



Original article

Medicinal plants resources of Western Himalayan Palas Valley, Indus Kohistan, Pakistan: Their uses and degrees of risk of extinction



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ABSTRACT

Present study was intended with the aim to document the pre-existence traditional knowledge and ethnomedicinal uses of plant species in the Palas valley. Data were collected during 2015–2016 to explore plants resource, their utilization and documentation of the indigenous knowledge. The current study reported a total of 65 medicinal plant species of 57 genera belonging to 40 families. Among 65 species, the leading parts were leaves (15) followed by fruits (12), stem (6) and berries (1), medicinally significant while, 13 plant species are medicinally important for rhizome, 4 for root, 4 for seed, 4 for bark and 1 each for resin. Similarly, thirteen species were used as a whole while twelve species as partial for medicinal purpose. Further, it is concluded that every part of plants such as bulb, rhizome, roots, barks, leaves, flowers, fruit and seed were used for various ailments. Moreover, among 65 plants species, 09 species are threatened and placed into Endangered (EN) and Least Concern (LC) categories of IUCN. The recorded data are very useful and reflects the significance of the Palas valley as medicinal plants resource area.

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1. Introduction

Plants are source of fodder and shelters for animals and other micro and macro organisms and also source of valuable medicines both for humans and animals around the globe. Floristically, Pakistan exist a high degree of diverse flora due to its unique topographic and climatic conditions (Ali and Qaiser, 2015). About 6000 vascular plant species have been documented for this country with maximum species richness in the northern mountainous regions. Further, of these, about 400 species are exclusively ende-

mic to Pakistan (Ali, 2008). These plants play an important role in socio economy of the region. Various authors in different era explored plants natural resources and documented their application and importance, especially with reference to medicinal uses. From Shavar Valley only 121 plants species have been recorded (Hussain et al., 2006) among them, 53% plant species were used as traditional medicines, 52% fodder, 25% fire wood, 24% honey bee and 15% were fruit plants. Besides this, the inhabitants of the valley especially farmers graded the plants and medicinal weeds, separated from the rest of the weed plants, approximately 61% weed plants were used for primary health care (Islam et al., 2006). Similarly, the local people have classified the plant natural resources according to their nature for multiple uses such as for food, shelter, fodder, fuel and for medicine (Ahmad et al., 2011), the locals of the area were used most of them for medicinal purpose while few of the species are being shifted to other part of the country for better marketing. A similar study has been conducted in northern Pakistan in which 10 species belonging to family Asteraceae were used against snake and scorpion bite (Butt

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et al., 2015). In another study, most of the members of the family Asteraceae and Lamiaceae were used against malaria and leishmaniasis parasites (Tariq et al., 2016). Further, the highest amount of artemisine, chemical compound used against malaria, was found in two different species of the genus *Artemisia*, available in northern Pakistan. Some workers (Mannan et al., 2010; Khan et al., 2007) have reported 88 species used by the locals as traditional medicines, among these, 32 were used for stomach or gastric problems, 10 species were used for renal disorder and seven species were used for jaundice and related fever. Due to lack of health facilities, access and unaffordability of allopathic drugs in the study area of Kalar Kahar, the local inhabitants have adopted 29 plant species for medicinal purposes (Ahmad and Hussain, 2008).

Similarly (Zahoor et al., 2017) have reported 96 plant species, used for different medicinal purposes in the form of extraction by the inhabitants of the Nava Pind and Shahpur Virkan. Likewise, 106 medicinally valuable plant species have been reported from Swat. Among these, most of them were herbaceous and most used parts were leaves, fruits and underground parts. The remedies were mostly developed in the form of decoction and powder form and taken orally (Akhtar et al., 2013). A total of 80 plant species have been investigated and recorded for medicinal purposes especially for gynecological problems, menstrual and vaginal infection (Sadeghi and Mahmood, 2014). A similar study has been conducted in which 9 plant species were identified for use in gynecological disorders especially wound healing among women and the local women are totally dependent upon the local plant resources, because of the unavailability and lack of access to the synthetic medicine (Lawal et al., 2013). In another investigation, 78 plants species have been documented as medicinal plants for the treatment of at least 77 different disorders in which the leaves were the most frequent part used and decoction was the major form of preparation (Islam et al., 2014). In another investigations, 84 plants have been reported and used by locals for different ailments (Abbas et al., 2017), 169 plants were reported to be used in herbal tea for treating different health condition (Jin et al., 2018). In the recent past, several plant species have been reported and used in various medicine preparations (Talukdar and Gupta, 2018), and for wide range of skin diseases (Wagh and Jain, 2018). Recently 129 medicinal plants species have been reported from Chenab catchment area of Punjab, Pakistan and used by the local people for various ailments (Umair et al., 2019). Similarly, in a recent finding, 54 families were found to be used for various neurological disorder in Pakistan (Khan et al., 2019). The adjoining areas of the Palas valley such as Skardu and Gilgit are rich source of medicinal plants and consider to be a center for the trade of medicinal plants (Salim et al., 2019).

