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TRADITIONAL DRUG THERAPIES FROM VARIOUS MEDICINAL PLANTS OF CENTRAL KARAKORAM NATIONAL PARK, GILGIT-BALTISTAN, PAKISTAN

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Abstract

Traditional medicines derived from indigenous plants play an important role in treating infectious diseases. This study examined traditional medicinal uses of indigenous plants and documented different traditional recipes used by local communities to treat different diseases in Baltistan Region. Forty-seven medicinal plants belonging to 22 families were collected. Twenty-one families were angiosperms, one was a pteridophyte (Equisetaceae), and one a gymnosperm (Ephedraceae). Crude extracts of these medicinal plants were used by the local people for treating diseases in a traditional system of medicine. Ranunculaceae, Asteraceae, Polygonaceae and Rosaceae were the most important families, each having five species with medicinal value. The species were found across a wide range of altitudes, from 2000 m to over 4000 m.

Introduction

In recent years, many pharmacognostic and pharmacological investigations of medicinal plants have been conducted to ascertain their therapeutic properties (Qasim *et al.,* 2010). New plant-derived drugs are increasingly available (Hussain *et al.,* 2011a). Herbal medicine use, along with other complementary therapies including homeopathy, Traditional Chinese Medicine (TCM) and osteopathy, is increasing in the Western world (Shinwari & Gilani, 2003). Pakistan has diverse climates and is rich in medicinal herbs. The northern parts of the mountainous regions of Pakistan are rich in biodiversity as they are situated at the junction of three mountain ranges (Shinwari *et al.,* 2000; Shinwari *et al.,* 2011). Almost 80% of Pakistan's endemic flowering plants are confined to the north and western mountains (Ali & Qaiser, 1986). There are approximately 6000 species of higher plants in Pakistan (Ali & Qaiser, 1986). Nearly 600 different plant species have been identified as having medicinal value (Shinwari, 1996). Of these species, the active constituents of approximately 500 species are known from research conducted in Pakistan or elsewhere (Williams & Ahmad, 1999).

Central Karakorum National Park (CKNP) was established in 1993, encompassing an area of 10,000 km^2. It is situated in Gilgit-Baltistan, Pakistan, and falls into three administrative districts: Gilgit, Skardu, and Ghanche. It is the largest protected area in Pakistan, and many famous peaks are located within the boundary, including K-2 (8611 m), Gashabrum-I (8068 m), Broad Peak (8047 m), Gashabrum II (8035m) and Mashabrum (7821 m)., Approximately 230 villages (97,608 people and 13,159 households) are located in areas adjoining to the park (www.cknp.org.pk). The area receives little rainfall in the summer season and heavy snowfall during the winter season. The Karakoram Mountains are considered a winter precipitation area influenced by the Westerlies (Paffen *et al.,* 1956).

Traditional therapies and uses of medicinal plants have not been documented in Central Karakorum National Park and the adjoining valleys of Skardu and Ghanche district (Gilgit-Baltistan, Pakistan). Therefore, this study was conducted to record indigenous knowledge of traditional uses of medicinal plants, species distributions and conservation approaches to address threats to local biodiversity.

Materials and Methods

Field visits were conducted during 2008-09 to collect and identify the altitudinal distribution of flora in Central Karakoram National Park and surrounding areas of Baltistan. Traditional methods of drug therapy were also documented. Frequent field trips were arranged in different villages near pastures of the Karakoram Range of Baltistan during August and September 2008 and May, June & July 2009. Information regarding traditional uses of medicinal plants was gathered through questionnaires, interviews, semi-structured interviews and group discussions with local elders, farmers, students and traditional healers (Table 1).

All plants were collected from the study area viz. Thalley, Hushe, Keris, Kanday from Ghanche district, Shigar, Basha and Rondu from Skardu district (Fig 1), were identified at the herbarium of the Department of Plant Sciences, Quaid-i-Azam University Islamabad (ISL) using the Annotated Catalogue of Vascular Plants of West Pakistan and Kashmir" by Stewart (1972) and the Flora of Pakistan (Nasir & Ali, 1971-2001).

Table 1. Sources of information about the use of medicinal plants in the Karakoram area.

Source of information	Local elders	Farmers	Group discussions (Each discussion having five people)	Questionnaires	Interviews/ semi-structured interviews	Traditional healers
Numbers	11	26	02	30	14	(02men, 01woman)

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Fig. 1. Map showing the study area of Baltistan (Ghanche and Skardu).

