Quantitative ethnobotanical appraisal of Shawal Valley, South Waziristan, Khyber Pakhtunkhwa, Pakistan

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Research

Abstract

Background: The primary goal of this study was to collect and document uses of plants by local residents of Shawal Valley, South Waziristan, Pakistan. The report of the present study can be useful for the continued investigation of the study area with the aim of obtaining further traditional information about local plants in the study area. The current report will also take part in further phytochemical studies.

Methodology: A semi-structured questionnaire was used to interview 65 residents (24 females and 41 males). The results were expressed as Relative Frequency of Citation (RFC), Use Value (UV), Fidelity Level (FL), Informant Consensus Factor (ICF), and Jaccard Index (JI).

Results: The research region is abode to 60 plant species belonging to 32 families of ethnobotanical significance. *Lamiaceae* family contributed the highest number of species (7 species), followed by *Pinaceae* (6 species). The most preferred plant parts among the reported species were the leaves (60%), followed by the stem (28.3%). *Thymus mongolicus* was found to have the highest RFC (0.86), while *Adiantum capillus-veneris* had the lowest (i.e. 0.02). The UV was between 0.02 and 1. *Thymus mongolicus* was found to have the greatest UV (UV=1); whereas *Adiantum capillus-veneris* had the lowest UV (0".02). Twelve plants had a fidelity level of 100%, while *Quercus dilatata* had the lowest (33.3%). Plants' ICF values varied from 0.87 to 0.96. The Average Direct Matrix Ranking revealed that *Quercus dilatata* received the highest rating (1st) for its diverse uses, followed by *Pinus wallichiana* (2nd), *Rumex dentatus* (3rd), *Pinus gerardiana* (4th), *and Zingiber officinale* (5th).

Conclusion: Ethnobotanical research indicates that indigenous people in the studied area are knowledgeable on the use of plants. These plants and indigenous knowledge must be preserved.

Keywords: Ethnobotanical survey; ethnomedicinal plants; Lamiaceae; Shawal; South Waziristan; informant consensus factor.

Background

Ethnobotanical studies are commonly conducted to evaluate the interrelationship between local communities and their surrounding wild plant species (Awan *et al*, 2021). These surveys are crucial to understanding the cultural heritage associated with the use of native plants and disclosing their values to scientists for possible implication in drug discovery. These types of studies help scientists to discover some novel drugs from plants (Omotayo *et al*, 2020). In addition, ethnobotanical investigations reveal the socioeconomic importance of medicinal plants (Silva *et al*, 2011; Arshad *et al*, 2014), preserve the indigenous knowledge in a particular area (Mesfin *et al*, 2009; Ambu *et al*, 2020), and provide useful data for the research of bioactive compounds against diverse diseases (Arshad *et al*, 2014). These kind of studies are important in preserving the indigenous knowledge about medicinal plants of a particular area (Mesfin *et al*, 2009; Ambu *et al*, 2020). These type of studies provide a window to discover some new active compounds found in the plants against some deadly diseases (Arshad *et al*, 2014).

Nowadays, the medicinal herbs represent a source for primary healthcare (Merouane et al, 2022), and play a significant role in uplifting the economic conditions of local communities in remote areas (Yaseen *et al*, 2013) . The use of medicinal plants is a common practice predominantly in the developing countries of the world. Traditional knowledge is often held by elderly people and traditional healers; unfortunately, the younger generations are not focused on obtaining this valuable knowledge from them (Adnan *et al*, 2014). The modern healthcare system is also imposing problems on traditional practices to cure diseases using medicinal plants (Amiri *et al*, 2013).

According to the World Health Organization (WHO), approximately 65% of the world’s population is dependent on traditional practices as primary health care (Farnsworth, 1988). Modern medicines are too expensive, especially for the people living in underdeveloped or even developing countries, so they always trust in traditional practices employing local plants until reaching a critical situation (Umair *et al*, 2019).

The country has over 600 wild plant species that are medicinally valuable (Hamayun, 2003), and widely exploited by the population as herbal drugs, apart from some big cities (Yaseen *et al*, 2013; Akram *et al*, 2011). The ethnobotany of Pakistani patrimony has received remarkable interest from local research and is still growing from different parts of the country (Umair *et al*, 2017). With time, the ethnobotany in Pakistan is growing and the researchers from different parts of the country have stated a lot of work (Umair *et al*, 2017). Although wild plants play a very important role in the lives of locals in the study area. Locals get medicines, food, and used plants as sources of income, along with other ethnobotanical prospects. However, every year, large numbers of these valuable plant species are lost due to poor collection and conservation practices. If the issues are not handled properly, they might result in the destruction of habitat and the extinction of species. Therefore, it is necessary to develop strategies for gathering medicinal plants in the wild and to train local collectors in growing and harvesting medicinal plants using proper collection techniques (Qureshi, 2012). The objective of the present study was i); to document the traditional ethnobotanical knowledge about different plants in a few villages (Sharjakalai, Razin, Raghzai, Bajjan, Tabbai and Sernarai) in Shawal valley, Khyber Pakhtoon Khawa, Pakistan, ii); to find out ethomedicinally important plant species, plant families and plant parts used to treat various diseases iii); to highlight the significance of flora in the lives of residents of the area under investigation.

Materials and Methods

Study area

Study area is located in South Waziristan's District Laddah's Shawal Hills (31°55'/32°40' latitude, 69°15'/70°15' longitude, 2500 m). The area of Shora Valley is located on eastern side of Pakistan. The area enclosed by Pirghar and Qutma Hills are to the south, Miami Kabul Khel and Jhoni Khel Wazir tribes are to the west, and Shoedar Hill in North Waziristan is to the north as shown in (Figure 1).The region climate in the summer season is hot and dry, with an average temperature of 27ºC. The winter season contains an average temperature of 17ºC The average annual rainfall of the region is 129 mm. April and May are considered the spring months. After mid-June, the summer season begins, and it lasts until the end of August. Summer is when there is the most precipitation. In the summer, a lot of ephemeral vegetation grows. The amount of rainfall in the autumn is quite little, only 15 to 25 cm. The soil in the region is often calcareous and shallow (Farooq et al, 2010).