On the other hand, due to over exploitation, habitat loss and climatic changes, many plant species become endangered. Unfortunately, we have little information regarding current status of the flora. International Union for Conservation of Nature and Natural Resources (IUCN) documented 12 species as threatened for Pakistan (IUCN, 2019). However, these species have not been evaluated based on current field studies. To date, in real sense, only 117 taxa have been evaluated according to IUCN Red List Categories and Criteria 2001 (Redlist Categories and Criteria: Version 3.1, 2001). Of these, 24 are Critically Endangered, 50 Endangered, 17 Vulnerable, 14 extinct, 3 regionally extinct, and remaining 9 taxa are Data Deficient (Abbas, 2010, Alam and Ali, 2009, 2010, Ali, 2010). This figure hardly meets about 1.9% of the total known vascular plant flora. None of us can deny the importance of plants especially their uses with respect to medicinal application in remote areas and their uses in modern commercialized products. Hence, Palas valley, a remote geographic region in Kohistan District was chosen to investigate traditional knowledge in relation to plants. The objectives of the present work were: 1. Exploration of

the medicinal flora 2. their medicinal and local uses and 3. documentation of the indigenous knowledge of the study area.

2. Materials and methods

2.1. Study area

Palas valley fall in the Western Himalayas and can be traced at 34°–52' to 35°–16'N and 72°–52' to 73°–35'E, on the globe with altitudes varies from 788 to 4370 m. The valley falls in Indus Kohistan, also known as Yagastan, and the land of free peoples. The valley possesses 1300 km² area which drains by two main streams viz. Mushaga and Shera Kot, joining the Indus river near Kehyal and Pattan towns, respectively. Geographically, it is bound in the North and North Eastern side by Jalkot valley, in the East by Kaghan, and in the South by Allai while its Western side is covered by Indus river (Fig. 1). The total population of the valley is 275,461 individuals (Anon. 2020), living under traditional conservative systems.

2.2. Data collection

Ethnomedicinal survey was carried out during 2015–2016 to explore medicinal plant and their uses. Ethnomedicinal data were collected through a semi structure questioner from the inhabitant of the Palas valley (Table 1). For ethnomedicinal information and traditional uses, a total of 125 individuals, 107 males and 18 females, from different ethnic groups were interviewed after taking consent through semi structure questionnaire (Tardio, 2008).

2.3. Sampling, preservation and identification

During field trip, plants specimens were collected, tagged, local names and related data were recorded on the spot. For taxonomic confirmation and identification, plant specimens were pressed in field through plant presser, dried, poisoned through Mercuric chloride and absolute alcohol (01 g/100 ml), mounted on standard herbarium sheets and identified with the help of available literature (Shinwari and Khan, 2000; Ali and Qaiser, 2007; Ali et al., 1989; Ali and Qaiser, 2015; Nasir and Ali, 1970–89). For confirmation and authentication, International Plant Names Index, (IPNI) (www.ipni.org) was used for correct botanical name and authorship. Moreover, for further confirmation, plant specimens were also compared with already existed specimens in various herbaria of Pakistan i.e. Hazara University Herbarium (HUP), Herbarium of University of Peshawar and Quaid-e-Azam University Herbarium (ISL). The plants' specimens were given the voucher number and submitted to Herbarium of Hazara University (HUP), Mansehra, KP, Pakistan. During field survey, pictures of various habitats and plants were captured, observations regarding abundance and precise location were also documented.

2.4. Ethnobotanical data analysis

The recorded data were analyzed by using ethnomedicinal indices such as relative frequency citations (RFCs) and fidelity level (FL) in order to evaluate the significance of the recorded species.

