Ethnomedicinal study of medicinal plants used by the inhabitants of tribal District North Waziristan, Khyber Pakhtunkhwa, Pakistan

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Research

Abstract

Background: Therapeutic plants are the wealth of any area for disease treatment. The current study was focused on report the traditional knowledge of unexplored areas of District North Waziristan, Pakistan. This was the first quantitative survey for studying the medicinal plants of the study area.

Methods: Ethnomedicinal data was collected from 130 informants through face-to-face interviews as well as semi-structured questionnaires. The collected data was analyzed through quantitative indices viz., Relative frequency of citations (RFC), Use value (UV), Fidelity level (FL), Jaccard index (JI), and Informant Consensus Factor **(**ICF).

Results: A total of 206 medicinal plant species belonging to 78 families were recorded which are being used by the natives of the área under study. Maximum number of species were reported for the treatment of constipation (36 spp.), followed by blood purification (22 spp.). The most frequently used plant parts were leaves (63 spp.) followed by fruits (49 spp.). In the case of recipe formulation, decoction was the leading method (58 spp.), followed by powder (47 spp.). The highest relative frequency of citation (RFC) was recorded for *Cydonia oblonga* (0.56), followed by *Morus alba* (0.55), *Berberis lycium* (0.54), and *Salvadora oleoides* (0.52). The highest Informant Consensus Factor **(**ICF) value was reported for gastrointestinal disorders (0.91).

Conclusions: The indigenous health professional in North Waziristan have a wealth of knowledge on therapeutic plants and their utilization. Harvesting of whole plants and roots exerted huge pressure on the native flora and there is an urgent need to initiate conservation strategy for the safeguard of medicinally important flora.

Keywords: quantitative study, traditional knowledge, relative frequency of citation, North Waziristan, Pakistan.

Background

For primary healthcare, about 80% of the traditional communities depend upon medicinal plants (Sarma *et al.* 2012; Khan *et al*. 2021). Different communities have widely used plant derived constituent which are used in the preparation of traditional

and herbal remedies (Dugani *et al.* 2018). In the distant study area, most of indigenous people are poor, mostly uneducated, and deprived of primary healthcare system (Khan *et al.* 2021). The indigenous people of the area typically depending on medicinal plants for their everyday life (Kamal *et al.* 2016). The studies contain all types of associations between plants and people, concerning their medicinal, religious beliefs and uses (Panigrahi *et al*. 2021). The plants are commonly used in the production of food, medicines and cosmetics (Petrakoua *et al.* 2020). In rural areas inhabitants use therapeutic plants in the form of herbal medication to cure various ailments due to effectiveness, easy availability, and trust (Hassan *et al.* 2017). Most of the rural areas people still use therapeutic plants as substitute of allopathic medicine (Birjees *et al.* 2021).

Therapeutic plant species contain a variety of bioactive compounds (Akkol *et al.* 2021; Hayat *et al.* 2021), that may help in the healing of different disease in animals and humans (Ahmad *et al.* 2020; Silva *et al.* 2020). The associated indigenous knowledge has been transferred orally from one generation to other generations (Zeleke 2016). Traditional medication is yet practiced in several regions and in developed countries (Marrelli *et al.* 2020). The medicinal plants utilization in modern drug has significantly increased, moreover indigenous knowledge is gradually declining due to reliance of people on modern health care methods, but this folk method yet dominates in the rural communities (Vitalini *et al.* 2013). Traditional knowledge about therapeutic plants is required for the conservation, protection, and herbal drugs development (Mesfin *et al.* 2009; Zahoor *et al.* 2017).

In Pakistan, there are more than 6000 flowering plants, out of which approximately 12% were used in medicines preparation (Bano *et al.* 2014) and used for the treatment of different human ailments (Jima & Megersa 2018). In most areas, few therapeutic plants are thought to be unique for a particular ailment (Hamayun *et al.* 2005). In Pakistan, most of the population is reliant on herbal drugs (Akram *et al.* 2011; Umair *et al.* 2017). Usually, herbs collectors are illiterate (Sodhi *et al.* 2004). In Pakistan, most of the medicinal plants have already become extinct due to overutilization (Rehman *et al.* 2022a). Herbal medications are preferred due to low price, ease of access with no side effects (Ishtiaq *et al.* 2021). Indigenous knowledge is often held by traditional healers and older people, but unfortunately the younger generations are not interested in gaining this precious knowledge from elder (Adnan *et al.* 2014). Furthermore, due to modernization and the lack of interest of the younger generation in traditional knowledge, which is declining rapidly, ethnoecological knowledge may vanish if not properly recorded (Rashid *et al.* 2015). Therefore, if not appropriately documented, ethnoecological knowledge may be diminished (Aziz *et al.* 2018; Rehman *et al.* 2022b). In Pakistan and adjacent area, ethnomedicinal studies have been reported from different regions (Ullah *et al.* 2013; Aziz *et al.* 2016; Hussain *et al*. 2018a; Hussain *et al.* 2021; Ishtiaq *et al.* 2021, Hussain *et al.* 2022). To the best of our knowledge, no quantitative ethnomedicinal study has priviously been reported from the study area. Therefore, this study was conducted to document the traditional knowledge about various local plants in Tribal District North Waziristan, KPK, Pakistan.

Materials and Methods

Study area

North Waziristan Tribal District, Khyber Pakhtunkhwa, Pakistan, is a hilly region that lies between 32°35′ and 33°20′ north latitude and 69°25′ and 70°40′ east longitude with an altitude of 2143 to 7717 feet. North Waziristan is bounded on the east by District Bannu and on the west by Afghanistan, on the south by District South Waziristan, on the North by Kurram Agency, Hangu District, and also by Afghanistan, (Fig. 1). The study area falls under Irano-Turanian Region. The area is bounded by mountains which are connected with Koh-e-Sulaiman in the south and Koh-e-Sufaid in the north. The area of North Waziristan under forests is 475000 acres; the North Waziristan area contains 4,707 square kilometers (1,817 sq mi). The study area is cultivable and fertile and is irrigated by three main rivers: Tochi, Kurram, and Katu rivers. Wazir and Dawar are the major tribes in the research area. Pashto is the major language.

Medicinal plants collection

The ethnomedicinal survey was carried out in Tribal District, North Waziristan from April 2018 to October 2020 to document medicinal plants. Field interviews were conducted from indigenous people including herbalist, professional, shepherd, old age people, Hakeems, and farmer. Many of them were over 60 years old (46.92%), 51–60 years old (40.00%), and 35–50 years (13.08%). A total of 130 local informants were interviewed belonging to different age groups. The data were recorded from local respondents by using semi-structured questionnaires as well as through face to face interviews. During the survey age, gender, education, occupation, vernacular names, family name, growth form, folk uses, use parts, mode of preparation, mode of application and route of administration were documented from the local people of the study area.

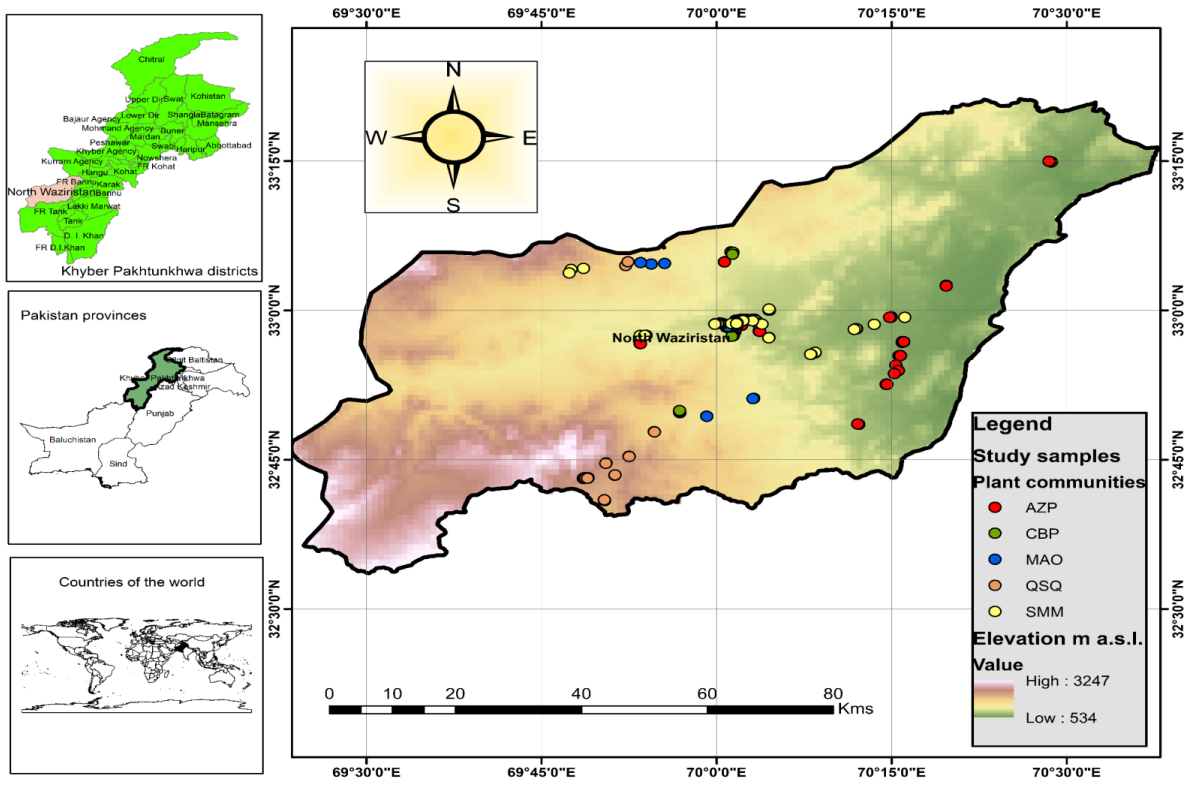

Figure 1. Map of the study area.

