Ethnomedicine use in the war affected region of northwest Pakistan

Muhammad Adnan1†, Ihsan Ullah1†, Akash Tariq1†, Waheed Murad1, Azizullah Azizullah1, Abdul Latif Khan2 and Nawab Ali3

Abstract

Background: North-West of Pakistan is bestowed with medicinal plant resources due to diverse geographical and habitat conditions. The traditional use of plants for curing various diseases forms an important part of the region’s cultural heritage. The study was carried out to document medicinal plants used in Frontier Region (FR) Bannu, an area affected by the “War on Terror”.

Methods: Fieldwork was carried out in four different seasons (spring, autumn, summer and winter) from March 2012 to February 2013. Data on medicinal plants was collected using structured and semi-structured questionnaires from 250 respondents. The voucher specimens were collected, processed and identified following standard methods.

Results: Of the 107 species of ethnomedicinal plants reported, fifty percent species are herbaceous. The majority of the reported species were wild (55%) but a substantial proportion are cultivated (29%). For most of the plant species (34%), leaves are the most commonly used part in the preparation of ethnomedicines. The most common use of species is for carminative purposes (14 species), with the next most common use being for blood purification (11 species). The main methods used in the preparation of ethnomedicinal recipes involves grinding and boiling, and nearly all the remedies are taken orally along with ingredients such as water, milk or honey for ease of ingestion. Traditional healers prepare plant remedies using one or more plants. There was a significant correlation ($r^2 = 0.95$) between the age of local people and the number of plants known to them, which indicates that in the coming 20 years, an approximate decrease of 75% in the indigenous knowledge may be expected.

Conclusion: Traditional medicines are important to the livelihoods of rural communities in the region affected by the Global war on Terrorism. The medicinal recipes are indigenous; however, there is a threat to their future use on account of rapid modernization and terrorist activities. Documentation of medicinal plants and recipes may help in the conservation of the regional indigenous medicinal knowledge for future generations and to provide a baseline for further studies.

Keywords: Indigenous knowledge, Traditional medicines, Medicinal plants, Diseases

Introduction

Plants have been used as folk medicine all over the world for centuries [1] and indigenous communities have developed their own specific knowledge on plant resources, uses, management and conservation [2]. Ethnomedicinal treatment is not merely a medical system but part of a culture [3]. Today, around 25% of all prescribed medicines in the developed world contain ingredients derived from medicinal plants [4]. It has been estimated that herbal medicines are used by more than 80% of the world’s population in developing countries to meet their primary healthcare needs [5]. The traditional use of plants and plant resources is rapidly increasing due to their minimal side-effects and (affordable) accessibility, and because they sometimes represent the only source of healthcare available to poorer communities [6]. However, the key issue in the current era is the loss of indigenous medicinal plant...
and preparation knowledge, which can serve as a guideline on plant-based therapeutic research for many scientists around the world.

Pakistan has a diverse flora containing a total of 1,572 genera and 5,521 species, most of which are confined to the Hindukush, Himalaya and Karakorum regions [7,8]. People collect about 600 medicinal plant species as one of the major non-timber forest products (NTFPs) [9]. Of these species, 500 are commonly used in traditional healthcare practices and 350 are traded for millions of US dollars to national and international markets [10]. Twenty-eight leading herbal manufacturing units use medicinal plants for making various preparations, which include 75 crude herbal drugs that are extensively exported. About 60,000 traditional practitioners (Hakeems) in rural and remote areas utilize medicinal plants as household remedies for curing several diseases [11]. Local communities have centuries of traditional knowledge and practice relating to plants of their regions that have been transmitted from generation to generation [12]. About 84% of the country's population was dependent on traditional medicines in the early 1950's [13]; however, the practice is now confined to remote areas [14].

This study has been carried out in the Frontier Region (FR) Bannu, which has suffered heavily due following the onset of the Global War on Terrorism. Various ethnomedicinal studies have been carried out [12,15-18] in other regions of Pakistan; however, the FR has yet to be explored due to limited access. The area represents one of the country's richest centers of biodiversity and it is a strong source of indigenous knowledge. Most of the population of the area is rural with a low literacy rate; hence they are more dependent upon natural resources, and especially on plants for their healthcare needs and livelihoods. War has crippled modern health facilities in the study area, which in turn has resulted in the spreading of gastrointestinal and skin related diseases among others. However, local people are increasingly using ethnomedicines to treat such diseases at the local level. Shinwari et al. [12] perceived a diminishing of indigenous knowledge due to the ever increasing influence of global commercialization and socio-economic transformation, and a dire need was expressed to preserve such knowledge on medicinal plants before it disappears. Hence, the present study was designed with the following objectives: (i) to identify and explore plant species that are being used locally for the treatment and prevention of various diseases; (ii) to document traditional recipes from medicinal plants including methods of preparation and modes of administration; and (iii) to investigate the current and future status of traditional knowledge among different age groups. The present study may help in the preservation of indigenous knowledge on ethnomedicines and provide baseline data for future studies.

Materials and methods

Study area

The present study was carried out in the Frontier Region (FR) Bannu located in the south of Khyber Pakhtunkhwa (KPK) Province, Pakistan (Figure 1). FR-Bannu consists of a total area of 877 square kilometers with a population of 19,593. The area lies within the Karakoram mountain range [19] between 32°-43 to 33°-06 N latitude and 73°-20 to 70°-07 E longitude. The total cultivated area is about 33,000 acres, with wheat, maize and sugarcane being the main cultivated crops [20]. About 25% of the inhabitants of the area as well as Afghan refugees are engaged in the collection and marketing of medicinal plants [20]. The area consists of alluvial plain with an annual rainfall of 111.36 mm [21]. The dominant plant species are _Acacia modesta, Acacia nilotica, Calotropis procera, Dodonaea viscosa_ and _Withania somnifera_.

Sampling

Ethnomedicinal data was collected in four field visits per season in spring, autumn, summer and winter from March 2012 to February 2013. The methods for the collection of data and voucher specimens during the field study followed that described by Martin [22]. Initially, local administrative officers and representatives (Malik) of the study area were visited, who provided information on key resource persons in the field of medicinal plants. The key persons then suggested 269 potential respondents (local healers, rural herbalists and elders), all of whom were known in the community for their knowledge on medicinal plants and ethnomedicines. Prior to data collection, a brief group discussion was held with the respondents in order to gain their consent, to explain objectives of the research study and to assure them protection of their traditional knowledge. This was done to clarify the purpose of the research and to build confidence among respondents so that they would provide reliable information without holding any suspicion. Among the respondents, 19 were reluctant to provide any information leaving a total of 250 respondents being selected for data collection.

The biographic characteristics of the respondents in this study include age, gender and ethnic group. Of the 250 respondents, 201 were male and 49 female, and all belonged to one of three ethnic groups (Wazir, Banuchi or Afghan refugees). Due to customary restrictions in the study area, it was difficult to identify and gain access to a large number of females with knowledge on medicinal plants. The majority of the respondents were aged between 35 and 90 years and most (133) were Waziri, the largest ethnic group of the study area (Table 1). All the respondents and focal persons of the study area provided permission to publish and protect the data on traditional medicines provided by them.
Identification of medicinal plants used as ethnomedicines

Structured and semi-structured questionnaires were designed for data collection. For this purpose, individual interviews were held with each respondent in the local language of Pashto, which is spoken by all ethnic groups in the study area. More structured questionnaires were used to obtain specific information about medicinal plants of the study area, and informants were asked about the number of plants known to them, their local names, life-form, medicinal uses, occurrence, plant status and the most preferred part used for treatment [23]. Plant life-form implied herb, shrub or tree. Plant use referred to the use of either part of the plant or several parts and were categorized accordingly as whole plant, leaves, roots, bark, flowers, seeds, shoots, rhizomes and fruits. Plant status referred to the classification of plants across three categories, i.e. wild or cultivated or both.

