

Shaheen Begum<sup>1\*</sup>, Naser M AbdElIslam<sup>2</sup>, Muhammad Adnan<sup>3</sup>, Akash Tariq<sup>3</sup>, Azra Yasmin<sup>1</sup> and Rukiya Hameed<sup>1</sup>

<sup>1</sup>Department of Environmental Sciences, Fatima Jinnah Women University 46000, the Mall Rawalpindi, Punjab, Pakistan. <sup>2</sup>Arriyadh Community College, King Saud University, Saudi Arabia. <sup>3</sup>Department of Botany, Kohat University of Science and Technology, 26000 Kohat, Pakistan.

\* Email: [shaheen\\_bakht@yahoo.com](mailto:shaheen_bakht@yahoo.com)

## Abstract

**Background:** Himalayan region of Pakistan has been known as a rich source for valuable medicinal plants. The present work is the documentation of indigenous knowledge of highly utilized plants as natural remedy by the local inhabitants of the northwest part of the country.

**Methodology:** Data on highly utilized medicinal plants were collected during May-September 2012 using semi-structured questionnaire from the elders, local herbalists and medicinal plants collectors.

**Results:** In total about 53, plants belonging to 38, families were highly utilized in the study area, of which majority of those (43), were medicinal plants. The most frequent part used in preparation of different medicinal remedies is leaves (53%). Most of the medicinal plant species (14) were used as antipyretic. The inhabitants of the study area were producing ethno-medicines mostly in crushed form (26%). Most of the remedies (74%), were taken orally within the study area. Ten species were found most valuable from the local's perspective such as *Bergenia ciliata*, *Hedera nepalensis* and *Viola canescens*.

**Conclusion:** In conclusion, traditional healers depend largely on naturally growing medicinal plant species, which are under severe threat. This study can provide a basis for further phyto-chemical and pharmacological studies on the region's medicinal plants. Moreover, documentation of indigenous recipes would serve as preservation of the knowledge for the generations to come.

**Key words:** Medicinal plants; Traditional knowledge; Diseases; Rural livelihood.

## Introduction

Medicinal plants have served as major sources for drugs for centuries. About half of the pharmaceuticals in use today are derived from medicinal plants (Fransworth and Soejarto, 1991). Most of the modern day drugs were invented by studying the traditional use of medicinal plants, which led to the development of very important and valuable drugs like Codeine, Digoxin, Vinblastine, Vincristine and Phytol (Lozoya, 1994). Traditional knowledge on plants used by humans is based on thousands of years' experience and by "trial and error" (Ahmed et al., 2013). The World Health Organization (WHO), estimated about 80% of the developing world dependence on medicinal plants for their primary health care due to socio-economic conditions (Adnan et al., 2012). The global market for medicinal and aromatic plants was \$62 billion in 2002, and may reach \$5 trillion by 2050 (Shinwari, 2010). Medicinal plants contain synergistic neutralizing combinations of active compounds (Gilani and Rahman, 2005). The primary benefits of using plant-derived medicines are: relatively safer than synthetic alternatives, offering profound therapeutic benefits and more affordable treatment (Boye, 1985). In the last 100 years, the science of ethno-botany has progressed and the trend is shifting from mere documentation process to a more practical one, which lays emphasis on the conservation and sustainable use of plant resources.

Pakistan is one of the few places on earth with a distinctive biodiversity, comprising of diverse climatic zones with a wide range of plant species. Approximately 600 plant species with medicinal properties are found in Pakistan (Shinwari, 2010). Traditional Unani medicine is popularly practiced among the large segment of its population (Hussain et al., 2008). Pakistan has about 50,000 registered practitioners of traditional medicines (Jabeen et al., 2009). Local communities of different regions in the country have century's old knowledge and traditional practices. Indigenous knowledge on plants has been transferred from generation to generation through oral communication and personal experience (Shinwari, 2010). In early 1950s, up to 84% of Pakistani population was dependent on indigenous medicines for traditional health practices (Hocking, 1958), but now this is practiced only in the remote rural areas (Ibrar et al., 2007). Due to modernization peoples' attention has shifted from this treasure and knowledge is eroding at a much faster rate (Mahmood et al., 2011). Hence, there is need for the preservation of such knowledge particularly within the Himalayan region of the country that consisted diverse plant species. It is evident from the available literature that such studies can constitute the starting point for the development of new drugs and useful substances (Cox and Balick, 1994).

In Nathiagali, north-west Pakistan, medicinal plants have been used as traditional medicine in treating different human ailments by the local people from time immemorial. The study area consisted over 150 medicinal plants and richest sources of ethno-medicines (Adnan et al., 2012). The area is designated as rural having low literacy rate and lack of modern health facilities. Therefore, the locals are more dependent upon natural resources especially on plants for variety of uses including healthcare. However, information is less on the extensively used medicinal plants and their recipes in the study area. Therefore, the present study was carried out to document and preserve the indigenous knowledge on the uses and recipes making at local level for the treatment of human ailments. Moreover, this study will evaluate the authenticity of ethno-medicinal uses with the already found phytochemical in such plants. The present study would prove very useful by depicting the traditional affiliation and dependence of rural people on the highly utilized medicinal flora. This work will serve as the baseline information for ethno-botanists, ecologists, phytochemists and pharmacologists for future research. Dissemination of the study outcomes among the locals will also help in the acceptance for the preservation of indigenous knowledge.