Results and Discussion

Humans have long used some species of plants as food sources and others for curing diseases and injuries. During the present investigation, 47 species of high medicinal value were collected and identified; all were used by local people for curing different diseases (Table 2). Twenty-two different plant families were represented, including one pteridophyte (Equisetaceae) and one gymnosperm (Ephedraceae). The remaining plants belonged to angiosperm families (Fig. 2). The dominant families were Asteraceae, Polygonaceae, Ranunculaceae and Rosaceae (each having five species), followed by Lamiaceae and Leguminosae (four species), Apiaceae (three species) and Zygophylaceae (two species) whereas remaining families have only species each (Fig 4).

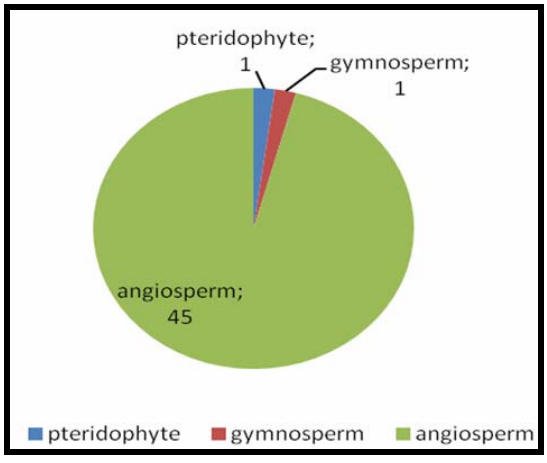

Fig 2. Life form classes of collected medicinal plants of CKNP, Baltistan.

All the plant species were collected between 2000 and 4000 m. *Viola canescens* and *Capparis spinosa* were found in a narrow range, i.e. from 2600-2900 m and 2100-2500 m, respectively. The antimicrobial properties of these species have been previously studied (Hussain *et al*., 2009). *Astragalus psilocentros* and *Oxyria digyna* both were found in a wider range, from 2100-4000 m. Majority of plant species were found to occur in mid altitude (Fig 3). Altitudinal gradients are complex and involve many different co-varying factors such as topography, soil and climate (Austien *et al*., 1996).

In mountain areas such as the Himalayas, the maximum number of endemic species is expected to occur at high elevations due to isolation mechanisms (Shrestha & Joshi, 1996). Many medicinal plants thrive in the Baltistan area, reflecting high levels of floral biodiversity. Studies in this area must use modern ways of identifying species (Shinwari & Shinwari, 2011), which will lead to reports of new taxa (Gilani *et al.*, 2003). The majority of the flora in this rich area has important uses in terms of medicines, economical value and other uses. Research and documentation on medicinal plants has been initiated by different non-governmental organizations including World Wildlife Fund (WWF), Baltistan Health & Education Foundation (BHEF), and the International Union for the Conservation of Nature (IUCN), and by the Forest and Agriculture Department of Gilgit-Baltistan. However, no sustainable approaches have been developed by these stakeholders. Much attention had been paid to documentation of the Himalayan region's medicinal plants, but no long-term conservation strategies have been outlined. It is hoped that long term collaboration between institutions like Quaid-i-Azam Universiny (QAU) Islamabad, Kararakorum International University Gilgit-Baltistan (KIU G.B) and Govt. organizations; Department

of Agriculture, Gilgit-Baltistan (DOA G.B) and CKNP, with a mandate for conserving medicinal and aromatic plants, would fill the gap.

Plant resources are declining rapidly due to increased traditional use by the mountain communities for medicinal purposes, (Shinwari & Gilani, 2003). The major factors threatening floral biodiversity in the area include changing climatic conditions, overgrazing and overharvesting. People living in the buffer zones surrounding the core park area mainly rely on natural resources and ecosystem services provided by the CKNP for their livelihoods (Salerno *et al.*, 2010). Anthropogenic factors and pressure on natural resources make it necessary to develop a comprehensive and sustainable park management plan (Hagler Bailly Pakistan 2005). Increasing tourist traffic and activities in the Karakorum region at high altitude pastures may pose threats to indigenous flora and would be another alarming factor for plants prevailing in the study area.

