

Full Length Research Paper

Traditional medicinal uses of plants in Gilgit-Baltistan, Pakistan

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Ghizer district of Gilgit-Baltistan, Pakistan is gifted with tremendous natural resources. Plant resources have long been used to cure different human as well as livestock ailments in this part like others in the world. This study was conducted to document the indigenous and traditional uses of medicinal plants, the status of traditional knowledge with the advancement of technology and modern healthcare facilities to find out the mode, part and way of usage and more importantly to know the threats for the plant resources to provide a baseline survey for conservation and management of medicinal plants. Field visits were conducted to collect the plant species in June and July, 2012. The information on local names and uses were collected from the local communities and herbalist through direct interview, questioners and showing photographs. The identification and nomenclature of the plant species was made by consulting different taxonomists and available literature especially following the flora of Pakistan. The data was analyzed using Excel spreadsheets and preference ranking, paired comparison test and direct matrix ranking. A total of 34 species belonging to 18 were used as medicine. Males above 40 years were found to be more knowledgeable regarding uses of medicinal plants than women and youngsters. The leaves are the most common part of plants used as medicine. Medicinal plants are in severe under pressure of over grazing, cutting and climate change impacts. Conservation of medicinal plants, awareness among the local inhabitants and promotion of indigenous knowledge by promotion of research activities are required.

Key words: Ghizer, ethnobotany, traditional uses, medicinal plants, diseases, threats, conservation.

INTRODUCTION

The use of plant by man is dated back to the human existence on earth. Wild plants have always been the matter of high concern and have always been used for

their potential of human well being (Ali et al., 2003). Pakistan, like many other countries of the world got rich plant resources used for medicinal as well as for other

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purposes. The unique geography with the mighty mountain ranges of Hindu-kush Himalayas and Karakorum has altitudes ranging from 0 to 8611 m, and therefore has a variety of climatic zones, and rich floral diversity. Pakistan has more than 6,000 species of higher plants (Ali and Qaiser, 1986; Shinwari and Qaiser, 2011). Northern Pakistan (Gilgit-Baltistan), not only harbors many of the endemic species, but also many of the genera have been originated and radiated such as *Astragalus* spp., *Causinia* spp. and *Alliums* pp. (Shinwari and Qaiser, 2011). Many known drugs (for example, tubocurarine, reserpine, aspirin and morphine etc) are discovered based on traditional knowledge. It is a fact that 25% of all medicinal prescription is based on substances derived from plants or plant derived synthetic analogs (Sara et al., 2009). The uses of many medicinal plants in management of infection diseases including bacteria are well known and validated in many cases (Zahin et al., 2010). The tribal people of Western Madhya Pradesh of India use 13 plants for the treatment of jaundice disease (Samvatsar and Diwanji, 2000). Recently, a similar study was conducted in Nepal and found a total of 161 plant species belonging to 86 families and 144 genera to cure 89 different human diseases (Luitel et al., 2014).

Goodman and Ghafoor (1992) collected information of about 114 plant species used by the village dwellers of Balochistan for nutritional, utilitarian and medicinal purposes. Haq and Hussain (1993) surveyed Mansehra District and collected 53 wild and 17 cultivated medicinal plants. Shah and Shinwari (1996) reported 171 plant species used as medicine by communities in Kharan district, Baluchistan. Iqbal (2010) recorded 67 medicinal and economic plants species belonging to 59 genera of 34 families from Dhirkot used for multipurpose needs. Bukhari (1994) worked on the vegetation analysis of Machyara National Park Muzafarabad AJK and reported 10 plants communities in different region used as medicine. Hazarat et al. (2010) reported 50 species belonging to 32 families of wild herbs, shrubs and trees of medicinal plants from Usherai Valley. Ali and Qaiser (2009) reported 83 taxa that were used locally in Chitral district of Hindukush range. Hussain et al. (2008) recorded 45 plant species used as folk medicines in the Hattar region, District Haripur. Hussain et al. (2007) indicated that there were 111 species of 46 families among them, 90 fodders, 52 medicinal, 40 firewood, 19 vegetable, 15 hatching, 13 timber and 9 fruit species from Mustuj, Chitral, Pakistan. According to Islam et al. (2006), 49 weed species were used as medicinal plants from the Shawar valley, District Swat. Out of them, 30 plants were used as traditional medicines.

An ethno-medicinal investigation of plants was carried out by Gorski and Miraj (2002) in Khanabad village and its allied pastures of district Gilgit and reported 126 plants

species distribution among 48 families. Khan and Khatoon (2007) reported 48 species of trees and shrubs in Haramosh and Bugrote valley which were used for medicines, shelter, agricultural tools and fuel. Similar studies were also conducted by Qureshi et al. (2006) and Khan et al. (2011) in Gilgit district and (Khunjerab National Park (KNP), Gilgit and found 43 and 26 plant species used for medicinal purposes, respectively. Shedayi and Gulshan (2012) conducted a study in the same district and found 35 plant species belonging to 27 families used for curing more than 25 different diseases. Biodiversity is rapidly declining worldwide (Butchart et al., 2010). Many of the endemic species in Gilgit are endangered, and may also be explored for ethnobotanical, pharmacological and pharmaceutical activities (Shinwari and Qaiser, 2011). Extensive grazing, uprooting of plants and soil-slope erosion, natural disasters and climate change are the major threats to the medicinal plants in the Gilgit-Baltistan (Sheikh et al., 2002; Shedayi and Gulshan, 2012). Many of these plants are threatened and some are endangered, but no proper attention is given for their conservation, effective management and wise use. Previous studies have reported some of the plant species and their effectiveness on various diseases, but not systemic synthesis has been conducted yet and especially on the conservation of medicinal plants under anthropogenic and climatic threats. The objectives of the current study are to (1) identify the local plants used as traditional medicine by the people; (2) to know the indigenous knowledge about plant uses; (3) to find out the major threats for the plant resources in the study area for conservation and management purposes and (4) to provide a baseline study for herbal pharmaceutical industries, conservation agencies and researchers.

