

ORIGINAL ARTICLE

Quantitative analysis of medicinal plants consumption in the highest mountainous region of Bahrain Valley, Northern Pakistan

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The purpose of the current study was to provide information on traditional uses of medicinal plants used by the inhabitants of Bahrain valley, District Swat, Northern Pakistan. This is the first quantitative ethnobotanical survey from the locality. A total of 134 informants were interviewed through semi-structured interviews and group discussions. The data were analyzed through quantifiable tools, i.e., informant consensus factor (ICF), Relative frequency of citation (RFC), Fidelity level (FL), Direct Matrix Ranking (DMR) and Use value (UV) indices. A total of 72 medicinal plants from 45 families were studied. The largest numbers of medicinal plants were reported from family Asteraceae with 5 species. Highest (0.89) informant consensus factor was observed for gastrointestinal and lowest (0.54) as painkiller. Highest fidelity level (94.12%) was observed for *Ajuga bracteosa* and lowest (56.52%) for *Plantago major*. The Relative frequency of citation was observed high (0.43) for *Valeriana jatamansi* while lowest for *Nerium oleander* (0.04). For Direct Matrix Ranking *Melia azedarach* (24) got first rank lowest (10) by *Vitex negundo*. Leaves (31%) were mostly used as the part used for ethnomedicines. Mostly herbs (65%) were detected for the preparation of ethnomedicines. Decoction (28%) was mostly observed with oral (76%) as a route of administration. The inhabitants in Northern Pakistan use mostly ethnomedicines for primary health care. Plants with high ICF value should be subjected to comprehensive pharmacological and phytochemical studies for novel drug discovery.

Keywords: Bahrain valley; informant consensus factor; medicinal plants; Northern Pakistan; traditional knowledge

Introduction

Ethnomedicinal studies play an important role in contemporary drugs discovery from native available medicinal plant resources. In traditional healing systems, wild resources of the medicinal plant have been under practice for centuries. The documentation of traditional knowledge of wild medicinal plant species is the good approach towards new drug discovery (Gilani & Atta-ur-Rahman, 2005). About 80% world population particularly in developing countries ethnomedicines are taken (approximately 85%) for different health disorders (Savikin et al., 2013). Although 25% of medicines are plants based in modern pharmacopeia, however, countless synthetic drugs are contrived from plants isolates. WHO (2002). Local people have adopted diverse styles of applications to use these natural resources in different ways (Adnan et al., 2014). This system of indigenous folk medicines based on uses of medicinal plants by the inhabitants has been passed from generations to generation at the passage of time orally (Ugulu et al., 2009).

Ethnobotanical research survey is not only applied for documenting ethnobotanical information, and circulating ethnopharmacological knowledge, but also provide the interaction between plant diversity and human society to know that at which degree plant diversity in natural environments is used and disturbs (Canales et al., 2005; Frei et al., 1998) and also can be considered as a part of culture (Heyd, 1995). Even now, about 25% of all recommended medicines in modern world comprise ingredients derivative from medicinal plant species (Rao, Palada & Becker, 2004). About, 50,000 flowering medicinal plant species are taken for medicinal purpose throughout the globe, out of the 422,000 are reported as flowering plants

(Govaerts, 2001; Parmesan, 2006). The traditional practice of medicinal plant species and plant resources is speedily growing in hilly areas because of their fewer side-effects, affordable, accessibility, and very affordable to the poor community (Acharya & Acharya, 2009; Hassan et al., 2017). The right selection of medicinal plant is the first obligation to initiate an ethnopharmacological study and to identify that at what rank the plant species is used for the preparation of ethnomedicines (Canales et al., 2005; Frei et al., 1998).

Pakistan has different vegetation comprising 1,572 genera and 5,521 species, most of them are found in Himalaya, Hindukush, and Karakorum areas (Ali & Qaiser, 2010; Sheikh, Ahmad & Khan, 2002). Out of a total 12% are used in the preparation of herbal medicines (Shinwari & Qaiser, 2011) About six hundreds (600) medicinal plants constitute the main non-timber forest products (NTFPs) (Adnan et al., 2012), five hundred (500) are used in traditional healthcare practices while three hundred and fifty (350) are traded to national and international markets for getting a huge money (billions of dollars) (Ahmad, 2003). Approximately sixty thousand (60,000) traditional practitioners (Hakeems) in urban especially in hilly areas use medicinal plant species for the preparation of household herbal medicines for the treatment of different health disorders. (Hamayun, 2004). Indigenous communities have centuries of traditional knowledge which has been diffused from generation to generation. (Shinwari, 2010).

Documentation of traditional knowledge in the study area may be an essential step toward plant conservation as the flora is under pressure due to unwise use of wild plant resources. In Pakistan northern areas are enriched with high valued medicinal plants which need appropriate assessment. Therefore current study was conducted (i) to identify and file traditional knowledge on indigenous plants used as remedy in Bahrain Valley, District Swat Northern Pakistan, (ii) To document that how and how many different health disorders are cured with medicinal plant species, (iii) to assess data using FIC, FL, DMR, UV and RFC, indices to discover high valued medicinal plant species in the area.

Materials and methods

Study area

Bahrain is a lush green mountain valley located in District Swat of Khyber Pakhtunkhwa, Northern Pakistan. It is a famous tourist spot. Topographically, the area lies in Hindukush foothills range. It lies 35° 12' 27" N, 72° 32' 44.16" E with 1,435 m above sea level (Figure 1). The valley has snow covered mountains, rivers, streams, meadows, forests and diversified vegetation with a huge number of medicinal species. Geoclimatically the area lies in the humid subtropical zone. The peoples of the locality are called Kohistanis and pashtoons (thorwali), they depend on agriculture, medicinal plants, royalty from forests and hotel business as the basic mean of earning. The soil is porous, light sandy, shallow and light to average in texture. The area has an annual average temperature of 16.6 °C and precipitation 866 mm. The driest month is November with 21 mm precipitation and the wettest month is March with an average precipitation of 120 mm. The hottest month of the year is July with an average temperature of 27.0 °C, while the coldest month is January with an average temperature of 4.8 °C.



Figure 1. Geographical location of study area.

Data collection and plant identification

Ethnomedicinal data was collected through group discussions and semi-structured interviews from 2013 to 2014 in the flowering season. A total of 134 informants of different ages were interviewed. Out of total randomly selected 50 (36 men and 14 women) as key informants. An ethnobotanical survey was collected following (Ahmad et al., 2014; Hassan et al., 2017) A questionnaire was structured in English in which Key questions were a local name, part used, types of disease cured,

preparation, socio-cultural information and dose taken etc. Informants were interviewed in their local language to get complete information about plant species. The collected plant species were confirmed through international plant name index (<http://www.ipni.org>), and plant list (www.theplantlist.org). Plant specimen were identified through flora of Pakistan (Ali, 1980; Nasir, 1981) in Herbarium Department of Botany University of Malakand and deposited as a future reference.

Quantitative analysis of ethnobotanical information

Indigenous knowledge was analyzed through different quantitative indices like Relative frequency citation (RFC), Use value (UV), Informant consensus factor (ICF), Fidelity level (FL) and Data matrix ranking (DMR). Data was structured into Excel spreadsheet 2007 and concise through graphical statistics like percentages and proportions.

Informant consensus factor (ICF)

Informant consensus factor can be applied to document consensus on the practical use of the medicinal plant for a specific ailment (Canales et al., 2005). The Informant consensus factor value ranges from 0 to 1. The ICF value will be high if a plant is reported by a large number of informants, while it will be low which means that, inhabitants had less knowledge about that plant species (Kloutsos et al., 2001; Teklehaymanot, 2009). The ICF value calculated by the formula (Tabuti, Lye & Dhillion, 2003).

$$ICF = \frac{nur - nt}{nur - 1}$$

Where "nur" is the total number of use reports for each disease class and "nt" is the number of species used in that class.

