Ethnobotanical inventory and medicinal applications of plants used by the local people of Cholistan desert, Pakistan

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Ethnobotany Research and Applications 25:21 (2023) - http://dx.doi.org/10.32859/era.25.21.1-23
Manuscript received: 29/08/2022 – Revised manuscript received: 14/02/2023 - Published: 21/02/2023

Databases and Inventories

Abstract

Background: The Cholistan desert has been inhabited by people who have a long tradition of utilizing medicinal plants to heal human diseases. The current study includes a detailed ethnobotanical inventory and the traditional therapeutic applications of medicinal plants in the Cholistan desert.

Methods: The primary data was obtained through field observations, interviews, and questionnaires between December 2021 and March 2022. Informant Consensus Factor (ICF), Relative frequency citation (RFCs), and fidelity level (FL) were used to access the relevance of medicinal plants. Pearson's chi-square test, One-way ANOVA and multiple logistic regression were performed to compare indigenous knowledge among respondents of various socio-demographic groups.

Results: 93 plants from 31 families were recorded. The Fic was calculated for sixteen different disease categories value range (0.82 to 0.50). *Heliotropium strigosum*, *Grewia villosa,* and *Capparis decidua* exhibited high RFCs value (0.49). The FL of *Chenopodium album* and *Farsetia hamiltonii* were 92.9 and 91.4%. Gender, age, educational status, and source of livelihood showed a significant positive impact (p-value < 0.001) on the respondents' indigenous knowledge about medicinal plants. Multiple logistic regression analysis confirmed that gender and education significantly affect (p-value < 0.001) the level of respondents' indigenous knowledge followed by age and source of livelihood.

Conclusion: This investigation revealed that traditional medicine based on ancient indigenous knowledge is still practiced as the first line of health care in the study area. Women are having vast ethnobotanical knowledge as compared to men and there is a significant gap in transmission of information from elder to younger generations.

Keywords: Medicinal plants, Indigenous Knowledge, Ethnobotanical indices, Socio-demographic factors, Regression analysis

Background

Plants have long been used to treat illnesses and afflictions, and this tradition dates back to the dawn of human existence (Hussain *et al.* 2018). Plant resources not only supply survival supplies, and medicinal, and forage benefits, but they also hold and maintain cultural heritages, and indigenous knowledge (Hameed *et al.* 2011). Traditional medicine is defined by the World Health Organization (WHO) as "the total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness" (WHO 2013). According to the WHO, 75% of herbal pharmaceuticals are traditional medical herbal drugs, while 25% of contemporary medicines are derived from historically utilized plant sources (Wang *et al.* 2002). The medical applications of more than 21,000 plant species have been documented globally (WHO 2002). Around 80% of people worldwide still rely on medicinal plants for their day-to-day medical needs (WHO 2002; Bandaranayake 2006). The World Health Organization estimates that 4 billion people in developing nations continuously rely on and believe in the advantages of herbal treatments (Khan *et al.* 2021).

Ethnomedicine, which is a collection of empirical regional practices based on local and indigenous knowledge systems, is a subfield of ethnobotany (Bussmann & Sharon 2006). To comprehend the social, cultural, and economic factors that impact health problems and resolve them, it is typically transmitted orally from generation to generation (Kunwar & Bussmann 2008). One of the possible solutions that can help and treat a variety of human health issues is medicinal flora (Hassan Ara Begum *et al.* 2022). The documentation of folk knowledge, particularly the remedial properties of plant species, has resulted in many important modern-day medications (Cox 2000; Umair *et al.* 2017). To build medicinal plant management and conservation initiatives, documentation of traditional knowledge and practices is also essential (Njoroge *et al.* 2004). Unfortunately, ethnobotanical elements of plants have received little study, as only hakims are related to therapeutic herbs (Ahmed *et al.* 2012).

Pakistan has more than 6,000 species of higher plants, of which 12 percent are employed as sources of medications (Bano *et al.* 2014) for a variety of human ailments (Ozkan *et al.* 2016; Jima & Megersa 2018). Most of the time, specific plant species are thought to be exceptional for treating a specific condition, although occasionally species have many purposes (Hamayun *et al.* 2005). Pakistan is one of the top eight nations exporting medicinal plants globally, according to the Export Promotion Agency (EPA) (Umair *et al.* 2017). Most herb collectors are uneducated or illiterate, and women and children are frequently the primary herb collectors (Sodhi *et al.* 2004).

Cholistan desert support diversified flora and the local inhabitants of an area's livelihood mostly depend upon rangeland vegetation. The wild plants of an area are used as fodder, food, medicine, fuel wood etc. by local communities (Ali *et al.* 2009; Azhar 2014). The majority of residents is poor, often illiterate, and deprived of modern facilities including education and healthcare. The local people mostly rely on plants and plant-based drugs for their daily life. The local dwellers possess great indigenous knowledge of medicinal plants for centuries (Azhar *et al.* 2018). The inhabitants of Cholistan desert are relying on indigenous vegetation for numerous ethnobotanical uses including human and veterinary medic treatments in specific traditional recipes (Azhar *et al.* 2015). However, indigenous plants and their use knowledge are threatened by habitat loss due to urbanization, industrialization, urban migration for livelihood by cultural changes with time. Due to overuse and land conversion, wild plants, particularly those with medicinal properties, are in decline (Azhar *et al.* 2022). Agricultural development, the production of charcoal, and the harvesting of firewood were regarded as major threats to the survival of medicinal plants in developing countries (Abebe *et al.* 2021). Ethnobotanical studies envisaged the signs of erosion of indigenous medicinal plant knowledge among the ethnic communities of Pakistan. A profound gap between the generations and a lack of a discal mindset of younger generation have caused waning in indigenous knowledge on plant utilization. Furthermore, modernization has started diminishing the interest on traditional practices of medicinal plants. To revamp the vanishing indigenous knowledge on various uses of the plants, ethnobotanical studies are of paramount importance. Ethnobotanical research can serve as a preferred and dependable route to drug discovery, as well as play an important role in biodiversity conservation (Shah & Hussain 2021). It demonstrates the urgent need for an extensive ethnobotanical survey to understand the judicious utilization of raw materials while also preparing an inventory for it, given that indigenous peoples of a given geographical area are associated with nature and rely on plants as a primary source of remedy for various ailments (Idm'hand *et al.* 2020). Traditional medicinal knowledge requires novel approaches for its preservation and for its sustainability among indigenous communities (Yaseen *et al.* 2018). The folk wisdom, if subjected to scientific scrutiny, could benefit humankind in many ways (Katewa 2009). The ethnobotanical studies will pave way to preserve the dwindling indigenous knowledge on medicinal plants. Among others, knowledge on traditional medicine varies with geographical location. Only a few studies are available about medicinal plants of the Cholistan rangeland (Azhar *et al.* 2018;

Rehaman *et al.* 2015; Sadia *et al.* 2015; Azhar 2014; Hameed *et al.* 2011). Detail ethnobotanical inventories of different rangelands of Pakistan done by researchers like Nara rangeland (Qureshi and Bhatti 2008), Thal rangeland (Shaheen *et al.* 2012), Thar rangeland (Yaseen *et al.* 2015) but the detail ethnobotanical inventory of Cholistan rangeland is still not available. Therefore, the current study includes a detailed ethnobotanical inventory and the traditional therapeutic applications of medicinal plants of the Cholistan desert, Southern Punjab, Pakistan.

Material and Methods

Study Area

The Cholistan rangeland is settled within the southern part of the geographic region Punjab province of the Islamic Republic of Pakistan having an area of 26,000 km^2. Geographically the study area lies between 27° 42′ and 29° 45′ North latitude and 69° 52′ and 75°24′ East longitude (Fig. 1) (Warris *et al.* 2013). The average annual rainfall is recorded between 100 to 250 millimeters while the average lowest temperature in winter is 6.5 °C and the mean maximum temperature in summer is 46.5 °C. The maximum temperature was recorded at around 51 °C (Azhar *et al.* 2014).

Data Collection associated with the field and household surveys

A combination of participatory observation and ethnobotanical tools associated with sample and data collection were utilized in this ethnobotanical research. Using the Participatory Rapid Appraisal Approach (PRA), a total of 120 local individuals, including traditional healers, were selected (Martin 1995). PRA provided a helpful perspective on the many aspects and experiences of local people with traditional plant remedies.

We were able to develop concerns that were relevant to the community but unknown to the investigators because of the informal gatherings and open-ended talks (Miles & Huberman 1994). First, the field survey was done during which cultural and botanical diversity were documented along with various livelihood sources and various ethnobotanical aspects. For this purpose, different research methods were used like well-designed semi-structured questionnaires, group discussions with local inhabitants, household interviews, interviews with local herbal experts, participatory observation, and market visits. Information was collected on different parts of wild vegetation which are used for different purposes by local peoples. A thought-through questionnaire was organized in English but also translated into local languages to document folk knowledge. After the collection of data, it was put into the excel sheet to develop a separate list of medicative species found in a study area with their ethnomedicinal uses.