METHODOLOGY

Study area

Ghizer district is rich in natural resources. It is the westernmost part of Gilgit-Baltistan and 91 km from the Provincial capital, Gilgit. Ghizer is the gateway between Gilgit and Chitral, Tajikistan via Iskomen and also to China. Ghizer is a multi-ethnic district and four major languages are spoken; shina, khowar, brushuisi and wakhi. Shina is spoken in Punial, Proper Ishkomen, and Centre Gupis. Khowar is spoken in Gupis, some parts of Yasin and some parts of lower Ishkomen (Chatorkhnad). Brushiski is spoken in the Yasin valley, while Wakhi is spoken in some parts of Ishkomen (Imit). The people of the area depend on agriculture and natural resources. Punial is situated at an elevation of 1520 to 2740 m. Singul, the former headquarter of Punial, is a very beautiful village with vast pastures and many lakes at high altitudes. The winter is cold with long nights and the summer is pleasant. All activities are taking place from spring to autumn. Summer is the only season for the cultivation and about 80% plants flower in this season. This area is very much fertile and famous for its fertile land, fruits and pastures. Medicinal plants have long being used for curing different diseases. The traditional knowledge is declining day by day and the medicinal

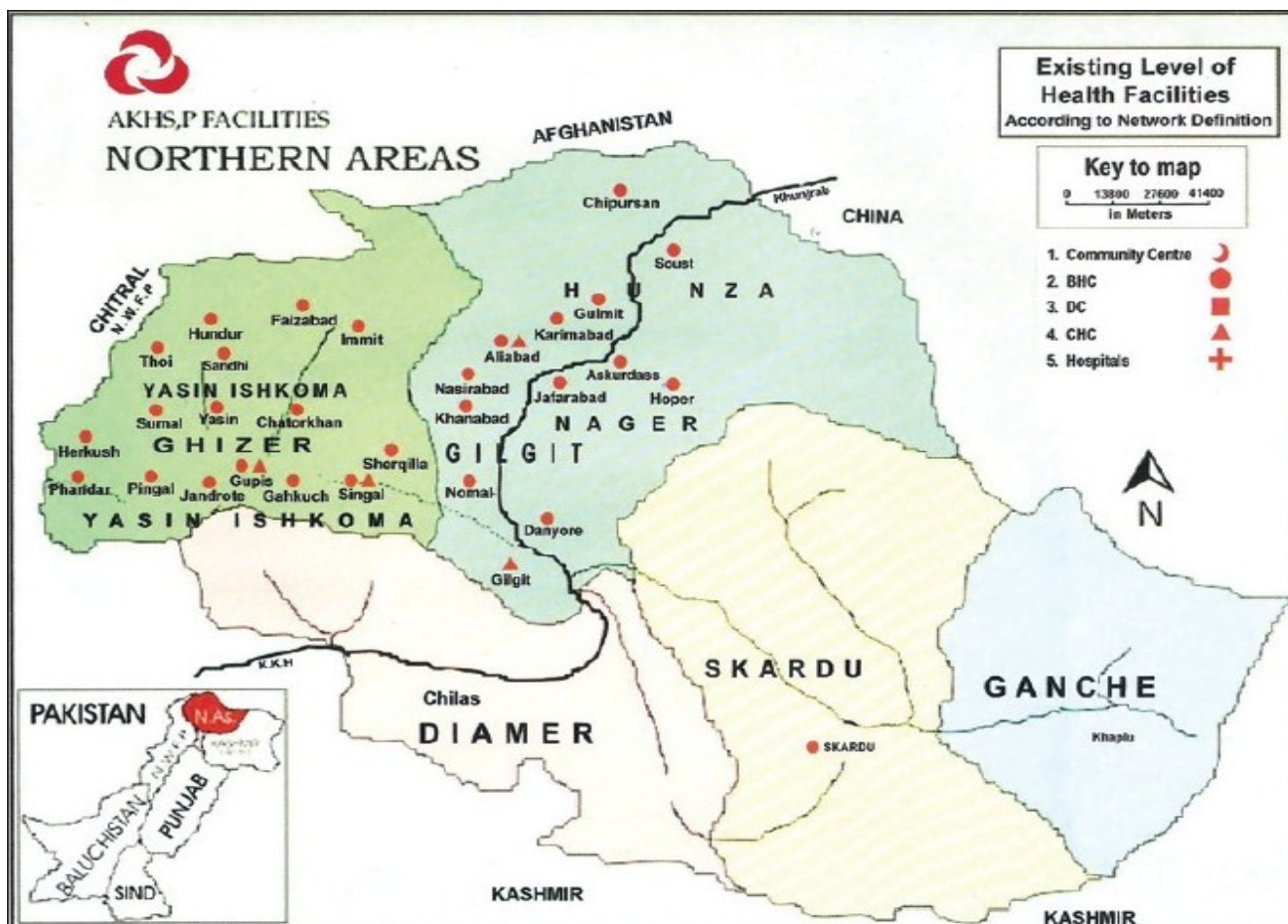


Figure 1. Map of the study area: District Ghizer and Singul valley village. Source: http://www.atmph.org/viewimage.asp?img=AnnTropMedPublicHealth_2011_4_1_57_80541_u7.jpg.