Use value (UV)

Use value (UV) provides the relative importance on the use of medicinal plant species. If the value is near to 1, UV will be high which shows the importance of plant species among informants while low UV will be near to 0 which shows few use reports were obtained for a given plant species (Phillips et al., 1994; Savikin et al., 2013). Use value (UV) can be calculated by using the formula (Kayani et al., 2014).

$$UV = \frac{U}{n}$$

Where UV is the use value, u is the value of a plant species to treat a disease while n is the number of respondents reporting overall usages of a plant species.

Relative frequency of citation (RFC)

Relative frequency of citation (RFC) shows the local importance and rank of each medicinal plant species (Vitalini et al., 2013). The RFC value may be 1 if informants report specific plant species as essential and will be 0 if nobody agrees with the use of plant species (Medeiros, Silva & Albuquerque, 2012). RFC can be calculated by the formula (Butt et al., 2015).

$$RFC = \frac{FC}{N} (0 \leq RFC \leq 1)$$

Where FC is informants number who reported the usage of medicinal plant species and N is the total number of informants who participated in the survey.

Fidelity level (FL)

Fidelity level (FL) is carried out to select best fit medicinal plant species for the treatment of a specific disease (Musa et al., 2011). FL value specifies the importance of a particular plant species because high value indicates a high frequency of plant uses against a specific disease. A low value indicates the use of plant species for various medicinal purposes with low usage against a specific disease. Fidelity level may be calculated by the formula (Friedman et al., 1986)

$$FL = \frac{Ip}{Iu} \times 100$$

Where Ip is the number of informants stated the usages of plant species for a specific disease category and Iu is the number of informants cited the use of that particular plant species for any other disease category.

Direct matrix ranking (DMR)

In order to rank medicinal different medicinal plant species, DMR was carried out. DMR can be applied to match plant diversity of certain plant based on data collection from respondents. (Cotton, 1996). A total of 15 experienced and knowledgeable informants were preferred for DMR data collection. Experienced and knowledgeable informants were allowed to give rank to medicinal plant species as 0=not used, 1=least used, 2=less used, 3=good, 4=very good, 5=best) to every single plant species. The average scores given to each plant species was summed up and ranked (Hassan et al., 2017).

Results and discussion

Demographic data

A total of 134 informants were interviewed for ethnomedicinal data collection, out of which 3 were the most experienced traditional healers and the rest were the local inhabitants of the area comprising only kohistani. Out of total randomly selected 50 respondents including 36 (72%) male and 14 (28%) female. The number of a male was high as compared to female due strict family rules for female. Age wise, informants were classified into 5 main categories. The majority of informants were between 70 to 80 years (34%). Mostly the informants (44%) were illiterates and more knowledgeable as compared to educated, while educated peoples also played a vital role in data collection. Among 3 traditional healers, all were experienced from 5-17 years (6%) (Table 1) (Figures 2-5).

Table 1. Demographic data of informants in Bahrain Northern Pakistan.

Gender	Density	% Contribution
Male	36	72
Female	14	28
Age classes		
30-40	8	16
40-50	6	12
50-60	10	20
60-70	9	18
70-80	17	34
Literacy level		
Illiterate	22	44
Primary	17	34
Secondary	9	18
Graduate	2	4
Professional level		
House wives	14	28
Teacher	6	12
Shopkeepers	7	14
Farmers	16	32
Labors	4	8
Hakeem and nomads	3	6

Taxonomic classification

A total of 72 medicinal plant species from 45 different families were studied and documented (Table 2). Asteraceae and Lamiaceae (7%) with 5 plant species each were the most leading families, followed by Amaranthaceae, Brassicaceae, Euphorbiaceae, Moraceae, Polygonaceae, Ranunculaceae, Solanaceae, with 10 plant species (11%), Polygonaceae with 5 species (6%), Brassicaceae, Pinaceae, Solanaceae with 3 plant species (4%) each, Asclepiadaceae, Caryophyllaceae, Convolvulaceae, Urticaceae with 2 plant species (3%) and other families contribute only one species. The large number of medicinal plant species reported from family Asteraceae is in agreement with (Bibi et al., 2014; Umair, Altaf & Abbasi, 2017) and Lamiaceae with (Dei Cas, Pugni & Fico, 2015; Hassan et al., 2017) at national and international where the inhabitants take more medicinal plant species from family Asteraceae and Lamiaceae. It might be due to their high traditional uses and wide distribution. Out of total medicinal plant species habit wise (65%) were herbs (Figure 4), which is in agreement with (Ahmad et al., 2014) who also observed herbs (58%) used by the inhabitants of Chail valley district Swat, Pakistan for the preparation of herbal medicines. Shrubs contribute (20%) and trees (15%). Our findings are in agreement with previous studies (Akhtar et al., 2013; Rehman et al., 2017). The wide usage percentage of herbs was due to their stress-free accessibility (Sanz-Biset et al., 2009; Uniyal et al., 2006) high efficacy, easily collection, the existence of pharmacologically active ingredients and easy for the preparation of herbal medicine (Hassan et al., 2017; Khan et al., 2014).

Table 2. Ethnomedicinal plant species of Bahrain valley, District Swat, Northern, Pakistan.

Botanical Name/Family/V. N	L.N am e	H a b it	Part Use	Therapeutic uses	Mode of preparation	Herbal formulation	Appli catio n mode	F C	R F C	U V	U R
<i>Acacia nilotica</i> L. Mimosaceae H.UOM.BG.403	Kek kar	tree	bark	carminative, diarrhea, dysentery	powder	bark is crushed into powder and take with water	oral	13	01	023	3
<i>Achillea millefolium</i> L. Asteraceae H.UOM.BG.404	Jara i	herb	leaves	stomach ache,	decoction	fresh leaves are boiled in water and make it cool	oral	11	008	009	1
<i>Achyranthes aspera</i> L. Amaranthaceae H.UOM.BG.405	Buc hka nda	herb	whole plant	toothache and digestive problems, bloody diarrhea, insect bite, asthma, cough	decoction	plant is boiled and makes decoction	oral	27	02	022	6

<i>Aconitum chasmanthum</i> S. Ranunculaceae H.UOM.BG.406	Zah arm ora	h e r b	rhizo me	joint pain, high fever, stupor, soothing	powde r	dried rhizome powder are mixed with butter oil	oral	4 7	0 . 3 5	0 . 0 9	4
<i>Acorus calamus</i> L. Aracaceae H.UOM.BG.407	skh a waj a	h e r b	root s	digestive disorders, chronic dysentery, diarrhea	powde r	dried root powdered are mixed with sugar	oral	5 1	0 . 3 8	0 . 0 6	3
<i>Ajuga bracteosa</i> W. Lamiaceae H.UOM.BG.408	Buti	h e r b	aeria l part s	chicken pox. Jaundice, Headache, diuretic, pimples, measles, stomach acidity, internal colic	juice	Juice of fresh aerial parts is taken orally before breakfast.	oral	5 6	0 . 4 2	0 . 1 4	8
<i>Ajuga parviflora</i> B. Lamiaceae H.UOM.BG.409	sra boti	h e r b	leav es	constipation, hepatitis, fever, treating tonsillitis, dermatitis	paste	leaf paste is prepared	oral	5 0	0 . 3 7	0 . 0 8	4
<i>Allium griffithianum</i> B. Amaryllidaceae H.UOM.BG.410	Gan dec har	h e r b	bulb	wounds pain, stimulant, carminative colic	powde r	bulbs are used to cure wounds pain	derm al	1 9	0 . 1 4	0 . 2 1	4
<i>Alnus nitida</i> S. Betulaceae H.UOM.BG.411	Ger ay	tr e e	leav es	sores, infection, diuretic, expectorant, diaphoretic	decoct ion	decoction of leaves is used	oral	2 3	0 . 1 7	0 . 2 2	5
<i>Berberis lycium</i> R. Berberidaceae H.UOM.BG.412	Kwa ray	s h r u b	bark	pimples, scabies, diabetes, wounds, blood purifier	crushe d	crushed bark is soaked in water and extract is used	oral	5 7	0 . 4 3	0 . 0 9	5
<i>Bergenia ciliata</i> S. Saxifragaceae H.UOM.BG.413	Gat pan a	h e r b	root s	urinary disorders, skin infections, demulcent	decoct ion	decoction of rhizome is prepared	oral	2 5	0 . 1 9	0 . 1 2	3
<i>Bistorta affinis</i> D. Polygonaceae H.UOM.BG.414	Anj aba r	h e r b	Rhizo me	fever, body pains, muscle contraction	powde r	powders prepared from rhizome and use with milk	oral	2 1	0 . 1 6	0 . 1 4	3
<i>Bistorta amplexicaulis</i> G. Polygonaceae H.UOM.BG.415	Anj aba r	h e r b	Root s	urinary disorders, cough, sore throat, joint pain	powde r	root powder are mixed with sugar and use with milk	oral	1 7	0 . 1 3	0 . 2 4	4
<i>Bunium persicum</i> B. F Apiaceae H.UOM.BG.416	ghr a spei rkai	h e r b	leav es	hearts problems	decoct ion	fruits are boiled in water and decoction is prepared	oral	2 4	0 . 1 8	0 . 0 4	1
<i>Calendula officinalis</i> L. Asteraceae H.UOM.BG.417	ash rafi	h e r b	root s	wound healing, fever, stomach ache, antiseptic	paste	root is crushed to make paste, and applied on forehead for fever	derm al	2 3	0 . 1 7	0 . 1 7	4
<i>Calotropis procera</i> D. Asclepiadaceae H.UOM.BG.418	spal mai	s h r u b	flow er	cough, asthma, dysentery, expectorant	powde r	powdered flowers are used with water	oral	1 7	0 . 1 3	0 . 2 4	4
<i>Cannabis sativa</i> L. Cannabaceae H.UOM.BG.419	bha ng	h e r b	leav es	indigestion, lever and stomach inflammations, pain killer	extrac t	fresh leaves extract is taken with sugar	oral	3 9	0 . 2 9	0 . 1 3	4
<i>Capsella bursa pastoris</i> L. Brassicaceae	ba mb esa	h e r	leav es	menstrual disorder, stimulant, astringent	decoct ion	fresh leaves decoction is prepared	oral	9	0 . 0 3	0 . 3	3