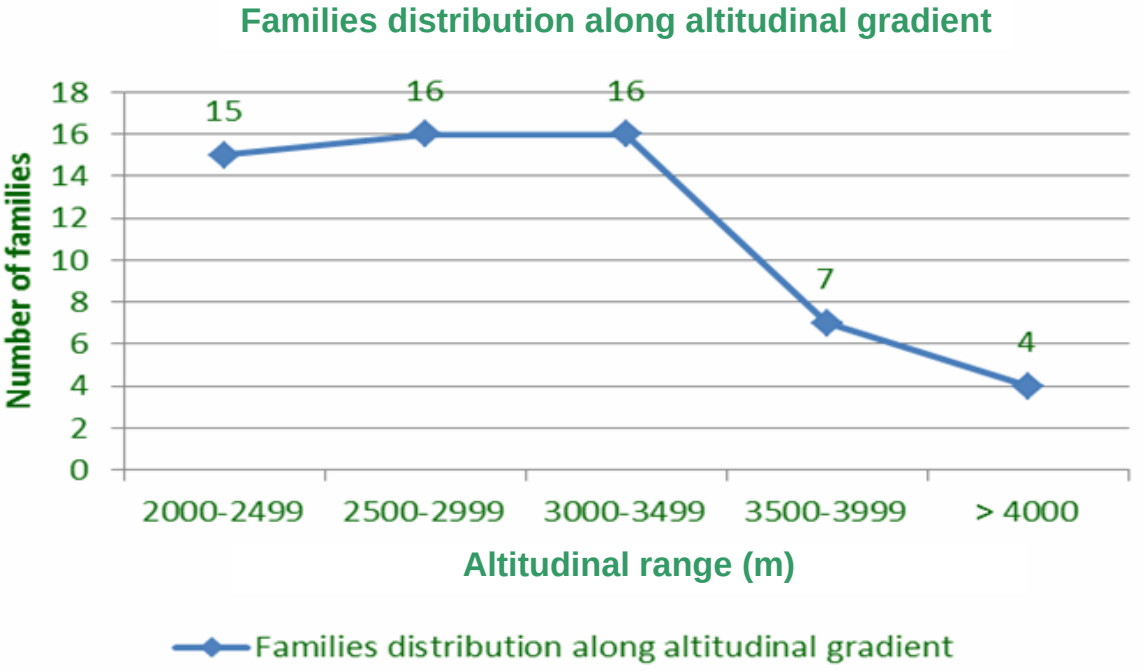

Fig 3. Family distribution at different altitudes.

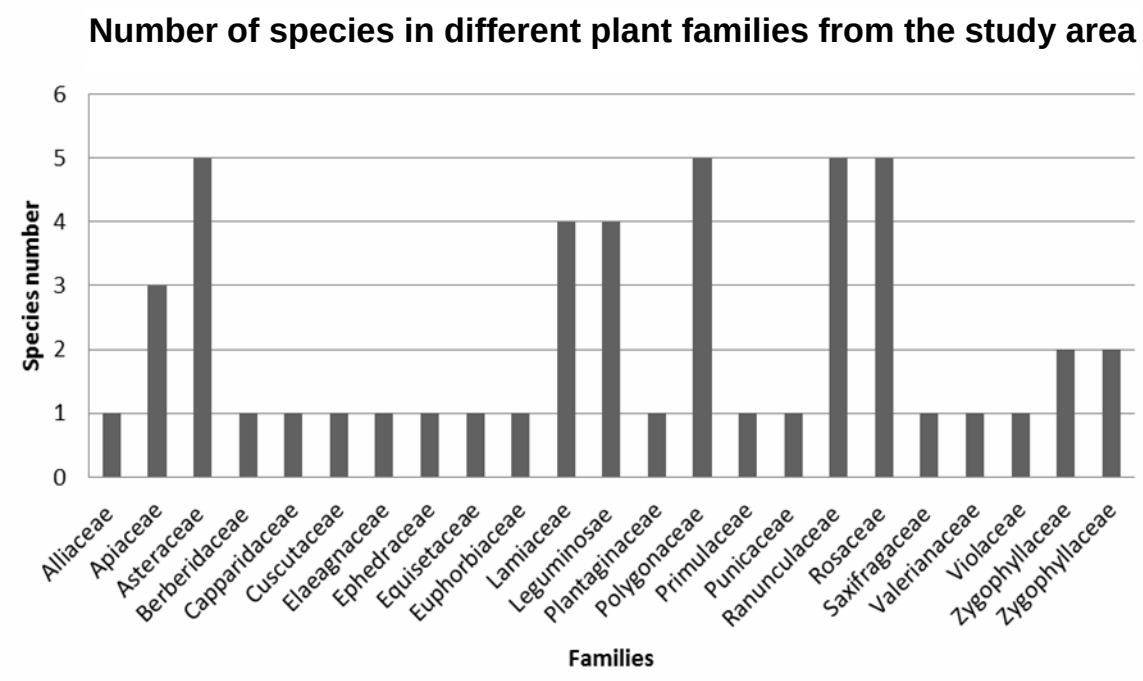

Fig 4. Chart showing number of species among families from the study area.