2.5. Relative frequency (RFCs)

The relative frequency (RFCs) of a species is calculated on the basis of number of frequency of citations (FC) by using the following formula.

$$RFCs = \frac{FCs}{N}$$

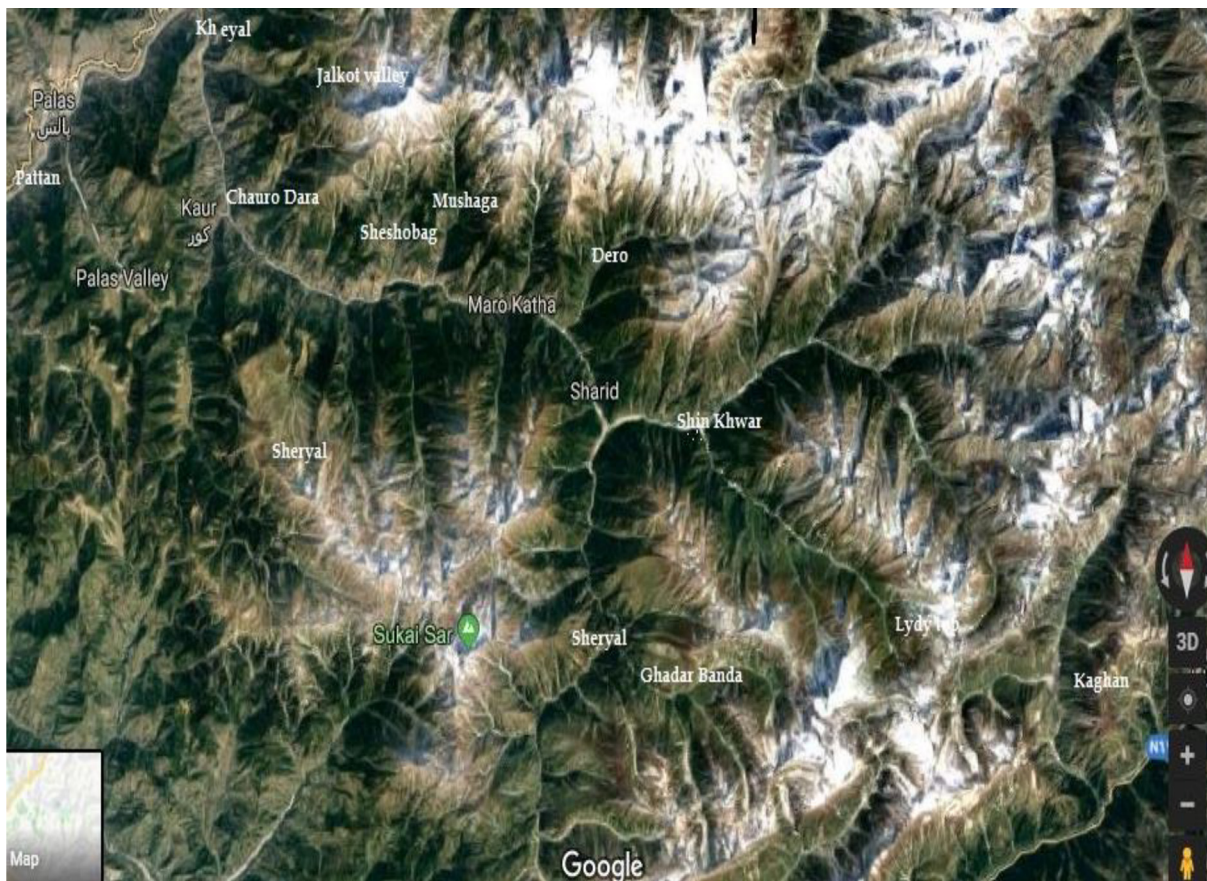


Fig. 1. Map of the study area.

Table 1
Demographic data of the respondents from study area.

S. #	Variable	Categories	No. of persons	%
1	Gender	Female	18	14.4
		Male	107	85.6
2	Informant category	Traditional health practioners	10	8.00
		Indigenous peoples	115	92.0
3	Age	15–20 years	11	8.8
		20–30 years	15	12.0
		30–40 years	22	17.6
		40–50 years	25	20.0
		50–60 years	32	25.6
		≥60 years	20	16.0
4	Educational background	Illiterate	50	40.0
		≤5 years	20	18.32
		8 years	15	16.0
		10 years	25	20.0
		12 years	15	12.0
5	Experience of THPs	<2 years	1	0.8
		2–5 years	3	2.4
		5–10 years	2	1.6
		10–20 years	3	2.4
		>20 years	1	0.8

where FCs is the number of informants who mentioned the use of plant species and N is the total number of informants.