Collection, Preservation, and Identification of Native Plant Species

Important medicinal plants and their parts were collected from the field surveys. These samples were tagged with their local names within the field. The mystifying plant species were confirmed with the help of local experts by showing plant materials and/or their pictures. The scientific names and families of documented plant species were confirmed by Taxonomists (Dr. Farooq Azhar, Dr. Muhammad Zubair, Dr. Ehsan Qadir) of Bahauddin Zakariya University, Multan Pakistan, and with the assistance of available literature on medicinal plants of Cholistan (Azhar 2014, Sadia *et al.* 2015, Hameed *et al.* 2011).

Ethno-botanical data analysis

To calculate the significance of the documented medicinal plant species the collected data was analyzed by using the following ethnobotanical indices:

Informant Consensus Factor (ICF)

The given formula for calculating the ICF is used as followed (Trotter and Logan 2019).

$$\text{ICF} = \frac{(\text{Number of use citations in each category} - \text{Number of medicinal plant species used})}{(\text{Number of use citations in each category} - 1)}$$

Relative frequency citation (RFCs)

The FC value was calculated by using the below formula as used by (Tardío and Pardo-de-Santayana 2008).

$$\text{RFCs} = \frac{(\text{Number of informants who mentioned the use of a plant species})}{(\text{Total number of informants})}$$

Fidelity level (FL)

The FL of the species was calculated by using the below formula used by (Alexiades and Sheldon 1996; Friedman 1986).

$$FL = \frac{(\text{Number of respondents reported utilization of medicinal plant for a specific disease})}{(\text{Total number of respondents mentioned the same plant for any ailment})} \times 100$$

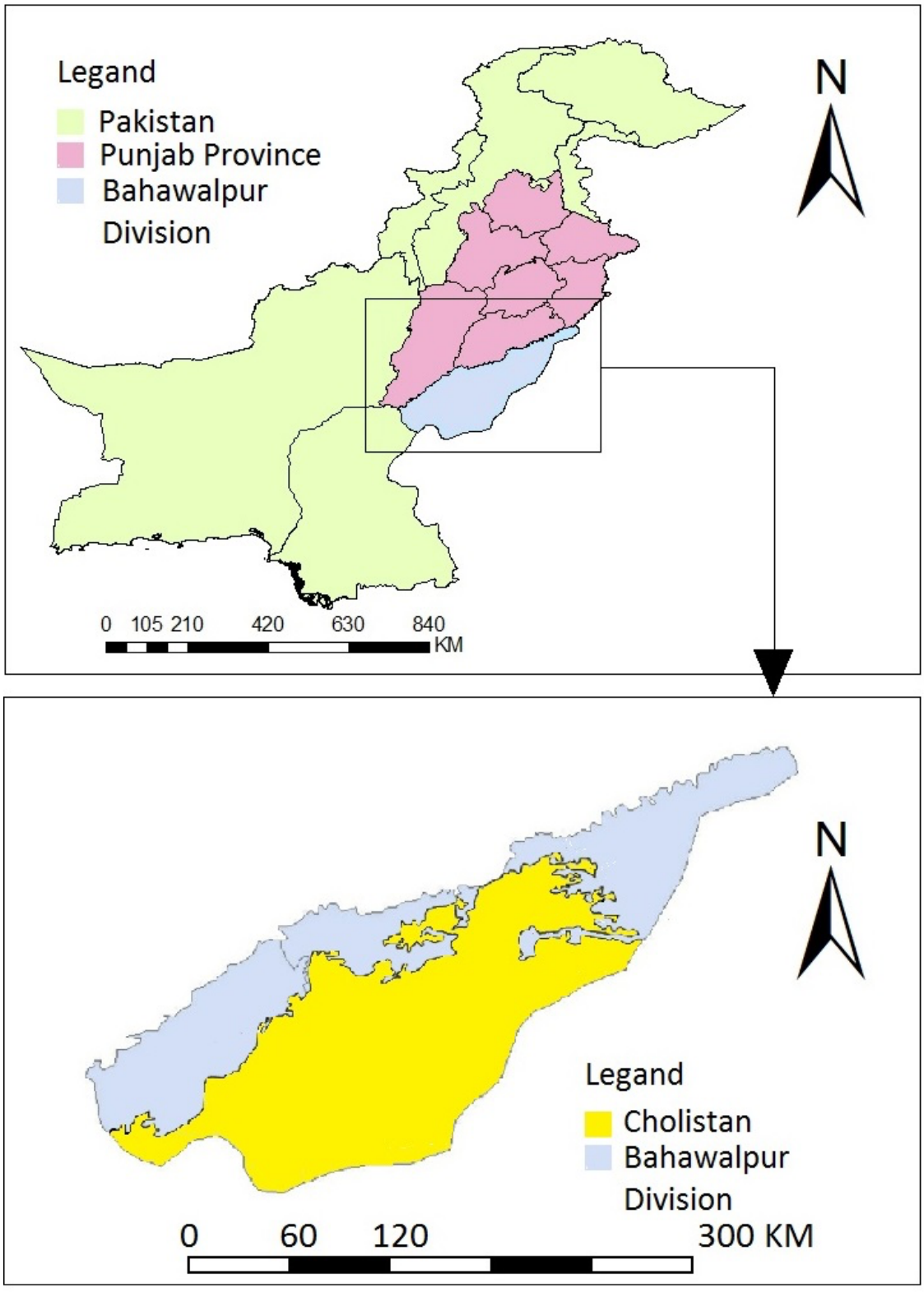

Figure 1. Map of the study area

Statistical Analysis

Pearson's chi-square test, One-way ANOVA and multiple logistic regression models were performed to evaluate the possessing indigenous knowledge among respondents of various socio-demographic groups by using SPSS (version 20.0). We have categorized respondents on the basis of gender (Male/ Female), age (young/ middle/ old age), educational level (Illiterate/ primary/ secondary/ higher secondary/ graduation) and source of livelihood (Farmers/ graziers/ healers/ jobholders).

Results

Socio-demographic characteristics of the respondents

A total of 120 local respondents, including local medicinal experts, were questioned, including 81.66% of men and 18.33% of women, to collect data on medicinal applications of plant species from 10 villages without regard to gender (Table 1). Islamic commandments, communal constraints, and a secluded environment, females typically avoid participating and sharing information. The informants were divided into three age groups: 20–40 years old, 40–60 years old, and above 60 years old. In terms of education, the majority of the respondents (58.33%) were illiterate, although 41.65% were literate, having primary to master-level schooling. Locals in the region rely on a variety of resources to survive. Farmers, herders, Traditional healers, and job seekers make up the majority of them. It was fascinating to learn that local healers provide free treatment to locals and share their traditional healing skills with others. The inhabitants of Cholistan are well-versed in the usage of local plants for medical purposes. Rapid industrialization and easy access to allopathic medications may be the primary factors eroding residents' traditional knowledge.

Table 1. Socioeconomic characteristics of the respondents

Characteristics	Distribution of Answer	Frequency	Percentage
Gender	Male	98	81.66
	Female	22	18.33
Age	20 and 40 years	23	19.16
	40 and 60 years	63	52.5
	> 60 years	34	28.33
Education	Uneducated	70	58.33
	Primary	22	18.33
	Secondary/ High Secondary	20	16.66
	Graduate	08	6.66
Source of livelihoods	Farmers	37	30.83
	Graziers	67	55.83
	Healers	07	5.83
	Job Holders	09	7.5

Indigenous Knowledge among Different demographic characters

The indigenous knowledge possessed by women and men has a significant difference (p-< 0.001). Women have more indigenous knowledge as compared to men. Domestic work is often performed by women in rural areas. They spend more time at home gathering resources like wood, local vegetables, and herbs. These maybe the reasons why women have significant indigenous knowledge of medicinal plants. (Middle-aged persons (40–60 years old) possessed higher indigenous knowledge as compared to other aged groups. This might be owing to a lack of interest in traditional medicines among children as well as memory loss due to aging in old people.

Table 2. Chi-Square test between genders, Age, and Respondents' Indigenous Knowledge

	Gender		**Age**			
Respondents indigenous Knowledge	**Men**	**Women**	**20 to 40 yr**	**40 to 60 yr**	**> 60 years**	**Statistical Value**
Having strong indigenous knowledge	18	12	5	20	12	$X^2 = 13.079$
Having weak indigenous knowledge	44	7	7	31	18	p-value < 0.001
Having no indigenous knowledge	36	3	11	12	4	
Total	98	22	23	63	34	

We also observed a significant difference (p = 0.001) between the levels of education and source of livelihood regarding the indigenous knowledge about medicinal plants. The mean value of the number of plants known to respondents appeared to decrease with increasing levels of education. The reason behind that may be the respondents of old age (> 60 yrs) and middle age (40 to 60 yrs) mostly fall in illiterate and primary levels of education. The young age (20 to 40 yrs) respondents fell in secondary/Higher secondary and graduation level of education did not take interest in traditional practices and had little knowledge about medicinal plants. The healers are having vast indigenous knowledge and cited the highest number of medicinal plants followed by graziers, farmers, and job holders.