Specimens of recorded medicinal plants were collected in their flowering and fruiting seasons during field visits and were processed in the laboratory using normal methods [22,24]. Specimens were identified with the help of a plant taxonomist in the Department of Botany, Kohat University of Science and Technology (KUST). Following plant identification, specimens were pressed and dried in blotting sheets. Before mounting on the herbarium sheets, the plants were treated either with formaldehyde or mercuric chloride solution (0.5%) in order to protect plant material from insect or fungal damage. The scientific names, family names and names of publication authors were corrected according to the flora of Pakistan and software index kewensis [8,25]. Identified plant specimens on herbarium sheets were placed in the herbarium at KUST.

Table 1 Age groups, number of interviews and male to female ratio of various ethnicities

| Age groups | No. of interviews | Wazir (Male, female) | Banucli (Male, female) | Afghan refugees (Male, female) |
|------------|-------------------|----------------------|------------------------|-------------------------------|
| 11-20      | 7                 | 4 (4, 0)             | 2 (2, 0)               | 1 (1,0)                       |
| 21-30      | 10                | 5 (5, 0)             | 3 (3, 0)               | 2 (2,0)                       |
| 31-40      | 18                | 9 (7, 2)             | 6 (5, 1)               | 3 (2, 1)                      |
| 41-50      | 30                | 17 (14, 3)           | 8 (7, 1)               | 5 (3, 2)                      |
| 51-60      | 52                | 30 (26, 4)           | 15 (12, 3)             | 7 (5, 2)                      |
| 61-70      | 60                | 36 (31, 5)           | 16 (10, 6)             | 8 (6, 2)                      |
| 71-80      | 43                | 22 (19, 3)           | 17 (12, 5)             | 4 (4, 0)                      |
| 81-90      | 30                | 10 (7, 3)            | 12 (9, 3)              | 8 (5, 3)                      |
| Total      | 250               | 133 (113, 20)        | 79 (60,19)             | 38 (28,10)                    |

Figure 1 Map of the study area.
Documentation of ethnomedicinal recipes
Semi-structured questionnaires were used to gather information on the mode of preparation and administration as well as information on typical compliments used with the ethnomedicines. The ailments treated were grouped into 21 types including febrifuge, carminative, stomach problems and chest infections among others. Questions on ethnomedicines inquired on modes of preparation (powder, boiled etc.), administration (oral or dermal), use of single or mixture of plants, ease of intake and other ingredients used such as water, sugar, milk and others. All the data collected through structured and semi-structured questionnaires were organized using Microsoft Excel.

Traditional knowledge and associated threats
Correlation between the age of the respondents and the number of medicinal plants known to them was analyzed using Pearson Correlation in SPSS [26]. Moreover, a conceptual diagram was developed in which the age groups in possession of indigenous knowledge were categorized and displayed showing current numbers (2013) and predicted numbers for 2023 and 2033. Data on the current status of indigenous knowledge was gathered during the present study while data for the next 10 and 20 years were predicted on the basis of a study by Shinwari [12], who predicted a 50% decline in indigenous medicinal plant knowledge among rural people for every 10 years due to modernization.

Results and discussion
The present study has recorded valuable ethnomedicinal knowledge from an area almost inaccessible due to the current armed conflict. Indigenous people from different localities have their own specific knowledge on the traditional utilization of medicinal plants [2] and our study highlights certain threats related to the disappearance of such knowledge. Medicinal plants represent a significant contribution to human health and it has been suggested that their use is one of the most significant ways in which humans directly reap the benefits provided from biodiversity [27].

Medicinal plants of the study area
In the war affected region of Pakistan, the use of folk remedies is a common practice and locals are highly dependent on the native flora for their healthcare needs. The inhabitants of the region use 107 plant species distributed across 90 genera and 56 families for the treatment of various ailments (Table 2). Such widespread use of medicinal plants for primary healthcare needs in the study area might be due to the lack of health facilities as a result of both increased armed conflict as well as cultural beliefs of the people who use ethnomedicines in the rural areas.

Figure 2 shows that herbs (53) and trees (32) are the most common life-form of the plants described by healers as having medicinal properties. The higher use of herbs for medicinal purposes in the study area may be due to their ease of collection, higher abundance and high effectiveness in the treatment of ailments in comparison to other life-forms [9], while in other regions it may also be due to seasonal variability or differences in socio-cultural beliefs and practices of healers. With regard to trees, their extensive use in the preparation of ethnomedicines might be linked to their ability to withstand long dry seasons, thus resulting in their availability throughout the year in arid and semi-arid areas [28].

Results indicate that most of the study plants (55%) are collected from the wild to treat different diseases (Table 2). The basic reason behind using wild plants may be due to three reasons: i) The inhabitants of the region are not very well off; ii) In the current situation of war they are heavily dependent on medicinal plants; or iii) Such species are readily available at minimum cost near households as compared to cultivated plants. Giday and Tilahun [29] also found that in Ethiopia the use of wild plants is more common than the use of cultivated plants, and people also use wild medicinal plants for economic purposes. As a result, in our study area, economically valuable species such as Caralluma tuberculata and Nannorrhops ritchiana [30] which have the potential to be cultivated [20] for ecological restoration and rural livelihood are under threat due to over-collection.