Table 2. Traditional uses of medicinal plants by local communities of Ghanche and Skardu, Baltistan.

S.No.	Species	Family	Local name	Altitudinal distribution	Part used	Disorder treated
	Aerial parts soon after collection are dried and special type of paste is prepared for application to infected site					
1.	*Aconitum napellus* var. *rotundifolium* (Kar. et Kir.) Hook.f. & Thoms.	Ranunculaceae	Booma	2900-3600 m	Aerial	Wound healing and boils
	Traditional dried leaves in shade are extracted with water. Also used as fuel, biofertilizer and for herds' bedding					
2.	*Artemisia brevifolia* Wall. ex DC	Asteraceae	Bursay	2100-3400 m	Leaves and flowers	Endoparasites
	Adults drink a decoction to control endoparasites while for children fresh aerial part is applied on abdomen or on the neck. Dried aerial part is mixed with manure to control grubs and other pests.					
3.	*Artemisia fragrans* Willd	Asteraceae	Kho Bursay	2100-3300 m	Aerial	Endoparasites
	The leaves are dried, powdered and extracted in water. A few drops of this watery extract are drunk by patients					
4.	*Artemisia rutifolia Spreng.*	Asteraceae	Kho Bursay	2100-3400 m	Aerial	Stomach disorders
	Root is specially used to make soup (joshanda) and tooth paste. It releases tooth ache and effective to control gum bleeding					
5.	*Astragalus psilocentros* Fisch	Leguminosae	Biacharchoo	2100-3800 m	Roots and thorny branches	Flue and tooth ache
	The dried rhizomes are boiled in water and extract is used orally for tooth ache, also used as mouth wash					
6.	*Velariana wallichii* DC.	Valerianaceae	Mushk-bala	2100-3400 m	Rhizomes	Tooth ache
	Leaves are dried and extract in water is used					
7.	*Buxus papillosa* C.K. Schneid	Buxaceae	Angaroo	2100-2800 m	Leaves	Skin disorders
	The oil of its seeds is used to treat joint pains and for baldness. Dried branches are used for fuel purposes					
8.	*Capparis spinosa* L.	Capparaceae	Kraba	2100-2500 m	Seeds and branches	Arthritis
	Ripened seeds are dried and used for different remedies. The seeds are extracted in water and drunk to patients to control diarrhea. It is also used as condiment. The powdered seeds are applied to the face to give a fashionable pale look					
9.	*Carum bulbocastanum* Koch.	Apiaceae	Thally	2600-3300 m	Seeds	Digestive problems, flue, diarrhea and indigestion
	Powder of dry aerial parts is used with milk for urine problem and constipation					
10.	*Cuscuta reflexa* Roxb.	Cuscutaceae	Ghbul thaq	2100-3200 m	Whole plant	Urine problems and constipation
	The flowers boiled in water are used as hair conditioner, roots to cure diarrhea, and leaves for the treatment of fever and stomach ache					
11.	*Delphinium brunonianum* Royle	Ranunculaceae	Makhoting	3500-4300 m	Whole plant	Baldness, diarrhea and stomach ache, fever
	Dried seed powder is used in green tea, hot soups and in curries etc. Its decoction seems to be more effective. The herb is also used as condiment					
12.	*Dracocephalum nuristanicum* Rech. f. & Edelb.	Apiaceae	Shamdun	3200-4000 m	Seeds	Gastrointestinal disorders and Stomach ache
	Used as toothpaste. The decoction is used by local females for muscles contraction after birth. Also effective for asthma and act as expectorant and central nervous system (CNS) stimulant					
13.	*Ephedra gerardiana* Wall. ex Stapf	Ephederaceae	Say	2100-3400 m	Ariel parts	Tooth ache, asthma and used as expectorant
	Dried aerial parts of the herb, used in solution form for taking bath was found to be effective to overcome urine problems in children					
14.	*Equisitum arvense* L.	Equisitaceae	Thangshingy harswa	2000-3200 m	Aerial parts	Urine disorders
	Ripened fruits are used to prepare juices and jams and jelly are effective to cure patients suffering from diabetes and high blood pressure etc					
15.	*Hippophae rhamnoides* L.	Elaeagnaceae	Soq	2000-3600 m	Leaves, fruits and seeds	High blood pressure, Blood clotting and diabetes
	Leaves are dried and used with hot soups and green tea. Also used as a carminative agent					
16.	*Mentha royleana* Benth.	Lamiaceae	Foling	2000-3300 m	Leaves	Stomachache and cold cough.
	Leaves are used fresh or dried, powdered and taken with either with water or curd					
17.	*Mentha arvensis* L.	Lamiaceae	Peeno	2100-3000 m	Leaves	Stomach disorders, expectorant
	Powder of dry leaves is taken with water to overcome the problem					
18.	*Nepeta leucolaena* Benth.	Lamiaceae	Azumal	2800-3400 m	Whole plant	Used to prevent constipation and stomach problems
	Local people use air dried aerial parts in powder form either with water or meal					
19.	*Polygonum hydropiper* L.	Polygonaceae	Thangmarcy	2800-3400 m	Aerial parts	Heart trouble and respiratory problems
	Aerial part is harvested during flowering period,allowed to dry used to make green tea and mixed in soup					
20.	*Potentilla bifurca* L.	Rosaceae	Tarqan	3000-3900 m	Aerial part	Stomach ache and nausea.
	Flower is extracted in boiling water and fed to patients of cough and those having stomach problems					
21.	*Potentilla salesoviana* Steph.	Rosaceae	Laik sman	2800-3800 m	Flower	Cough and stomach problems
	Paste is made from the dried powdered seeds, applied on the fore head 2-3 times a day. It is believed that if the paste sticks to the fore head after application, then the type of hepatitis is curable					
22.	*Sophora mollis* (Royle) Baker	Leguminosae	Khakhol	2200-2700 m	Seeds and leaves	Hepatitis