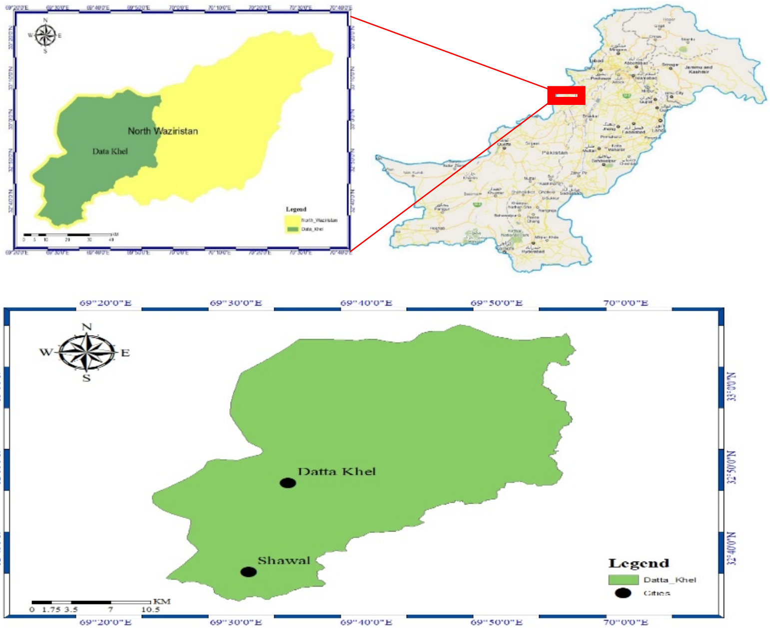

Figure 1. Map of the study area

Ethnobotanical data collection

The current study was conducted during the period March 2021 to August 2022 in villages namely Sharjakalai, Razin, Raghzai, Bajjan, Tabbai and Sernarai located in Shawal valley, South Waziristan Agency, Pakistan.. For data collection, a Rapid appraisal approach (RAA) was carried out, and native residents were asked for their knowledge about local plants. The assessments were based on the interactions with the indigenous people in person during group gatherings and semi-structured discussions (Martin, 1995). The total number of informants was 65, including 41 males, and 24 females. Throughout the survey, permanent connection with local people were maintained to confirm the validity of traditional knowledge. The necessary data were documented, including vernacular names, locality, and medicinal values. All the collected data were analyzed through Microsoft Excel (2016). Plants were identified with the help of flora of Pakistan (http://www.efloras.org/flora) and the plant list (http://www.theplantlist.org/) was used for the nomenclature of plant species.

Quantitative ethnobotany

Relative Frequency of Citation (RFC)

The following formula was used to determine the RFC of medicinally important plants:

$$RFC = FC/N \quad (0 < RFC < 1)$$

The RFC index determines the importance of different species in a given area (Birjees *et al*, 2021).

Frequency of Citation and Use Value

The frequency of citations as cited by the informants was calculated for each species using the Philips and Gentry (1993) formula as follows:

$$UV_x = \Sigma U_x / N_x$$

Where "Ux" is the number of uses per species for species x as determined by each individual informant, and "N" denotes the overall number of informants who designated the specific species x.

Informant Consensus Factor

The Informant Consensus Factor (ICF) was estimated using Heinrich *et al.* (1998).

$$ICF = (Nur-Nt)/(Nur-1)$$

Where "Nt" is the number of times a species is utilized for that illness category, and "Nur" denotes the number of usage citations for each disease category. The ICF values reveal the uniformity of the data on a certain category of illness (Farnsworth *et al*, 1988; Heinrich *et al*. 1998).

Fidelity Level

The fidelity level (FL) determines which species is preferred for treating a certain condition over others (Canales *et al*, 2005; Bennett and Prance, 2000). The following formula was used to calculate the FL for plant species:

$$FL (\%) = NP/N \times 100$$

Where "N" represents the proportion of respondents who mention using a species for a specific diseases category and "NP" represents the proportion of respondents who mention using a species for any diseases category.

Direct Matrix Ranking (DMR)

Information due to usage variety of useful medicinal plants was assessed by direct matrix ranking (DMR) as defined by Cotton (1996) which includes various (i.e. women and men) key informers. The participants for their practise were nominated on the basis of their extensive experience as traditional herbalists living in the area as defined by Yineger *et al*, (2007).

Jaccard Coefficient of Similarity (JCS)

JCS is used by ethnobotanists to compare reported species to previously published data collected from nearby locations (Yaseen *et al*, 2015). JCS was calculated (Kidane *et al*, 2018) as follows:

$$JCS= c/ (a+ b+ c).$$

The number of species only present in the surrounding region is indicated by the letter "a" in this case. The number of species that are unique to the research region is indicated by the letter "b." c is the number of species that are present in both region a and area b.

Results and Discussion

Ethnobotanical data collection

Ethnobotanically, a total of 60 plant species from 32 families are being used by the natives for a variety of uses. Plants were displayed together with their scientific names, local names, families, plant parts used, life forms as well as their uses. In addition, the previous literature was observed to find out whether there was similarity, dissimilarity, or novelty in these research findings (Table 5).

Demographic Data of the Informants

Through in-person interviews and questionnaires, information about ethnobotanical plants was collected from 65 locals (Table 5). In terms of gender, there were 24 female participants (36.92%) and 41 male participants (63.08%) in this study (Figure 2). Some elderly women work in the fields alongside men or herders, which helped document the uses of plants. The rationale for the high percentage of male informants is that it was considerably simpler to obtain information from males than from women. In a similar vein, 12.3% of informants identified as traditional health practitioners (THPs), and 88% of both genders are indigenous to the research region. Age statistics revealed that people between the ages of 60 and 80 are the ones who are most knowledgeable about traditional medicines (9.2 %), followed by those with ages between 20-40 years (40%) and then 40-60 years (50.76 %).

Diversity of plants and their life forms

Five different growth forms were recorded during the survey (Figure 3), and it was observed that herbs dominated the area by contributing 40 species, followed by trees (14 species), shrubs (3 species), mushrooms (2 species), and rhizomes (1 species). These results agreed with those of Amjad *et al*. (2017). The use of herbs was dominate because of their high availability.

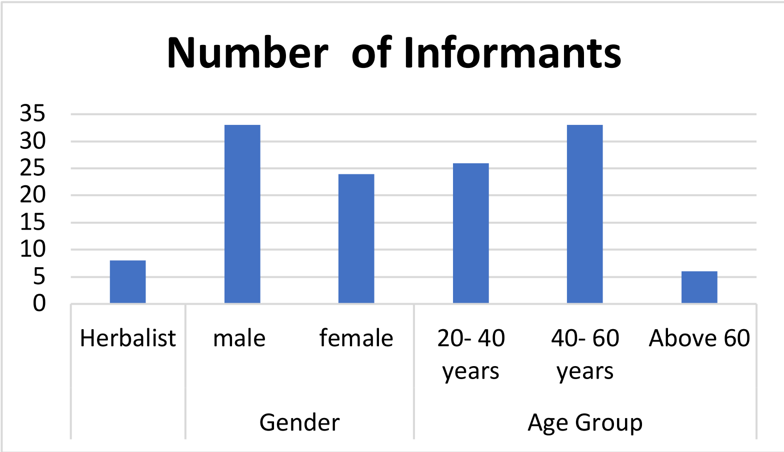

Figure 2. Demographic Data of Informant

Table 1.Family importance value of ethnobotanical plants in Shawal valley

Family	No.	Percentage
Lamiaceae	7	21.875
Pinaceae	6	18.75
Malvaceae	5	15.62
Solanaceae	3	9.37
Moraceae	3	9.37
Rosaceae	2	6.25
Alliaceae	2	6.25
Umbellifereae	2	6.25
Polygonaceae	2	6.25
Fabaceae	2	6.25
Appiaceae	1	3.125
Chenopodiaceae	1	3.125
Aizoaceae	1	3.125
Fagaceae	1	3.125
Ranunculaceea	1	3.125
Russulaceae	1	3.125
Zingiberaceae	1	3.125
Juglandaceae	1	3.125
Amaranthaceae	1	3.125
Oxillidaceae	1	3.125
Berberidaceae	1	3.125
Scropholriaceae	1	3.125
Cannabaceae	1	3.125
Ephideraceae	1	3.125
Utricaceae	1	3.125
Brassicaceae	1	3.125
Salicaceea	1	3.125
Zygophyllaceea	1	3.125
Morchellaceae	1	3.125
Aspergaceae	1	3.125
Pterridaceae	1	3.125
Araceae	1	3.125

