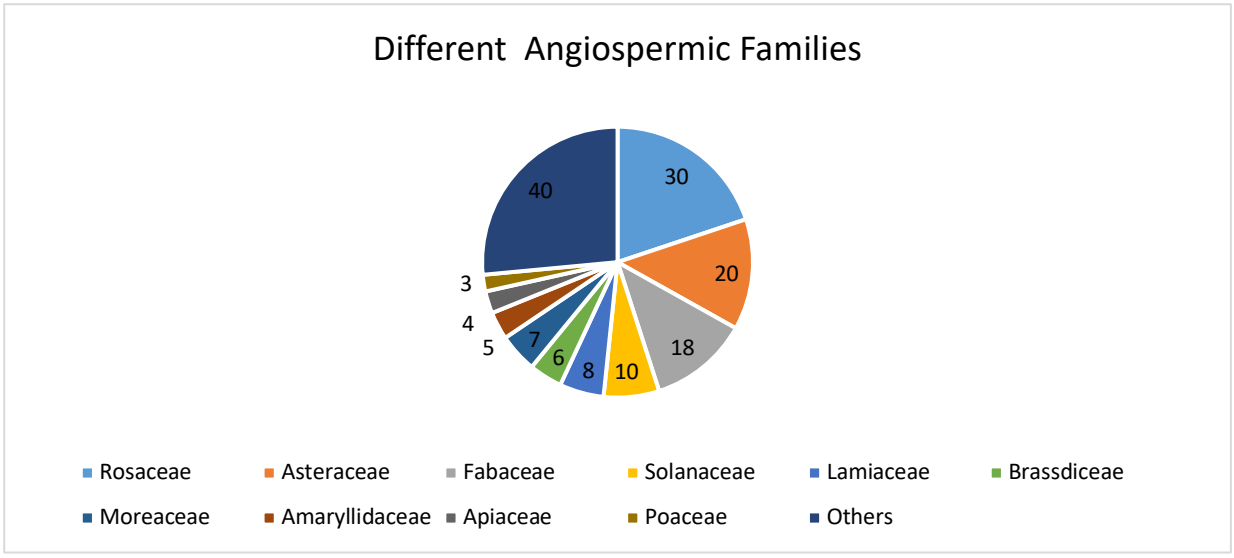

Figure 3. Dominant plant families

Table 1**.** Comparative analysis of local plants used by communities living in two geographical regions.

Botanical Name/Family Name/Habit/ Voucher no	**Part used Kohat**	**Part used Parachinar**	**Local Name/ Place**	**Part used: Recipe preparation**	**Cure for the disease**	**Dosage, treatment duration, and toxicity if any**	**FC**	**RFC**
Aloe vera (L.) Burm.f./ Asphodelaceae/ Shrub/BOT-KHS-23	+	+	Korghandal/Kohat	Leaves: take a sticky gel or mash the whole leaves and apply on the affected area.	Used for acne and skin problems.	Used by elders 3/4 days a week in small quantity.	17	0.022
			Alovera/ Parachinar		Used for acne, hair fall, and dandruff.	Used by elders once a week.		
Apteranthes tuberculata N.E.Br./ Apocynaceae/ Herb	+	+	Pawani/ Kohat	Stem: they are cooked.	Used for stomach and diabetes and skin.	Used by elders in a small amount 1 time to 1 month.	23	0.030
			Pawani/ Parachinar	Stem: they used raw.	Used for diabetes.	Used by elders 2 times for 2/3 month.		
Allium sativum L./ Amaryllidaceae/ Shrub/BOT-KHS-19	+	+	Ozha/ Kohat	Whole plant: they are used as raw or their juice.	Used for controlling hair fall, acne, and anti-fungal.	Used by elders once a week for 1 month.	20	0.026
			Ogha /Parachinar		Used for hair fall.	Used by elders twice a week.		
Cannabis sativa L./ Cannabaceae/ Shrub/BOT-KHS-143	+	+	Bung/ Kohat	Leaves and seeds: they are used to boil.	Used for burnt skin.	Used by elders one time on the skin for 1 week.	20	0.026
			Bang/ Parachinar	Whole plants: they are used as raw, boiled and their juice.	Used for sedative, anti-inflammatory, and anodyne.	Used by elders once a week for 1 month.		
Coriandrum sativum L./ Apiaceae/ Herb/BOT-KHS-39	+	+	Dhania/ Kohat	Leaves: they are crushed and mixed with yogurt.	Used for skin and stomach problems.	Used by both elders and children 1 small bowl per day 1/2 weeks.	30	0.04
			Dhania/ Parachinar	Leaves: the raw leaves chow in the morning or boil in the water.	Used for bad smell of mouth and stomach pain.	Used by elders 1 month in the morning.		
Curcuma longa L./ Zingiberaceae/ Shrub/BOT-KHS-43	+	+	Korkamand/Kohat	Rhizome: they use raw and mashed and make a powder and mix it with milk.	Used for infection.	Used by elders 1 cup for 5/6 days.	25	0.033
			Korkamand/ Parachinar	Rhizome: they use raw and mashed and make a powder and mix it with milk, water, and food.	Used for intestinal infection.	Used by elders 1 glass for 7 days and children used 1 small cup for 5 days.		

Mentha longifolia L./ Lamiaceae/ herb/BOT-KHS-183	+	+	Zangali nana/ Kohat	Leaves: they are used raw and herbal tea.	Used for stomach pain.	Used by elders 1 time for 7 days and for children 1 time for 3 days.	22	0.029
			Wailani/ Parachinar	Whole plants: they are used as raw, boiled, and herbal tea.	Used for chest problems, flu, coughs, stomach cramps, and headaches.	Used by elders in the morning 1 tea cup for 15 days.		
Morus nigra L./ Moraceae/ Tree/BOT-KHS-184	+	+	Tor tooth/ Kohat	Fruit: they are eating directly.	Used for anthelmintic purgative.	Used by elders 1 time to 7 days and for children 1 time for 2 days.	21	0.028
			Tortooth/ Parachinar	Fruit: they are used as herbal tea.	Used for cough.	Used by elders at night 1 tea cup.		
Mentha spicata L./ Lamiaceae/ Herb/BOT-KHS-274	+	+	Podina/ Kohat	Leaves: grained and mixed with yogurt.	Used for stomach problems.	Used by both elders and children 1 bowl per day.	29	0.038
			Podina/ Parachinar	Leaves: they are used as herbal tea, raw or boiled in water.	Used for stomach pain, intestinal infection, and skin problems.	Used by both elders and children as herbal tea 1 time.		
Malva sylvestris L./ Malvaceae/Herb/BOT-KHS-271	+	+	Piskai Kohat	Leaves: boil in water or mash the leaves and extract the water.	Used for itching and painful skin disease.	Used by elders in a small cup for 3/4 days or apply the extract	77	0.102
			Takoly/ Parachinar	Leaves: they are used as herbal tea, raw, and their abstract.	Used for itching and stomach problems.	Used by elders as herbal tea or apply the juice on a wound.		
Plantago lanceolata L./ Plantaginaceae/ Herb/BOT-KHS-275	+	+	Ishakbool/ Kohat	Husk: they mix in milk or water.	Used for constipation and stomach problems	Used by both elders and children 1 small bowl per day 1/2 weeks.	34	0.045
			Ghazaki/ Parachinar	Leaves: they used raw mashed and extracted the juice and applied an effective area.	Used for damaged tissue repair and bleeding.	Used by both elders and children at night for 2/3 days.		
Papaver somniferum L./ Papaveraceae/ Shrub/BOT-KHS-66	+	+	Dodha/ Kohat	Pods: they dry and make an herbal tea. Seeds: they are used in curry.	Used for chest disease, food.	Used by elders 1 small bowl per day 1 week.	30	0.04
			Dodha/ Parachinar	Pods: they are used as herbal tea.	Used for chest infection and cough.	Used by elders at night 1 tea cup.		
Rosa chinensis Jacq. L. / Rosaceae/ Shrub/BOT-KHS-76	+	+	Gulab/ Kohat	Flowers: they are used raw or mixed with milk or make a paste.	Used for skin disease and constipation.	Used by elders to chew the petals for 4 days and apply the past on effective areas.	28	0.037