Ethnomedicinal uses
The majority of plant species reported in the study area were used for carminative (14), blood purifying (11) or febrifuge (9) purposes, and each of the 8 species were used to treat stomach or chest problems (Figure 3). These findings are in line with other ethnobotanical studies [9,31], where most plant species were reported to be used for the treatment of chest, fever or gastro-intestinal related diseases. Such diseases may have been recently exacerbated due to the increasing armed conflict and lack of security in the area, a lack of proper sanitation, or because of wood-fuel smoke inside houses. Moreover, the majority of people in the study have little or no access to safe drinking water, which may have increased the prevalence of waterborne diseases [32]. Gastrointestinal problems are not only common in the study area but are a common issue for the whole country. According to Ribeiro et al. [33], such diseases can result in higher mortality rates if not treated promptly. Results of the field surveys indicate that Acacia nilotica, Caralluma tuberculata, Convolvulus arvensis, Nannorrhops ritchiana, Withania somnifera and some other species are used for the treatment of more
| Serial no. | Botanical names | Family          | Local names | Life form | Part used | Plant occurrence status | Medicinal uses | Recipes |
|-----------|-----------------|-----------------|-------------|-----------|-----------|------------------------|----------------|---------|
| 1         | *Acacia arabica* (Lam.) Willd. | Mimosaceae | Kekar | Tree | Bark | Wild | Wound healing | Dermal use of the wood ash on wounds. |
| 2         | *Acacia modesta* Wall. | Mimosaceae | Palosa | Tree | Leaves | Wild | Tonic, stimulant | Powdered leaves or gum are taken orally at the rate of one teaspoon with milk to get instant energy. Also useful as a sex tonic. |
| 3         | *Acacia nilotica* (L.) Delile | Mimosaceae | Kekkar | Tree | Shoots | Wild | Carminative, Increase the sperm flow | Grind the newly born shoots along with some condiments (zeera) and pomegranate flowers, and use orally as carminative for infants. |
| 4         | *Allium sativum* L. | Amaryllidaceae | Ezzha | Herb | Fruit | Cultivated | Decrease cholesterol, Bones disorders | 3-5 pieces of garlic are taken orally on a daily basis to decrease the cholesterol level. Ground garlic with butter is used dermally for bone pains. |
| 5         | *Aloe barbadensis* Mill. | Asparagaceae | Zargaya | Shrub | Leaves | Wild | Wound healing | Cut the leaf and add powdered *Curcuma longa* for dermal use on wounds. |
| 6         | *Amaranthus viridis* L. | Amaranthaceae | Unknown | Herb | Leaves | Wild | Emollient | A decoction of the leaves is used dermally as an emollient and for inflammation. Root juice is also used for the same purpose. |
| 7         | *Ampelodesmos mauritanicus* (Poir.) T. Durand & Schinz | Poaceae | Khaas | Herb | Leaves | Wild | Vermicides | Leaves boiled in water and used orally. |
| 8         | *Artemisia maritima* L. | Asteraceae | Jhaan | Herb | Flowers | Wild | Vermicides | Grind the dried florets or flowers and take 1–2 teaspoons orally for intestinal worms. |
| 9         | *Arundo donax* L. | Poaceae | Kalam | Herb | Rhizome | Wild | Diuretic | Burn the underground part. The resultant ash is boiled with water, which is filtered then for oral uptake. |
| 10        | *Asparagus adscendens* Roxb. | Asparagaceae | Unknown | Herb | Rhizome | Wild | Carminative, Demulcent | Grind roots and make powder. Take this powder orally at the rate of one teaspoon. |
| 11        | *Bambusa bambos* (L.) Voss | Poaceae | Baanss | Herb | Leaves | Cultivated | Expectorant | Extract the juice from the leaves and take orally along with honey. |
| 12        | *Bauhinia variegata* L. | Papilionaceae | Kachnaal | Tree | Flowers | Cultivated | Carminative | Grind the dried flowers for oral uptake. |
| 13        | *Brassica oleracea* L. | Brassicaceae | Gobee | Herb | Leaves | Cultivated | Vegetable, arthritis | Boil the leaves in water till it becomes greasy for dermal use on arthritis. |
| 14        | *Brassica rapa* L. | Brassicaceae | Shaljam | Herb | Whole plant | Cultivated | Blood purifier, appetizer, | Make as a pickle for an appetizer. Cook it as a vegetable, which helps in blood purification. |
| 15        | *Bryophyllum pinnatum* (Lam.) Oken | Crassulaceae | Zakhm-hayat | Shrub | Whole plant | Wild/cultivated | Vermicide | Boil 10 grams of the plant in water and grind. Orally taken for 7 days on an empty stomach to kill the intestinal worms. |
| No. | Plant Name                          | Family       | Part Used      | Origin          | Use                        | Method describe                                                                 |
|-----|------------------------------------|--------------|----------------|-----------------|----------------------------|--------------------------------------------------------------------------------|
| 16  | Calotropis procera (Aiton) Dryand  | Apocynaceae  | Spalmaka Shrub | Milky extract   | Wild Dermatitis, antiseptic | Cut into portions to secrete the milky juice, which is used dermally for the curing dermatitis. Also used as an antiseptic. |
| 17  | Cannabis sativa L.                 | Cannabaceae  | Bhaang Shrub   | Seeds, leaves   | Wild/cultivated Analgesic  | Boil leaves and seeds in water and then spray the water dermally on painful areas. |
| 18  | Capparis aphylla. Roth, Nov.       | Capparaceae  | Karrir Tree    | Wood            | Wild Low back pain         | Smolder the wood to charcoal, add 2–3 gram of this charcoal into the cooking oil to make a paste that is used dermally for back pain. |
| 19  | Caralluma tuberculata N.E.Br.      | Apocynaceae  | Pawoona Shrub  | Whole plant     | Wild Anti-diabetic, decrease cholesterol. | Cook it like a vegetable that is taken orally for diabetes treatment. Also, eat directly as a salad for slimming and for diabetic purposes. |
| 20  | Cassia fistula L.                  | Caesalpiniaceae | Garda nail Tree | Fruits, leaves | Cultivated Febrifuge, Purgative | Boil leaves and flowers as vegetables. Eat 2–4 fruits over 3 days for constipation. |
| 21  | Centaurea solstitialis L.          | Asteraceae   | Barham dandi   | Herb Whole plant | Wild Febrifuge             | 2 spoons of powdered form are taken orally with water 3 times a day for 3 days. |
| 22  | Chirita asperifolia (Blume) B.L.Burtt | Gesneriaceae | Cherita Herb | Leaves, flowers | Wild Febrifuge             | Take 25 grams of aerial part and boil it like green tea for reducing fever. |
| 23  | Chenopodium album L.               | Amaranthaceae | Surma Herb | Leaves, root    | Wild Laxative, Jaundice and urinary diseases | Extract the juice from their leaves, which is taken orally as a laxative. |
| 24  | Chenopodium ambrosioides L.        | Amaranthaceae | Unknown Herb | Fruits          | Wild Dyspepsia              | The dried ripe fruits are crushed into powder form, which is taken orally with water. |
| 25  | Cicer arietinum L.                 | Papilionaceae | Chana Herb | Fruits or grains | Cultivated Ethno veterinary, skin itching | Grind their grains and massage this flour dermally on the itching places. Also used for ethno-veterinary purposes. |
| 26  | Cichorium intybus L.               | Asteraceae   | Bhangara Herb | Whole plant     | Wild Carminative            | The whole plant is used for carminative purposes. |
| 27  | Citrullus colocynthis (L.) Schrad  | Cucurbitaceae | Indrine Herb | Whole plant     | Wild Arthritis, head ache   | Cook the plant or fruit in olive oil and massage into joints or head. |
| 28  | Convolvulus arvensis L.            | Convolvulaceae | Parvateeye Herb | Root            | Wild Purgative              | Dried roots are grinded for oral uptake of 1–2 spoons. |
| 29  | Cordia gharaf Ehrenb. ex Asch.     | Boraginaceae | Lasora Tree   | Fruit           | Wild/cultivated Asthma, expectorant | Dried fruits are used orally for the treatment of several diseases. |
| 30  | Coriandrum sativum L.              | Apiaceae     | Dhania Herb   | Leaves          | Cultivated Carminative      | Roast their leaves and take with water orally. |
| No. | Latin Name               | Family     | Common Name | Type    | Use                  | Preparation                                                                                           |
|-----|-------------------------|------------|-------------|---------|----------------------|-------------------------------------------------------------------------------------------------------|
| 31  | Cucumis sativus L.      | Cucurbitaceae | Kera        | Herb    | Fruit                | Cultivated                                                                                           |
|     |                         |            |             |         |                      | Dermal use of ground fruit on the lower part of the foot to treat fever. Also good for digestion.       |
| 32  | Curcuma longa L.        | Zingiberaceae | Kurkaman    | Shrub   | Rhizome              | Cultivated                                                                                           |
|     |                         |            |             |         |                      | Analgesic, Flu and nasal congestion                                                                  |
|     |                         |            |             |         |                      | Powder form of ground rhizome mixed with lime and dermally used on the painful area.                   |
|     |                         |            |             |         |                      | Put powder form on the burning coal and inhale the smoke to instantly relieve nasal congestion.       |
| 33  | Cuscuta reflexa Roxb.   | Convolvulaceae | Akas bail   | Herb    | Whole plant          | Wild                                                                                                 |
|     |                         |            |             |         |                      | Wound healing, analgesic                                                                               |
|     |                         |            |             |         |                      | Grind the plant in an adequate amount and cook it in the oil for dermal use on wounds.                |
| 34  | Cymbopogon schoenanthus (L.) Spreng. | Poaceae | Kana        | Herb    | Whole plant          | Wild                                                                                                 |
|     |                         |            |             |         |                      | Dysentery, vermicides                                                                                |