## Materials and Methods

### Study area

The study was carried out in Nathiagali located in North-West of Pakistan (Figure 1). It lies between 34°-01 to 34°-38 latitude and 73°-22.8

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E longitudes under the altitudinal range between 1220 m to 2865 m. The study area includes Nathiagali and adjoining villages (Malachh, Kalaband, Kala Pani, Kanisan and Dounga Gali), surrounding Ayubia National Park (ANP). The Park supports one of the best examples of moist Himalayan temperate forest in Pakistan and is surrounded by a human population of about 50,000 people living in 8000 households. The community living around the ANP depends on the natural resources of the park for their livelihoods (Aumeeruddy, 2004). Most of the vegetation in and around Ayubia National Park is heavily influenced by the action of humans.

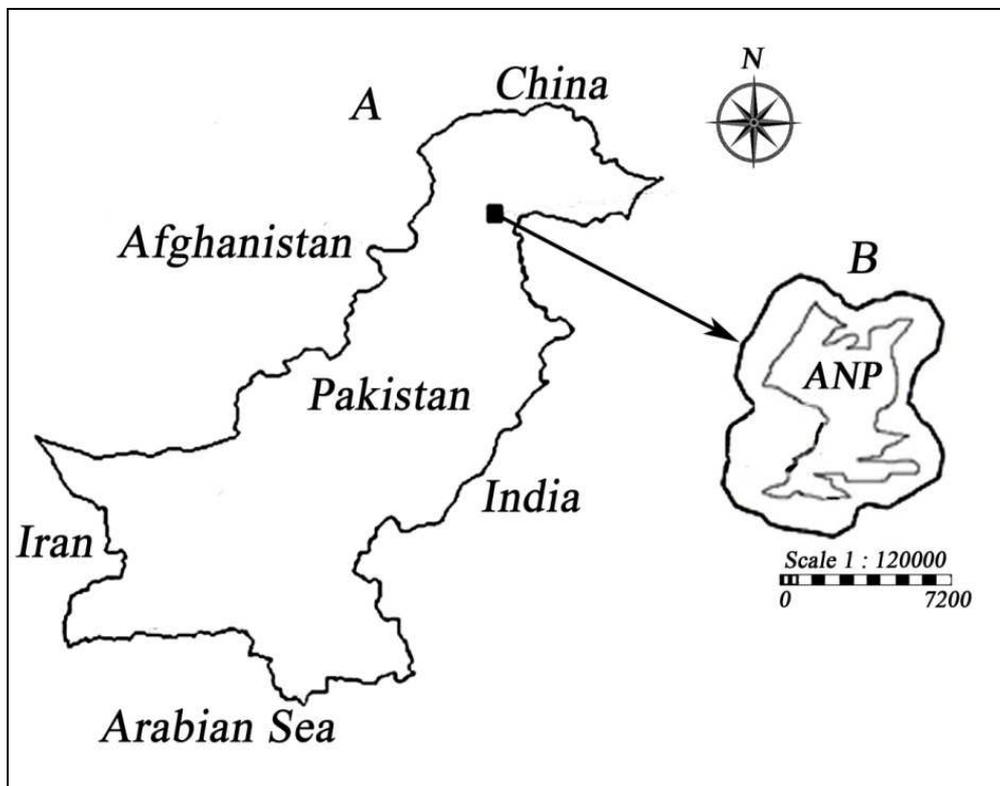


Figure 1: Map of the study area.

### Plants and uses

The Park is comprised of sub-alpine meadows, moist temperate forests and the sub-tropical pine forest ecotype (Aumeeruddy, 2004). About 410, species of combined vegetation have been reported from the study area belonging to Fungi, Lichens, Pteridophytes and Spermatophytes (Shafiq, 2003). Of these, about 200 are reported to be herb species including ferns (Shinwari, 2010). About 152 species are of medicinal and economic importance (Adnan et al., 2012). Many of them are of medicinal and economic importance. Dominant tree species are *Abies pindrow* Royel, *Cedrus deodara* G. Don, *Pinus roxburghii* Sargent, *Pinus wallichiana* A.B. Jacks, *Quercus incana* Roxb and *Taxus wallichiana* Zacc (Shafiq, 2003). Fuel wood consumption by each household in the study area has been estimated at 11,000 kg/year (Adnan & Hölscher, 2010). Large amounts of fodder, mainly grasses and herbaceous species, are collected by women from May to November each year. Annually, 13 tons of fodder is consumed per household (Rabia & Khan, 2004).