Ethnomedicinal plant species showed that the largest family of the study area was Lamiaceae (Table 1) which contributed 7 species, followed by Pinaceae (6 spp.), Malvaceae (5 spp.), Solanaceae (3 spp.), Moraceae (3 species), Rosaceae, Alliaceae, Appiaceae, Polygonaceae and Fabaceae (2 spp. each), while rest of families contributed single species. The Lamiaceae family received the most reports due to its richness and diversity in the study area.

Plant parts used and their mode of utilization

Results of this study indicated that leaves have a maximum usage percentage (60%) as shown in Figure 4. It was followed by the stem (28.3%), seeds (23.33%), fruits (21.66%), whole plant (11.66) roots (9.20%), bark (8.33%) flower (8.33%), aerial parts (5%), (3.45%), bulb (3.33%), tuber, rhizome, and resin (1.66%). According to Biswas and Rahman (2017), leaves are the primary photosynthetic organs responsible for the synthesis of constituents that are active against various diseases. Thus, their preference over other parts of plants is because of the accumulation of active constituents in them. Different parts of plants were used by indigenous people in different ways, like decoction, juice, extract, powder, etc.

Health issues

The information revealed that the local population had several health problems, the most prevalent of which were gastrointestinal (GIT) disorders, respiratory disorders, urinary disorders, neuro-muscular disorders, kidney disorders, skin and eye issues, mouth issues, diabetes, wounds, hepatic disorders, blood diseases, sexual diseases, and antidotes (Figure 5). It has been documented by various research studies that almost all of these health concerns were prevalent in various regions of the study area (Akram*et al*, 2011; Umair *et al*, 2017; Umair *et al*, 2019).

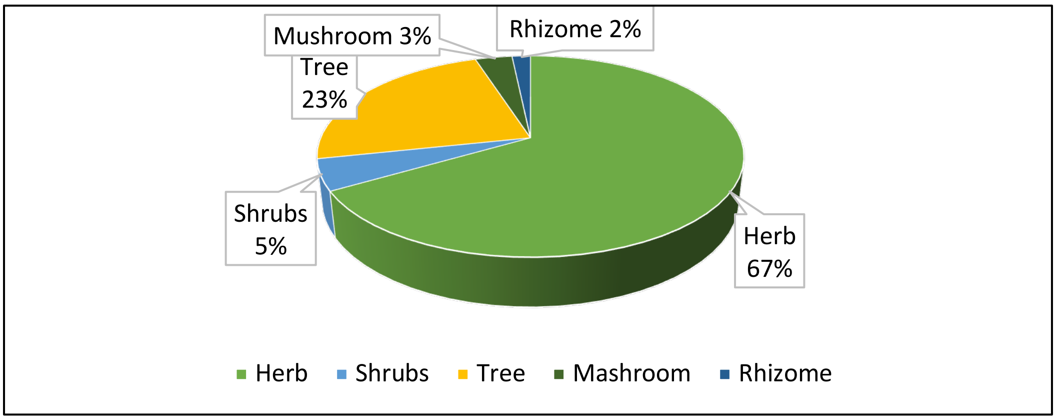

Figure 3. Percentage of growth forms of medicinal plants.

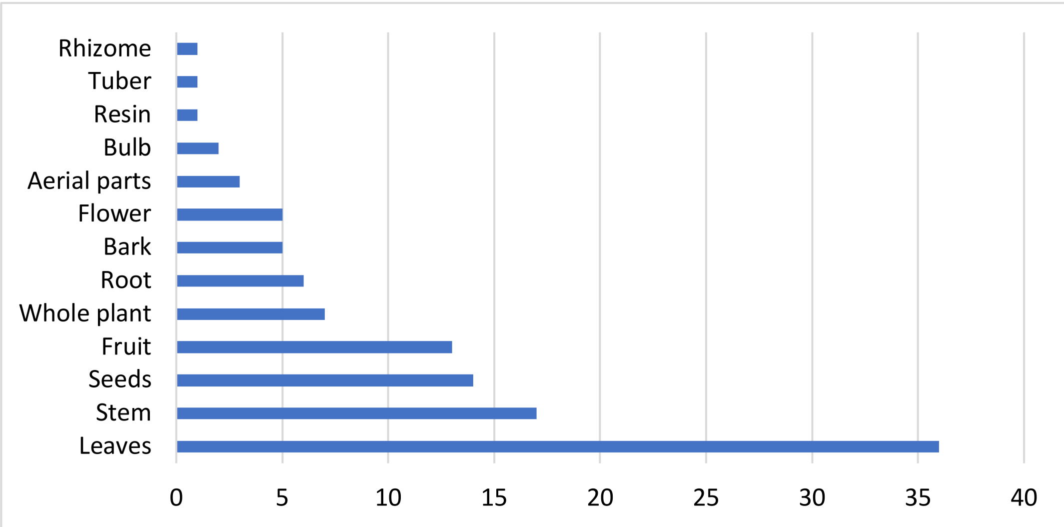

Figure 4. Percentages of plant part used.