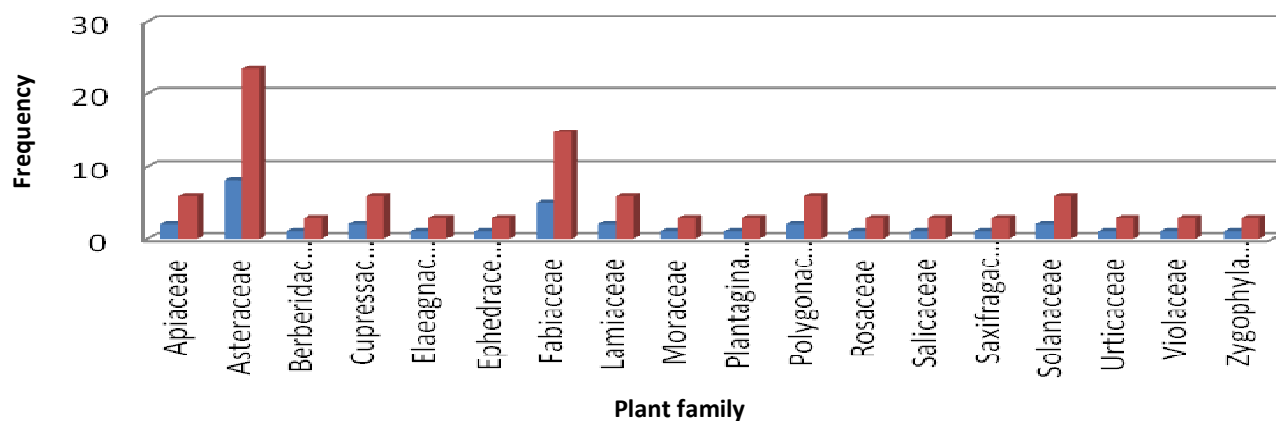


Figure 2. Number of plant species in each family.

plants are under threats of anthropogenic and natural disasters. Conservation, management and sustainable use are not under consideration (Figure 1).

Collection of plants and data

This study was conducted in Singul Valley to document the

medicinal plants and to address the key problems/threats to the plant wealth in this very important area. Two field visits were conducted during summer 2012 to collect plants species from the study area. Plants were collected, pressed, dried and made herbarium. The identification of the voucher specimens and nomenclature were made in the herbarium of Karakoram International University (KIU) and with the help of flora of Pakistan (Ali and Qaiser, 1995). Indigenous knowledge about the medicinal uses of the plant species were obtained through questionnaires, direct interviews and showing voucher specimens and photographs to about 100 local inhabitants of the area. The number of males and females aged above 40 and below 40 were 50 each, respectively. Semi structured and structured questionnaires were used to collect the data. The results were then noted and tabulated. The specimens were kept in the herbarium of Karakoram International University for future use.

Data analysis

The data was analyzed using Excel spreadsheets. All plant species ranked according to their preference of use by the inhabitants such as 0 to 4, where 0 was not preferred and 4 was most preferred. Ranks for all medicinal plants in each family were sorted by paired comparison test and the preference level for each medicinal plant species found out to know the plants species used the most or least according to Fechner (1860) and Mueller (1986). We ranked the plants as 1 to 5 (1 with most usage and 5 with least usage) according to the percentage after paired comparison test. The ranking was based on percentages such as, 1 to 15 ranked 5, 16 to 31 ranked 4, 32 to 47 ranked 3, 48 to 63 ranked 2 and those falling in 64 to 79 as 1. We also used direct matrix ranking for the number of plants used to cure each disease based on the information obtained from the inhabitants. While for all other data, simple tabulation for number and percentage was made on excel spreadsheet and charts were drawn. Direct matrix ranking method was also used for plants used for other purposes. This was done by selecting 7 plant species selected to know their uses other than medical use such as fodder, fuel and thatching/timber. The plants and uses were then ranked according to their total score.

RESULTS

Number of medicinal plants in each family

A total of 34 species belonging to 18 families in which 8 were Asteraceae, 5 were Fabaceae, Apiaceae, cupressaceae, Lamiaceae, polygonaceae and Solanaceae having 2 of each, while Berberidaceae, Elaeagnaceae, Ephedraceae, Moraceae, Rosaceae, Saxifragaceae, Salicaceae, Urticaceae, Violaceae and Zygophyllaceae having only 1 species of each, were discovered to have been used mostly for curing different diseases as mentioned in the Figure 2.

Uses of plants

When the plants were ranked after paired comparison test, It was found that 3 plant species fall in rank 1, 5 in 2, 7 in 3 and 4 each and 12 plant species fall in rank 5. Rank

1 shows the plant used the most and rank 5 shows the plant used the least as shown in the Table 1.

Diseases and number of plants

Based on the information of the inhabitants highest number 31 (91%) of plant species used to treat digestive disorders (DD) was found, followed by respiratory disorders (RD) 17 (50%), rheumatism (Rm) 10 (29%), skin diseases (SD) and stimulant (St) 7 (21%) each, fever (Fr) and toothache (Ta) 6 (18%) each, astringent (As) 4 (12%), antiseptic (An), headache (Ha), wounds (Wn) body pain (Bp), diuretic (Dr) and hair problems (HP) 3 (9%), jaundice (Jn), aromatic use (Ar), weight loss (WL), diabetes (Db), pneumonia (Pn) and blood diseases (BD) 2 (6%), blood pressure (BP), hypertension (Ht), cancer (Cn), hepatitis (Hp), insomnia (In), aphrodisiac (Ap), backache (Ba), earache (Ea), heart problems (HP), tuberculosis (TB), evil repellent (ER), animal bite (AB) 1 (3%) each and ranked as 1, 2, 3, 4, 5, 6, 7, 8, 9, respectively as shown in Table 2.

Ethnomedicinal knowledge

Bases on the information obtained from the people during the survey, the percentage of knowledgeable people aged above 40 and below 40 and males and females were 80:20 and 60:40, respectively as indicated in the Figure 3.

Plants used for veterinary

Some plant species were also being used for the treatment of livestock such as goat, sheep, cow, donkey and horse.

