Revista Brasileira de Farmacognosia 29 (2019) 665–676

Brazilian Journal of Pharmacognosy
REVISTA BRASILEIRA DE FARMACOGNOSIA
www.elsevier.com/locate/bjp

Original Article

Quantitative ethnopharmacological profiling of medicinal shrubs used by indigenous communities of Rawalakot, District Poonch, Azad Jammu and Kashmir, Pakistan

Sajjad Hussain [a], Abdul Hamid [b], Khawaja Shafique Ahmad [a,*], Ansar Mehmood [a], Fahim Nawaz [c], Haroon Ahmed [d]

[a] Department of Botany, University of the Poonch Rawalakot, Azad Kashmir
[b] Department of Horticulture, University of Poonch Rawalakot, Azad Kashmir
[c] Department of Agronomy, Mian Nawaz Sharif, University of Agriculture, Multan, Pakistan
[d] Department of Biosciences, COMSATS Institute of Information Technology, Islamabad, Pakistan

ARTICLE INFO

Article history:
Received 29 June 2018
Accepted 7 June 2019

Keywords:
Medicinal shrubs
Use value
Family importance value
Jaccard index
Rawalakot
Himalaya

ABSTRACT

This paper presents the first comprehensive report on traditional uses of medicinal shrubs of Rawalakot city, district Poonch, Azad Jammu and Kashmir, Pakistan. Ethobotanical data obtained from 120 informants were analyzed by relative frequency citation, use value, family use value, informant consensus factor, fidelity level and Jaccard index. In total, 41 shrubs belonging to 24 families and 34 genera were documented. Rosaceae was reported the most dominant family in the area (six species) and Berberidaceae showed maximum family use value (0.68). Leaves (35%) and fruits (33%) were the most commonly used plant parts and most of the medicines were prepared in the form of decoction. The high informant consensus factor value (0.94) was recorded for diabetic disease category. Medicinal plants with high fidelity level values (100% each) were *Berberis lycium, Cydonia oblanga, Ricinus communis, Ziziphus jujuba* and *Nerium oleander*. *Berberis lycium* was the most significant shrub in the area with highest use value (0.68). Relative frequency citation value was maximum for *Rubus ellipticus* (0.30), *Nerium oleander* and *Indigofera heterantha* (0.10 each). Percentage of similar plant uses ranged from 21.05 to 0.62% and dissimilarity percentage ranged from 32.50 to 0.66%. Out of the 41 shrub species, six were reported with new therapeutic uses and may represent new bioresources. These were *Debregeasia salicifolia* (diabetes), *Desmodium elegans* (anti-cancerous), *Hibiscus rosa-sinensis* (jaundice), *Hypericum oblongifolium* (arthritis), *Sarcococca saligna* (tuberculosis), *Rubus niveus* (chronic cough) and *Otostegia limbata* (renal disorders). We suggest that species reported with high use value should be involved in cultivation and agricultural practices for their sustainable use and those reported with new therapeutic uses should be employed in further biotechnological, pharmacological and clinical studies in order to validate their traditional uses.

Introduction

Ethnobotany is the systematic study of plants and their practical uses through the traditional knowledge of a local culture and people (Jennings et al., 2014). Plants serve humans with food, shelter, fuel, medicines and fodder for their animals (Towns and van Andel, 2016). Ethnobotanical knowledge is of great importance encompasses both wild and domesticated plants (Sansanelli et al., 2017; Faruque et al., 2018). Main focus of the ethnobotany is documentation and preservation of traditional medicinal knowledge, community development and conservation of endangered species (Ajaib et al., 2014). Medicinal plants containing therapeutic agents have been used in healthcare to cure human diseases and nowadays still represent an important tool for the identification of novel drugs (Alarcon et al., 2015).

Medicinal plants contain substances that can be used for therapeutic purposes and large number of plants have been used in traditional system for many years (Ahmad et al., 2017). Low economic state of the human population is the major reason for using medicinal plants for the treatment of diseases instead of synthetic medicines (Aziz et al., 2017). Other reasons are accessibility and promising efficacy of natural medicines comparable to the high cost and adverse effects of synthetic drug agents (Kayani et al., 2014; Rehman et al. 2017).

* Corresponding author.
E-mail: ahmadks@upr.edu.pk (K.S. Ahmad).

https://doi.org/10.1016/j.bjp.2019.06.008

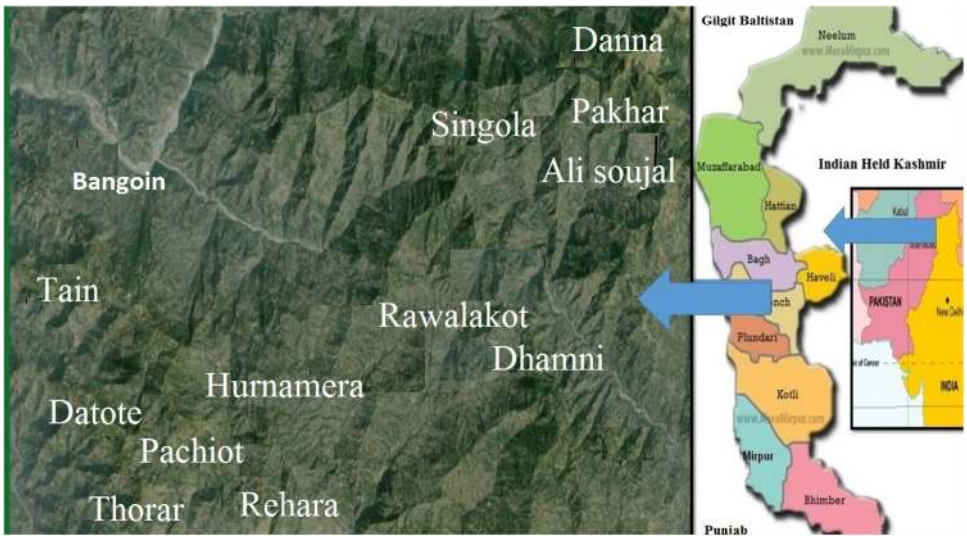

Fig. 1. Geographical location of study area (Right) Localities surveyed during s tudy (Left).

Out of 422,000 flowering plants, about 35,000 to 50,000 plants are being used for medicinal purposes (Govaerts, 2001; Schippmann et al., 2002). It is estimated that in developing countries, about 80% of the population rely on medicinal plant products for self-medication (WHO, 2002; York et al., 2011). In Pakistan, about 5,700 to 6,000 species of vascular plants are present (Shinwari, 2004; Ahmad et al., 2012a; Ahmed and Murtaza, 2014), of these about 400-600 are used for medicinal purpose (Malik et al., 2005).

Traditional knowledge is used for the well-being of humans in order to improve physical and mental disorders all over the world (Demie et al., 2018). It is now a well-documented fact that ethnobotanical knowledge plays a significant role in the world economy and is not only cherished in daily lives of humans, but also in modern industry and agriculture (Oliver, 2013). Thus, ethnobotanical inquiries on medicinal plants are one of the most primary human concerns (Ana et al., 2013).

In modern ethnobotany, information related to bio-resources for the well-being of human focuses on social and economic aspects, effective conservational strategies of local flora and environmental protection (Jain, 2004; Begum et al., 2018). Ethical demands are capacity building among native people, preservation of the knowledge and mutual sharing of benefits from commercial use of the indigenous knowledge (Faruque et al., 2018). Modern scientific approach in ethnobotany is to ensure the accuracy of data with statistical support and use of quantitative indices of the data (Ahmad et al., 2017).

Latest developments in the field of ethnobotany in the last few decades include quantitative approaches including multivariate statistical analysis (Rivera et al., 2007), use value indexation (Mukherjee et al., 2012) and associating information with floristic and phytosociological inventories (Ahmad et al. 2012a; Ong and Kim 2014). Researchers have developed and applied ethnobotanical indices to ethnopharmacological data that measure cultural and medicinal importance of plants quantitatively (Abbasi et al., 2013; Abbas et al., 2016; Popović et al., 2016; Khan et al. 2017; Ahmad et al., 2017; Shaheen et al., 2017, Faruque et al., 2018). These indices are used to evaluate the utilization of plants in different purposes such as food (Pieroni, 2017), veterinary medicine (Khattak et al., 2015), human disease remedies (Ali et al., 2018) and economic benefits obtained from plants (Camou-Guerrero et al., 2008). One common purpose of these quantitative ethnobotanical indices was to determine the importance of plants for ethnic and indigenous people (Ong and Kim, 2014).

Azad Jammu and Kashmir (AJK) is a self-governing State, administrated by Pakistan. It lies at the foothills of western part of Himalaya, having an area of about 13,269 Km^2. The area is divided into northern mountains and southern plains. Northern mountainous region includes district Muzaffarabad, Bagh, Poonch and Hawaili and southern part includes district Kotli, Bhimber and Mirpur. Rawalakot (study area) is of the capital city of district Poonch in Pakistani Administrated Azad Jammu and Kashmir (AJK). It is well-known for having significantly diverse flora with a remarkable portion of endemic plant species (Rashid et al., 2015) and about 80% of the endemic plants of Pakistan are present in the western parts of the Himalaya (Ali, 2008).

In the last few years, several ethnobotanical studies have been conducted on large scale in different parts of Pakistani side of Azad Jammu and Kashmir (Ajaib et al., 2010; Ahmad et al., 2012a; Shaheen et al., 2012; Khan et al., 2012; Ahmad et al., 2012b, Ishtiaq et al., 2013; Bano et al., 2014a; Ahmad et al., 2017; Shaheen et al., 2017). However, this is the first comprehensive study with the sole aim of documenting the indigenous knowledge about the medicinal shrubs with therapeutic uses in the Rawalakot city and its allied areas of district Poonch, AJK, Pakistan and their cultural importance among local communities. Ethnobotanical data collected by interviewing local informants is analyzed and authenticated using quantitative tools.