|     |                         |            |             |         |                      | Boil the leaves in water and the juice is taken orally as a vermicide.                                |
| 35  | Cymbopogon citratus (DC.) Stapf | Poaceae | Lemon grass | Herb    | Leaves               | Wild/cultivated                                                                                     |
|     |                         |            |             |         |                      | Febrifuge, Flu                                                                                       |
|     |                         |            |             |         |                      | Boil the leaves in water for 5 minutes and add water to the milk for oral use.                        |
| 36  | Cynodon dactylon var.oursii (A. Camus) J.R. Harlan & de Wet | Poaceae | Ovshoo      | Herb    | Whole plant          | Wild                                                                                                 |
|     |                         |            |             |         |                      | Smallpox, bloody piles                                                                              |
|     |                         |            |             |         |                      | Grind it along with Curcuma longa and rice. Use the mixture for smallpox. For piles treatment, grind it with Cannabis sativa leaves, add milk and use orally 2 times a day. |
| 37  | Dalbergia sissoo DC.    | Papilionaceae | Sheesham    | Tree    | Leaves               | Wild/cultivated                                                                                     |
|     |                         |            |             |         |                      | Mental disorder                                                                                      |
|     |                         |            |             |         |                      | Take 10 g leaves, add 3 pieces of black pepper and grind for oral use.                               |
| 38  | Datura stramonium L.    | Solanaceae | Dhatoora    | Herb    | Roots, seeds         | Wild                                                                                                 |
|     |                         |            |             |         |                      | Asthma, expectorant                                                                                  |
|     |                         |            |             |         |                      | Roast the leaves and inhale the smoke for asthma. Seeds are used as expectorant. Excess use can be lethal. |
| 39  | Digera muricata (L.) Mart. | Amaranthaceae | Unknown    | Herb    | Leaves, shoots       | Wild                                                                                                 |
|     |                         |            |             |         |                      | Urinary tract infection                                                                              |
|     |                         |            |             |         |                      | Leaves and shoots are taken orally as a vegetable to treat urinary tract infection.                   |
| 40  | Dodonaea viscosa Jacq.  | Sapindaceae | Sanatha     | Shrub   | Leaves               | Wild/cultivated                                                                                     |
|     |                         |            |             |         |                      | Rheumatism, swelling and burns                                                                       |
|     |                         |            |             |         |                      | Grind the leaves and add small amount of water to make fine paste for dermal use.                     |
| 41  | Echinops echinatus Roxb. | Asteraceae | Ont katara  | Herb    | Roots                | Wild                                                                                                 |
|     |                         |            |             |         |                      | Liver disease                                                                                        |
|     |                         |            |             |         |                      | Root is mixed with vinegar to make tea for oral use.                                                  |
| 42  | Eriobotrya japonica (Thunb.) Lindl. | Rosaceae | Alokaat     | Tree    | Fruits               | Cultivated                                                                                           |
|     |                         |            |             |         |                      | Produce the fresh blood, stop the bleeding                                                            |
|     |                         |            |             |         |                      | Take simply their fruits orally for management of several diseases.                                  |
| 43  | Eugenia jambolana Lam.  | Myrtaceae  | Jaman       | Tree    | Fruits, seeds        | Cultivated                                                                                           |
|     |                         |            |             |         |                      | Antidiabetic, stomach problems                                                                       |
|     |                         |            |             |         |                      | For stomach problems, grind the dried non-edible portion of fruits for oral uptake at a rate of 1–2 spoons daily for 3 days. Powder is also used for the treatment of diabetics. |
| No. | Plant Name                        | Family          | Common Name    | Type        | Origin       | Uses                                         | Applications                                                                 |
|-----|----------------------------------|-----------------|----------------|-------------|--------------|------------------------------------------------|-------------------------------------------------------------------------------|
| 44  | Euphorbia helioscopia L.         | Euphorbiaceae   | Purporai Herb  | Shoot       | Wild         | Skin disease                                   | Grind the dried shoots to powder for dermal use on the skin.                 |
| 45  | Euphorbia hirta L.              | Euphorbiaceae   | Unknown Herb   | Whole plant | Wild         | Carminative, expectorant                      | Extract of milky juice is used orally for infants for both diseases.         |
| 46  | Euphorbia tirucalli L.          | Euphorbiaceae   | Tohaar Tree/   | Tree/shrub  | Extract      | Piles treatment                                | Extract their juice, add flour to it and make small tablets for oral use.    |
| 47  | Fagonia arabica L.              | Zygophyllaceae  | Dhamsa Shrub   | Whole plant | Wild         | Febrifuge, expectorant                        | Paste it with dried grapes and boil the mixture in order to make a tea for oral use. |
| 48  | Fagonia cretica L.              | Zygophyllaceae  | Spelaghzai Herb| Whole plant | Wild         | Cooling agent, scabies treatment              | Grind the whole plant in water and filter it to remove the solid contents and then take 1 glass of it orally. |
| 49  | Fagonia indica Burm.f.          | Zygophyllaceae  | Spelaghzai Herb| Whole plant | Wild         | Purgative                                      | Grind the whole plant and take 2–3 spoons orally for purgative purposes.    |
| 50  | Ficus carica L.                 | Moraceae        | Barrh Tree     | Leaves      | Wild         | Wound healing                                  | Burn the leaves and the ash is sprayed on the wounds dermally.              |
| 51  | Ficus elastica Roxb. ex Hornem. | Moraceae        | Unknown Tree   | Leaves      | Cultivated   | Wound healing                                  | Bark decoction is generally used for wound healing effect.                  |
| 52  | Ficus religiosa L.              | Moraceae        | Peppal Tree    | Bark, leaves| Cultivated   | Stomach problems, wounds healing               | Burn the bark and make powder from it. Take 5 grams of it orally with water for diarrhea; leaves are used for wound healing. |
| 53  | Fumaria indica (Hausskn.) Pugsley| Papaveraceae    | Pith-panra Herb| Whole plant | Wild         | Blood purifier, Febrifuge                      | Extract their juice and take orally for purification of blood. Its tea is used for fever. |
| 54  | Grewia asiatica L.              | Malvaceae       | Falsa Tree     | Fruits      | Wild/cultivated| Diabetics, cooling agent                      | Simply eat their fruits to help diabetics. Also provide cooling sensation. |
| 55  | Justicia adhatoda L.            | Acanthaceae     | Unknown Shrub  | Leaves      | Wild         | Rheumatism, stomachache                       | Grind the leaves and mix it with honey. The paste is used dermally around the swelling. |
| 56  | Lactuca sativa L.               | Asteraceae      | Salad Herb     | Leaves      | Cultivated   | Blood purifier                                 | Simply use as a salad for blood purification.                               |
| 57  | Lallemantia royleana Benth.     | Lamiaceae       | Balango Herb   | Seeds       | Wild         | Sexual purposes, carminative                  | Eat seeds up to 2–5 gram to increase sperm capability. Also used as carminative. |
| 58  | Lawsonia alba Lam.              | Lythraceae      | Mehndi ka poda | Tree Flowers| Cultivated   | Sexual purpose                                 | Cooking of the flowers along with meat is useful in increasing sexual power. |
| 59  | Melia azedarach L.              | Meliaceae       | Bankara Tree   | Seeds       | Wild/cultivated| Piles treatment                               | Eat seed's internal portion of 2–3 seeds only, but do not exceed as they may be lethal. |
| No. | Common Name          | Family       | Scientific Name | Type       | Part(s) Description      | Use(s)                      |
|-----|---------------------|--------------|-----------------|------------|--------------------------|-----------------------------|
| 60  | Mentha piperita L.  | Lamiaceae    | Podina Herb     | Leaves    | Cultivated, Carminative  | Make tea from their leaves and use orally 4–5 times a day. |
| 61  | Mirabilis jalapa L. | Nyctaginaceae| Gul-e-abassi Herb| Root, flowers | Wild, Wild | Piles treatment, blood purifier and sexual purpose | Their roots are cooked with meat to increase sperm production and blood purification. Powdered flowers are used orally for piles treatment. |