Table 3. The impact of educational level & Source of Livelihood on the traditional knowledge

Educational Level	**Number of Informants**	**Percentage (%)**	**Mean value of the number of Plants known**	**Statistical Value**
Illiterate	70	58.3	5.6	p-value of Anova 0.001
Primary	22	18.3	4.3	
Secondary/Higher Sec.	20	16.7	3.5	
Graduation	08	6.7	2.6	
Source of Livelihood	**Number of Informants**	**Percentage (%)**	**Mean value of the number of Plants known**	**Statistical Value**
Farmers	37	30.8	4.5	p-value of Anova 0.001
Graziers	67	55.8	4.8	
Healers	07	5.8	5.3	
Job Holders	09	7.5	2.2	

Multiple logistic regressions showed that gender, age, education, and source of livelihood had a significantly positive impact on the level of possessing indigenous knowledge among respondents as shown in (Table 4). Gender and education are the two main demographic factors that significantly affect the level of respondents' indigenous knowledge followed by age and source of livelihood.

Table 4. Socio-demographic factors affecting the traditional knowledge of medicinal plants

Independent Variables	**B**	**SE**	**Wald**	**df**	**Sig**	**Exp (B)**
Gender	.649	.592	1.173	1	0.00*	1.978
Age	.524	.399	1.696	1	0.02*	1.507
Education	.572	.392	1.764	1	0.007*	1.809
Source of livelihood	.437	.477	.987	1	0.024*	1.624

Note: Dependent Variable = Medicinal traditional Knowledge, Number of respondents = 120, Exp (B) = an odds ratio (probability of success/probability of failure), SE = standard estimate error = statistically non-significant at 0.05 level of significance, Sig = significance, B = regression coefficients, Wald statistics = $b/(SE)^2$, df = degree of freedom. *Statistically significant at 0.05 level of significance.

Medicinal plants reported, availability and habit

A total of 93 plant species belonging to 31 families have been recorded as shown in (fig. 2), and the native inhabitants of the Cholistan desert utilize them in a variety of ways. The medicinal uses include parts used, methods of preparation, and administration wherever available. (Table 5) showed the detailed inventory of all recorded species found in the study area.

Fabaceae led the way, followed by Poaceae, Amaranthaceae, and Apocynaceae, each with 6 species. The therapeutic relevance of the first eight families may be related to the common distribution of species from these families in the research region.

Herbs were dominant with a 61.30% contribution (Fig. 3c), followed by shrubs, trees, grasses, sedges, and climbers (18.30, 8.60, 7.50, 2.20, and 2.20%) respectively.

Medicinal plants and their Part(s) used, preparation methods, and administration

Based on their kinds and numbers, the portions of plant species utilized were classified into eighteen (18) categories, including Whole plant, Roots, Leaves, Bark, Fruit, Seeds, Flowers, Green Twigs, Root Bark, Deela, Pods, Latex, Flower buds, Gums, Nuts and Thorns. The whole plant was the most frequently used plant part (64 species), followed by roots (19), leaves (17), bark (12), and Fruits (11). (Fig. 3a) shows the features of the plant parts used to cure various ailments.

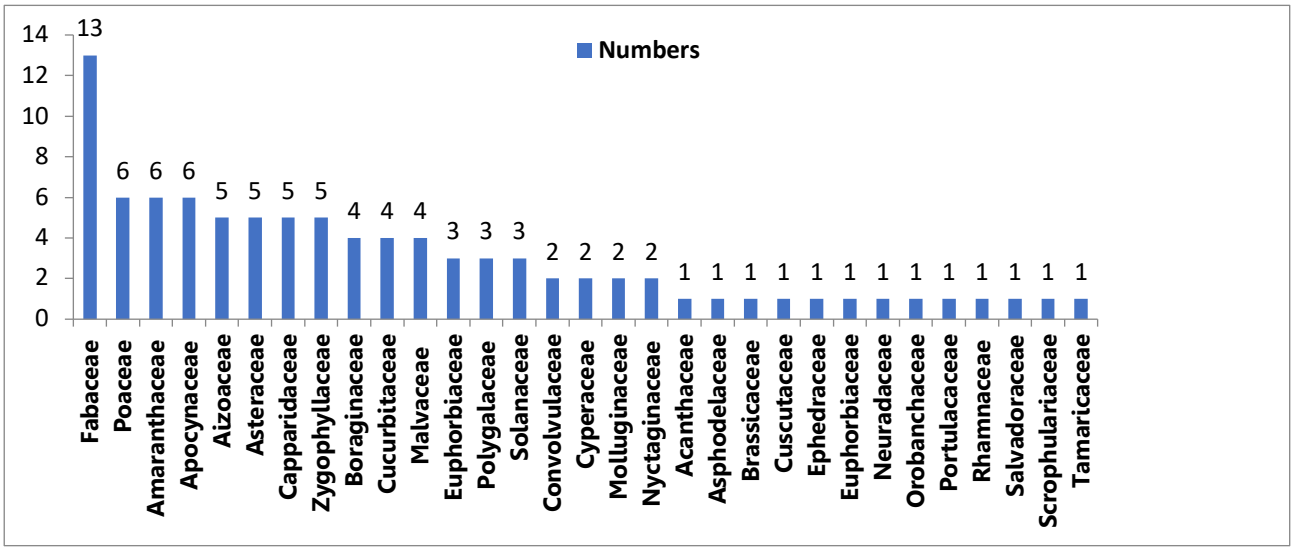

Figure 2. Medicinal plant species distribution according to their family

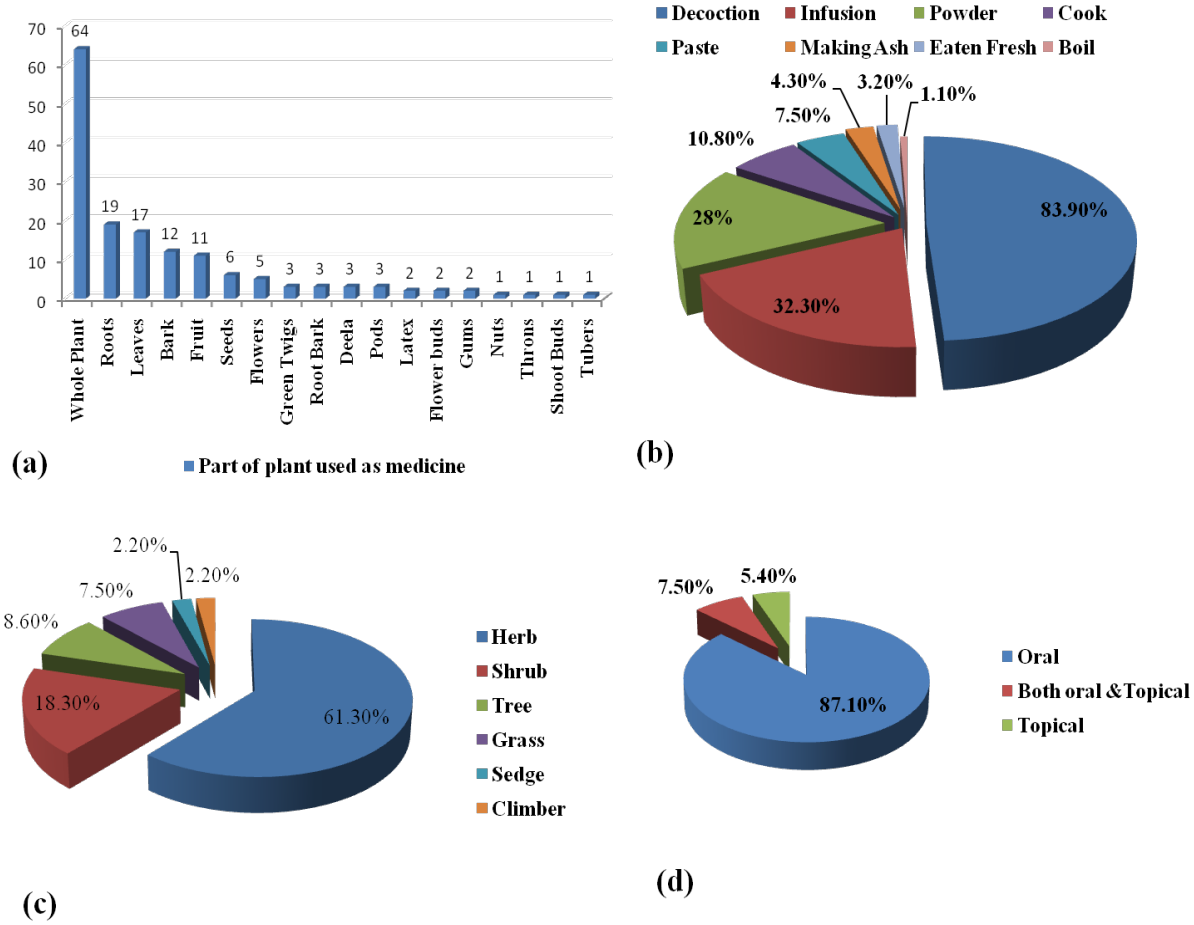

Figure 3. (a) Plant parts used in various disease treatments, (b) Modes of drug formulation, (c) Life forms of medicinal plant, (d) Mode of Administration

To cure various disorders, the people of the study area employ eight types of medicine formulations, as shown in (Fig. 3b). Among these, the decoction was dominant (78 medications), followed by infusion (30 medications), powder (26 medications), cook (10 medications) and paste (7 medications).

Three groups of medication administration methods were identified (Fig. 3d). Approximately 87.10% of the recipes were consumed orally, 5.40% were administered topically, and 7.50% were both oral and topical.