Identification and Preservation of Plants

The collected specimens were pressed, dried, poisoned with (1% $HgCl_2$ solution), and were mounted on standard herbarium sheets. The plants specimens were identified by Prof. Dr. Rahmatullah Qureshi and confirmed by using published literature (Ali and Nasir 1970-2002). A voucher number was assigned to all individual species and the specimens were submitted at the herbarium of Hazara University (HU), Mansehra, Dhudial for future references.

Quantitative data analysis

Indigenous knowledge is quantitatively analyzed using different quantitative indices such as Fidelity Level (FL %), Frequency of citation (FC), Relative Frequency of Citation (RFC), Use Reports (URs), Use Value (UV), Informants Consensus Factor (ICF), and Jaccard index (JI).

Fidelity Level (FL %)

The Fidelity Level (FL) is the percentage of informants who mention the utilization of particular medicinal plant species to cure specific ailments in the study area. The Fidelity Level (FL) is calculated by using the following formula (Yaseen *et al.* 2015; Rehman *et al.* 2023a).

$$\mathrm{FL}\ (\%) = \frac{\mathrm{Np}}{\mathrm{N}}\ \mathrm{x}\ 100$$

Where "Np" is the particular number of citations for a specific disease and "N" is the total number of respondents citing the plant species for any ailments.

Informants Consensus Factor (ICF)

The informant consensus factor (ICF) was used to seek agreement among the informants on the documented cures for each ailment category (Cerqueira *et al.* 2020). The ICF value ranges from (0 to 1). Thus, the following formula was used.

$$\mathrm{ICF} = \frac{\mathrm{Nur} - \mathrm{Nt}}{\mathrm{Nur} - 1}$$

Where "Nur" is the number of use reports in each disease category and "Nt" is the number of taxa used.

Relative Frequency of Citation (RFC)

The RFC value for indigenous therapeutic plant is based on the number of informants for each plant species. Relative frequency of citation (RFC) is obtained by dividing a frequency of citation (FC) by the total number of informants in the survey (N). RFC was calculated by using following formula (Butt *et al.* 2015; Rehman *et al.* 2022c):

$$\mathrm{RFC} = \frac{\mathrm{FC}}{\mathrm{N}} (0< \mathrm{RFC} < 1)$$

Where "FC" is the frequency of citation and "N" is the total number of informants taking part in the survey (N=130).

Use Value (UV)

Use value (UV) of a species was carried out by using the following formula (Savikin *et al.* 2013; Rehman *et al.* 2023b).

$$\mathrm{UV} = \frac{\mathrm{u}}{\mathrm{n}}$$

u =Number of use reports documented by the informants for a given medicinal plant.
n=Total number of informants interviewed for a specific medicinal plant.

Jaccard index (JI)

This index is used to find out the similarity of traditional knowledge among various ethnic groups; the present study was compared with previously published literature from the adjoining areas by using the Jaccard index (Gonzalez-Tejero *et al.* 2008).

$$\mathrm{JI} = \frac{\mathrm{C\ x\ 100}}{(\mathrm{a} + \mathrm{b}) - \mathrm{c}}$$

Where 'a' is the recorded number of plants species in the present research area, 'b' is the number of plant species in the adjacent area and 'c' is the number of plant species common in both areas.

Results and Discussion

Demographic description

A total of 130 informants were interviewed. Most informants were male (83.08%) rather than female (16.92%). Similar findings were reported by others (Malik *et al.* 2018; Amjad *et al.* 2020). The prevalence of male informants in the study area was due to that female informants cannot talk with male interviewers out of their families. So participation of females' informants was too less in number in the documentation of data citations. The vast majority of respondents were herbalists (29.23%), followed by professional (21.54%) and shepherd (19.23%). Many of them were over 60 years old (46.92%), 51–60 years old (40.00%), and 35–50 years (13.08%). Due to the lack of some educational facilities in that area, most of the informants were illiterate (46.15%) (Table 1). But some were educated, showing that they had awareness of education (9.23%). Many informants had completed their primary (30.77%), and middle level (13.85%). All the informants spoke Pashto. The majority of information was collected from the rural area informants when compared with urban area informants, similar to other studies compared with urban groups (Giday *et al.* 2009; Salhi *et al.* 2010).

Table 1. Demographic information of the Informants:

Gender	**Number of informants N = 130**	**Percentages (%)**
Male	108	83.08
Female	22	16.92
Age groups		
35-50	17	13.08
51-60	52	40.00
> 60 years	61	46.92
Educational level		
Illiterate	60	46.15
Primary level	40	30.77
Middle level	18	13.85

Secondary level	12	9.23
Social livelihoods		
Herbalist	38	29.23
Farmer	12	9.23
Shepherd	25	19.23
Gardeners	17	13.08
Professional	28	21.54
Shopkeeper	6	4.62
Trader	4	3.08

Phytodiversity and Growth forms

All therapeutic plant species along with their botanical names, family name, accession number, parts utilized, mode of preparation, mode of administration, disease treated, and quantitative data analysis are shown in (Table 2). A total of 206 therapeutic plants belonging to 78 families were documented from the research area which has curative uses. Comparing the plant species with the related floras, 158 species (76.70%) were native to the area, followed by cultivated 31 species (15.05%), 11 weed species (5.34%), 5 species (2.43.61%) were naturalized, and1 species (0.49%) were exotic invasive (Table 2). The leading family was Lamiaceae with (18 spp.) followed by family Asteraceae with (16 spp.) and family Rosaceae with (12 spp.) (Table 2). Our findings are similar to the previous research work (Tuasha *et al.* 2018; Aziz *et al.* 2018; Chikowe *et al.* 2020; Rehman *et al.,* 2022a). This is possible due to most of its therapeutic plants being available all over the year and easy adaptation to their environment.

In terms of growth forms, the dominant growth forms was herbs (126 spp.) followed by trees (35 spp.), shrubs (31 spp.), climbers (5 spp.) and ferns (2 spp.) (Fig. 2). Herbs often have a maximum amount of plant derived compounds (Lulekal *et al.* 2013), are easily accessible and have abundant growth in wild environment. Similar to other studies conducted by (Uniyal *et al.* 2013), easy accessibility of herbaceous plants or therapeutic plant species, valuable therapeutic action, and low price of the health care system are the major factors for the choice and advancement of herbal medication in the economically backward rural communities (Konno 2004). The dominant growth form was herbaceous in the study area show similar results reported by Uniyal *et al.* (2006), Kayani *et al.* (2015) and Rehman *et al.* (2022b).

Plant parts used in the preparation of remedies

The most commonly used plant parts were leaves (63 spp.), followed by fruits (49 spp.), shoots (44spp.), whole plant (29 spp.), seeds (27 spp.), roots (15 spp.), bark (8 spp.), aerial parts (7 spp.) and rhizome (6 spp.) in the study area (Fig. 3). Similar results were reported by (Daoudi *et al.* 2016; Jdaidi & Hasnaoui 2016). The collection of leaves and preparations of medication from leaves are so easy as compared to the other plant parts. For this reason, leaves are frequently used in herbal remedies preparation (Telefo *et al.* 2011). The removal of leaves from the medicinal plants can cause less harm as compared to the removal of other parts of the plant (Kadir *et al*. 2013). The high use of leaves in herbal remedies preparation is also reported in previous research work (Akhtar *et al*. 2013; Hachi *et al.* 2015; Shah *et al.* 2016). Leaves show the maximum percentage, because of the reason that is the primary photosynthetic organ that contains a maximum amount of phytochemicals, essential oils and secondary metabolites. These metabolites have been shown to be effective in the cure of a various ailments.

Mode of preparation and administration

The dominant mode of preparation was decoction (58 spp.), followed by powder (47 spp.), raw (40 spp.), juice (31 spp.), paste (17 spp.), poultice (14 spp.), infusion (12 spp.), soaking (10 spp.), latex (9 spp.), herbal tea (8 spp.), oil (7 spp.), and potherb (4 spp.) (Fig. 4). Decoction was the most common medicine preparation technique. A possible argument may be the simplicity of the preparation procedure (Malik *et al.* 2019). Another cause is that boiling of the plant parts in water leads to the extraction and availability of various compounds for the treatment of diseases (Bibi *et al.* 2015). Similarly, decoction and powder were documented as the most frequently used methods for herbal remedies preparation in previous research work (Slimani *et al*. 2016; Shah *et al.* 2020). Also, similar findings were reported by others (Butt *et al.* 2015; Rashid *et al.* 2015; Ijaz *et al.* 2016). In the present study, dominant route of administration is orally advised (175 spp.), followed by topical (65 spp.), drop and inhale (3 spp.) each, and chewing (2 spp.) (Fig. 5). It was thought that the oral route is the most suitable route of administration in the study area for the patient. Similar findings were reported by others (Benarba *et al.* 2014; Chermat & Gharzouli 2015; Mrabti *et al.* 2019; Mir *et al.* 2021; Zatout *et al.* 2021).

Herbal therapies of indigenous plants

Tribal communities have a wide range of information about indigenous medication based on traditional plants for primary medical care (Rekka *et al*. 2013). In all, 145 diseases /ailments were treated by using 206 medicinal plants (Fig.6). A single ailment is treated by many plants as; more than one plant is active for different disorders. The common disease in the research area was constipation that was treated with 36 plant species followed by blood purification (22 spp.), wounds healing (21 spp.), expel intestinal worms (19 spp.), anti-malarial and cough (18 spp.) each, anti-diabetic (17 spp.), and so on. Similar result was reported in other studied areas (Shuaib *et al.* 2014: Ikram *et al.* 2014).

