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A STEP TOWARDS THE DOCUMENTATION OF INDIGENOUS KNOWLEDGE ABOUT THE MEDICINAL PLANTS IN MOLLAGORI: A TRIBAL WAR AFFECTED AREA OF FATA, PAKISTAN

NAFEES ULLAH[1], SIRAJ-UD-DIN[2], FAZLI RAHIM[3], RAINER W. BUSSMANN[4], HAMMAD AHMAD JAN[1] AND SHER WALI[1*]

[1]*Department of Botany, Islamia College, Peshawar, Pakistan*
[2]*Department of Botany, University of Peshawar, Pakistan*
[3]*Department of Botany, Bacha Khan University Charsadda, Pakistan*
[4]*Department of Ethnobotany, Institute of Botany, Ilia State University, Tbilisi, Georgia*
**Corresponding author's email: sherwali@icp.edu.pk*

Abstract

The present work was conducted with the aim to record the ethnic medicinal knowledge. This work is the first effort to document the folk knowledge of medicinal plants. From 2013-14, 87 participants were interviewed through semi-structured questionnaires. During the field work 45 medicinal plants belonging to 27 families were encountered. Lamiaceae was the dominant family in terms of species (5 sp.). The most common life form was herbs (60%), and leaves (16 sp. 28%) were most commonly used in various ailments. The most important mode of preparation was decoction (34.88%). According to FI value was *Ziziphus nummularia* (0.42) was the most important species. The highest ICF value was recorded for Anti-Poisoning (0.928) recipes, and the maximum Jaccard Similarity Index in comparison with Malakand Pass Hills (14.16%). The documentation of the therapeutic flora shows that the use of medicinal plants in the study area plays a vital role in the basic healthcare system of the native communities. The predominant use of whole plants and seed is an alarming situation for the conservation of local medicinal flora. Therefore, education of the local communities about the conservation of medicinal plants is the need. This work will also serve as baseline for future investigations.

Key words: Documentation, Indigenous knowledge, Medicinal plants, Mollagori, Pakistan

Introduction

Ethnic therapeutic practices can offer leads for the development of new and more effective plant based allopathic medicines. Indigenous therapeutic practices have been developed since very early age for the cure of ailments (Halberstein, 2005). According to the World Health Organization (WHO) many current drugs (25%), and drugs in development (11%) are of plant based (Rates, 2001). Therapeutic plants are often the first option for the cure of different ailments in third world countries. According to WHO an estimated 80% of people in third world countries purely depend on traditional therapeutic plants for their primary health-care. According to Hostettmann *et al*., (2000), approximately 90% of people in African countries principally use therapeutic plants to cure various diseases. Similarly, in Pakistan more than 80% of the population people use therapeutic plants for their primary health-care needs. The knowledge of indigenous therapeutic plants is traditionally transmitted from one generation to the other (Mahmood *et al*., 2011a, 2011b, 2011c), but socio-economic changes can lead to a loss of traditional information about medicinal plants. The use of therapeutic plants differs widely from country to country and even from place to place in a given area. This fluctuation involves many factors like history, local culture, community attitude and beliefs (Šavikin *et al*., 2013).

Mullagori located in Khyber Agency was one of the Federally Administered Tribal Area of Pakistan (FATA) inhabited by Pashtun tribe. Recently all the Federally Administered Tribal Areas of Pakistan (FATA) are merged with the provincial administration of Khyber Pakhtunkhwa government. The area has been exposed to complex patters of sectarian violence: From 2007 to 2015 the area was under the control of terrorists. The area selected for the study is a remote part of the Pakistan. The local community has no direct access to modern health services whatsoever. The local people mainly depend on cattle, agriculture, and local natural assets for their livelihoods. The most prevalent reason for the low health care access in the study area is the influence of terroristic activities, which not only drastically affect the health care system, but also education system and other developmental programs. No scientific literature exists for the study area, and no ethnobotanical work has been done. This was the reason why we selected this area for our ethnomedicinal study, with the objectives to gather and document local indigenous knowledge of medicinal plants, to prevent future knowledge loss, to make the local community aware about the importance of indigenous knowledge of local medicinal plants, and to educate the Mollagori community about the conservation status of medicinal plants.

Material and Methods

Description of the study area: The study area (Mullagori) is situated between 30^0 $04^{'}$ $57.5^{"}$ to 34^0 $09^{'}$ $15.7^{"}$ N and 71^0 $18^{'}$ $58^{"}$ to 71^0 $22^{'}$ $16^{"}$ E (Fig. 1). The Mullagori covers about 300 km^2. The study area is bordered in the North by Mohmand Agency (tribal area), East by Jamrud (tribal area), the district Peshawar in the South, and to the West by Landi Kotal (tribal area). Altitudes vary, with an average altitude of 600 m, and the highest altitude 980m at Masoom Baba (Bureau of Statistics (FATA Cell), 2012).

The study area has two distinct topographic regions: 1) the *Plain region* and 2) the *Lowarha Mena* (hilly region). The study area is separated on one side by the Tatara Hill from Khyber Agency and on the other side from Mohmand Agency by the Kabul River. The hills of the study area are covered by dry grasslands, with Gurgura (*Reptonia buxifolia*) as most common species. The area has a population of about 50000, and there is only one primary school for girls and only one high school (up to 10th) for boys.

Collection of ethnomedicinal knowledge: Several trips to the research area were made in spring, summer and winter 2013-14. In the study area the vegetation period lasts from March to September. During this period collection of medicinal plants was done. General information about the research area was obtained from the office of the Political Agent, Khyber Agency and the offices of the local government.

A total of 87 local people (both male and female) aged 25-87 years, were interviewed after obtaining Prior Informed Consent. However, only 5 women could be interviewed due to Pashtun cultural restrictions, in which females were not allowed to talk with men outside the family (Shah *et al*., 2016) (Table 1). The education level in the study area is very low. We used semi-structured questionnaires which included: (1) Questions about the informants i.e. informant name, place of residence, gender, education and age. (2) Questions about therapeutic plants i.e. Plant local name, indigenous therapeutic practice, plant part used as medicine, administration route, full indigenous therapeutic recipes. In order to gather maximum indigenous medicinal data the interview was kept open. Every respondent was questioned about almost all the plants species in order to gather maximum information from different respondents.