			Gulab/ Parachinar	Flowers: they are used raw, boiled, or mixed with milk or water.		Used by elders to chew the petals 2/ 3 times for 4/5 days and apply the paste on the skin once a week.		
Withania coagulans (Stocks) Dunal/ Solanaceae/ Shrub/BOT-KHS-87	+	+	Khapyanga/ Kohat	Seeds: they are dried and directly taken with water.	Used for gastrointestinal disease.	Used by elders for 3/4 seeds 2/3 days.	86	0.114
			Hapyangia/ Parachinar		Used for stomach pain, vomiting and intestinal infection.	Used by elders for 2/3 seeds in the morning for 7 days.		
Vachellia farnesiana (L.) Willd./ Fabaceae/Tree/BOT-KHS-235	+	_	Kikar/ Kohat	Gum: they are used directly or roasted.	Used as a tonic for leucorrhea and diabetes.	4/5 pieces of gum are roasted or eaten directly by elders 1 time for 2 weeks.	3	0.004
Azadirachta indica A.Juss. / Meliaceae/ Tree/BOT-KHS-26	+	_	Neem/ Kohat	Leaves: they are used as an herbal tea and applied directly on effective skin.	Used for skin disease, asthma	Used by elders for 2/3 days.	5	0.006
Artemisia tripartita Rydb**./** Asteraceae/Shrub/BOT-KHS-236	_	+	Tarha/ Parachinar	Leaves: they are dry and boil in water.	Used for stomach pain, intestinal infection	Used for elders 1 cup for 7 days and children 2 teaspoons for 4 days.	1	0.001
Artemisia absinthium L./ Asteraceae/Shrub/BOT-KHS-237	_	+	Mastiara/ Parachinar	Leaves: they are boiled in water.	Used for digestive problems, liver, intestinal disease, fever and to improve blood circulation	Used by elders in the morning 1 glass for 6 days.	5	0.006
Senegalia modesta Wall. P.J.H.Hurter/ Fabaceae/TreeBOT-KHS-238	_	+	Phulahi/ Parachinar	Bark and leaves: make a powder mix with oil and apply, mash the leaf, and apply effective area.	Used for bacterial infection, wounds, backache	Used by elders 2 times for 1/2 weeks and children used for 1 time for 1 week.	3	0.004
Allium cepa L**./** Amaryllidacea/Shrub/BOT-KHS-239	_	+	Payaaz/ Parachinar	Whole plant: they are used raw, extracted from the juice, and mixed with oil or water.	Used for hair fall.	Used by elders for once a week for 2 days.	20	0.026
Beta vulgaris L**./** Amaranthaceae/Shrub/BOT-KHS-240	_	+	Chundaer/ Parachinar	Stem: they are used raw, juice, or boiled in water.	Used for blood purification.	Used by elders and children at any time.	11	0.014
Bergenia ciliate (Haw.) Sternb./ Saxifragaceae/Herb/BOT-KHS-241	+	_	Zakham-e-Hayat / Kohat	Leaves: grind or direct use.	Used for wound healing	Used for both elders and children for 3/4 days.	21	0.028

Brassica rapa L./ Brassicaceae/ Shrub/BOT-KHS-27	+	_	Sharsham/ Kohat	Seeds: they are boiled in olive oil and applied to hairs.	Used for dandruff	Used by both twice a week for 1/2 months.	4	0.005
Carthamus oxyacantha M.Bieb./ Asteraceae/BOT-KHS-137	+	_	Zeer azghakay/ Kohat	Seeds: extract oil from them.	Used for astringent, ulcer	Used by both elders and children in cooking 2-3 teaspoons for 1/2 months.	1	0.001
Calotropis procera (Aiton) Dryand./ Apocynaceae/Shrub/BOT-KHS-28	+	_	Spalmaki/ Kohat	Latex: they are applied directly on the affected area of the skin.	Used for skin disorders	Used only by elders in a small amount for 1 time to 1/3 days.	5	0.006
Cynadon dactylon L. pers/ Poaceae /Herb/BOT-KHS-207	+	_	Wakhana /Kohat	Roots and leaves: are used as an herbal tea.	Used for anemia dysentery and diabetes	only used by elders for 3/4 days a week	4	0.005
Cassia fistula L./ Fabaceae/Tree/BOT-KHS-32	+	_	Amaltas/ Kohat	Seeds or fruit: they are boiled in water and fruit eaten directly.	Used for asthma, cold, cough	Used for both for elders 1 cup for 2/3 days and for children 1/2 teaspoon for 2 times.	3	0.004
Cichorium intybus L./ Asteraceae/Herb/BOT-KHS-174	_	+	Sheen gualy/ Parachinar	Leave and Flower: they are used as an herbal tea, raw, and juice.	Used for fever, Tonic, weight loss, and constipation.	Used for elders 1 cup for 1/2 month, and children 1 teaspoon for 4 days.	7	0.009
Celtis caucasica Willd./ Cannabaceae/Tree/BOT-KHS-242	_	+	Togha/ Parachinar	Bark and fruit: they are used as herbal tea and applied directly on effective areas.	Used for wound healing, or burning	Used for elders 1 cup for 1 week, and applied at night for 3/5 days.	8	0.010
Cardiospermum halicacabum L./ Sapindaceae/ shrub/BOT-KHS-244	_	+	Toray wana/ Parachinar	Root: they are dry and mixed with tea coffee powder.	Used for Cough, skin, and stomach pain.	Used by elders 1 cup at night for 7 days	3	0.004
Chenopodium album L./ Chenopodiaceae/Herb/BOT-KHS-168	_	+	Srmai/ Parachinar	Young shoots: they are used as an herbal tea.	Used for hepatitis, and constipation	Used by elders 1 cup any time for 2/3 months	2	0.002
Clematis grata Wall./ Ranunculaceae/Herb/BOT-KHS-243	_	+	Prewati/ Parachinar	Leaves: they are used as an herbal tea.	Used for ringworm.	Used by elders for 1 time for 1 week.	4	0.005
Conyza aegytiaca L. Dryand. Ex Aiton/ Asteraceae/shrub/BOT-KHS-245	_	+	Spina rinzaka/ Parachinar	Flowers: they are used in dry form and mixed with milk or water.	Used for skin disorders, and pimples.	Used by elders at night for 1/2 weeks.	1	0.001