Materials and Methods

Study area

Kashmir is a State that is administrated by two countries: India and Pakistan. Pakistani administrated part is known as Azad Jammu and Kashmir (AJK). Rawalakot is the capital city of Poonch district in Pakistani administrated, Azad Jammu and Kashmir (latitude 33°51'32.18Ñ, longitude 73° 45'34.93Ë). It occupies an area of about 380 sq miles and elevation levels range from 1500 to 1638 m above sea level (Fig. 1). The area lies in western part of the Himalaya and supports more than 400 of medicinal plant species (Begum et al., 2018). Climate of the area is subtropical (lower altitude) to humid temperate type (high altitude). Summer is moderate but winter experiences a heavy snowfall from later fortnight of December to the end of February. June is the hottest month with an average temperature of 34 °C and coldest is January with an average temperature of 11 °C (Faiz et al., 2014). The average temperature of summer is 27-29 °C and in winter it drops between 0-3 °C. The

Table 1
Demographic profile of the informants included in the survey (N = 120).

Informants	Demographic Information	Total	Percentages (%)
Gender	Men	80	66.67
	Women	40	33.33
Categories	Traditional healers	20	16.67
	Indigenous people	100	83.33
Age groups	30–45	40	33.33
	46-60	55	45.83
	61-75	15	12.50
	76 and above	10	8.33
Educational level	Illiterate	40	33.33
	10 years of education	20	16.67
	12 years of education	20	16.67
	14 years of education	15	12.50
	16 years of education	10	8.33
	18 or more years of education	15	12.50
Occupation	House wives	30	25.00
	Shopkeepers	15	12.50
	Farmers	25	20.83
	Labors	20	16.67
	Teachers	10	8.33
	Hakeems	20	16.67

annual rainfall is variable year to year with an average of about 55.08 inches. The area has usually two seasons; a growing and a dormant season. Both plants and animals are adapted to dry and cold conditions (Qamar et al., 2010). The forests of the area are divided into three types *i.e.*, sub-tropical broad and pine leaves forest and Himalayan moist temperate forests (Champion et al., 1965). Open grasslands are occupied mainly by grasses and other small herbs while, woodlands are dominated by conifers such as *Pinus roxburghii*, *P. wallichiana*, *Cedrus deodara*, *Abies pindrow* and *Picea smithiana*. Local people are primarily farmers and rear livestock. They grow maize, wheat, beans, vegetables and fruits to fulfill their daily needs (Khan et al., 2012). Apples, apricots, peaches, walnuts, plumbs and pears are cultivated and traded in the local market. The study area has quite diverse ethnic composition. Main tribes are Gujjars, Rajputs, Sudhans, Khawaja and Jats. According to the last census held in 2014, there are 4,980 households in Rawalakot and each household comprises of an average of 7.6 members (Shaheen et al., 2017). Pahari is the main language of the area. Besides, Gojri, Hindko and Kashmiri is also spoken in different parts of the study area. There are 25 high schools, eight inter colleges, five degree colleges, one medical college and one university in the study area. Besides public sector educational institutes, many institutes are also serving in private sector resulting in high literacy rate. The area is characterized by high mountains with poor road network and basic health facilities are often not available to poor families in remote areas (Amjad et al., 2017; Shaheen et al., 2017).

Demography and data collection

Demographic information of the informants was obtained and documented through face to face interviews. In order to collect the ethnobotanical information on medicinal shrubs, extensive field visits were made during the year 2016 and data were gathered from informants through pre-planned questionnaires using standardized data collecting protocols (Alexiades, 1996; Martin, 2004; Heinrich et al., 2009). A total of 120 informants were interviewed through convenience sampling. Of these, eighty informants were male and forty were female (Table 1). Out of the total, twenty informants were well-known traditional healers in the study area and one hundred informants were indigenous practitioners. Young informants (40) were between the ages of 30-45 years, 55 were the ages of 40-60 years and fifteen were 61 to 75 years old. Rest of the informants were of the age of 76 or above. Majority of the informants (40) were illiterates and 55 informants were having 10 to 16 years of education. About ten informants were holding master degree and 25 were M.Phil and Ph.D.

During interviews, it was observed that older and less educated people have more traditional knowledge of plants than younger people. The informants were belonging to different professions such as housewives (30), shopkeepers (15), farmers (25), labors (20), teachers (10) and hakeems (20). Information on medicinal shrubs was carefully recorded during the interviews and rules of PIC were strictly followed (Cotton, 1996; Khan et al., 2014). All the informants were interviewed in local language Pahari. The key questions on medicinal shrubs were on local name, part used, mode of preparation and administration, amount of dose given, disease treated and personal experience of informants. All the information was further authenticated by Hakeems (herbal doctors). Code of ethics of International Society of Ethnobiology (2008) was followed during data collection (http://ethnobiology.net/code-of-ethics/).

Plant preservation and identification

For preservation, plants were first pressed, dried and then preserved on herbarium sheets. Before mounting plants on herbarium sheets, specimens were sprayed with 1% $HgCl_2$ solution in order to avoid fungal attack. At the end, each plant species was assigned with a voucher number. Plant scientific names were authenticated with the help of Flora of Pakistan (Nasir and Ali, 1970-1989; Ali and Nasir, 1989-1992; Ali and Qaiser, 1993-2008; Ali and Nasir, 1970-2002), Catalogue of vascular plants of West Pakistan and Kashmir (Stewart et al., 1972), Flora of China, International Plant Names Index (IPNI), Scopus, Web of Science and Google scholar. Species names were supplemented with families, life forms and folk medicinal uses. Life forms were categorized according to the proposed system of Raunkiaer (1934) and Brown (1977). Identified plant specimens were deposited at the Herbarium of department of Botany, University of the Poonch, Rawalakot, AJK.

Data analysis

The scientific precision of ethnobotanical research has been increased dramatically in last few decades. One important aspect of ethnobotany is the assessment of ethnobotanical knowledge of plants by quantitative techniques to in order produce valuable and less tangible data Quantitative indices in ethnobotany can offer data amenable to hypothesis-testing, statistical authentication and comparative analysis (Hoffman and Gallaher, 2007). In this study, ethnobotanical data were tested through Relative Frequency of Citation, (RFC), Use Value (UV), Family Use Value (FUV), Informants Consensus Factor (ICF), Fidelity Level (FL) and Jaccard Similarity Index (JI).

Relative Frequency of Citation (RFC)

Relative frequency of citation was appraised to measure the agreement among the informants of the study area on documented medicinal plants. RFC was evaluated by a method described by Vitalini et al. (2013).

$$RFC = \frac{FC}{N}$$

Where, FC is the number of informants mentioned the uses of plant species and N is the total number of informants interviewed in the study area. For example, RFC for *Astragalus psilocentros* is 0.05 which is calculated by dividing number of informants who mentioned this plant (FC = 7) with total number of informants interviewed in the study area (N = 120).

Use Value (UV)

The use value (UV) demonstrates the significance of a species by considering number of use reports mentioned by local inhabitants of the study area. Use value of each species was evaluated by generating score "1" for major uses and "0.5" for minor uses (Prance et al., 1987).

$$UV = \frac{\sum^{ui}}{Ni}$$

Where, U*i* is the number of use reports for species and N*i* is the total number of informants interviewed for given plant species. For example, use value of *Berberis lycium* was calculated 0.68 by dividing use reports (Ui = 5.5) with total number of informants (Ni = 8).

Family Use Value (FUV)

Additionally, in order to describe the most important plant families in the study area, Family Use Value (FUV) was calculated using use values of the species.

$$FUV = \frac{UVs}{ns}$$

Where, UVs is the use values of the species, and ns is the total number of species within each family.

Fidelity Level (FL %)

The most preferred species for the treatment of particular disease was evaluated by fidelity level. FL was calculated by a formula described by Friedman et al. (1986).

$$FL = \frac{Np}{N} \times 100$$

N_p is the total number of informants citing the species for the treatment of particular disease and N is the total number of informant citing the species for the treatment of any disease.

A high FL means that there is high frequency of plants use for the treatment of specific disease *e.g.*, fidelity level of *Berberis lycium* for healing of bone fractures is 100% where total number of informants citing the species for the treatment of particular disease (Np = 8) and total number of informant citing the species for the treatment of any disease (N = 8).

Informant Consensus Factor (ICF)

Informant consensus factor was used to measure the agreement among the local informants of the area for the use of medicinal plant species against a disease category (Trotter and Logan, 1986; Heinrich et al., 2009). ICF is based on correlation between informant's knowledge and its value ranges between 0-1. A value near to 1 indicates that there is homogeneity of information among local informants (Abu-Irmaileh and Afifi, 2003; Giday et al., 2009).

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

Here, N_{ur} is the total number of use citations for each disease and N_t is the total number of species used for the treatment of that disease.

Jaccard Index (JI)

The data presented in our study were compared with already published data in adjacent areas of Himalayan territory and other parts of the world. Jaccard index is widely used to know the species composition, commonness of species and similarity in indigenous uses of plant species by appraising percentage of reported species and their medicinal uses (Ahmad et al., 2017).

$$JI = cx\frac{100}{a+b+c}$$

where, 'a' represent the number of plants in an area 'a' (study area), 'b' is number of plants in area b (neighboring area) and 'c' is number of plants common to area a and b.

Results and discussion

A list of recorded shrubs with botanical names, families, and local names, medicinal and other uses is presented in Table 2. In total, 41 shrubs belonging to 24 families and 34 genera were catalogued and documented from the study area, which are being used in folk remedies for the treatment of various ailments. The dominant family in terms of the number of plant species was Rosaceae (six species), followed by Caprifoliaceae (three species), Oleaceae (three species), Leguminosae (three species) and Rhamnaceae (three species). Elaeagnaceae, Euphorbiaceae, Lamiaceae and Verbenaceae were represented by two species while remaining fifteen families were monospecific (Fig. 2). Rashid et al. (2015) also reported Rosaceae as a dominant family with nine species from Himalayan region of Azad Jammu and Kashmir, Pakistan. Rosaceae is the third most economically important group in plant families and diet of many people is enriched by its fruits. Dominance of Rosaceae in Rawalakot reflect the fact that most of the member of this family are cultivated for food in the area. Therefore, plants of the family are easily accessed and processed by the local people for the treatment of various diseases. Further, climate of the study area is of temperate type which provides ideal conditions for the growth of Rosaceae plants. It has been reported that fruit of the Rosaceae is rich in phenolic contents, thus representing a good source of compounds with antioxidant properties (Miller and Ruiz-Larrea, 2002). It is well documented fact that commonly occurring plant species in any area have greater chance of their widespread uses by the local people in disease management (Ahmed et al., 2013).

