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Cultural Significance and Indigenous Knowledge of Medicinal Plants in Tehsil Arifwala, Punjab, Pakistan: A Comprehensive Study

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ABSTRACT

For countless generations, humans have incorporated plants into their daily lives for a variety of purposes, particularly in traditional medicine. The objective of the present study was to ascertain, document, and investigate the cultural significance of medicinal plants and the associated indigenous knowledge among the population of Tehsil Arifwala, Punjab, Pakistan. An analysis of the indigenous knowledge regarding these plants was conducted through interviews with the local population using a semi-structured questionnaire, supplemented by group discussions and field observations. Quantitative indices, including Informant Consensus Factor (ICF), Utilization Value (UV), Fidelity Level (FL), Relative Popularity Level (RPL), and Rank Order Priority (ROP), were employed in the analysis. A total of 148 plant species, representing 129 genera and 58 families, were recorded. The study involved 120 participants (70 men and 50 women), revealing 148 medicinal plant species across 58 families. Among these, monocots accounted for 26 species from 8 families, while dicots comprised 122 species from 50 families, with Poaceae being the most prevalent monocot family (17 species). The dominant growth form identified was herbs (52%), followed by trees (16%), shrubs (15%), grasses (12%), creepers (3.30%), and climbers (3.30%). The most commonly utilized plant parts were whole plants (35%), leaves (33%), and fruits (10%). Extraction methods primarily included extracts (19%), followed by powders, pastes, decoctions, oils, infusions, teas, and syrups, with values of 14%, 11%, 9%, and 8%, respectively. Respiratory disorders were the most frequently reported ailments (78 occurrences), followed by joint pain (59 occurrences) and gastrointestinal issues (56 occurrences). The ICF varied significantly, ranging from 0.13 for asthma to 0.96 for digestive problems. Utilization Values ranged from 0.07 for *Pistia stratiotes* to 0.66 for *Withania somnifera* L. Popular plants, including *Mentha spicata* and *Ocimum basilicum*, exhibited RPL values between 0.8 and 0.9, while less commonly utilized species, such as *Alhagi maurorum* Medik and *Withania somnifera* L. had RPL values of 0.33 and 0.36, respectively. Based on the ROP, *Mentha spicata* L. and *Ficus palmata* ranked the highest with scores of 90 and 88, respectively, whereas *Parthenium hysterophorus* L. and *Veronica persica* were less utilized with ROP scores of 63 and 64, respectively. This study aims to bridge the gap between scientific and traditional medicinal practices, supporting drug development and conservation efforts for endangered medicinal plants. The high RPL values for popular plants suggest their viability for further research and potential therapeutic applications.

Keywords: Ailments treated; Ethnobotany; Informant Consensus Factor (ICF); Medicinal flora; Relative popularity level (RPL); Rank order priority (ROP).

INTRODUCTION

Relative cultural importance is a global botanical index presented for concerning in collecting qualitative (as for type of treated disease) and quantitative (as for determining the medicinal plants) data. It is used in ethnobotany for evaluating and testing the medicinal plant part in standard advanced methods. It refers for the value of ethnobotany not only on the same region but also all over the world. The reported plant part value (RPPV) is a new expression used to focus on the role and sustainable use of medicinal plant part in human health conservation (Olugbenga *et al*., 2021).

The study took place in the Arifwala Tehsil of the Pakpattan District within Punjab Province, Pakistan. Arifwala is located in the southwestern part of Pakpattan and has a population of 87,360, lying 381 km (237 miles) south of Islamabad, the capital of Pakistan, and 45 km from Sahiwal. This area, characterized by a hot and humid subtropical monsoon climate, encompasses 152 km^2 of land with silty soil, moderate depth ranging from 60 to 90 cm. Ethnobotanical studies focus on the intricate relationship between indigenous communities and the flora in their surroundings, encompassing the various practices and cultural beliefs associated with the diverse uses of plants (Mustafa *et al.*, 2023). It captures humid forests in the form of coniferous ones. They are extended in the North to dry temperate regions where create different plant communities encouraging grazing and cutting at natural vegetation (Muhammad *et al*., 2011). These studies are essential for highlighting the significance of indigenous plant species, particularly in the discovery of novel pharmaceuticals. There is a total

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of 422,000 plant species, out of which 52,887–52,200 are utilized as medicinal resources across various regions of the world (Jamal *et al*., 2012). Consequently, plants with medicinal properties make up 17.1% of the global flora. These plants are used to cure numerous illnesses in different medical systems worldwide. Approximately 35,000 to 70,000 plant species are utilized globally in traditional medicine. Due to their cost-effectiveness and reliability, they provide a viable option for medical treatment in less developed countries where access to conventional medicine may be limited (Barakatullah *et al*., 2009).

Herbal medicine has historically been the most readily available and cost-effective choice for communities lacking access to contemporary medications, particularly in the realm of primary healthcare systems. Throughout the course of human history, individuals have depended on plants to fulfill a diverse array of requirements. Ethnobotanists not only research the medical characteristics of plants, but also aim to comprehend their practical uses, including their functions as food, fodder, clothing, shelter, fuel, and furniture (Rana *et al*., 2020). Due to the oral transmission of folk and local medical knowledge over written documentation from one generation to the next, the amount of traditional knowledge is gradually dwindling. This important conventional information needs to be saved. The preservation of indigenous ethnomedical knowledge is crucial and could aid in the creation of new medications (Khan *et al*., 2015). Research has been conducted in a variety of universities over the last decade to determine the antibacterial, anticancer, antioxidant, and anti-inflammatory benefits of medicinal plants (Qaseem *et al*., 2019). Many studies on the indigenous applications of medicinal plants in Pakistan have been undertaken, although the investigated region remains unexplored. There is absolutely no information about the ethnoecological, ethnobotanical or ethno- pharmacological properties of the plants in Tehsil Arifwala, District Pakpattan. Herbal remedies are preferred over allopathic treatments in certain locations due to their lower cost and less adverse effects (Mustafa *et al*., 2023). The loss of indigenous knowledge poses a challenge to poor rural economies like those in the study area, which are focused on traditional livestock rearing. As a result, it was believed necessary to essay the ethnobotanical knowledge held by the people of the various regions and preserve the area's traditional wisdom before it was lost forever. In this study an effort was made to disseminate important indigenous and beneficial medicinal knowledge of native flora, so that scientific research on these plants might be conducted in future (Tufail *et al*., 2020). Therefore, the study aimed to document and analyzes the cultural significance and indigenous knowledge associated with medicinal plants among the local population of Tehsil Arifwala, Punjab, Pakistan. Through qualitative and quantitative assessments, the research seeks to reveal the utilization patterns, growth forms, extraction methods, and prevalent ailments treated with these plants. By employing various indices such as Informant Consensus Factor (ICF), Utilization Value (UV), Fidelity Level (FL), Relative Popularity Level (RPL), and Rank Order Priority (ROP), the study endeavors to provide a comprehensive understanding of the medicinal flora in the region. Ultimately, the research aims to bridge the gap between traditional and scientific medicine, fostering potential applications in drug development and conservation strategies for endangered medicinal species, while simultaneously preserving the rich ethnobotanical heritage of the community. It also aspires to serve as a benchmark for future references and the standardization of traditional herbs.