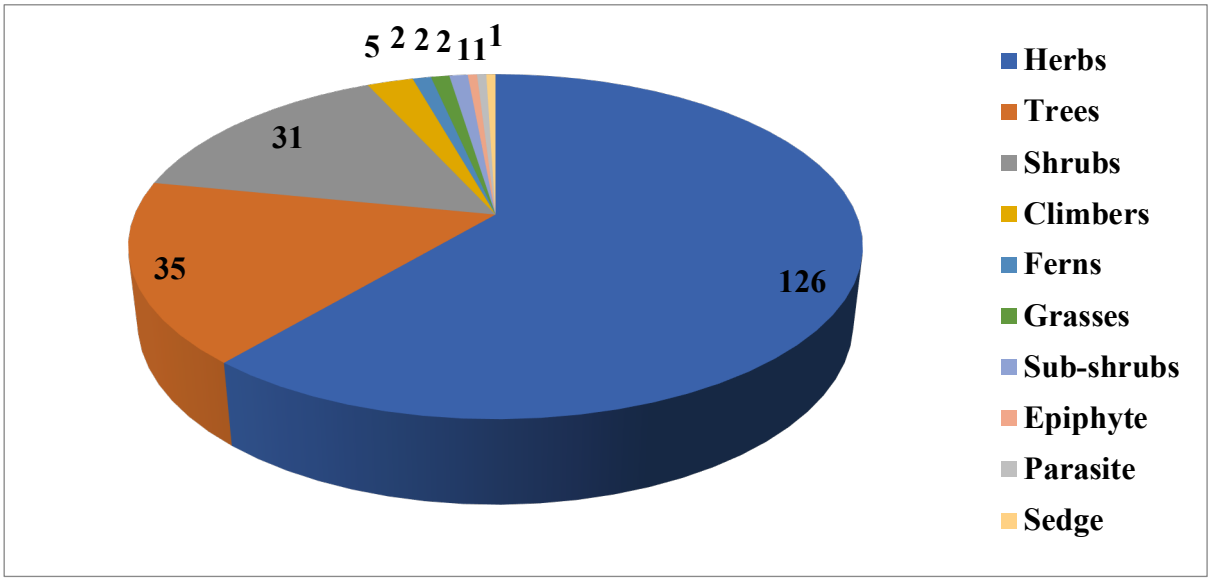

Figure 2. Growth forms of therapeutic plants in District North Waziristan, Pakistan.

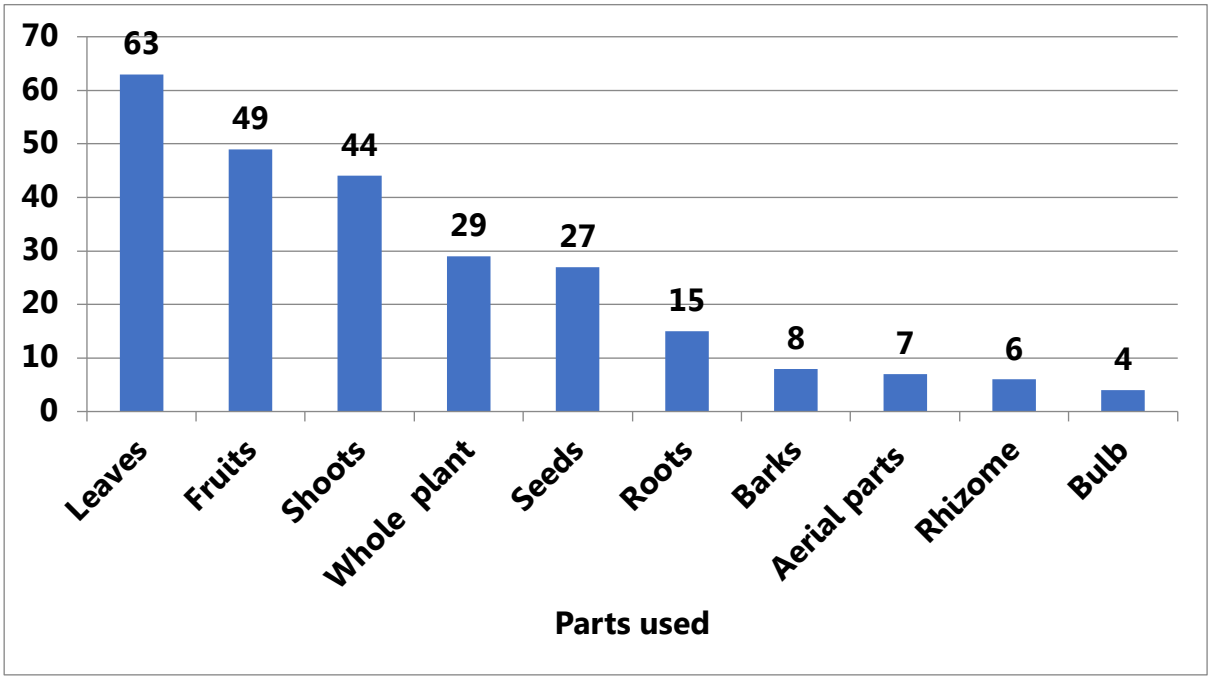

Figure 3. Plant parts used in remedies preparations in District North Waziristan, Pakistan.

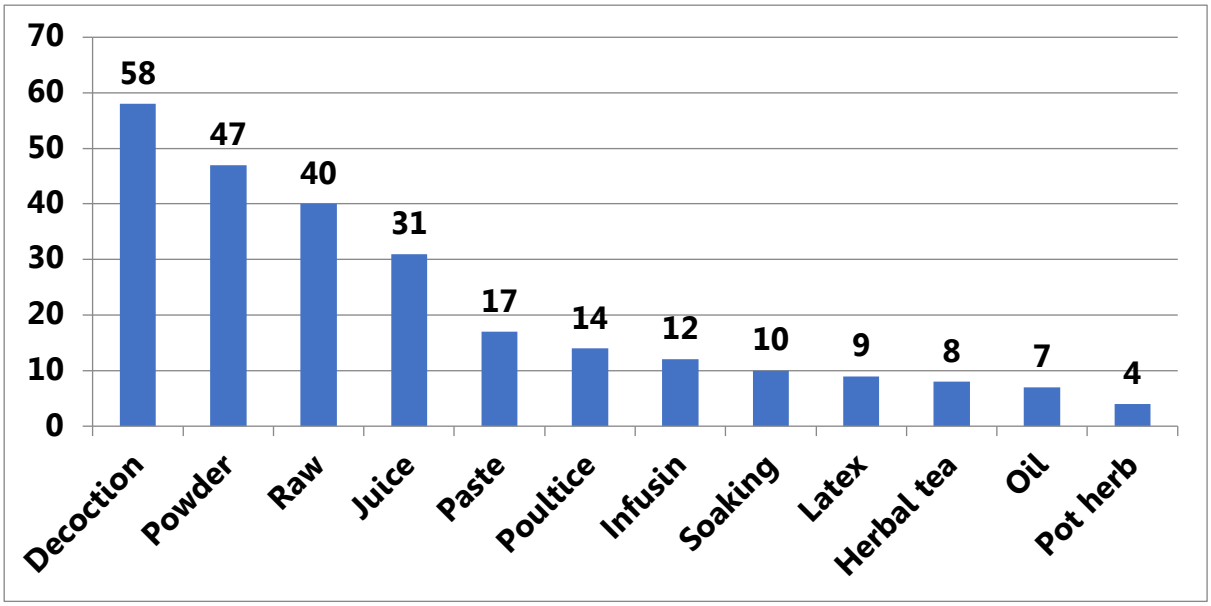

Figure 4. Mode of preparation of remedies in District North Waziristan, Pakistan.

Relative frequency of citation (RFC)

A relative frequency of citation was used to assess the most frequently used therapeutic plants (Mrabti *et al.* 2019) for the treatment of disorders. In the current study, the RFC value ranges from 0.09 to 0.56 (Table 2). The plant species in the study area with a high degree of RFC were *Cydonia oblonga* (0.56), followed by *Morus alba* (0.55), *Berberis lycium* (0.54). The lowest RFC value was recorded for *Erigeron alpine and Galinsoga parviflora* (0.09 each). The relative frequency of citation reveals the tribe's familiarity with the healing properties of specific plants. It also indicates accessibility and efficacy with fewer side effects (Vitalini *et al.* 2013; Kayani *et al.* 2015). Those therapeutic plant species having high RFC value must be further evaluated for pharmaceutical and phytochemical analysis to identify their active component for any medication preparation (Vitalini *et al.* 2013; Yaseen 2019).

Used value (UV)

According to Kayani *et al.* (2014), the use value is a quantitative technique of ethnobotany that associates the significance of medicinal plants among indigenous people with regards to their uses. The use value in our recorded data ranged from 0.07 to 0.21 and the use reports (URs) ranged from 2 to 9 (Table 2). The highest use value was reported for *Ajuga bracteosa* (0.21), followed by *Artemisia martima*, *Coriandrum sativm* and *Ziziphora tenuier* (0.19) each. The lowest use value (UV) was recorded for *Rumex hastatus* (0.07). It was observed that the highest use value were due to the maximum number of use reports (URs) in the research area. The maximum used values of reported medicinal plants might indicate their local professional expertise, which leads to a preference option for the disorders (Ullah *et al.* 2014). Therapeutic plants with the lowest use value do not mean that they are not therapeutically important, but it is shown that the indigenous knowledge about these therapeutic plant species is limited and / or less availability of the therapeutic plant (Chaudhary *et al.* 2006; Mahmood *et al.* 2013). Medicinal plants for which the use value (UV) is high due to their common distribution in the study area and the local community are familiar for their therapeutic value (Rahman *et al.* 2016; Rehman *et al.* 2023c). The use-value (UV) reveals the relative importance of the utilization of therapeutic plant species in a particular area (Hassan *et al.* 2019). It is recommended that therapeutic plants species with the highest use values (UV) should be further studied for biological and phytochemicals activities (Vitalini *et al.* 2013; Yaseen 2019).