Local therapeutic categories

The lives of rural people, especially those who live in dry areas, are extremely difficult. These people are sensitive to a variety of illnesses as a result of their constant endeavor to survive in social hierarchies. Medicinal plant species are used by the people of the Cholistan rangeland to heal a variety of diseases. The emic categorization approach was used to categorize these disorders into sixteen groups given in (Fig. 4).

Gastrointestinal (GIT) diseases (hyperacidity, ulcer, abdominal pain, piles), skin diseases (skin redness and irritation, gangrene Scabies, psoriasis, patchy skin, acne, pimples), respiratory tract infections (bronchial asthma, pneumonia, pulmonary tuberculosis, cough, chest tightness) and bones/muscles/joint ailments (arthritis, bone fractures), hepatic disorders (hepatitis, jaundice), cardiovascular disorders (Hypotension, Hypertension, heartburn) were the common health problems. Domestic sanitary circumstances and food habits may be to blame for GIT diseases. GIT infections may also be caused by the frequent consumption of teas, red chilies, and low-fiber foods. Similarly, the incidence of dermatological disorders might be attributed to high levels of (Ultraviolet) UV light and poorly managed public cleanliness. Furthermore, residents are susceptible to respiratory diseases due to extended exposure to harsh and unfriendly weather and allergens. The tough topography and strenuous lifestyle may be linked to bone and joint problems. Our data give us a clear picture of the frequency and distribution of public illnesses. In this context, the current study proposes an important concept for framing long-term health policies that communicate health risks, precautions, and effective treatment through integrated illness management.

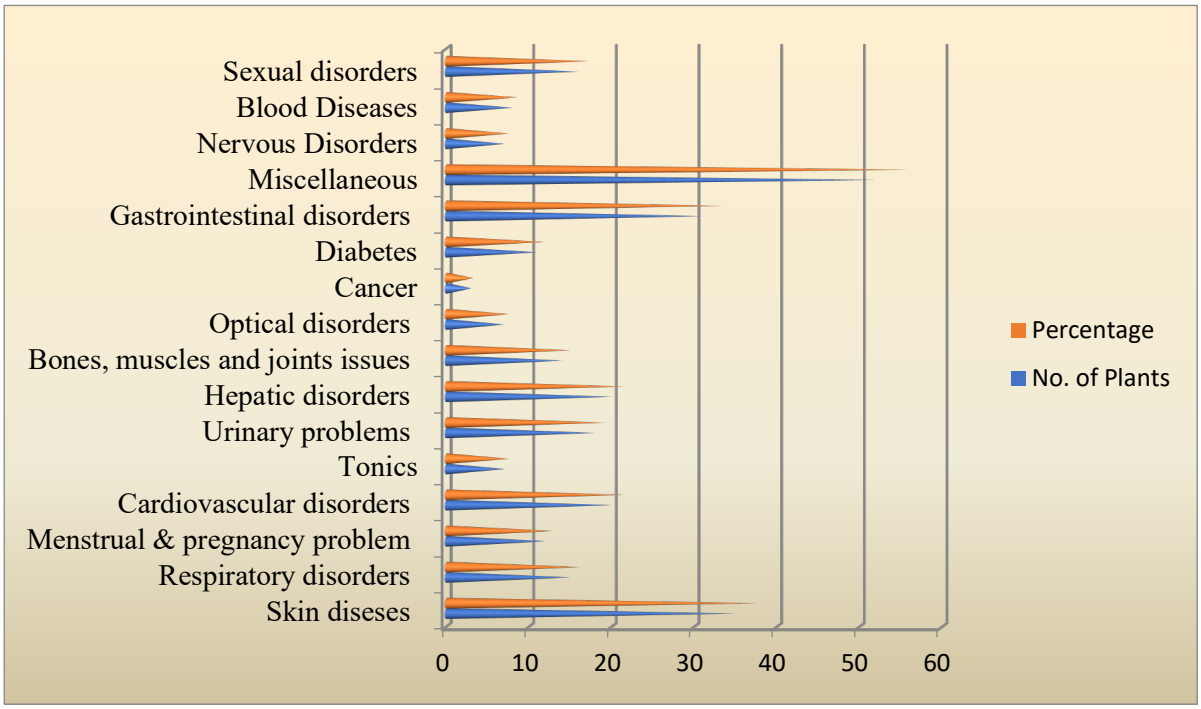

Figure 4. Number of plants and percentage against different diseases

Ethnobotanical data assessment by using different indices

The ethnobotanical quantitative indicators ICF, RFCs, and FL were used to assess homogeneity in the traditional knowledge of medicinal plants utilized by the people of the Cholistan rangeland. The reported diseases were initially divided into 16 kinds of aliments based on their use reports to compute ICF. The ICF was calculated for sixteen different disease categories (0.82 to 0.50) given in (fig. 5). The RFCs of the reported species ranged (0.49 to 0.07). The RFCs value of the top twenty plant species is given in (fig. 6). *Heliotropium strigosum* Willd., *Grewia villosa* Willd. And *Capparis decidua* (Forssk.) exhibited a high RFCs value (0.49) followed by *Rhynchosia capitata* (B. Heyne ex Roth) DC., *Seetzenia lanata* (Willd.) Bullock, and *Acacia nilotica* (L.) Willd. ex Delile (0.48) whereas the lowest RFCs

value (0.07) was calculated for *Tribulus longipetalus Viv.* The reported species' FL varied from 23.1 to 92.9%. The FL of the top twenty plant species is given in (fig.7). The FL of *Chenopodium album* L. and *Farsetia hamiltonii* Royle. were 92.9 and 91.4%, respectively, while *Dipterygium glaucum* Decne. had the lowest FL (23.1%). *Cleome brachycarpa* M. Vahl ex Triana and Planchon, *Withania somnifera* (L.), *Indigofera argentea* Burm. f., *Tamarix aphylla* (L.) Lanza, *Euphorbia granulate* Forssk, *Alhagi maurorum* Medik., and *Chrozophora plicata* (Vahl) A. Juss. ex Spreng. were also the most popular species, with FL over 85%.

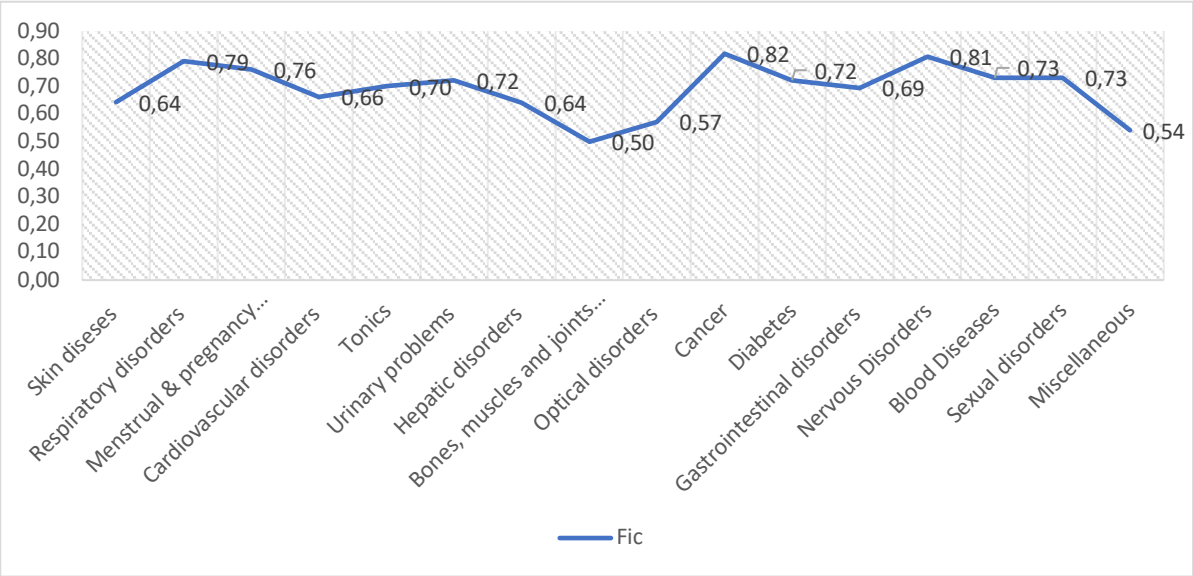

Figure 5. Informant Consensus Factor (ICF) values of most important medicinal plant species