2.6. Fidelity level (FL)

Fidelity level shows the ratio between the number of informants who mentioned the use of a plant species for a particular purpose and total number of informants who mentioned uses of

that species for any purpose. FL is expressed in percent and claiming the use of plant species for same major purpose.

$$FL (\%) = \frac{lp}{lu} \times 100$$

where lp is number of informants who mentioned uses of a species for a particular purpose and lu is the total number of informants who suggested the same species for any purpose.

2.7. Conservation status

For understanding the conservation status, the recorded plant species were checked through IUCN red list of threatened species (www.iucnredlist.org).

3. Results

The Palas valley is intact and rich in plant biodiversity, especially with reference to medicinal flora due to inaccessibility to the commercial market. Therefore, every aspect of life of the local inhabitants of the valley is directly or indirectly depend on plants, especially for primary health care. The Valley possesses a total 65 medicinal plants species belonging to 56 genera and 41 families (Table 2).

A list of all the recorded species including their botanical names, local names, their respective family, habit, part used, local uses for primary health care and quantitative indices are presented in (Table 3). Initially, all the collected medicinal plants were grouped into herbs, shrubs, trees and climbers on the basis of their life form and growth habit. According to this criteria, 55% medicinal plants species are belonging to herbs, 21% to shrubs, 19% to trees and 05% to climbers (Fig. 2) (see Table 4).

3.1. Family wise composition

The family wise composition of used medicinal plants revealed that the leading families are Rosaceae, Asteraceae, Ranunculaceae, Polygonaceae and Salicaceae represented at the rate of 9%, 7%, 6%, 6% and 4%, respectively. Similarly, family Alliaceae, Asparagaceae, Berberidaceae, Fagaceae, Pinaceae and Saxifragaceae are represented at the rate of 3% while the remaining families are almost occurred at 1% (Fig. 3).

3.2. Occurrence of medicinal plants species per family

The inhabitants of Palas Valley use a total of 65 plant species for primary health care. The highest number of species belong to family Rosaceae (7 species), followed by family Asteraceae (5 species). Similarly, family Ranunculaceae, Polygonaceae, Violaceae have 4 species each and family Salicaceae possess 3 species while family Alliaceae, Asparagaceae, Berberidaceae, Papilionaceae, Pinaceae and Saxifragaceae have 2 species each. The remaining families possess a single species (Fig. 4). Therefore, Rosaceae and Asteraceae are the leading families followed by Ranunculaceae, Polygonaceae and Violaceae, possessing highest number of medicinal plants species. Moreover, the significance of families depends upon species richness (medicinal plants), distribution and their availability to the local community.

Table 2

List of families.

Sr. No	Family	Sr. No	Family	Sr. No	Family	Sr.No	Family
1	Aceraceae	11	Cupressaceae	21	Labiatae	31	Ranunculaceae
2	Alliaceae	12	Cuscutaceae	22	Lamiaceae	32	Ranunculaceae
3	Apiaceae	13	Dioscoraceae	23	Mimosaceae	33	Rosaceae
4	Apocynaceae	14	Ephedraceae	24	Oleaceae	34	Salicaceae
5	Araliaceae	15		25	Papilionaceae	35	Sambucaceae
6	Asparagaceae	16	Fumaraceae	26	Pinaceae	36	Saxifragaceae
7	Asteraceae	17	Funicaceae	27	Polygonaceae	37	Scropularaceae
8	Berberidaceae	18	Grassulariaceae	28	Primulaceae	38	Solanaceae
9	Brassicaceae	19	Guttiferae	29	Pteridophyte	39	Thymalaceae
10	Caprifoliaceae	20	Juglandaceae	30	Punicaceae	40	Trillaceae
						41	Vitaceae

3.3. Part (s) used, number of parts used per species

The inhabitants of the valley use different parts of medicinal plants as source of drug in different ways such as a single part i.e. underground part (15%), bulb1%, tuber (1%), stem (7%), bark (stem, root) 5%, leaves (17%), fruits (14%), seeds (5%) and gum (1%). Sometime the inhabitants use as a whole plant (15%) or partially (14%) as source of drug (Fig. 5). Partial parts and single part (s) of the medicinal plants mostly belong to shrub, trees and climber while the whole plants used are mostly herbs. In some cases, combination of different parts of a single species or different species are used with different formulation such as powder, decoction, extract, paste etc as source of drug for different diseases. Further, the highest number of parts (4 parts i.e root, stem, leaves and fruit) used as source of drug by the inhabitants of the valley, belongs to 11 species viz. *Artemisia scoparia*, *Aquilegia nivalis*, *Corydalis govani-ana*, *Hypericum perforatum*, *Nasturtium officinale*, *Pteridium aquilinum*, *Rumex hastatus*, *Thymus serpyllum*, *Viola biflora*, *Viola canescens* and *Viola betonicifolia* followed by *Nerium oleander* and *Punica granatum*. Similarly, two different parts of a single species are used as source of drug from *Artemisia absinthium*, *Achillea mille-folium*, *Berberis lyceum*, *Berberis pseudumbellata*, *Daphne papyracea* and *Delphinium roylei* etc while single part is used as a source of drug from remaining species by the local community (Fig. 6a & b).