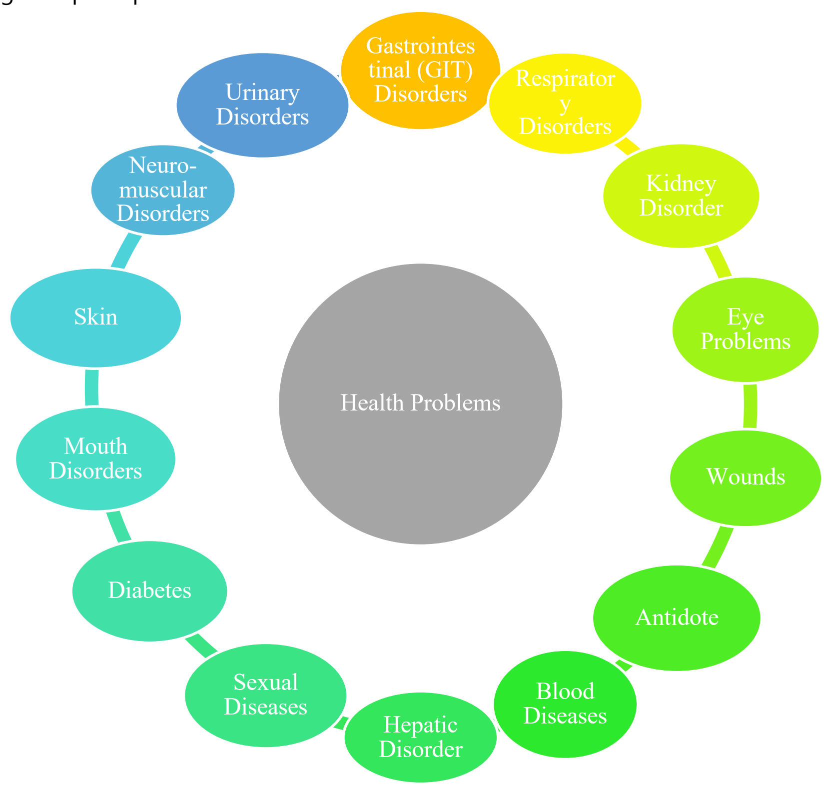

Figure 5. Health issues of the people in the study area

Quantitative Data Analysis

Relative Frequency of Citation (RFC)

The RFC value of any species explains the level of popularity of any plant species among the study area's local inhabitants. The RFC values ranged from 0.02 to 0.86 (Table 2). The highest RFC value was recorded for *Thymus mongolicus* i.e. 0.86, followed by *Mintha longifolia* (0.85), *Juglans regia* (0.82) *Pinus gerardiana* (0.77), *Quercus dilita* (0.71), *Nepeta cataria* (0.68), *Ficus carica* (0.66), *Portulaca oleracea* (0.66). These plants were very rich in study area and people are much familiar about them and their uses. Their importance for treating various diseases was popular among the locals. *Adiantum capilus-veneris* had the lowest RFC (0.02). Among plant species with high RFC, our studies showed that *Thymus mongolicus* was used for gastric problems. *Thymus mongolicus* has been used to treat digestive and gastric issues in previous studies (Aziz et al, 2016).This is also consistent with Qaiser et al. (2013)'s report on plant use for gastrointestinal diseases.. Hence, our reported uses of *Thymus mongolicus* and *Mentha longifolia* strongly correlate with previous literature (Table 2 and 5). Plants with high RFC values could be processed further for evaluating important phytochemicals and for the synthesis of drugs.

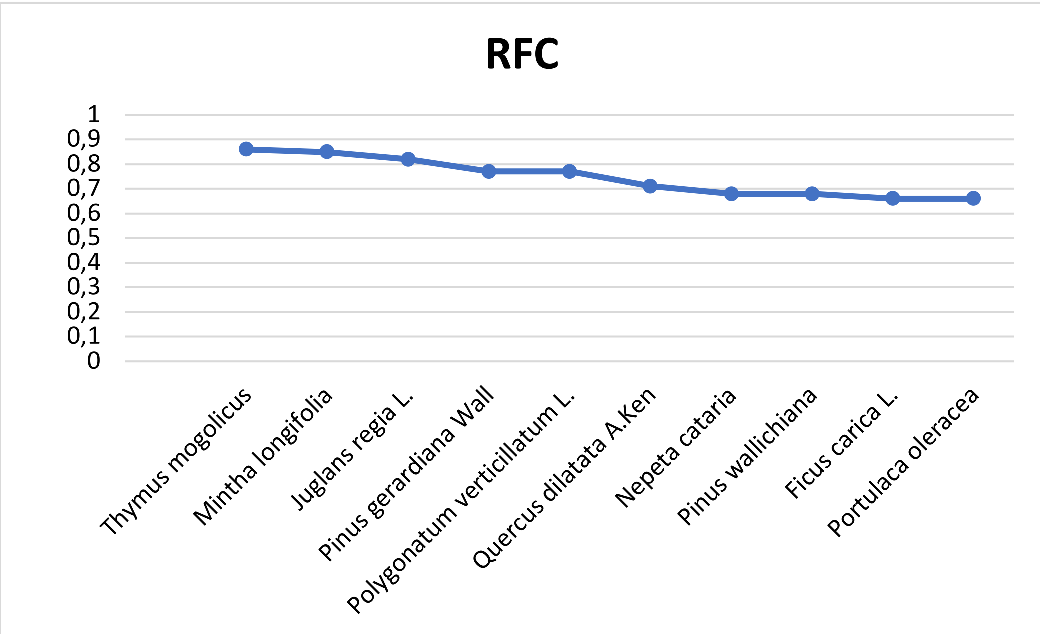

Figure 6. Plants in Shawal Valley with high RFC values

Use Value (UV)

The use value was calculated to check out the important plant species based on their uses. In this study, UV values ranged from 0.02 to 1 (Table 2 and 5). The highest use value was reported for *Thymus mongolicus* with UV=1, followed by *Mentha longifolia* and *Foeniculum vulgare* with UV=0.97 and *Juglans regia* UV=0.94, respectively. *Adiantum capilus-vaneris had lowest UV values 0.02*. Plants that have more natural abundance in any area are widely studied because local people are well aware of their properties and frequently apply them in various applications. According to Yaseen (2019), ethnomedicinal species having high UVs and RFCs values should be checked to evaluate and demonstrate their pharmacological activity. While plants with low UVs are not un-important(Amjad *et al*, 2017), but their low values designate that residents are unaware of their applications, and this hinders the transfer of knowledge to descendants.

Table 2. RFC and UV values of medicinal plants

Scientific name	**FC**	**RFC**	**ΣUi**	**UV**
Abelmoschus esculentus (L.) Moench	42	0.65	57	0.88
Abies pindrow (Royle ex D.Don) Royle	18	0.28	33	0.51
Adiantum capillus-veneris L.	1	0.02	1	0.02
Allium cepa L.	24	0.37	38	0.58
Allium sativum L.	32	0.49	46	0.71