| 62  | Momordica charantia | Cucurbitaceae| Karela Shrub    | Leaves    | Cultivated, Vegetable, diabetics and hepatitis | As a vegetable, it's useful for diabetics and hepatitis. |
| 63  | Monotheca buxifolia (Falc.) A. DC. | Sapotaceae | Gurgura Tree Fruits, leaves | Wild/ Cultivated | Purgative, Refrigerant | Make juice of their parts and use orally as a purgative and cooling agent. |
| 64  | Moringa oleifera Lam. | Moringaceae | Sohanjna Tree | Root | Cultivated, Kidney-stone, vermicides | Cut their roots and boil in water. Add milk and drink for kidney stones and worms. |
| 65  | Morus alba L.       | Moraceae     | Shah –toot Tree | Fruits    | Cultivated, Heart, Liver tonic | Eat their fruits, which provide the energy to the heart and liver. |
| 66  | Morus nigra L.      | Moraceae     | Tooth-siah Tree | Leaves, root | Wild/ Cultivated, Analgesic | Boil their leaves and roots in order to make tea for oral use. |
| 67  | Musa acuminata Colla. | Musaceae     | Kela Tree | Fruit | Cultivated, Menstruation, antidiabetic | Juice of the fruit is mixed in yogurt for oral uptake during menstruation. In antidiabetic case, roast and powder the flower for oral use. |
| 68  | Nannorrhops ritchiana (Griff.) Aitch. | Arecaceae | Mazara Shrub | Leaves | Wild, Wild | Carminative, veterinary | Mostly their leaves are used to boil. The juice is then used orally. |
| 69  | Nerium oleander L.  | Apocynaceae  | Kanir Shrub | Roots | Cultivated, Sexual purpose, strengthen the penis | Cut the root into small pieces and then boil along with milk and pour into the thin cloth and extract like butter for oral use in adequate amounts for sexual purposes. |
| 70  | Nyctanthes arbor-tristis L. | Oleaceae | Haar singhar Shrub | Flowers | Wild/cultivated | Cough, antipyretic | Take 6 fresh leaves and grind in water with half a gram of ginger and take orally. |
| 71  | Ocimum basilicum L.  | Lamiaceae    | Takhm-rehan Herb | Seeds | Wild | Blood purifier | Place the seeds in water to soften and enlarge, then take orally. |
| 72  | Olea ferruginea (Sol.) Steud. | Oleaceae | Zaiton Shrub | Whole plant | Wild | Toothache, antidiabetic | Make powder of it and then take 1 teaspoon for 45 days orally on an empty stomach, which is helpful in uncontrolled diabetics. |
| No. | Species                  | Family       | Common Name | Part Used | Growth Habit | Use                          | Preparation                                                                 |
|-----|-------------------------|--------------|-------------|-----------|--------------|------------------------------|----------------------------------------------------------------------------|
| 73  | *Opuntia triacantha* (Willd.) Sweet | Cactaceae    | Zaqqoom     | Leaves    | Wild         | Dermatitis                   | Extract their mucilaginous material, which is found in between leaves. Add cooking oil, make a paste and use dermally. |
| 74  | *Oxalis corniculata* L. | Oxilidaceae  | Tarookay    | Leaves, root | Wild         | Stomach, wound healing and Anthelmintic | Extract juice from fresh leaves and use orally against stomach troubles. Leaves are used as vegetables. Crushed leaves are dermally used on wounds. Decoction of root is anthelmintic. |
| 75  | *Papaver somniferum* L. | Papaveraceae | Opium       | Shrub     | Wild/ Cultivated | Analgesic, narcotics         | Boil the water and add the extract of opium to it and take 1–2 spoons orally of this syrup. |
| 76  | *Peganum harmala* L. | Zygophyllaceae | Spelaanee   | Seeds     | Wild         | Psycho-spiritual purposes    | Put it on burning coal in order to produce smoke, which is used locally to repel evils. |
| 77  | *Pennisetum americanum* (L.) Leeke | Poaceae      | Bajra       | Grain     | Cultivated   | Carminative                  | Tie the grains in the piece of cloth, heat it and place in the abdominal region to combat pain. |
| 78  | *Periploca aphylla* Decne. | Asclepiadaceae | Baradda     | Shoots    | Wild         | Tumors, swellings            | Generally their milky juice is extracted and then used dermally for tumors. |
| 79  | *Phoenix dactylifera* L. | Arecaceae    | Khajor      | Tree      | Wild/ Cultivated | Stomach, liver tonic and carminative | Ripened fruit is useful for liver and stomach. Seeds are crushed to make a powder, which is used orally as a carminative. |
| 80  | *Plantago major* L. | Plantaginaceae | Barthang    | Herb      | Leaves       | Dental pain                  | Boil leaves in water and make tea. Cool and wash the mouth. |
| 81  | *Portulaca oleracea* L. | Portulacaceae | Kulfa-ssag  | Herb      | Leaves       | Antidiabetic                 | Cook like a vegetable. Do not heat it too much. The color must remain light green. |
| 82  | *Psidium guajava* L. | Myrtaceae    | Amrood      | Tree      | Cultivated   | Purgative                    | Whole fruit is eaten simply as a purgative. |
| 83  | *Punica granatum* L. | Lythraceae   | Anar        | Tree      | Cultivated   | Febrifuge, vermicide          | Grind the fruit and orally take 1 spoon 2–3 times a day to kill intestinal germs. For fever, make pomegranate juice, add a little opium, then add sugar for and take orally. |
| 84  | *Raphanus sativus* L. | Brassicaceae | Mooly       | Whole plant | Cultivated   | Stomach problems, break the kidney stone and hepatitis | Eating simply is helpful in digestion and for the treatment of kidney stones. Boil their leaves in water and add sugar for oral uptake to treat hepatitis. |
| No. | Plant Name                  | Family       | Common Name | Part Used | Source    | Use                             |
|-----|----------------------------|--------------|-------------|-----------|----------|---------------------------------|
| 85  | Rhazya stricta Decne.      | Apocynaceae  | Ghandaryee  | Shrub     | Wild     | Analgesic                       |
|     |                            |              |             | Root      |          | Boil roots in water for 10 minutes and cool. Wash teeth with this for pain relief. |
| 86  | Ricinus communis L.         | Euphorbiaceae| Arand       | Shrub     | Wild     | Analgesic                       |
|     |                            |              |             | Fruits,  |          | Heat the leaves and fruits for the release of oil, which is spread on the desired place. |
|     |                            |              |             | leaves    |          |                                 |
| 87  | Saccharum officinarum L.    | Poaceae      | Gana        | Shrub     | Cultivated | Strengthen the teeth’s, blood purifier and expectorant |
|     |                            |              |             | Fruit     |          | Remove the upper portion and then cut down into small pieces and chew, which strengthens the teeth and cures others diseases. |
| 88  | Salvadora persica L.        | Salvadoraceae| Miswak Tree | Shrub     | Wild/ Cultivated | Blood purifier |
|     |                            |              |             | Bark      |          | Bark is commonly used as a purifying agent. |
| 89  | Salvia aegyptiaca L.        | Lamiaceae    | Balango     | Herb      | Wild     | Sexual purpose, male fertility   |
|     |                            |              |             | Small     |          | Eat directly. Small grains increase sperm count and thicken the sexual fluid. Also used for the treatment of infertile parents. |
|     |                            |              |             | grains    |          |                                 |
| 90  | Silybum marianum (L.) Gaertn.| Asteraceae   | Ont katara  | Herb      | Wild     | Liver disease, carminative       |
|     |                            |              |             | Whole     |          | Cut the roots, add vinegar and make tea, which is used orally for liver disease and for carminative purposes. Cut the roots and add vinegar in order to make pickle. |
|     |                            |              |             | plant     |          |                                 |
| 91  | Sisymbrium iria L.          | Brassicaceae | Kharkasai   | Herb      | Wild     | Febrifuge, expectorant          |
|     |                            |              |             | Seeds     |          | Seeds are used as an expectorant and used externally as a stimulating poultice. Seeds also used orally to reduce fever. |
| 92  | Sisymbrium officinale (L.) Scop.| Brassicaceae | Khob-kalah  | Herb      | Wild     | Febrifuge, expectorant          |
|     |                            |              |             | Whole     |          | Dry the plant into powder form, which is used orally for typhoid fever. |
|     |                            |              |             | plant     |          |                                 |
| 93  | Solanum nigrum L.          | Solanaceae   | Makko       | Shrub     | Wild     | Cancer treatment, sedative       |
|     |                            |              |             | Leaves,   |          | Grind the leaves and add maize flour in equal quantity and mix both for oral treatment in the case of cancer treatment. Boil roots in water for making tea and use as a sedative. |
|     |                            |              |             | Root      |          |                                 |
| 94  | Solanum pseudocapsicum L.   | Solanaceae   | Kuty lala   | Herb      | Wild     | Arthritis                        |
|     |                            |              |             | Leaves    |          | Grind leaves and make a paste. Put on joints for the treatment of arthritis. |
| 95  | Solanum surattense Burm. f.| Solanaceae   | Maraghareye | Herb      | Wild     | Foot cracks                      |
|     |                            |              |             | Fruits    |          | Cut fruits into two pieces, and massage on the foot cracks. |
| 96  | Spinacia oleracea L.        | Amaranthaceae| Palak       | Shrub     | Cultivated | Cooling agent                    |
|     |                            |              |             | Leaves    |          | Boil 5–8 leaves in water and take orally for calming the stomach. |
| 97  | Tamarix aphylla (L.) H. Karst.| Tamaricaceae | Ghazz       | Tree      | Wild     | Smallpox, flatulence             |
|     |                            |              |             | Leaves    |          | Simply burn the leaves and take their decoction for the treatment of smallpox. |
than one type of ailment. Our findings are in line with the ethnobotanical studies carried out by Badshah and Hussain [34] and Khan [35], who also reported various medicinal uses for the aforementioned plants. The multiple uses for each plant serve as a strong indicator of the natural availability of a variety of therapeutic phytochemicals within the plants, and such findings may prompt further research into their medicinal application.