MATERIALS AND METHODS

Study area and demographic data of informants

Arifwala is a tehsil located in the Pakpattan District of the Punjab province of Pakistan, situated at approximately 30° 17' 0" North latitude and 73° 4' 0" East longitude. Species were collected from eight localities within the Pakpattan District, Punjab, Pakistan, including the River Sutlej, Adda Kameer, Adda Rangshah, Arifwala city, Diluwala Pul, Chowk Marly, and Kaboola Shareef. The study area has a total population of 87,360 in Arifwala, which is located in the sub-tropical monsoon region of Punjab. It is situated 420 feet above sea level. Farmers make up the majority of the population. The agricultural area covers 1,274 acres, while the urban area encompasses 457 acres (Khan and Ali (2021).

Corn (*Zea mays* L.) is a prominent cash crops in Arifwala, alongside other key crops such as wheat (*Triticum aestivum* L.), sugarcane (*Saccharum officinarum* L.), and cotton (*Gossypium herbaceum* L.), as well as various vegetables. The region's climate is also well-suited for the cultivation of citrus fruits, including *Citrullus lanatus* (Thunb.) Matsum. and Nakai, *Syzygium cumini* (L.) Skeels, and *Mangifera indica* L. The fertile soil of District Arifwala supports a rich phytodiversity, making it an ideal agricultural area. Vegetation data of Arifwala shows that the most dominating flora of the area comprise of *Parthenium hysterophorus* L., *Euphorbia antiquorum* L., *Oxalis corniculata* L., *Calo-tropis procera* (Aiton) W.T.Aiton, *Cynodon dactylon* (L.) Pers., *Desmostachya bipinnata* (L.) Stapf, *Vachellia karroo* (Hayne) Banfi and Galasso considered as dominant species in all the eight zones of the study area followed by *Acacia nilotica* (L.) Delile, *Albizia lebbeck* (L.) Benth., *Aloe vera* (L.) Burm. f., *Azadirachta indica* A. Juss., *Chenopodium album* L., *Cheno-podiastrum murale* (L.) S. Fuentes, Uotila and Borsch, *Cordia myxa* L., *Cynodon dactylon* (L.) Pers., *Dalbergia sissoo* Roxb., *Datura stramonium* L., *Digera muricata* (L.) Mart., *Echinochloa colonum* (L.) Link, *Eucalyptus citriodora* Hook. *Ficus benghalensis* L., *Ficus religiosa* L., *Melia azedarach* L., *Morus alba* L., *Ricinus communis* L., *Salvadora oleoides* Decne., *Solanum nigrum* L., *Withania somnifera* (L.) Dunal. Local *villagers* with expertise in indigenous herbal flora and their practical applications were selected as

informants, with a maximum of 120 respondents (comprising 70 males and 50 females).

Sources of Ethnoecological data collection

Sixty-five informants were sampled during random visits in the area while, the other 55 informants were designated by the local individuals, including religious leaders, traditional healers, hakims, herbalists, pansaars and were sampled during arbitrary trips in the region. All the informants in the study area were chosen based on the level of expertise they provided throughout their interviews (Map 1).

Plant sample identification

The identification of plant specimens (Table 1) was followed according to Flora of Pakistan by Ali *et al*. (2001). The information which recorded on the herbarium sheets were; botanical name, family name, plant's location, and habitat etc. The determined voucher specimens were deposited in the herbarium of Dr. Sultan Ahmad Herbarium, GCU Lahore. For this investigation, interviews were conducted with 120 individuals, 70 men and 50 women. Fieldwork for this study included interviews with dayiahs, shepherds, transporters, farmers, housewives, labor, teachers, students (from elementary school through college), merchants, pansari, herbalists, and hakims.

Quantitative ethnobotanical data Analysis

Seven ethnobotanical indexes were used to examine the gathered information based on ethnobotany and ethnoecology; Direct matrix ranking, Fidelity level value (FL %), Used value index (UVI), Informant consensus factor (ICF), Preference ranking, Relative popularity level (RPL) and Rank order priority (ROP). We followed the quantitative tools for better help and with the best ethnobotanical inquiry about the most valuable and usage of medicinal plants for most prevailing ailments of the area.

Direct matrix ranking

The informants were asked to rank 53 plants on a scale of 1 to 10 to determine the different human requirements or use categories and which plants were employed for them. The most valuable species in the research area were determined to be the species with the highest score (Martin *et al.*, 1995).

Fidelity level value (FL %)

The identification of the most prevalent diseases treated with a specific plant, as well as other disorders that can be treated with the same plant, was accomplished by utilizing the fidelity level (FL%). The fidelity level enables us to promptly ascertain the best appropriate species for treating a specific ailment. The formula as follows:

$$F\ value(\%) = \frac{NP}{N} X\ 100$$

Where N and P are both indicate the count of informants who reported using plants as a medicine for different ailments. NP specifically shows the count of informants who reported utilizing a particular species of plants for a specific sickness (Alexiades, 1996).

Used value index (UVi)

The used value index (UVi) is a valuable tool in ethnobotany for assessing the significance of various plant species as perceived by local communities. It quantifies the diverse uses that local people have for plants including food, medicine, building materials, or cultural significance. The UVi can be calculated following the method of Muhammad *et al*. (2022). As formula shows:

$$UVi = \sum_{i=1}^{n} Ui$$

Where, *i* represents the frequency of use (how often is each plant used); *ni* is number of different uses for each species; n represents the total number of species considered in the study.

In order to obtain this information, it is necessary to determine the number of informants interviewed about the specific plant, as well as the number of reports ((U)) provided by those informants.

Informant consensus factor (ICF)

The ICF (Heinrich *et al*., 1998) was employed to assess the informants' knowledge reliability on the particular plant species used for treating each disease within several disease categories. The goal of the ICF was to achieve consensus among the informants regarding the recorded treatments for each category of disorders. As a result, the formula shown below was applied.

$$\mathrm{ICF} = \frac{\mathrm{Nt}}{\mathrm{N_{ur}} - 1}$$

Where, Nt represents the total number of plant species used; N_{ur} represent the quantities given for each disease category.

Preference ranking

The evaluation of each plant's level of efficacy in its most popular therapeutic applications and to pinpoint potential risks, preference rating was carried out. Accoording to their personal preferences, informants assigned a score to each species, with 1 being the least important and 10 being the most significant. By adding up each value, the ranking was determined. The most significant category in the community was thought to be the one with the highest score (Martin *et al*., 1995).

Relative popularity level (RPL)

The Relative Potency Level (RPL) is a reliable measure of the effectiveness of a plant species in treating specific diseases. Although they may have a similar floral morphology, different plant species might exhibit diverse therapeutic properties. A rectification scale is devised to categorize all the discovered plant species according to their level of popularity. The relative popularity level (RPL) ranged from 0.1 to 1.0. A number of 1.0 signified that a plant was highly effective in curing significant ailments and indicating complete popularity for treating major ailments. whereas a value of 0.1 indicated that a plant species had no documented ability to treat common ailments. For commonly found plant species, it is advisable to select a relative popularity level (RPL) number that is

close to or equal to one. However, for less common plant species, a rather lower RPL value is recommended. It serves as an indicator of the plant's popularity and significance in traditional medicine. The study determined the relative popularity level (RPL) of the plant species and categorized it as either popular or unpopular (Ajaib *et al*., 2021).