Amaranthus viridis L.	37	0.57	37	0.57
Arisaema draconitum (L.) Schott	3	0.05	4	0.06
Astragalus grahamianus Benth.	8	0.12	12	0.18
Beberis lyceum Royle.	25	0.38	32	0.49
Cannabis sativa L.	33	0.51	43	0.66
Cedrus deodara (Roxb. ex D.Don) G.Don)	19	0.29	23	0.35
Chenopodium album L.	4	0.06	5	0.08
Coriandrum sativum L.	39	0.60	39	0.60
Daucus carota L.	5	0.08	8	0.12
Ephedra intermedia Schrenk & C.A.Mey.	20	0.31	47	0.72
Ficus carica L.	43	0.66	49	0.75
Foeniculum vulgare Mill.	32	0.49	54	0.83
Hibiscus trionum L.	6	0.09	13	0.20
Juglans regia L.	53	0.82	61	0.94
Leontopodium nivale (Ten.) Huet ex Hand.-Mazz.	15	0.23	39	0.60
Malva neglecta Wallr.	18	0.28	45	0.69
Malva parviflora. L.	33	0.51	38	0.58
Malva pusilla Sm.	14	0.22	28	0.43
Marrubium vulgare L.	16	0.25	21	0.32
Mentha piperita L.	28	0.43	37	0.57
Mentha longifolia (L.) L.	55	0.85	63	0.97
Morchella esculenta L.	40	0.62	62	0.95
Morus nigra L.	11	0.17	26	0.40
Nepeta cataria L.	44	0.68	52	0.80
Oxalis carniculata L.	31	0.48	44	0.68
Parthenium hystrophorus L.	5	0.08	10	0.15
Perovskia *atriplicifolia* Benth	4	0.06	9	0.14
Picea smithiana (Wall.) Boiss.	32	0.49	52	0.80
Pinus gerardiana Wall. ex D.Don	50	0.77	58	0.89
Pinus roxburghii Sarg.	18	0.28	32	0.49
Pinus wallichiana A.B.Jack	44	0.68	44	0.68
Polygonatum verticillatum (L.) All.	50	0.77	53	0.82
Portulaca oleracea L.	43	0.66	51	0.78
Prunus armeniaca L.	13	0.20	25	0.38
Pyrus malus L.	15	0.23	31	0.48
Quercus dilatata Royle	46	0.71	50	0.77
Ranunculus muricatus L.	2	0.03	4	0.06
Raphanus sativus L.	20	0.31	20	0.31
Rumex dentatus L.	17	0.26	32	0.49
Rumex hastatus D.Don.	19	0.29	36	0.55
Russula emetic Schaef	6	0.09	13	0.20
Salix babylonica L.	11	0.17	28	0.43
Salvia nubicola Wall. ex Sweet	35	0.54	53	0.82
Solanum nigrum L.	6	0.09	12	0.18
Solanum tuberosum L.	32	0.49	49	0.75
Solanum villosum Mill.	14	0.22	29	0.45
Sophora mollis (Royle) Baker	10	0.15	22	0.34
Tagetes patula L.	20	0.31	42	0.65
Taraxacum officinale L.	4	0.06	9	0.14
Thymus mongolicus (Ronniger) Ronniger	56	0.86	65	1.00
Tribulus terristris L.	9	0.14	30	0.46
Urtica dioica L.	13	0.20	39	0.60
Verbascum thapsus L.	9	0.14	8	0.12
Xanthium spinosum L.	12	0.18	16	0.25
Zingiber officinale Roscoe.	39	0.60	39	0.60

Fidelity Level (FL)

The Fidelity level (FL) was calculated to reveal the informant consensus regarding the use of specific plant species for specific purposes (Siddique *et al*, 2021).The specificity of a plant species for treating a specific disease highlights its value over other plant species that are used for the same purpose. The FL was ranged from 33.33% to 100% in this study (Table 3). There were 12 plant species such as *Abelmoschus esculentum, Chenopodium album, Corriendrum sativum, Malva neglecta, Oxalis corniculata, Parthenium hystrophorous, Pinus wallichiana, Prunus armeniaca, Solanum nigrum,* and *Tagetus patula* possessed a 100% fidelity level. It was followed by *Picea smithiana* (98.11%), *Amaranthus viridis* (97.14%) and *Nepetacateria* (95.45%). *Oxalis corniculata* and *Corriendrum sativum* have the highest FL for gastric problems, which is also in agreement with the study of Usman*et al*. (2021). High fidelity shows plant specificity for specific disease, while low fidelity shows random treatment.

Table 3.Fidelity level of medicinal plants from study area

Scientific name	**Medicinal use**	**NP**	**N**	**FL**
Abelmoschus esculentus (L.) Moench	Vegetable	44	44	100.0
Abies pindrow (Royle ex D.Don) Royle	Asthma	20	24	83.33
Adiantum capillus-veneris L.	Demulcent	8	13	61.54
Allium cepa L.	Aphrodisiac	3	5	60.00
Allium sativum L.	lowers blood pressure	26	32	81.25
Amaranthus viridis L.	Vegetable	34	35	97.14
Arisaema draconitum (L.) Schott	Health tonic	45	50	90.00
Astragalus grahamianus Benth.	Analgesic	28	31	90.32
Beberis lyceum Royle.	Kidney problems	47	50	94.00
Cannabis sativa L.	Narcotic	7	9	77.78
Cedrus deodara (Roxb. ex D.Don) G.Don	Antiseptic	4	6	66.67
Chenopodium album L.	Jaundice	17	17	100.0
Coriandrum sativum L.	Carminative	20	20	100.0
Daucus carota L.	Eyesight	41	46	89.13
Ephedra intermedia Schrenk & C.A.Mey.	Stomachic	33	33	100.0
Ficus carica L.	Constipation	8	11	72.73
Foeniculum vulgare Mill.	Digestive	5	10	50.00
Hibiscus trionum L.	Stomach pain	2	3	66.67
Juglans regia L.	Brain tonic	25	28	89.29
Leontopodium nivale (Ten.) Huet ex Hand.-Mazz.	Abdominal aches	8	13	61.54
Malva neglecta Wallr.	Cough	18	18	100.0
Malva parviflora. L.	Cough	7	14	50.00
Malva pusilla Sm.	Piles	13	20	65.00
Marrubium vulgare L.	Cough	9	15	60.00
Mentha piperita L.	Carminative	30	32	93.75
Mentha longifolia (L.) L.	Digestive	3	4	75.00
Morchella esculenta L.	Tonic	8	15	53.33
Morus nigra L.	Cough, Constipation	4	6	66.67
Nepeta cataria L.	Carminative	42	44	95.45
Oxalis carniculata L.	Digestive	4	4	100.0
Parthenium hystrophorus L.	Urinary tract infection	43	43	100.0
Perovskia *atriplicifolia* Benth	Refrigerant	14	20	70.00
Picea smithiana (Wall.) Boiss.	Furniture, wounds	52	53	98.11
Pinus gerardiana Wall. ex D.Don	Tonic, fire	13	14	92.86
Pinus roxburghii Sarg.	Stimulant, fire	6	9	66.67
Pinus wallichiana A.B.Jack	Furniture, antiseptic	1	1	100.0
Polygonatum verticillatum (L.) All.	Sex tonic	10	19	52.63
Portulaca oleracea L.	GTIs and UTIs	24	32	75.00
Prunus armeniaca L.	Tonic	56	56	100.0
Pyrus malus L.	Blood increasing tonic	3	5	60.00
Quercus dilatata Royle	Fodder, Sex tonic	4	12	33.33
Ranunculus muricatus L.	Analgesic, kidney stone	6	11	54.55