Table 2. (Cont'd.).

S.No.	Species	Family	Local name	Altitudinal distribution	Part used	Disorder treated
	Fully matured floral tops are cut and dried and fine powder is made. Its decoction is used with water to expel worms once a day. Its powder is taken with water on daily basis to control high blood pressure as well as digestive disorders					
23.	*Tanacetum senecionis* J.Gay ex DC.	Asteraceae	Hilteree/Tialo	3200-4100 m	Floral parts	High Blood pressure, digestive disorders and asthma
	Fresh roots collected from plants in early spring are dried and powdered. For eye redness etc a ew drops of infusion are used to cure the problem. Drinking a decoction is believed to be effective for gastrointestinal disorders					
24.	*Thalictrum foliolosum* DC.	Ranunculaceae	Momyrun	2200-3300 m	Root parts	Opthalmia and gastritis
	Aerial part is harvested and dried in the shade. A decoction is used for these remedies. Dried leaves are also used with green tea. Local people use it as herbal tea					
25.	*Thymus serpyllum* L.	Lamiaceae	Ree tumburuk	3400-4200 m	Leaves and floral parts	Sore throat, fever and stomach problem
	A decoction is made from ground seeds used to overcome the problem. Different local healers use different doses according to the patient's age and severity of the disorder					
26.	*Tribulus terrestris* L.	Zygophyllaceae	Cocoloq/Cocoring	2100-3200 m	Seeds	Urinary disorders
	Decoction is made from fresh or dried flowers to use against headache and top act as a cooling agent. A paste for treating pus and dermal infections is also made by mixing powder of this herb and of *Potetilla* sp					
27.	*Trifolium fragiferum* L.	Leguminosae	Gul-e-nasreen	2000-3300 m	Flowers and leaves	Headache and dermal infection
	Both fresh and dried leaves are used to cure thirst problems and also used as an alternative source of water where water is not available. For patients of jaundice, the dried leaves are taken with water as two doses per day					
28.	*Oxyria digyna* L.	Polygonaceae	Skyurbutaq	2100-3800 m	Aerial parts	Jaundice, Thirst problems
	Fresh flowers are harvested during spring season and saved in dried form and used with green tea					
29.	*Viola canescens* Wall.ex Roxb.	Violaceae	Skora mindoq	2600-2900 m	Floral part	Sore throat and cough
	Used as vegetable and seeds as carminative					
30.	*Trigonella foenum-graecum* L.	Leguminosae	Shamilik	2200-2800 m	whole plant	Stomach problems
	The aerial parts are extracted in water and also eaten fresh					
31.	*Taraxum officinale* Wigg.	Asteraceae	Shantha	2000-3600 m	Flowers and leaves	arthritis
	The powdered flower is taken with water twice a day					
32.	*Primula farinose* L.	Primulaceae	Spangpunar	2200-3200 m	Flower	Blood purifier, dysentery
	Special type of paste is prepared from bark in water and dried bark is used to make tea					
33.	*Rosa webbiana* Wall.ex Royle	Rosaceae	Sia marpho	3000-3600 m	Floral part and bark	Skin inflammation
	The petals are boiled in water to make a special type of tea					
34.	*Rosa indica* L.	Rosaceae	Ghulab	up to 2800 m	Floral part	Constipation and abdominal problems
	The flour is mixed with apricot oil in boiling water and processed and applied to skin as a paste over night. The flour is crushed with broad bean and special type of traditional bread is made					