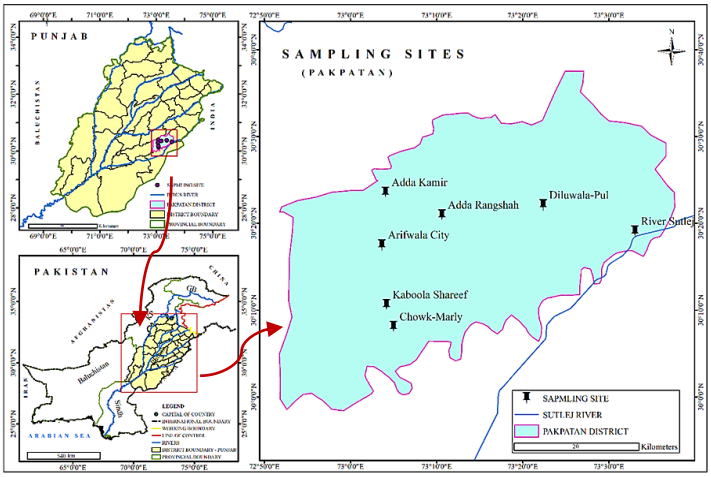
Rank order priority (ROP)

To accurately rank plant species based on varying Fidelity Level (FL) and Relative Popularity Level (RPL) values, a correction factor known as Rank Order Priority (ROP) was employed. The ROP is calculated by determining the product of the FL value and the RPL value, as described by Amjad *et al.* (2017). The formula for calculating ROP is expressed as follows:

$$ROP = RPL \times FL$$

Where, RPL is relative popularity level; FL is the fidelity level value.

The ROP index ranges from 0 to 100, with 100 indicating the plant species with the highest relative importance and prevalence of use among the local community. The ROP index, also provides a quantitative measure of the cultural significance and traditional knowledge associated with the use of different plant species, allowing for comparative analysis between species. However, The Relative Popularity Level (RPL) value for each plant species is determined based on its medicinal use and the frequency with which it is cited by informants in ethnobotanical studies.



Map (1): Study area showing the sampling sites.

RESULTS

Demographic characteristic of the study area

A total of 120 participants were surveyed, categorized by age as follows: 40 participants aged 30 to 45, 50 aged 46 to 60, 20 aged 61 to 75, and 10 aged 76 to 80. Additionally, respondents were classified into five categories based on their literacy levels. The majority of data were collected from participants aged 46 to 60, followed by those aged 30 to 45, 61 to 75, and those aged 76 to 80 (Figure 1).

Diversity of ethnomedicinal flora

The present analysis identified a total of 148 distinct species of medicinal plants, belonging to 58 different families. Of the entire plant population, 26 species were classified under 8 monocot families and 122 plants belonged to 50 dicot families. Tables (1 and S1) showed detailed information about each medicinal plant, including its scientific name, family name, local name, part used, method of preparation, and its various uses. The Poaceae family was the most abundant group of medicinal plants in this study, consisting of 17 species. Poaceae belonged to the monocotyledonous group of plants. The Fabaceae family was the second most abundant group with thirteen species, followed by the Asteraceae family with eleven species, and finally the Euphorbiaceae family with nine species.

The plant samples consisted of 52% herbs, 16% trees, 15% shrubs, 12% grasses, 3.3% creepers, and 3.3% climbers. Members of these families were routinely integrated into medical practice due to their abundance of bioactive compounds and advantageous pharmacological effects.

Plant parts, method of preparation and application

While all components of plants were significant the treatment of different ailments, the entire plant was the most frequently utilized in traditional medicinal preparations (35% of the time). The most plant part used in treating diseases was roots and leaves, 52% and 48% respectively. The current study revealed that out of the 49 traditional recipes used for treating helminthiasis, the survey identified 41 different plant species. The indigenous people of Sahiwal district in Pakistan primarily utilized *Brassica campestris* L. and *Mallotus philippinensis* (Lam.) Muell. -Arg. The major plant component was stated as leaves ten times, followed by seeds with nine occurrences, and several minor components. Only 10% of recipes required the use of many types of plants, whereas the remaining 89.8% of recipes only required the use of a single type of plant. As part of the preparation process, solutions were created by the utilization of crushing, grinding, soaking, boiling, and mixing. All recipes were administered orally (Figure 2).

The diverse techniques employed by the local communities in the research area to treat various illnesses encompass decoction, extract, juice, powder, paste, infusion, poultice, tea, and ash, among others. The medication preparation procedures that were predominantly utilized included extraction (19%), pulverization (14%), pasting (11%), decoction (8%), oil infusion (11%), infusion (9%), tea brewing (8%), and syrup formulation (8%).

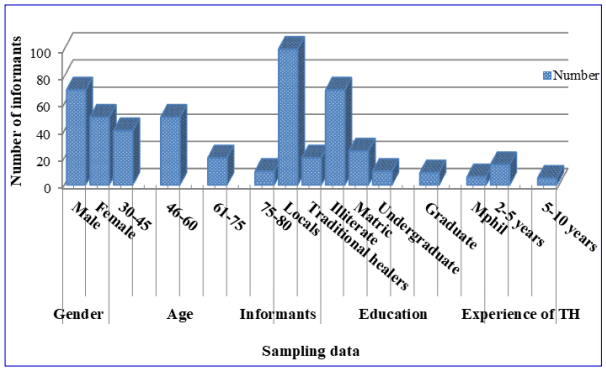


Figure (1): Demographic data of participants

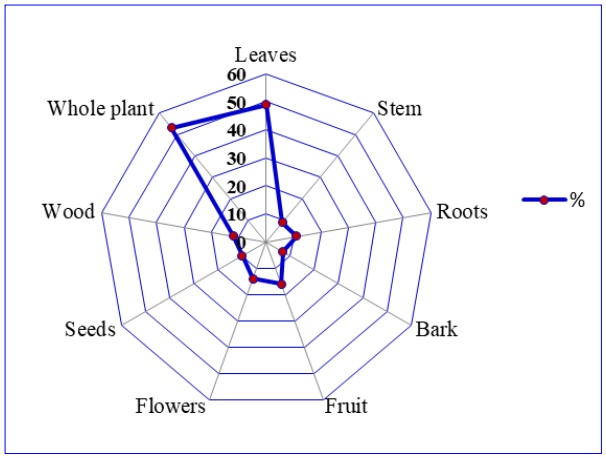


Figure (2): Proportional use of plant parts in disease treatment: A study from the local area.

Informant consensus factor (ICF) analysis

To calculate the Informant Consensus Factor (ICF), the reported disorders were initially classified into 29 unique disease categories based on their consumption statistics. Among the three main disease groups, respiratory diseases were the most prevalent, with 78 reported cases. Joint pain was referenced in 59 reports, while stomach issues accounted for 56 reports. Approximately 19% of the plant species were used to treat dermatological conditions, whereas gastrointestinal tract disorders, fevers, respiratory ailments, wounds, and blood purification represented 15%, 13%, 12%, 11%, and 9%, respectively (Figure 3, Table 2).

Fidelity level (FL) and Use Value Index (UVI)

Fidelity Level (FL)

The Fidelity Level indicates the percentage of informants who reported using a specific plant species for a particular medicinal purpose. A higher FL suggests that the plant is commonly used to treat a certain ailment. In this study, the fidelity level (FL) of the 64 most significant plant species varied from 17 to 100%. Typically, the high frequency of occurrence of a certain disease in an area was indicated by the high FL (frequency of occurrence of a disease in a plant species) of a species. This suggested that the inhabitants of the area rely on specific plant species to treat the sickness. *Mentha spicata* L., *Acacia nilotica* L.Willd. ex Delile and *Cordia myxa* L. with maximum FL values (100%, 96 % and 95% respectively), were used against Stomach ulcers, joint pains, and cough respectively. The plant species with 100% FL for example *Sesamum orientale* L. had also been reported strong usefulness against iron deficiency (Anemia) and *Solanum nigrum* L. against Sore eyes with 100% FL values. While *Sisymbrium irio* L. (Asthma), *Veronica persica* Poir. (Hernia, Rheumatism) and *Withania somnifera* (L.) Dunal (Irregular menstruation) were the species with lowest FL values percentages e.g., 17%, 20% and 20%, respectively. The fidelity level of most important plants used for domestic purposes was also calculated. *Mangifera indica* L. (Fruit, Pickles), *Raphanus raphanistrum* L. (Vegetable), *Bauhinia purpurea* L. (Fodder, Fuel), *Dalbergia sissoo* Roxb. exDC. (Furniture), *Trifolium alexandrinum* L. (Fodder), *Triticum aestivum* L. (Food, Feed, Handicrafts) and *Tripidium bengalense* (Retz.) H. Scholz (Baskets, Thatching, Brooms) were the plants with highest fidelity levels ranged from 96%-100% (Table 3, Figure 4).