Plant part usages and mode of administration

Among various plant parts used, the leaves (35%) were most often used for the preparation of medicines followed by fruits (33%), roots (14%), seeds (9%) and flowers (7%) (Fig. 3). Similar studies conducted in the allied areas also reported that ethnic populations also utilized mostly leaves for the preparation of herbal drugs at home (Kayani et al., 2014; Ahmad et al., 2017). Frequency of the plant part used in different areas depends on the sharing of cultural knowledge and availability of plant in that particular area (Jamila and Mostafa, 2014). The reason why leaves were mostly used is that this might be due to the fact that leaves are effortlessly collected than underground parts, fruits and flowers and they are easily processed for the preparation of plant based medicines (Ahmed et al., 2013). Contradictory to our findings, Hunde et al. (2006) reported that roots were most frequently used part and this could be related to different ethnobotanical culture, preference of the people and variation in environmental conditions (Meragia et al., 2016).

The most frequently used process of crude preparation of medicinal plants was decoction (fourteen species) followed by paste (nine species), powder (eight species), fruit (eight species) juice (three species) and seeds (three species) and oil (one species). Crude preparation of decoction obtained from boiling plant parts in water for the treatment of ailment is common practice among the ethnic communities of Rawalakot. Most of the ailments in the study area were treated orally (Fig. 4), which is in good agreement with some other reports from the neighboring areas (Ishtiaq et al., 2013; Qureshi et al., 2009). Meragia et al. (2016) reported that people in

Table 2
List of ethnobotanically important shrubs of Rawalakot, Azad Jammu and Kashmir Pakistan.

	Taxon	Family	Vernacular name	[a]Use reports	UR	FC	RFC	UVs	FL%
1.	*Justicia adhatoda* L. Upr-raw-208	Acanthaceae	Bakor	Decoction of leaves is used in bronchitis[6]. Twigs are used as fuel wood[4] and leaves are also used as fodder[2].	1.5	9	0.07	0.16	66
2.	*Cotinus coggygria* Scop. Upr-raw-117	Anacardiaceae	Bann	Twigs are used as toothbrushes[7]. Leaves powder is antiseptic[4]	1.5	7	0.05	0.21	57
3.	*Calotropis procera* (Aiton) Dryand. Upr-raw-109	Apocynaceae	Ak	Flower juice is used in ear pain[5]. Paste of flowers is used to cure skin infection[3].	1.5	7	0.05	0.21	71
4.	*Nerium oleander* L. Upr-raw-265		Kanair	Plant is ornamental[9]. Twigs are used as toothbrush in toothache[12]. Leaves paste is used to treat skin infections[7].	2.5	12	0.10	0.20	100
5.	*Berberis lycium* Royle Upr-raw-81	Berberidaceae	Sumbal	Powder made from root bark is cooked in milk to heal bone fractures[8], treat diabetes[8]and stomach disorders[8]. Leaves are chewed in sore throat[5]. Fruit is edible[8]. Twigs are used as fuel[3].	5.5	8	0.06	0.68	100
6.	*Sarcococca saligna* (D.Don) Müll. Arg. Upr-raw-205	Buxaceae	Nadroon	Leaves paste is used to treat tuberclosis[5] and headache[3]. Root bark powder is used for the treatment of uterus infections[3].	1.5	7	0.05	0.21	42
7.	*Lonicera quinquelocularis* Hard. Upr-raw-172	Caprifoliaceae	Tittrola	Twigs are used as fuel[4]. Ripened seeds are used against skin cracks[5].	1.5	9	0.07	0.16	55
8.	*Viburnum cotinifolium* D.Don. Upr-raw-309		Jammar	Fruit is edible[5] and blood purified[5]. Shoots are used for making toothbrushes[3]	2	9	0.07	0.22	55
9.	*Viburnum grandiflorum* Wall. ex DC. Upr-raw-310		Jammar	Fruit is edible[7] and blood purifier[5]. Shoots are used for making toothbrushes[5].	2	8	0.06	0.25	62
10.	*Diospyros kaki* Thunb. Upr-raw-52	Ebenaceae	Amlook	Fruit is laxative[7], refrigerant[3] and effective in dyspepsia.	2.5	9	0.07	0.27	77
11.	*Elaeagnus angustifolia* L. Upr-raw-95	Elaeagnaceae	Konkol	Fruit is edible[7], blood purifier[8] and gives relief in dysentery[4].	2.5	9	0.07	0.27	88
12.	*Elaeagnus umbellata* Thunb. Upr-raw-96		Ghiyani	Fruit is edible[7], effective in dysentery[5]. Plant is used for fuel wood[7].	2.5	7	0.05	0.35	71
13.	*Mallotus philippensis* (Lam.) Müll. Arg. Upr-raw-190	Euphorbiaceae	Kamila	Twigs are used as fuel wood[9]. Leaves paste is used in skin diseases[5]. Powder from fruits is used against intestinal worms[6].	2	11	0.09	0.18	54
14.	*Ricinus communis* L. Upr-raw-144		Hernoli	Seed oil is laxative[9]. Leaves decoction is used to reduce swelling of wounds[7] and toothache[3].	2.5	9	0.07	0.27	100
15.	*Hypericum oblongifolium* Choisy Upr-raw-126	Hypericaceae	Chamba	Decoction of leaves is taken for arthritis[5], dysentery[6] and diarrhea[5]. Plant is ornamental[3].	2.5	7	0.05	0.35	71
16.	*Colebrookea oppositifolia* Sm.	Lamiaceae	Chiela	Leaves paste is used in Wound healing[4] and epilepsy[3]	1.5	7	0.05	0.21	57
17.	*Otostegia limbata* (Benth.) Boiss. Upr-raw-33		Chitti sumbal	Leaves are antiseptic[2]. Decoction of leaves is used in kidney disorder[7] and toothache[5].	2	8	0.06	0.25	62
18.	*Astragalus psilocentros* Fisch. Upr-raw-68	Leguminosae	Jandkanda	Decoction of leaves is used in Ulcer[3]. Leaves are used as fodder[6].	1.5	7	0.05	0.21	42
19.	*Hibiscus rosa-sinensis* L. Upr-raw-68	Malvaceae	Miswak	Leaf juice is used against Jaundice[12]. Flower powder is used in respiratory infection[5] and twigs are used as alternative of toothbrushes[11].	2.5	11	0.09	0.22	45
20.	*Myrsine africana* L. Upr-raw-264	Myrsinaceae	Gugal	Decoction of leaves is used in intestinal wounds[5] and is considered good blood purifier[4].	2	8	0.06	0.25	62
21.	*Jasminum humile* L. Upr-raw-207	Oleaceae	Chamba	Plant is ornamental[5]. Decoction of roots is used in ring worms[5]. Flower powder in used as paste for skin infections[6].	2.5	8	0.06	0.31	75
22.	*Jasminum officinale* L. Upr-raw-154		Chmabaili	Plant is ornamental[7]. Root decoction is diuretic[5]. Powder made from flowers is effective in cough[7].	3	11	0.09	0.27	63
23.	*Ligustrum ovalifolium* Hassk. Upr-raw-215		Patti	Plant is ornamental[7]	1	7	0.05	0.14	0
24.	*Desmodium elegans* DC. Upr-raw-77	Papilionaceae	helphaat	Leaves are anticancer[2]. Twigs are used for fuel[3] and fodder[3].	0.5	6	0.05	0.08	0
25.	*Indigofera heterantha* Wall. ex Brandis Upr-raw-44		Jand	Shoots are used in baskets[13], brooms[13]. Paste of stem bark is used in scabies[5].	2.5	13	0.10	0.19	38
26.	*Leptopus cordifolius* Decne. Upr-raw-200	Phyllanthaceae	Merola	Shoots are used for making brooms[5] and baskets[3].	1.5	8	0.06	0.18	0

Table 2 (*Continued*)