Further, recorded data shows that different plant species contributing at different levels as source of drug to the local health care system such as *Aquilegia nivalis* contributing 13%, *A. modesta* 10%, *Berberis species* 14%, *Hypericum perforatum* 8% and *Pinus wallichiana* 8%. Likewise, *Bergenia ciliata*, *Nasturtium officinale*, *Punica granatum*, *Dioscoria deltoidea*, *Juglans regia*, *Ephedra intermedia* contributing 6% each while *Aconitum laeve*, *Primula denticulata* 5% each and the remaining species contributing in the range of 1–4% as source of drug to the local health care system (Fig. 7a & b).

These plant species are used as single crude drug or in combination with others for treating a single or different diseases. There are several medicinal plants i.e *Ajuga bracteosa*, *Juglans regia*, *Punica granatum*, *Ephedra intermedia*, *Nasturtium officinale* and *Berberis lycium* etc used for different diseases and have multiple uses (Table 3).

From the above documented plant species, picture of the few representative medicinal plants, their habit and one of the sub valley of the study area are presented in (Fig. 8).

3.4. Conservation status

In the present research work, internationally documented 9 threatened species were found in the study area. Of these, *Taxus wallichiana* Zucc, *Aconitum heterophyllum* Royle and *Berberis pseudumbellata* have been categorized as Endangered, while *Acer caesium* Wall. ex Brandis, *Ephedra intermedia*, *Juniperus communis* L., *Punica granatum* L., *Populus ciliata* Wall. and *Quercus alba* as least

Table 3
Detailed information of collected and identified plant species along with their uses.

S. #	Plant species and Accession number	Family	Local Name	Common Name	^A Life Habits/ Life forms			^B Part(s)/ Mode of utilization	Applicati-on mode	Therapeutic uses	^C Quantitative indices						
					P	T	W				FC	RFC	UR	UV	RIL	FL%	^D Previo-usly used
	<i>Acer caesium</i> Wall. ex. Brandis HU-NO.121	Aceraceae	Chain	Chain	P	T	W	BR. Inner surface of Bark	oral	Skin problem	13	0.10	20	3.3	3.9	83.4	5♦11♦19♦28♦30♦41♦
	<i>Allium humile</i> Knuth. HU-NO.170	Alliaceae	Palon	Jangli Piaz	S	H	W	LE. Powder	oral	Headache, vomiting and boosting nervous system	22	0.17	22	3.1	3.7	22.7	18♦20♦29♦23♦45♦
	<i>Allium griffithianum</i> Boiss. HU-NO.161	Alliaceae	Jangli Piaz	Jangli Piaz	P	H	W	LE. Fresh leave, powder and decoction	Oral	Appetizer, stimulating agent, expelling gas from the stomach and digestive disorder	27	0.21	26	3.7	4.0	37.0	18♦20♦29♦45♦2♦3♦4♦5♦6♦7♦8♦
	<i>Artemisia scoparia</i> Waldast. & Kit. HU-NO.174	Asteraceae	Jawkai	Jawkai	P	H	W	SH. juice, cooked RT. decoction; ST. decoction	Topica, Oral	Diarrhea, evacuate the bowel and cure the inflammation of ear	18	0.14	15	3.0	3.8	55.5	1♦2♦3♦4♦5♦6♦7♦8♦
	<i>Artemisia absinthium</i> L. HU-NO.172	Asteraceae	Jawkey	Jawkey	p	H	W	SH. juice FL. decoction	Oral	Stimulating digestion, Tonic, anti parasitic and vermifuge	20	0.16	8	2.6	3.4	40.0	1♦2♦3♦4♦5♦6♦7♦8♦
	<i>Achillea millefolium</i> L. HU-NO.183	Asteraceae			P	H	W	LE. Decoction and cooked RT. Decoction and cooked	Oral	Carminative, antispasmodic, hemorrhoids and leucorrhoea.	13	0.10	18	3.6	2.9	53.8	1♦2♦3♦4♦5♦6♦7♦8♦
	<i>Ajuga integrifolia</i> Buch.-Him. Ex D. Don HU-NO.190	Labiatae	Buti	Buti	P	H	W	LE. Extraction, Juice, grinding WP. Decoction	Oral and Past keeping	Astringent, Tonic, antiseptic, hypertension, throat sore, blood purifier, colic and jaundice, vermifuge	30	0.24	22	3.1	3.9	83.3	46♦47♦48♦
	<i>Acacia modesta</i> Wall. HU-NO.192	Mimosaceae	Kikar	Kikar	P	T	W	SG. Gum	Oral	Tonic, useful as restorative, sexual tonic, pain killer especially for backache and used as stimulant	24	0.19	19	2.1	3.0	41.6	49♦50♦51♦53♦
	<i>Aconitum heterophyllum</i> Wall. ex Royle HU-NO.195	Ranunculaceae	Zaharmora	Zaharmora	P	H	W	RH. Powder and decoction	Oral	Thermogenic, dysentery, diarrhea, stomach disorders, malarial fever, vomiting, hemorrhage, internal inflammatory disease, general physical weakness. stomach pain, digestive, regulation of periodic cycle, tonic and expulsion of phlegm	40	0.32	26	2.8	3.6	87.5	52♦54♦55♦
	<i>Aquilegia nivalis</i> (Baker) Falc. ex B.D.Jacks HU-NO.200	Ranunculaceae			P	H	W	LE. Powder RT. decoction ST. decoction	Oral	Snake biting	17	0.13	12	2.4	3.1	29.4	56♦55♦57♦
	<i>Berberis lycium</i> Royle	Berberidaceae	Kawri,	Zyarlargi	P	S	W	ST, Bk. Powder	Oral	Jaundice, hepatitis, internal sores, painful disorder of	35	0.28	40	3.6	4.0	71.5	58♦59♦60♦61♦