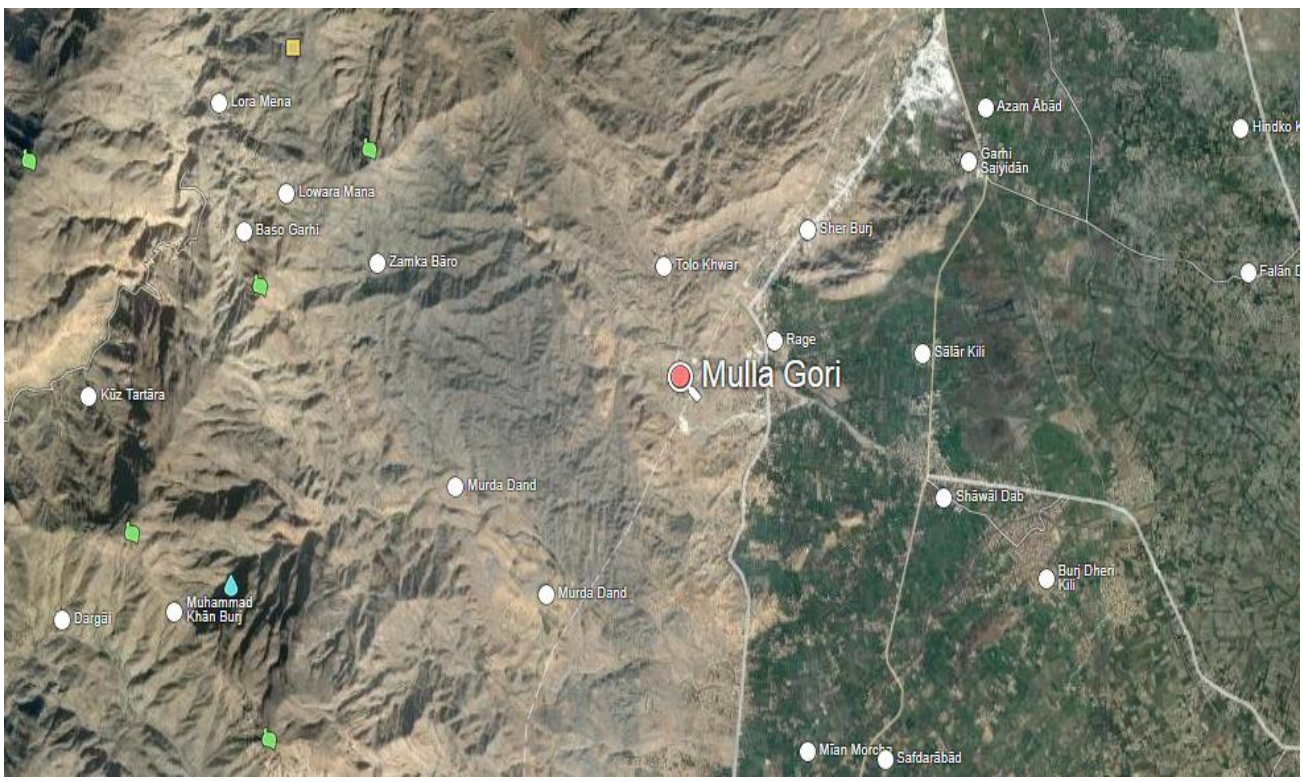

Fig. 1. Geographical location of the study area.

Table 1. Showing the demographic record of the local informants.

Total number of informants = 87	
Male	**Female**
82 (94.25%)	5 (5.76%)
Age groups	**Percentage**
25-35	13 (14.94%)
36-45	18 (20.68%)
46-60	27 (31.03%)
61-80	19 (21.83%)
Above 80	10 (11.49%)
Education status	
Illiterate	46 (52.87%)
Grade 1-5	19 (21.83%)
Grade 6-10	13 (14.94%)
Above Grade 10	09 (10.34%)

Medicinal plant identification: The collected plants were identified with the help of Flora of Pakistan (Tropicos, 2015). These identified plants used against different ailments were also verified and updated with the plantlist (the plantlist, 2015). The dried and processed plant specimens were then submitted to the herbarium of the Department of Botany, Islamia College, Peshawar, Pakistan for future reference.

Quantitative evaluation of ethnomedicinal data: In order to test a hypothesis quantitative data analysis is important (Barkatullah *et al*., 2015; Hoffman & Gallagher, 2007). Quantitative data helps in maximizing the probability to identify correctly the promising therapeutically important plants. Also a qualitative assessment helps to estimate the importance of each

medicinal plant and is essential to elucidate pharmaceutical candidacy plants (Barkatullah *et al*., 2015). Numerous quantitative indices are used to analyze ethnobotanical data, and we selected the following:

Familiarity index (FI): To elucidate the popularity of medicinal plants within the indigenous community of the study area the familiarity index (FI) was used (Khan and Ahmad, 2015):

$$FI = FC/N \times 100$$

where FC stands for the rate a particular medicinal plant used as remedy and N is the number of informants interviewed.

Family Importance Value (FIV): To find the most versatile medicinal plant family, the family importance value (FIV) was used (Khan and Ahmad, 2015). This was calculated as:

$$FIV = FC\ (family)/N \times 100$$

With FC (family) the total number of respondents reporting a family, and N is the total number of all respondents interviewed.

Informant Consensus Factor (ICF): To assess the uniformity of respondents' knowledge about indigenous therapeutic plants the informant consensus factor (ICF) was used (Heinrich *et al*., 1998 and Shah *et al*., 2016). This was calculated by using:

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

where Nur stands for the number of use reports for a single category of disease, and Nt is number of taxa/species used for this single disease category.

Jaccard similarity index (JI): The data collected in this work was compared with 17 previously published ethnobotanical articles from Pakistan and adjoining countries, to find the similarity and differences to the present survey (Yaseen *et al*., 2015; Kayani *et al*., 2015; González-Tejero *et al*., 2008; Höft *et al*., 1999). This was calculated by using:

$$JI = C \times 100/(a + b + c)$$

In the above formula c represents the medicinal plants reported from both locations, a number of medicinal plants reported only from the present study area, and b representing the number of medicinal plants reported only from other areas.