Daucus carota L./ Apiaceae/Herb/BOT-KHS-246	–	+	Gajera/ Parachinar	Root: they boil or extract the juice.	Used for stomach pain and skin	Used by elders and children at any time.	9	0.012
Dalbergia sissoo Roxb. ex DC./ Fabaceae/Tree/BOT-KHS-44	+	_	Shisham/ Kohat	Leaves, bark, and gum: they grind or make an herbal tea.	Used for Skin irritation and Leukocoria	Used for elders for 2/3 days once a week.	2	0.002
Datura metel L./Solanaceae/Shrub/BOT-KHS-144	+	_	Dhatura/ Khat	Leaves, seeds, and flowers: are boiled in water and make an herbal tea.	Used for asthma and sexual weakness	Used by elders for 3-4 days in a weak	3	0.004
Euphorbia hirta L./ Euphorbiaceae/Herb/BOT-KHS-247	+	_	Dhoodak/ Kohat	Leaves: they are used as an herbal tea.	Use for asthma and bronchitis	Used by elders 2/3 days a week.	3	0.004
Eucalyptus camalduensis Dehnh./ Mytrtaceae/Tree/BOT-KHS-248	+	_	Lachi/ Kohat	Leaves and bark: they are used as an herbal tea.	Used for bronchial cough, asthma	Used by elder 1 time for 1/2 weeks.	7	0.009
Eriobotrya japonica (Thunb.) Lindl./ Rosaceae/Tree/BOT-KHS-96	_	+	Loquat/ Parachinar	Leaves: they are boiled in water.	Used for kidney stone treatment	Used for elders 1 glass in the morning for 7 days and children 1 tea cup for 5 days.	3	0.004
Ephedra intermedia Schrenk & C.A.Mey./ Ephedraceae/Herb/BOT-KHS-249	_	+	Bandoky/ Parachinar	Fruit and stem: they are used raw, and cooked.	Used for Asthma, and teeth cleaning.	Used by elders once a week for 1 month.	4	0.005
Elaeagus angustifolia L./Elaeagnaceae/Tree/BOT-KHS-250	_	+	Sanzaly/ Parachinar	Leaves: take the raw leaves and place them in the chest	Used for chest infection, and cough.	Used by children 1 week.	5	0.006
Ephedera gerardiana Wall. ex Stapf/ Ephedraceae/Herb/BOT-KHS-252	_	+	Mava/ Parachinar	Leaves: they are used as dry or raw and make herbal tea.	Used to treat cough and flu and reduce swelling of mucous membranes.	Used by elders 2 times for 1 week.	1	0.001
Equisetum arvense L./ Equisetaceae/Herb/BOT-KHS-253	_	+	Bandaky/ Parachinar	Whole plant: they are used as juice or herbal tea.	Used to treat kidney stones.	Used by elders 2 times for 2/3 weeks.	3	0.004
Euphorbia helioscopia L./ Euphorbiaceae/Herb/BOT-KHS-254	_	+	Pashwota/ Parachinar	Latex: they are used raw.	Used for pimples and fungal infections.	Used by elders only 1 time	2	0.002
Fumaria officinalis L./ Papaveraceae/Herb/BOT-KHS-255	_	+	Chaptara/ Parachinar	Whole plants: they are boiled and make an herbal tea.	Used for jaundice, pain, blood purification	Used for elders 1 tea cup for 7 days and children 1 Teaspoon for 3 days.	5	0.006

Foeniculum vulgara Mill./ Apiaceae/Herb/BOT-KHS-53	_	+	Kogalyna/ Parachinar	Leaves: they are used as an herbal tea or raw and boiled in water.	Used for stomach pain, intestinal infection, skin problems, kidney stones, and sore throat.	Used for elders 2/ 3 times and for children used only 1 time for 1 week.	3	0.004
Ficus carica L./ Moraceae/ Tree/BOT-KHS-52/	_	+	Inzar/ Parachinar	Fruit: directly used.	Used to treat stomach disorders.	Used by elders and children at any time.	4	0.005
Fumaria indica **(**Hausskn.) Pugsley/ Papaveraceae/Herb/BOT-KHS-256	_	+	Mastyara/ Parachinar	Whole plant: they are used as herbal tea.	Used for fever, constipation, and skin diseases.	Used by elders in the morning for 1 week.	5	0.006
Ficus recemosa L./ Moraceae/ Tree/BOT-KHS-257	_	+	Ormal/ Parachinar	Latex: directly used.	Used to treat Inflammation due to wasp bites.	Used by elders and children if needed.	8	0.010
Helianthus annuus L./ Asteraceae/Shrub/BOT-KHS-229	+	_	Mazdegan gul/ Kohat	Seeds: they are dried and eaten directly.	used for heart disease	Used by elders for 2/3 days for 1 week.	1	0.001
Hibiscus trionum L./ Malvaceae/Herb/BOT-KHS-276	_	+	Toro aghyaz/ Parachinar	Leaves: they are used as herbal tea or extract the juice.	Used for the treatment of itching and painful skin diseases.	Used by elders 1 cup for 2 weeks.	1	0.001
Indigofera gerardiana Wall. ex Brandis/ Fabaceae/ Shrub/ BOT-KHS-277	_	+	Ghoreja/ Parachinar	Roots: they are used directly as food or herbal tea.	Used to treat stomach pain.	Used by elders 1 time for 2/3 weeks.	2	0.002
Juglans regia L**./** Guglandaceae/Tree/BOT-KHS-55	_	+	Waghaz/ Parachinar	Bark: they are used in powder form.	Used for teeth ache or cleaning.	Used by elders at night and morning for 2/3 months.	2	0.002
Melia azedarch L./ Meliaceae/Tree/BOT-KHS-8	+	_	Bakonrah/Kohat	Leaves: they are grained and make a paste and apply on the effective area.	Anti-allergic and used for stomach disease	Used by both children and elders in a small quantity to 4/5 days.	3	0.004
Morus alba L./ Moraceae/Tree/BOT-KHS-60	+	_	Speen tooth/ Kohat	Fruit: they are used directly.	Used as anthalmative, purgative	Used in small quantities by children and elders 1 time for 1 week.	1	0.001
Mentha arvensis L./ Lamiaceae/Herb/BOT-KHS-58	_	+	Velina/ Parachinar	Whole plant: they are used as herbal tea, raw or boiled with water.	Used for stomach pain, intestinal infection, and skin problems.	Used by elders 2 / 3 times and for children 2 teaspoons 2 times.	3	0.004
Melothria scabra Naudin**/** Cucurbitaceae/Shrub/BOT-KHS-258	_	+	Parpando/ Parachinar	Fruit: they are fried with oil.	Used for diabetes.	Used by elders of any time.	4	0.005