H.UOM.BG.420		b							7	3	
<i>Caralluma tuberculata</i> R. Asclepiadaceae H.UOM.BG.421	pa ma nka y	s h r u b	whol e plan t	anti- diabetic, tonic, fever, carminative	fresh	fresh leaves are cooked as a vegetable and eaten	oral	5 4	0 4	0 0 7	4
<i>Chenopodium album</i> L. Amaranthaceae H.UOM.BG.422	sar may	h e r b	whol e plan t	constipation, intestinal worms	fresh	fresh leaves are cooked as a vegetable and eaten	oral	1 1	0 0 8	0 1 8	2
<i>Chenopodium botrys</i> L. Amaranthaceae H.UOM.BG.423	skh a kha raw a	h e r b	aeria l part s	diuretic, antispasmodic, carminative and laxative	soup	soup is prepared from aerial parts	oral	1 3	0 1	0 3 1	4
<i>Cichorium intybus</i> L. Asteraceae H.UOM.BG.424	han	h e r b	leav es	anti-inflammatory, hepatic complaints, fever, jaundice, gas trouble, antiasthmatic	decoct ion	decoction of leaves	oral	3 4	0 2 5	0 1 8	6
<i>Clematis grata</i> W. Ranunculaceae H.UOM.BG.425	zela i	s h r u b	leav es	boils	paste	fresh leaves paste are applied on boils	derm al	1 6	0 1 2	0 0 6	1
<i>Convolvulus arvensis</i> . Convolvulaceae H.UOM.BG.426	pre wat kai	h e r b	leav es	constipation, intestinal worms, Purgative	extrac t	fresh plant extract is taken with sugar	oral	2 0	0 1 5	0 1 5	3
<i>Curcuma longa</i> L. Zingiberaceae H.UOM.BG.427	kur ka ma n	s h r u b	Rhiz ome	analgesic, flu and nasal congestion	powde r	powder is mixed with lime and dermally used on the painful area.	derm al	3 8	0 2 8	0 0 8	3
<i>Dalbergia sissoo</i> D. Papilionaceae H.UOM.BG.428	sha wa e	tr e e	leav es	mental disorder, stimulant, astringent, boils, gonorrhoea	decoct ion	decoction of leaves is prepared	oral	2 9	0 2 2	0 1 7	5
<i>Daphne mucronata</i> R. Thymelaeaceae H.UOM.BG.429	leg h ona y	s h r u b	whol e plan t	wounds, abdominal pain, swellings, gastrointestinal	powde r	root powder are taken orally with water as gastro-intestinal irritant	oral	1 5	0 1 1	0 2 7	4
<i>Datura stramonium</i> L. Solanaceae H.UOM.BG.430	dat hor a	H e r b	root s	asthma, expectorant, fever, sedative, anodyne	powde r	a minute amount of powder are taken with water	oral	2 6	0 1 9	0 1 9	5
<i>Debregeasia saeneb</i> F. Urticaceae H.UOM.BG.431	ajlai	s h r u b	whol e plan t	urticaria, jaundice, eczema, dermatitis	powde r	arial parts powder mixed with mustard oil	derm al	3 2	0 2 4	0 1 3	4
<i>Dodonaea viscosa</i> L. Sapindaceae H.UOM.BG.432	ghw aras kay	s h r u b	Leav es	Rheumatism, wounds, burns, swellings	paste	The leaves are warmed and kept on joints to relieve pain	derm al	2 2	0 1 6	0 1 8	4
<i>Duchesnea indica</i> J. Rosaceae H.UOM.BG.433	zma ki toot h	h e r b	fruit	bloody diarrhea, tonic, laxative	paste	fruit paste is prepared	oral	7 0 5	0 0 3	0 4 3	3
<i>Eruca sativa</i> M. Brassicaceae	sala d	h e	whol e	bleeding piles, ear pain,	extrac t	oil is slightly warmed over fire and poured	ear drop	9 0 0	0 0 0	0 0 2	2