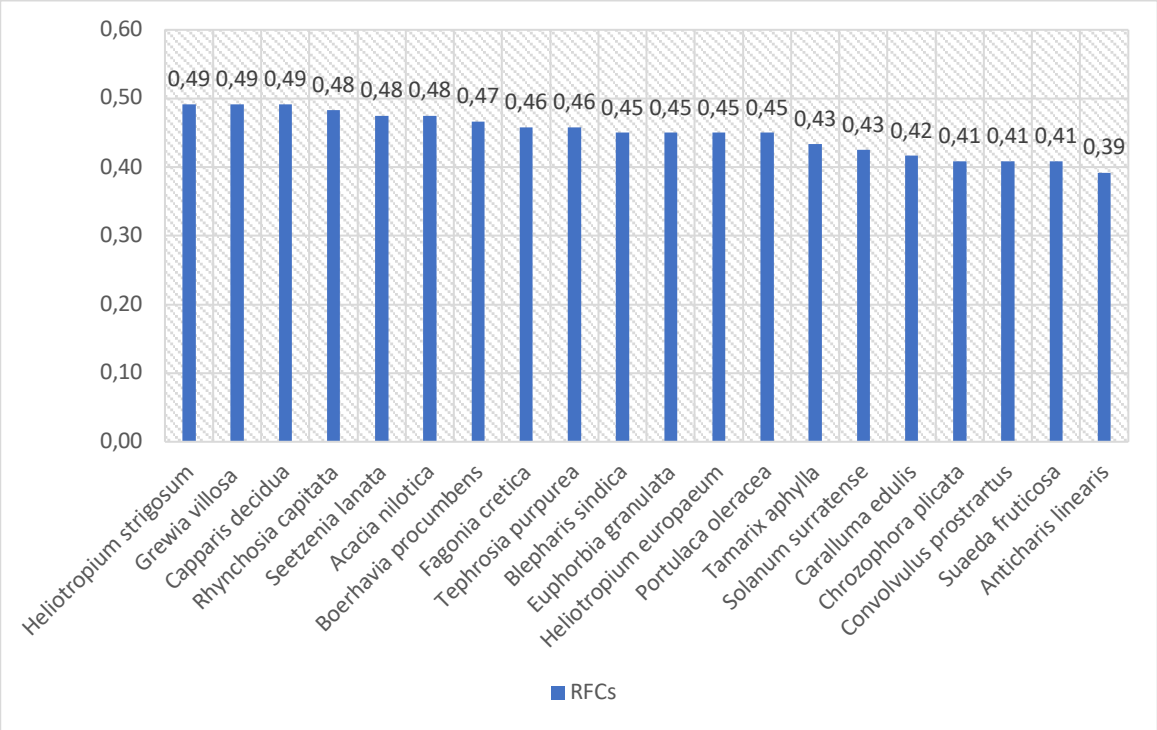

Figure 6. (Relative Frequency Citations) RFCs values of top twenty medicinal plants

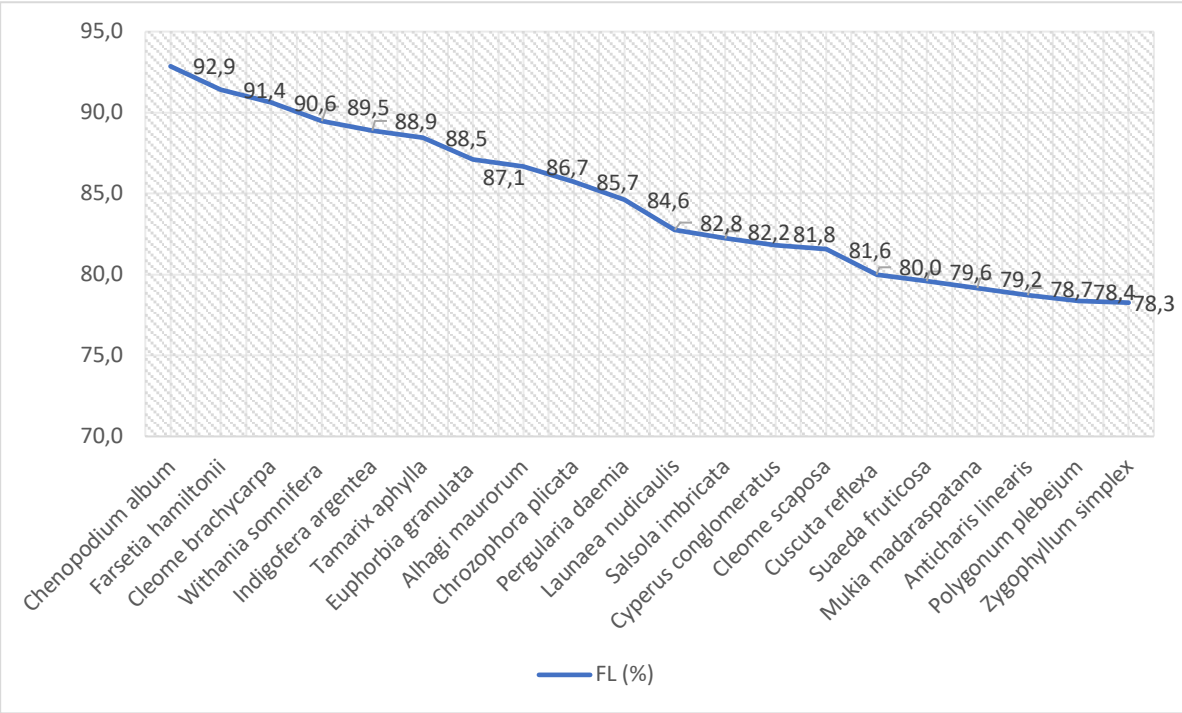

Figure 7. Fidelity Level (FL %) value of the top twenty medicinal plants reported against a particular disease

Discussion

Different demographic factors (i.e., Gender, age, educational status, and source of livelihood) showed a significant positive impact ($p < 0.001$) on the respondent's indigenous knowledge about medicinal plants. Gender and education are the two main demographic factors that significantly affect the level of respondents' indigenous knowledge followed by age and source of livelihood. Dulal *et al.* (2022) also confirmed that gender, age, and educational status significantly affected traditional medicinal knowledge. We observed a significant difference ($p < 0.001$) between the men and women regarding indigenous knowledge about medicinal plants. Dulal *et al.* (2022) also reported the same result. Women are having strong indigenous knowledge as compared to men in the study area. (Middle-aged persons (40–60 years old) possessed higher indigenous knowledge as compared to other aged groups similar to the result reported by Abbas *et al.* (2017) while studying the ethnobotany of the Shigar valley Himalayan region. Bhaila *et al.* (2022) also observed that teenage people are not taking an interest due to a lack of indigenous knowledge. The mean value of the number of plants known to respondents appeared to decrease with increasing levels of education. Similar results were reported by different researchers in their studies (Gebru *et al.* 2021; Kassa *et al.* 2020). The healers are having vast indigenous knowledge and cited the highest number of medicinal plants followed by graziers, farmers, and job holders (Abbas *et al.* 2017; Dulal *et al.* 2022; Bhaila *et al.* 2022).

During the present study a total of 93 medicinally important plant species belonging to 31 families were reported. Documented richness of species was similar to various other studies from different rangeland areas of Pakistan e.g., 87 plant species reported from Thar rangeland by Yaseen *et al.* (2015), 51 plant species reported from Nara rangeland by Qureshi *et al.* (2008) 54 plant species from Thal rangeland reported by Shaheen *et al.* (2012) while 110 plant species reported by Jain et al. (2009) from Rajasthan rangeland India, 76 plant species reported by Ding et al. (2022) from Alpine Desert, China and 48 plant species reported by Shrestha *et al.* (2016) from eastern Nepal. Fabaceae was recorded to be the dominant plant family in the area and leaves were the most commonly utilized plant part with decoction as the major mode of herbal recipe preparation. Similar results have found in the previous studies conducted in Cholistan rangeland (Sadia *et al.* 2015; Hameed *et al.* 2011; Ahmed *et al.* 2014) and other rangeland areas of Pakistan (Yaseen *et al.* 2015; Qureshi and Bhatti 2008; Shaheen *et al.* 2012). The whole plant was the most frequently used plant part (64 species), followed by roots (19), leaves (17), bark (12), and Fruits (11). Similarly, some other ethnomedicinal studies (Tali *et al.* 2019, Hu *et al.* 2020; Jan *et al.* 2021) reported whole plant as the most exploited plant part to treat various diseases.

Cholistan people's folk cures were compared to the previous study undertaken in Cholistan, other parts of the country, and on a global scale. In adjacent countries, notably India, which shares ecosystems comparable to the