Momordica charantia L./ Cucurbitaceae/ Shrub/BOT-KHS-59	_	+	Karala/ Parachinar	Fruit: they are used raw, juice, and cooked.	Used for skin diseases, diabetes, and blood pressure.	Used by elders of any time.	3	0.004
Marrubium vulgare L./ Lamiaceae /Herb/BOT-KHS-259	_	+	Darshool/ Parachinar	Leaves: they are eaten raw with bread for skin or mashed and the juice is applied to hair.	Used for skin disorders, and hair loss.	Used by elders 1 time for 2 months.	2	0.002
Ocimum basilicum L./Lamiaceae /Herb/BOT-KHS-64	+	_	Niaz Boo/ Kohat	Leaves: they are boiled in water and drink this water.	Used for heart and stomach disease	Used by elders for 2/3 days in a week	1	0.001
Ocimum tenuiflorum L./ Lamiaceae /Shrub/BOT-KHS-260	+	_	Tulsi/ Kohat	Leaves: they are used as an herbal tea.	Used for asthma, cold, cough	Used for elders for 3/4 days one tea cup for 1 week.	4	0.005
Oxalis corniculata L./ Oxalidaceae/Herb/BOT-KHS-142	_	+	Bibi shuftala/ Parachinar	Whole plant: they are used as raw or extracted juice and mixed with butter or oil applied on the effective area.	Used for influenza, fever, urinary tract infection, diarrhea, skin infection, and muscular swelling.	Used by elders 3 times for 2 weeks.	1	0.001
Opuntia stricta (Haw.) Haw./ Cactaceae/Herb/BOT-KHS-103	_	+	Tohar/ Parachinar	Tohar: they are used as juice.	Used for anemia.	Used by elders in the morning 1 cup 2/3 months.	1	0.001
Onosma hispida Wall. ex G. Don/ Boraginaceae/Herb/BOT-KHS-9	_	+	Paisho khona/ Parachinar	Root and flower: they are used to dry and make a powder or boil with water.	Used for wound healing, pain relief, bites and stings	Used by elders 1 time for only one 1 week.	1	0.001
Olea capensis L./Oleaceae/Tree/BOT-KHS-9	_	+	Khona/ Parachinar	Branches: Direct used.	Used as a toothbrush for Toothache.	Used by elders at night.	1	0.001
Punica granatum L./ Lythraceae/Tree/BOT-KHS-105	_	+	Anar/ Parachinar	Cote of fruit: they are dry and make a powder and mix with water.	Used for stomach problems.	Used by elders 1 time for 1/2 weeks at night.	2	0.002
Platanus orientalis L./ Platanaceae/ Tree/BOT-KHS-261	_	+	Cheenar/ Parachinar	Bark: used as a decoction.	Used for acne, and pimple.	Used by elders on top at night for 1 week.	1	0.001
Persicaria barbata (L.) Hara/ Polygonaceae/Herb/BOT-KHS-262	_	+	Surguly/ Parachinar	Whole plants: they are boiled or cooked as food.	Used for respiratory disorders, skin infections, and kidney stones.	Used by elders 1 time for 1 week.	1	0.001

Quercus baloot Griff./ Fagaceae/Tree/BOT-KHS-263	_	+	Chairay/ Parachinar	Seed: they are used as raw or make their juice.	Used for Diabetes, and skin infections.	Used by elders at any time.	2	0.002
Quercus incana W. Bartram/ Fagaceae/Tree/BOT-KHS-264	_	+	Peerge wana / Parachinar	Bark: they are used as powder.	Used for bone fracture.	Used by elders and children 1/2 time a day.	1	0.001
Ricinus communis L./Euphorbiaceae/Shrub/BOT-KHS-75	+	_	Caster bean/ Kohat	Leaves: they are used as an herbal tea.	Used for sciatica	Used by elders once a week for 1 month.	3	0.004
Rumex crispus L./ Polygonaceae/Herb/BOT-KHS-147	_	+	Zumde/ Parachinar	Whole plant: they are used as an herbal tea or raw and dry to make a powder.	Used for skin problems, bleeding of gum, and cough.	Used by elders for 2 times for 1 week.	2	0.002
Robinia pseudoacacia L./Fabaceae/ Tree/BOT-KHS-265	_	+	Kikar/ Parachinar	Leaves: they are used as herbal tea	Used for diabetes.	Used by elders in the morning 1 cup 1/2 weeks.	3	0.004
Rosa webbiana Wall./ Rosaceae/Shrub/BOT-KHS-266	+	_	Zangaly gulab/ Kohat	Pastels: direct used.	Used as a memory stimulant.	Used by elders at any time.	2	0.002
Solanum tuberosum L./ Solanaceae*/S*hrub/BOT-KHS-80	_	+	Logo/ Parachinar	Tuber: they are mashed and make a smooth paste.	Used for burning skin.	Used by both elders and children apply on effective skin twice a day for 4/5 days.	6	0.008
Sorghum halepense (L.) Pers./Poaceae/ Herb/BOT-KHS-267	_	+	Dadam/ Parachinar	Rhizome: used as Juice or powder on top.	Used for snake bite, and anti-inflammatory	Used by elders and children if needed.	3	0.004
Thuja koraiensis Nakai/ Cupressaceae/Tree/BOT-KHS-268	+	_	Saroo/ Kohat	Fruit: they are Grained and applied on the infected tooth.	Used for toothache	Used by elders for 2 times a day for 5 minutes.	4	0.005
Tulipa clusiana Redoute/ Liliaceae/Herb/BOT-KHS-269	_	+	Shundi gul/ Parachinar	Rhizomes: they are used raw or mixed with milk and make a smooth paste.	Used for Cough, cold, headache, and anti-internal worm.	Used by elders and children 2/3 time for 1/2 weeks.	3	0.004
Tamarix aphylla (L.) H.Karst./ Tamaricaceae /Tree/BOT-KHS-83	+	_	Ghaz/ Kohat	Root and bark: used as Decoction.	Toothache, anti-inflammatory	Used by elders for 1/2 time for 2 weeks.	3	0.004
Taxus fuana Griff. Taxaceae/Tree/BOT-KHS-270	+	_	Banrya/ Kohat	Leaves and bark: used as powder or juice.	Used for diabetes, and hepatitis.	Used by elders for 1 time for 2 weeks.	1	0.001

Viola odorata L./ Violaceae/Herb/BOT-KHS-85	_	+	Banafsha/ Parachinar	Leaves: they are used as an herbal tea.	Used for Cough, and chest infection.	Used by elders 1 tea cup at night for 1/2 weeks and children 2 teaspoons at night for 4 days.	2	0.002
Vitis vinifera L./Vitaceae/Tree/BOT-KHS-86	_	+	Angoor/ Parachinar	Leaves: they are boiled with water and applied on hair.	Used for hair fall.	Used by elders once a week for 2/3 months.	4	0.005
Verbascum thapsus L./ Scrophulariacea /Herb/BOT-KHS-272	+	_	Kharghogy/ Kohat	Leaves: they are used as juice.	Used for inflammatory diseases, and cough.	Used by elders 1 time for 1 week.	13	0.017
Vachellia nilotica (L.) P.J.H. Hurter & Mabb./ Fabaceae /Tree/BOT-KHS-203	+	_	Kikar/ Kohat	Gum: they are used directly or roasted and make a powder.	Used as a tonic for leucorrhea	Used by elders for 1 time for 2 weeks.	4	0.005
Withania somnifera (L.) Dunal / Solanaceae/Shrub/BOT-KHS-273	+	_	Kotelal/ Kohat	Leaves: they are used as decoction or directly on top.	Used for bone fracture and bronchitis.	Used by elders 1 time for 1/2 weeks.	5	0.006
xanthium strumarium Lour./ Asteraceae/Shrub/BOT-KHS-225	_	+	zargorak or azgi gul/ Parachinar	Leaves and seeds: they are used as a powder or a dry.	Used for kidney stones and T.B.	Used by elders early in the morning for 5 days.	4	0.005
Ziziphus jujuba Mill./ Rhamnaceae/Tree/BOT-KHS-89	+	_	Bera/ Kohat	Leaves: they are grained mixed in olive oil and applied on hair.	Used for dandruff	Used by both for 3/4 days once a week for 1 month.	3	0.004
Ziziphus nummularia (Burm.f) Wight & Arn./ Rhamnaceae/Shrub/BOT-KHS-109	+	_	Bar / Kohat	Fruit and leaves: they are eaten directly and leaves are chewed.	Used as a tonic expectorant	Used by elders to chew leaves 2-3 times and fruit is used by both elders and children in a small amount 1 time for 4 days.	2	0.002
Zingiber officinale Roscoe./ Zingiberaceae/ Herb/BOT-KHS-110	_	+	Adrak/ Parachinar	Rhizomes: they are used as herbal tea, raw or dry, and make a powder.	Used for stomach problems, colic, gas, diarrhea as well as weight loss.	Used by elders and children any time at night.	5	0.006

Part Use and Use Categories

The primary individuals in the area primarily relied on various plant parts, including leaves, stems, roots, bark, the whole plant, fruit, rhizome, and tuber, for the preparation of herbal treatments. Among the reported plant parts, the leaf is the most commonly used medicinal component, followed in order by the fruit, whole plant, bark, stem, roots, and rhizome (Figure 4).