Table 2. Medicinal plants with scientific name, family name, voucher no., local name, part used, mode of preparation, mode of administration, diseases treated and quantitative analysis (FC, RFC, UV, URs, FL) used among the dwellers of North Waziristan, Pakistan.

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Acanthaceae										
*Justicia adhatoda*L. SR-13233	Native	Bikarh	Leaves, roots	Decoction, Powder	Oral	40	0.31	0.15	6	87.50
Adiantaceae										
Adiantum capillus-veneris L. SR-13459	Native	Ebe bote	Fronds, rhizome	Infusion, paste, poultices	Oral, topical	13	0.10	0.15	2	76.92
Agavaceae										
Agave cantala (Haw.) Roxb. Ex Salm-Dyck. SR-13460	Naturalized	Shway botay	Whole plant	Juice, poultice	Drop, topical	14	0.11	0.14	2	64.29
Aizoaceae										
Trianthema portulacastrum L. SR-13339	Weed	Deravenay botay	Shoots, roots	Decoction, powder	Oral	23	0.18	0.09	2	69.57
Alliaceae										
Allium cepa L. SR-13461	Cultivated	Pyoz	Bulb	Raw, baking	Oral, topical	57	0.44	0.12	7	87.72
Allium sativum L. SR-13462	Cultivated	Yeza	Bulb	Raw	Oral	59	0.45	0.14	8	88.14
Amaranthaceae										
Achyranthesaspera L. SR-13311	Weed	Ghoshkai	Whole plant	Juice	Oral, topical	43	0.33	0.14	6	90.70
Aerva javanica (Burm.f.) Juss. Ex Schult SR-13357	Native	Ghar velanai	Aerial parts	Paste, juice	Oral, topical	17	0.13	0.12	2	70.59
Amaranthus spinosus L. SR-13326	Native	Ghota surme	Seed, shoot	Poultice, extract	Oral, topical	18	0.14	0.11	2	66.67
Amaranthus viridis L. SR-13341	Native	Surmi	Leaves, roots	Juice, paste	Oral, topical	19	0.15	0.16	3	68.42
Celosia argentea L. SR-13286	Weed	Plash gul	Whole plant	Poultice, Decoction	Oral, topical	14	0.11	0.14	2	71.43
Digera muricata (L.) Mart. SR-13320	Weed	Soba ghonde	Whole plant	Decoction, infusion	Oral	39	0.3	0.08	3	82.05

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Anacardiaceae										
Pistacia integerrima J. L. Stewart ex Brandis. SR-13464	Native	Shnia	Fruits	Raw	Oral	61	0.47	0.13	8	86.89
Pistacia vera L. SR-13465	Cultivated	Pesta	Fruits	Raw	Oral	62	0.48	0.11	7	87.10
Apiaceae										
Bunium persicum (Boiss.) Fedtsch. SR-13466	Native	Toora zera	Whole plant	Poultice	Topical	54	0.42	0.15	8	87.04
Bupleurum falcatum L. SR-13443	Native	Pest bote	Leaves, shoots	Decoction	Oral, topical	21	0.16	0.14	3	61.90
Carum carvi L. SR-13467	Native	Zera	Shoots	Decoction	Oral	67	0.52	0.12	8	82.09
Coriandrum sativum L. SR-13468	Cultivated	Dania	Seeds	Powder	Oral	16	0.12	0.19	3	56.25
Daucus carota L. SR-13469	Cultivated	Gajer	Root	Raw	Oral	41	0.32	0.10	4	85.37
Torilis arvensis (Huds.) Link. SR-13445	Weed	Sperkay ghonde	Leaves	Powder	Oral	17	0.13	0.12	2	64.71
Torilis japonica (Houtt.) DC. SR-13470	Weed	Sperkay ghonde	Seeds, root	Powder, Decoction	Oral	15	0.12	0.13	2	60.00
Trachyspermum ammi L. SR-13206	Native	Sperkiye	Seeds	Powder	Oral	67	0.52	0.12	8	100.00
Araceae										
Arisaema flavum (Forsk.) Schott. SR-13268	Native	Varekai mangore boti	Rhizome	Paste	Topical	14	0.11	0.14	2	64.29
Arisaema jacquemontii Blume. SR-13471	Native	Ghot mangore boti	Rhizome,fruits	Powder	Topical	14	0.11	0.14	2	64.29
Arecaceae										
Phoenix dactylifera L. SR-13248	Native	Khajira	Fruit	Soaking	Oral	31	0.24	0.10	3	77.42
Asclepiadaceae										
Calotropis Procera (Wild) R. Brown. SR-13185	Native	Spalmai	Fruits, leaves, stem	Latex	Topical	63	0.48	0.13	8	84.13

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Caralluma tuberculata N.E. Brown, Gardn. SR-13195	Native	Pamanai	Stem	Raw	Oral	66	0.51	0.12	8	96.97
Periploca Aphylla Dcne. SR-13379	Native	Barara	Whole plant	Latex, powder	Oral, topical	44	0.34	0.14	6	84.09
Asphodelaceae										
Aloe vera L. SR-13472	Naturalized	Zargeya	Leaves	Gel	Topical	16	0.12	0.13	2	81.25
Asphodelus tenuifolius Cav. SR-13436	Native	Pyuzgai	Leaves	Raw	Oral, topical	31	0.24	0.13	4	51.61
Eremurus persicus (Jaub. & Spach) Boiss. SR-13174	Native	Gandana	Whole plant	Juice	Oral	25	0.19	0.16	4	60.00
Asteraceae										
Artemisia martima L. SR-13264	Native	Terkha	Aerial parts	Decoction	Oral	36	0.28	0.19	7	80.56
Calendula arvensis (Vaill.) L. SR-13367	Native	Zergulay	Leaves	Decoction, poultice	Oral, topical	16	0.12	0.13	2	56.25
Carthamus oxyacantha Bieb. SR-13138	Native	Azghechan gul	Flower, leaves, shoots	Powder	Oral	13	0.10	0.15	2	61.54
Cichorium intybus L. SR-13334	Weed	Ghot khatakai	Aerial parts, roots	Decoction	Oral	18	0.14	0.11	2	72.22
Cnicus benedictus L. SR-13473	Native	Pest azghi	Aerial parts	Decoction	Oral	14	0.11	0.14	2	71.43
Erigeron alpines L. SR-13221	Native	Pest gul	Whole plant	Powder	Oral	12	0.09	0.14	2	58.33
Galinsoga parviflora Cav. SR-13449	Native	Pest boti	Shoots	Juice	Oral	12	0.09	0.17	2	66.67
Heteropapus biennis (Ledeb.) Tamamsch. SR-13458	Native	Pervetia gul	Aerial parts	Decoction	Oral	13	0.1	0.15	2	53.85
Sonchus arvensis L.	Native	Khatakay	Leaves	Paste	Topical	12	0.09	0.17	2	50.00

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13335										
Sonchus asper L. SR-13228	Native	Azghi khatakai	Leaves	Decoction	Oral	12	0.09	0.17	2	50.00
Sonchus oleraceus L. SR-13156	Native	Tareza	Shoots, leaves	Decoction	Oral	12	0.09	0.17	2	50.00
Reichardia tingitana (L.) Roth. SR-13199	Native	Khataki Gul	Leaves	Infusion, Powder	Drop, oral	15	0.12	0.13	2	53.33
Senecio chrysanthemoides DC. SR-13426	Native	Zer ghot gul	Rhizome	Decoction	Oral	16	0.12	0.13	2	56.25
Tagetes minuta L. SR-13260	Invasive	Zenda gula	Shoots	Infusion	Oral	16	0.12	0.13	2	62.50
Taraxicum officinale F.H.Wigg SR-13256	Native	Khataki Gul	Root	Decoction	Oral	17	0.13	0.17	2	64.71
Xanthium strumarium L. SR-13238	Native	Chechan boti	Leaves	Decoction, paste	Oral, topical	14	0.11	0.14	2	57.14
Balsaminaceae										
Impatiens glandulifera Royle. SR-13263	Native	Khr gul	Flower, shoots	Decoction, soaking	Oral	14	0.11	0.14	2	64.29
Berberidaceae										
Berberis lycium Royle. SR-13444	Native	Danedar bote	Fruits, bark	Raw, decoction	Oral	70	0.54	0.13	9	95.71
Bignoniaceae										
Tecomella undulata (Roxb.) Seeman. SR-13378	Native	Rawdana	Whole plant	Powder, soaking	Oral	68	0.52	0.12	8	100.00
Boraginaceae										
Arnebia hispidissima (Lehm.) A. DC. SR-13159	Native	Spy gul	Whole plant	Decoction	Oral	17	0.13	0.12	2	64.71
Cordia myxa L. SR-13476	Cultivated	Lawsera	Fruits	Raw	Oral	61	0.47	0.15	9	93.44
Brassicaceae										
Brassica campestris L. SR-13218	Cultivated	Shershem	Seeds	Oil	Topical	29	0.22	0.10	3	62.07
Brassica juncea (L.) Czern. Et Coss.	Native	Zangali shershem	Leaves, seeds	Paste	Oral, topical	15	0.12	0.13	2	60.00