All parts of medicinal plants - including the leaves, stem, flower, bark, roots, fruits and seeds are used by traditional healers and local people, but the part of the plant collected for each specific purpose depends on the requirements of the user and type of plant. Figure 4 shows that 34% of plants were used for their leaves in the making of various products.
medicinal preparations, which is easy to process into a digestible paste and have less conservational issues than the collection of roots, bark, stem or the whole plant [36]. The predominance of leaf use in the preparation of remedies has also been reported by Muthu et al. [37] and Kala et al. [38] and similar results have been reported from other areas of Pakistan [35,39,40].

Drying and pulverizing into powder, boiling for tea, juicing and pounding into a paste are the common preparation methods observed for our study area (Table 2). According to Deeba [41], grinding or crushing and boiling are the most common and effective methods of active ingredient extraction. While the majority of preparations of remedies in our study area involved the use of single plant, some of the remedies were prepared by combining different plants, for example, the powder of *Acacia nilotica* is mixed with the flowers of *Punica granatum* to be used for carminative purposes. Similarly, a mixture of leaves of *Aloe barbadensis* with the powder form of *Curcuma longa* is used to treat wounds, while the whole plant of *Cynodon dactylon* is mixed with leaves of *Cannabis sativa* and ground to powder for use against bleeding piles. According to traditional healers, complex medicines of two or more plant species are more potent than those prepared with a single species. The use of multiple therapies in traditional medicine based on combining plants has recently been shown to increase the efficacy of some herbal medicines [42]. According to Bussmann and Sharon [43], the use of more than one plant species to prepare a remedy for ailments is attributed to the additive or synergistic effects that they could have during ailment treatment. The method of drug
preparation in many cases varies from individual to individual, while the same plant material for the same ailment may be prepared in different ways by different traditional healers. For example, in the present study the leaves and roots of *Oxalis corniculata* are used for stomach problems in powder form, but according to Murad *et al.* [44], the same plant is used for the same ailment in juice form in the Malakand district of Pakistan. Similarly, leaves of *Cannabis sativa* in boiled form are therapeutically very active against relieving pain in the study area, but the same plant is prepared in powder form to treat the same in the Swat region of Pakistan [5]. Such similarities in the cross-cultural usage of the traditional plant remedies are a strong indication of the bioactivity potential of the documented plant species. Table 2 shows that nearly all plant remedies are ingested orally in combination with other ingredients (vehicles) such as water, sugar, lime, wheat flour, mustard oil, honey, butter and milk to minimize the effect of the remedy’s astringent taste. It has been suggested that the use of such vehicles may dilute or reduce the relative potency of the drug [45]. However, there is no consensus on the dosage and frequency of the medication among healers because the dosage varies according to the type and severity of the illness or injury being treated.