Raphanus sativus L.	Hepatitis	22	33	66.67
Rumex dentatus L.	Vegetable, Constipation	4	6	66.67
Rumex hastatus D.Don.	Astringent, vegetable	2	4	50.00
Russula emetic Schaef	Food, Eye tonic	15	18	83.33
Salix babylonica L.	Ear ache	7	8	87.50
Salvia nubicola Wall. ex Sweet	Mouth sweetener	25	37	67.57
Solanum nigrum L.	Jaundice	32	32	100.0
Solanum tuberosum L.	Food	32	39	82.05
Solanum villosum Mill.	Fever	35	42	83.33
Sophora mollis (Royle) Baker	Gastrointestinal	17	25	68.00
Tagetes patula L.	Cooling agent	2	2	100.0
Taraxacum officinale L.	Diuretic	38	40	95.00
Thymus mongolicus (Ronniger) Ronniger	Carminative	41	43	95.35
Tribulus terristris L.	Fodder, Kidney stone	55	55	100.0
Urtica dioica L.	Digestive	33	39	84.62
Verbascum thapsus L.	Antihelmintic	15	19	78.95
Xanthium spinosum L.	Diuretic	8	18	44.44
Zingiber officinale Roscoe.	Flavoring agent, cough	14	16	87.50

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) was calculated to find out the homogeneity among the consents of informants regarding the use of plants for different purposes (Ishtiaq *et al*, 2016). The inhabitants of the study area use medicinal plants to treat 40 different types of health disorders. In the present study, ICF was examined for 18 ailment categories: (1) GIT disorders; (2) respiratory disorders; (3) neuromuscular disorders; (4) kidney problems; (5) food; (6) eye diseases; (7) mouth diseases; (8) diabetes; (9) dermatological disorders; (10) wounds; (11) Hepatic problems; (12) blood diseases; (13) sexual diseases; (14) furniture; (15) covering the roof; (16) fuel; (17) fodder and (18) antidote. The values ranged from 0.87 to 0.96. The highest ICF value (0.96) was achieved by gastrointestinal disorders (GIT). It was followed by respiratory disorders with an ICF value of 0.95.

The highest ICF for gastrointestinal disorders (diarrhea, dysentery, vomiting, and abdominal pain) was also consistent with the previous literature of Birjees *et al.* (2021). Plant species for treating GIT disorders include *Thymus mongolicus, Mentha longifolia, Portulaca oleracea, Berberis lyceum,* and *Oxalis corniculata.* Respiratory disorders include cough, asthma, and sore throat. The plants used for respiratory diseases include *Ephedra intermedia, Malva parviflora, Allium cepa, Malva neglecta, Malva pusilla, Morus nigra* and *Zingiber officinale.* The lowest ICF value (0.87) was found for food, covering roofs, and antidotes**.** ICF value determines the effectiveness of plants for treating a disease and should be preferred for treating that disease (Yaseen, 2019).

Table 4. ICF values of the plant species exploited for several use categories.

Plant used Categories	**Nur**	**Nt**	**ICF**
Gastrointestinal	674	30	0.96
Respiratory disorder	168	9	0.95
Kidney disorders	58	5	0.94
Furniture	332	18	0.95
Mouth diseases	198	13	0.94
Dermattological disorders	242	16	0.94
Eye diseases	73	6	0.93
Wounds	136	10	0.93
Blood diseases	109	9	0.93
Sexual diseases	169	12	0.93
Fuel	109	9	0.93
Diabetes	25	3	0.92
Neuromuscular disorders	45	6	0.89
Hepatic disorders	138	17	0.88
Animal fodder	138	17	0.88
Food	32	5	0.87
Covering roof	62	9	0.87
Antidote	55	7	0.87

Table 5. Plants from the study areas with ethnobotanical values

Family	Botanical name	Local name	Habit	Parts used	UV	RFC	FL%	Comparison with previous studies
Aizoaceae	*Portulaca oleracea* L.	Sormai	Herb	Leaves and seeds	0.78	0.66	75.0	1Δ,2Δ,3₷,4Δ,5Δ
Alliaceae	*Allium cepa* L.	Pioz	Herb	Bulb	0.58	0.37	60.0	1Δ,2Δ,3●,4●,5Δ
Alliaceae	*Allium sativum* L.	Vizza	Herb	Bulb	0.71	0.49	81.2	1Δ,2Δ,3Δ,4Δ,5Δ
Amaranthaceae	*Amaranthus viridis* L.	Ranzaka	Herb	Leaves	0.57	0.57	97.1	1Δ,2Δ,3₷,4₷,5Δ
Amaranthaceae	*Chenopodium album* L.	Zonda	Herb	Leaves	0.08	0.06	100.0	1Δ,2₷,3©,4●,5Δ
Apiaceae	*Coriandrum sativum* L.	Dhnya	Herb	Aerial parts	0.60		100.0	1Δ,2Δ,3Δ,4●,5Δ
Apiaceae	*Daucus carota* L.	Gajara	Herb	Leaves, roots and seeds	0.12	0.08	89.1	1Δ,2Δ,3Δ,4₷,5Δ
Apiaceae	*Foeniculum vulgare* Mill.	Badyan	Herb	Fruit and fresh leaves	0.83	0.49	50.0	1Δ,2Δ,3Δ,4Δ,5Δ
Araceae	*Arisaema draconitum* (L.) Schott	---------	Herb	Tuber	0.06	0.05	90.0	1Δ,2Δ,3Δ,4●,5Δ
Asparagaceae	*Polygonatum verticillatum* (L.) All.	Meralam	Herb	Aerial part	0.82	0.77	52.6	1Δ,2Δ,3Δ,4Δ,5Δ
Asteraceae	*Astragalus grahamianus* Benth.	Azghai	Herb	Leaves	0.18	0.12	90.32	1Δ,2Δ,3₷,4Δ,5Δ
Asteraceae	*Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz.	-------	Herb	Leaves and flower	0.60	0.23	61.5	1Δ,2Δ,3Δ,4Δ,5Δ
Asteraceae	*Tagetes patula* L.	Zyerrgullai	Herb	Fruit	0.65	0.31	100.0	1Δ,2Δ,3Δ,4₷,5Δ
Asteraceae	*Taraxacum officinale* L.	Zeyerr gul	Herb	Whole plant, Leaves extract and roots	0.14	0.06	95.0	1₷,2Δ,3₷,4Δ,5Δ
Asteraceae	*Xanthium spinosum* L.	Spin azghai	Herb	Whole plant	0.25	0.18	44.4	1Δ,2Δ,3●,4Δ,5Δ
Asterceae	*Parthenium hystrophorus* L.	---------	Herb	Leaves	0.15	0.08	100.0	1Δ,2Δ,3Δ,4Δ,5Δ
Berberidaceae	*Beberis lyceum* Royle.	De wrogha betai/ Zyeer largai	Shrub	Roots, leaves and bark	0.49	0.38	94.0	1₷,2₷,3₷,4₷,5Δ
Brassicaceae	*Raphanus sativus* L.	Milai	Herb	Root and leaves	0.31	0.31	66.6	1Δ,2Δ,3Δ,4Δ,5Δ
Cannabaceae	*Cannabis sativa* L.	Bhangee	Herb	Leaves, stem and seeds	0.66	0.51	77.7	1Δ,2₷,3●,4©,5Δ
Ephideraceae	*Ephedra intermedia* Schrenk & C.A. Mey.	Mova	Shrub	Leaves and shoot	0.72	0.31	100.0	1Δ,2₷,3Δ,4₷,5Δ