H.UOM.BG.434		r b	plan t			into ears to relieve pain.			0 7	2 2	
<i>Euphorbia helioscopia</i> L. Euphorbiaceae H.UOM.BG.435	ma nda no	h e r b	seed s	skin eruption, intestinal problems, constipation,	latex	milky latex, roasted with additive, also applied on skin	oral	5	0 0 4	0 0 6	3
<i>Euphorbia wallichii</i> H. Euphorbiaceae H.UOM.BG.436	arg ha mal a	h e r b	Late x	wounds, skin diseases, emetic, cathartic	latex	stem latex is applied over skin to treat the wounds and to remove pain	derm al	1 8	0 1 3	0 2 2	4
<i>Fagonia indica</i> B. Zygophyllaceae H.UOM.BG.437	azg aka y	h e r b	areal part	blood purifier, skin infection, diabetes	decoct ion	whole plant is boiled in water and applied on skin	derm al	2 3	0 1 7	0 1 3	3
<i>Ficus carica</i> L. Moraceae H.UOM.BG.438	ainz ar	tr e e	fruit	boils, laxative, asthma, sexual debility	fresh	fruits are mixed with milk	Oral	3 2	0 2 4	0 1 3	4
<i>Foeniculum vulgare</i> M. Umbelliferae H.UOM.BG.439	sou nf	h e r b	fruit, leav es	gastrointestinal, abdominal pain, stimulant, vermicide	juice	juice of the fruit is used	oral	2 1	0 1 6	0 1 9	4
<i>Fumaria indica</i> P. Fumariaceae H.UOM.BG.440	pap ra	h e r b	whol e plan t	blood purifier, High fever, chest pain, diuretic	decoct ion	Plant is boiled in water	oral	4 1	0 3 1	0 0 7	3
<i>Geranium wallichianum</i> D. Geraniaceae H.UOM.BG.441	Sraz ela	h e r b	rhizo mes	backache, mouth ulceration, chronic diarrhea	powde r	rhizomes powder is mixed with wheat flour, sugar and oil	oral	3 0	0 2 2	0 1 1	3
<i>Grewia asiatica</i> L. Malvaceae H.UOM.BG.442	fals a	tr e e	whol e plan t	diabetics, cooling agent, stomachic,	fresh	fruits is taken orally	oral	1 9	0 1 4	0 1 6	3
<i>Gymnosporia royleana</i> W. Celastraceae H.UOM.BG.443	Sur Azg hay	s h r u b	seed	colic, dysentery, diarrhea in children	decoct ion	the plant is boiled with salt and water	oral	3 3	0 2 5	0 0 9	3
<i>Hedera nepalensis</i> K. Araliaceae H.UOM.BG.444	Pal olze la	h e r b	leav es	heart disease, cancer, diabetes	decoct ion	Fresh and ground leaves are boiled in water	oral	4 1	0 3 1	0 0 7	3
<i>Impatiens bicolor</i> R. Balsaminaceae H.UOM.BG.445	atra ng	h e r b	Who le plan t	joint pains. speeding defecation	paste	paste of leaves is applied for joint pains	derm al	1 2	0 0 9	0 1 7	2
<i>Ipomoea purpurea</i> L. Convolvulaceae H.UOM.BG.446	pre wat a	h e r b	Leav es	wound healing, painkiller, blood clotting. lice killer	crushe d	Leaves are grinded and the extract is used for washing hairs to get rid of lice.	derm al	3 1	0 2 3	0 1 3	4
<i>Isodon rugosus</i> W. Lamiaceae H.UOM.BG.447	spe rkay	h e r b	Leav es	antiseptic, dermatitis, wound	crushe d	leaves are crushed and applied on skin	derm al	4 2	0 3 1	0 0 5	2
<i>Justicia adhatoda</i> L. Acanthaceae H.UOM.BG.448	beik and	s h r u b	root	asthma, cold, cough, high fever	crushe d	dried, ground leaves mixed with sugar and root extract mixed with sugar	oral	1 5	0 1 1	0 2 7	4
<i>Lactuca sativa</i> L.	sala	h	leav	blood purifier, sedative,	fresh	fresh leaves are taken	oral	1	0	0	1

Asteraceae H.UOM.BG.449	d	e r b	es	diuretic		with meal		9	.	.		
									1	0		
									4	5		
<i>Melia azedarach</i> L. Meliaceae H.UOM.BG.450	thor a sha nda i	tr e e	fruit	leprosy, urinary disorders, diuretic,	crushe d	ripened fruits are crushed and mixed with wheat flour	oral	3	0	0	3	
								7	.	.		
									2	0		
									8	8		
<i>Mentha arvensis</i> L. Lamiaceae H.UOM.BG.451	pod ina	h e r b	leav es	vomiting, nausea, dysentery	paste	dried leaves are taken with curd to control dysentery vomiting and nausea	oral	4	0	0	3	
								3	.	.		
									3	0		
									2	7		
<i>Mentha longifolia</i> L. Lamiaceae H.UOM.BG.452	wel any	h e r b	Who le plan t	indigestion, vomiting, cholera, carminative, colic	powde r	plant powder taken with water	Oral	5	0	0	3	
								3	.	.		
									4	0		
									6			
<i>Mirabilis jalapa</i> L. Nyctaginaceae H.UOM.BG.453	Gul- e- aba ssi	h e r b	root	piles, blood purifier, cathartic, dropsy	juice	leaves juice are taken	Oral	1	0	0	4	
								3	.	.		
									1	3		
									1			
<i>Morus alba</i> L. Moraceae H.UOM.BG.454	spin toot h	tr e e	fruit	heart, liver tonic, dyspepsia	fresh	fresh ripen fruit is taken	oral	2	0	0	3	
								3	.	.		
									1	1		
									7	3		
<i>Morus nigra</i> L. Moraceae H.UOM.BG.455	thor tho oth	tr e e	fruit	analgesic, flu and throat infection	fresh	fresh ripen fruit is taken	oral	1	0	0	3	
								9	.	.		
									1	1		
									4	6		
<i>Nasturtium officinale</i> R. Brassicaceae H.UOM.BG.456	Tar me era	h e r b	whol e plan t	blood purifier, diuretic, antiscorbic, expectorant	decoct ion	leaves are boiled in water	oral	2	0	0	4	
								4	.	.		
									1	1		
									8	7		
<i>Nerium oleander</i> L. Apocynaceae H.UOM.BG.457	gan dec har	s h r u b	whol e plan t	heart diseases, Sexual purpose ,diuretic, cathartic	decoct ion	plant especially flowers are boiled with milk	oral	5	0	0	4	
									.	.		
									0	8		
									4			
<i>Plantago major</i> L. Plantaginaceae H.UOM.BG.458	sath	h e r b	areal part	pain killer, carminative, stomach disorders, purgative	decoct ion	arial parts are crushed and taken with yogurt and milk	oral	3	0	0	4	
								5	.	.		
									2	1		
									6	1		
<i>Polygonum barbatum</i> L. Polygonaceae H.UOM.BG.459	pul pol uk	h e r b	whol e plan t	stomach disorders, constipation, infections	paste	leaf paste is applied on skin infections	derm al	1	0	0	3	
								1	.	.		
									0	2		
									8	7		
<i>Quercus incana</i> B. Fagaceae H.UOM.BG.460	ban j	tr e e	fruit	urinary disorders, asthma, diarrhea, gonorrhoea	powde r	half roasted fruit powder is mixed in honey	Oral	2	0	0	4	
								0	.	.		
									1	2		
									5			
<i>Ranunculus muricatus</i> L. Ranunculaceae H.UOM.BG.61	zyar gwa lay	h e r b	leav es	skin infection, wounds	paste	fresh leaf paste is applied on infected skin	derm al	7	0	0	2	
									.	.		
									0	2		
									5	9		
<i>Ricinus communis</i> L. Euphorbiaceae H.UOM.BG.462	arh and a	s h r u b	leav es and fruit s	constipation, jaundice, abdominal pain	fresh	leaves are heated and applied over the abdomen	derm al	8	0	0	3	
									.	.		
									0	3		
									6	8		
<i>Salix alba</i> L. Salicaceae H.UOM.BG.463	wal a	tr e e	Bark	pain, fever, astringent	decoct ion	cleaned bark is boiled in water	Oral	4	0	0	3	
								8	.	.		
									3	0		
									6	6		

<i>Silene conoidea</i> L. Caryophyllaceae H.UOM.BG.464	bas hka	h e r b	seed s, leav es	pimples, backache, emollient	paste	paste is prepared by grinding seeds and young leaves and applied externally	dermal	1 0	0 .	0 .	3 3
<i>Silene vulgaris</i> M. Caryophyllaceae H.UOM.BG.465	mat a r ran gay	h e r b	leav es, flow ers	respiratory diseases, cough, asthma	decoction	leaves and flowers are boiled in water	Oral	1 4	0 .	0 .	3 2 1
<i>Solanum nigrum</i> L. Solanaceae H.UOM.BG.466	thor ka mac ho	h e r b	leav es	eye pain, expectorant, laxative, leprosy, Sedative	crushed	leaves and fruits are crushed and eaten with water	Oral	4 1	0 .	0 .	5 1 2
<i>Solanum pseudocapsicum</i> L. Solanaceae H.UOM.BG.467	ka mac ho	h e r b	fruit	diabetes, toothache	fresh	eaten as a raw in small amount	oral	3 9	0 .	0 .	2 0 5
<i>Taraxacum officinale</i> N. Asteraceae H.UOM.BG.468	bud abu dai	h e r b	rhizo me	jaundice, diuretic, tonic, aperient	decoction	fresh rhizome is boiled in water	oral	2 1	0 .	0 .	4 1 9
<i>Urtica dioica</i> L. Urticaceae H.UOM.BG.469	sez onk ay	h e r b	whol e plan t	external irritant, stringent, diuretic	juice	juice of plant is used as external irritant	dermal	3 9	0 .	0 .	3 0 8
<i>Valeriana jatamansi</i> J. Valerianaceae H.UOM.BG.470	mu shk ebal a	h e r b	Root /leav es	diarrhea, dysentery, analgesic, skin infections, carminative	decoction	leaves are boiled in water	oral	5 8	0 .	0 .	5 0 9
<i>Viola canescens</i> W. Violaceae H.UOM.BG.471	ban afsh a	h e r b	whol e plan t	fever and chills, muscle tension, sore throat, laxative	decoction	plant is boiled with water and sugar	oral	5 0	0 .	0 .	5 1 7
<i>Vitex negundo</i> L. Verbenaceae H.UOM.BG.472	war ma nda i	s h r u b	Leav es	mild fever, urinary disorders, worms problem anthelmintic	extract	leaves are boiled in water, filtered and extract is prepared	oral	7 .	0 .	0 .	4 5 7
<i>Zanthoxylum armatum</i> D. Rutaceae H.UOM.BG.473	da mb ara	s h r u b	seed	stomach disorders, tooth problems	powder	powder of dry fruit are taken with meal and water	oral	3 5	0 .	0 .	2 0 6
<i>Zizyphus jujuba</i> M. Rhamnaceae H.UOM.BG.474	mar kha nai	tr e e	Leav es	skin infections, diabetes	fresh	Fresh leaves are chewed	oral	3 4	0 .	0 .	2 0 6