Form used as medicine

Most of the plants were used as juice (31%) followed by powder form (25%), paste (20%), direct (19%) and as a fume (55) as indicated in the Figure 4.

Parts used

The survey results in the Figure 5 show that different parts are used for medicinal purpose such as leaves (25%), fruit (17%), root (16%), seed and flower (12% each) and whole plant (10%).

Plants used for other purposes

Medicinal plants were also used for other purposes such

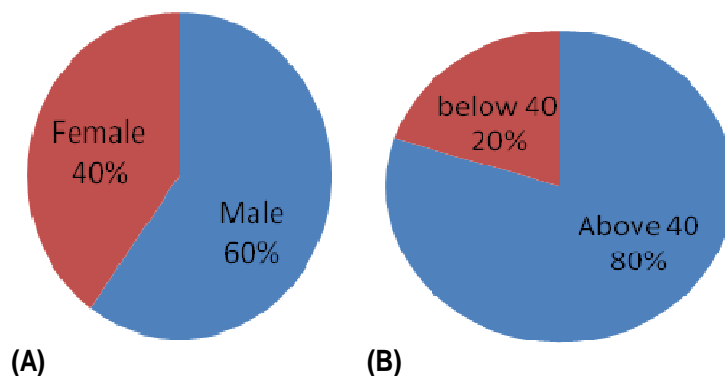


Figure 3. (A) sex- and (B) age-wise percentage knowledge.

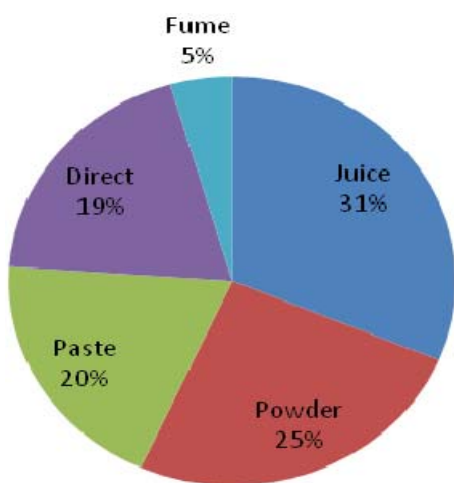


Figure 4. Form in which plants were used as medicine.

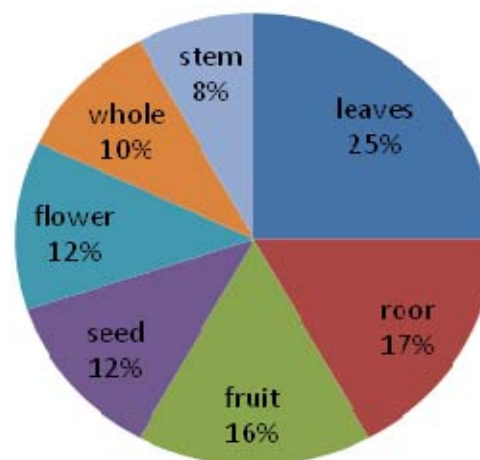


Figure 6. Parts of plants used as medicine.

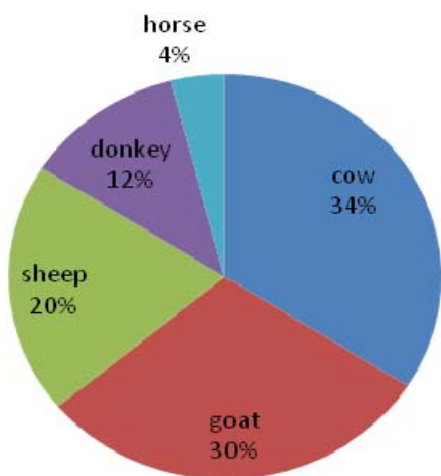


Figure 5. Medicinal plants used to treat livestock.

as fodder (50%) followed by fuel (33%) and for thatching and others (17%) (Figure 6).

Major threats to the medicinal plants

The major threats to the medicinal plants as shown in the Figure 7 indicate grazing pressure (28%), fodder (22%), fuel (22%), natural disasters (17%) and others for example, thatching/timber (11%).

DISCUSSION

Pakistan enlisted more than 500 species of flowering plants being used as medicine. Medicinal plants have an important value in socio-cultural, spiritual and medicinal

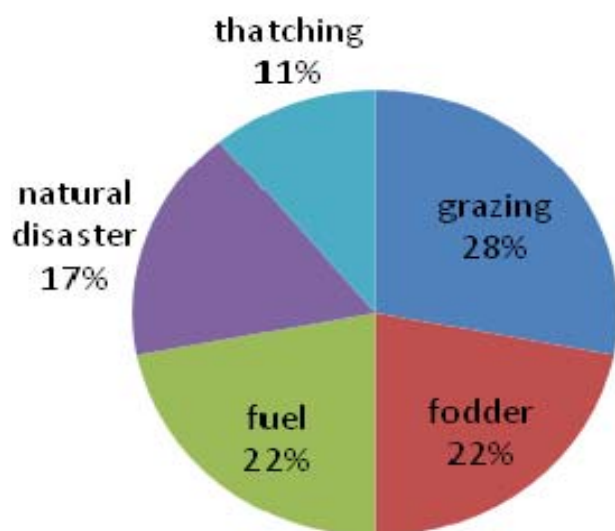


Figure 7. Major threats to the medicinal plants.

uses in rural and tribal lives of the developing countries (Shinwari et al., 2005). Hocking (1998) estimated that in the early 1950 up to 84% of the Pakistan population was depending upon traditional medicines for all or most of their medicinal needs, which was mainly focused on information regarding traditional uses of plants. The use of traditional medicine and medicinal plants in most developing countries, as a normative basis for the maintenance of good health, has been widely observed (United Nations Educational Scientific and Cultural Organization (UNESCO), 1996). Gorman (1992) drew attention to the power of Chinese folk medicinal potions in treating maladies from eczema and malaria to respiratory disorders. Elisabetsky and Castilhos (1990) reported that annual world market value for medicines derived from medicinal plants by indigenous people of Himalaya was US \$43 billion. Tariq et al. (1995) tested medicinal plants for their antimicrobial activities against 25 different pathogens and non pathogens from Karachi, Sindh Province. Most of the plants were found similar to the study conducted by Arshad and Gulshan (2012) because of the same climatic, topographic and soil features in both the study areas.