	Taxon	Family	Vernacular name	[a]Use reports	UR	FC	RFC	UVs	FL%
27.	*Punica granatum* L. Upr-raw-34	Punicaceae	Daroona	Fruit is blood purifier[7], tonic[5]. Dried seeds are refrigerant[7]. Wood is used as fuel[9].	2.5	8	0.06	0.31	87
28.	*Ziziphus jujuba* Mill. Upr-raw-120	Rhamnaceae	Bhermunni	Fruit is edible[7]. Dried fruit is stimulant[7]. Twigs are used for fuel wood[4].	1.5	7	0.05	0.21	100
29.	*Ziziphus oxyphylla* Edgew. Upr-raw-119		Brunhii	Leaves juice is used in allergy[4] and Jaundice[3]. Root decoction is used in intestinal worms[5] and flatulence[5].	4	11	0.09	0.36	45
30.	*Ziziphus spina-christi* (L.) Desf. Upr-raw-141		Bairee	Decoction of leaves is used in stomach problems[5]. Root and fruit decoction is used in diabetes[7].	2	9	0.07	0.22	77
31.	*Cotoneaster roseus* Edgew. Upr-raw-114	Rosaceae	Loon	Shoots are used as walking sticks[6]	1	6	0.05	0.16	0
32.	*Cydonia oblonga* Mill. Upr-raw-110		Bai dana	Fruits are known to delay ejaculation[7]and laxative[6]. Plant is ornamental[4].	3	7	0.05	0.42	100
33.	*Rosa brunonii* Lindl. Upr-raw-145		Chell	Flower paste is used against scabies[5]. Juice of fresh flowers is used for eye infections[7]. Leaves are used as fodder[5].	3	7	0.05	0.42	71
34.	*Rubus fruticosus* L. Upr-raw-172		Akhrry	Fruit is edible[9]. Root decoction is used in dysentery[4] and whooping cough[5]	3	11	0.09	0.27	45
35.	*Rubus ellipticus* Sm. Upr-raw-173		Akhrry	Fruit is edible[5]and laxative[3].	1.5	5	0.30	0.04	60
36.	*Rubus niveus* Thunb. Upr-raw-204		Pagnar	Fruit is edible[9], laxative[5] and effective in chronic cough. Leaves are used as fodder[4].	2.5	9	0.07	0.27	55
37.	*Zanthoxylum armatum* DC. Upr-raw-29	Rutaceae	Timber	Fruit is carminative[5] and condiment[7]. Shoots are used in toothbrush[9], toothache[9] and walking sticks[4].	5	11	0.09	0.45	81
38.	*Dodonaea viscosa* Jacq. Upr-raw-94	Sapindaceae	Sanatha	Plant is used for fuel[8]. Leaves paste reduces wound swellings[5] and cure skin infections[3]	2	11	0.09	0.18	45
39.	*Debregeasia salicifolia* (D.Don) Rendle Upr-raw-74	Urticaceae	Sandari	Leaves decoction is used in skin infections[7], diabetes[4] anddysentery[5] in animals.	2.5	10	0.08	0.27	70
40.	*Lantana camara* L. Upr-raw-155	Verbenaceae	Ghenari	Decoction of whole plant is used in diabetes[5] and malaria[5].	1.5	7	0.05	0.21	71
41.	*Vitex negundo* L. Upr-raw-100		Banna	Leaves paste is used against chest pain[5]. Plant is used as fuel wood[4] and fodder[4].	1	9	0.07	0.11	55

[a] The numbers in superscript (use reports) are use-citations which show the number of times informants reported a plant species for a particular use category.

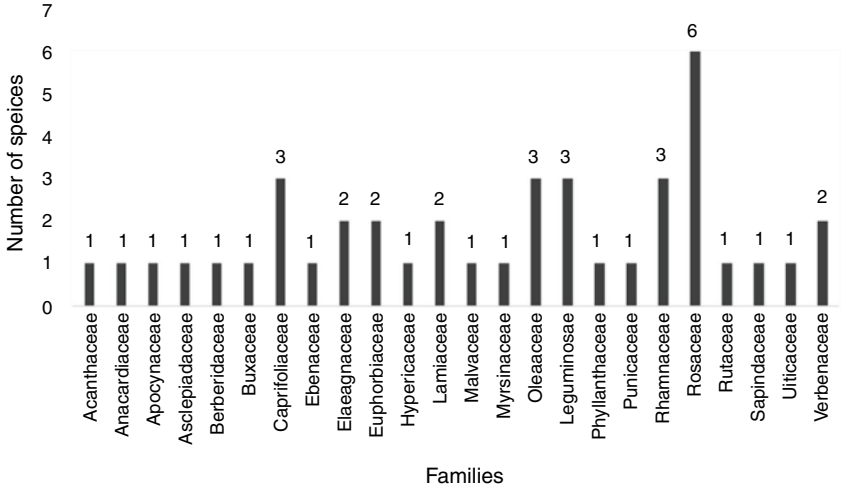

Fig. 2. Common families with species number in the study area.

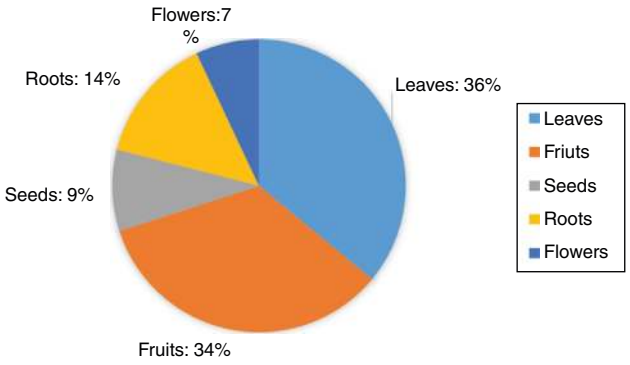

Fig. 3. Percentage of plants parts used by local inhabitants.

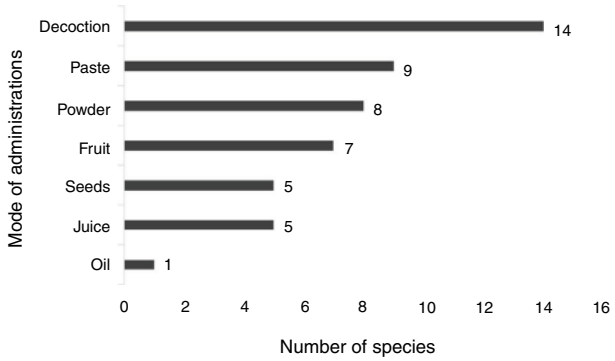

Fig. 4. Methods of preparation of herbal recipes in the study area.

Delanta, Northern Ethiopia used herbal medicine to cure daily ailments. They reported that leaves were the most frequently part used (32.6%) and oral route was the most common way of administration (43.9%).

Relative Frequency of Citation (RFC) and Use Values (UV)

The RFC shows important plant species who received maximum number of use citations from informants. *Rubus ellipticus* (0.30), *Nerium oleander* (0.10), and *Indigofera heterantha* (0.10) were the most cited medicinal shrubs (Table 2). High frequency of citations shows the importance of local plant species among informants and their exploitation in the area (Ahmad et al., 2017). The use value of each species was recorded by generating score "1" for major uses and "0.5" for minor uses. Plant species with high UV were *Berberis lycium* (0.68), *Zanthoxylum armatum* (0.45), *Rosa brunonii* and *Cydonia oblonga* (0.42) and *Ziziphus oxyphylla* (0.36). *Berberis lycium* was the most frequently used plant by local population for healing of bone fractures, diabetes and sour throat. *Zanthoxylum armatum* was found highly effective as remedy for the treatment of toothache and *Cydonia oblongata* was used to delay ejaculation. The high UV indicates the common occurrence of these species in the area and dependence of the indigenous communities as they frequently used these species in herbal therapies for the treatment of various ailments. It has been shown that plants which are used in some repetitive manners are likely to have high UV and biological activities (Amjad et al., 2017). Dominant plant species in the study area with high UV are well-known to the local people and they use them in the home remedies over a long time which popularized them in the area and have a greater possibility of being familiarized into the local culture (Shaheen et al., 2017). *Ligustrum ovalifolium* (0.14), *Vitex negundo* (0.11), *Desmodium elegans* (0.08) and *Rubus ellipticus* (0.04) showed low use values (Table 2) which indicates that these species are less used by local inhabitants because they are not well-familiar to the ethnobotanical uses of these plants. Consistency in use of a medicinal plant for the same purpose is a sign that the species has some active ingredients which validate their use and may serve as a clue for further pharmacological exploration (Ribeiro et al., 2017). Plants with high use value remain good source for drug discoveries (Mukherjee et al., 2012). On the other hand, plants with low use value are not necessarily less important but their low values may indicate that informants have less knowledge about their uses in daily ailments. Another possibility is the loss of cultural knowledge due to geographical barriers (Leonti, 2011).

Family Use Value (FUV)

In order to assess the most important plant families in the study area, family use value (FUV) was calculated by using UV of the species and the total number of species within each family (Table 4). Berberidaceae showed the maximum family use value (0.68), followed by Rutaceae (0.45), Guttiferae (0.35) and Punicaceae (0.31). Oleaceae showed the minimum family use value (0.15), followed by Acanthaceae (0.16), Papilionaceae (0.16) and Verbenaceae (0.16) and Spindaceae (0.18). Families with least number of species and high UVs relatively showed high FUVs. This shows the importance of individual plant species in rural communities and the popularity of a family could be correlated with plants availability and their involvement in traditional medicines (Cadena-González et al., 2013). Moreover, low FUVs represent less availability of plant species in the area and less familiarity in local communities (Ladio et al., 2007).

Fidelity Level (FL)

Results revealed that maximum fidelity level (Table 2) was shown by *Cydonia oblonga* for delay ejaculation (100%), *Ziziphus jujuba* for tonic (100%), *Berberis lycium* for delay ejaculation (100%), *Ricinus communis* for wound infection (100%) and *Nerium oleander* for skin infections (100%) followed by *Elaeagnus angustifolia* for blood purifier (88%), *Punica granatum* for blood purifier (87%) and *Zanthoxylum armatum* for toothache (81%). High fidelity level indicates most preferred plant species for the treatment of particular disease (Shil et al., 2014). The medicinal plants that are largely used by the local communities usually have higher fidelity level than less popular plants. Fidelity level is useful ethnobotanical technique in the selection of most preferred plant species by informants for the cure of a particular disease (Khan et al., 2014). High FL plants may contain large amount of bioactive compounds therefore, are highly recommended for further phytochemical investigations (Hassan-Abdallah et al., 2013). The species with least fidelity level were *Astragalus psilocentros* for ulcer (42%), *Sarcococca saligna* for uterus infection (42%) and *Indigofera heterantha* for scabies (38%). Low values of fidelity level of the species indicate that they were not preferred for treatment of any ailment (Cheikhyoussef et al., 2011). Another reason of low fidelity level may be the less knowledge of informant about the specific use of a plant for the treatment of a specific ailment (Rehman et al., 2017).

Informant Consensus Factor (ICF)

All the species used for the treatment of various diseases are group into eight categories on the basis of disease treated (Table 3). Highest ICF was recorded for diabetes (0.94) followed by toothache (0.89) intestinal disorders (0.88) constipation (0.86) skin infection (0.86) blood purification (0.85) stomach disorders (0.83) respiratory disorders (0.81) and dysentery (0.76). Outcomes of this study were in accordance with the studies done by other researchers (Ahmed and Murtaz, 2014; Rashid et al., 2015; Shah et al., 2015).