Relative popularity level (RPL)

The Relative Popularity Level (RPL) is a more accurate metric than the use value index (UVI) for assessing the effectiveness of plant species in relation to specific diseases. In our study encompassing 29 different disease categories, 120 informants identified a total of 64 plant species, as detailed in Figure (5). These species were particularly emphasized by the informants and will be discussed further.

Our analysis revealed a significant correlation between the number of informants who reported using a specific plant species for a given disease and the total

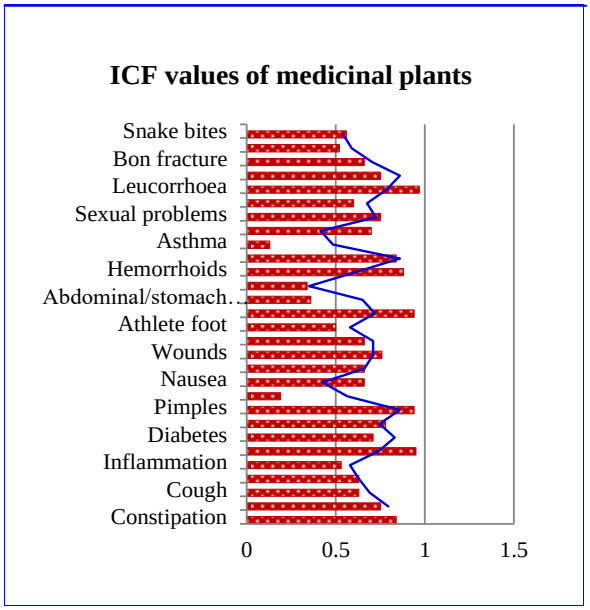


Figure (3): ICF values of medicinal plants: Insights into traditional remedies.

Table (1): Ethnobotanical uses and characteristics of local flora.

No.	Families	Scientific name	Local names	Flowering period	Life form	Part used	Utilization technique	Ethnobotanical uses with recipes
1	Acanthaceae	*Eranthemum pulchellum* Andrews	Gulsham	January-April	Evergreen shrub	Leaves, stems, and roots	Leave extract	• Ornamental, • **Medicinal uses**: Treat of fissures and blisters, antimicrobial and antiseptic agents to clean homes.
2	Aizoaceae	*Dorotheanthus bellidiformis* (Burm. f.) N. E. Br.	Gurumukhi	Summer	Mat-forming herb	Whole plant	Powder	• Ornamental • Used in rock gardens for coloring during-spring purposes.
		Trianthema portulacastrum L.	It-sit	Winter	Succulent herb	Roots	Powder, Decoction, Extract	• The plant powedered are used against: liver infection, asthma, jaundice. • The roots in bitter powdered form in com-bination with ginger are used as cathartic.
		Alternanthera sessilis Red	Gandhalboti\ Waglon	Winter	Perennial herb	Stems, roots and leaves	Syrup, Tea, Topical, Oral	• Eye Diseases: Stems and leaves are used for treatment. • Acne: Herb applied topically for acne treatment. • Inflamed Wounds: Root helps in reducing inflammation of wounds. • Conditions: Used locally with other herbs for hepatitis, chest tightness, bronchitis, and asthma. • Snake Bites & Diarrhea: Aids in alleviating symptoms. • Hypertension: Foliage and young stems boiled and consumed as a remedy.
3	Amaranthaceae	*Atriplex halimus L.*	Lon-chos	July-August	Fodder shrub	Leaves	Extract, Ash	• Four-winged saltbush is a highly nutritious feed plant for most cattle. These animals encompass sheep, goats, and cattle. • The ash of burnt plant is used as the alkali in making soap. • Leaf extract helps reducing elevated blood glucose level in diabetes.
		Bassia muricata (L.) Asch.	Ghabitha	March	Annual or perennial sub-shrubs	Shoots, Leaves	Extracted essential oil	• The extracted essential oil, by hydrodistillation of shoot of *Bassia muricata*, is an eco-friendly tool for weed management to control *Chenopodium murale*. • Insecticidal activities.
		Digera muricata (L.) Mart.	Tandhlah	July-august	A small, ascending herb.	whole plant	Powder, Paste	• Commonly grazed as forage, particularly by sheep and goats. • Seeds and flowers are used to treat urinary disorders. • Consumed as a vegetable, often in combination with lentils • Also cooked as saag (a traditional dish).

Table (1): continued

No.	Families	Scientific name	Local names	Flowering period	Life form	Part used	Utilization technique	Ethnobotanical uses with recipes

4	Anacardiaceae	*Magnifera indica L.*	Ambb	Late winter-early spring	Fruiting Tree	Whole plant	Juice, paste, syrup, prickle	• **Consumption Methods**:
								  • Raw: Eaten when mature and green.
								  • Cooked: Prepared using traditional methods.
								  • Processed: Used in various products such as: Pickles, Chutneys, Dried slices, Canned slices in syrup, Juice, Puree and Paste.
								• **Traditional Medicine**:
								  • Astringents derived from dehydrated flowers or bark.
								  • Kernel decoctions prepared for medicinal use.
								  • Antibiotic Properties: Extracts from unripe fruit, bark, stems, and leaves exhibit antibiotic activity.
								• **Wood Characteristics**:
								  Robustness and longevity.
								  High degree of malleability.

5	Annonaceae	*Polyalthia longifolia (Sonn.) Thwaites*	Ulta-ashook	Spring	A tall handsome tree	Bark and leaves, Topical, Oral	Juice, decoction; Paste	• **Health Benefits**: Treats stomachache, Alleviates body pain, Reduces fever, Acts as a liver tonic. • **Ornamental Uses:** Used for making hedges and boundaries. • **Medicinal Uses:** • Bark and leaves are used to treat:Microbial infections, Inflammation, Diabetes and Various diseases of the digestive system
6	Apiaceae	*Anethum graveolens L.*	Soye	August-September	perennial herb plant	Whole plant	Powder	• **Traditional medicine** has utilized the following qualities of the fruits (seeds):Carminative, Stomachic and Digestive. • These qualities help relieve symptoms such as: Indigestion, Gas, Hemorrhoids, Bad breath and Colic. • **The flowers utilization**: As a garnish, Incorporated into salads, Preserved in pickles, According to Hakeem's reference, it is recommended that:Patients with type 2 diabetes consume 3 grams of dill powder daily for a duration of eight weeks.
		Foeniculum vulgare Mill.	Saunf	Spring	Seasonal herb	Whole plant	Juice, infusion, Extract	• **Leaf Consumption**: Leaf bases can be consumed raw or cooked; chopped leaves are often used as a salad garnish. • **Root Preparation**: Roots are cooked and consumed as a vegetable. • **Fruit Utilization**: Fragrant fruits (referred to as 'seeds') used as a culinary spice to enhance food flavor and the juice is linked with improving visual acuity. • **Medicinal Uses**:Hot infusions of the fruits promote lactation and sweating and Fruits exhibit various medicinal properties, acting as a stimulant, stomachic, expectorant, and carminative. • **Essential Oil Applications**: • Essential oil of the fruits is used in cosmetics production (soaps, creams, lotions, perfumes). The residual material post-extraction used as fodders.