Plants in each family

In the study area, Asteraceae had highest number of medicinal plants followed by Fabaceae while a previous study, in the same district, showed similar results having family Asteraceae, which is the highest number of plant species, as compared to others (Shedayi and Gulshan, 2012). Our results were much similar to the findings of

Khan et al. (2011) in which they found Asteraceae family contributing the highest number of species (11.63%), followed by Fabaceae, Lamiaceae and Rosaceae (9.30%) each, Chenopodiaceae and Elaeagnaceae (4.65%) each. An ethnobotanical study conducted in another district by Khan and Khatoon (2008) shows Compositae (Asteraceae) containing 14 species followed by Labiatae (Lamiaceae), with 8 species then Gentianaceae, Ranunculaceae and Umbelliferae (6 species each). The plants used for medical purposes are mostly the same, with little variation in number of species in each family in the Gilgit-Baltistan of Pakistan.

Uses of the plants

When the plants were ranked after paired comparison test of matrix, it was found that 3 plant species fall in the rank 1, 5 in 2, 7 in 3 and 4 each and 12 plant species fall in rank 5. It means that the most popular medicinal plant species among the people are 3, such as *Hippophae rhamnoides* L., *Mentha longifolia* L. and *Plantago ovata* L., ranking at 1, used to cure cough, bronchial congestion, as cosmetics, skin protection, cancer migraines, headaches, cold, nasal catarrh, fever, indigestion, profuse mucus discharge, stomachic, astringent, anti rheumatic, whooping cough, asthma, respiratory inflammation (Humans and livestock), toothache, gum problem, chronic dysentery, diarrhea and constipation as shown in Table 1. It is also noticed that these plants have multiple uses to cure diseases. Most of the plants species (12 species) have only one use or are least in use, this is because of the lack or decline of the traditional knowledge among the people, as very few people know their use and are not popular among the masses. In earlier studies, Khan and Suriya (2008), Khan et al. (2011) and Shedayi and Gulshan (2012) also showed that most of the plant species are popular in most part of the world, especially in Gilgit-Baltistan. Our results confirm the plants, their popularity and uses against diseases.

Diseases and number of plants

It is worth mentioning here that we have merged many related diseases in one category such as dyspepsia, stomachic, demulcent, purgative, laxative, diarrhea, dysentery, constipation, worms, anthelmintic, carminative and gastric problems in digestive disorders (DD), bronchial spasmodic, sore throat, cough, asthma in respiratory disorders (RD), arthritis, joint pain in rheumatism (Rm), boils, deodorant in skin diseases (SD), narcotics, tonic in stimulant (St), diaphoretic in fever (Fr), gum problems in toothache (Ta), migraines in headache (Ha), fractures in wounds (Wn), sore in body pain (Bp) for

Table 1. Uses, paired comparison percentage and rank of medicinal plants in Gilgit-Baltistan, Pakistan.

No.	Name of Plant Spp. & Family	Family	Local name	Parts Used	Form	Uses	%	Rank
A	<i>Artemisia maritima</i> Linn.	Asteraceae	Zoon	Leaves, flower, buds	Juice	Anthelmintic, Stomachic, dyspepsia, flatulence extraction of ringworms and dysentery	44	3
B	<i>Anaphalis nepalensis</i> var. <i>nepalensis</i> (C. B. Clarke) Ridley	Asteraceae	Chikee	Flower, fruits	Fume, powder	Aromatic, gastro-intestinal ailment	12	5
C	<i>Taraxacum officinale</i> L.	Asteraceae	Ishkanache	Leaves, roots	Powde, juice	Diuretic, Jaundice and constipation	30	4
D	<i>Astragalus falconeri</i> Bunge var. <i>pilosus</i> (Ali).	Fabaceae	Hapocho	Stem, leaves	Powder	Diarrhea and digestive problems	10	5
E	<i>Angelica glauca</i> Edgew.	Apiaceae	Chora	Stem, Seeds, roots	Juice, powder	Carminative expectorant, stimulant, stomachic and tonic, headache, fever, skin rushes, wounds, rheumatism and toothaches, diaphoretic and diuretic	12	5
F	<i>Echinops echinatus</i> Roxb	Asteraceae	Jacheer	Whole plants	Juice, direct	Diuretic and treat digestive problems of horses	20	4
G	<i>Berberis lyceum</i> Royle	Berberidaceae	Ishkeen	Roots, Fruits	Paste, powder	Rheumatism and joint pain, diabetes, bone injuries, Fractures and wounds (livestock and Humans)	47	3
H	<i>Bergenia stracheyi</i> (Hook. f. & Thoms) Engl	Saxifragaceae	Sanspar	Roots, leaves	Juice, paste, direct	Rheumatic, arthritic and back bone pain, aphrodisiac for sexual stimulation and wounds. Green tea	8	5
I	<i>Cupressus sempervirens</i> L.	Cupressaceae	Saro	Fruits, stem	Direct, juice	Anthelmintic and astringent	9	5
J	<i>Carum carvi</i> L.	Apiaceae	Hayyo	Seed, fruits.	Powder, direct	Ingredient of the food and spices. Carminative, appetite stimulant. Herbal tea	20	4
K	<i>Carthamus tinctorious</i> L.	Asteraceae	Pock	Leaves	Paste, juice	Skin disease, bronchitis, arthritic and constipation	47	3
L	<i>Datura stramonium</i> Linn	Solanaceae	Daturo	Flower, fruit seeds, leaves	Juice, powder, paste	Earache, dandruff and hair loss, toothache, anti spasmodic and narcotic and boils and sores	52	2
M	<i>Elaeagnus angustifolia</i> L.	Elaeagnacea	Ghundair	Flower, Fruits, gum	direct	Fragrant, mental relaxation, satisfaction and happiness. Sour throat, cough, colds, fevers and asthma	60	2
N	<i>Hippophae rhamnoides</i> L.	Asteraceae	Buru	Fruits	Juice, paste, powder, direct	Cough Bronchial congestion. Cosmetics, skin protection and cancer.	68	1