Fabaceae	*Sophora mollis* (Royle) Baker	Ghujer	Herb	Seeds, leaves roots	0.34	0.15	68.0	1₷,2₷,3₷,4₷,5Δ
Fagaceae	*Quercus dilatata* Royle	Ghurra cherrai	Tree	Stem, Leaves and fruit corn	0.77	0.71	33.3	1●,2●,3●,4₷,5Δ
Juglandaceae	*Juglans regia* L.	Matak	Tree	Leaves, Bark and fruit	0.94	0.82	89.2	1Δ,2₷,3₷,4₷,5Δ
Lamaiceae	*Thymus mongolicus* (Ronniger) Ronniger	Marvizye	Herb	Leaves and stem	1.00	0.86	95.3	1Δ,2Δ,3₷,4Δ,5Δ
Lamiaceae	*Marrubium vulgare* L.	Mako wana	Herb	Whole plant	0.32	0.25	60.0	1Δ,2₷,3₷,4Δ,5Δ
Lamiaceae	*Mentha piperita* L.	Welanai	Herb	Leaves	0.57	0.43	93.7	1Δ,2Δ,3Δ,4Δ,5●
Lamiaceae	*Mentha longifolia* (L.) L.	Podeena	Herb	Leaves and stem	0.97	0.85	75.0	1Δ,2Δ,3₷,4Δ,5Δ
Lamiaceae	*Nepeta cataria* L.	Chamjan betai	Herb	Flower and mostly leaves	0.80	0.68	95.4	1Δ,2Δ,3₷,4₷,5Δ
Lamiaceae	Perovskia *atriplicifolia* Benth	Shinshubai	Sub shrub	Flowers	0.14	0.06	70.0	1Δ,2Δ,3₷,4₷,5Δ
Lamiaceae	*Salvia nubicola* Wall. ex Sweet	Khanir	Herb	Leaves, Stem and flower	0.82	0.54	67.5	1●,2Δ,3Δ,4●,5Δ
Malvaceae	*Abelmoschus esculentus* (L.) Moench	Bhindai	Herb	Fruit, Seeds and leaves	0.88	0.65	100.0	1Δ,2Δ,3Δ,4©,5Δ
Malvaceae	*Hibiscus trionum* L.	Khatool	Herb	Flower, leaves	0.20	0.09	66.6	1Δ,2Δ,3₷,4Δ,5Δ
Malvaceae	*Malva neglecta* Wallr.	Tikali	Herb	Seeds	0.69	0.28	100.0	1₷,2₷,3₷,4₷,5Δ
Malvaceae	*Malva parviflora.* L.	Tikali	Herb	Leaves, roots and seeds	0.58	0.51	50.0	1Δ,2Δ,3₷,4₷,5Δ
Malvaceae	*Malva pusilla* Sm.	Nagankai	Herb	Leaves and seeds	0.43	0.22	65.0	1Δ,2Δ,3₷,4Δ,5Δ
Moraceae	*Ficus carica* L.	Togha	Tree	Fruit	0.75	0.66	72.7	1Δ,2Δ,3₷,4₷,5Δ
Moraceae	*Morus nigra* L.	Tor teet	Tree	Fruit, stem	0.40	0.17	66.6	1Δ,2Δ,3Δ,4Δ,5Δ
Morchellaceae	*Morchella esculenta* L.	Karrkicho	Mushroom	Aerial parts	0.95	0.62	53.3	1Δ,2Δ,3Δ,4Δ,5●
Oxiladaceae	*Oxalis carniculata* L.	Tervekye	Herb	Leaves	0.68	0.48	100.0	1Δ,2₷,3●,4Δ,5Δ
Pinaceae	*Abies pindrow* (Royle ex D.Don) Royle	Lmanza	Tree	Leaves, Seeds and bark	0.51	0.28	83.3	1©,2Δ,3Δ,4Δ,5Δ
Pinaceae	*Cedrus deodara* (Roxb. ex D.Don) G.Don	Dayar	tree	Oil, Bark, Fruit and Stem.	0.35	0.29	66.6	1₷,2₷,3Δ,4Δ,5Δ

Pinaceae	*Pinus gerardiana Wall. ex D.Don*	Zanghozai	Tree	Seeds, stem	0.89	0.77	92.8	1S,2S,3Δ,4Δ,5Δ
Pinaceae	*Pinus roxburghii* Sarg.	Sargent	Tree	Bark, wood, fruit and resin.	0.49	0.28	66.6	1Δ,2Δ,3Δ,4Δ,5Δ
Pinaceae	*Pinus wallichiana* A.B.Jack	Nashtar	Tree	Wood and leaves	0.68	0.68	100.0	1S,2S,3Δ,4Δ,5Δ
Pinceae	*Picea smithiana* (Wall.) Boiss.	Kharrsrap	Tree	Whole plant	0.80	0.49	98.1	1Δ,2Δ,3Δ,4Δ,5Δ
Polygonaceae	*Rumex dentatus* L.	Surmai	Herb	Leaves, roots and seeds	0.49	0.26	66.6	1©,2Δ,3Δ,4Δ,,5Δ
Polygonaceae	*Rumex hastatus* D.Don.	Sormai	Herb	Leaves	0.55	0.29	50.0	1Δ,2Δ,3Δ,4Δ,5Δ
Pteridaceae	*Adiantum capillus-veneris* L.	Maidenhair fern	Herbaceous	Fronds	0.02	0.02	61.5	1●,2●,3S,4Δ,5Δ
Ranunculaceae	*Ranunculus muricatus* L.	---------	Herb	Leaves	0.06	0.03	54.5	1S,2Δ,3S,4Δ,5Δ
Rosaceae	*Prunus armeniaca* L.	Mandata	Tree	Fruit, Stem, leaves and seeds	0.38	0.20	100.0	1Δ,2Δ,3Δ,4Δ,5Δ
Rosaceae	*Pyrus malus* L.	Manrra	Tree	Fruit, Stem and leaves	0.48	0.23	60.0	1Δ,2Δ,3Δ,4Δ,5Δ
Russulaceae	*Russula emetic* Schaef	Kastorai	Mushroom	Aerial	0.20	0.09	83.3	1Δ,2Δ,3Δ,4Δ,5Δ
Salicaceea	*Salix babylonica* L.	Walla	Tree	Leaves and stem	0.43	0.17	87.5	1Δ,2Δ,3S,4Δ,5Δ
Scrophulariaceae	*Verbascum thapsus* L.		Herb	Leaves	0.12	0.14	78.95	1S,2●,3,4Δ,5Δ
Solanaceae	*Solanum nigrum* L.	---------	Herb	Leaves and fruit	0.18	0.09	100.0	1S,2Δ,3S,4Δ,5Δ
Solanaceae	*Solanum tuberosum* L.	Allo/Alig	Herb	Tuber	0.75	0.49	82.0	1Δ,2Δ,3Δ,4Δ,5Δ
Solanaceae	*Solanum villosum* Mill.	Kozabaye	Herb	Whole plant	0.45	0.22	83.3	1Δ,2Δ,3Δ,4Δ,5Δ
Utricaceae	*Urtica dioica* L.	Sazankye	Herb	Leaves	0.60	0.20	84.62	1S,2S,3S,4Δ,5Δ
Zingiberaceae	*Zingiber officinale* Roscoe.	Adrak	Herb	Rhizome and leaves	0.60	0.60	87.50	1Δ,2Δ,3Δ,4Δ,5Δ
Zygophyllaceae	*Tribulus terristris* L.	Maklende	Herb	Fruit and stem	0.46	0.14	100.0	1Δ,2Δ,3S,4Δ,5Δ