### Data collection

Data on ethno-botany and ethno-medicines was collected from May-September 2012, through a semi-structured questionnaire. Data was collected on those plants that were highly utilized in the study area as mentioned in previous study by Adnan et al. (2012). Data was randomly collected from 80 local people belongs to 80 households especially older people, women's and rural herbalists (Hakeems) above the age of 35 years who were familiar with traditional uses of plants particularly for medicinal, veterinary, fruit, vegetable, fodder, fuel and others. The purpose behind selecting mostly elder people compared to young people was to collect reliable and effective data regarding traditional utilization of plants. Questionnaire contained all the appropriate questions required for the collection traditional knowledge on plants. This included data on non timber forest products (medicinal, fodder, fuel wood, vegetable etc). Local names, medicinal uses (antipyretic, gastro-intestinal disorders, respiratory disorders etc), plant part used (leaves, stem, roots, fruit etc), were also gathered. Additional data on the route of administration of medicinal plants (Oral, dermal, ear & nose, eyes and both oral/dermal), medicinal recipes preparation method (decoction, crushed, powder, infusion, juice etc), and ingredients used when taking these recipes were recorded. Data was also collected on the number of children, women and men involved in the collection and processing of medicinal plants per household.

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Market survey was also conducted for only those medicinal plants, which were highly marketable amongst the highly utilized species in the study area (Adnan et al., 2012). Moreover, 25 research articles were reviewed regarding the presence of active chemical constituents in such medicinal plants. All the data was organized using Microsoft Excel. Field trips were made with local people for the collection of recorded medicinal plants. The plants were identified by the taxonomists of Kohat University of Science and Technology. Scientific names, family names and publication authors were corrected according to the Flora of Pakistan and software index kewensis (Ali and Qaiser, 2010; Index kewensis, 1997).

## Results

Altogether 53 plants belonging to 38 families were documented from the study area. Maximum number of 43 plants was used medicinally followed by 23, as fodder (Table 1). Most of the plants recorded were herbs (94%) followed by trees (4%), and shrubs (2%). The most widely sought plant parts in the preparation of different medicinal recipes were the leaves (53%), followed by roots (34%), (Figure 2). Majority of the medicinal plants were used as antipyretic (14), followed by gastro-intestinal disorders (13) (Figure 3). Medicinal plants such as *Achillea millefolium*, *Bergenia ciliata* and *Hedera nepalensis* consisted phytochemical like flavonoids, phenols and alkaloids (Table 3), that have therapeutic action against gastro-intestinal disorders and antipyretic.

The inhabitants of the study area were making ethno-medicines mostly in crushed form (26%) followed by powder (23%) (Table 2). The traditional healers of the study area used single or mixture of plants to prepare different recipes for the treatment of variety of diseases. It was observed that the recipes are mostly taken as oral (74%), followed by dermal (10%) (Table 1.). It has been found that various ingredient such as butter, milk, water and sugar were used along medicinal recipes.

A total of 10 species were found to be highly valuable medicinal species from the local perspective having higher market prices (Table 3). Women (45%), were mostly involved in the collection and processing of medicinal plants followed by children (32%), and men (23%).

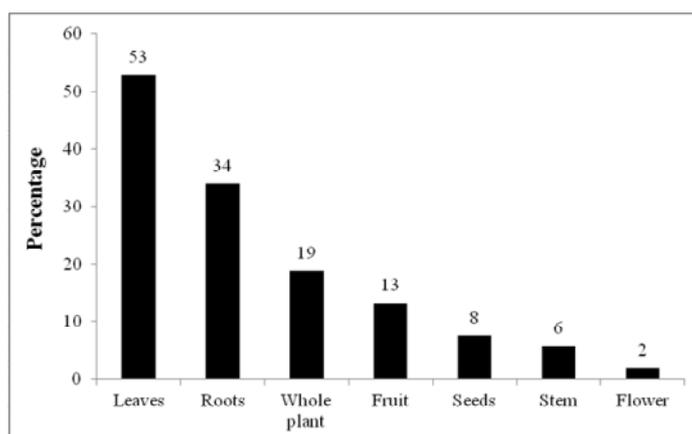


Figure 2: Number of plants based on their part use for making medicinal recipes.

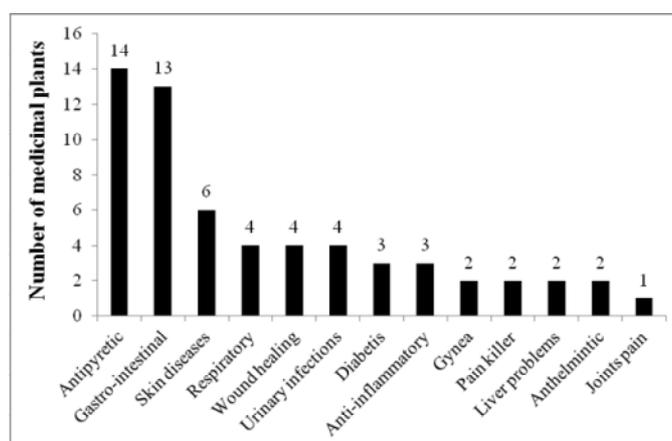


Figure 3: Number of medicinal plants used for treating various ailments in the study area.