Part used, mode of preparation and application

For the preparation of ethnomedicines the inhabitants used leaves (31%) mostly followed by whole plant (21%), fruit and root (9%), rhizome (7%), seed and aerial parts (6%), bark (4%), bulb, flower and latex (1%) (Figure 3). Our study is in line at national and international level with (Hazrat et al., 2011; Randrianarivony et al., 2017) where leaves are mostly used for the preparation of ethnomedicine.

The inhabitants did not report any side effect however some plants were poisons which might be due to proper and administered doze utilization. The inhabitant's used decoction, crushed, extract, juice, latex, paste, powder, soup and in raw form. They use decoction (28%) commonly for the preparation of ethnomedicine followed by powder (21%), raw and paste (14%), juice, extract (6%), latex (3%) and (1%) as a soup (Figure 2). The results are in line with other studies at national and international level (Ahmad et al., 2014; Chellappandian et al., 2012) where healer use mostly decoction for the preparation of ethnomedicine. It might be due to get more chemical constituents for fruitful results. The taste of ethnomedicine is mostly very bitter and unpleasant, therefore they use additive like wheat flour, sugar, milk, salt, honey, desi ghee. In the locality frequently ethno medicines (76%) were taken as orally followed by dermal (22%) and ear drops (2%) (Figure 5). Our conclusions are in the settlement at national and international level with (Hassan et al., 2017; Namukobe et al., 2011) and (Ssegawa & Kasenene, 2007), who also observed that the main practice in preparation of herbal medicine was decoction with

oral intake. For external use, they use oil paste and poultice mostly for skin irritation, infection and joint pain. The results are in agreement with (Umair, Altaf & Abbasi, 2017).

Informant consensus factor (ICF)

To calculate ICF diseases were categorized into 10 different categories based on use reports obtained (Table 2). Highest number of use reports (93) were observed for gastrointestinal and (92) for antispasmodic while lowest (23) for tonic. Out of total (14.5%) plant species were used as febrifuge followed by diuretic (13.19%), painkiller (11.11%), carminative (11.8%), diarrhoea and dysentery (10.41%), antispasmodic (9.72%), dermatitis (9.02), gastrointestinal (7.63%), anti-diabetic (6.94%) and tonic (5.55%) (Table 3). Informants consensus factor plays an important role in plant selection for phytochemical and pharmacological analysis (Giday et al., 2007). In our study, mostly plant species were used as a febrifuge (21) and a diuretic (19), which might be due to bad hygiene, unpurified drinking water, cold weather and effective use of herbal drugs. Our results are in connection with (Amiri, Jabbarzadeh & Akhondi, 2012; Korkmaz et al., 2016) where the inhabitants use mostly plant species as febrifuge and diuretic. High Informant consensus factor, ICF (0.89) was observed for gastrointestinal disorder while lowest (0.54) for painkiller, which is parallel with the study of (Zahoor et al., 2017).

Table 3. Informant consensus factor of traditional medicinal plants used as remedy Bahrain Valley.

Disorders	Number of use reports (NUR)	Use percentage	reports	Number of taxa used (Nt)	Taxa Percentage	ICF
Carminative	71	11.25	17	17	11.8	0.77
Gastrointestinal	93	10.45	11	11	7.63	0.89
Diuretic	87	13.78	19	19	13.19	0.79
Antispasmodic	92	12.51	14	14	9.72	0.85
Febrifuge	92	14.58	21	21	14.5	0.78
Diarrhea/dysentery	81	12.83	15	15	10.41	0.82
Dermatitis	59	9.35	13	13	9.02	0.79
Anti-diabetic	39	6.18	10	10	6.94	0.76
Pain killer	34	5.38	16	16	11.11	0.54
Tonic	23	3.64	8	8	5.55	0.68

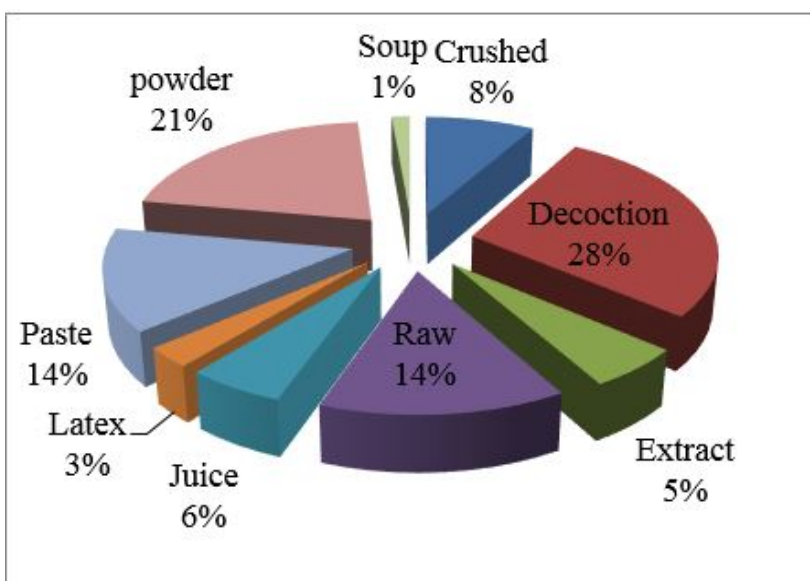


Figure 2. Methods for preparation of ethno medicines.

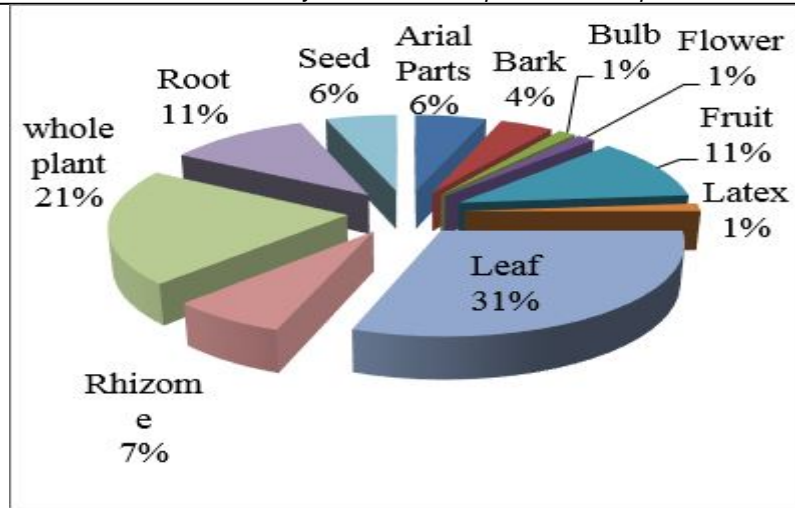


Figure 3. Part used for preparation of ethno medicine.