**Traditional knowledge and age of the respondents**

Data analysis showed that there is a strong positive correlation ($r^2 = 0.95$) between the respondent’s age and the number of medicinal plants known to them (Figure 5). In our study younger people up to 25 years old knew of approximately 15 medicinal plant species, which is far fewer than that of older people. Hussain *et al.* [46] in the South Waziristan and Parveen *et al.* [47] in the Thar Desert of India reported that people older than 30 years of age are more knowledgeable than younger ones in terms of medicinal plants and their uses. Ethnomedicinal recipes made by the local elders (collectors, traditional practitioners) are more effective than those made by young

**Figure 5** Pearson correlation between age of the respondents and the number of medicinal plants known to them.

**Figure 6** A conceptual diagram on the current and future status of indigenous knowledge.
people [37,47]. This may be partly explained by recent trends of modernization that have caused the level of information being directly transmitted between generations to be greatly reduced [9], and which may lead to the eventual disappearance of such knowledge and the weakening of the relationship between people and plants. Figure 6 represents a conceptual diagram that projects a decline in indigenous medicinal plant knowledge of around 75% in the coming 20 years. Another cause of such a decline may be related to the influence of increased armed conflict in the region. A large proportion of the inhabitants of the investigated area have recently migrated to urban areas, which may exacerbate any decline in indigenous knowledge as modernization and disinterest among youth in the urban areas has rendered traditional knowledge almost extinct [12]. Traditional knowledge is now confined to the remote areas of Pakistan [14], but various remote regions are vulnerable to annual climate-change-induced water scarcity and flooding and others problems such as financial crises, high transportation costs, increased prices of consumer goods, shortages of clean water, poor social networks and terrorism, all of which encourage the migration of a large proportion of the population toward urban areas. A study conducted by Cheikhyousaf et al. [48] showed that most of the healers in the region gained their knowledge from their grandparents. Considering the current high levels of youth migration from rural areas, such relationships are less likely to be formed across generations, resulting in the loss of medicinal plant knowledge when traditional healers pass away. As such, the documentation of traditional knowledge on ethnomedicinal uses is regarded as a necessity to safeguard future generations and encourage further research studies.

**Conclusion**

Traditional medicines serve as an integral source of rural livelihood in the study region in northwestern Pakistan, which is severely affected by armed conflict in the so-called War on Terror. The study area has plenty of medicinal plants for the preparation of medicinal remedies that can be experts in the preparation of various ethnomedicinal remedies. Moreover, the use of specific plant parts, similar uses of some plants in different regions and multiple uses of single plants for the preparation of medicinal remedies suggest the prevalence of biologically active compounds across a range of medicinal plant species. Further phytochemical analysis, pharmaceutical application and clinical trials are therefore recommended in order to evaluate the authenticity of ethnomedicinal uses to scientific standards. Indigenous knowledge on ethnomedicinal preparations persist more among older traditional healers, however, such knowledge is being lost to younger generations and continuing armed conflict in the region may further inhibit the transition of such knowledge. As such, studies on the documentation of ethnomedicines may be extended to other war-affected areas for the protection of traditional knowledge.

**Competing interests**

The authors declare that they have no competing interests.

**Authors’ contributions**

MA designed the research project, conducted statistical analysis and provided comments on the draft manuscript. IU conducted the field work, wrote the draft manuscript and has equally contributed as first author with MA. AT analyzed the data and helped in writing the draft of the manuscript. AL, WM, NA and ALK provided comments and suggestions on the draft manuscript. All authors have read and approved the final manuscript.

**Acknowledgment**

Staff at the Department of Botany, Kohat University of Science & Technology is highly acknowledged for their help and support. We also thank the local respondents for sharing their indigenous knowledge with us. Authors are thankful to Mouhammad Sherin Zaman and Prof. Hashim Khan (community representatives) for giving permission to collect data. The authors owe thanks to Dr. Muhammad Naeem Butt and Dr. Syed Shujaat Ali, Kohat University of Science & Technology for language correction and academic support.

**Author details**

1Department of Botany, Kohat University of Science and Technology, 26000 Kohat, Pakistan.
2Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Oman.
3Department of Biotechnology and Genetic Engineering, Kohat University of Science and Technology, 26000 Kohat, Pakistan.

**Received: 18 June 2013 Accepted: 27 January 2014**

**Published: 31 January 2014**

**References**

1. Smitherman LC, Janisse J, Mathur A. The use offolk remedies among children in an urban black community: remedies for fever, colic, and teething. Pediatrics. 2005, 2: 297–304.
2. Cotton CM: Ethnobotany: Principles and Applications. New York: John Wiley and Sons; 1996:412.
3. Thomas H: Indigenous knowledge, emancipation and alienation. J Knowledge Transfer Util 1998, 1:63–73.
4. Rao MR, Palada MC, Becker BN: Medicinal and aromatic plants in agro-forestry systems. Agroforestry Syst 2004, 61:107–122.
5. Akhtar N, Rashid A, Musafir W, Bergmeier E: Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. J Ethnobiol Ethnomed 2013, 9:25.
6. Acharya KP, Acharya R: Ethnobotanical study of medicinal plants used by Tharu Community of Parroha VDC, Rupandehi District, Nepal. Scientific World 2009, 7:80–84.
7. Sheikh K, Ahmad T, Khan MA: Use, exploitation and prospects for conservation: people and plant biodiversity of Naltar Valley, northwestern Karakorums, Pakistan. Biodivers Conserv 2002, 11:715–742.
8. Ali SI, Quaiser M: Flora of Pakistan. No 1–215 (1972–2010), Pakistan. http://www.efloras.org/flora_page.aspx?flora_id=5, accessed on 9 November, 2010.
9. Adnan M, Begum S, Latif A, Tareen AM, Lee LJ: Medicinal plants and their uses in selected temperate zones of Pakistani Hindukush- Himalaya. J Med Plants Res 2012, 6:4113–4127.
10. Ahmad H: Capacity building for cultivation and sustainable harvesting of medicinal and aromatic plants. In Proceeding of international workshop on conservation and sustainable uses of medicinal and aromatic plants in Pakistan, WWF Pakistan. Edited by Ahmad H, Khan AA. 2003:31–36.
11. Hamayun M: Studies on Ethnobotany, conservation and plant diversity of Utro and Gabral valleys, district Swat, Pakistan. Pakistan: Quaid-i-Azam University Islamabad, 2004. PhD thesis.
12. Shinwari ZK: Medicinal plants research in Pakistan. J Med Plants Res 2010, 4:161–176.
13. Hocking GM: Pakistan medicinal plants. Qualitas Plantarium Ethnobotanical Material Vegetables 1958, 5145–153.
14. Irbr M, Hussain F, Sultan A: Ethnobotanical studies on plant resources of Ranyal Hills, District Shangla, Pakistan. Pak J Bot 2007, 3:29–337.
et al. Journal of Ethnobiology and Ethnomedicine 2014, 10:16
http://www.ethnobiomed.com/content/10/1/16

Page 16 of 16

15. Hamayun M, Khan SA, Kim HY, Leechae U: Traditional knowledge and ex-situ conservation of some threatened medicinal Plants of Swat Kohistan. Pak J Bot 2006, 2:205–209.