Table (1): Continued

No.	Families	Scientific name	Local names	Flowering period	Life form	Part used	Utilization technique	Ethnobotanical uses with recipes

		Catharanthus roseus (L.) G.Don	Sada-bahaar/Bara-massi	March-April	Perennial herb	Root and Leaves	Powder	• **Primary Use**:
								  • Utilized primarily for ornamental purposes.
								• **Toxicity Consideration**:
								  • Employed exclusively in medicinal form due to inherent toxicity.
								• **Medicinal Applications**:
								  • Alleviates muscle discomfort.
								  • Acts as a depressant of the central nervous system.
								  • Provides treatment for wasp stings.
								  • Promotes wound healing.

7	Apocynaceae	*Nerium oleander L.*	Ganira, Kunair	June-October	Evergreen Shrub	Flowers and leaves	Extract, dye, latex	• **Primary Use**:
								  • Cultivated for both decorative and outdoor purposes.
								  • **Uses**:
								  • **Flowers**: Utilized for the production of a green pigment.
								  • **Leaves**: Contain a small amount of latex, which can be used to create rubber.
								• **Medicinal Applications**:
								  • Used to treat:
								  • Scabies, Cancer, Leprosy, Ulcers, Chancres, Swellings, Various skin disorders
								• **Pesticidal Properties**:
								  • Exhibits multiple applications as an insecticide, parasiticide, and rodenticide.

8	Arecaceae	*Chamaedorea seifrizi Burret*	Narah	Spring-Summer	Evergreen perennial tree	Stem	Powder	• **Primary Use:**• Utilized primarily for ornamental purposes. • **Wood craft:** Tobacco pipes and bamboo flutes (bansuri) are crafted from this material.

9	Asclepiadaceae	*Calotropis procera (Aiton) Dryand.*	Akh	Winter	Perennial shrub	Whole plant	Extract, paste, poultice, Latex, decoction	• **Primary** Use:
								  • Valued as a medicinal herb.
								• **Medicinal Applications**:
								  • Alleviates burns, treats hepatitis,
								  • addresses odontalgia (toothache), relieves asthma, used for malaria treatment and
								  • effective against lice infestation.

Table (1): Continued

No.	Families	Scientific name	Local names	Flowering period	Life form	Part used	Utilization technique	Ethnobotanical uses with recipes
10	Araceae	*Phoenix dactylifera L.*	Khajoor/ khajii	After 4-5 years	Evergreen Tree	Whole plant	Powder, paste, juice, Gum	• **Edible Fruit**: Cultivated primarily for its sweet, nutritious fruit. • **Shade and Shelter**:Provides shade and shelter in various environments. • **Fuel and Firewood**:The tree yields wood suitable for fuel and firewood. • **Beverage Base**:Fruit or other parts may serve as a base for beverages. • **Flour/Starch Production**: Parts of the tree can be processed into flour or starch for culinary uses. • **Honey Flora**:The tree's flowers attract pollinators, contributing to honey produc-tion. • **Oil and Fat**: Seeds or other components may yield oil or fat for culinary or industrial uses. • **Gum/Resin**:Produces gum or resin with various applications. • **Wood and Timber**:Wood is utilized for construction, including flooring and roofing. • **Handmade Articles**:Bark and leaves are crafted into items such as handle fans and other handmade products. **Nutritional Value**: • Fruit or parts of the tree can address dietary deficiencies, particularly iron. **Animal Feed**: • Seeds are processed by soaking and grinding, providing feed for livestock. **Sustainable Use**: • Various products derived from the tree promote sustainable use and resource management.
		Pistia stratiotes L.	Sabs booti	June-September	Floating herb	Whole plant	Decoction, juice, extract, paste	• **Medicinal Uses:** Relieves asthma, Alleviates eczema, Aids in painful urination, treats piles, reduces swollen joints and used for leprosy. • **Administration Routes:** Topical, oral and anal.

Table (2): Informants Consensus factor (ICF) according to plant-based remedies for common diseases: A comparative analysis of efficacy and important medicinal plant species.

Diseases Categories	ICF	Important plant of this category	Diseases Categories	ICF	Important plant of this category
Constipation	0.84	*Ficus palmata* Forssk.	**Pimples**	0.94	Aloe vera (L.) Burm. f.
Kidney stones	0.75	*Alhagi maurorum* Medik	**Fever**	0.19	Malva parviflora L.
Cough	0.93	*Morus alba* L.	**Nausea**	0.66	Cymbopogon citratus (DC.) Stapf
Digestive problems	0.96	*Oxalis debilis* kunth	**Jaundice**	0.66	Trianthema portulacastrum L.
Inflammation	0.53	*Polyalthia longifolia* (Sonn.) Thwaites	**Wounds**	0.76	Calotropis procera (Aiton) Dryand.
Cooling effect	0.95	*Mentha spicata* L.	**Boils**	0.66	Oxalis corniculata L.
Diabetes	0.71	*Atriplex halimus* L.	**Athlete foot**	0.5	Moringa oleifera Lam.
Diarrhea	0.78	*Syzygium cumini* (L.) Skeels	**Joint pains**	0.94	Acacia nilotica (L.) Delile
Stomach problem	0.36	*Datura inoxia* Mill	**Asthma**	0.13	Ranunculus muricatus L.
Skin problems	0.34	*Aloe vera* (L.) Burm. F.	**Blood purifier**	0.7	Convolvulus arvensis L.
Hemorrhoids	0.88	*Anethum graveolens* L.	**Sexual problem**	0.75	Chenopodiastrum murale L.
Toothache	0.84	*Salvedora oleides* Dacene.	**Antidandruff**	0.6	Eclipta prostrate (L.) L.
Leucorrhoea	0.5	*Phoenix dactylifera* L.	**Bon fracture**	0.66	Stellaria media (L.) Vill.
Snake bites	0.56	*Ludwigia adscendens* (L.) H. Hara	**Anti-lice**	0.75	Cannabis sativa L.
Insect repellents	0.52	*Melia azedarach* L.			

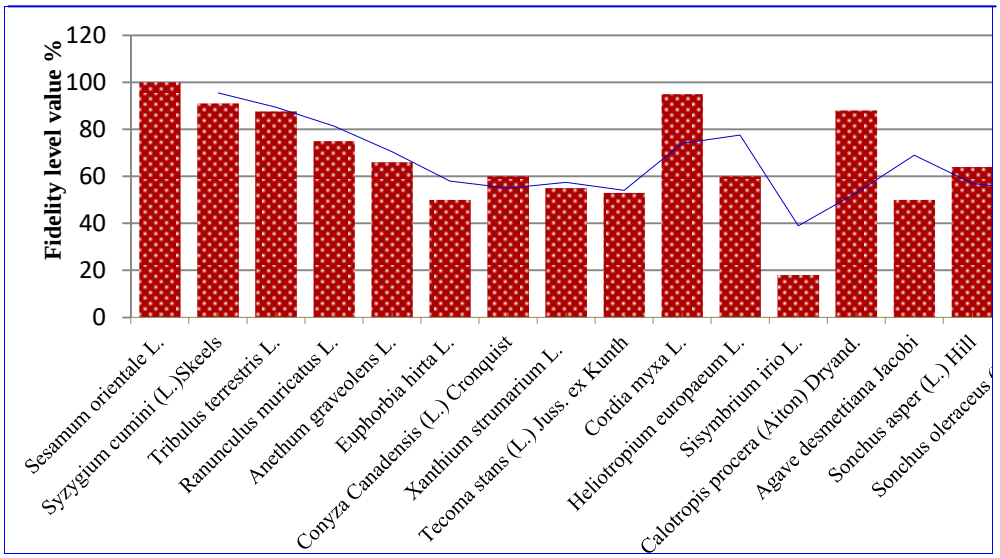


Figure (4): Fidelity level of medicinal plants: Insights into traditional remedies.