35.	*Polygonum tataricum* L.	Polygonacea	Bro Kho-Bro	2000-3400 m	Leaves, seeds	High blood pressure, diabetes, skin disorders
	The seeds are ground and bread is prepared. The leaves are cooked as vegetable					
36.	*Fagopyrum esculentum* Moench.	Polygonaceae	Ghiawas, sta-Bro	2000-3200m	Leaves, seed	Gastric disorder, high blood pressure and diabetes
	Paste is prepared in water and applied to skin twice a day					
37.	*Aquilegia pubiflora*	Ranunculaceae	Koo-kuk	2750-3300 m	Leaves, floral part	Skin burns and wound healing
	The floral parts are dried in shade and boiled in water to prepare paste					
38.	*Aquilegia fragrans Benth.*	Ranunculaceae	Karfo Koo-kuk	2750-3300 m	Leaves, floral part	Boils and wound healing
	The fruits are eaten fresh. Bark, roots and leaves are boiled in water and extract is used for drinking					
39.	*Berberis lyceum* Royle	Berberidaceae	Skyurboo	2350-3000 m	leaves, fruits, barks, roots	Internal disorders, stomach problems
	The seeds are burnt and smoke is produced which is antiseptic					
40.	*Peganum harmala* L.	Zygophyllaceae	Isman	2100-3100 m	Seeds	Skin disorders
	Dried powder is used orally with water and paste with water is used for wound healing					
41.	*Megasea ciliata* Haw.	Saxifragaceae	Shaphur/Shapus	3500-4100 m	roots and leaves	wound healing and heart problems
	Decoction is prepared and applied to skin					
42.	*Rumex chelepensis* Mill.	Polygonaceae	Sa-shing	2100-3000 m	Roots	skin problems
	The seed is harvested very carefully at the time of maturity and used with 1 cup of hot water or milk					
43.	*Plantago major* L.	Planataginaceae	Boqna	2200-3200 m	Seeds	chronic dysentery
	Fresh fruit is eaten with fried flour of wheat or barley (chafay) to overcome abdominal disorders. Dried fruits are used as stomachic, seed oil is used as condiment					
44.	*Prunus armeniaca* L.	Rosaceae	Chooli	Up to 3100 m	Seed	Stomach, abdominal disorders
	Fresh fruits are eaten. The fruit pericarp or bark is powdered and taken with water to cure dysentery					
45.	*Punica granatum* L	Punicaceae	Sio	2000-2300 m	Fruits and bark	used to treat dysentery
	The bulbs and leaves are eaten fresh as salad. The bulbs are crushed and pasted on boils					
46.	*Allium cepa* L.	Alliaceaee	Song	up to 3400 m	Bulbs and leaves	boils
	The fruits are taken after meal along with sugar. A special kind of tea is prepared by boiling fruits in water and taken twice a day					
47.	*Foeniculum vulgare* Mill.	Apiaceaee	Badian	up to 3000 m	Fruit	Eye disorders

Conclusion

The traditional phytotherapies we investigated will provide a basis for future clinical research to establish the therapeutic properties of various formulae used by indigenous people. There is a need for the sustainable utilization and conservation of these plant resources and for further research into the bioactive ingredients in plant species of this region. Efforts also have to be made to domesticate rare and endangered species through methods such as tissue culture (Hussain *et al.*, 2011b), and to quantify genetic diversity within species to select individual plants with the highest levels of bioactive compounds (Jan *et al.*, 2011).

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