16. Jabeen A, Khan AM, Ahmad M, Zafar M, Ahmad F: Indigenous uses of economically important flora of Margallah hills national park, Islamabad, Pakistan. Afr J Biotechnol 2009, 2:763–764.

17. Gilani SS, Shinwari ZK: Sustainable harvest of medicinal plants at Bulahsbar Nullah, Astore (Northern Pakistan). J Ethnopharmacol 2003, 84:299–208.

18. Haq F, Ahmad H, Alam M: Traditional uses of medicinal plants of Nandiar Khwair catchment (District Battagram), Pakistan. J Med Plants Res 2011, 1:39–48.

19. Haq F, Ahmad H, Alam M, Ahmad IB: Species diversity of vascular plants of Nandiar valley western Himalaya, Pakistan. Pak J Bot 2010, 42:213–229.

20. Sameen: Some of the ethnomedicinally important plants of FR-Bannu region, KPK, Pakistan. Master Thesis. Pakistan: Bannu University, 2009.

21. Jehanzeb K, Rooman K, Rizwana Aleem Q: Ethnobotanical Study of Commonly Used Weeds of District Bannu, Khyber Pakhtunkhwa (Pakistan). J Med Plant Stud 2013, 1:6–10.

22. Martin GJ: Ethnobotany: A methods manual. London: Chapman and Hall; 1995.

23. Waller DP: Methods in ethnobotany research. J Ethnopharmacol 1993, 38:189–195.

24. Kim H, Song MJ: Ethnobotany. World Science Com: In Seoul, 2008.

25. Index Kewensis 2.0: On compact disc version 2.0 for the IBM PC. United Kingdom: Oxford University Press; 1997.

26. SPSS Inc: SPSS Version 16.0 for Windows. SPSS, Chicago IL 2007.

27. Bannister K, Prophet River Ethnobotany: A report on traditional plant knowledge and contemporary concerns of the Prophet River First Nation. Northeastern British Colombia: Prophet River First Nation and Prophet River Contracting Ltd; 2006:1–53.

28. Maroey A: Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives. J Ethnobot Ethnomed 2011, 9:31.

29. Banister K, Prophet River Ethnobotany: A report on traditional plant knowledge and contemporary concerns of the Prophet River First Nation. Northeastern British Colombia: Prophet River First Nation and Prophet River Contracting Ltd; 2006:1–53.

30. Giday M, Teklehaymanot T: Ethnobotanical study of plant used in management of livestock health problems by Afar people of Ader district, Afar Regional State, Ethiopia. J Ethnobiol Ethnomed 2013, 9:18.

31. Sheh Z, Khan DUA, Hussain F: Ethnobotanical studies of some plants of Chagharzai valley, district Buner, Pakistan. Pak J Bot 2011, 3:1445–1452.

32. Khan AA: Role of conservation of medicinal and aromatic plants in the socioeconomic development of rural poor. In International workshop on conservation and sustainable use of medicinal and aromatic plants in Pakistan. Joint venture by WFF-Pakistan, MINFAL and Qarshi Industries Pvt. Ltd. Lahore, Pakistan: Ihsan Printers; 2003.

33. Azizullah A, Khattak MNK, Richter P, Höder PD: Water pollution in Pakistan and its impact on public health. Environ Int 2011, 37:479–497.

34. Ribeiro A, Romeiras MM, Tavares J, Faria MT: Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. J Ethnopharmacol 2010, 6:33.

35. Badshah L, Hussain F: People preferences and use of local medicinal flora in District Tank, Pakistan. Med Plants Res Pakistan 2011, 1:22–29.

36. Khan N, Ahmed M, Ahmad A, Shaukat SS, Wahab M, Ajali M, Siddiqui MF, Nasir M: Important medicinal plants of Chitral Gol National Park (Cgnp) Pakistan. Pak J Bot 2011, 2:797–809.

37. Ticktin T: The ecological implications of harvesting non-timber forest products. J Appl Ecol 2004, 41:11–21.

38. Muthu C, Ayyanar M, Raja N, Ignacimuthu S: Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. J Ethnobiol Ethnomed 2006, 2:43.

39. Kala CP: Ethnomedical botany of the Apatani in the eastern Himalayan region of India. J Ethnobiol Ethnomed 2005, 1:11–18.

40. Murad W, Azizullah A, Adnan M, Tariq A, Khan KU, Waheed S, Ahmad A: Ethnobotanical assessment of plant resources of Banda Daud Shah, District Karak, Pakistan. J Ethnobiol Ethnomed 2013, 9:7–17.

41. Shihwan ZK, Rehman M, Watanabe T, Yoshihika Y: Medicinal and Aromatic Plants of Pakistan: A Pictorial Guide. Kohat University of Science and Technology, Kohat, Pakistan, 2006.

42. Deeba F: Documentation of ethnoveterinary practices in urban and peri-urban areas of Faisalabad, Pakistan. Faisalabad Pakistan: University of Agriculture; 2009. PhD Thesis.

43. Hussain S, Ali A, Wahab M, Ahmad A, Siddiqui MF: Inclusion in PubMed, CAS, Scopus and Google Scholar

44. Ribeiro A, Romeiras MM, Tavares J, Faria MT: Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. J Ethnopharmacol 2010, 6:33.

45. Badshah L, Hussain F: People preferences and use of local medicinal flora in District Tank, Pakistan. Med Plants Res Pakistan 2011, 1:22–29.

46. Khan N, Ahmed M, Ahmad A, Shaukat SS, Wahab M, Ajali M, Siddiqui MF, Nasir M: Important medicinal plants of Chitral Gol National Park (Cgnp) Pakistan. Pak J Bot 2011, 2:797–809.

47. Ticktin T: The ecological implications of harvesting non-timber forest products. J Appl Ecol 2004, 41:11–21.

48. Muthu C, Ayyanar M, Raja N, Ignacimuthu S: Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. J Ethnobiol Ethnomed 2006, 2:43.

49. Kala CP: Ethnomedical botany of the Apatani in the eastern Himalayan region of India. J Ethnobiol Ethnomed 2005, 1:11–18.

50. Murad W, Azizullah A, Adnan M, Tariq A, Khan KU, Waheed S, Ahmad A: Ethnobotanical assessment of plant resources of Banda Daud Shah, District Karak, Pakistan. J Ethnobiol Ethnomed 2013, 9:7–17.

51. Shihwan ZK, Rehman M, Watanabe T, Yoshihika Y: Medicinal and Aromatic Plants of Pakistan: A Pictorial Guide. Kohat University of Science and Technology, Kohat, Pakistan, 2006.

52. Deeba F: Documentation of ethnoveterinary practices in urban and peri-urban areas of Faisalabad, Pakistan. Faisalabad Pakistan: University of Agriculture; 2009. PhD Thesis.

Cite this article as: Adnan et al.: Ethnomedicine use in the war affected region of northwest Pakistan. Journal of Ethnobiology and Ethnomedicine 2014 10:16.

Submit your next manuscript to BioMed Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at www.biomedcentral.com/submit