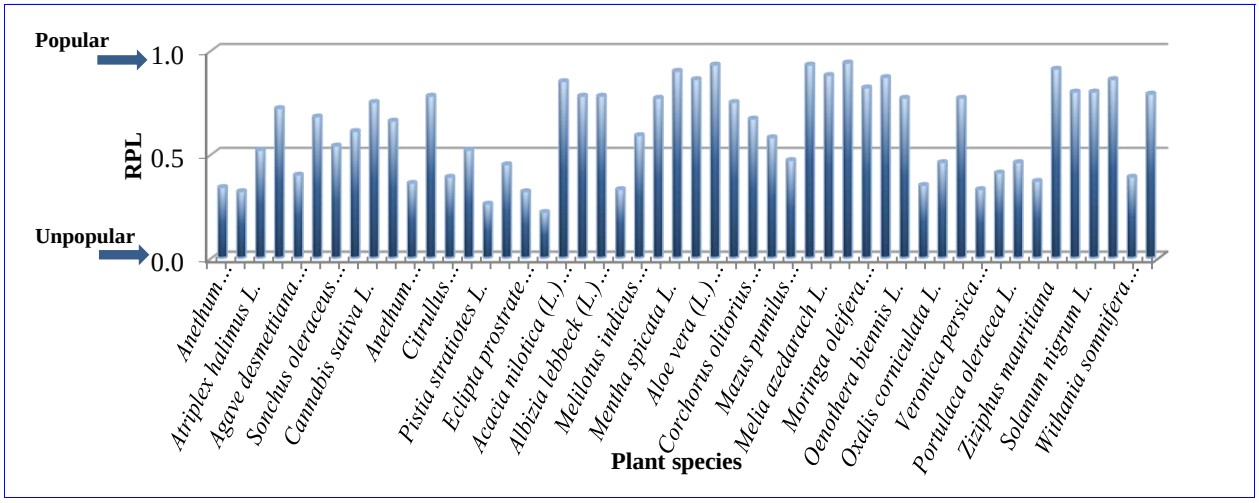


Figure (5): Relative popularity level (RPL) of medicinal plant species showing popularity trends of plant species.

number of applications attributed to that species. Specifically, the 12 plant species mentioned by at least 10 informants were categorized as "popular," indicating a high fidelity level in remedy use. Conversely, those species cited by 10 informants or fewer were classified as "unpopular."

At the point where the average number of applications per plant species ceases to increase with the addition of more informants, the distinction between popular and unpopular species begins to blur. Among the identified popular plant species with RPL values ranging from 0.8 to 0.9 are *Mentha spicata L., Ocimum basilicum L., Aloe vera (L.) Burm. f,. Azadira*chta *indica* A. Juss., *Melia azedarach* L., and *Ficus palmata* Forssk, however, unpopular one are *Parthenium hysterophorus* L., *Pistia stratiotes* L., *Eclipta prostrate* (L.), *Trianthema portulacastrum* L. and *Anethum graveolens* L. (Figure 5).

Use Value (UV)

The Use Value represents the relative importance of a plant species to a community in a given area. A higher UV indicates more frequent use and exploitation of the plant. The highest UV is 0.67, observed for *Oxalis debilis kunth* for treating digestive irregularities. This plant is considered the most important among the listed species for this particular purpose. Other plants with high UV include *Citrullus colocynthis* (0.58) for constipation, *Convolvulus arvensis* (0.58) as a blood purifier, and *Oenothera biennis* (0.57) for allergic skin reactions. These plants are also highly valued by the community for their medicinal properties. Meanwhile, the lowest UV is 0.07, observed for *Pistia stratiotes* L. for painful urination. This suggests that this plant is the least used among the listed species for treating this ailment. In general, this information can guide further phyto-chemical and pharmacological studies to confirm their medicinal potential and develop standardized herbal drugs.

The Rank Order Priority (ROP) index

This calculated value is utilized to systematically rank plant species based on their varying FL (Frequency of Use Use) values. The resultant ROP values serve as correction factors to adjust the FL values, leading to the final ROP values presented in Figure (6) and recorded in Table (3).

Among the 64 species evaluated, only ten species achieved an ROP score above 75. This limited number may reflect a declining popularity of herbal medicines within the local communities of the study area. Based on ROP value pharmacological studies to confirm their medicinal potential and develop standardized herbal drugs. *Mentha spicata* L. and *Ficus palmata* Forssk. were widely utilized species with ROP = 90 and 88 ranked at number 1 and 2. The other plant species with significant ROP were: *Cordia myxa, Acacia nilotica, Solanum virginianum, Solanum nigrum, Syzygium cumini, Datura inoxia, Sesamum orientale* and *Ziziphus mauritiana* (82, 81, 81, 80, 79, 77, 77 and 75 respectively). The ROP values reported for medicinal plants used in Hafizabad district by (Umair *et al*., 2017). However, *Parthenium hysterophorus* L. (ROP = 63) and *Veronica persica* Poir. (ROP = 64), against painful secretions of ear and rheumatism, respectively were least utilized species by the inhabitants of the study area (Figure 6).

DISCUSSION

The comprehension of ethnomedicine decreased among respondents between the ages of 30 and 45. Table (1) demonstrates that respondents between the ages of 30 and 45 were the least knowledgeable. The trend among today's youth to favor allopathic medicine over alternative remedies may contribute to this loss of knowledge (Sargin, 2015; Serag *et al*., 2023). Furthermore, it was demonstrated that the prevalence of ethnomedical knowledge decreased as literacy rates increased. As literacy rates increased, the capacity of individuals to utilize traditional medicine decreased proportionally. This trend may be attributed to the fact that individuals with higher levels of education tend to prefer modern healthcare systems over traditional remedies. Similar findings have been reported by other researchers (Usman *et al*., 2021). Meanwhile, traditional medicinal knowledge is often passed down orally through generations. Increased literacy can disrupt this transmission, as younger generations may prioritize formal education and modern practices over traditional knowledge systems. This shift can result in a gradual loss of ethnobotanical knowledge and the medicinal use of local plants. Additionally, both men and women exhibited virtually identical levels of ethnobotanical knowledge. However, increased literacy may influence their choices differently, with educated women sometimes maintaining more connection to traditional practices compared to men who may lean towards modern healthcare options.

The predominance of vegetation in the location under study may be explained by its temperature and topography. Compared to shrubs and trees, herbs are more robust and rapidly regenerate. Herbs are also easily accessible. Herbs can readily adapt to weather changes because they contain so many different types of bioactive chemicals. Herbs are more effective as remedies than shrubs and trees because they typically contain a greater number of bioactive compounds. In regions of high altitude, herbaceous plants tend to dominate over deciduous shrubs and trees (Wali *et al.*, 2022).