Table 3
Informant consensus factor for most prevailing diseases in the study area.

Disease category	Number of use reports (N_{ur})	Number of species (N_t)	ICF
Dysentery	18	5	0.76
Respiratory disorders	17	4	0.81
Stomach disorders	13	3	0.83
Blood purification	29	5	0.85
Skin infection	46	7	0.86
Constipation	31	5	0.86
Intestinal disorders	18	3	0.88
Toothache	29	4	0.89
Diabetes	20	2	0.94

Table 4
Importance value of the families in the study area.

Family	∑UVs	ns	FUV
Oleaceae	0.45	3	0.15
Acanthaceae	0.16	1	0.16
Leguminosae	0.48	3	0.16
Verbenaceae	0.32	2	0.16
Phyllanthaceae	0.18	1	0.18
Sapindaceae	0.18	1	0.18
Apocynaceae	0.2	1	0.2
Anacardiaceae	0.21	1	0.21
Asclepiadaceae	0.21	1	0.21
Buxaceae	0.21	1	0.21
Malvaceae	0.22	1	0.22
Caprifoliaceae	0.68	3	0.23
Euphorbiaceae	0.45	2	0.23
Lamiaceae	0.46	2	0.23
Myrsinaceae	0.25	1	0.25
Rhamnaceae	0.79	3	0.26
Rosaceae	1.58	6	0.26
Ebenaceae	0.27	1	0.27
Urticaceae	0.27	1	0.27
Elaeagnaceae	0.62	2	0.31
Punicaceae	0.31	1	0.31
Hypericaceae	0.35	1	0.35
Rutaceae	0.45	1	0.45
Berberidaceae	0.68	1	0.68

Higher ICF value indicates that specific disease is effectively treated by local inhabitants. High prevalence of aforementioned ailments may reflect the poor socioeconomic and hygienic conditions of the deprived people. These findings are in line with other study conducted by Teklehaymanot and Giday (2007) in northwestern Ethiopia. High ICF shows high degree of agreement among informants and the usage of different species for treatment of particular disease. Low ICF value may represent the less occurrence of a particular disease category in the study area at one hand and may indicate less consistency of informer's knowledge on the other hand (Teklehaymanot and Giday, 2007). It has been reported that high ICF values could be linked with high use values of the plants for one disease group (Madikizela et al., 2012). According to Bennett and Prance (2000) and Albuquerque (2002) for an indigenous community, the most important plant is one that has multipurpose medicinal uses in order to treat a variety of diseases and hence is believed an effective medicine.

Traditional therapeutic uses

Powder made from root bark of *Berberis lycium* is cooked in milk for healing bone fractures, diabetes and stomach disorders however, Aziz et al. (2017) reported that powder of the same plant is also used for jaundice and mouth disease. *Cydonia oblonga* fruit is laxative and may cause delay in ejaculation. Contrary to these uses, Pieroni (2017) reported that villagers in South-Eastern Albania used decoction of this plant in drinks as appetizing agent. Flower paste of *Rosa brunonii* is used to treat scabies and juice made from fresh flowers is effective for eye infections. These results are in good agreement with Ahmad et al. (2013) but they also reported effectiveness of the same plant in heart and digestive diseases. *Rubus niveus* fruit is edible and laxative. This plant is reported to cure chronic cough for the first time in our study whereas Uniyal et al. (2006) reported that root paste of same plants is used for curing excessive bleeding in women during menses. *Ziziphus jujuba* fruit is edible and stimulant and these findings are in in accordance with Pieroni (2017). According to Aziz et al. (2017) fruit of the plant is given to diabetic person to control sugar level in the blood. Juice prepared from leaves of *Ziziphus oxyphylla* is used in allergy and jaundice. Additionally, decoction of roots is used to remove intestinal worms and relief from flatulence. According to Ahmad et al. (2017b), this plant is traditionally used in diabetes and liver diseases in different parts of Pakistan. Decoction of the leaves of *Ziziphus spina-christi* is helpful in stomach problems. According to Dafni et al. (2005), *Ziziphus spina-christi* has historical, religious and pharmacological significance for Muslims, Jews and Christians in Israel. According to them, boiled leaves of the plant are effective in asthma, blood pressure and skin diseases, fruits are helpful to cure liver disorders while powder of the root is very useful for diabetic patient. *Zanthoxylum armatum* fruit is carminative which is in agreement of Alam et al. (2018). Paste made from leaves of *Dodonaea viscosa* is used to reduce wound swellings and cure skin infections. Phondani et al. (2015) reported that paste made from the leaves of *D. viscosa* is used to treat toothache. The decoction of the leaves of *Justicia adhatoda* is used in bronchitis which is in agreement with the other studies conducted by Khan et al. (2017) and Singh and Huidrom (2013). Additionally, they also reported the usefulness of this plant in dysentery, fever, pneumonia and cough. *Lonicera quinquelocularis* ripened seeds are effect against skin cracks. According to Ahmed et al. (2013), extract of fresh leaves of the same plant is used for vision improvement. *Viburnum cotinifolium* and *V. grandiflorum* fruits are edible and blood purifier. These reports are in line with the study of Amjad et al. (2017) conducted in the same study region. *Cotinus coggygria* leaves are antiseptic and Koleva et al. (2015) also reported the similar use of this plant in Bulgaria. Milky juice of *Calotropis procera* made from flowers is used in ear pain but according to Aziz et al. (2017), extract, paste and poultice made from the leaves of the same plant is widely used for the treatment of asthma, hepatitis and malaria in Hafizabad district of Punjab, Pakistan. Paste made from the leaves of *Nerium oleander* is used to cure skin infections. Sheen et al. (2017) reported that beside skin treatment, same plant is also used for the treatment of wound healing, leprosy and snakebite in district Poonch, Azad Kashmir, Pakistan. Decoction made from the leaves of *Sarcococca saligna* is effective in tuberculosis and powder made from root bark in eaten in order to treat uterus infection. Additionally, Ahmad et al. (2017a) reported that indigenous people of Neelum Valley use leaf extract of the same plant as blood purifier. *Desmodium elegans* leaves have anticancer properties. Similar results were documented by Khan et al. (2013) through *in-vitro* studies. *Elaeagnus angustifolia* fruit is blood purifier and effective in dysentery. Apart from these ethnobotanical uses, fruit is also used to improve immunity and treat heart diseases among indigenous communities of Rawalakot, district Poonch, Azad Jammu and Kashmir, Pakistan (Amjad et al., 2017). Paste made from leaves of *Mallotus philippensis* is used to cure skin diseases and powder made from fruits is given cattle to remove intestinal worms. Besides, Sharma et al. (2012) reported the use of this plant in other ailments including diarrhea, typhoid and skin ailments by the tribes of Bohpal, India. Paste made from leaves of *Hypericum oblongifolium* was first time reported in this study for the treatment of arthritis. *Colebrookea oppositifolia* leaves paste is used in wound healing and epilepsy. Ajaib et al. (2018) reported strong antibacterial and antifungal activities of the

same plant. Leaf decoction of *Astragalus psilocentros* is used in kidney disorders and stomach ulcer. Bano et al. (2014b) also reported this plant for the same purpose. Paste made from stem bark of *Indigofera heterantha* is used to treat scabies which is in line with the study of Ahmad et al. (2012a). *Hibiscus rosa-sinensis* flower powder is given in respiratory infection and jaundice. Beside these uses, Amir et al. (2017) also reported the other uses of this plant in sexual dysfunction, asthma and heartburn. Decoction made from the leaves of *Myrsine africana* is used in intestinal wounds. Haq (2012) reported that leaves are also used as blood purifier and fruit powder is effective for cough. Roots of *Jasminum humile* are used in ring worms and powder made from flowers is used in skin infections. *Jasminum officinale* roots are diuretic. These results are in a good agreement with the study of Sher et al. (2011). *Punica granatum* fruit is good blood purifier and tonic. Dried seeds are refrigerant. Rehman et al. (2017) also documented the same folk uses of this plant. *Debregeasia salicifolia* leaves are used in skin infections, diabetes and dysentery in cattle. Similar results were reported by Shaheen et al. (2017). Whole plant of *Lantana camara* is used in diabetes and malaria but Amir et al. (2017) reported the uses of same plant for diarrhea, constipation, asthma and snakebite. Paste made from leaves of *Vitex negundo* is used against chest pain. According to Basri et al. (2014), leaf extract of the same plant is used as nerve tonic and vermifuge.

Jaccard Index (JI)

Jaccard index was performed to compare present investigation with 25 other studies conducted in the surrounding regions of Pakistan, India, Kahmir, Nepal, Iran, Bangladesh, China and Brazil. Due to significant differences in culture and origin among indigenous communities, ethnobotanical knowledge varies greatly from area to area (Leonti, 2011). An extensive research with substantial wisdom of information is required during documentation and comparison of traditional knowledge in order to explore the novel medicinal resources (Ladio et al., 2007). In this study, percentage of similar uses ranged from 21.05 to 0.10 and percentage of dissimilar uses ranged from 26.32 to 0.10 (S1 Table). The top three highest degree of similarities was recorded from Pakistan with studies conducted by Ajaib et al. (2010) in the adjacent district Kotli, Azad Kashmir (JI, 32.50), trailed by Amjad et al. (2015) with a JI of 27.27 and Shaheen et al. (2017) with a JI of 17.09 and these studies were conducted in the same territory of Poonch division of Azad Kashmir. Among neighboring countries, the highest degree of resemblance in ethnobotanical uses was matched with Singh et al. (2012) with a JI of 14.86 from India. The lowest degree of similarity was found with Hong et al. (2015) from China, Maleki and Akhani (2018) from Southern Iran and Ribeiro et al. (2017) from Brazil with JIs of 0.66, 0.69 and 0.88 respectively. The high degree of similarity in the folk uses may reflect similar type of vegetation, same climatic condition and cultural exchange among the local inhabitants (Ahmad et al., 2017; Esakkimuthu et al., 2018; Faruque et al., 2018). Plant communities present in the surrounding areas have more similar plants and more common traditional therapeutic uses than the communities of more distant areas (Shaheen et al., 2017). On the other hand, low similarity index of folk uses shows that less social trade could have been occurred in the past between the indigenous groups bringing about the differences in the ethnobotanical knowledge in the region (Aziz et al., 2017). Geological detachment among groups has incredible effect on change in vegetation composition and change of social learning and this may be a reason for the loss of ethnobotanical information (Amjad et al., 2017).