Results

Demographic characteristics of the informants in respect to medicinal plants utilization: The ages of informants ranged from 25-87 years and majority of the informants belonged to the age group of 46-60 (Table 1). Most of the informants had not completed primary school. The study area is located in the typical Pashtun tribal area, where the women are strictly prohibited to talk with men outside the family. In addition, the area was under Taliban influence, and thus this restriction was strictly enforced and only 5 women could be interviewed. Thus the lack of female participants may have affected our study results.

Medicinal plants diversity and diseases cured: During the survey, 45 medicinal plant species, belonging to 27 families and 45 genera were collected. The highest number of species belonged to Lamiaceae (5 species), while Amaranthaceae, Asteraceae and Poaceae had four species each. The herbs (27 sp.) were the dominant life form, followed by shrubs (11 sp.) and trees (7 sp.) (Fig. 2). Details about all species and their uses are given in Table 2.

Preparation of herbal medicines and commonly used plants parts: In the study the most usable plant part in recipes was leaves (16 sp. 28%), followed by whole plant (14 sp. 24%), and fruits (8 sp. 14%) (Fig. 3). For different diseases there were seven major modes of administrations, i.e. decoction, direct/ raw, extract/juice, infusion, paste/ poultice, powder and tea (Fig. 4). The complete indigenous herbal recipes are shown in Table 2.

Most common therapeutic plants: To elucidate the most commonly used therapeutic the familiarity index (FI) was also used (Tabuti *et al*., 2004; Kidane *et al*., 2014; Khan and Ahmad, 2015). According to the FI the highest value was recorded for *Ziziphus nummularia* (0.42), followed by *Prosopis juliflora* (0.40), *Citrus medica* (0.37), *Acacia modesta* and *Fagonia indica* (0.36 each). The lowest value was found for *Forsskaolea tenacissima* and *Citrullus colocynthis* (0.034 each) (Table 2 and Fig. 5).

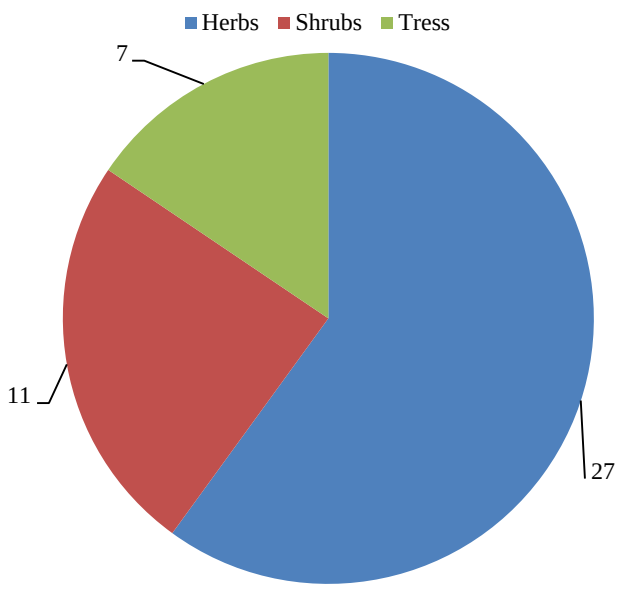

Fig. 2. Life forms of collected medicinal plant species.

Table 2. Listing plants' botanical names, families, voucher number, FI values, part used, recipes and preparation modes.

S. No.	Family name	Taxonomic name/ Voucher No.	FI	Local name	Part used	Recipes	Preparation mode (s)	Side effect
1.	Acanthaceae	*Justicia adhatoda* L. (N-01)	0.13	Ghardanay	Leaves	Fresh 100g of leaves are grinded to make paste, added to it one and half teaspoon of powdered turmeric. This is taken with water from 2-3g 2 times daily to cure asthma and cough. Fresh leaves (7 leaves) are boiled in 300-400 ml of water until half of water remains, and then the decoction is filtered. Then Honey (2-3 tea spoons) is added. The decoction prepared is taken in three dosages for cure of cough and asthma.	Paste/Decoction	No side effect was reported
2.	Amaranthaceae	*Aerva javanica* (Burm.f.) Juss. ex Schult. (N-02)	0.08	Sperkay	Whole plant	The fresh green plant about 15g is taken washed and grinded to make the paste. The paste is mixed with 1L of water. This medicine is used one time a day to cure kidney stone for 15 days. The roots are washed and dried. These dried roots are powdered. The powder is used as antimony (Surma) for sore eyes.	Paste/Powder	No side effect was reported
3.	Amaranthaceae	*Chenopodium album* L. (N-03)	0.05	Lewanay sarma	Whole plant	Leaves and fresh stems are cooked locally called "Sag". This is used to cure constipation.		No side effect was reported
4.	Amaranthaceae	*Dysphania ambrosioides* (L.) Mosyakin & Clemants (N-04)	0.17	Shodah pay	Leaves	The fresh leaves (1-2) are boiled in water 300ml to form decoction. This is taken orally 2 times a day (1 tea spoon) to kill round worms.	Decoction	High dosage may cause vomiting
5.	Apocynaceae	*Calotropis procera* (Aiton) Dryand. (N-05)	0.10	Spalmay	Latex/braches/stem	Plant latex is applied externally on the region of snake bite 2-3 times daily for 1 week. Young stem or branches are directly used as toothbrush.	Latex/Direct	No side effect was reported
6.	Apocynaceae	*Periploca aphylla* Decne. (N-06)	0.12	Barara/bubble	Branches/flowers	The branches and flowers are washed and dried in shade. These are then powdered. This powder drug is taken with water (2-4 grams) 2 times a day after meal to cure constipation and stomach ulcer.	Powder	No side effect was reported
7.	Apocynaceae	*Rhazya stricta* Decne. (N-07)	0.06	Ghandaray	Leaves flowers & seeds	The leaves are washed, dried and grinded to make powder. The powder is kept in mouth for some time to cure blisters of mouth. The fresh leaves (4-5) are grinded. Add to this water (1 L) and then filter it. One cup of the medicine is taken daily to cure skin infections.	Decoction	Poisonous for cattle
8.	Asteraceae	*Artemisia scoparia* Waldst. & Kitam. (N-08)	0.21	Dar ghoran	Shoot and seeds	The whole green plant is boiled in water of about 500-600 mL to make a decoction. This decoction is taken about 1 cup at night time to remove parasites of intestine.	Decoction	No side effect was reported
9.	Asteraceae	*Cousinia thomsonii* C.B.Clarke (N-09)	0.14	Kayarkanday	Root and leaves	The fresh leaves and roots are crushed to form a paste, which is externally applied to cure body pain and joints pain.	Paste	No side effect was reported
10.	Asteraceae	*Himalaiella heteromalla* (D.Don) Raab-Straube (N-10)	0.19	Shodah pay	Seeds	Fresh seeds are crushed to form paste, which is externally applied to areas of animal bites.	Paste	No side effect was reported
11.	Asteraceae	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal (N-11)	0.16	Zyarguley	Whole plant	The fresh plant is boiled in water to form decoction. The decoction is used to cure painful urination.	Decoction	
12.	Boraginaceae	*Ehretia obtusifolia Hochst.* ex A.DC. (N-12)	0.09	Mamarny	Whole plant	The fresh plant is boiled in water to form decoction. The decoction is taken orally and kept remain for some time in mouth to cure sore throat (3-4 times daily).	Decoction	No side effect was reported
13.	Brassicaceae	*Farsetia jacquemontii* Hook.f. & Thomson. (N-13)	0.22	Zangali molai	Root	The roots are powdered and taken orally about half tea spoon after meal with water for heartburn and dyspepsia.	Powder	No side effect was reported