Relative frequency of citation (RFC) and use value (UV)

Relative frequency of citation (RFC) shows the local importance and rank of each medicinal plant species, while Use value (UV) provides the relative importance on the use of medicinal plant species (Vitalini et al., 2013). The RFC was observed high (0.43) for *Valeriana jatamansi* followed by *Ajuga bracteosa* (0.42), *Caralluma tuberculata* and *Mentha longifolia* (0.40) while lowest for *Nerium oleander* (0.04), *Ranunculus muricatus*, *Vitex negundo* (0.05) and *Ricinus communis* (0.6) (Table 2). It was clear from the fact that knowledgeable inhabitants have a comprehensive knowledge regarding medicinal plants in the study area (Northern Pakistan). Our results are in line with (Ahmad et al., 2014) who also observed nearly same RFC (0.42) for *Valeriana jatamansi*, 0.24 for *Ajuga bracteosa* and 0.88 for *Mentha longifolia* which were usually well-known by the inhabitants with in the same district. Use value (UV) provides the relative importance on the use of medicinal plant species (Savikin et al., 2013). The use value (UV) was observed high (0.80) for *Nerium oleander* while lowest (0.05) for *Isodon rugosus*, *Lactuca sativa* and *Solanum pseudocapsicum*. *Nerium oleander* has used a substitute of *Digitalis* and is a good cardiac stimulant, diuretic, cathartic and sexual stimulant. It might be due to that highly poisonous plants have highly biologically active compounds which depend on preparation method and doze taken for fruitful results. The use value (UV) of *Nerium oleander* has also been observed by (Bulut & Tuzlaci, 2013) as (0.04) for Rheumatism. Our study is in agreement with (Shinwari et al., 2006) where the inhabitants in the same district use *Nerium oleander* as a diuretic, cathartic and to treat cardiac diseases, *Isodon rugosus* as antiseptic (Hassan et al., 2017) and *Lactuca* as a sedative (Ali et al., 2016).

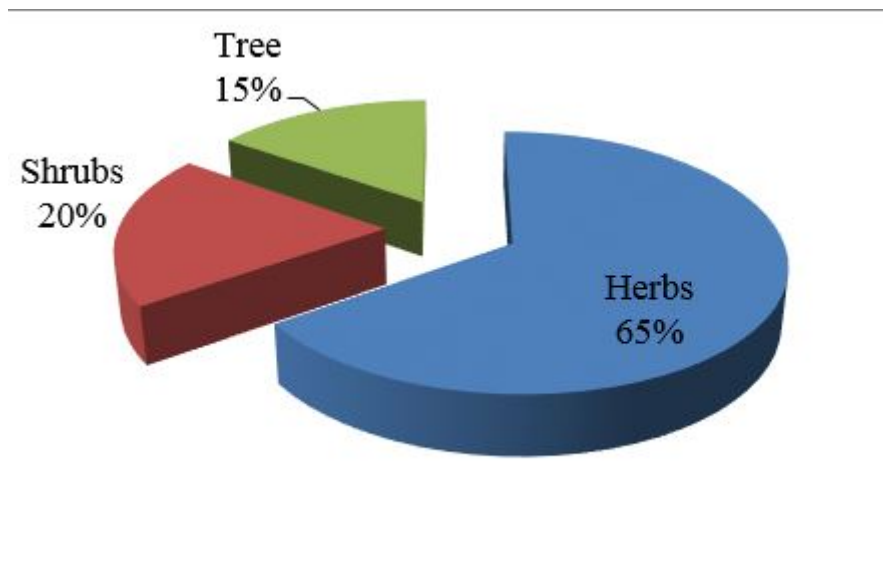


Figure 4. Habit of medicinal plant species.

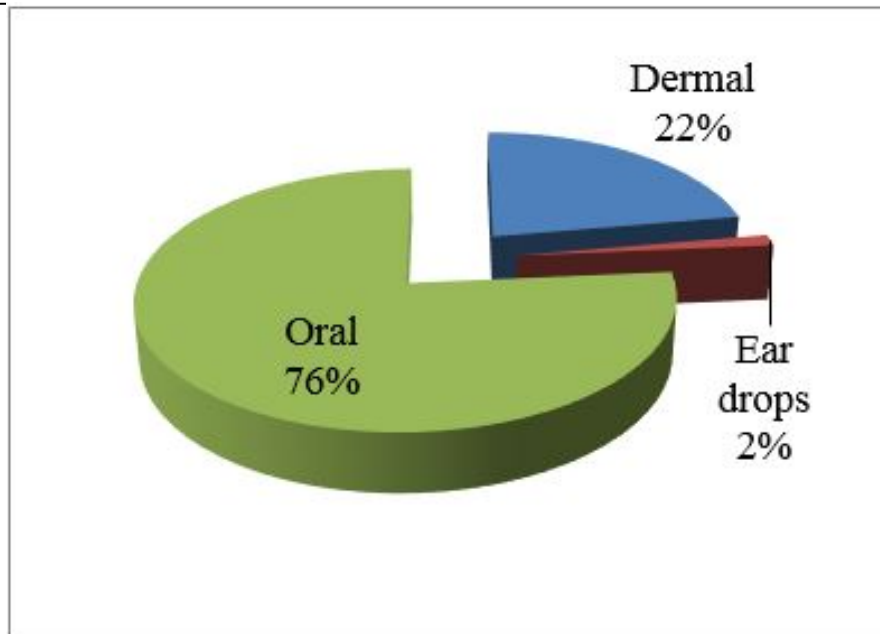


Figure 5. Mode of application of ethnomedicines.

Fidelity level (FL)

Fidelity level indicates informants percentage appealing the usages of definite medicinal plant species for the similar major purpose. Fidelity level (FL) of high valued 18 medicinal plant species was observed 92.31 to 56.52 (Table 4). Plant species with high FL value identifies the usages of specific plant species for a specific disease in the study area (Bibi et al., 2014). High fidelity level 94.12% was observed for *Ajuga bracteosa* (stomach disorder) followed by *Achyranthes aspera* 92.31% (asthma, cough), *Salix alba* (Pain and fever) and lowest 56.52% for *Plantago major*. *Ajuga bracteosa* with (100%) fidelity level has already been observed for diabetic disorders by (Ahmad & Habib, 2014), *Achyranthes aspera* (82%) as antimalarial by (Wangpan et al., 2016), *Plantago major* as purgative by (Shinwari et al., 2006) and *Salix alba* as painkiller by (Chevallier, 1998).

Table 4. FL values of frequently used traditional medicinal plants as remedy in Bahrain Valley.

Botanical Name	Major Disorders	LP	LU	FL
<i>Achyranthes aspera</i> L.	Asthma, cough	12	13	92.31
<i>Aconitum chasmanthum</i> S.	High fever	14	17	82.35
<i>Ajuga bracteosa</i> W.	Stomach disorder	16	17	94.12
<i>Cichorium intybus</i> L.	Anti-inflammatory	9	13	69.23
<i>Fagonia indica</i> B.	Skin infection	14	19	73.68
<i>Foeniculum vulgare</i> M.	Stimulant	9	13	69.23
<i>Fumaria indica</i> P	Blood purifier	7	10	70
<i>Ipomoea purpurea</i> L.	Blood clotting	11	16	68.75
<i>Melia azedarach</i> L.	Urinary disorders	19	25	76
<i>Mentha longifolia</i> L.	Carminative	11	15	73.33
<i>Nasturtium officinale</i> R	Antiscorbic	26	30	86.67
<i>Plantago major</i> L.	Purgative	13	23	56.52
<i>Salix alba</i> L.	Pain killer	21	29	72.41
<i>Solanum nigrum</i> L.	Laxative	13	20	65
<i>Valeriana jatamansi</i> J.	Skin infections	17	19	89.47
<i>Viola canescens</i> W.	Sore throat	18	24	75
<i>Vitex negundo</i> L.	Anthelmintic	8	14	57.14
<i>Zanthoxylum armatum</i> D.	Tooth problems	6	10	60

Direct matrix ranking (DMR)

In order to rank medicinal different medicinal plant species, DMR was carried out. DMR can be applied to match plant diversity of certain plant based on data collection from respondents. (Cotton, 1996). A total of 15 experienced and knowledgeable informants were preferred for DMR data collection. Experienced and knowledgeable informants were allowed to give rank to medicinal plant species as 0=not used, 1=least used, 2=less used, 3=good, 4=very good, 5=best to every single plant species (Table 5). The average scores given to each plant species was summed up and ranked (Hassan et al., 2017). DMR was observed high for trees mostly followed by shrubs. Highest DMR was observed for *Melia azedarach* (24) followed by

Dalbergia sisso (22) and lowest (10) for *Vitex negundo*.