Cholistan desert, much work has been done on medicinal characteristics and folk applications of medicinal plants (Ayyanar and Ignacimuthu 2005; Jain *et al.* 2009; Nirmala *et al.* 2022; Lal *et al.* 2022; Taleuzzaman *et al.* 2022). Unfortunately, while many plants native to the Cholistan desert are widely utilized by locals, their therapeutic use has yet to be established. *Neurada procumbens* L. is one of the most remarkable examples, and the over-exploitation of this valuable plant has put its local status in jeopardy. This plant is widely used for debility and sexual dysfunction, as a cooling agent, a powerful tonic, and a strong stimulant (Sadia *et al.* 2015; Hameed *et al.* 2011; Qureshi *et al.* 2010). There are several other native plants whose functions and chemical ingredients have yet to be discovered. *Aerva javanica* (Burm. f.) Juss., *C. decidua*, *C. brachycarpa*, *Crotalaria burhia* Buch.–Ham. ex Benth, *D. glaucum*, *Gisekia pharnacioides* L., and *Suaeda fruticosa* Forssk. ex J. F. Gmel. are among the species used for antiparasitic properties against intestinal worms (Sadia *et al.* 2015; Hameed *et al.* 2011). *A. javanica*, *A. maurorum*, *Calotropis procera* (Aiton) W. T. Aiton, and *C. decidua* are medicinal plants used for stomach and intestinal symptoms such as diarrhea, indigestion, discomfort, flatulence, and loss of appetite (Yaseen *et al.* 2015; Sadia *et al.* 2015; Hameed *et al.* 2011; Qureshi *et al.* 2010). Blood purifiers include *Mollugo cerviana* (L.) Ser. ex DC. and *B. procumbens* (Sadia *et al.* 2015; Hameed *et al.* 2011), while tonics include *A. nilotica*, *C. procera*, and *Cressa cretica* L. (Sadia *et al.* 2015; Hameed *et al.* 2011). *C. decidua*, *Capparis spinosa* L., *C. burhia*, and *Euphorbia prostrate* Aiton are among the plants with wound-healing and pain-relieving characteristics (Sadia *et al.* 2015; Hameed *et al.* 2011). Some plants are well-known for their ability to effectively cure chronic illnesses: Antihepatotoxic *Trianthema triquetrum* Willd., hepatoprotective *Haloxylon salicornicum* (Moq.) Bunge ex Boiss, and cancer-fighting *Cleome scaposa* DC. (Sadia *et al.* 2015; Hameed *et al.* 2011). Many plant species are used as traditional cures by residents of the Cholistan desert. For respiratory tract disorders such common cough, bronchitis, and asthma, they usually utilise *G. pharnacioides* and *C. cretica* (Sadia *et al.* 2015; Hameed *et al.* 2011). Constipation, stomach distress, and gastrointestinal discomforts are treated with *Leptadenia pyrotechnica* (Forssk.) Decne., *Cyperus conglomerates* Rottb., and *W. somnifera*. Blood purification and cardio-vascular disorders such as heartburn and cardiac difficulties are treated using *B. procumbens*, *M. cerviana*, and *Prosopis cineraria* (L.) Druce (Sadia *et al.* 2015; Hameed *et al.* 2011). High blood pressure and eczema can be treated with *G. pharnacioides*, *Salsola imbricate* Forssk. And *C. cretica* (Sadia *et al.* 2015; Hameed *et al.* 2011). *Citrullus colocynthis* (L.) Schrad., *A. javanica*, and *Haloxylon stocksii* (Boiss.) Benth. and Hook. f. are all excellent remedies for urinary problems, particularly renal and bladder stones (Sadia *et al.* 2015; Hameed *et al.* 2011). A variety of medicinal plants are used to treat aches and pains, as well as cuts and wounds. *L. pyrotechnica*, *A. javanica* and *Mukia maderaspatana* (L.) M. Roem. are among the most important medicinal plants (Sadia *et al.* 2015; Hameed *et al.* 2011; Qureshi *et al.* 2010). *W. somnifera* is good for aching eyes, *S. fruticosa* is good for eye infections, and *M. cerviana* is good for enhancing eyesight (Sadia *et al.* 2015; Hameed *et al.* 2011). *A. maurorum* may help with liver inflammation, *C. spinosa* can help with cancer and tumors, and *C. conglomeratus* can help with hair loss and baldness (Sadia *et al.* 2015; Hameed *et al.* 2011).

The ICF within a community and between cultural groups reveals which plants are commonly utilized, assisting in the selection of plants for pharmacological and phytochemical research (Giday *et al.* 2007). When a single or few plants are recorded to be used by a significant number of respondents to cure a specific ailment, ICF values are always higher, whereas low ICF values indicate that informants disagree about which plant to employ (Heinrich *et al.* 1998; Canales *et al.* 2005). The FL reflects which species are most frequently referenced by locals while treating a specific disease. According to Lozada *et al.* (2006), information on a species' FL is of more importance than other plant-based statistics. The high FL of these species is due to their widespread availability, distribution, and detailed knowledge of medicinal applications, doses, and recipes. It is considered that medicinal plants that are utilized for the same disease category regularly are more likely to be physiologically active (Trotter and Logan 2019).

Conclusions

According to the findings of this study, the Cholistan desert is abundant in indigenous medicinal plants. This investigation revealed that traditional medicine based on ancient indigenous knowledge is still practiced mostly in the Cholistan desert. A total of 93 plant species belonging to 31 families were identified. Fabaceae was the leading family (n = 13). The ICF was calculated for sixteen different disease categories value range (0.82 to 0.50). H. strigosum, G. villosa, and C. decidua exhibited high RFCs value 0.49. The FL of C. album and F. hamiltonii were 92.9 and 91.4%. Different demographic factors (i.e. Gender, age, educational status, and source of livelihood) showed a significant positive impact ($p < 0.001$) on the respondent's indigenous knowledge about medicinal plants. Gender and education are the two main demographic factors that significantly affect the level of respondents' indigenous knowledge followed by age and source of livelihood. We observed a significant difference ($p < 0.001$) regarding the indigenous knowledge about medicinal plants between the Gender, age, educational status, and source of livelihood of the respondents. It is also concluded that women are having vast ethnobotanical knowledge as compared to men and there is a huge gap in knowledge transmission from the older to the younger generation.

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Table 5. Detail list of medicinal plant species of the Cholistan desert, Southern Punjab, Pakistan

Scientific Name/Common Name/Voucher No.	Family Name	Habit	Part (S) Used	Formulation	Application	Aliment (S) Cured
Abutilon muticum (Delile) Sweet /Kanghi-buti/FRW-88-BZU	Malvaceae	Shrub	leaves, Roots	Decoction	Oral	Kidney disorders, gas trouble, kidney stones and heartburn
Acacia jacquemontii Benth. /Banwli or Pahadi kikar/Frw-19-BZU	Fabaceae	Tree	Bark, Leaves, Throns, Pods	Decoction	Oral	Pyrexia, coughing, viral infections
Acacia nilotica (L.) Willd. ex Delile /Babul or Kikar/Frw-18-BZU	Fabaceae	Tree	Leaves, Bark, Flowers, Fruit, Gums, Pods	Powder	Oral	leucorrhoea, male sexual dysfunction, dysentery and diabetes
Aerva javanica (Burm. f.) Juss. /Bui/FRW-89-BZU	Amaranthaceae	Shrub	Whole Plant, Roots, Root Bark, Leaves	Infusion, Decoction	Oral	Gall stones, Kidney stone and upper respiratory tract infection, Constipation and antiparasitic drug
Alhagi maurorum Medik. /Jawansa/FRW-87-BZU	Fabaceae	Shrub	Whole Plant, Roots	Infusion, Decoction	Oral	Detoxify blood, Hepatitis-C and respiratory disorders
Anticharis linearis (Benth.) Hochst. ex Aschers./Assmani butti /FRW-29-BZU	Scrophulariaceae	Herb	Leaves	Infusion, Paste	Both oral & Topical	Tiredness, head pain, inflammation in eye, and Hypotension
Arnebia hispidissima (Lehm.) A. DC. /Sorkhi butti/FRW-30-BZU	Boraginaceae	Herb	Whole Plant	Infusion, Decoction	Oral	Mental disorder, uterine contraction, epilepsy and dementia
Asphodelus tenuifolius Cav. /Piazi/FRW-31-BZU	Asphodelaceae	Herb	Whole Plant	Powder	Topical	Blood purifier, Patchy skin, Bronchial asthma and allergy
Blepharis sindica Stocks ex T. Anderson /Gandi-Buti/FRW-32-BZU	Acanthaceae	Herb	Whole Plant	Decoction	Oral	Hypotension, anemia, General weakness and pain
Boerhavia diffusa L. /Biskhipra/FRW-33-BZU	Nyctaginaceae	Herb	Whole Plant, Roots	Decoction	Oral	Renal failure, Blood in urine and Painful urination
Boerhavia procumbens Banks ex Roxb. /Biskhipra/FRW-34-BZU	Nyctaginaceae	Herb	Whole Plant	Infusion, Decoction	Oral	Renal failure, Blood in urine, blood purifier, Chest infections and dysmenorrhea
Calligonum polygonoides Pall. /Phog/FRW-90-BZU	Polygonaceae	Shrub	Flowers, Green Twigs, Floral Buds	Cook, Paste, Eaten Fresh	Both oral & Topical	Pink eye, heart burn, pain in eyes, severe thirst and Indigestion
Calotropis procera (Aiton) W.T. Aiton /Ak/FRW-91-BZU	Asclepiadaceae	Shrub	Latex, Leaves, Flower Buds, Root Bark, Shoot Buds	Paste, Eaten Fresh, Decoction	Both oral & Topical	Epilepsy, Painful menstruation, uterus problems, Snake bite, sexually transmitted diseases
Capparis decidua (Forssk.) Pax /Karir/FRW-17-BZU	Capparidaceae	Tree	Leaves, Fruit, Stem, Roots		Oral	Hemorrhoids, obesity, bone fractures, fevers, painful menstruation and indigestion