Table 2. (Cont'd.).

S. No.	Family name	Taxonomic name/ Voucher No.	FI	Local name	Part used	Recipes	Preparation mode (s)	Side effect
14.	Capparaceae	*Capparis decidua* (Forssk.) Edgew. (N-14)	0.18	Kheera	Branches	The old branches are dried and burnt to form ash. The 5 g of ash is mixed with 1 L of goat milk. The remedy is taken orally tow times a day to treat broken bones. The young braches are used as "Miswak" (tooth stick) to cure toothache.	Ash/Direct	No side effect was reported
15.	Cleomaceae	*Cleome brachycarpa* (Forssk.) Vahl ex DC. (N-15)	0.04	Ghwarbooti	Whole plant	The plant is dried in shade and then powdered. The powder (half tea spoon) is taken with water to cure abdominal pain.	Powder	No side effect was reported
16.	Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad. (N-16)	0.03	Ghatmarghonay	Fruits	The fresh fruit and water are taken in 1:6 amounts and boiled to form decoction. This remedy is taken orally about 5 ml 2 times a day to treat constipation.	Decoction	No side effect was reported
17.	Juglandaceae	*Juglans regia* L. (N-17)	0.26	Ghoz	Fruit, bark, leaves	The seed are directly used as tonic for brain. Leaves (3-4) are boiled in water of about 1L to form a decoction, which is taken 1 teaspoon to kill intestinal worms.	Decoction	No side effect was reported
18.	Lamiaceae	*Mentha longifolia* L. (N-18)	0.35	Velenay	Whole plant	The fresh leaves (4-5) are boiled in water of about 3-4 cups to from decoction. This is cool down and taken orally 2-3 times a day about half cup for indigestion.	Decoction	No side effect was reported
19.	Lamiaceae	*Micromeria biflora* (Buch.-Ham. ex D.Don) Benth. (N-19)	0.28	Shamakay	Whole plant	The green leaves are directly rubbed on teeth to cure toothache. The green leaves are warmed and applied on fore head to cure headache	Direct	No side effect was reported
20.	Lamiaceae	*Rydingia limbata* (Benth.) Scheen &V.A.Albert (N-20)	0.13	Soorazghay	Whole plant	The plant is boiled in water of about 1L to prepare a decoction. The decoction is taken 2 times a day about half cup to cure jaundice.	Decoction	No side effect was reported
21.	Lamiaceae	*Salvia aegyptiaca* L. (N-21)	0.24	Dagura	Above ground part	The leaves are dried and ground to powder. 10g of powder is mixed with 5g leaves powder of *Menthe longifolia*. This is mixed with yogurt of about 1 cup. The medicine is taken 2-3 times a day to cure diarrhea.	Powder	No side effect was reported
22.	Lamiaceae	*Vitex negundo* L. (N-22)	0.14	Marmanday	Whole plant	The green leaves are warmed and applied to cure chest and back pains.	Direct	No side effect was reported
23.	Menispermaceae	*Cocculus pendulus* (J.R.Forst. &G.Forst.) Diels. (N-23)	0.11	Werri	Whole plant	The roots (50g) are boiled in water about 1L of water. The decoction formed is taken 2 times a day for cold and cough.	Decoction	No side effect was reported
24.	Mimosaceae	*Acacia modesta* Wall. (N-24)	0.36	Palosa	Gum	The gum of plant (50g) is mixed with Desi Ghee and wheat flour and added to it sugar and then cocked. This is used as tonic.		No side effect was reported
25.	Mimosaceae	*Prosopis juliflora* (Sw.) DC. (N-25)	0.40	Lewanaykikar	Leaves	The green leaves are crushed to form poultice which is external applied on wounds.	Poultice	No side effect was reported
26.	Moraceae	*Ficus carica* L. (N-26)	0.25	Inzar	Stem, leaves & fruits	The fruits (3-4) are kept in water of about 1 cup for whole night and then drink at morning before breakfast to cure piles and Constipation.	Juice	No side effect was reported
27.	Nyctaginaceae	*Boerhavia procumbents* Banks ex Roxb. (N-27)	0.18	Soorbanday	Leaves	The fresh leaves (up to 10) are collected, washed and boiled in water of 1L until the half of water evaporates. This is used to cure boils.	Infusion	No side effect was reported
28.	Oxalidaceae	*Oxalis corniculata* L. (N-28)	0.29	Tarukey/ Pishtarey Saag	Leaves	The fresh leaves are plant are crushed and mixed in water and left for whole night under open sky, then at morning it is filtered. The extract obtained is used to cure jaundice (one cup) 2 times a day for 2 weeks.	Extract	No side effect was reported

Table 2. (Cont'd.).