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**Table 1:** Plants and uses.

Botanical Name	Local Name	Family Name	Habit	Parts Used	NTFP's Uses	Medicinal Uses	Recipes	Route
<i>Achillea millefolium</i> L.	Sounfi buti	Compositae	Herb	Whole plant	Medicinal, fodder, cosmetics and dye	Antipyretic, gastro-intestinal and diabetes	The whole plant is first mashed and then boiled in milk to extract different therapeutic compounds and decoction is used as remedy in severe fever and constipation	Oral
<i>Adiantum incisum</i> Forsk.	Kakhpai	Adiantaceae	Herb	Whole plant	Medicinal and fodder	Respiratory problems, antipyretic and gynea	Infusion is made in water and is taken Oral for treating disorders.	Oral
<i>Agrimonia eupatoria</i> L	Kanachika	Rosaceae	Herb	Leaves	Dye	-----	-----	
<i>Ajuga bracteosa</i> Benth.	Ratti butti	Lamiaceae	Herb	Whole plant	Medicinal	Antipyretic and gastro-intestinal	Leaf paste is used Oral to relief fever and constipation	Oral
<i>Althaea rosea</i> (L) Cav.	Gul-e-khaira	Malvaceae	Herb	Roots	Medicinal	Hepatitis, gastro-intestinal, liver, kidney problems	Roots are dip in new earthen pot for whole night. In the following morning the water juice is drunk for kidney and other problems	Oral
<i>Androsace rotundifolia</i> Y Nasir.	Kounki butti	Primalaceae	Herb	Leaves	Medicinal	Urinary infections	The leaves are crushed and the paste of the leaves is taken along water.	Oral
<i>Angelica glauca</i> Edgew.	Chora	Apiaceae	Herb	Roots	Ethno-veterinary	Gastro-intestinal	Powdered roots are taken with milk for Gastro-intestinal disorders.	Oral
<i>Aquilegia pubiflora</i> Wal.ex.Royle.	Phool	Ranunculaceae	Herb	Stem	Medicinal and fodder	Ulcer, Gynea	Paste is prepared in water and used for skin infection externally and Oral with milk to treat ulcer and gynea problems	Dermal/ Oral
<i>Arisaema flavum</i> (Forssk) Schott.	Adbis	Araceae	Herb	Root and stem	Medicinal, ethno-veterinary and insecticide	Skin	The root and stem paste is externally applied on skin	Dermal
<i>Arisaema jacquemontii</i>	Adbis	Araceae	Herb	Fruit	Insecticide and medicinal	Antipyretic	Fruit is poisonous and used as insecticide. Very small quantity is used during meal for relieving fever.	Oral
<i>Arisaema ringens</i>	Cobra plant	Araceae	Tree	Whole plant	Medicinal	Pain relief	-----	Oral
<i>Artemisia fragrans</i> Wild.	Chao	Asteraceae	Herb	Leaves	Medicinal	Antipyretic and skin diseases	Juice of fresh leaves mixed with brown sugar and given Oral in fever and skin disease	Dermal/ Oral
<i>Berberis lyceum</i> Royle.	Sunmbal	Berberidaceae	Spiny Shrub	Leaves, fruits, bark and roots	Medicinal, ethno-veterinary, fodder and dye	Gastro-intestinal, diabetes, wounds	The paste of root bark is externally applied on wounds. Crushed bark is soaked in water and the resultant extract is taken early morning to treat diabetes and Gastro-intestinal disorders. Leaves are used as fodder.	Dermal/ Oral
<i>Bergenia ciliata</i> (Haw) Sternb.	But phay	Saxifragaceae	Herb	Roots	Medicinal, fodder and cosmetics	Digestive disorders, Diabetes	Roots are dried in sunshine and then grind to make powder. Half tea spoon of this powder in the following morning is taken along desi ghee to treat digestive and diabetic problems	Oral
<i>Bistorta amplexicaulis</i> D.Don	Masloon	Polygonaceae	Herb	Leaves and roots	Medicinal and fodder	Respiratory disorders, gastro-intestinal and antipyretic	Powder mixed with little salt is used for treatment of various disorders.	Oral
<i>Canabis sativa</i> L.	Bhangh	Cannabinaceae	Herb	Leaves & branches	Medicinal, narcotic and handicraft	Antispasmodic	The leaves are antispasmodic, narcotic. They are boiled and the warmed leaves are tied over the affected parts of the body for the treatment of spasm.	Dermal