Capparis spinosa L. /Kubber/FRW-92-BZU	Capparidaceae	Shrub	Leaves, Flowers, Fruit	Cook, Infusion, Decoction	Oral	Arthritis, asthma, enlarged spleen, muscle pain and liver disorders
Caralluma edulis (Edgew.) Benth. ex Hook. f. /Seetoo/FRW-35-BZU	Asclepiadaceae	Herb	Whole Plant	Cook, Eaten Fresh	Oral	Diuretic and increases sexual pleasure or performance
Cassia italica (Mill.) Spreng. /Ghoray wall or sana/FRW-93-BZU	Fabaceae	Shrub	Whole Plant	Decoction	Oral	joint pain, fever, constipation, pain and indigestion
Cenchrus biflorus Roxb. /Mohabat Boti/FRW-08-BZU	Poaceae	Grass	Whole Plant	Infusion, Decoction	Oral	Antiparasitic drug
Cenchrus ciliaris L. /Dhaman/FRW-07-BZU	Poaceae	Grass	Whole Plant	Infusion	Oral	Kidney infection, cancer, wound healing and antiparasitic drug
Cenchrus setiger Vahl /Choti-Dhaman/FRW-16-BZU	Poaceae	Grass	Whole Plant	Infusion	Oral	Allergy, antiparasitic drug, fever and common cold
Chenopodium album L. /Bathu/FRW-36-BZU	Chenopodiaceae	Herb	Whole Plant	Cook, Decoction	Oral	Antiparasitic drug, diuretic, increases sexual pleasure or performance, Tonics, abdominal pain, eye disorders, throat problems
Chrozophora plicata (Vahl) A. Juss. ex Spreng. /Nilkari/FRW-37-BZU	Euphorbiaceae	Herb	Whole Plant	Decoction	Oral	Cuts & Wounds, peptic ulcer, coughing, Lower respiratory tract infection and Pulmonary tuberculosis (TB)
Cistanche tubulosa Wight /Phaphorr/FRW-38-BZU	Orobanchaceae	Herb	Whole Plant	Infusion, Decoction	Oral	Erectile-dysfunction, cough, Peptic ulcer, vomiting and diarrhea
Citrullus colocynthis (L.) Schrad. /Tumma or Kor tumma /FRW-39-BZU	Cucurbitaceae	Herb	Roots, Fruit, Seeds, Gums	Decoction	Oral	Radiculopathy, High blood sugar, painful menstruation and digestive disorders
Cleome brachycarpa M. Vahl ex Triana & Planchon /Noli or Harnoli/FRW-40-BZU	Capparidaceae	Herb	Whole Plant	Decoction	Oral	Antiparasitic drug, Liver disorders and high blood sugar
Cleome scaposa DC. /Kastoori Buti/FRW-41-BZU	Capparidaceae	Herb	Whole Plant	Infusion, Decoction	Oral	Pyrexia due to malarial attack, peptic ulcer, Hotness, Itchiness and high blood sugar
Convolvulus prostrates Forssk. /Hiran Buti/FRW-42-BZU	Convolvulaceae	Herb	Leaves, Green Twigs	Decoction	Oral	High blood sugar, constipation, fever and heartburning
Corchorus depressus Stocks /Bhao-phali/FRW-43-BZU	Tiliaceae	Herb	Whole Plant	Infusion, Decoction, Powder	Oral	Increases sexual pleasure or performance and Male sexual disorders
Corchorus trilacularis auct. Non-L. /Bari Buo-phali/FRW-53-BZU	Tiliaceae	Herb	Leaves	Infusion	Oral	Painful urination and kidney infection
Cressa cretica L. /Oin or Ooini/FRW-44-BZU	Convolvulaceae	Herb	Whole Plant	Paste, Decoction	Both oral & Topical	Bronchial asthma, blood purifier, Chest tightness, skin diseases,

						anorexia, as tonic and sexual stimulant
Crotalaria burhia Buch.–Ham. ex Benth /Chag/FRW-94-BZU	Fabaceae	Shrub	Whole Plant	Boil, Decoction	Oral	Skin diseases, reduces fever, joint pain, stomachache, Relieves pain in the body
Cucumis melo L. /Chibbar/FRW-45-BZU	Cucurbitaceae	Herb	Fruit	Cook, Powder, Decoction	Oral	Hyperacidity, increase appetite, bad eating habits and constipation
Cuscuta reflexa Roxb. /Akashbail/FRW-80-BZU	Cuscutaceae	Herb	Whole Plant	Powder, Decoction	Oral	Lice and dandruff, unhealthy skin and itching.
Cymbopogon jwarancusa Schult. /Khawi/FRW-05-BZU	Poaceae	Grass	Whole Plant, Roots		Oral	Disease of heart muscles, hysteria, Diarrhea, vomiting, joint and muscle pain and as diuretic
Cynodon dactylon (L.) Pers. /Khabal or Talla/FRW-10-BZU	Poaceae	Grass	Whole Plant		Oral	Bleeding of all types, Skin problems, brain and heart tonic
Cyperus conglomeratus Rottb. /Deela/FRW-04-BZU	Cyperaceae	Sedges	Whole Plant		Oral	Indigestion, hyperacidity and constipation
Cyperus rotundus L. /Deela or Murki/FRW-03-BZU	Cyperaceae	Sedges	Roots, Deela, Tubers		Oral	High sugar in blood, pain or burning with urination, excessive urination and Loss of appetite
Dipterygium glaucum Decne. /Phel/FRW-95-BZU	Capparidaceae	Shrub	Whole Plant	Infusion, Decoction	Oral	Jaundice, blood purifier, Skin redness and irritation
Echinops echinatus Roxb. /Unt Katara/FRW-46-BZU	Asteraceae	Herb	Whole Plant, Roots	Powder, Decoction	Oral	Hepatitis, icterus, loss of appetite, Bad eating habits and indigestion
Ephedra ciliata Fisch. & C. A. Mey. /Choti Phog/FRW-28-BZU	Ephedraceae	Shrub	Green Twigs, Floral Buds	Decoction	Oral	Asthma, bronchitis, pain in head and cough
Euphorbia granulata Forssk. /Dudheli/FRW-81-BZU	Euphorbiaceae	Herb	Whole Plant	Powder, Decoction	Oral	Skin diseases, high blood sugar, Antiparasitic drug and constipation
Euphorbia granulata Forssk. /Hazar Dani/FRW-47-BZU	Euphorbiaceae	Herb	Whole plant	Paste, Decoction	Both oral & Topical	Blood purifier, dermal diseases, pain, diabetes and Antiparasitic drug
Euphorbia prostrata Aiton /Hazar Dani/FRW-48-BZU	Euphorbiaceae	Herb	Whole plant	Paste, Decoction	Both oral & Topical	Hemorrhoids, eczema, gangrene Scabies and psoriasis, sexual weakness, skin redness and irritation
Fagonia cretica auct. Non Linn. Parker /Dhamasa/FRW-49-BZU	Zygophyllaceae	Herb	Whole Plant, Roots	Infusion, Decoction	Oral	Blood purifier, wounds, cancer, chronic fever, Liver diseases, Anameia, fever, pain

Farsetia hamiltonii Royle. /Fareed buti or Lathia/FRW-50-BZU	Brassicaceae	Herb	Whole Plant	Powder, Decoction	Oral	Excessive urination and Inflammations, as stimulant, Gastrointestinal disorders, muscle pain and High blood sugar
Gisekia pharnaceoides L. /Buloka Sag/FRW-51-BZU	Aizoaceae	Herb	Whole Plant	Decoction	Oral	Hepatitis, Liver disorders, ulcer, Loss of appetite, constipation, bad eating habits, fever and pain, Antiparasitic drug and skin infections
Glinus lotoides L. /Phatokar or Gandi-Booti/FRW-52-BZU	Molluginaceae	Herb	Whole plant	Decoction	Oral	Ulcer, Wound healer and antiseptic, Diarrhea, liver problems, externally to cure boils and wounds
Grewia villosa Willd. /Jalidar/FRW-20-BZU	Tiliaceae	Shrub	Whole Plant	Decoction, Powder	Oral	Kidney disorders, eye pain, venereal diseases
Haloxylon salicornicum (Moq.) Bunge ex Boiss /Lana/FRW-26-BZU	Chenopodiaceae	Shrub	Whole Plant	Making Ash	Topical	Bleeding gums, Indigestion, insect stings and liver disorders
Haloxylon stocksii (Boiss.) Benth. & Hook. f. /Khar or Sajji/FRW-27-BZU	Chenopodiaceae	Shrub	Whole Plant	Making Ash	Topical	peptic ulcer and Kidney stone
Heliotropium crispum Desf. /Hathi Sundi/FRW-54-BZU	Boraginaceae	Herb	Whole plant	Decoction	Oral	Renal stone, Erectile-dysfunction, weakness and indigestion
Heliotropium europaeum L. /Hathi Sundi/FRW-55-BZU	Boraginaceae	Herb	Whole plant	Decoction	Oral	Increases sexual pleasure or performance and High Blood Pressure
Heliotropium strigosum Willd. /Gorakh Pan/FRW-56-BZU	Boraginaceae	Herb	Whole plant	Infusion	Oral	Jaundice, hepatitis, blood purifier, Joint pain, inflammation in eye, open wounds and sore nipples of breasts
Indigofera argentea Burm. f. /Neel/FRW-58-BZU	Fabaceae	Herb	Whole plant	Infusion, Decoction	Oral	Malarial fever, jaundice, head pain, stomachache disorder, Antiparasitic drug and patchy skin
Indigofera sessiliflora DC. /Jantri/FRW-57-BZU	Fabaceae	Herb	Whole plant	Infusion, Decoction	Oral	Liver disorders, Skin rash and blood purifier
Launaea nudicaulis (L.) Hook. f. /Bhattal/FRW-59-BZU	Asteraceae	Herb	Whole plant	Decoction	Oral	Chronic constipation and Indigestion
Launaea resedifolia (L.) Kuntze. /Dhudhkal/FRW-60-BZU	Asteraceae	Herb	Whole plant	Decoction	Oral	Hepatitis, Loss of appetite and fever