Table 3 (continued)

S. #	Plant species and Accession number	Family	Local Name	Common Name	A Life Habits/ Life forms			B Part(s)/ Mode of utilization	Applicati- on mode	Therapeutic uses	C Quantitative indices						D Previo-usly used	
											FC	RFC	UR	UV	RIL	FL%		
										and decoction Rt. Decoction ST. Powder RT. Powder and decoction							joints, aphrodisiac, body coldness and antiseptic.	
	<i>Berberis pseudumbellata</i> R.Parker HU-NO.199	Berberidaceae	Shugloo	Zyarlargi	P	S	W	ST. Powder RT. Powder and decoction	Oral	Joints disorder, maintaining body temperature, external and internal body wound healing, Jaundice and contraction of muscles	25	0.20	35	3.5	3.9	80.0	62■59■60■61■	
	<i>Bistorta alpine</i> HU-NO.132	Polygonaceae	Spinsar	Shalkhy	P	H	W	RT. Powder	Oral	Anti-inflammatory and astringent	18	0.14	30	3.0	3.5	88.8	63◆64◆65	
	<i>Brassica tournefortii</i> Gouan HU-NO.133	Brassicaceae	The ghra	Sharsham	A	H	W	LE. Coocked	Oral	Carminative, stimulating agent, laxatives	23	0.18	33	2.7	3.1	78.2	66■67◆	
	<i>Bistorta amplexicaulis</i> HU-NO.134	Polygonaceae	Rain	Anjabar,	P	H	W	RH. Powder Decoction	Oral	Against sore throat, mouth washing or tongue and laryngitis.	26	0.20	27	2.7	2.9	57.6	63◆64◆65	
	<i>Bergenia stracheyi</i> HU-NO.140	Saxifragaceae	Koarat	Koarat	P	H	W	RH. Powder and decoction	Oral	Increase the flow of urine, demulcent and constrict muscles, kidney stone	31	0.24	13	2.1	3.0	64.5	69◆70■71◆	
	<i>Bergenia ciliata</i> (Haw) Sternb. HU-NO.143	Saxifragaceae	Gat Panra	Koarat,	P	H	W	RH. Powder and decoction	Oral	healing of ulcer, loose motion, as anti-cancer, tonic, backache, healing of wounds and piles.	34	0.27	22	2.7	3.0	55.5	72■73◆69◆8◆	
	<i>Corydalis govaniiana</i> Wall. HU-NO.144	Fumaraceae	Mamera	Mamera	P	H	W	LE. Juice, Powder RT. Powder	Oral	Tonic, diuretic, ophthalmatic	17	0.13	30	3.0	2.9	30.1	6◆8◆11■	
	<i>Cuscuta reflexa</i> Roxb. HU-NO.150	Cuscutaceae	Neladaray	Neladaray	A	C	W	WP. Juice, powder	Oral	Jaundice, diuretic, carminative, Used as vermifuge in cattle	30	0.24	27	3.8	4.0	71.4	2■3■9◆	
	<i>Clematis vitalba</i> L. HU-NO.151	Ranunculaceae	Zeali	Zeali	P	C	W	LE. Powder and juice	Oral Topica	Strong analgesic, Applied for arthritic joints, relieve pain, removal of waste products, juice is reported to relieve headache.	42	0.33	30	3.0	3.4	71.4	11◆9◆8◆	
	<i>Cotoneaster microphyllus</i> Wall. ex Lindl HU-NO.149	Rosaceae	Loni	Kharwara	P	S	W	LE. Powder and decoction	Oral	Constriction of tissues	26	0.20	32	2.6	3.0		8◆11◆9◆6◆	
	<i>Crataegus songarica</i> C. Koch HU-NO.148	Rosaceae	Shenthal	Shenthal	P	S	W	FL. Decoction FR. Juice, whole	Oral	Heart tonic, enhance blood circulation, various heart diseases.	28	0.22	38	2.5	2.9	53.5	6◆8◆9◆11	
	<i>Delphinium roylei</i> Munz HU-NO.155	Ranunculaceae	Legony	Legony	P	S	W	SD. Whole seed or powder and topical	Oral	Paralyzing agent, mostly in the form of ointment, neuralgia and causing cardiac depressant.	20	0.16	30	2.7	3.0	75.3	8◆11◆18◆19	
	<i>Dioscorea deltoidea</i> Wall. ex Griseb. HU-NO.163	Dioscoraceae	Zelyii,	Khanas	P	C	W	RH. Powder	Oral	Excessive secretion of bile, diuretic, facilitating secretion, expulsion of phlegm and mucus from respiratory tract,	48	0.38	45	3.2	3.8	52.0	3◆4◆5◆	