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13477										
Capsella bursa-pastoris (L.) Medik SR-13422	Weed	Avor bote	Whole plant	Decoction, herbal tea	Oral	33	0.25	0.12	4	69.70
Eruca sativa Mill. SR-13479	Native	Khatel	Seeds	Oil	Oral	23	0.18	0.17	4	56.52
Lepidium sativum L. SR-13320	Native	Bashke ghonde	Seeds	Powder	Oral	13	0.10	0.15	2	46.15
Nasturtium officinale R.Br. SR-13317	Native	Narm bote	Leaves, seeds, shoots	Herbal tea, oil	Oral, topical	17	0.13	0.12	2	64.71
Rephanus sativus L. SR-13480	Cultivated	Mulai	Root	Raw	Oral	44	0.34	0.09	4	52.27
Sisymbrium irio L. SR-13366	Native	Melai ghnde	Leaves, seed, shoots	Decoction, powder	Oral	13	0.10	0.15	2	69.23
Cactaceae										
Opuntia dillenii Haw. SR-13168	Native	Sapare gul	Cladodes, flower, fruits	Infusion, juice, raw	Oral, topical	21	0.16	0.10	2	61.90
Opuntiaficus-indica (L) Mill. SR-13481	Naturalized	Sapare gul	Cladodes, fruits	Juice, decoction	Oral, topical	17	0.13	0.12	2	64.71
Caesalpiniaceae										
Cassia fistula L. SR-13483	Cultivated	Gernalia	Fruits	Pulp	Oral	53	0.41	0.13	7	88.68
Parkinsonia aculeate L. SR-13141	Native	Pest kekar	Seed pod	Decoction	Oral	13	0.10	0.15	2	53.85
Cannabinaceae										
Cannabis sativa L. SR-13324	Native	Banga	Leaves	Infusion, powder, chars	Oral, inhale	23	0.18	0.17	4	69.57
Capparidaceae										
Capparis decidua (Forssk.) Edge. SR-13484	Native	Sre dane	Fruits, bark	Raw, powder	Oral, topical	57	0.44	0.11	6	75.44
Capparis spinosa L. SR-13177	Native	Gher Toondah	Whole plant	Decoction	Oral	54	0.42	0.13	7	72.22
Caryophyllaceae										
Stellaria media (L.) Vill. SR-13146	Native	Pastekai bote	Whole plant	Poultice, decoction	Oral, topical	14	0.11	0.14	2	57.14

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Celastraceae										
Gymnosporia nemorosa (Eckl. & Zeyh.) Szyszyl. SR-13364	Native	Sagher zai	Leaves, bark	Decoction, powder	Oral	29	0.22	0.14	4	62.07
Chenopodiaceae										
Chenopodium album L. SR-13227	Native	Khre sapaka	Leaves, shoots	Pot herb, juice	Oral	19	0.15	0.16	3	63.16
Chenopodium ambrosioides L. SR-13531	Native	Gheta sapaka	Shoot, leaves	Infusion, juice	Oral, topical	14	0.11	0.14	2	64.29
Chenopodium murale L. SR-13430	Native		Leaves, shoots	Pot herb	Oral	14	0.11	0.14	2	64.29
Dysphania botrys L. SR-13415	Native	Ghar bang	Shoots	Decoction	Oral	13	0.10	0.15	2	61.54
Spinacia oleracea L. SR-13231	Weed	Parkhorai	Shoots, leaves	Potherb	Oral	27	0.21	0.11	3	59.26
Convolvulaceae										
Convolvulus arvensis L. SR-13215	Native	Purvuthia	Leaves, shoot	Oral	Leaves, shoot	18	0.14	0.11	2	61.11
Cucurbitaceae										
Citrullus colocynthis (L.) Schrad. SR-13486	Native	Maraginye	Fruits	Sweet dish	Oral	59	0.45	0.12	7	72.88
Cucurbita moschata Duchesne. SR-13487	Cultivated	Halwa kadi	Fruits	Sweet dish	Oral	33	0.25	0.09	3	57.58
Cucumis melo subsp. Agrestis (Naud.) rebensc. SR-13251	Native	Kharbezgai	Fruits, seeds	Powder, rubbing	Oral, topical	38	0.29	0.16	6	57.89
Memordica charantia L. SR-13487	Cultivated	Karela	Fruits	Raw, juice	Oral	43	0.33	0.14	6	72.09
Cuscutaceae										
Cuscuta reflexa Roxb. SR-13488	Native	Akash bel	Whole plant	Ash, juice	Oral, topical	13	0.10	0.15	2	38.46
Cyperaceae										
Cyprus rotundus L.	Native	Deela	Rhizome	Paste, powder	Oral, topical	23	0.18	0.13	3	60.87

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13296										
Ebenaceae										
Diospyrus kaki L. SR-13489	Cultivated	Sure amlok	Fruit	Raw	Oral	17	0.13	0.12	2	64.71
Elaeagnaceae										
Elaeagnus hortensis M.Bieb. SR-13313	Native	Sanzalla	Fruits, bark	Powder	Oral	14	0.11	0.14	2	50.00
Ephedraceae										
Ephedra procera Fisch. & C. A. Mey. SR-13444	Native	Mowah	Aerial parts	Decoction	Oral, topical	63	0.48	0.11	7	95.24
Equisetaceae										
Equisetum arvense L. SR-13216	Native	Bandkai	Shoots	Decoction	Oral	14	0.11	0.14	2	50.00
Euphorbiaceae										
Euphorbia heleoscopia L. SR-13316	Native	Selvergotia	Whole plant	Latex	Topical	16	0.12	0.13	2	50.00
*Euphorbia prostrata*L. SR-13359	Native	Prata	Whole plant	Infusion	Oral, topical	16	0.12	0.13	2	56.25
Ricinus communis L. SR-13132	Native	Rund	Leaves, seeds	Poultice, oil	Topical	38	0.29	0.08	3	73.68
Fagaceae										
Quercus baloot Griff. SR-13258	Native	Tora serai	Fruits	Baking	Oral	49	0.38	0.12	6	87.76
Quercus incana Roxb. SR-13491	Native	Spina serai	Fruits	Powder	Oral	49	0.38	0.12	6	87.76
Quercus dilatata Royle. SR-13212	Native	Serai	Bark	Poultice	Topical	49	0.38	0.12	6	87.76
Fumariaceae										
Fumaria indica (Hausskn.) Pugsley. SR-13312	Native	Shatra papra	Whole plant	Juice	Oral	13	0.10	0.15	2	53.85

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Gentianaceae										
Gentiana kurreo Royle. SR-13261	Native	Sheen gul	Root	Decoction	Oral	15	0.12	0.13	2	53.33
Geraniaceae										
Erodium cicutarium L. SR-13209	Native	Dhania ghonde	Whole plant	Herbal tea	Oral	17	0.13	0.18	3	64.71
Geranium willianum D.Don ex Sweet. SR-13389	Native	Varekai bote	Whole plant, rhizome	Powder, Paste	Oral, topical	14	0.11	0.14	2	50.00
Juglandaceae										
Juglans regia L. SR-13457	Native	Matak	Fruits	Raw	Oral	44	0.34	0.11	5	88.64
Labiatae										
Ajuga bracteosa Wall. SR-13425	Native	Ghotakai bote	Whole plant	Powder	Oral	19	0.15	0.21	4	57.89
Ajuga parviflora Benth. SR-13413	Native	Beian bote	Whole plant	Decoction	Oral	17	0.13	0.12	2	64.71
Isodon rogosus (Wall. ex Benth.) SR-13385	Native	Ghez bee bote	Shoots	Decoction	Drop	38	0.29	0.16	6	81.58
Lycopus europaeus L. SR-13377	Native	Ebe bote	Shoots	Decoction	Oral	38	0.29	0.11	4	86.84
*Marrubium vulgare*L. SR-13239	Native	Babar bote	Shoots	Decoction	Oral	14	0.11	0.14	2	50.00
Mentha spicata L. SR-13283	Cultivated	Poodina	Shoots, leaves	Powder	Oral	34	0.26	0.15	5	85.29
Mentha longifolia (L.) Huds. SR-13331	Native	Velanai	Shoots, root	Juice	Oral	41	0.32	0.17	7	85.37
*Mentha viridis*L. SR-13284	Cultivated	Serkare velnai	Whole plant	Decoction	Oral	29	0.22	0.14	4	79.31
Nepeta cataria L. SR-13420	Native	Khez bee boti	Whole plant	Herbal tea	Oral	16	0.12	0.13	2	56.25
Nepeta laevigata (D. Don) Hand.	Native	Sheen berai	Seeds	Soaking	Oral	19	0.15	0.11	2	73.68

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13259										
Ocimum basilicum L. SR-13492	Cultivated	Bubrai	Leaves	Decoction	Oral	16	0.12	0.13	2	56.25
Salvia aegyptiaca L. SR-13273	Native	Malenga tukhem	Seeds	Soaking	Oral	33	0.25	0.09	3	72.73
Salvia macrosiphon Boiss. SR-13374	Native	Der shel	Whole plant	Juice	Oral	47	0.36	0.09	4	74.47
Salvia moocroftiana Wall. SR-13431	Native	Ghote pakhe	Leaves, Shoots	Powder, poultice	Oral, topical	21	0.16	0.10	2	61.90
Salvia nubicola Wall. ex Sweet. SR-13394	Native	Khez bee bote	Shoots	Juice	Oral	17	0.13	0.12	2	64.71
Teucrium stocksianum Boiss. SR-13274	Native	Matokai bote	Shoots	Powder	Oral	52	0.4	0.12	6	44.23
Thymus linearis Benth. SR-13451	Native	Prêt bote	Shoots	Decoction	Oral	21	0.16	0.10	2	71.43
Ziziphora tenuier L. SR-13414	Native	Khez bee boti	Shoots	Herbal tea	Oral	16	0.12	0.19	3	56.25
Liliaceae										
Fritillaria imperialis L. SR-13383	Native	Gigar gul	Bulb	Powder	Oral	16	0.12	0.13	2	50.00
Tulipa clusiana DC. SR-13271	Native	Shande Gul	Bulb	Powder	Oral	18	0.14	0.11	2	50.00
Linaceae										
Linum strictum L. SR-13192	Native	Sreshan bote	Seed	Oil, juice	Oral, topical	21	0.16	0.14	3	66.67
Loranthaceae										
Viscum album L. SR-13244	Native	Zarkatel bote	Leaves	Paste	Topical	14	0.11	0.14	2	42.86
Malvaceae										
Abutilon indicum (L.) Sweet. SR-13340	Native	Zer gulai	Whole plant	Powder, soaking	Oral	22	0.17	0.14	3	57.14
Hibiscus trionum L.	Native	Bahindai gul	Shoots	Decoction, Powder	Oral	14	0.11	0.14	2	53.85