The indigenous inhabitants of the Western Himalayas have historically utilized the plant's leaves for their therapeutic properties (Wali *et al.,* 2022) have found that the act of gathering plant roots and stems might provide a significant danger to the indigenous plant life. However, the utilization of leaves is more advantageous for the preservation of medicinal plants that are collected by herbalists (Hussain *et al*., 2008). Previous reports have documented a wide variety of preparation methods from different regions of Pakistan and other areas (Wagay, 2016). Traditional healers in the research region utilize a variety of plant species, together with milk, honey, eggs, butter, salt, sugar, water, and other ingredients. Additionally, some herbal

Table (3): Medicinal plants of study area and their therapeutic applications: Fidelity levels and use values.

Botanical name	Therapeutic application	Np†	N††	Fidelity Level	Use Value
Anethum graveolens L.	Hemorrhoids	10	15	66.00	0.16
Trianthema portulacastrum L.	Liver disorders	9	20	45.00	0.10
Atriplex halimus L.	Diabetes	6	10	60.00	0.38
Calotropis procera (Aiton) Dryand.	Wounds healing	40	45	88.00	0.50
Agave desmettiana Jacobi	Constipation	10	20	50.00	0.21
Sonchus asper (L.) Hill	Anemia	23	36	64.00	0.37
Sonchus oleraceus (L.) L.	Headaches	8	18	44.44	0.10
Morus alba L.	Cough and sore throat	25	40	62.50	0.15
Cannabis sativa L.	Stomach pain	13	25	52.00	0.15
Digera muricata (L.) Mart.	Urinary disorders	12	14	86.00	0.33
Anethum graveolens L.	Gastric problems	5	15	33.33	0.10
Foeniculum vulgare Mill.	Eye disorders	12	15	80.00	0.54
Citrullus colocynthis (L.) Schrad.	Constipation	6	17	36.00	0.58
Nerium oleander L.	Skin ulcers	15	20	75.00	0.19
Pistia stratiotes L.	Painful urination	5	15	33.33	0.07
Artemisia vulgaris L.	Vermifuge	6	7	86.00	0.11
Eclipta prostrate (L.) L.	Anti-hair fall	10	16	62.50	0.35
Parthenium hysterophorus L.	Painful secretions of ear	3	9	33.33	0.37
Conyza Canadensis (L.) Cronquist	Diarrhea	12	20	60.00	0.50
Xanthium strumarium L.	Smallpox	10	18	55.00	0.55
Tecoma stans (L.) Juss. ex Kunth	Intestinal worms	10	19	53.00	0.16
Cordia myxa L.	Cough	23	24	95.00	0.10
Heliotropium europaeum L.	Warts	12	20	60.00	0.14
Sisymbrium irio L.	Asthma	3	17	18.00	0.27
Cerastium glomeratum Thuill.	Headaches	3	10	30.00	0.46
Stellaria media (L.) Vill.	Gastrointestinal disorders	2	12	17.00	0.50
Chenopodiastrum murale L.	Joint pain	3	10	30.00	0.55
Cleome viscosa L.	Skin ulcers	12	23	52.17	0.33
Convolvulus arvensis L.	Blood purifier	9	17	53.00	0.58
Euphorbia helioscopia L.	Febrifuge	4	12	33.33	0.11
Euphorbia hirta L.	Dengue fever	5	10	50.00	0.13
Acacia nilotica (L.) Delile	Joint pain	47	49	96.00	0.14
Acacia karroo Hayne	Diarrhea	35	38	92.10	0.37
Albizia lebbeck (L.) Benth.	Gastrointestinal disorders	43	50	86.00	0.27
Alhagi maurorum Medik	Kidney stones	10	23	43.47	0.40
Melilotus indicus (L.) All.	Skin rashes	10	20	50.00	0.41
Senna occidentalis (L.) Link	Malaria	20	27	74.07	0.19
Mentha spicata L.	Stomach ulcers	45	45	100.00	0.50
Ocimum basilicum L.	Indigestion	40	50	80.00	0.58
Aloe vera (L.) Burm. f.	Joint pain	37	50	74.00	0.55
Ammannia auriculata Wild.	Ringworms	5	15	33.33	0.45
Corchorus olitorius L.	Tumors	6	18	33.33	0.41
Malva parviflora L.	Fever	8	15	53.33	0.37
Mazus pumilus (Burm.f.) Steenis	Typhoid	3	10	30.00	0.33
Azadirachta indica A. Juss.	Skin ulcers	30	50	60.00	0.26
Melia azedarach L.	Snake bites	20	30	67.00	0.30
Ficus palmata Forssk.	Constipation	45	48	94.00	0.20
Moringa oleifera Lam.	Anti-hair fall	40	45	89.00	0.16
Syzygium cumini (L.) Skeels	Diarrhea	30	33	91.00	0.19
Oenothera biennis L.	Allergic skin reactions	10	20	50.00	0.57
Oxalis debilis kunth	Digestive irregularties	5	10	50.00	0.67
Oxalis corniculata L.	Urinary tract infections	10	17	59.00	0.18
Sesamum orientale L.	Anemia	25	27	100.00	0.31
Veronica persica Poir.	Hernia, Rheumatism	2	10	20.00	0.13
Polypogon monspeliensis (L.) Desf.	Heart tremors	4	24	17.00	0.19
Portulaca oleracea L.	Wound healing	7	14	50.00	0.19
Phyllanthus niruri L.	Hepatitis B	2	3	67.00	0.38
Ranunculus muricatus L.	Asthma	12	16	75.00	0.24
Ziziphus mauritiana	Diarrhea, Chicken pox	40	48	83.33	0.09
Datura inoxia Mill	Stomach and intestinal pain	35	36	97.00	0.50
Solanum nigrum L.	Sore eyes	23	27	100.00	0.10
Solanum virginianum L.	Cough, chest pain	19	20	95.00	0.15
Withania somnifera (L.) Dunal	Irregular menstruation	6	30	20.00	0.66
Tribulus terrestris L.	Diarrhea	35	40	87.50	0.32

†NP, number of informants who utilize plant for specific disorder; †† N, total number of informants.