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Botanical Name	Local Name	Family Name	Habit	Parts Used	NTFP's Uses	Medicinal Uses	Recipes	Route
<i>Chenopodium album</i> L.	Sarmay	Chenopodiaceae	Herb	Leaves	Vegetable and medicinal	Anthelmintic	Leaves are cooked and taken to expel worms	Oral
<i>Chrysanthemum leucanthemum</i> Linn	Chity Phool	Euphorbiaceae	Herb	Whole plant	Fodder, handicraft and insecticide	-----		
<i>Clematis grata</i> Wall.	Bilri	Ranunculaceae	Herb	Whole plant	Fodder	-----	Whole plant is used as fodder	Oral
<i>Coptis tecta</i> Wall.	Mamera	Mimosaceae	Herb	Whole plant	Medicinal	Eye infections	-----	Eyes
<i>Dispacus inermis</i> Wall	Tandi	Dispaceae	Herb	Leaves	Vegetable	-----	Leaves are cooked and used as vegetable	Oral
<i>Dryopteris ramose</i> (Hope) C. Chir.	Pakha	Aspidiaceae	Herb	Leaves	Medicinal, fodder and vegetable	Vegetable constipation and aphrodisiac	Young leaves are collected between March-May and dry to make powder and mix with milk and used again constipation	Oral
<i>Euphorbia wallichii</i> Hook f.	Hirvy	Euphorbiaceae	Herb	Whole plant	Medicinal and fodder	Skin diseases	For the treatment of eczema, equal quantity of the plant with <i>Cuscuta reflexa</i> is made into paste and applied on the affected parts twice a day.	Dermal
<i>Frageria nubicola</i> Lindl ex Lacaíta.	Pinjakha	Rosaceae	Herb	Leaves, seeds and fruits	Medicinal, fodder and vegetable	Anti-inflammatory, gastro-intestinal and Diuretic	Fruit juice extracted and believed to cure gastro-intestinal problems	Oral
<i>Gallium aparine</i> L.	Kochan	Rubiaceae	Herb	Whole plant	Medicinal and fodder	Gastro-intestinal, antipyretic and diuretic	Juice is extracted from the whole plant and is used for different ailments.	Oral
<i>Gentiana kurroo</i> Royle.	Nile kanth	Gentianaceae	Herb	Roots	Medicinal and vegetable	For stomach pain and urinary infections	Roots are taken and dried in sunshine to make powder and taken along desi ghee to cure different infections	Oral
<i>Geranium wallichianum</i> D. Don ex sweet.	Ratunjot	Geraniaceae	Herb	Roots	Medicinal, vegetable and fodder	Joints pain	The roots are dried and grinded, sugar and milk are added in it, and it is used for pain in joints.	Oral
<i>Glycyrrhiza glabra</i> Waldst and Kit.	Mullathi	Papilionaceae	Herb	Roots	Medicinal	Gastro-intestinal	The aqueous extract from boiled roots is taken Oral to treat abdominal pain.	Oral
<i>Hedera nepalensis</i> K. Koch(Syn:H.helix L)	Albumber	Araliaceae	Herb	Leaves	Medicinal, ethno-veterinary and fodder	Diabetes	The dried branches and leaves are grinded and the powder is used early in the morning with water against diabetes	Oral
<i>Impatien bicolor</i> Royle	Batmandar	Balsaminaceae	Herb	Seeds and leaves	Medicinal and fodder	Antipyretic and diuretic	Paste of leaves is prepared and with sugar used against fever and urinary infection	Oral
<i>Leucanthemum vulgare</i> Lam.	Margue rite	Asteraceae	Herb	Whole plant	Fodder		-----	
<i>Mentha arvensis</i> L.	Chita podina	Labiataeae	Herb	Leaves	Medicinal and ethno-veterinary	Vomiting and stomach problems	Dried leaves are taken Oral to stop vomiting. Its leaves are added in green tea and used for digestive problems and cholera.	Oral
<i>Mentha longifolia</i> L.	Gangli podina	Labiataeae	Herb	Leaves	Medicinal and ethno-veterinary	Gastro-intestinal disorders	Leaves of <i>Mentha longifolia</i> , young fruits of <i>Zanthoxylum alatum</i> are grinded with seeds of <i>Punica</i>	Oral