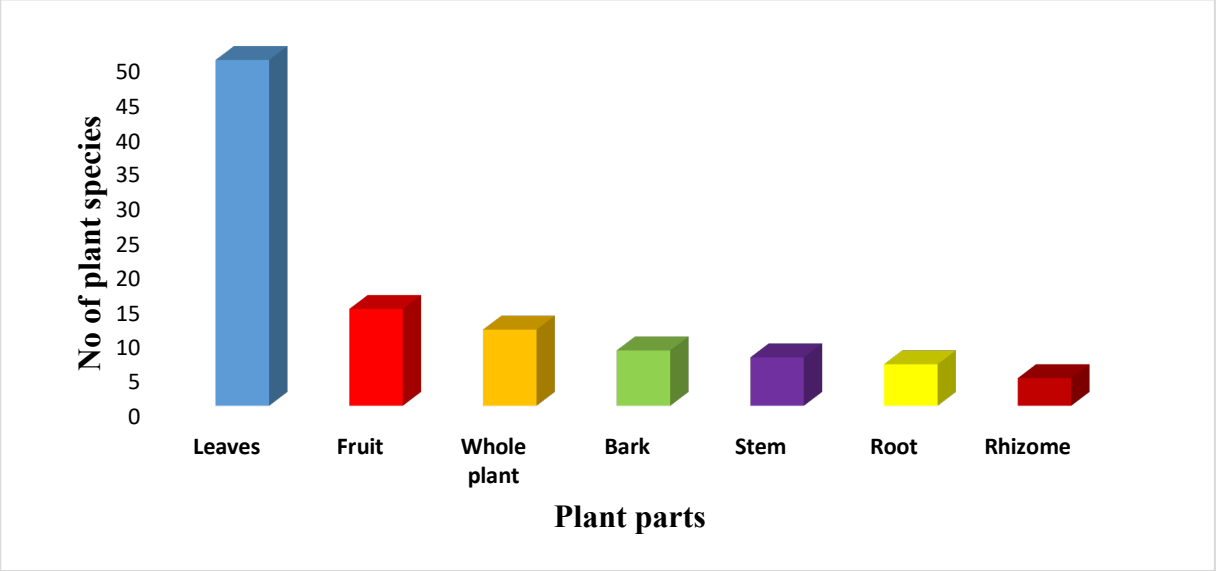

Figure 4. Detail of plant parts used as medicine

Relative Frequency Citation (RFC)

Withania coagulans was found to have the highest RFC (0.114), followed by *Malva sylvestris* (0.102), *Plantago lanceolate* (0.045), *Coriandrum sativum* and *Papaver somniferum* (0.04), *Curcuma longa* and *Caralluma tuberculata* (0.033). The least RFC was observed for *Artemisia tripartita*, *Carthamus oxyacantha*, *Conyza aegytiaca*, *Ephedera gerardiana*, and *Helianthus annuus* respectively (Table 2).

Informant Consensus Factor (ICF)

For calculating informant consensus factor (ICF) to various ailment categories 750 use reports were observed for gastrointestinal followed by skin disorders (230 use reports), cardiovascular disorders (56 use reports), diabetes (50 use reports), kidney disorders (40 use reports), blood purification (28), and sexual disorders (20) (Table 2). During the present study, it has been noted that gastrointestinal has a high ICF value (0.214) followed by skin disorders (0.143). The lowest ICF value was observed for sexual disorders (0.05).

Table 2. ICF of categories of diseases treated with medicinal plants

Disease Categories	Number of species (Nt)	Number of use Report (Nur)	ICF
Gastrointestinal	70	326	0.214
Skin	33	230	0.143
Cardiovascular disorders	10	56	0.178
Diabetes	6	50	0.12
Kidney	5	40	0.125
Blood purification	4	28	0.142
Sexual	1	20	0.05

Discussion

Ethnomedicinal plants are widely used in traditional medicine systems to treat a wide range of ailments, and their demand for alternative medicine is on the rise. About 80% of the populations in developing countries rely on medicinal plants to treat diseases, maintaining and improving the lives of their generation (Hussain *et al*. 2018; Haq *et al.* 2022).

In the current research, a total of 326 participants (130 males and 196 females) took part in gathering traditional knowledge regarding the use of ethnomedicines. The information collected was organized into various categories based on age, education, and occupation. In the current research, the number of female participants exceeded that of male participants. This could be attributed to women having greater knowledge about traditional plant recipes, as well as their increased involvement in household responsibilities, taking care of family members and their children. A research study was carried out by (Malik et al. 2029) and included 150 participants (100 females and 50 males). They provided information about various illnesses, such as diabetes, gastrointestinal issues, and urinary tract infections. Our findings were in line with (Mussarat et al. 2021), which indicated that females comprised the majority of the respondents. According to recent findings, leaves are the most frequently utilized part of plants, making up 50% of their usage. This is beneficial since it minimizes the damage to plants by allowing for the removal of leaves rather than stems or roots. A study conducted by Kadir et al. (2012) reported that leaves were utilized 90% of the time, while fruits and roots were used 16%. Both seeds and entire plants accounted for 8% each. In another investigation, leaves emerged as the most frequently used ingredient in the preparation of traditional medicines. Because leaves are abundant in tannins, glycosides, alkaloids, and saponins, which provide a variety of phytochemicals (Tag *et al*. 2012).

In the current correlated survey conducted in both districts, 14 plant species out of 103 were reported that were utilized commonly in both districts as traditional medicine. Some of the common species include *Aloe barbadensis, Allium sativum*, *Cannabis sativa*, *Malva sylvestris,* and *Withania coagulans* (Figure 5).

Figure 5. The plants collected in the study area: **a.** *Withania coagulans,* **b.** *Malva sylvestris*, **c.** *Allium griffithianum in dry form, d. Artemisia absinthium e. Mentha longifolia* f. *Allium griffithianum*

However, 86 plant species were individually used as a local medicine which was regarded as uncommon between the two districts. Based on a comparative analysis conducted by (Aziz *et al*. 2018), 94 medicinal plant taxa were identified. Most of these plants (72 species) were used in the Bajaur Agency rather than the South Waziristan Agency (37 species). In both agencies, only 15 medicinal plants were used in common by indigenous communities, indicating a low level of interregional consensus regarding ethno-veterinary practices (Aziz *et al*. 2018). An outcome from the present study indicates that plant

species reported belong to 50 different plant families. Among these Rosaceae was reported as dominant with 31 plant species while Asteraceae ranked second with 20 species. A similar study was conducted by (Belhouala and Benarba 2021) where documented total of 167 species belonging to 70 families were recorded. Lamiaceae (13%), Asteraceae (13%), Apiaceae (7%), and Rosaceae and Fabaceae (5% each) were the most cited families. According to (Zivkovic *et al*. 2021), In the Jablanica district, there are 89 plant species from 49 groups that are used as herbal treatments. The most often reported plant families were Rosaceae (17%), Asteraceae (17%), and Lamiaceae (23%).