Table 5. DMR Score of most frequently used medicinal plants species.

Plant	Agriculture tools	Construction	Fodder	Fuel	Medicinal	Rank
<i>Acacia nilotica</i> L.	3	4	3	5	4	19
<i>Alnus nitida</i> S.	3	3	2	5	3	16
<i>Berberis lycium</i> R.	0	0	3	4	5	12
<i>Dalbergia sissoo</i> D.	5	5	3	5	4	22
<i>Ficus carica</i> L.	3	1	2	4	4	14
<i>Melia azedarach</i> L.	3	4	4	5	4	19
<i>Melia azedarach</i> L.	5	5	4	5	5	24
<i>Morus alba</i> L.	4	4	3	5	3	19
<i>Salix alba</i> L.	3	3	2	3	5	16
<i>Vitex negundo</i> L.	0	0	2	4	4	10
<i>Zanthoxylum armatum</i> D.	0	0	4	4	5	14

Conclusions

The inhabitants depend on medicinal plant species for the treatment of different health disorders although English medicine is reachable up to some extent. Mostly the aged people claimed that they are using ethnomedicine since childhood; this knowledge has been passed from elders to the youngster. The inhabitants use *Berberis lycium* for mouth sour, *Canabis sativa* as painkiller, stomach disorders, *Mentha longifolia* as carminative, and colic on a regular basis as per need. Harvesting of plant species for fuelwood and medicinal purpose was observed commonly in the locality. The inhabitants were found unaware about sustainable use, conservation, and storage of medicinal plant species, which can affect the biodiversity of the region. The peoples of the locality were observed agree to share their ethnobotanical knowledge with investigators. In the current study, many medicinal plant species were documented which need further phytochemical investigation. Further exploration, awareness, conservative strategies, joint collaboration and wise use of resources are highly recommended.

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References

- Acharya, R., & Acharya, K. P. (2009). Ethnobotanical study of medicinal plants used by Tharu community of Parroha VDC, Rupandehi district, Nepal. *Scientific World*, 7(7), 80-84.
- Adnan, M., Begum, S., Khan, A. L., Tareen, A. M., & Lee, I. J. (2012). Medicinal plants and their uses in selected temperate zones of Pakistani Hindukush-Himalaya. *Journal of medicinal plants research*, 6(24), 4113-4127.
- Adnan, M., Ullah, I., Tariq, A., Murad, W., Azizullah, A., Khan, A. L., & Ali, N. (2014). Ethnomedicine use in the war affected region of northwest Pakistan. *Journal of Ethnobiology and Ethnomedicine*, 10(1), 16.
- Ahmad, H. (2003). Capacity building for cultivation and sustainable harvesting of medicinal and aromatic plants. Conservation and sustainable uses of medical and aromatic plants of Pakistan. *Ethnobotany Project, World Wide Fund for Nature Pakistan (WWF-P)*. Islamabad, Pakistan, 31-36.
- Ahmad, K. S., & Habib, S. (2014). Indigenous knowledge of some medicinal plants of Himalaya region, Dawarian village, Neelum valley, Azad Jammu and Kashmir, Pakistan. *Universal Journal of Plant Science*, 2(2), 40-47.
- Ahmad, M., Sultana, S., Fazl-i-Hadi, S., Ben Hadda, T., Rashid, S., Zafar, M., Khan, M. A., Khan, M. P. Z., & Yaseen, G. (2014). An Ethnobotanical study of Medicinal Plants in high mountainous region of Chail valley (District Swat-Pakistan). *Journal of ethnobiology and ethnomedicine*, 10(1), 36.
- Akhtar, N., Rashid, A., Murad, W., & Bergmeier, E. (2013). Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. *Journal of ethnobiology and ethnomedicine*, 9(1), 25.
- Ali, S. (1980). *Flora of Pakistan*. Pakistan Agricultural Research Council.
- Ali, S., & Qaiser, M. 2010. *Flora of Pakistan*. No 1-215 (1972-2010), Pakistan. http://www.efloras.org/flora_page.aspx?flora_id=5, accessed on 9 November.
- Ali, W., & Hamiduddin, A. A., Aslam, M., Nasir, A. (2016) Tikh-E-Kahu (*Lactuca sativa* LINN): Pharmacological and Phytochemical Profile and Uses is Unani Medicine. *J. Pharm. Sci. Innov*, 5(1), 1-4.
- Amiri, M. S., Jabbarzadeh, P., & Akhondi, M. (2012). An ethnobotanical survey of medicinal plants used by indigenous people in Zangelanlo district, Northeast Iran. *Journal of Medicinal Plants Research*, 6(5), 749-753.
- Bibi, T., Ahmad, M., Bakhsh, T. R., Mohammad, T. N., Jabeen, R., Rehman, S.-U., Sultana, S., Zafar, M., & Yaseen, G. (2014). Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan. *Journal of ethnopharmacology*, 157, 79-89.
- Bulut, G. & Tuzlaci, E. 2013. An ethnobotanical study of medicinal plants in Turgutlu (Manisa-Turkey). *Journal of Ethnopharmacology*,

149(3): 633-647.