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Botanical Name	Local Name	Family Name	Habit	Parts Used	NTFP's Uses	Medicinal Uses	Recipes	Route
<i>Morchella esculenta</i> L.	Gucchhi	Morchellaceae	Herb	Leaves	Medicinal	Tonic	granatum, and green chilies to make "Chatni" which is used to treat gastro-intestinal problems Locally the morels are fried with cows ghee and used after meal which is considered as a general body tonic.	Oral
<i>Nepeta leavigata</i> (D.Don) Hand. – Mazz.	Muskbal	Lamiaceae	Herb	Leaves	fodder	-----	Used as fodder	Oral
<i>Oxalis debilis</i> L.	Teenpatra	Oxalidaceae	Herb	Leaves	Medicinal	Skin, antipyretic, asthma, anti-diabetic and Anthelmentic	The leaves of the plant are crushed and the extract is used	Oral Oral against fever and diabetes
<i>Paeonia emodi</i> Wall. Ex Royle.	Mameikh	Paeoniaceae	Herb	Roots	Medicinal, ethno-veterinary and vegetable	Backache, antipyretic and epilepsy	Roots are dried and their taken along sweet dishes to cure backache	Oral
<i>Podophyllum hexandrum</i> Royle.	Bankakri	Berberidacea	Herb	Fruit & seeds	Medicinal	Stomach and liver disorders	Highly poisonous but expert healers use it in little amount to cure stomach and liver disorders	Oral
<i>Polygonum amplexicaul</i> D. Don.	Musloon	Polygonaceae	Herb	Roots	Medicinal, fodder and vegetable	Antipyretic	Roots and flowers are crushed to obtained juice and taken	Oral
<i>Pronella vulgaris</i> L.	Na	Lamiaceae	Herb	Leaves	Medicinal and fodder	Anti-inflammatory	Both fresh and dry leaves are used against inflammation	Dermal
<i>Ranunculus muricatus</i> L.	Rat mondia	Ranunculaceae	Herb	Leaves	Fodder		It is used as fodder.	Oral
<i>Rheum webbianum</i> Royle.	Chutiya	Polygonaceae	Herb	Roots	Medicinal	Healing internal wounds	Rhizomes are cooked and eat to cure internal wounds	Oral
<i>Rubdosia longituba</i>	Boi	Lamiaceae	Herb	Roots	Medicinal and fodder	Ear and nose infections	-----	Ear and nose
<i>Rumex dentatus</i>	Khatimble	Polygonaceae	Herb	Leaves & roots	Medicinal and fodder	Healing wounds and jaundice	The extract of the leaves is used as antiseptic against wounds. Leaves are grinded and used against jaundice	Oral/ Dermal
<i>Rumex nepalensis</i> Spreng.	Hoola	Polygonaceae	Herb	Leaves	Medicinal	Healing wounds	The extract of the leaves is used as antiseptic against wounds.	Dermal
<i>Senecio salignus</i> DC	Chita ula	Asteraceae	Herb	Leaves, roots, seeds and fruit	Medicinal, ethno-veterinary and fodder	Anti-inflammatory and gastro-intestinal	Crushed leaves and roots are taken along milk to cure gastro-intestinal diseases	Oral
<i>Solanum nigrum</i> L.	Katch mach	Solanaceae	Herb	Roots, leaves and Fruit	Medicinal	Gastro-intestinal	Leaves and fruits are cooked and used against abdominal swellings and stomach-ache.	Oral
<i>Swertia chirata</i> Buch.	Charieta	Apiaceae	Herb	leaves	Medicinal	Antipyretic, skin diseases	The leaves are grinded and the paste is dissolved in water along with some brown sugar and is used against fever especially malaria.	Oral/ Dermal
<i>Urtica dioka</i> L.	Bichu boti	Urticaceae	Herb	leaves and roots	Medicinal, ethno-veterinary and vegetable	Astringent and anthelmentic	Decoction of the plant is astringent and anthelmentic. Leaves cause severe irritation which can be soothed by rubbing leaves of Rumex.	Oral

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Botanical Name	Local Name	Family Name	Habit	Parts Used	NTFP's Uses	Medicinal Uses	Recipes	Route
<i>Valeriana jatamansi</i> Wall.	Mushke-bala	Velerianaceae	Herb	Roots	Medicinal and fodder	Antipyretic and Skin disease	Decoction of roots is prepared and used again fever and externally for skin	Oral/ Dermal
<i>Viola canescens</i> Wall.	Pholala	Velerianaceae	Herb	Leaves & roots	Medicinal, fodder and vegetable	Cough and respiratory problems	The leaves paste is mixed with brown sugar to be used against cough, cold and other respiratory problems.	Oral
<i>Viola serpens</i> Wall.	Banafsha	Violaceae	Herb	Leaves and flowers	Medicinal	Cooling agent	Flowers and Leaves are boiled in water for one hour. One cup of this decoction is used three times in a day to reduce body weakness and provide cooling effect	Oral
<i>Zanthroxylum armatum</i> DC.	Timber	Rutaceae	Tree	Fruit & stem	Medicinal, ethno-veterinary, vegetable and cosmetics	Antipyretic, Gastro-intestinal and dental pain	Young fruits are grinded with seeds of <i>Punica granatum</i> , leaves of <i>Mentha longifolia</i> and green chilies to make "Chatni". Its fruits are highly carminative and also used against stomach-ach. Young branches are used as "Miswak" just like toothbrush.	Oral

**Table 2;** Common preparation methods for ethono-medicines.

Method	Preparations	% age
Crushed	14	26
Powder	12	23
Cooked	8	15
Others	8	15
Decoction	6	11
Juice	4	8
Infusion	1	2
Total	53	100