S. No.	Family name	Taxonomic name/ Voucher No.	FI	Local name	Part used	Recipes	Preparation mode (s)	Side effect
29.	Papaveraceae	*Argemone mexicana* L. (N-29)	0.08	Kaareza	Seeds	The seeds are dried and powdered and mixed with the rhizomes of *Curcuma aromatic* and *Acorus calamus* to form a paste. The pate is used for any skin disease.	Powder	No side effect was reported
30.	Papilionaceae	*Melilotus indicus* (L.) All. (N-30)	0.20	Lewanay surgulay	Whole plant	The flowers are boiled in water; the infusion formed is remedy good remedy for abdominal cramps.	Infusion	No side effect was reported
31.	Plantaginaceae	*Plantago ciliata* Desf. (N-31)	0.17	Speghol	Leaves & Seeds	The green leaves are collected washed and cooked to cure fever. The seeds 1-2 teaspoons are mixed in milk of one cup to form a paste and then taken orally to cure constipation.	Paste	No side effect was reported
32.	Poaceae	*Arundo donax* L. (N-32)	0.31	Nul	Stem & rhizome	The green leaves are crushed to make paste which is applied on wounds.	Paste	No side effect was reported
33.	Poaceae	*Cymbopogon jwarancusa* (Jones) Schult. (N-33)	0.12	Ghuzay	Leaves	The green leaves are boiled in green tea, which is used to cure flu and seasonal fever.	Tea	No side effect was reported
34.	Poaceae	*Cynodon dactylon* (L.) Pers. (N-34)	0.06	Kabal	Leaves	The fresh leaves of the plant are crushed to form paste and applied on wounds.	Paste	No side effect was reported
35.	Poaceae	*Phalaris minor* Retz. (N-35)	0.24	Badagal	Leaves, seed and Fruit	The decoction of fresh leaves is used to cure dysentery. The decoction is taken 2-3 times a day one cup.	Decoction	No side effect was reported
36.	Polygonaceae	*Rumex vesicarius* L. (N-36)	0.33	Thrushakay	Leaves	The green fresh leaves (4-5) are taken orally raw for 3-4 times a day to cure liver problems.	Raw	No side effect was reported
37.	Rhamnaceae	*Ziziphus nummularia* (Burm.f.) Wight &Arn. (N-37)	0.42	Karkanrra	Fruits	The fruits are boiled in water of about half to one litter of water to prepare a decoction, half cup is taken orally 3 times a day to cure influenza.	Decoction	No side effect was reported
38.	Rutaceae	*Citrus medica* L. (N-38)	0.37	Naranj	Fruits	The juice of fruit about 1-2 tea spoons is mixed in half glass of water a drink for indigestion.	Juice	No side effect was reported
39.	Scrophulariaceae	*Verbascum Thapsus* L. (N-39)	0.16	Khar ghwage	Leaves	The green leaves are warmed and tied on joints to relieve pain.	Raw	No side effect was reported
40.	Sapotaceae	*Sideroxylon mascatense* (A.DC.) T.D. Penn. (N-40)	0.21	Gorgura	Leaves	The green leaves 1-2 are chewed 2-3 times a day to improve digestion.	Raw	No side effect was reported
41.	Simaroubaceae	*Ailanthus altissima* (Mill.) Swingle (N-41)	0.05	Lewanay shanday	Gum	The gum obtained from plant is mixed with in a cup of milk and boiled to a decoction, which is taken 2-3 times a day to cure dysentery.	Decoction	No side effect was reported
42.	Solanaceae	*Solanum surattense* Burm. f. (N-42)	0.32	Maraghonay	Fruit	The fruit is directly placed in between the aching teeth for few minutes to cure toothache.	Raw	No side effect was reported
43.	Solanaceae	*Solanum americanum* Mill. (N-43)	0.14	Kachmacho	Fruit	The juice obtained from fruits is directly applied to cure skin inflammation.	Juice	No side effect was reported
44.	Urticaceae	*Forsskaolea tenacissima* L. (N-44)	0.16	Torapanra	Whole plant	The whole plant is boiled in water of about 2L until the half of water evaporates. The decoction is taken orally about half cup 2-3 times a day to cure fever.	Decoction	No side effect was reported
45.	Zygophyllaceae	*Fagonia indica* Burm.f. (N-45)	0.36	Azghakay	Whole plant	The juice is extracted from the plant. One tea spoon of it is mixed in one glass of water and taken 2-3 times a day as a blood cooling agent.	Juice	No side effect was reported

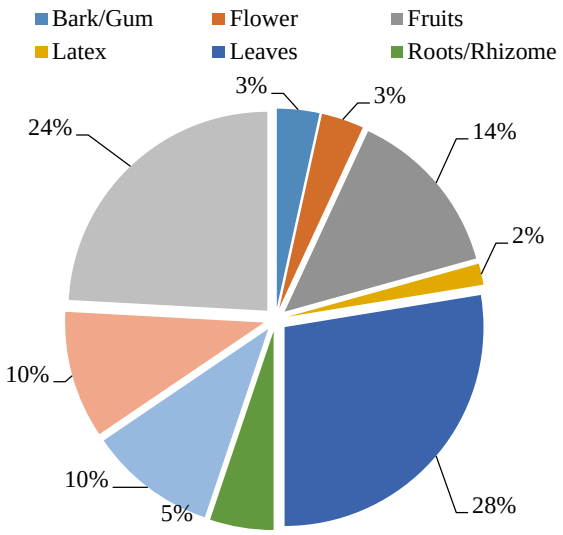

Fig. 3. Presenting percentage values of plants' parts used in the preparation of different ailments.

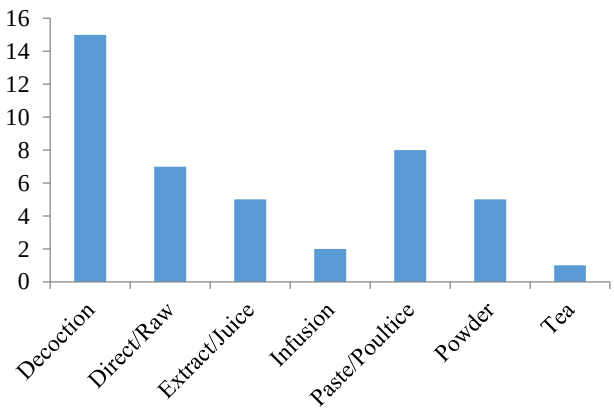

Fig. 4. Modes of administration.