(continued on next page)

Table 3 (continued)

S. #	Plant species and Accession number	Family	Local Name	Common Name	A Life Habits/ Life forms			B Part(s)/ Mode of utilization	Applicati-on mode	Therapeutic uses	C Quantitative indices						
					P	S	W				FC	RFC	UR	UV	RIL	FL%	D Previo-usly used
	<i>Duchesnea indica</i> (Andr.) Focke HU-NO.168	Rosaceae	Jangli toot	Jangli toot	P	S	W	FR. Whole and juice	Oral	strong vermifuge and hormone production Used as nerves tonic, as astringent in diarrhea and mild laxative.	23	0.18	47	3.1	3.5	30	11♦18♦8♦
	<i>Daphne papyracea</i> Wall. ex Steud. HU-NO.169	Thymelaeaceae	Kutilal	Legony	P	S	W	FR. Whole, Juice	Oral	Used as narcotic, paralyzing tongue	27	0.21	18	3.0	2.8	29.6	19♦29■45♦
	<i>Datura stramonium</i> L. HU-NO.146	Solanaceae			P	S	W	LE. Extract SD. Extract	Past and Topical	Used for various skin problem, poisonous and rarely used for oral administration.	36	0.28	30	3.0	3.6	55.5	56■3♦4♦11■
	<i>Ephedra intermedia</i> Schrenk and C. A Mey HU-NO.147	Ephedraceae	Mahu	Mahu	P	S	W	Br. Powder WP. Powder and decoction	Oral	Used for respiratory disorder, pain and stiffness in the joints, heart and urinary disorder.	45	0.36	24	2.6	3.3	66.6	11♦3♦4♦46■
	<i>Hypericum perforatum</i> L. HU-NO.153	Guttiferae	Shna Chai	Green Tea	P	H	W	LE. Decoction, Topical ST. Decoction FL. Decoction RH.	Oral	Used as tea, for gastric disorder, for control of irregular menstruation, hemorrhoid, prolapsed uterus and anus, diarrhea as diuretic.	40	0.32	27	3.3	3.7	50.0	46♦5♦8♦4c
	<i>Heracleum candicans</i> Wall. ex DC. HU-NO.154	Apiaceae	Skhawara	Skhawaja	P	H	W	RH. Powder, decoction and Topical Powder	Oral	Rejoining of wrong joint, enhancing sexual desire of animals, thermogenic.	30	0.24	21	3.5	2.5	33	11■41♦29♦4♦
	<i>Inula rosmarinifolia</i> (Labill.) Less. HU-NO.175	Asteraceae	The ghra nawarpars	Sun flower	P	H	W	RH. Powder	Oral	Enhance gastric secretions, increase the desire for food and increase the flow of urine.	25	0.20	20	3.4	2.8	28.0	41♦46♦4♦
	<i>Inula</i> sp HU-NO.179	Asteraceae	The ghra nawarpars, Kut	Sun flower	P	H	W	RH. Powder	Oral	Enhancing gastric secretions, increase food, drink, and increase the flow of urine.	21	0.16	12	4.0	2.7	28.0	41♦46♦4♦5♦
	<i>Juniperus communis</i> L. HU-NO.178	Cupressaceae	Googar	Juniper	P	S	W	LE. Dry powder		Smoking medicine	24	0.19	34	3.4	3.5	29.1	3♦3♦■4♦11♦