Table 1. Contd.

O	<i>Ephedra jerardiana</i> Wall.	Ephedraceae	Soom	Whole plants	Powder, paste	Respiratory tract infection and bone fractures.	35	3
P	<i>Ficus carica</i> L.	Moraceae	Faag	Fruits	Juice,	Cardiac troubles, abdominal problems, constipation and skin problems	34	3
Q	<i>Glycyrrhiza glabra</i> Linn.	Fabaceae	Shalako	Roots	Powder, direct	Fever, cough, Asthma and digestive problem. Fodder.	11	5
R	<i>Juniperus excelsa</i> Bieb.	Cupressaceae	Chilli	Barries	Powder, fume, paste	Tuberculosis, diabetes, repelling evils, joint pain and swelling	25	4
S	<i>Mentha longifolia</i> L.	Lamiaceae	Phileel	Leaves	Juice,	Migraines, headaches, cold, nasal catarrh, fever, indigestion, profuse mucus discharge, stomachic, astringent, anti rheumatic, whooping cough, asthma and respiratory inflammation (Humans and livestock)	68	1
T	<i>Medicago sativa</i> L.	Fabaceae	Ishfit	Leaves	Powder, decoction	Constipation, blood pressure, stomachache food and vegetables	19	4
U	<i>Melilotus officinalis</i> (L.)	Fabaceae	Bissasing	Flower, leaves	Juice	Hypertension, insomnia, promotes lymphatic drainage and reduces fluid retention	15	5
V	<i>Plantago ovata</i> L.	Plantaginaceae	Ispaghoal	Seeds, leaves, roots	Powder, juice	Toothache, gum problem, chronic dysentery, diarrhea and constipation	64	1
W	<i>Peganum harmala</i> L.	Zygophylacea	Ispandure	seeds	Fume, paste, Juice	Rheumatism, removal of lice and stomachache	45	3
X	<i>Prunus amygdalus</i> (L.) Batsch	Rosaceae	Kono	Fruits	Juice, paste, powder	Demulcent, stimulant, laxative, hair oil, cooking oil, massage, diabetes, detergent and tooth powder	48	2
Y	<i>Rumex hastatus</i> (Don).	Polygonaceae	Churki	Leaves, roots, stem, berries	Direct, powder, juice	Carminative, stomachic, flavoring and purgative	37	3
Z	<i>Rheum emodi</i> Wall	Polygonaceae	Jarochuntal	Whole plant	Juice, tonic	Blood diseases, blood purifier, stomachic, tonic for dyspepsia and tonic for livestock	3	5
AA	<i>Saphora mollis</i> (Royle)	Fabaceae	Poshool	Leaves	Direct, paste	Food (Humans, cattle) skin allergic and antiseptic.	2	5
BB	<i>Salix alba</i> L.	Salicaceae	Bayo	Stem, leaves	Direct, juice, paste	Toothpicks, handcrafts, joint pain, headache and body pain	3	5

Table 1. Contd.

CC	<i>Saussurea heteromalla</i> (D. Don) Hand.-Mazz	Asteraceae	Kali zira	Seeds	Direct, paste	Carminative and animal bite	50	2
DD	<i>Saussurea lappa</i> (Dcne.) Sch.	Asteraceae	Minal	Stem, roots	Juice,	Antiseptic, disinfectant, anti-inflammatory and bronchial asthma	31	4
EE	<i>Solanum nigrum</i> L.	Solanaceae	Gabeeli	Leaves, fruit	Powder, direct	Jaundice and digestive problems of livestock	30	4
FF	<i>Thymus serpyllum</i> Linn	Lamiaceae	Tumuro	Leaves, Whole plants	Powder, juice	Whooping cough, asthma, respiratory inflammation deodorant, strong antiseptic, stomach trouble and fever	59	2
GG	<i>Urticaceae Urtica utilis hort. ex de Vriese</i>	Urticaceae	Jomi	Leaves	Direct, paste,	Vegetables, hair shampoos and Arthritis	1	5
HH	<i>Viola serpens</i> Wall.	Violaceae	Lilio	Whole plants	Juice	Fever, cough and pneumonia	1	5

Table 2. Showing number and percentage of plants used to treat different diseases.