- Butt, M. A., Ahmad, M., Fatima, A., Sultana, S., Zafar, M., Yaseen, G., Ashraf, M. A., Shinwari, Z. K., & Kayani, S. (2015). Ethnomedicinal uses of plants for the treatment of snake and scorpion bite in Northern Pakistan. *Journal of Ethnopharmacology*, 168, 164-181.
- Canales, M., Hernández, T., Caballero, J., Romo de Vivar, A., Avila, G., Duran, A., & Lira, R. Informant consensus factor and antibacterial activity of the medicinal plants used by the people of San Rafael Coxcatlán, Puebla, México. *Journal of Ethnopharmacology*, 97(3), 429-439.
- Chellappandian, M., Mutheeswaran, S., Pandikumar, P., Duraipandiyan, V., & Ignacimuthu, S. (2012). Quantitative ethnobotany of traditional Siddha medical practitioners from Radhapuram taluk of Tirunelveli District, Tamil Nadu, India. *Journal of ethnopharmacology*, 143(2), 540-547.
- Chevallier, A. (1998). *Materia Medica*. Middlesex University, USA.
- Cotton, C. M., & Wilkie, P. (1996). *Ethnobotany: principles and applications* (No. Sirsi) i9780471955375). Chichester: John Wiley & Sons.
- Dei Cas, L., Pugni, F., & Fico, G. (2015). Tradition of use on medicinal species in Valfurva (Sondrio, Italy). *Journal of ethnopharmacology*, 163, 113-134.
- Frei, B., Baltisberger, M., Sticher, O., & Heinrich, M. (1998). Medical ethnobotany of the Zapotecs of the Isthmus-Sierra (Oaxaca, Mexico): Documentation and assessment of indigenous uses. *Journal of Ethnopharmacology*, 62(2), 149-165.
- Friedman, J., Yaniv, Z., Dafni, A., & Palewitch, D. (1986). A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. *Journal of ethnopharmacology*, 16(2-3), 275-287.
- Giday, M., Teklehaymanot, T., Animut, A., & Mekonnen, Y. (2007). Medicinal plants of the Shinasha, Agew-awi and Amhara peoples in northwest Ethiopia. *Journal of Ethnopharmacology*, 110(3), 516-525.
- Gilani, A. H. (2005). Trends in ethnopharmacology. *Journal of ethnopharmacology*, 100(1-2), 43-49.
- Govaerts, R. (2001). How many species of seed plants are there?. *Taxon*, 50(4), 1085-1090.
- Hamayun, M. (2010). *Studies on Ethnobotany, conservation and plant diversity of Utror and Gabral valleys, district Swat, Pakistan* (PhD thesis). Islamabad, Pakistan: Quaid-i-Azam University.
- Hassan, N., Nisar, M., Kakar, S., Hassan, F., Zhiwei, Z., Nong, L., Khan, M., Shuaib, M., & Wang, D. (2017). Determination of informant consensus factor of medicinal plants used as therapy in district Dir Lower Pakistan. *Journal of medicinal plant studies*, 5(4), 183-188.
- Hassan, N., Wang, D., Shuaib, M., Zhiwei, Z., Nisar, M., Ahmad, W., Ahmad, S., & Khan, A. (2017). Identification and ethnobotanical survey of profitable medicinal plants used as remedy in Sangina Pakistan. *International Journal of Herbal Medicine*, 5(4), 117-123.
- Hassan, N., Wang, D., Zhiwei, Z., Nisar, M., & Zhu, Y. 2017. Determination and analysis of informant consensus factor of medicinal plant species used as remedy in Northern Pakistan. *Journal of Biodiversity and Environmental Sciences*, 11(2): 117-133.
- Hazrat, A., Nisar, M., Shah, G., & Ahmad, S. (2011). Ethnobotanical study of some elite plants belonging to Dir, Kohistan valley, Khyber Pukhtunkhwa, Pakistan. *Pak J Bot*, 43(2), 787-795.
- Heyd, T. (1995). Indigenous knowledge, emancipation and alienation. *Knowledge and Policy*, 8(1), 63-73.
- Kayani, S., Ahmad, M., Zafar, M., Sultana, S., Khan, M. P. Z., Ashraf, M. A., Hussain, J., & Yaseen, G. (2014). Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies-Abbottabad, Northern Pakistan. *Journal of ethnopharmacology*, 156, 47-60.
- 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. *Evidence-based complementary and alternative medicine*, 2014.
- Kloutsos, G., Balatsouras, D. G., Kaberos, A. C., Kandiloros, D., Ferekidis, E., & Economou, C. (2001). Upper airway edema resulting from use of *Ecballium elaterium*. *The Laryngoscope*, 111(9), 1652-1655.
- Korkmaz, M., Karakuş, S., Özçelik, H., & Selvi, S. (2016). An ethnobotanical study on medicinal plants in Erzincan, Turkey.
- Medeiros, M. F. T., Silva, O. S., & Albuquerque, U. P. (2011). Quantification in ethnobotanical research: an overview of indices used from 1995 to 2009. *Sitientibus série Ciências Biológicas*, 11(2), 211-300.
- Musa, M. S., Abdelrasool, F. E., Elsheikh, E. A., Ahmed, L. A., Mahmoud, A. L. E., & Yagi, S. M. (2011). Ethnobotanical study of medicinal plants in the Blue Nile State, South-eastern Sudan. *Journal of Medicinal Plants Research*, 5(17), 4287-4297.
- Namukobe, J., Kasenene, J. M., Kiremire, B. T., Byamukama, R., Kamatenesi-Mugisha, M., Krief, S., Dumontet, V., & Kabasa, J. D. (2011). Traditional plants used for medicinal purposes by local communities around the Northern sector of Kibale National Park, Uganda. *Journal of ethnopharmacology*, 136(1), 236-245.
- Nasir, E. (1981). *Flora of Pakistan*, Agriculture Research Conference, 1981, Islamabad (Pakistan), 24-27 Oct. 1981. PARC.
- Parmesan C. (2006). ecological and evolutionary responses to recent climate change. *the annual Review of ecology, evolution, and systematics* 37: 637-69. http://cns.utexas.edu/communications/File/annRev_CCImpacts2006.pdf accessed, 1(20), 07.
- Phillips, O., Gentry, A. H., Reynel, C., Wilkin, P., & Gálvez-Durand B. C. (1994). Quantitative ethnobotany and Amazonian conservation. *Conservation biology*, 8(1), 225-248.
- Randrianarivony, T. N., Ramarosandratana, A. V., Andriamihajarivo, T. H., Rakotoarivony, F., Jeannoda, V. H., Randrianasolo, A., & Bussmann, R. W. (2017). The most used medicinal plants by communities in Mahaboboka, Amboronabo, Mikoboka, Southwestern Madagascar. *Journal of ethnobiology and ethnomedicine*, 13(1), 19.
- Rao, M., Palada, M., & Becker, B. (2004). Medicinal and aromatic plants in agro-forestry systems. *Agroforestry Syst* 61: 107-122.
- Rehman, M. N., Ahmad, M., Sultana, S., Zafar, M., & Edwards, S. (2017). Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. *Revista Brasileira de Farmacognosia*, 27(6), 751-775.
- Sanz-Biset, J., Campos-de-la-Cruz, J., Epiquién-Rivera, M. A., & Canigüeral, S. (2009). A first survey on the medicinal plants of the Chazuta valley (Peruvian Amazon). *Journal of Ethnopharmacology*, 122(2), 333-362.
- Šavikin, K., Zdunić, G., Menković, N., Živković, J., Čujić, N., Tereščenko, M., & Bigović, D. (2013). Ethnobotanical study on traditional use of medicinal plants in South-Western Serbia, Zlatibor district. *Journal of ethnopharmacology*, 146(3), 803-810.
- Sheikh, K., Ahmad, T., & Khan, M. A. (2002). Use, exploitation and prospects for conservation: people and plant biodiversity of Naltar Valley, northwestern Karakorums, Pakistan. *Biodiversity & Conservation*, 11(4), 715-742.
- Shinwari, Z. K., Watanabe, T., Rehman, M., & Youshikawa, T. (2006). *A pictorial guide to Medicinal Plants of Pakistan*. KUST. Kohat, Pakistan. ISBN:969-8870-00-8.

- Shinwari, Z. K. (2010). Medicinal plants research in Pakistan. *Journal of medicinal plants research*, 4(3), 161-176.
- Shinwari, Z. K., & Qaiser, M. (2011). Efforts on conservation and sustainable use of medicinal plants of Pakistan. *Pak. J. Bot*, 43(1), 5-10.
- Ssegawa, P., & Kasenene, J. M. (2007). Medicinal plant diversity and uses in the Sango bay area, Southern Uganda. *Journal of Ethnopharmacology*, 113(3), 521-540.
- Tabuti, J. R., Lye, K. A., & Dhillon, S. S. (2003). Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. *Journal of ethnopharmacology*, 88(1), 19-44.
- Teklehaymanot, T. (2009). Ethnobotanical study of knowledge and medicinal plants use by the people in Dek Island in Ethiopia. *Journal of Ethnopharmacology*, 124(1), 69-78.
- Ugulu, I., Baslar, S., Yorek, N., & Dogan, Y. (2009). The investigation and quantitative ethnobotanical evaluation of medicinal plants used around Izmir province, Turkey. *Journal of Medicinal plants research*, 3(5), 345-367.
- Umair, M., Altaf, M., & Abbasi, A. M. (2017). An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. *PloS one*, 12(6), e0177912.
- 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. *Journal of ethnobiology and ethnomedicine*, 2(1), 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. *Journal of Ethnopharmacology*, 145(2), 517-529.
- Wangpan, T., Chetry, L., Tsering, J., taka, T., & Tangjang, S. (2016). Anti-Malarial Plants of Jonai, India: an Ethnobotanical Approach. *Notulae Scientia Biologicae*, 8(1), 27-32.
- WHO. (2002). WHO. Traditional Medicine and Alternative Medicines. Geneva. Fact Sheet. No. 271.
- Zahoor, M., Yousaf, Z., Aqsa, T., Haroon, M., Saleh, N., Aftab, A., Javed, S., Qadeer, M., & Ramazan, H. (2017). An ethnopharmacological evaluation of Navapind and Shahpur Virkanin district Sheikupura, Pakistan for their herbal medicines. *Journal of ethnobiology and ethnomedicine*, 13(1), 27.

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