**Table 3:** Phytochemical review of highly marketable species.

Botanical Name	Part Used	Chemical Constituent	References	Market prices (US\$ Kg <sup>-1</sup> )
<i>Achillea millefolium</i>	Leaves and flower	Saponins, flavonoids, alkaloids, essential oil, volatile oil, proazulene, azulene, terpenes, tannin, coumarins, sterols, vitamins, amino and fatty acid, phenol carbonic acid, ethanol and hydroalcoholic.	(Kumar et al., 2011; Gupta & Sharma, 2006)	3.15
<i>Adiantum incisum</i>	Whole plant	Triterpenoids, Noroleanane, adininaonol, adiantuoleanone, flavonoids	(Pan et al., 2011)	8.1
<i>Bergenia ciliata</i>	Roots	Flavonoids, tannins, phenols, sterol, alkaloid, glycosides, tannin acid, gallic acid, berginin, catechin, gallicin, anthraquinone.	(Ruby et al., 2012)	2.5
<i>Dryopteris ramose</i>	Leaves	Phenols, tannins, flavonoids, alkaloids.	(Gupta & Sharma, 2006)	7.15
<i>Fragaria nubicola</i>	Fruit, leaves and roots.	Resin, tannin, carotenoids, ellagic acid, flavonoids.	(Shinwari, 2003)	8.1
<i>Hedera nepalensis</i>	Aerial parts, leaves, stem	Tri terpenoid, saponins, polyynes, steroids and flavonoids.	(Ahmad, 2012; Uddin et al., 2012)	5.11
<i>Paeonia emodi</i>	Rhizomes	Saponins, ash, oleanolic acid, betulinic acid, ethyl gallate, methyl grevillate and 1, 5-dihydroxy-3-methylanthraquinone, monoterpene.	(Khan et al., 2005; Chaurasia et al., 2010)	2.25
<i>Podophyllum hexandrum</i>	Fruit and seeds, leaves, root	Podophyllotoxins, podophyllin, podophyllic acid, podophylloquercin, starch and tannin, lignans, resin.	(Sharma, 2013)	2.15
<i>Valeriana jatamansi</i>	Rhizome	Alkaloids, flavonoids, tannins and saponins, volatile oil, citric acid, malic acid, maliol, succinic acid and tartaric acid.	(Fazal, 2007)	3.75
<i>Viola canescens</i>	Whole Plant	Alkaloids, tannin, coumarins, flavonoids, glycosides, carbohydrates, phenolic compounds, saponins.	(Barkatullah et al., 2012)	8.75

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## Discussion

People of the Nathiagali depend on plant resources and extensive use of those for various ailments. They know useful plants and the preparation of recipes through personal experience, ancestral prescription and long utility. Herbs are mostly the primary source/s of medicinal plants in the study area. Abundant use of herbs for medicinal purposes might be due to its wide occurrence, easy availability and high therapeutic activity as compared to other growth forms. Our study is in line with the findings of Mohammed (2004), Gebre (2005) and Teklehaymanot and Giday (2007), which shows that herbs are more effective in the treatment of ailments as compared with other growth forms.

Almost all plant parts are used in the study area for the preparation of different ethno-medicines but the leaves and roots are mostly preferred parts to be used. The basic reason behind collecting leaves may be attributed to its easy availability in all four seasons of the year and the relatively easy collection method. This type of harvesting is non-destructive because it does not affect the life cycle of the plant. Roots are the second most common harvested plant part in the investigated area. This could be associated with the fact that roots remain in the soil and are easily available even during the dry season. Another possible reason could be that the roots of herbaceous plants can be easily harvested by digging out the whole plant. Same results were also reported by Ketema et al. (2013), and Hussain et al., (2006), where leaves and roots are mostly used for the treatment of variety of diseases. However the use of medicinal plants roots either for the immediate treatment of ailment or for commercialization purpose to generate income, could have negative impact on the biological diversity and conservation.

Mostly the plants are used in the study area to treat different ailments like antipyretic and gastro-intestinal problems. Same findings were reported from other regions of Pakistan (Adnan et al., 2012; Khan et al., 2011). The possible reason behind these ailments is bad hygienic conditions and fuel wood smoke inside houses. People of the area drink bacterial contaminated water due to the lack of water filtering facilities that result in gastro-intestinal diseases (Azizullah et al., 2011). The traditional uses of plants have been scientifically proved by various studies like roots of *Bergenia ciliata* in the present study is used against gastro-intestinal disorders and diabetes. This, may be due to the presence of different therapeutic compounds in the roots like phenols, tannins, steroids, saponins, flavonoids, gallic acid and gallicin, which have strong antidiabetic, antiulcer, antidiarrheal and antioxidant activities (Ruby et al., 2012; Singh et al., 2011). In another example, *Achillea millefolium* is traditionally used as antipyretic, antidiabetic and treating gastro-intestinal disorders. The presence of phytochemical in this plant species such as flavonoids, terpenoids, lignans, amino acid derivatives, fatty acids and alkaloids have proven strong action against such disorders (Saeidnia et al., 2011). Moreover, Ahmad et al., (2012), found that the leaves of *Hedera nepalensis* contain tri-terpenoid, saponins, polyynes, steroids, and flavonoids that are having strong antidiabetic potential. Hence, each medicinal plant consisted of therapeutically active agents that are active against certain disease exactly as treated locally using traditional methods. These scientific explanations authenticate the reliability of ethno-medicines and also encourage pharmacologists and chemists to carry out further chemical investigation on traditionally used medicinal plants.