Leptadenia pyrotechnica (Forssk.) Decne. /Khip/FRW-25-BZU	Asclepiadaceae	Shrub	leaves, Roots, Shoots	Decoction, Powder	Oral	Obesity, dysmenorrhea, Abdominal cramps and high blood sugar
Limeum indicum Stocks ex T. Anderson /Lonri/FRW-61-BZU	Aizoaceae	Herb	Whole plant	Infusion	Oral	Piles, High blood sugar and Indigestion
Melilotus officinalis (L.) Lam. /Sinji/FRW-62-BZU	Fabaceae	Herb	Whole plant	Cook, Decoction	Oral	Pain in head, nausea and stimulate appetite
Mollugo cerviana (L.) Ser. ex DC. /Padi or Sarr/FRW-63-BZU	Molluginaceae	Herb	Roots, Whole Plant	Decoction	Oral	Gonorrhoea, painful urination, venereal disease, skin allergy and detoxify blood.
Mukia madaraspatana (L.) M. Roem. /Gawala-kakri/Frw-02-BZU	Cucurbitaceae	Climber	shoots, Roots, Seeds	Infusion, Decoction	Oral	Jaundice and muscular weakness
Neurada procumbens L. /Chhapri/FRW-64-BZU	Neuradaceae	Herb	Whole plant	Cook, Decoction	Oral	Sexual tonic, sunstroke and Hypotension
Oligochaeta ramosa (Roxb.) Wegentiz /Birham Dandi/FRW-65-BZU	Asteraceae	Herb	Whole plant	Infusion, Decoction	Oral	Allergy, pain in joints, Irritation, liver diseases, and as brain tonic
Oxystelma esculantum (L. f.) Sm. /Dudhani/FRw-01-BZU	Asclepiadaceae	Climber	Whole plant	Infusion, Decoction	Oral	Painful urination, Gonorrhoea, blood purifier and sexually transmitted diseases
Panicum antidotale Retz. /Murrot or Bansi Ghaa/FRW-11-BZU	Poaceae	Grass	Whole Plant, Seeds	Decoction	Oral	Cough, throat infection, viral infection and problem in breathing
Peganum harmala L. /Harmal/FRW-83-BZU	Zygophyllaceae	Herb	Whole Plant	Powder, Decoction	Oral	Gynecological issues, convulsions, mental illness, patchy skin and Pain in abdomen
Pentatropis spiralis (Forssk.) Decne /Hiran Buti/FRW-66-BZU	Asclpiadaceae	Herb	Leaves, Stem, Latex	Paste, Decoction	Both oral & Topical	Bleeding diathesis, ulcer and wound
Pergularia daemia (Forssk.) Chiov. /Karial/FRW-82-BZU	Asclepiadaceae	Herb	Whole Plant	Powder, Decoction	Oral	Antiparasitic drug, gas trouble, difficulty in breathing, acidity and pregnancy issues
Polygala erioptera var. *vahliana* (DC.) Chodat /Asmani Buti/FRW-67-BZU	Polygalaceae	Herb	Whole Plant	Infusion, Decoction	Oral	Detoxify blood, liver disorders and skin disease
Polygonum plebejum R. Br., Prodr. /Charri Hatha/FRW-68-BZU	Polygonaceae	Herb	Roots, Whole plant	Powder, Decoction	Oral	Cough, bronchitis, Bronchial asthma, pneumonia, indigestion, vomiting and diarrhea
Portulaca oleracea L. /Lonak/FRW-71-BZU	Portulacaceae	Herb	Whole plant	Cook, Decoction	Oral	Cough, piles, constipation and weakness
Praecitrullus fistulosus (Stocks) Pangalo /Jangli Tindy/FRW-69-BZU	Cucurbitaceae	Herb	Fruit	Cook, Powder	Oral	Appetizer, indigestion and weakness
Prosopis cineraria (L.) Druce /Jandi or Kanda/FRW-16-BZU	Fabaceae	Tree	Leavers, Bark, Flowers, Pods, Fruit	Powder, Decoction	Oral	Anemia, contraceptive, Heal wounds, joint and muscle pain

Prosopis juliflora (Sw.) DC. /Maskit/FRW-15-BZU	Fabaceae	Tree	Leaves, Bark	Decoction	Oral	Dermatitis, bone fractures and cure gall stones
Psoralea plicata Delile /Makka Buti/FRW-70-BZU	Fabaceae	Herb	Roots, Seeds	Powder, Decoction	Oral	Skin diseases and Blood purifier
Rhynchosia capitata (B. Heyne ex Roth) DC. /Choti Ghore Wall/FRW-72-BZU	Fabaceae	Herb	Whole plant	Decoction	Oral	Indigestion, constipation and vomiting
Saccharum bengalense Retz. /Sarkanda/FRW-09-BZU	Poaceae	Grass	Roots	Infusion, Decoction	Oral	Kidney stone and painful urination
Salsola imbricata Forssk. /Lani/FRW-23-BZU	Chenopodiaceae	Shrub	Whole Plant	Making Ash	Topical	Abdominal distension, antiparasitic drug, itching and sores
Salvadora oleoides Decne. /Pilu or Wan/FRW-14-BZU	Salvadoraceae	Tree	Fruit, Bark, Leaves, Stem	Cook, Decoction	Oral	Bone fractures, cure gall stones, bad eating habits and bleeding gums
Seetzenia lanata (Willd.) Bullock /Jeuli Buti/FRW-73-BZU	Zygophyllaceae	Herb	Whole plant	Decoction	Oral	stimulant, pyrexia and High blood pressure
Sesuvium sesuvioides (Fenzl) Verdc. /Barri Ulwaiti/FRW-75-BZU	Aizoaceae	Herb	Whole plant	Decoction	Oral	Joint pain and nosebleed
Solanum surratense Burm. f. /Kandiari/FRW-74-BZU	Solanaceae	Herb	Whole plant	Powder, Decoction	Oral	Bronchial asthma, Joint pain, severe headache, hair stimulant, and gastric problem
Suaeda fruticosa Forssk. ex J. F. Gmel. /Kali Lani/FRW-22-BZU	Chenopodiaceae	Shrub	Whole Plant	Making Ash	Topical	Constipation, dysmenorrhea, red eyes, indigestion and wound healing
Tamarix aphylla (L.) Lanza /Ukhan or Frash/FRW-13-BZU	Tamaracaceae	Tree	Leaves, Bark, Nuts	Powder, Decoction	Oral	Ulcer, sexual weakness and skin problems
Tephrosia purpurea (L.) Pers. /Jhilli/FRW-21-BZU	Fabaceae	Shrub	Whole Plant	Decoction, Powder	Oral	Liver disorders, peptic ulcer, lower respiratory tract infection, Hemorrhoids, cancer/malignant tumor and skin allergy
Trianthema triquetram Willd. /Choti Ulwaiti/FRW-77-BZU	Aizoaceae	Herb	Whole Plant	Powder, Decoction, Infusion	Oral	Skin disease, diabetes and inflammation
Tribulus longipetalus Viv. /Tirkindi or Bakhara/FRW-76-BZU	Zygophyllaceae	Herb	Fruit, Seeds, Whole Plant	Powder, Decoction	Oral	Kidney stone, Erectile-dysfunction, male sexual problems and anemia
Withania coagulens Stocks /Paneer/FRW-85-BZU	Solanaceae	Herb	Whole Plant, Fruit	Powder, Decoction	Oral	hepatitis, jaundice, anorexia, skin problems, chronic fever, bad eating habits
Withania somnifera L. /Asgandh/FRW-86-BZU	Solanaceae	Herb	Leaves, Root Bark, Roots	Powder, Decoction, Infusion	Oral	Erectile-dysfunction, premature ejaculation, diabetes, Peripheral

						neuropathy, arthritis and as sexual tonic
Zaleya pentandra (L.) C. Jeffrey /Itsit or Wisah/FRW-79-BZU	Aizoaceae	Herb	Roots	Powder, Decoction	Oral	Painful urination, kidney stone, blood in urine
Zizyphus spina-christi (L.) Desf. /Beri/FRW-12-BZU	Rhamnaceae	Tree	Fruit, Bark, Leaves, Seeds	Powder, Decoction	Oral	Jaundice, hepatitis, indigestion, leucorrhoea, menstrual disorders, Skin diseases and hair roughness
Zygophyllum simplex L. /Lunak/FRW-78-BZU	Zygophyllaceae	Herb	Whole Plant	Powder, Decoction	Oral	Blood purifier, Patchy skin, wounds, acne and Bleeding

Declarations

Ethics approval: All participants provided oral prior informed consent.
Consent to publish: The paper does not show any personal data. Availability of data and materials: The authors will provide the raw data on request without the names of informants.
Competing interests and conflict of interest: The authors declare that they have no competing interests or conflicts of interest.
Funding: The research paper is a part of the Ph.D. thesis of the first author (Ehsan Ali). The research study is funded by Higher Education Commission Pakistan under NRPU Project 11119.
Authors' contribution: EA deliberated this work, conducted a field survey, performs statistical analysis, and wrote the manuscript. MFA read, corrected, and approved the manuscript.

Acknowledgments

The authors are thankful to the Higher education commission of Pakistan for financial assistance.

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