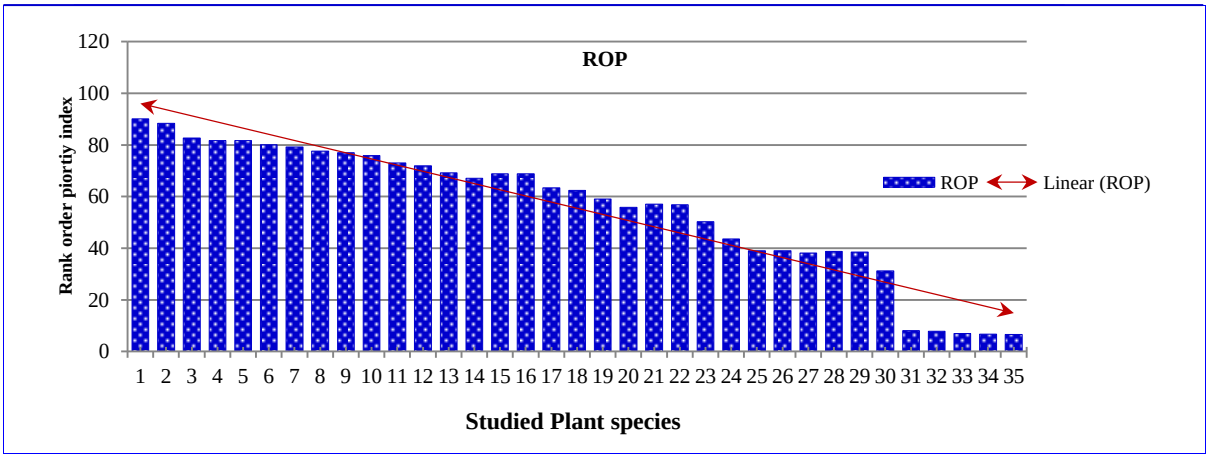


Figure (6): Rank order priority of plant species used by local community in Tehsil Arifwala, District Pakpattan, Punjab, Pakistan. 1, *M. spicata* ; 2, *F.palmata* ; 3, *C. myxa*; 4, *A.nilotica* ; 5, *S. virginianum* ; 6, *Solanum nigrum* L.;7, *Syzygium cumini* L.Skeels; 8, *Datura inoxia* Mill; 9, *Sesamum orientale* L.; 10, *Ziziphus mauritiana;* 11, *Moringa oleifera* Lam.; 12, *Acacia karroo* Hayne; 13, Tribulus terrestris L.; 14, *Albizia lebbeck* (L.) Benth.; 15, *Ocimum basilicum* L.; 16, *Aloe vera* (L.) Burm. f.;17, *Calotropis procera* (Aiton) Dryand.; 18, *Foeniculum vulgare* Mill.; 19, *Melia azedarach* L.; 20, *Azadirachta indica* A.Juss.; 21, *Senna occidentalis* (L.) Link; 22, *Digera muricata* (L.) Mart.;23, *Phyllanthus niruri;* 24 , *Sonchus asper* (L.) Hill; 25, *Cannabis sativa* L; 26, *Nerium oleander* L.; 27, *Morus alba* L.; 28, *Artemisia vulgaris* L.; 29, *Oenothera biennis* L.; 30, *Atriplex halimus* L.; 31, *Stellaria media* (L.) Vill.; 32, *Withania somnifera* (L.) Dunal; 33, *Polypogon monspeliensis* (L.) Desf.; 34, *Parthenium hysterophorus* L.; 35, *Veronica persica* Poir.

formulations are utilized as eardrops, bath additives, and for sniffing. Burning the medicinal plant species produces gases that are inhaled. Some plant pieces are also simply crushed and scented. Similar application methods were noted in the Hafizabad district. Some plant species' leaves and bark are cooked, and the resulting decoction is used as bath salts to treat bodily aches. The use of herbal baths, however, is becoming less popular due to a change in lifestyle, and today only the leaves of *Ziziphus mauritiana* are used to bathe the deceased. To cure skin infections, cuts, wounds, snake bites, rheumatic headaches, and body pain, it is typical to apply paste, poultices, or pharmaceutical oils directly to the affected area. The District of Bahawalnagar boasts a rich flora with 50 ethno-medicinal plants used for various ailments, including headaches, ulcers, and fever. Local inhabitants employ methods like drying, decoction, and jam-making for treatment. Leaves (41%), flowers (16%), and fruits (16%) are the most commonly used plant parts for medicinal purposes (Saleem *et al*., 2017).

The ICF analysis indicated a significant prevalence of dermatological and gastrointestinal issues in the research area, potentially linked to a lack of sufficient clean water supply. Similar findings were reported in a previous study conducted by Khanum et al. (2022). However, Aaqil *et al.* (2017) found that more species were utilized for treating gastrointestinal diseases than for dermatological conditions. The International Classification of Functioning, Disability and Health (ICF) ratings for different disease categories varied from 0.1 (respiratory problems) to 0.9 (gastrointestinal diseases). The average ICF value across all categories was 0.16, which aligns with previous studies conducted in Pakistan.

The study pointed to certain grasses, including *Arundo donax, Desmostachya bipinnata, Eleusine indica* *Hordeum vulgare*, and *Pennisetum glaucum*, were commonly utilized for treating various gastrointestinal problems. These plants demonstrated a 100% fidelity level (FL) when used for ailments such as digestive issues, indigestion, and worm infestations.The used value of the species' usage was ascertained based on the frequency with which local inhabitants report employing it. The used value index in this study ranged from 0.07 to 0.66. According to reports, species that had more applications for humans tend to have a higher use value index compared to plants with fewer reported uses. *Withania somnifera* (L.) Dunal was found to have the highest utilization value index (0.66), while Pistia stratiotes L. had the lowest value (0.07). In accordance with the findings of Usman *et al*. (2021), an examination of plant species in Southern Punjab, Pakistan revealed notable variations in their respective Usage Value indices.

The study identified *Conyza Canadensis* L. and *Cuscuta reflexa* Roxb. as the plant species with the highest use values, both registering at 0.58, while *Xanthium strumarium* L. followed closely with a use value index of 0.37. Conversely, the study noted that *Withania somnifera* (L.) Dunal exhibited the lowest use value at 0.032. Moreover, a separate investigation conducted by Zahoor *et al*. (2017) in the regions of Navapind and Shahpur Virkan, district Sheikupura, Pakistan, unveiled a broader spectrum of use values for various plant species. In this study, values ranged from 0.005 to 0.07 with the highest UV recorded for *Mollugo verticillata* L. at 0.07, and *Vachellia farnesiana* (L.) and *Celtis occidentalis* L. both registering at 0.04. Conversely, *Coriandrum sativum* L. exhibited the lowest UV value at 0.005, while *Thanatus tenellus* L. and *Lathyrus aphaca* L. displayed use values indices of 0.0053 and 0.0055, respectively.

The plant species with highest UV values are often physiologically more active (Heinrich *et al*., 1998). Therefore, the potential for a plant species to treat certain disease is identified by its used value index.

The remarkable efficacy of certain plant species and the knowledge of indigenous peoples who specifically specify their usage as herbal medicine may be responsible for their high appeal. This is the first baseline investigation of how native inhabitants employ common plant species to treat specific illnesses. These results agreed with earlier research on the status of medicinal plants in Pakistan. In these studies, *Alhagi maurorum* Medik (urinary disorder) and *Withania somnifera* (L.) Dunal (Irregular menstruation) were reported as unpopular plant species due to low RPL values e.g., 0.33-0.36.

All over the world, ethnobotanical scientists have sought to report the toxicological impacts of wild plant dosages on human physiological functions in order to identify optimal alternative natural remedies as substitutes for industrial ones. Numerous studies on ethnobotany across various global regions can help interpret and pave the way for discovering the most recommended cures to replace commercial products with significant value (Preeti *et al.*, 2021). This current study will collaborate with another survey conducted in Karachi, the largest metropolis in Pakistan (Anjum *et al*., 2024), to provide a comprehensive overview of ethnobotany in the country. Conducting ethnobotanical research globally presents several challenges including loss of indigenous knowledge, environmental degradation, cultural changes, regulatory barriers and integration with modern science.

CONCLUSION

The present study recorded the traditional knowledge and utilization of medicinal plants by the local communities in Tehsil Arifwala, Punjab, Pakistan. Despite the high levels of industrialization, overgrazing, and urbanization in the region, the economic and medicinal value of the indigenous wild plant species has declined due to heavy biotic and abiotic stresses, low plant regeneration, and the constant high rate of plant extraction. Through comprehensive interviews and quantitative analyses, a substantial diversity of 148 medicinal plant species has been documented, with an emphasis on their uses, extraction methods, and the specific ailments they address. The results indicate a strong reliance on indigenous plant species for treating respiratory disorders, joint pain, and gastrointestinal issues, reflecting the enduring relationship between the local population and their environment. The high Informant Consensus Factor values associated with certain ailments underscore the importance of these plants in traditional healthcare practices. The study not only emphasizes the therapeutic potential of widely-used species, such as *Mentha spicata* and *Withania somnifera*, but also calls for increased attention to the conservation of less-utilized yet valuable medicinal plants. Ultimately, this research serves as a vital step toward integrating traditional knowledge with scientific exploration, paving the way for future drug development and the sustainable management of medicinal biodiversity in the region.

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