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13252										
Malva neglecta Wallr. SR-13368	Native	Spee takalay	Leaves	Decoction	Oral	13	0.10	0.15	2	
Meliaceae										78.26
Melia azedarach L. SR-13266	Native	Bakana	Fruits, leaves	Pulp	Oral, topical	23	0.18	0.13	3	
Menispermaceae										65.22
Cocculus pendulus (J. R. & G. Forst.) Diels. SR-13573	Native	Matokai	Root, fruits	Decoction	Oral	23	0.18	0.13	3	71.43
Mimosaceae										
Acacia modesta Wall. SR-13196	Native	Palosa	Bark, seeds	Decoction, Powder	Oral	43	0.33	0.14	6	97.67
Acacia nilotica (L.) Deliled. SR-13448	Native	Kikar	Bark	Decoction	Oral	39	0.30	0.10	4	69.23
Leucaena leucocephala (Lam.) de Wit. SR-13358	Native	Pest kekar	Seeds	Powder	Oral	16	0.12	0.13	2	56.25
*Prosopis glandulosa*Torr. SR-13222	Native	Prêt kekar	Leaves	Juice	Oral, topical	16	0.12	0.13	2	56.25
Moraceae										
Ficus carica L. SR-13124	Native	Inzar	Fruit, leaves	Raw, latex	Oral, topical	42	0.32	0.14	6	80.95
Ficus palmata Forssk. SR-13139	Native	Zangali Inzar	Fruits, leaves	Raw, latex	Oral, topical	39	0.30	0.15	6	79.49
Morus alba L. SR-13435	Native	Spin Thooth	Fruits	Raw	Oral	71	0.55	0.13	9	98.59
Morus nigra L. SR-13330	Native	Tor Thooth	Fruits	Juice	Oral	68	0.52	0.15	9	98.53
Myrtaceae										
Eucalyptus camaldulensis Dehnh. SR-13498	Naturalized	Lochai	Leaves	Decoction	Oral	13	0.10	0.15	2	46.15

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Psidium guajava L. SR-13499	Cultivated	Ambrith	Fruits	Raw	Oral	39	0.30	0.13	5	82.05
Nyctaginaceae										
Boerhavia diffusa L. SR-13373	Native	Prêt bote	Shoots, roots	Poultice, powder	Oral, topical	24	0.18	0.13	3	75.00
Mirabilis jalapa L. SR-13500	Cultivated	Mazdegar Gul	Root	Powder	Oral	17	0.13	0.12	2	88.24
Oleaceae										
Olea europaea L. SR-13503	Cultivated	Zaiton	Fruits, leaves	Raw, chewing	Oral, chewing	27	0.21	0.11	3	77.78
Olea ferruginea Royle. SR-13404	Native	Shawan	Fruit, leaves	Raw, chewing	Oral, chewing	27	0.21	0.11	3	77.78
Oxalidaceae										
Oxalis corniculata L. SR-13254	Native	Terwekai	Shoots	Paste	Topical	16	0.12	0.13	2	56.25
Papaveraceae										
Glaucium elegans Fish. & Mey. SR-13181	Native	Lala gul	Whole plant	Latex	Topical	16	0.12	0.13	2	68.75
Papaver rhoeas L. SR-13395	Native	Zagali afeem	Capsule	Latex	Oral, inhale	14	0.11	0.14	2	57.14
Papaver somniferum L. SR-13504	Cultivated	Afeem	Capsule	Latex	Oral	46	0.35	0.13	6	84.78
Papilionaceae										
Argyrolobium roseum (Camb.) Jaub. SR-13390	Native	Makhani booti	Leaves	Powder	Oral	34	0.26	0.18	6	79.41
Arachis hypogaea L. SR-13539	Cultivated	Mungphali	Seeds	Raw	Oral	40	0.31	0.10	4	77.50
Indigofera heterantha Brandis. SR-13423	Native	Ser gul	Bark, leaves	Decoction, powder	Oral	42	0.32	0.14	6	88.10
Medicago polymorpha L. SR-13365	Native	Malkindie	Aerial parts	Decoction	Oral	16	0.12	0.13	2	56.25

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Sophora mollis (Royle) Baker. SR-13249	Native	Deravenai boti	Leaves, seeds	Powder, paste	Oral, topical	26	0.20	0.08	2	69.23
Pinaceae										
Cedrus atlantica (Endl.) Manetti ex Carrière SR-13453	Native	Almanza	Stem	Oil	Topical	26	0.20	0.12	3	73.08
Cedrus deodara (Roxb. ex D. Don) G. Don. SR-13455	Native	Almanza	Stem	Oil	Topical	26	0.20	0.12	3	73.08
Pinus gerardiana Wall. ex Lamb. SR-13505	Native	Zanrghozai	Seeds	Raw	Oral	51	0.39	0.12	6	88.24
Pinus roxburghii Sargent. SR-13438	Native	Zanrghozai	Seeds	Raw	Oral	51	0.39	0.12	6	64.71
Plantaginaceae										
Plantago ciliata Desf. SR-13211	Native	Isobhel	Husk	Soaking	Oral	19	0.15	0.11	2	73.68
Plantago lanceolata L. SR-13210	Native	Khatakai	Leaves, seeds	Paste, juice	Oral, topical	23	0.18	0.13	3	69.57
Plantago major L. SR-13308	Native	Ghot khatakai	Leaves, seeds	Paste, soaking	Oral, topical	24	0.18	0.13	3	70.83
Plantago ovata Forssk. SR-13391	Native	Isobaghel	Husk	Soaking	Oral	57	0.44	0.14	8	100.00
Veronica anagallis-aquatica L. SR-13290	Native	Ebe boti	Leaves, shoots	Decoction	Oral	13	0.10	0.15	2	53.85
Poaceae										
Dactyloctenium aegypticum (L.) Willd. SR-13242	Native	Voshe	Seeds	Decoction	Oral	14	0.11	0.14	2	57.14
Hordeum murinum L. SR-13343	Cultivated	Babar voshe	Shoots	Decoction	Oral	25	0.19	0.12	3	52.00

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Polygonaceae										
Persicaria glabra (Wild.) M. Gomes. SR-13208	Native	Ebe bote	Leaves	Juice	Oral	17	0.13	0.12	2	64.71
Polygonum aviculare L. SR-13450	Native	Vare pakhe bote	Leaves, shoot	Decoction	Oral	16	0.12	0.13	2	56.25
Polygonum plebeium R.Br. SR-13428	Native	Vare pakhe bote	Leaves, shoot	Decoction	Oral	16	0.12	0.13	2	56.25
Rumex dentatus L. SR-13517	Native	Zandan	Leaves	Poultice	Topical	17	0.13	0.12	2	64.71
Rumex hastatus D.Don. SR-13518	Native	Zandan	Leaves	Juice	Oral	27	0.21	0.07	2	70.37
Portulacaceae										
Portulaca oleracea L. SR-13169	Weed	Zengali purkhurhai	Shoots, seeds	Juice, soaking, Potherb	Oral	23	0.18	0.13	3	60.87
Portulaca quadrifida L. SR-13519	Weed	Serkori purkhurhai	Shoots, seeds	Crushing, warmed	Topical	19	0.15	0.11	2	73.68
Primulaceae										
Anagallis arvensis L. SR-13361	Native	Push boti	Whole plant	Juice	Topical	21	0.16	0.10	2	61.90
Androsace rotundifolia Hardwicke. SR-13424	Native	Ser gulakai	Leaves	Crushing	Oral	14	0.11	0.14	2	57.14
Punicaceae										
Punica granatum L. SR-13333	Native	valengai	Fruits	Juice, powder	Oral	56	0.43	0.13	7	94.64
Ranunculaceae										
Ranunculus muricatus L. SR-13322	Native	Zer gulai	Shoots	Decoction	Oral	17	0.13	0.12	2	64.71
Ranunculus sceleratus L. SR-13135	Native	Zer gulai	Shoot	Juice	Topical	16	0.12	0.13	2	68.75
Rhamnaceae										
Zizyphus mauritiana Lam.	Native	Bera	Fruits, leaves	Raw, Paste	Oral, topical	43	0.33	0.09	4	86.05

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
SR-13198										
Zizypus nummlaria (Burm.f.) Wight & Arn. SR-13179	Native	Karkana	Fruits, leaves	Raw, Paste	Oral, topical	19	0.15	0.11	2	68.42
Rosaceae										
Cydonia oblonga Mill. SR-13520	Cultivated	Bahi	Fruits	Raw, Jam	Oral	73	0.56	0.12	9	100.00
Eriobotrya japonica (Thunb.) Lindl. SR-13521	Cultivated	Aloquat	Fruits	Raw, Juice	Oral	47	0.36	0.15	7	78.72
Fragaria vesca L. SR-13522	Cultivated	Strawberry	Fruits	Raw, chewing	Oral, topical	33	0.25	0.09	3	51.52
Fragaria nubicola (Hook.f.) Lindl. SR-13429	Native	Zangali strawberry	Fruits	Raw, juice	Oral, topical	13	0.10	0.15	2	69.23
Malus domestica Borkh. SR-13522	Cultivated	Manra	Fruit	Raw, Juice	Oral	32	0.25	0.09	3	59.38
Potentill aerecta (L.) Raeusch. SR.13432	Native	Zer gulakai	Whole plant	Powder	Oral	13	0.10	0.15	2	61.54
Potentilla supine L. SR-13538	Native	Dhania ghonde	Roots	Powder	Topical	14	0.11	0.14	2	64.29
Prunus armeniaca L. SR-13125	Cultivated	Mundetha	Flower, fruits	Infusion, raw	Oral	47	0.36	0.17	8	87.23
Prunus domestica L. SR-13521	Native	Alucha	Fruits	Raw, juice	Oral	47	0.36	0.15	7	87.23
Prunus microcarpa C. A. Mey. SR-13522	Native	Voly	Fruits	Raw	Oral	41	0.32	0.15	6	85.37
Pyrus communis L. SR-13299	Cultivated	Nashpati	Fruits	Raw	Oral	33	0.25	0.09	3	63.64
Rosa indica L. SR-13524	Native	Gulab	Petal	Gulqand	Oral	31	0.24	0.10	3	74.19
Rubiaceae										
Galium aparine L. SR-13183	Native	Chechan boti	Shoots, leaves	Herbal tea, paste	Oral, topical	13	0.10	0.15	2	46.15