Diseases	DD	RD	Rm	SD	St	Fr	Ta	As	Ha	Wn	Bp	Dr	HP	Jn	Ar	WL	Db	BD	Pn	BP	Ht	Cn	Hp	In	Ap	Ba	Ea	HP	TB	ER	AB
No. of plants	31	17	10	7	7	6	6	4	3	3	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Percentage	91	50	29	21	21	18	18	12	9	9	9	9	9	6	6	6	6	6	6	3	3	3	3	3	3	3	3	3	3	3	3
Rank	1	2	3	4	4	5	5	6	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9

DD (digestive disorders), RD (respiratory disorders), Rm (Rheumatism), SD (skin diseases), St (stimulants), Fr (fever), Ta (toothache), As (Astringent), Ha (headache), Wn (wound), Bp (body pain), Dr (diuretic), HP (hair problems), Jn (jaundice), Ar (aromatic), WL (weight loss), Db (diabetes), BD (blood diseases), Pn (Pneumonia), BP (blood pressure), Ht (hypertension), Cn (cancer), Hp (hepatitis), In (insomnia), Ap (Aphrodisiac), Ba (backache), Ea (earache), HP (heart problem), TB (tuberculosis), ER (ear repellent) and AB (animal bite).

tabulation and easily calculation purpose. The reason for using most of the plants for digestive and stomach problems is due to the most common diseases caused by unhygienic water and food stuff. Respiratory diseases as ranked 2 are also more common because of the fire smoke, smoking and severe cold weather in winter. Another reason for using most of the plants for digestive, respiratory and rheumatic disorders is due to having many complex diseases to all these as compared to other diseases. Some plants have multiple uses while others have only one use. Some diseases are cured by multiple plant species, while

species, while some others are cured by only one plant species. Similarly, some plants are used to treat multiple diseases while some plants are used to cure only one specific disease. As also mentioned by Luitel et al. (2014), the highest number of plant species was used for gastrointestinal-related diseases followed by cuts and wounds, and fever. *Artemisia maritima*, *Artemisia annum* and *Hippophea rhamnoides* are used to treat more than one disease (Shedayi and Gulshan, 2012).

In a similar study conducted by Khan et al. (2011) in the Khunjerab National Park it was found that 43 plant species were used to treat 29

diseases which were in an order of fever (9 spp.), followed by cough, digestive (5 spp. each), wounds, eye infection, abdominal pain, jaundice, blood pressure and diarrhea (4 spp. each) while the rest of the diseases were treated by fewer species. In every region, people have their own indigenous priorities based on the knowledge transferred from their forefathers. Many results for the treatment are similar with some variations due to ethnic differences and climatic variations. Walter and Hamilton (1993) reported that about 35,000 to 250,000 species of the plants have been used for medicinal purpose worldwide. The

indigenous knowledge of plants has been transferred from generation to generation. These plants are used to treat almost any kind of disease from headache to stomachic to cut and wound (Bhardwaj and Ghakar, 2005). Mohan et al. (2007) recorded 80 plants species belonging to 72 genera and 46 families used by the people of Tamil Nadu, India for the treatment of similar diseases as ours like diabetes, rheumatism, jaundice, fever, cold, cough and snake bite.

Age and sex wise knowledge about the medicinal plants

The results after the survey showed that the indigenous knowledge about the medicinal uses of the local plants is declining. The remaining knowledge is confined to the older folks of the area as compared to the youngsters with a percentage ratio of 80:20 and males were more knowledgeable as compared to the females with a percentage ratio of 60:40 (Figure 3A and B). The results are much similar to those of the previous studies of Qureshi et al. (2006), Khan et al. (2011), Guimbo et al. (2011) and Shedayi and Gulshan (2012). It is because of the reason that the males spend most of their time in outdoor activities and field work such as visitors, shepherds, farmers etc and are more in touch with the nature/plants as compared to the females as they are mostly confined to the household activities. The young generation has no exposure to such activities because of the technological advancements; they are more involved in electronic media and have less traditional knowledge of the nature and plants.

Form in which plants are used as medicine

Medicinal plants are collected directly from the site, dried, converted into powder or juice form and used for curing of diseases. For example, *Ephedra* spp are boiled to get juice as syrup for treatment. It was found that most of the inhabitants used plants in juice form followed by powder, paste, direct, and fumes of very few plants are used for curing diseases, as shown in Figure 4. The forms in which medicinal plants used vary from region to region due to their priorities, available resources and knowledge transferred and circumstances. While in a previous study Shedayi and Gulshan (2012) showed the results for direct (45%), paste (33%) and powder (22%). Most people use medicinal plants in direct form, some use as paste form, and few uses as powder form (Fallah et al., 2005). Paste form was used the most (38%), juice (24%), powder (20%), fresh plant parts (6%), and decoction (12%) by traditional healers in Tamil Nadu and India (Muthu et al.,

2006).

Medicinal plants used to treat livestock

There are several plant species which are used in treatment of livestock but few important plants are commonly and frequently used for treatment of livestock diseases in the study area such as *Mentha longifolia* L., *Echinops echinatus* Roxb, *Berberis lycium* Royle, *Solanum nigrum* L., *Rheum emodi* wall. ex Meissn. *Berberis lycium* is used as pain killer. It was found out that livestock such as cow, goat, sheep, donkey and horses are mostly treated by medicinal plants (Figure 5). This result shows the importance of the livestock and the care provided to them. Cow is the most beneficial livestock in the country and in Gilgit-Baltistan in particular for milk, meat and organic manure. Goat is considered the most important for its meat, milk, hair and organic manure. Sheep is used for wool, meat, milk (sometimes) and organic manure. Donkey is used for transportation and considered still valuable to carry goods and wood (fuel and timber), but is being replaced by modern transport facilities like tractor and other vehicles. Anciently, horses were considered the most important animals for transportation purpose for long distances but this has been replaced by buses, hauses, jeeps and motor cars. Still, some people keep horses to play polo (the famous game in Gilgit-Baltistan) and for recreational purposes. Horses need lots of investment, care, food and labor, that is why this animal is rarely been kept at homes. Besides all these, livestock is a major source of income for the people in the area. Many previous findings support our study such as the percentage of livestock treated as sheep (35%), buffalo (30%) goat (24%) and horse (20%) and plant species such as *Artemisia* spp., *Hippophae* spp. and *S. nigrum* used for the treatment of livestock (Shedayi and Gulshan, 2012). Oral diseases and eye disorders of livestock are treated by plants (Tapsoba and Deschamps, 2006). Eight plant species have veterinary importance to treat livestock (Teklehaymanot and Giday, 2007). Giday and Ameni (2003) reported 83 medicinal plants used to cure 37 types of livestock ailments.