Direct Matrix Ranking (DMR)
The people of the current study area ranked species differently on the basis of their significance as well as their preferences. Five plant species were selected for DMR ranking. This selection was based on their medicinal uses, as well as their use for making fuel, furniture, and fodder for animals. Highest ranking was given to *Quercus dilata* for its multipurpose uses, followed by *Pinus wallichiana* (Table 6). Data was collected from 14 key informants, and plants were given scores out of 5 based on their uses for each category. Local people ranked these plants for their great potential because they are being used for medicinal, fuel, furniture, fodder, and food purposes. Over-exploitation of multi-purposes species for non-medicinal purpose results in the reduction of highly medicinal species (Kidane *et al*, 2018).

Table 6. Direct Matrix Ranking of 14 informants for 5 medicinal plants

Plant species	Medicinal	Furniture	Fuel	Fodder	Food	Total	Rank
Quercus dilatata A.ken	5	0	4	3	3	15	1st
Pinus Wallichiana A.B Jacks	2	5	4	2	0	13	2th
Rumex dentatus L.	3	0	0	4	5	12	3rd
Pinus gerardiana Wall.	4	0	3	0	4	11	4th
Zingiber officinale Roscoe.	4	0	0	0	5	09	5th

Jaccard Coefficient of Similarity (JCS)
Ethnobotanists use JCS for making comparisons of reported research species with previously published data gathered from adjoining areas (Yaseen *et al*, 2015). A few ethnomedicine research papers from neighboring areas were chosen for review in JCS (Table 7).. The high value of JCS was determined as 36% by Aziz *et al.* (2016), followed by 26% by Farooq *et al.* (2012), 22% by Farooq *et al.* (2010) and 18% by Qaisar *et al.*(2013). High value of JCS may be due to the common vegetation, traditions and geography between two regions. High similarity may be due to sharing of knowledge about ethnobotanical flora. Low JCS (1.63%) was reported by Badshah *et al.* (2015). Low similarity may be attributed to remarkable differences in cultural adoption, vegetation, and geographic zones.

Table 7. Jaccard Coefficient of Similarity (JCS) of study area

Previous study area	References	Total species in adjoining area	Total species in present study	Plants found only in adjoining area (a)	Plant found only in study area (b)	Plants common in both areas (c)	a+b+c	JI	JI%
Phytosociology of Shawal pushziarat	(Farooq *et al*, 2010)	69	60	50	10	17	77	0.22	22%
Ethnobotany of Wazir and Daur Tribe NWA	(Qaisar *et al*, 2013)	88	60	70	10	18	98	0.18	18 %
Ethnomedicinal survey of Ladha SWA	(Aziz *et al*, 2016)	82	60	48	12	34	94	0.36	36%
Ethnobotanical study of Birmal SWA	(Farooq *et al*, 2012)	72	60	51	9	21	81	0.25	26%
Pharmacological Activity of Wild Mushrooms	(Badshah *et al*, 2015)	4	60	3	57	1	61	0.01	1.63%

Conclusion
The results of the current quantitative ethnobotanical study showed that the natives of Shawal Valley from South Waziristan are well acquaintance with the usage of plants. Owing to inexpensive and readily available of these plants, residents of this area are using native plant species to treat health issues of diverse nature. However, elder people were extremely knowledgeable to the traditional usage of medicinal herbs, and young people are less keen to learn about it. The majority of plants in this area with higher usage values were widespread and well-known to the local population. Additionally, there is a need for residents of the study area to be aware of the sustainable use of medicinal plants for their long-term and persistent availability. The preservation of these plant species is the

gateway toward developing efficacious remedies for treating disease. Enhancing the sustainable use and conservation of indigenous knowledge of useful medicinal plants may benefit to improve the living standards of poor people. It is necessary to recognize the endangered and threatened flora in Shawal valley to develop conservation strategies. Hence, it is necessary to document the indigenous knowledge of useful plants and their therapeutic uses before they are lost forever.

Recommendations

- Findings from the present study can be used to generate or improve policies aimed at reducing plant diversity in the study area.

- The author suggested that the phytochemical composition and biological activity of these plants are still not fully known and may contain pharmaceutically important constituents. Thus, more investigation is required, and these plants could be a promising source of novel drugs and potentially useful new pharmaceuticals.

Declarations

List of abbreviations: RFC=Relative Frequency of Citation, UV= Use Value, FL= Fidelity Level, ICF= Informant Consensus Factor and JI= Jaccard Index, FC= Frequency of Citation, RFC= Relative frequency of citation, UR= Use reports,UV=Use value.

Ethics Approval: The authors confirm that study was reviewed and approved by an Institutional Review Board of Pir Mehr Ali Shah-Arid Agriculture University Rawalpindi, Pakistan (Ethics Committee as well as by Advanced Studies and Research Board) before the study began. The committee further approved the study has no direct harmful impact on participants and biodiversity of area under investigation. All participants provided oral prior informed consent before the interviews.

Consent for publications: Oral permission. All authors agreed for submission.

Data Availability: Data is available on demand.

Conflict of Interest: Authors have no conflict of interest.

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Authors' Contribution: The study was carried out by H.U. R.Q. designed/developed and supervised the work. Y.B. and A.S. contributed as supervisory committee members. M.M. contributed in editing the manuscript. M.I helped in statistical analysis. M.M. offered suggestions. The revised write-up has been done by SA. All writers read and contributed to the modification of the article after reading the initial draft. All authors have read and approved it.

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