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Rutaceae										
Citrus limon (L.) Burm. f. SR-13526	Cultivated	Nimbo	Fruits	Juice	Oral, topical	41	0.32	0.15	6	80.49
Citrus sinensis (L.) Osbeck. SR-13527	Cultivated	Malta	Fruits	Juice	Oral	42	0.32	0.14	6	73.81
Salvadoraceae										
Salvadora oleoides Decne. SR-13148	Native	Plawan	Fruits, leaves	Raw, powder	Oral	67	0.52	0.13	9	100.00
Sapotaceae										
Monotheca buxifolia (Falc) A. DC. SR-13267	Native	Gurguray	Fruits	Raw	Oral	57	0.44	0.16	9	96.49
Scrophulariaceae										
Verbascum thapsus L. SR-13158	Native	Jhngli tambako	Leaves	Powder	Topical	14	0.11	0.14	2	57.14
Simaroubaceae										
Ailanthus altissima (Mill.) Swingle. SR-13134	Naturalized	Sarkore bakana	Leaves	Crushing, soaking	Topical	21	0.16	0.14	3	76.19
Solanaceae										
Lycopersicon esculentum (L.) Mill. SR-13534	Cultivated	Tamater	Fruit	Juice	Topical	44	0.34	0.09	4	75.00
Solanum nigrum L. SR-13321	Native	Gorgore ghonde	Fruits, shoots, leaves	Decoction, poultice, raw	Oral, topical	36	0.28	0.08	3	86.11
Solanum surratense Brum. f. SR-13396	Native	Marhaghinya	Fruits	Decoction, Powder	Oral	46	0.35	0.09	4	89.13
Withania coagulans (Stocks.) Dunal. SR-13188	Native	Shapyanga	Fruits	Powder	Oral	58	0.45	0.10	6	98.28
Withania somnifera (L.) Dunal. SR-13230	Native	Sredane	Root	Powder	Oral	35	0.27	0.14	2	82.86
Thymelaeaceae										
Daphne mucronata Royle. SR-13440	Native	Sre remrakai	Leaves	Poultice	Topical	16	0.12	0.13	2	68.75

Family and Scientific name/ Voucher No.	Status	Local name	Part used	Mode of preparation	Mode of administration	FC	RFC	UV	URs	FL%
Tiliaceae										
Corchorus olitorius L. SR-13325	Native	Genjan	Leaves	Pot herb	Oral	33	0.25	0.12	4	69.70
Urticaceae										
Urtica dioica L. SR-13128	Native	Seezonkai	Shoots, leaves	Decoction	Oral	13	0.10	0.13	2	61.54
Verbenaceae										
Phyla nodiflora (L.) Greene. SR-13319	Native	Ebe bote	Whole plant	Herbal tea	Oral	17	0.13	0.12	2	64.71
Verbena officinalis L. SR-13293	Native	Bechawai	Shoots	Decoction	Oral	15	0.12	0.13	2	60.00
Vitex negundo L. SR-13171	Native	Marwandai.	Leaves	Herbal tea	Oral	29	0.22	0.10	3	72.41
Violaceae										
Viola stocksii Boiss. SR-13149	Native	Makhanr booti	Leaves	Powder	Oral	61	0.47	0.15	9	100.00
Vitaceae										
Vitis vinifera L. SR-13538	Cultivated	Melawa	Fruits, leaves	Raw, wrapping	Oral, topical	56	0.43	0.07	4	76.79
Zygophyllaceae										
Fagonia cretica L. SR-13204	Native	Spelaghzii	Shoots	Decoction	Oral	64	0.49	0.13	8	98.44
Peganum harmala L. SR-13163	Native	Spilanai	Seeds	Smoke	Inhale	19	0.15	0.16	3	89.47
Tribulus terrestris L. SR-13236	Native	Kandalai	Seeds	Powder	Oral	39	0.30	0.08	3	94.87

Key words: SR= Sabith Rehman, RFC=Relative frequency of citation, FC= Frequency of citation, UV= Use value, URs= Used Reports, FL% = fidelity level.

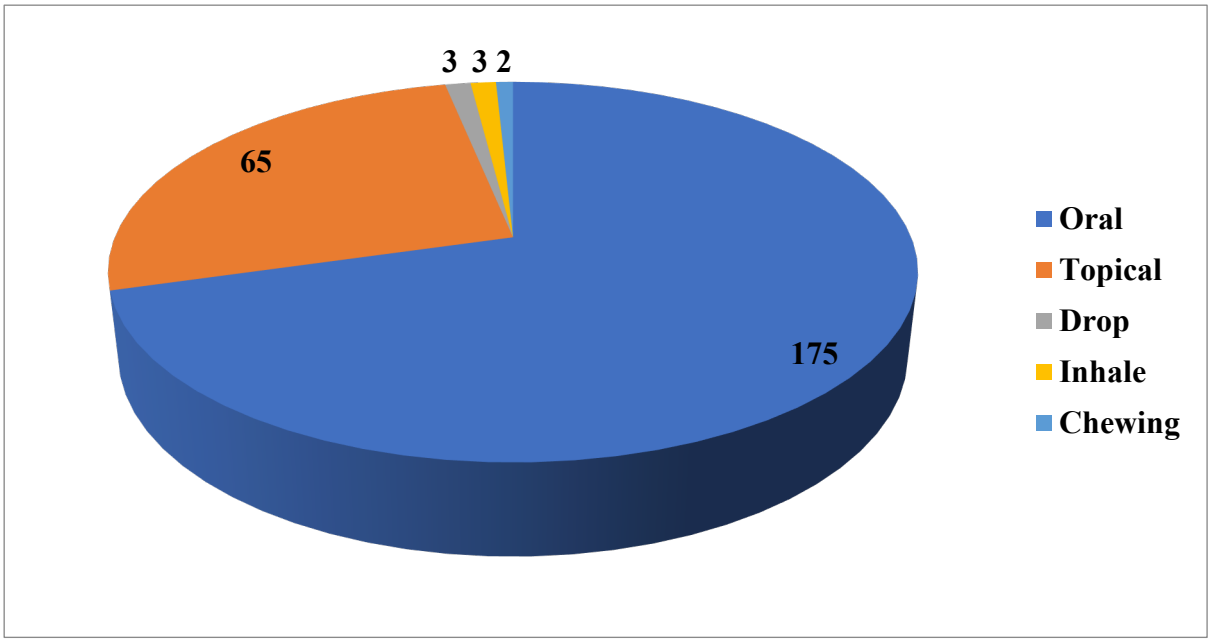

Figure 5. Mode of administration in District North Waziristan, Pakistan

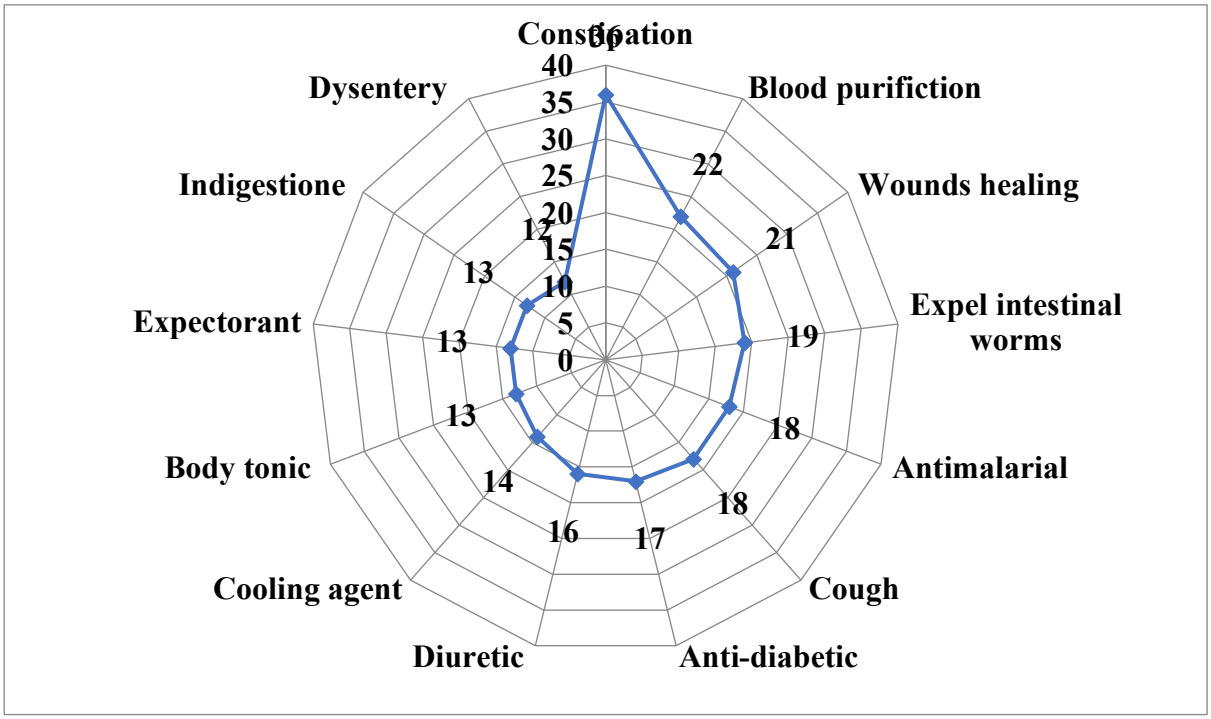

Figure 6. Number of plant species used for the treatment of different diseases in District North Waziristan.