The use of plants to cure different disease: All collected plants species were grouped into 13 disease categories. The Informant Consensus Factor (ICF) showed that Anti-Poisoning (0.928) had the highest value, followed by Nervous disorders (0.913), Wounds healing (0.909), Blood-Cardiac disorders and Urinary disorders (0.90), Ear-Eye diseases and Sexual diseases (0.87), Tonics (0.85), Fever (0.84), Respiratory disorders (0.78), Skin & Muscu-skeletal disorders (0.69) and Digestive disorders (0.58) (Table 3 and Fig. 6).

Novelty of the study results: To find out the similarity and novelty of our work, we compared the collected medicinal plant knowledge with 17 previously published ethnomedicinal/ethnobotanical articles of neighboring areas (Table 4) calculating the Jaccard Similarity Index (JI). The results obtained show a similarity with other studies from 2.17% to 14.16% (Fig. 7). The highest percentage of similarity was observed with the study conducted in Malakand Pass Hills by Barakatullah *et al*., (2015) (14.16%), followed Charkotli Hill Batkhela by Barakatullah *et al*., (2009) (13.28%) and study conducted in Banda Daud Shah, District Karak by Murad *et al*., (2013) (13.18%). Similarly, the lowest percentage of similarity was shown for the study done by Guarrera *et al*., (2005) (2.17%). This overall indicates that the population of our study region harbors very distinct ethnomedicinal knowledge.

Table 3. Showing Informants Consensus Factor value of major ailments categories.

S.No.	Disease Categories	Nt	Nur	ICF
1.	Anti-Poisoning	2	15	0.92
2.	Blood & Cardiac disorders	3	21	0.90
3.	Digestive disorders	28	66	0.58
4.	Ear & Eye diseases	2	9	0.87
5.	Fever	6	34	0.84
6.	Mouth diseases	3	17	0.87
7.	Nervous disorders	3	24	0.91
8.	Respiratory disorders	10	43	0.78
9.	Sex diseases	2	9	0.87
10.	Skin & Muscu-skeletal disorders	18	57	0.69
11.	Tonics	5	28	0.85
12.	Urinary disorders	2	11	0.90
13.	Wounds healing	3	23	0.90

Table 4. Listing values of Jaccard Similarity Index calculated for comparing the medicinal plants reported from the study area.

S. No.	A	C	B	Difference	Other study areas	JSI values
1.	41	4	33	29	Abdullahpur, Bangladesh	5.40
2.	42	3	96	93	Acquapendente, Italy	2.17
3.	40	5	79	74	Bajaur Agency	4.20
4.	33	12	58	46	Banda Daud Shah, District Karak	13.18
5.	40	5	30	25	Bhiwani Distt. Haryana, India	7.14
6.	28	17	100	83	Charkotli Hill, Batkela, Malakand	13.28
7.	36	9	75	66	Hazar Nao Forest, Malakand District, North Pakistan	8.10
8.	37	8	55	57	Jalala, Distt Mardan	7.84
9.	33	12	82	70	Kot Manzary Baba valley, Malakand Agency, Pakistan'	10.43
10.	39	6	51	45	Lateritic Belt of West Bengal	6.66
11.	28	17	92	75	Malakand Pass Hills	14.16
12.	38	7	63	56	Mohmand Agency, Pakistan	6.93
13.	36	9	70	61	People Living, around Indus River	8.49
14.	41	4	30	26	Sidhi Distt., Madhya Pradesh, India	5.63
15.	35	10	59	49	Tehsil Tangi District Charsadda	10.63
16.	40	5	50	45	Wana district south Waziristan agency, Pakistan	5.55
17.	32	13	107	94	War affected North-West region of Pakistan	9.35

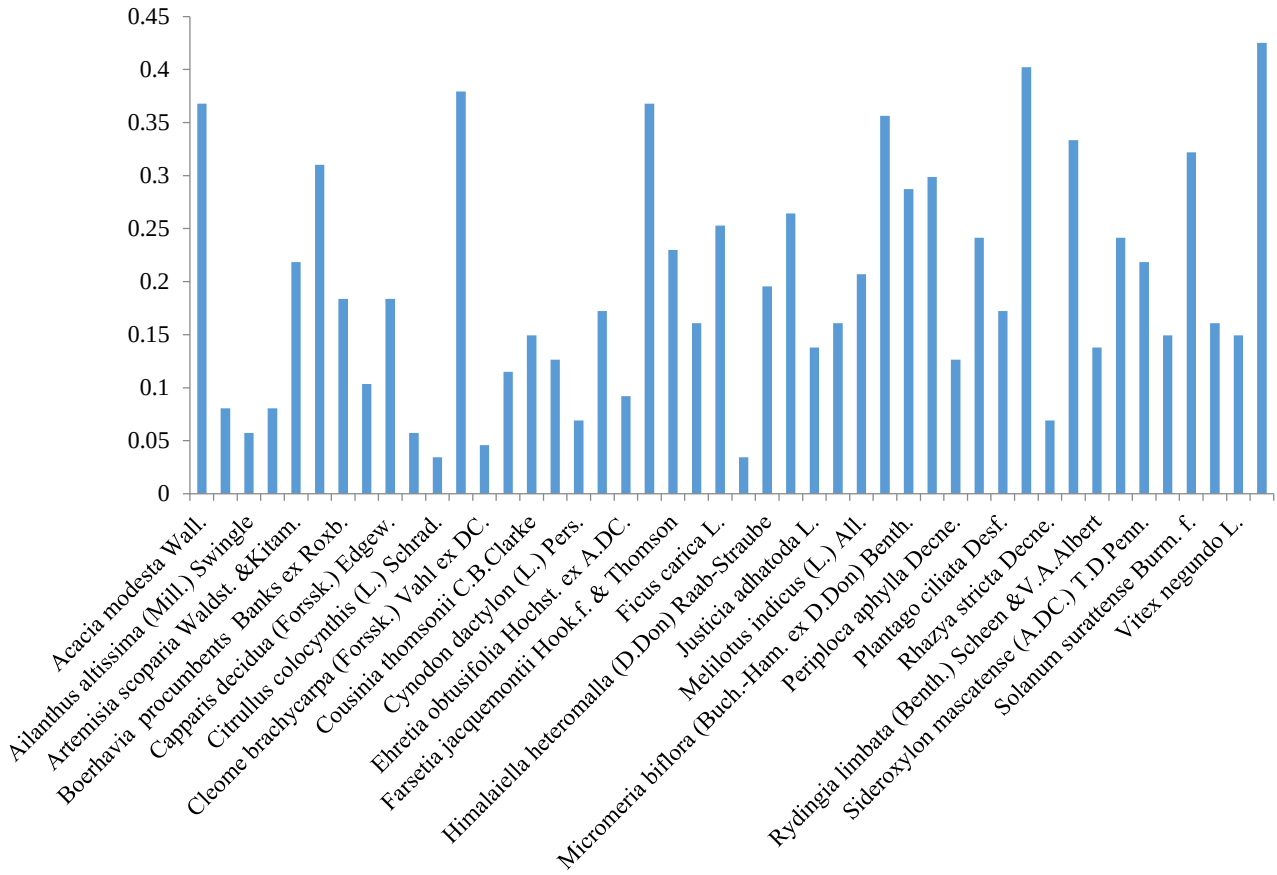

Fig. 5. FI value for each plant species.