Novelty and future impact

For novel uses, the recorded ethnobotanical information was compared with published work in the data base of Scopus, PubMed, BioMed Central, Web of Science and Google Scholars. The data showed noteworthy differences in plants usage for diverse administrative modes. Out of 41 medicinal shrubs, six species in this study were reported with new therapeutic uses for the first time. Newly reported species and their uses include: *Debregeasia salicifolia* (diabetes), *Desmodium elegans* (anticancer), *Hibiscus rosa-sinensis* (jaundice), *Hypericum oblongifolium* (arthritis), *Sarcococca saligna* (tuberculosis), *Rubus niveus* (chronic cough) and *Otostegia limbata* (renal disorders). Of these species, *Hypericum oblongifolium* is less explored pharmacologically to date. It is recommended that such species should be employed in phytochemical studies in order to validate their traditional uses. Moreover, plants reported with high use values need particular attention for pharmacological investigations.

Conclusion

This is the first quantitative report that emphasis on traditional knowledge of medicinal shrubs being exploited by the local people for their recognized importance in indigenous healthcare in Rawalakot, district Poonch, Azad Kashmir, Pakistan. The documented plant species with high use values indicate the existence of valuable phytochemical compounds. New claims of species in therapeutic uses showed that still much can be learned from exploring medicinal shrubs. There is a need for the phytochemical, pharmacological, microbiological, toxicological, preclinical, and clinical inquiries of the reported taxa in order to draw general conclusions on ethnopharmacological relationships, efficacy and safe use of traditional medicines. Realizing the continuous erosion in the traditional knowledge of medicinal plants, endless efforts are needed to conduct more floristic and ethnobotanical studies in the research area for the conservation of medicinal knowledge on plants. We emphasize that both conservational strategies (*e.g.* in situ and ex situ conservation and cultivation practices) and resource management (*e.g.* good agricultural practices and sustainable use solutions) should be adequately taken into account for the sustainable use of medicinal plant resources. We also recommend that biotechnical approaches (*e.g.* tissue culture, micropropagation, synthetic seed technology, and molecular marker-based approaches) should be applied to improve yield and modify the potency of medicinal plants.

Authors' contribution

SH carried out the research survey, collected the ethnobotanical data and wrote the manuscript. AH, KSA and AM identified the plant material and helped in the data analysis. FN and HA provided comments on the final draft manuscript. All authors have approved the final manuscript.

Availability of data and materials

The raw data contain the names of all participants, and cannot be shared in this form.

Ethics disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Patient data protection. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Funding

No funding was received for this study.

Competing interest

The authors declare that they have no competing interest.

Acknowledgements

We are thankful to the local respondents for sharing their indigenous knowledge.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.bjp.2019.06.008.

References

Abbas, Z., Khan, S.M., Abbasi, A.M., Andrea, P., Ullah, Z., Iqbal, M., Ahmad, Z., 2016. Ethnobotany of the Balti community, Tormik valley, Karakorum Range, Baltistan, Pakistan. J. Ethnobiol. Ethnomed., http://dx.doi.org/10.1186/s13002-016-0114-y.

Abbasi, A.M., Khan, M.A., Shah, M.H., Shah, M.M., Pervez, A., Ahmad, M., 2013. Ethnobotanical appraisal and cultural values of medicinally important wild edible vegetables of Lesser Himalayas-Pakistan. J. Ethnobiol. Ethnomed., http://dx.doi.org/10.1186/1746-4269-9-66.

Abu-Irmaileh, B.E., Afifi, F.U., 2003. Herbal medicine in Jordan with special emphasis on commonly used herbs. J. Ethnopharmacol. 89, 193–197.

Ahmad, K.S., Hamid, A., Nawaz, F., Hameed, M., Ahmad, F., Deng, J., Akhtar, N., Wazarat, A., Mahroof, S., 2017a. Ethnopharmacological studies of indigenous plants in Kel village, Neelum Valley, Azad Kashmir, Pakistan. J. Ethnobiol. Ethnomed, http://dx.doi.org/10.1186/s13002-017-0196-1.

Ahmad, K.S., Qureshi, R., Hameed, M., Ahmad, F., Nawaz, T., 2012a. Conservation assessment and medicinal importance of some plants resources from Sharda, Neelum Valley, Azad Jammu and Kashmir, Pakistan. Int. J. Agric. Biol 14, 997–1000.

Ahmad, K.S., Qureshi, R., Hameed, M., Ahmad, F., Nawaz, T., 2012b. Floristic Diversity and Ethnobotany of Senhsa, District Kotli, Azad Jammu & Kashmir Pakistan. Pak. J. Bot. 44, 195–201.

Ahmad, R., Ahmad, N, Naqvi, A.A., 2017b. *¨Ziziphus oxyphylla¨*: Ethnobotanical, ethnopharmacological and phytochemical review. Biomed. Pharmacother. 91, 970–998.

Ahmed, E., Arshad, M., Saboor, A., Qureshi, R., Mustafa, G., Sadiq, S., Chaudhari, S.K., 2013. Ethnobotanical appraisal and medicinal use of plants in Patriata, New Murree, evidence from Pakistan. J. Ethnobiol. Ethnomed. 9, http://dx.doi.org/10.1186/1746-4269-9-13.

Ahmed, M.J., Murtaza, G., 2014. A study of medicinal plants used as ethnoveterinary harnessing potential phytotherapy in Bheri, District Muzaffarabad (Pakistan). J. Ethnopharmacol. 159, 209–214.

Ajaib, M., Abid, S., Anjum, M., Noshad, Q., Siddiqui, M.F., Iqbal, M.A., 2018. Phytochemical, antibacterial and antifungal activities of leaves and bark of *Colebrookea oppositifolia*: an ethnomedicinal plant. Pure Appl. Biol. 1, 138–151.

Ajaib, M., Haider, S.K., Zikrea, A., Siddiqui, M.F., 2014. Ethnobotanical Studies of Herbs of Agra Valley Parachinar, Upper Kurram Agency, Pakistan. Int. J. Biol. Biotech. 11, 71–83.

Ajaib, M., Khan, Z., Khan, N., Wahab, M., 2010. Ethnobotanical studies on useful shrubs of district Kotli, Azad Jammu & Kashmir, Pakistan. Pak. J. Bot. 3, 1407–1415.

Alam, F., Najam Saqib, Q.N., Ashraf, M., 2018. *Zanthoxylum armatum* DC extracts from fruit, bark and leaf induce hypolipidemic and hypoglycemic effects in mice- *in vivo* and *in vitro* study. BMC Complement. Altern. Med. 18, http://dx.doi.org/10.1186/s12906-018-2138-4.

Alarcon, R., Pardo-de-Santayana, M., Priestley, C., Morales, R., Heinrich, M., 2015. Medicinal and local food plants in the south of Alava (Basque Country, Spain). J. Ethnopharmacol. 176, 207–224.

Albuquerque, U.P., 2002. Introdução à Etnobotânica. Bagaço, Recife, pp. 87.

Alexiades, M.N., 1996. Selected Guidelines for Ethnobotanical research: A Field Manual. The New York Botanical Garden, Bronx, N.Y.

Ali, K., Khan, N., Inayat-Ur, R., Khan, W., Ali, M., Uddin, M., Nisar, M., 2018. The ethnobotanical domain of the Swat Valley, Pakistan. J. Ethnobiol. Ethnomed., http://dx.doi.org/10.1186/s13002-018-0237-4.

Ali, S.I., 2008. Significance of flora with special reference to Pakistan. Pak. J. Bot. 40, 967–971.

Ali, S.I., Nasir, Y.J. 1989-1992. Flora of Pakistan. No.191-204. Islamabad, Pakistan.

Ali, S.I., Qaiser, M. 1993-2008. Flora of Pakistan. No.-204-2015. Islamabad, Pakistan.

Ali, S.I., Qaiser, M. 1992-2009. Flora of Pakistan. No. 194-217. Department of Botany, University of Karachi, Karachi.

Amjad, M.S., Arshad, M., Qureshi, R., 2015. Ethnobotanical inventory and folk uses of indigenous plants from Pir Nasoora National Park, Azad Jammu and Kashmir. Asian Pac. J. Trop. Biomed 5, 234–241.

Amjad, M.S., Qaeem, M.F., Ahmad, I., Khan, S.U., Chaudhari, S.K., Malik, N.Z., Shaheen, H., Khan, A.M., 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLoS ONE. 12, e0171896, http://dx.doi.org/10.1371/journal.pone.0171896.

Ana, L.C., Cadena, G., Marten, S., Ida, T., 2013. Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquira, Boyacá Colombia. J. Ethnobiol. Ethnomed. 9, 23, http://dx.doi.org/10.1186/1746-4269-9-23.

Aziz, M.A., Adnan, M., Khan, A.H., Shahat, A.A., Al-Said, M., Ullah, R., 2017. Traditional uses of medicinal plants practiced by the indigenous communities. J. Ethnobiol. Ethnomed. 198, 268–281.

Bano, A., Ahmad, M., Zafar, M., Sultana, S., Rashid, S., Khan, M.A., 2014a. Ethnomedicinal knowledge of the most commonly used plants from Deosai Plateau, Western Himalayas, Gilgit Baltistan, Pakistan. J. Ethnopharmacol. 155, 1046–1052.