The study reveals regional variations in the use of medicinal plants. In Kohat, *Cannabis sativa* leaves are used for treating burns, while in Parachinar, they are used for inflammation, sedation, and pain relief. Similarly, *Coriandrum sativum* is used for skin and stomach issues in Kohat but for halitosis in Parachinar. *Withania coagulans* seeds are employed to treat gastrointestinal diseases in Kohat and stomach pain and intestinal infections in other regions.

A similar study conducted in Kohat documented that *Enegalia modesta* was used for joint pain, dental pain, and labor pain (Ullah *et al*. 2016). Similarly, *Bauhinia variegata* as an astringent, carminative, purgative, and animal abdominal problems, *Brassica oleracea, Celtis sinensis,* and *Delphinium uncinatum* reported against piles, astringent, and diuretic veterinary abdominal problems menstrual disorders. Plant species like *Jatropha curcas* were used as antimicrobial agents (Zamin *et al*. 2024).

In Kohat, medicinal formulations were commonly used both orally and topically to treat various ailments, including skin, dental, and eye problems. Most remedies were prepared from single plant species, though some involved combining multiple species for specific uses. For example, refugees used a mixture of *Melia azedarach* root extract and *Juglans regia* bark extract as natural hair dye. The crushed leaves of *Nerium oleander* and *Fegonia indica* were applied to treat pimples and itching, while a mixture of *Peganum harmala*, *Trigonella foenum-graecum*, and *Lepidium sativum* leaves was boiled, and the decoction was consumed by women to induce menstruation. These practices highlight the diversity and adaptability of traditional medicinal knowledge in the region (Ali *et al.* 2024; Shah *et al*. 2023; Shah *et al*. 2023).

According to the current study, the Parachinar region is reported to have the majority of traditional medicinal plants than Kohat. The reason is due to differences in climatic conditions, soil types, average rainfall, temperature, languages, cultures, and ethnobotanical knowledge between the two regions**.** A study conducted in 2023 through structured questionnaires reported that the local population uses a total of 20 common plant species belonging to 17 families to cure a variety of diseases. Altogether, 20 plants were recorded that were used in the formulation of different ethno-medicinal preparations for curing 18 different types of diseases. Among the uses, some are administered in the form of single drugs to cure indigestion, reduced lactation, colic pain, colds, fevers, mouth diseases, eye problems, etc. In some cases, compound drug preparations are used for urinary troubles, diarrhea boils in the nose (Azzahra *et al*. 2023). A similar study conducted by Munir *et al*. 2022 identified 75 plants spanning 78 families that are traditionally used to treat various human ailments. The largest number of species was linked to digestive disorders, followed closely by respiratory diseases. Among these plants, herbs comprised 52 species, making them the most frequently utilized. The study also documented 74 wild medicinal species employed in 170 herbal remedies, which address 84 different illnesses across 15 categories of diseases.

The findings of the current study indicate that Bergenia ciliate exhibited the highest relative frequency citation (RFC) at 0.122, followed by *Allium cepa* at 0.101. Other notable species included *Verbascum thapsus* at 0.055, *Daucus carota* at 0.027, and both *Celtis caucasica* and *Ficus recemosa* with an RFC of 0.024. Additionally, a study conducted by Nazar et al. (2024) revealed that *Apteranthes tuberculata* had the highest RFC at 0.147, followed by *Momordica charantia* at 0.11, *Zygophyllum indicum* at 0.092, and *Withania coagulans* at 0.078. The value of RFC ranged between 0.93 and 0.04. *Berberis lycium* had the highest RFC value (0.81). Other plant species with significant RFC value were *Ajuga bracteosa, Prunella vulgaris, Adiantum capillus-veneris, Desmodium polycarpum, Pinus roxburgii, Rosa brunonii, Punica granatum, Zanthoxylum armatum*, and *Jasminum mesnyi*. The plant species with high RFC value were abundant in the area therefore the local people were very familiar with them, particularly concerning the ethnomedicinal perspective over a long period (Amjad *et al*. 2020; Haq *et al.* 2023).

In the current research, the ICF values for various categories of ailments addressed by the local informants in this survey varied from 0.05 to 0.124. Gastrointestinal, skin, and cardiovascular conditions were identified as the most common categories of ailments for medicinal plants in this area, with ICF values of 0.214, 0.183, and 0.178, respectively. Gastrointestinal scored the highest ICF (0.214). Maximum use reports were observed Gastrointestinal (326 use reports), skin (180 use reports), and cardiovascular disorders (56 use reports). These findings are due to high-use reports for plant species such as *Allium cepa*, *Verbascum thapsus*, and *Ficus recemosa* in the treatment of Gastrointestinal, skin disorders, and

cardiovascular disorders. According to a study conducted in 2020, high-use reports were diarrhea (47 use reports) followed by amebic dysentery (44 use reports) and stomach pain (35 use reports). A high ICF indicates the use of a relatively smaller number of taxa by a large number of informants whereas a low value is indicative of information disagreements about using a particular plant in the treatment of a particular disease (Tufail *et al*. 2020).

Conclusions

There exists a distinction in the usage of plant parts, disease treatment, and formulation of recipes, and therapies, which highlights a notable contrast in how these plants are utilized across both cultures. The study reveals that plant potentials may vary from one region to another. Knowledge regarding medicinal plants and their uses was diverse among the two locations. This variation might seem from the different diseases that are more common and severe in the regions where these plants are applied. Extensive research has been performed on various components of these plants (*M. sylvestris* and *W. coagulans*). Due to the characteristics of these plants, further research efforts are underway to explore their untapped and underutilized potential.

Future Recommendations

For the conversation of the wealth of medicinal plant resources herbal/ethnobotanical gardens should be established. With the cooperation/ involvement of the local people germ-plasm collection of useful plants should be carried out. Nurseries should be developed to supply propagating material of medicinal plants to local inhabitants. With the in vitro technology, these plants should be immediately grown which are very difficult to grow. These plants contain strong antimicrobial compounds and are strongly recommended for further biological activity. There is a need to identify the active compounds present in these plants. There is a further need to check the biological potential of these isolated compounds for other microorganisms.

Declarations

Ethical approval and consent of participants: Participants gave their prior consent before the interviews after the objectives of the study had been clearly explained to them.
Availability of data and materials: Data used in this work are available from the corresponding author.
Conflict of interest: The authors declare that they have no conflict of interest.
Funding: This research did not receive any funding from any agency.
Authors' contributions: RB conceptualization, methodology. Investigation and writing original draft; AN formal analysis, and indices formulation; FM and ZK review and editing, writing discussion; MA supervision; WH revised the manuscript.

Acknowledgments

We would like to express our gratitude to all those who contributed to this study on medicinal plants. Special thanks to Shumaila Babar for her efforts to make this team work successfully, and Dr. Wahid Hussain for their invaluable inputs in manuscript, support and guidance. Lastly, we extend our heartfelt thanks to our families and friends for their encouragement throughout this research.