Parts mostly used in medicinal purposes

Different parts used to treat different diseases are shown in the Figure 6. While in a previous study, such as Shedayi and Gulshan (2012), the results found were similar but in some cases these were different, such as whole plant used mostly (28%) while flowers some times (13%). It may be because people in different area prefer different parts according to their available circumstances

Table 3. Average score for direct matrix ranking of 7 medicinal plant species with different uses other than medicinal use.

Plants→ Uses	<i>Elaeagnus angustifolia</i> L.	<i>Artemisia maritima</i> Linn.	<i>Juniperus excelsa</i> Bieb.	<i>Medicago sativa</i> L.	<i>Thymus serpyllum</i> Linn	<i>Saussurea heteromalla</i> (D. Don) Hand.-Mazz	<i>Solanum nigrum</i> L.	<i>Planta goovata</i> L.	Total	Rank
Fodder	3	5	0	5	5	4	5	4	31	1
Fuel	5	5	5	1	0	0	0	0	16	2
Thatching	4	5	5	0	0	0	0	0	14	3
Total	5	15	10	6	5	4	5	4	-	-
Rank	4	1	2	3	4	5	4	5	-	-

and knowledge transferred from their ancestors. Underground parts were used the most, followed by leaves and aerial parts; stem and flowers were the least used plant parts (Uniyal et al., 2006).

Medicinal plants used for other purposes

Medicinal plants are also being used for other purposes by the local people, which are considered one of the major threats for the medicinal plants of the area. Many of these plants have more than one local uses (Iqbal, 2010). Among other uses of the medicinal plants, fodder for cattle, as a fuel and thatching/timber are some of the uses. Our results as shown in the Table 3 indicate that these plants are not only being used for medicinal purposes but many of these are also used for other purposes such as fodder, fuel and thatching/timber. *Artemisia maritima* Linn. ranked 1 followed by *Juniperus excelsa* Bieb as 2, *Medicago sativa* L. as 3, *Elaeagnus angustifolia* L., *Thymus serpyllum* Linn and *Solanum nigrum* L. each ranked 4 while the least used rank for the plants such as *Saussurea heteromalla* (D. Don) Hand.-Mazz and *Plantago ovata* L. were 5 each. Plants were being used as fodder for livestock ranked, followed by fuel and thatching/timber. The

results in a previous study conducted by Shedayi and Gulshan (2012) in Gahkuch show a little difference such as fuel (45%), food (44%) and vegetable (11%). People use medicinal plants as food for their animals (Shinwari and Malik, 1989). People living in the mountain of Pakistan use plants in many ways, including medicines, timber, wood, firewood, food and fodder (Hussain and Khaliq, 1996). Many woody plants have been used as medicines, timber, shelter, domestic items and fuel (Khan and Khatoon, 2007). Various medicinal plant species are also used as food (Husain et al., 2009). According to Khan et al. (2011), plant species in Khunjerab National Park have been used for food, medicine, shelter and fuel for long time. Medicinal plants are used as fodder the most in the study area, it is because all people depend on livestock for their daily requirements such milk, wool, manure, meat and commercial purposes to generate income. These animals depend on the plant species found around and ultimately the medicinal plants were used as fodder at highest rate.

The major threats to medicinal plants

During the survey we found that overgrazing by

livestock and cutting for fodder and fuel and thatching/timber are serious issues, while natural disasters such as floods and avalanches are the other threats. In the near and far future, the climate impact will be a serious threat for the ecosystem including these medicinal plants. The results shown in Figure 7 indicate the major threats to the medicinal plants in the study area. These results are much similar to our previous study by Shedayi and Gulshan (2012), such as overgrazing (45%), cutting (30%) and natural disasters (25%). This result shows that the grazing and fodder combine form 50% pressure on the medicinal plants, it is due to the huge number of live stock in the area and solely relies on the pastures and agricultural land for their food. Being the less privileged area, most of the people depend on natural resources to meet their requirements, for example they cut the trees and shrubs for fuel and thatching requirements. Due to cutting of plants, rocky area and climate change, floods and avalanches are frequent which are also destroying the natural plant resources along with other damages. Khan et al. (2011) showed great concern about the changing climate and its impact on the plant resources of Gilgit-Baltistan, while Qureshi et al. (2006) also stressed to focus on the conservation issue in this very important part of the

world, as many endemic medicinal and economic plants are found in this region. According to Tendon (1996), the Himalayan region is under pressure of urbanization and exploitation by pharmaceutical companies. The issue of vulnerability, exploration and extinction risk should be addressed pragmatically (Khan and Aslam, 2004).

Conclusion

The plant resources in this area are used to treat different diseases of humans and livestock. Asteraceae and Fabaceae are the high ranked families having most medicinal plants as compared to others. *H. rhamnoides* L., *M. longifolia* L. and *P. ovata* L. are the most popular high ranked medicinal plant species among the people in the study area while digestive disorders, respiratory disorders and rheumatic problems are the most common diseases and most of the plants are used to cure these diseases. Medicinal plants are also used for other purposes such as fodder, fuel and thatching/timber. The indigenous knowledge about plant utilization is confined only to the older male folks. Medicinal plants are severely under pressure of over grazing, cutting and climate change impacts. It is recommended that the comprehensive conservation plan should be developed to save the local medicinal plants. Strategies should also be taken to promote the indigenous and traditional knowledge about uses of these medicinal plants so that these could be saved before wipe up. Research activities should be enhanced to create awareness for the local folk and to promote knowledge to the next generation, with the integration of folk medicinal knowledge with modern health care.

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Conflict of Interest

We declare that we have no conflict of competing interest.

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