Bano, A., Ahmad, M., Hadda, T.B., Saboor, A., Sultana, S., Zafar, M., Khan, M.P.Z., Arshad, M., Ashraf, M.A., 2014b. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. J. Ethnobiol. Ethnomed. 10, http://dx.doi.org/10.1186/1746-4269-10-43.

Basri, F., Sharma, H.P., Firdaus, S., Jain, P., Ranjan, A., 2014. A review of ethnomedicinal plant-*Vitex negundo* Linn. Int. J. Adv. Res. 3, 882–894.

Begum, S., Hussain, S., Mehmood, A., Ahmad, K.S., Hamid, A., 2018. Harnessing the potential of medicinal plants used for the treatment of diabetes in rural areas of Azad Jammu and Kashmir, Pakistan. Appl. Ecol. Env. Res. 5, 6549–6566.

Bennett, B.C., Prance, G.T., 2000. Introduced plants in the Indigenous pharmacopoeia of Northern South America: introduced plants in the indigenous pharmacopoeia of northern South America. Econ. Bot. 54, 90–102.

Brown, C.H., 1977. Folk Botanical Life-Forms: Their Universality and Growth. Am. Anthropol. 79, 317–342.

Cadena-González, A.L., Sørensen, M., Theilade, I., 2013. Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquira, Boyacá, Colombia. J. Ethnobiol. Ethnomed, http://dx.doi.org/10.1186/1746-4269-9-23.

Camou-Guerrero, A., Reyes-Garcia, V., Martínez-Ramos, M., Casas, A., 2008. Knowledge and use value of plant species in a Rarámuri community: a gender perspective for conservation. Human Ecol. 36, 259–272.

Champion, H.G., Seth, S.K., Khattak, G.M., 1965. Forest Types of Pakistan. Pakistan Forest Institute Peshawar, pp. 1–238.

Cotton, C.M., 1996. Ethnobotany: Principles and Applications, 1 ed. Wiley, Chichester, New York.

Dafni, A., Levy, S., Lev, E., 2005. The ethnobotany of Christ's Thorn Jujube (*Ziziphus spina-christi*) in Israel. J. Ethnobiol. Ethnomed. 1, http://dx.doi.org/10.1186/1746-4269-1-8.

Della, A., Paraskeva-Hadjichambi, D., Hadjichambis, A.C., 2006. An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus. J. Ethnobiol. Ethnomed. 2, http://dx.doi.org/10.1186/1746-4269-2-34.

Demie, G., Negash, M., Awas, T., 2018. Ethnobotanical study of medicinal plants used by indigenous people in and around Dirre Sheikh Hussein heritage site of South-eastern Ethiopia. J. Ethnopharmacol. 220, 87–93.

Esakkimuthu, S., Darvin, S., Mutheeswaran, S., Paulraj, G., Pandikumar, P., Ignacimuthu, S., Al-Dhabi, N.A., 2018. A study on food-medicine continuum among the non-institutionally trained siddha practitioners of Tiruvallur district, Tamil Nadu, India. J. Ethnobiol. Ethnomed., http://dx.doi.org/10.1186/s13002-018-0240-9.

Faiz, A.H., Ghufarn, M.A., Mian, A., Akhtar, T., 2014. Floral Diversity of Tolipir National Park (TNP), Azad Jammu and Kashmir, Pakistan. Biologia (Pakistan) 1, 43–55.

Faruque, M.O., Uddin, S.B., Barlow, J.W., Hu, S., Dong, S., Cai, Q., Li, X., Hu, X., 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. Front. Pharmacol. 9, http://dx.doi.org/10.3389/fphar.2018.00040.

Friedman, J., Yaniv, Z., Dafni, A., Palewitch, D., 1986. A preliminary classification of the healing potential of medicinal plants, based on the rational analysis of an ethnopharmacological field survey among Bedouins in Negev Desert, Israel. J. Ethnopharmacol. 16, 275–287.

Giday, M., Asfaw, Z., Woldu, Z., 2009. Medicinal plants of the Meinit ethnic group of Ethiopia: an ethnobotanical study. J. Ethnopharmacol. 124, 513–521.

Govaerts, R., 2001. How many species of seed plant are there? Taxon. 50, 1085–1090.

Haq, F., 2012. The Ethnobotanical uses of medicinal plants of Allai Valley, Western Himalaya Pakistan. Int. J. Plant Res. 1, 21–34.

Hassan-Abdallah, A., Merito, A., Hassan, S., Aboubaker, D., Djama, M., Asfaw, Z., Kelbessa, E., 2013. Medicinal plants and their uses by the people in the region of Randa, Djibouti. J. Ethnopharmacol 148, 8701–8713.