Fidelity level (FL %)

Fidelity level (FL %) is used to identify the medicinal plant species that are most preferred by the indigenous people for the cure of specific diseases (Yaseen *et al.* 2015). The medicinal plants with the highest curing effects have the highest fidelity level of 100%. The therapeutic plants that were reported by a single respondent were not considered for the FL level study. In this study, FL ranged from 38.46% to 100% (Table 2). Six species viz., *Trachyspermum ammi, Tecomella undulata*, *Plantago ovata, Salvadora oleoides, Cydonia oblonga* and *Viola stocksii* were used with 100% FL against indigestion, hepatitis, constipation, libido enhancer, heart diseases, and libido enhancer, respectively, followed by *Morus alba* (98.59%), while the lowest FL value was recorded in the case of *Cuscuta reflexa* (*38*.46%) for scabies. The maximum fidelity level (FL) value determines the choice of informants to cure the specific ailment (Bisi-Johnson *et al.* 2010; Karakose 2022). It is a fact that the higher the plant's utilization, the higher will be the FL value (Farnsworth *et al.* 1988; Sahil 2014; Rehman *et al.* 2023d).

Informant consensus factor (ICF)

ICF was used to identify therapeutic plants used by inhabitants of the district of North Waziristan to cure a group of disorders. To determine the informants' consensus factor (ICF), various diseases were grouped into 8 different disease categories based on taxa utilized and use reports (Table 4.). In other words, the ICF value explains the cultural consistency in the use of a group of therapeutic plant species to cure a specific disease (Cerqueira *et al.* 2020). The informant consensus factors (ICF) have been computed for every category. In the present study, the ICF values ranged from 0.69 to 0.91 per use categories. The highest ICF value was reported for gastrointestinal disorders (0.91), followed by skeleto-muscular pain, inflammation, and fever with ICF value (0.90), and the least one (ICF= 0. 69) was reported for Cardio-vascular problems. Similar results were documented by (Shah *et al.* 2020; Birjees *et al.* 2021), who reported the highest ICF value for gastrointestinal disorders. Therapeutic plant species with maximum ICF values indicate that the indigenous person has a well-defined choice criterion and that traditional knowledge is shared among respondents about their effectiveness (Mootoosamy and Mahomoodally 2014). Therefore, medicinal plants with high ICF values are to be preferred for advanced studies on pharmacological and phytochemical basis.

Table 4. Informant consensus factor (ICF) for human diseases groups

Sr. No.	Ailment categories	Biomedical term	Nt	Nur	ICF
1	Gastro intestinal problems	Indigestion, Constipation, diarrhea, flatulence, dysentery, abdominal pain, acidity, intestinal worms	114	1200	0.91
2	Skeleto-muscular pain and inflammation	Headache, muscular pain, joint pain, arthritis, inflammation	40	400	0.90
3	Fever	Typhoid, jaundice, fever	23	231	0.90
4	General disorder	Diabetes, tonic	33	300	0.89
5	Dermatological problems and cosmetics	Athlete foot, wounds, pimples, cut, boils, ringworms, smallpox, dandruff	53	435	0.88
6	Throat, ear, and nose disorder	Cough, sore throat, flu, earache, asthma	51	421	0.88
7	Urinogenital disorder	Aphrodisiac, bladder incontinence, kidneys disorder, sexual debility	29	197	0.86
8	Cardio-vascular problems	Blood pressure	32	100	0.69

Legends: Nt= Number of taxa, Nur= Number of use reports, ICF= Informants consensus factor

Jaccard index (JI)

Ethnobotanists use Jaccard similarity index (JI) for making comparisons of reported plants with previously published literature gathered from adjacent areas (Yaseen *et al.* 2015). A few ethnomedicinal research works were chosen from adjoining areas for review in Jaccard index (JI) (Table 5). The comparative analysis of these 206 plants showed that similarity index ranges from 15.86% to 6.45% and the dissimilarity index ranged from 63.00% to 41.46%. The maximum level of the Jaccard index (JI) was found in the literature with the studies of Hussain *et al.* (2022), Haq *et al.* (2022), Ullah *et al.* (2021), Hussain *et al.* (2018b) and Aziz *et al.* (2016) with JI values (24.8, 23.45, 22.8, 21.63 and 19.5% respectively (Table 5). The highest degree of similarity index with Aziz *et al.* (2016) in the area of South Waziristan agency, Pakistan, revealed similarity in ethnic groups, geography and vegetation in both regions. The minimum level of the Jaccard index (JI) was noted for the work of Murad *et al.* (2013) with JI value (14.8%) (Table 5). The lowest JI values indicate incomplete cultural exchange between the adjacent areas, which are separated by mountain ranges and other cultural differences. The ecological barriers had an important influence on the flora. The low similarity may be due to variations in the indigenous knowledge among various communities, with difference in their culture and social behaviors (Ullah *et al.* 2014). The main reasons for the lower similarity index used in a literature study of the adjacent area are cultural adaptations in response to changes in population and habitat, which could be directly observed in the loss of ethnomedicinal, ethnopharmacological and ethnobotanical knowledge in the adjoining areas (Murad *et al.* 2013). The Jaccard index (JI) shows the results by comparing the similarity of common plant species with similar uses and common plant species with dissimilar uses. Some researchers had thought that the variation in ethnographic information might be due to the impact of environmental conditions on the therapeutic properties of some plant species (Tabuti *et al.* 2003).

Table 5. Jaccard index comparison of current study with previous reports.

Previous studies	No. of species reported(A)	No. of species in present study area(B)	Plants common in both areas(C)	Species only in aligned areas	% of Similarity	% of Dissimilarity	Species only in studied area	c×100	A+B	(A+B)-C	Jaccard Index (JI)	References
Ladha district South Waziristan agency, Pakistan	82	206	47	35	15.86%	41%	159	4700	288	241	19.5	(Aziz *et al.* 2016)
Central Kurram, Khyber Pakhtunkhwa North West Pakistan	106	206	62	44	10.38%	48%	144	6200	312	250	24.8	(Hussain *et al.* 2022)
Koh-e-Safaid Range, northern Pakistani-Afghan borders	92	206	53	39	9.80%	47.80%	153	5300	298	245	21.63	(Hussain *et al*. 2018b)
District Bannu, Pakistan	85	206	54	31	12.94%	51.00%	152	5400	291	237	22.8	(Ullah *et al.* 2021)
Banda Daud Shah, District Karak, Pakistan	58	206	34	24	8.62%	50%	172	3400	264	230	14.8	(Murad *et al.* 2013)
Pashat Valley, Bajaur,along Pakistan–Afghanistan border:	73	206	53	20	9.60%	63.00%	153	5300	279	226	23.45	(Haq *et al.* 2022)
Lakki Marwat District of Pakistan	62	206	38	24	6.45%	54.80%	168	3800	268	230	16.52	(Ullah *et al*. 2014)

Some novel ethnomedicinal uses

Compared with the literature from the nearby areas (Ullah *et al.* 2013; Aziz *et al.* 2016; Hussain *et al.* 2022) had comparatively fewer similarities. The comparative survey with previously documented therapeutic plants showed, that 13 plant species viz. *Acacia modesta* (increase libido) (URs=6), *Argyrolobium roseum* (aphrodisiac) (URs=6), *Berberis lyceum* (diabetes) (URs=9), *Corchorus olitorius* (diabetes) (URs=4), *Ephedra procera* (hemoptysis, antiseptic) (URs=7), *Morus alba* (constipation) (URs=9), *Peganum harmala* (antiseptic) (URs=3), *Salvadora oleoides* (enhance libido) (URs=9), *Tecomella undulata* (hepatitis) (URs=8), *Pistacia integerrima* (diabetes) (URs=8), *Prunus armeniaca* (constipation) (URs=8), *Quercus baloot* (diuretic) (URs=6), and *Withania coagulans* (cooling agent) (URs=6) have been documented their specific uses for the first time not being documented in the previous literature.

Conclusion

This study recorded a total of 206 therapeutic plants belonging to 78 families which are being used by the natives in preparing traditional medicines to treat various ailments. Of them, 158 species (76.70%) were native. It is revealed that inhabitants of the study area possess a rich indigenous knowledge inherited from their forefather and records of this important knowledge has provided novel information from the study area. The dominant family was Lamiaceae. The plant part which was commonly used in herbal remedies preparation was leaves. The common disease in the study area was constipation. The highest RFC value was recorded for *Cydonia oblonga* (0.56). The highest use value was calculated for *Ajuga bracteosa* (0.21). The highest ICF value was reported for gastrointestinal disorders (0.91). Although this traditional use of medicinal plants is only restricted to old people whereas younger people is not interested in gaining this traditional knowledge. Those medicinal plants with the highest RFC, UV, and FL values should be exposed to pharmacological and phytochemical analysis to validate their effectiveness and safety for huge utilization.

Declarations

List of abbreviations: Relative Frequency of Citation (RFC), Use Reports (URs); Use Value (UV), Fidelity Level (FL), Jaccard index (JI), and informant consensus factors (ICF).

Ethics statement: Prior to the survey, we obtained oral informed consent from each participant.

Consent for publications: Not applicable.

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Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.

Availability of data and materials: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.

Author's contributions: The manuscript is written by Sabith Rehman. Zafar Iqbal and Rahmatullah Qureshisupervised this work. Muhammad Younas formal analysis. All the authors approved the final manuscript after revision.

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