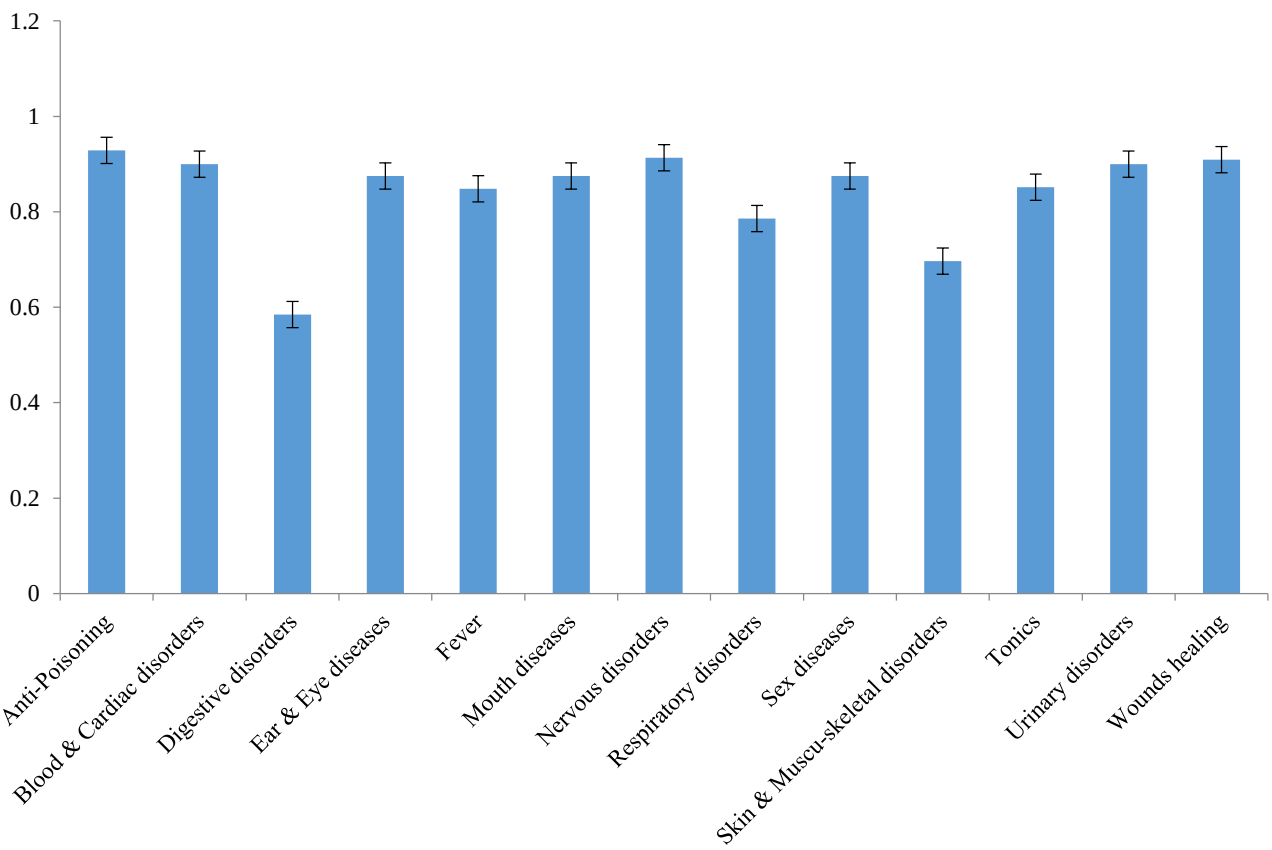

Fig. 6. Informant Consensus Factor (ICF) values for major ailments groups.