The traditional healers of the Nathiagali use different methods of drugs preparation. Most of the ethno-medicines are taken in crushed and powder form. According to Deeba (2009) these two are the most common and effective methods of drugs extraction. Majority of the recipes in the study area are made by using single plant material while there are certain remedies that are the mixture of two or more plant species like *Euphorbia walichii* is mixed with *Cuscuta reflexa* and used against skin infections. Similarly, the leaves of *Mentha longifolia*, young fruits of *Zanthoxylum alatumare*, seeds of *Punica granatum* and *Capsicum annum* are grinded together to make "Chatni" (paste like) that is proved effective in curing gastro-intestinal disorders. The use of crushing and powder technique and mixing two or more plants could be associated with the healer's belief of neutralizing the synergistic effect in treating an illness. This finding is consistent with earlier reports (Teklehaymanot and Giday, 2007; Filate et al., 2009), however, disagree with other studies (Yirga, 2011; Lal and Yadav, 1983) where the frequent use of concoction was the main use form. It is likely that these differences are associated with the differences in culture and knowledge in different socio-cultural groups. Remedies are mostly taken orally in the study area. The choice of oral administration may be related to the use of some solvents or additives (milk, butter, water and sugar) that are commonly believed to serve as a vehicle in transporting the remedies inside. The additives are also important in minimizing discomfort; improve the taste and reduce adverse effects like vomiting and diarrhea, and enhance the efficacy and healing conditions (Ketema et al., 2013). Supporting findings to our study were also reported by other researchers indicating the oral route is the most preferred mode of administration (Filate et al., 2009; Mesfin et al., 2009).

Medicinal plants serve as an income generation source for most of the local people besides using it for the treatment of various diseases (Adnan et al., 2012). Most of the medicinal plant resources used by the marginal communities have not been conserved but rather irrationally exploited. Medicinal plants have been unsustainably collected from wild habitats for domestic and commercial purposes without any strategies reported to conserve them. This lack of efforts to sustain these resources may result in depletion from natural habitats (Qureshi et al., 2006). In our study it was found that mostly women are collecting medicinal plants. Ahmad and Javed (2007), found that women and other collectors have no proper training of harvesting and processing of medicinal plants, which may result in tremendous losses both in terms of quality and quantity. Ecologically, improper harvesting leads to damage the survival of individual plants (Ticktin, 2004).

The study shows that people of the area are much dependant on the native flora for acquiring their basic requirements. One of the major reasons is that the whole area is rural in nature and most of the people keep livestock as other source of income. The analysis of the ethno-botanical data shows that a large number of medicinal plant species are also used for fodder/forage purpose. Hence, the area is facing a threat of overgrazing and over collection of plants as fodder. Moreover, trampling of animals makes the soil compacted and seed germination and seedlings are also getting damaged (Sher and Hussain, 2008). People of the area are also involved in cutting trees for fulfilling the fuel wood requirement and income generation due to the absence of modern fuel resources. Ahmed et al., (2013) also recorded similar results in their study conducted in new Muree, Pakistan. Deforestation is another major threat towards the extinction of such species as mentioned in a study conducted by Adnan and Hölscher (2011, 2012). Hence, medicinal plants are valuable for the rural livelihood, however at the same time are also facing certain conservation concerns. High utilization of plants and lack of conservation initiatives may result in depletion of the precious flora, which as a consequence may reduce the indigenous knowledge on ethnomedicines.

## Conclusions

The study proved that medicinal plants are playing significant role/s in meeting the primary health care and economic needs of the people in the study area. The people of the region especially women have much knowledge that has been transferred from their parents on the treatments of various health disorders with the use of ethno-medicines. However, it is a dilemma that the younger generation is totally ignorant about such precious

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traditional knowledge on plants that might be due to their reliability on allopathic drugs and modernization. This study has contributed in the documentation of enormous indigenous knowledge on medicinal plants and plant-based remedies practiced among the natives of the study area. Moreover, the ethno-medicinal uses have been confirmed by the presence of phytochemical in these medicinal plants that are proven in the modern day pharmaceutical science against certain diseases. Furthermore, the information generated may validate studies on the acceptability of plant-based remedies on human health both nationally and internationally. There are certain threats to this valuable flora of the region like overexploitation, improper collection, grazing and deforestation. Future studies can be done on such aspects and to quantify the loss of valuable flora due to such malpractices. Moreover, it is recommended to give proper training to the medicinal plants collectors to avoid losses. Protection should be given to those forests where there is overexploitation. Reforestation in the region can also be a way forward for the recovery of medicinal plants. Such highly utilized medicinal flora must be subjected to cultivation trials under agro-forestry system. This may improve rural livelihood, address conservation concerns on this precious flora and ecological restoration in the study area.

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