Literature cited

Abbas W, Hussain W, Hussain W, Badshah L, Hussain K, Pieroni A. 2020 Traditional wild vegetables gathered by four religious groups in Kurram District, Khyber Pakhtunkhwa, North-West Pakistan. Genetic Resources and Crop Evolution 67:1521-1536.

Adeniyi A, Asase A, Ekpe PK, Asitoakor BK, Adu-Gyamfi A, Avekor PY. 2018. Ethnobotanical study of medicinal plants from Ghana; confirmation of ethnobotanical uses, and review of biological and toxicological studies on medicinal plants used in Apra Hills Sacred Grove. Journal of Herbal Medicine 14:76-87. doi: 10.1016/j.hermed.2018.02.001.

Alemu M, Asfaw Z, Lulekal E, Warkineh B, Debella A, Sisay B, Debebe E. 2024. Ethnobotanical study of traditional medicinal plants used by the local people in Habru District, North Wollo Zone, Ethiopia. Journal of Ethnobiology and Ethnomedicine 20(1):4.

Ali M, Huang Z., Bai Y, Tng DY, Qin F, Fang, Z. 2024. A multifaceted approach to expanding conservation efforts in the Pan-Himalayan landscape. Journal of Cleaner Production 476:143783.

Ali SI & Qaiser M.1995-2018. Flora of Pakistan. Department of Botany, University of Karachi.

Amjad MS, Zahoor U, Bussmann RW, Altaf M, Gardazi SM, Abbasi AM. 2020. Ethnobotanical survey of the medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine.16:1-28.

Aziz MA, Adnan M, Khan AH, Sufyan M, Khan SN. 2018. Cross-cultural analysis of medicinal plants commonly used in ethnoveterinary practices at South Waziristan Agency and Bajaur Agency, Federally Administrated Tribal Areas (FATA), Pakistan. Journal of Ethnopharmacology 210:443-468.

Aziz MA, Khan AH, Adnan M, Ullah H. 2018.Traditional uses of medicinal plants used by Indigenous communities for veterinary practices at Bajaur Agency, Pakistan. Journal of Ethnobiology and Ethnomedicine. 14:1-8.

Aziz Z, Lotfi A. 2018. Ethnobotanical survey of medicinal and aromatic plants used by the people of Targuist in the North of Morocco. Der Pharma Chemical 10(5).

Azzahra F, Astuti AD. 2023. Comparative Study Of The Use Of Natural Ingredients in Ethnomedical Study In Indonesia On The Herbal Formulary Of The RI Ministry Of Health. Stannum: Jurnal Sains dan Terapan Kimia 5(2):58-74.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MP, Arshad M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the Skardu valley at the high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine 10:1-8.

Belhouala K, Benarba B. 2021. Medicinal plants used by traditional healers in Algeria: A multiregional ethnobotanical study. Frontiers in Pharmacology 12:760492.

Eddouks M, Bidi A, El Bouhali B, Hajji L, Zeggwagh NA. 2014. Antidiabetic plants improve insulin sensitivity. Journal of Pharmacy and Pharmacology 66(9):1197-1214.

Gillani SW, Ahmad M, Zafar M, Haq SM, Waheed M, Manzoor M, Shaheen H, Sultana S, Rehman FU, Makhkamov T. 2024. An insight into indigenous ethnobotanical knowledge of medicinal and aromatic plants from Kashmir Himalayan region. Ethnobotany Research and Applications 28:1-21.

Haq SM, Hassan M, Bussmann RW, Calixto ES, Rahman IU, Sakhi S, Ijaz F, Hashem A, Al-Arjani AB, Almutairi KF, Abd_Allah EF. 2022. A cross-cultural analysis of plant resources among five ethnic groups in the Western Himalayan region of Jammu and Kashmir. Biology 11(4):491. doi: 10.3390/biology11040491.

Haq SM, Singh B. 2020 Ethnobotany as a science of preserving traditional knowledge: Traditional uses of wild medicinal plants from District Reasi, J&K (Northwestern Himalaya), India. Botanical Leads for Drug Discovery 277-293. doi: 10.1007/978-981-15-5917-4_13.

Haq A, Badshah L, Ali A, Ullah A, Khan SM, Ullah I. 2022. Ethnobotanical study of medicinal plants of Pashat Valley, Bajaur, along Pakistan–Afghanistan border: a mountainous region of the Hindu Kush Range. Nordic Journal of Botany (11):1-20. doi: 10.1111/njb.03580.

Haq A, Badshah L, Hussain W, Ullah I. 2023. Quantitative ethnobotanical exploration of wild medicinal plants of Arang Valley, District Bajaur, Khyber Pakhtunkhwa, Pakistan: a mountainous region of the Hindu Kush Range. Ethnobotany Research and Applications 25:1-29.

Hussain S, Hussain W, Nawaz A, Badshah L, Ali A, Ullah S, Ali M, Hussain H, Bussmann RW. 2022. Quantitative ethnomedicinal study of indigenous knowledge on medicinal plants used by the tribal communities of Central Kurram, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 23:1-31.

Hussain ST, Muhammad S, Khan S, Hussain W, Pieroni A. 2023. Ethnobotany for food security and ecological transition: wild food plant gathering and consumption among four cultural groups in Kurram District, NW Pakistan. Journal of Ethnobiology and Ethnomedicine.19(1):35.

Hussain W, Abbas W, Pieroni A. 2023. Exercising ethnobiological resilience in turbulent times and places: in memoriam Sayed Hussain (1998–2023). Journal of Ethnobiology and Ethnomedicine 19(1):23. doi: 10.1186/s13002-023-00596-2.

Hussain W, Badshah L, Ullah M, Ali M, Ali A, Hussain F. 2018. The quantitative study of medicinal plants used by the communities residing in Koh-e-Safaid Range, northern Pakistani-Afghan borders. Journal of Ethnobiology and Ethnomedicine 14:1-8.

Hussain W, Ullah M, Dastagir G, Badshah LA. 2018. Quantitative ethnobotanical appraisal of medicinal plants used by inhabitants of lower Kurram, Kurram agency, Pakistan. Avicenna Journal of Phytomedicine. 8(4):313.

Hussain W, Abbas W, Pieroni, A. 2023. Exercising ethnobiological resilience in turbulent times and places: in memoriam Sayed Hussain (1998–2023). Journal of Ethnobiology and Ethnomedicine 19(1):23.

Jan HA, Abidin SZU, Bhatti MZ, Ahmad L, Alghamdi AK, Alkreathy HM. 2022. Medicinal Plants and Related Ethnomedicinal Knowledge in the Communities of Khadukhel Tehsil, Buner District, Pakistan. Sustainability 14(20):13077. doi: 10.3390/su142013077.

Kadir MF, Sayeed MS, Shams T, Mia MM. 2012. Ethnobotanical survey of medicinal plants used by Bangladeshi traditional health practitioners in the management of diabetes mellitus. Journal of Ethnopharmacology 144(3):605-611.

Kang A, Moon SK, Cho SY, Park SU, Jung WS, Park JM, Ko CN, Cho KH, Kwon S. 2020. Herbal medicine treatments for essential tremor: A retrospective chart review study. Journal of Herbal Medicine. 19:100295. doi: 10.1016/j.hermed.2019.100295.

Mahmood A, Malik RN, Shinwari ZK, Mahmood AQ. 2011. Ethnobotanical survey of plants from Neelum, Azad Jammu and Kashmir, Pakistan. Pakistan Journal of Botany 43(1):105-110.