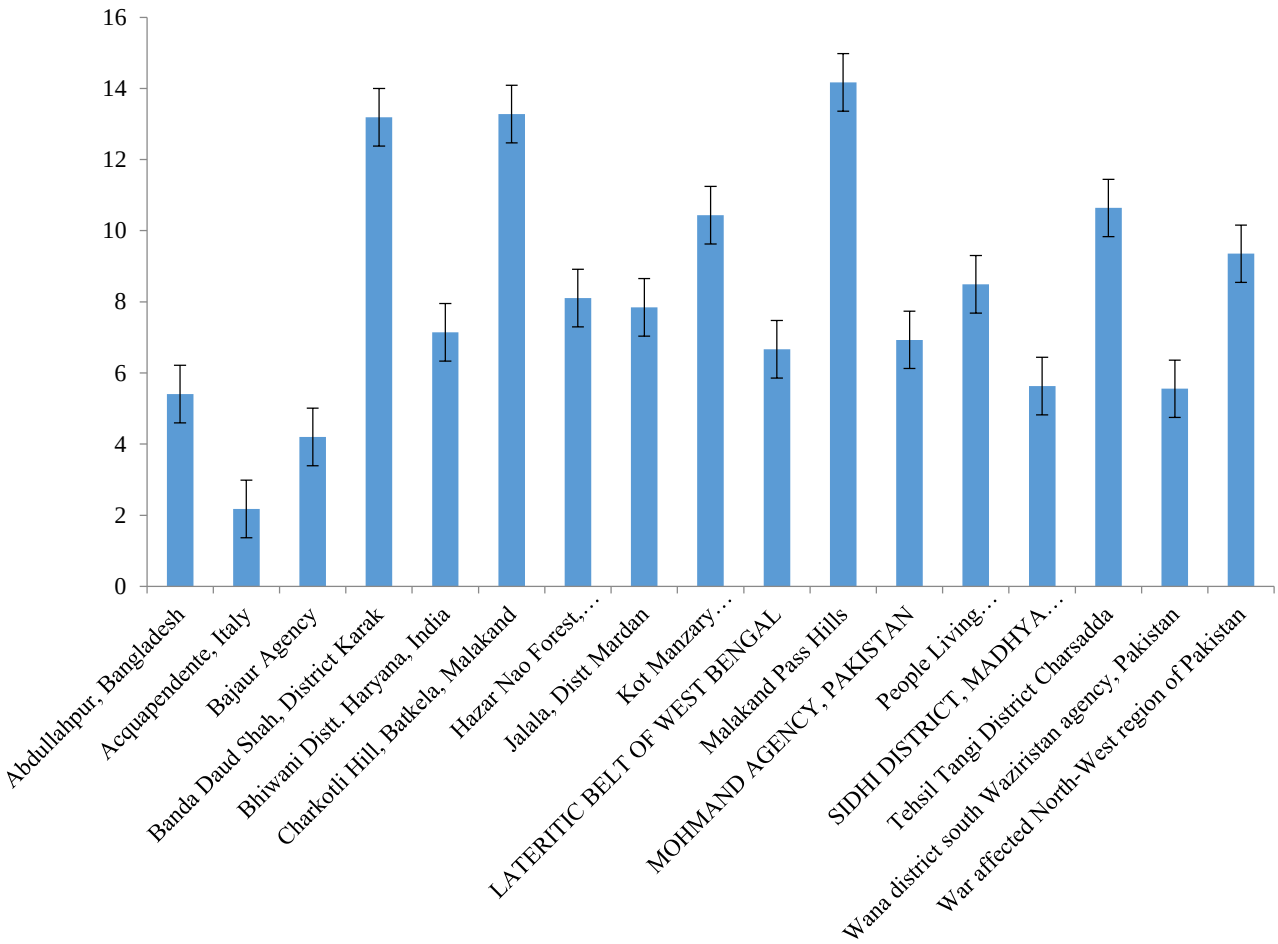

Fig. 7. Jaccard Similarity Index of different communities.

Discussion

Demographic characteristics of the informants in respect to medicinal plants utilization: Often, with the advancement in medical science, people prefer the modern healthcare system, but herbal medicines are often seen as having no/less side effects (Shinwari, 2010; Gilani & Rahman, 2005). In our work illiterate informants were more knowledgeable about the use of therapeutic plants. The reason may be the proclivity of educated people towards modern healthcare systems. It was also observed that the young generation gave very little importance to traditional folk medicinal knowledge. According to literature from other parts of the world, women are often more knowledgeable of therapeutic plant usage (Khan & Ahmad, 2015).

Medicinal plants diversity and diseases cured: The high number of therapeutic plant species were documented of Lamiaceae, Amaranthaceae, Asteraceae and Poaceae was also reported in other ethnomedicnal studies, e.g. Sher & Hussain (2009); Shah *et al*., (2016); Bennett & Prance (2000); Gürdal & Kültür (2013), Nasab & Khosravi (2014). The reason of the dominancy of family Lamiaceae may be laid in the fact that often the most common a plant group in an area has greater the probability of its use (Ahmad *et al*., 2014). Lamiaceae are used in large number as medicine due to their volatile oils, which are composed chiefly of monoterpenes (Yamane *et al*., 2010 and Abe & Ohtani, 2013). The most commonly used life forms were herbs (60%), very similar to other studies. Herbs often have a high amount of bioactive compounds (Mesfin *et al*., 2009; Teklehaymanot, 2009; Lulekal *et al*., 2013; Giday *et al*., 2009), and they are more effective in their medicinal action than shrubs and trees (Adnan *et al*., 2014). Herbs also grow more commonly along road-sides and in home gardens (Shrestha & Dhillion, 2003; Tabuti *et al*., 2010; Ayyanar and Ignacimuthu, 2005; Uniyal *et al*., 2006; Ragupathy *et al*., 2008; Giday *et al*., 2009; Sanz-Biset *et al*., 2009), thus being easily accessible.

Plant parts used and types of herbal preparations: During the field work and as per interviews most widely used plant part were leaves (16 sp.) and whole plant (14 sp.). The use of whole plant in the preparation of herbal remedies was also documented by Bibi *et al*., (2014), Khuankaew *et al*., (2014) and Shinwari *et al*., (2020). The common use of leaves in folk herbal remedies was also reported in different ethno-medicinal studies conducted by Singh & Singh (2009), Kadir *et al*., (2012), Kadir *et al*., (2013); Islam *et al*., (2014), Teklehaymanot (2009), Ibrar & Hussain (2009), Tabuti *et al*., (2010) and Upadhyay *et al*., (2010). Leaves are thought to be used more commonly in indigenous herbal medicines because their collection requires less effort (Giday *et al*., 2009). Also leaves often contain different essential compounds in large amount as compared to other plant parts (Ghorbani,

2005). The use of leaves is less harmful to plant as compared to other plant plats and thus has a conservation advantage (Kadir *et al*., 2012; Kadir *et al*., 2013). Decoction and infusion were documented as dominant modes of preparation of herbal remedies, similar to Rehecho *et al*., (2011), Nadembega *et al*., (2011) and Alzweiri *et al*., (2011).

Conclusion

The medicinal flora of the study area is a vital part in the basic healthcare structure of the native communities, because the area is remote and not even basic health care facilities are available, as the area has greatly been affected by war for the last three decades. To cure a number of diseases the population used a wide variety of therapeutic medicinal plants. It was observed that in different parts of the study area similar uses were documented for the same medicinal plant, and often more than one medicinal use for same medicinal plant was observed. It was also found that the ethnomedicinal knowledge was greatly restricted to the older generation, and that the younger generation had little knowledge about medicinal plants, the ongoing conflict against terrorism in the area may constrain the transmission of knowledge. Overgrazing and overharvesting of the medicinal flora are the major threats to the native flora. Steps towards the conservation of indigenous knowledge and medicinal flora of the study area are of great importance. For this purpose a project should be developed to evaluate the local flora pharmacologically, and to cause awareness among the local communities about the conservation of the medicinal flora

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