Heinrich, M., Edwards, S., Moerman, D.E., Leonti, M., 2009. Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods. J. Ethnopharmacol. 124, 1–17.
Hoffman, B., Gallaher, T., 2007. Importance indices in Ethnobotany. Ethnobot. Res. Appl. 5, 201–218.
Hong, L., Guo, Z., Huang, K., Wei, S., Liu, B., Meng, S., Long, C., 2015. Ethnobotanical study on medicinal plants used by Maonan people in China. J. Ethnobiol. Ethnomed. 11, http://dx.doi.org/10.1186/s13002-015-0019-1.
Hunde, D., Asfaw, Z., Kelbessa, E., 2006. Use of traditional medicinal plants by people of 'Boosat' Sub District, Central Eastern Ethiopia. Ethiop. J. Health Sci. 2, 141–155.
Ishtiaq, M, Maqbool, M., Hussain, T., Shah, A., 2013. Role of indigenous knowledge in biodiversity conservation of an area: a case study on tree ethnobotany of Soona Valley, District Bhimber Azad Kashmir, Pakistan. Pak. J. Bot. 45, 157–164.
Ishtiaq, M., Mumtaz, A.S., Hussain, T., Ghani, A., 2012. Medicinal plant diversity in the flora of Leepa Valley, Muzaffarabad (AJK), Pakistan. Afri. J. Biotechnol. 11, 3087–3098.
Jain, S.K., 2004. Credibility of traditional knowledge criterion of multilocational and multiethnic use. Ind. J. Trad. Know. 3, 137–153.
Jamila, F., Mostafa, E., 2014. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. J. Ethnopharmacol. 154, 76–87.
Jan, H.A., Jan, S., Ahmad, N., Aysha, M., 2017. Ethno-medicinal survey of indigenous medicinal plants used by the local population of Goleen Valley, Chitral, Pakistan. SM. J. Med. Plant. Stud. 1, 1004.
Jennings, H.M., Merrell, J., Thompson, J.L., Heinrich, M., 2014. Food or medicine? The food-medicine interface in households in Sylhet. J. Ethnopharmacol. 167, 97–104.
Kayani, S., Ahmad, M., Zafar, M., Sultana, S., Khan, M.P.Z., Ashraf, M.A., Hussin, J., Yaseen, G., 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies Abbottabad, Northern Pakistan. J. Ethnopharmacol. 156, 46–60.
Khan, I., Abdelsalam, N.M., Fouad, H., Tariq, A., Ullah, R., Adnan, M., 2014. Application of Ethnobotanical indices on the use of traditional medicines against common diseases. Evid. Based Complement. Alternat. Med., http://dx.doi.org/10.1155/2014/635371.
Khan, A., Usman, R., Rauf, A., Wang, M., Muhammad, N., Aman, A., Tahir, T.H.M., 2013. In vitro biological screening of the stem of Desmodium elegans. Asian Pac. J. Trop. Biomed. 9, 711–715.
Khan, I., Jan, S.A., Shinwari, Z.K., Ali, M., Khan, S., Kumar, T., 2017. Ethnobotany and medicinal uses of folklore medicinal plants belonging to family Acanthaceae: An updated review. MOJ. Biol. Med. 2, 34–38.
Khan, M.A., Khan, M.A., Mujtaba, G., Hussain, M., 2012. Ethnobotanical study about medicinal plants of Poonch valley, Azad Jammu and Kashmir. J. Anim. Plant Sci. 22, 493–500.
Khan, S.W., Khatoon, S., 2007. Ethnobotanical studies on useful trees and shrubs of haramosh and bugrote valleys, in Gilgit Northern areas of Pakistan. Pak. J. Bot. 39, 699–710.
Khattak, N.S., Nouroz, F., Rahman, I., Noreen, S., 2015. Ethno veterinary uses of medicinal plants of district Karak, Pakistan. J. Ethnopharmacol. 171, 273–279.
Koleva, V., Dragoeva, A., Nanova, Z., Koynova, T., Dashev, G., 2015. An ethnobotanical study on current status of some medicinal plants used in Bulgaria. Int. J. Curr. Microbiol. App. Sci. 4, 297–305.
Ladio, A.H., Lozada, M., Weigandt, M., 2007. Comparison of traditional wild plant knowledge between aboriginal communities inhabiting arid and forest environments in Patagonia, Argentina. J. Arid Environ 69, 695–715.
Leonti, M., 2011. The future is written: impact of scripts on the cognition, selection, knowledge and transmission of medicinal plant use and its implications for ethnobotany and ethnopharmacology. J. Ethnopharmacol. 134, 542–555.
Li, D., Xing, F., 2016. Ethnobotanical study on medicinal plants used by local Hoklos people on Hainan Island, China. J. Ethnopharmacol. 194, 358–368.
Luitel, D.R., Rokaya, M.B., Timsina, B., Münzbergová, Z., 2014. Medicinal plants used by the Tamang community in the Makawanpur district of central Nepal. J. Ethnobiol. Ethnomed, http://dx.doi.org/10.1186/1746-4269-10-5.
Madikizela, B., Ndhlala, A.R., Finnie, J.F., Staden, V.J., 2012. Ethnopharmacological study of plants from Pondoland used against diarrhea. J. Ethnopharmacol. 141, 61–71.
Maleki, T., Akhani, H., 2018. Ethnobotanical and ethnomedicinal studies in Baluchi tribes: a case study in Mt. Taftan, southeastern Iran. J. Ethnopharmacol. 217, 163–177.
Malik, F., Hussain, S., Dil, A.S., Hannan, A., Gilani, A.H., Chapter 22) 2005. Islamic Republic of Pakistan. In: Ong, C.K., Bodeker, G, Grundy, C, Burford, G, Shein, K (Eds.), (Eds.), WHO Global Atlas of Traditional, Complementary and Alternative Medicine (Mapvolume). World Health Organization, Geneva, pp. 165–169.
Martin, G.J., 2004. Ethnobotany: A Methods Manual. Earths can Publications Ltd, London.
Meragia, M., Asfaw, Z, Argaw, M., 2016. The status of ethnobotanical knowledge of medicinal plants and the impacts of resettlement in Delanta, Northwestern Wello, Northern Ethiopia. Evid. Based Complement. Alternat. Med., http://dx.doi.org/10.1155/2016/5060247.
Miller, N.J., Ruiz-Larrea, M.B., 2002. Flavonoids and other plant phenols in the diet: their significance as antioxidants. J. Nutr. Environ. Med. 12, 39–51.
Mukherjee, P.K., Nema, N.K., Venkatesh, P., Debnath, P.K., 2012. Changing scenario for promotion and development of Ayurvedaway forward. J. Ethnopharmacol. 143, 424–434.
Nasir, E., Ali, S. 1970-1989. Flora of West Pakistan. No. 1-190. Islamabad, Pakistan.
Oliver, J.F., 2013. The role of traditional medicine practice in primary health care within Aboriginal Australia: a review of the literature. J. Ethnobiol. Ethnomed. 9, http://dx.doi.org/10.1186/1746-4269-9-46.
Ong, H.G., Kim, Y.D., 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras Island, Philippines. J. Ethnopharmacol. 157, 228–242.
Parthiban, R., Vijayakumar, S., Prabhu, S., Gnanaselvam, J., Yabesh, E.M., 2016. Quantitative traditional knowledge of medicinal plants used to treat livestock diseases from Kudavasal taluk of Thiruvarur district, Tamil Nadu, India. Rev. Bras. Pharmacogn. 26, 109–121.
Phondani, P.C., Bhatt, A., Elsarrag, E., Horr, Y.A., 2016. Ethnobotanical magnitude towards sustainable utilization of wild foliage in Arabian Desert. J. Tradit. Complement. Med. 3, 209–218.
Pieroni, A., 2017. Traditional uses of wild food plants, medicinal plants, and domestic remedies in Albanian, Aromanian and Macedonian villages in South-Eastern Albania. J. Herb. Med. 9, 81–90.
Popović, Z., Matić, R., Bojović, S., Stefanović, M., Vidaković, V., 2016. Ethnobotany and herbal medicine in modern complementary and alternative medicine: an overview of publications in the field of I & C medicine 2001-2013. J. Ethnopharmacol. 2, 182–192.
Prance, G.T., Balee, W., Boom, B.M., Carneiro, R.L., 1987. Quantitative ethnobotany and the case for conservation in Amazonia. Conserv. Biol 1, 296–310.
Qamar, Z.Q., Anwar, M., Dar, N.I., Ali, U., 2010. Ethno-botanical study of wild medicinal plants of Neelum Valley, Azad Jammu and Kashmir, Pakistan. Pak. J. Wildlife 1, 25–30.
Qureshi, R.A., Ghufran, M.A., Gilani, S.A., Yousaf, Z., Abbas, G., Batool, A., 2009. Indigenous Medicinal Plants used by Local women in Southern Himalayan Region of Pakistan. Pak. J. Bot 41, 19–25.
Rashid, S., Ahmed, M., Zafar, M., Sultana, S., Ayub, M., Khan, M.A., Yaseen, G., 2015. Ethnobotanical survey of medicinally important shrubs and trees of Himalayan region of Azad Jammu and Kashmir, Pakistan. J. Ethnopharmacol. 166, 340–351.
Raunkiaer, C., 1934. The life forms of plants and statistical plant geography. Clarendon Press, Oxford.
Rehman, M.N., Ahmad, M., Sultana, S., Zafar, M., Edward, S., 2017. Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. Rev. Bras. Farmacogn. 27, 751–775.
Ribeiro, R.V., Bieski, I.G.C., Balogun, S.O., Martins, D.T.O., 2017. Ethnobotanical study of medicinal plants used by Ribeirinhos in the North Araguaia microregion, Mato Grosso, Brazil. J. Ethnopharmacol. 205, 69–102.
Rivera, D., Obón, C., Inocencio, C., Heinrich, M., Verde, A., Fajardo, J., Palzón, J.A., 2007. Gathered food plants in the mountains of Castilla-La Mancha (Spain): Ethnobotany and multivariate analysis. Eco. Bot. 61, http://dx.doi.org/10.1663/0013-0001(2007)61[269:GFPITM]2.0.CO;2.
Sansanelli, S., Ferri, M., Salinitro, M., Tassoni, A., 2017. Ethnobotanical survey of wild food plants traditionally collected and consumed in the Middle Agri Valley (Basilicata region, southern Italy). J. Ethnobiol. Ethnomed. 13, http://dx.doi.org/10.1186/s13002-017-0177-4.
Schippmann, U., Leaman, D.J., Cunningham, A.B.,2002. Impact of cultivation and gathering of medicinal plants on biodiversity: global trends and issues. In: Proceedings of the Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. 9th Regular Session of the Commission on Genetic Resources for Food and Agriculture. FAO, Rome, Italy, pp. 143–167.
Shah, A., Bharati, K.A., Ahmad, J., Sharma, M.P., 2015. New ethnomedicinal claims from Gujjar and Bakerwals tribes of Rajouri and Poonch districts of Jammu and Kashmir, India. J. Ethnopharmacol 166, 119–128.
Shaheen, H., Qaseem, M.F., Amjad, M.S., Bruschi, P., 2017. Exploration of ethno-medicinal knowledge among rural communities of Pearl Valley; Rawalakot, District Poonch Azad Jammu and Kashmir. Plos One, http://dx.doi.org/10.1371/journal.pone.0183956.
Shaheen, H., Shinwari, Z.K., Qureshi, R.A., Ullah, Z., 2012. Indigenous plant resources and their utilization practices in village populations of Kashmir Himalayas. Pak. J. Bot. 44, 739–745.
Sharma, J., Varma, R., Varma, A., 2012. Ethnobotanical study of *Mallotus philippensis* L. Mull. Arg. on tribes of Bohpal, Madhya Pardesh, India. Int. J. Med. Arom. Plants 3, 434–446.
Sher, Z., Khan, Z., Hussain, F., 2012. Ethnobotanical studies of some plants of Chagharzai Valley, District Buner, Pakistan. Pak. J. Bot. 3, 1445–1452.
Shil, S., Choudhury, M.D., Das, S., 2014. Indigenous knowledge of medicinal plants used by the Reang tribe of Tripura state of India. J. Ethnopharmacol. 152, 135–141.
Shinwari, Z.K., 2004. How to sustainably use Medicinal Plants: Looking Ahead. In: Proceeding of International Workshop held in Islamabad, pp. 47–56.
Singh, A., Nautiyal, M.C., Kunwar, R.M., Bussmann, R.W., 2017. Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India. J. Ethnobiol. Ethnomed, http://dx.doi.org/10.1186/s13002-017-0178-3.
Singh, A.G., Kumar, A., Tewari, D.D., 2012. An Ethnobotanical Survey of medicinal plants used in Terai forest of western Nepal. J. Ethnobiol. Ethnomed., http://dx.doi.org/10.1186/1746-4269-8-19.
Singh, K.J., Huidrom, D., 2013. Ethnobotanical uses of medicinal plant, *Justicia adhatoda* L. by Meitei community of Manipur, India. J. Coastal Life Med. 4, 322–325.
Stewart, R., Nasir, R.E., Ali, S.I., 1972. Flora of West Pakistan. An annotated catalogue the vascular plants of West Pakistan and Kashmir. Published under, PL-480 Res. Project. Fakhri Printing Press, Karachi, pp. 1–1028.

Teklehaymanot, T., Giday, M., 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. J. Ethnobiol. Ethnomed. 3, http://dx.doi.org/10.1186/1746-4269-3-12.

Towns, A.M., van Andel, T., 2016. Wild plants, pregnancy, and the food-medicine continuum in the southern regions of Ghana and Benin. J. Ethnopharmacol. 179, 375–382.

Trotter, R.T., Logan, M.H., 1986. Informant consensus: a new approach for identify- ing potentially effective medicinal plants. In: Etkin, N.L. (Ed.), Plants in Indigenous Medicine and Diet, Behavioural Approaches. Redgrave Publishing Company, Bedford Hills, New York, pp. 91–112.

Ullah, S., Khan, M.R., Shah, N.A., Shah, S.A., Majid, M., Farooq, M.A., 2014. Ethnomedicinal plant use value in the Lakki Marwat district of Pakistan. J. Ethnopharmacol. 158, 412–422.

Uniyal, S.K., Singh, K.N., Jamwal, P., Lal, B., 2006. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. J. Ethnomed. Ethnobiol. 2, http://dx.doi.org/10.1186/1746-4269-2-14.

Vitalini, S., Iriti, M., Puricelli, C., Ciuchi, D., Segale, A., Fico, G., 2013. Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy) an alpine ethnobotanical study. J. Ethnopharmacol. 145, 517–529.

WHO, 2002. Traditional Medicine: Growing Needs and Potentials. Geneva.

York, T., DeWet, H., Vuuren, S.F., 2011. Plants used for treating respiratory infections in rural Maputaland, KwaZulu-Natal, South Africa. J. Ethnopharmacol. 135, 696–710.

Zareen, A., Khan, Z., Ajaib, M., 2013. Ethnobotanical evaluation of the shrubs of Central Punjab, Pakistan. Biologia 59, 139-14.