Malik K, Ahmad M, Zafar M, Ullah R, Mahmood HM, Parveen B, Rashid N, Sultana S, Shah SN, Lubna. 2019. An ethnobotanical study of medicinal plants used to treat skin diseases in northern Pakistan. BMC Complementary and Alternative Medicine 19:1-38.

Munir M, Sadia S, Khan A, Rahim BZ, Gagosh Nayyar B, Ahmad KS, Khan AM, Fatima I, Qureshi R. 2020. Ethnobotanical study of Mandi Ahmad Abad, District Okara, Pakistan. Plos one 17(4):e0265125.

Mussarat S, Adnan M, Begum S, Alqarawi AA, Rehman SU, Abd_Allah EF. 2021. Diversity of traditionally used polyherbal medicines. Pakistan Journal of Botany 53(4):10-30.

Mussarat S, Ali R, Ali S, Mothana RA, Ullah R, Adnan M. 2021.Medicinal animals and plants as alternative and complementary medicine in southern regions of Khyber Pakhtunkhwa, Pakistan. Frontiers in Pharmacology 12. doi: 10.3389/fphar.2021.649046

Mwangi VI, Mumo RM, Nyachieo A, Onkoba N. 2018. Herbal medicine in the treatment of poverty associated parasitic diseases: A case of sub-Saharan Africa. Journal of Herbal Medicine. 1(10):1-7.

Nazar A, Adnan M, Shah SM, Bari A, Ullah R, Tariq A, Ahmad N. 2024. Ethnobotanical assessment of antidiabetic medicinal plants in District Karak, Pakistan. BMC Complementary Medicine and Therapies. 24(1):173.

Nazir I, Intisar A, Din MI, Khan JS, Ahmed E, Aamir A, Manzoor M, Irfan M. 2023. Volatile Composition and Antibacterial Activity of Fruits of Withania coagulans Dunal. Pakistan Journal of Scientific & Industrial Research Series A: Physical Sciences. 66(3):227-33.

Petrakou K, Iatrou G, Lamari FN. 2020. Ethnopharmacological survey of medicinal plants traded in herbal markets in the Peloponnisos, Greece. Journal of Herbal Medicine 19:100-305. doi: 10.1016/j.hermed.2019.100305.

Qadir SU, Raja V. 2021 Herbal medicine: Old practice and modern perspectives. Phytomedicine 149-180. doi: 10.1016/B978-0-12-824109-7.00001-7.

Rashid N, Gbedomon RC, Ahmad M, Salako VK, Zafar M, Malik K. 2018. Traditional knowledge of herbal drinks among indigenous communities in Azad Jammu and Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 14:1-20.

Rehman S, Iqbal Z, Qureshi R, Shah GM, Afzal A, Rahman KU, Hussain W, Younas M, Latif S, Siddiqa A, Shah SS. 2024. Quantitative ethnomedicinal survey of wild edible fruits used by the indigenous community in North Waziristan, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications. 28:1-20.

Shah AA, Badshah L, Khalid N, Shah MA, Manduzai AK, Faiz A, De Chiara M, Mattalia G, Sõukand R, Pieroni A. 2023. Disadvantaged Economic Conditions and Stricter Border Rules Shape Afghan Refugees' Ethnobotany: Insights from Kohat District, NW Pakistan. Plants 12 (3):574.

Sher H, Aldosari A, Ali A, de Boer HJ. 2014. Economic benefits of high-value medicinal plants to Pakistani communities: an analysis of current practice and potential. Journal of Ethnobiology and Ethnomedicine 10:1-6.

Shinwari ZK, Gilani SA, Khan AL. 2012. Biodiversity loss, emerging infectious diseases, and impact on humans and crops. Pakistan. Journal.Botany 44(1):137-42.

Sulaiman, Shah S, Khan S, Bussmann RW, Ali M, Hussain D, Hussain W. 2020. Quantitative ethnobotanical study of Indigenous knowledge on medicinal plants used by the tribal communities of Gokand Valley, District Buner, Khyber Pakhtunkhwa, Pakistan. Plants 9(8):1001.

Tag H, Kalita P, Dwivedi P, Das AK, Namsa ND. 2012. Herbal medicines used in the treatment of diabetes mellitus in Arunachal Himalaya, northeast, India. Journal of Ethnopharmacology 14 (3):786-95.

Tufail M, Hussain K, Nawaz K, Bhatti KH, Yasin G, Ali SS. 2023. Ethnobotanical survey of important wild medicinal plants of tehsil Gojra, District Toba Tek Singh, Punjab, Pakistan. Ethnobotany Research and Applications 20:1-4.

Turan K, Akcan M, Kalfa OM. 2021. Preparation, Characterization and Antibacterial Activity of Malva Sylvestris L. Seed Extract Containing Novel Electrospun PVA Nanofibers. Gazi University Journal of Science 34(4):987-998.

Ullah I, Khan JA, Adhikari A, Shahid M. 2016. Hepatoprotective effect of Monotheca buxifolia fruit against antitubercular drugs-induced hepatotoxicity in rats. Bangladesh Journal of Pharmacology 11(1):248-256. doi: 10.3329/bjp.v11i1.25289.

Ullah S, Badshah L, Hussain W, Hussain I, Ali A. 2023. Quantitative ethnobotanical appraisal of plants used by inhabitants of Jelar Valley, Dir Upper, Northern Pakistan. Ethnobotany Research and Applications 25:1-21.

Umair M, Altaf M, Ahsan T, Bussmann RW, Abbasi AM, Gatasheh MK, Elrobh M. 2024. Study of medicinal plants used in the ethnoveterinary medical system in riverine areas of Punjab, Pakistan. Journal of Ethnobiology and Ethnomedicine 20(1):48. doi: 10.1186/s13002-024-00686-9.

Umair M, Altaf M, Bussmann RW, Abbasi AM. 2019. Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. Journal of Ethnobiology and Ethnomedicine 15:1-31.

Wagh VV, Jain AK. 2020. Ethnopharmacological survey of plants used by the Bhil and Bhilala ethnic community in dermatological disorders in Western Madhya Pradesh, India. Journal of Herbal Medicine 19:100-234. doi: 10.1016/j.hermed.2018.09.005.

Wanzala W, Minyoso SI. 2024. Ethnomedicines in the 21st century: challenges and opportunities in the contemporary world. Journal of Medicinal Herbs and Ethnomedicine 10:12-36. doi: 10.25081/jmhe.2024.v10.8832.

WHO. 2023. Global partners commit to advancing evidence-based traditional, complementary, and integrative medicine. World Health Organization. The First WHO Traditional Medicine Global Summit was held in Gandhinagar, Gujarat, India on the 17th and 18th August 2023. Retrieved from https://www.who.int/news/item/19-08-2023-global-partners-commit-to-advance-evidence-based traditional--complementary-and-integrative-medicine.

Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J, Zafar M. 2015. Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. Journal of Ethnopharmacology 163:43-59.

Zamin M, Adnan M, Begum S, Ullah I. 2024. Novel plant uses and their conservation status in a semi-arid subtropical region of Pakistan. Ethnobotany Research and Applications. 29:1-49.

Zivkovic J, Ilic M, Zdunic G, Jovanovic-Ljeskovic N, Menkovic N, Savikin K. 2021.Traditional use of medicinal plants in Jablanica district (South-Eastern Serbia): ethnobotanical survey and comparison with scientific data. Genetic Resources and Crop Evolution, 68(4):1655-1674.