	<i>Juglans regia</i> L. HU-NO.125	Juglandaceae	Atchoy, Akhrote	Walnut	P	T	W	BR. Solid piece, husk bark FR. Whole LE. Powder SD. Powder	Oral, Topical and past	Brain and health tonic, antiseptic, antimicrobial, teeth cleaner and cosmetic.	40	0.32	32	3.8	4.0	75.0	11■46♦4♦3
	<i>Lathyrus lanegatus</i> L. HU-NO.180	Papilionaceae	Zangli Mater	Wild Pea	P	H	W	LE. Powder SD. Powder	Tropical, Past	Healing agent, wound healing and antiseptic.	33	0.26	35	3.5	3.8	21.2	3♦73 ♦4♦11■
	<i>Lathyrus pratensis</i> HU-NO.191	Papilionaceae	Zangli Mater	Wild Pea	P	H	W	LE. Powder SD. Powder	Tropical, Past	Healing agent for external wound	30	0.24	30	3.0	3.4	30.0	4♦11■3♦73 ♦
	<i>Malus himalaica</i> (Max) Schn. HU-NO.193	Rosaceae	Magrath	Gangli Apple	P	T	W	FR. Whole fruit and Juice	Orally whole fruit or	Tonic, blood purifier, relieving pain and stomach disorder.	31	0.24	33	2.7	3.2	64.5	4♦11♦3♦4♦41■

Table 3 (continued)

S. #	Plant species and Accession number	Family	Local Name	Common Name	A Life Habits/ Life forms			B Part(s)/ Mode of utilization	Applicati-on mode	Therapeutic uses	C Quantitative indices						D Previo-usly used
					P	H	W				FC	RFC	UR	UV	RIL	FL%	
	<i>Nasturtium officinale</i> R. Br. HU-NO.196	Brassicaceae	Thalmera	Thalmera	P	H	W	WP. Cooked	Juice Oral, Past	Blood purifier, diuretic, antiscorbic, expectorant, tonic for anemia and removing skin roughness	40	0.32	27	2.7	3.0	75.0	3♦4■11■5♦8♦
	<i>Nerium oleander</i> L. HU-NO.194	Apocynaceae	Myswak boty	Myswak boty	P	S	W	LE. Powder ST. Peace	Oral	Heart disorder, increasing the flow of urine, evacuating the bowels and scorpion biting	31	0.24	16	2.6	2.8	33.3	5■3♦56♦4♦11♦
	<i>Olea ferruginea</i> Royle HU-NO.198	Oleaceae	Khona	Zithoon	P	T	W	LE. Powder BR. Powder FR. Juice	Oral, Topical	Gonorrhoea, fever and debility. oil is used for rubefacient, relieving joint pain and used for digestive disorder.	36	0.28	12	2.0	2.5	55.5	3♦56♦5♦55♦11■
	<i>Punica protopunica</i> Balf. HU-NO.197	Punicaceae	Anar	Wild Anar	P	T	W	FR-BR. Powder	Oral	Used for control of urine flow in Children during night time, diarrhea, dysentery and urinary disorder, also used as astringent and vermifuge.	32	0.25	30	3.0	3.5	46.8	3♦56■11■41■8♦
	<i>Polygonatum verticillatum</i> All. HU-NO.201	Asparagaceae	Noor Alam	Noor Alam	P	H	W	RH. Powder	Oral	Used as demulcent, tonic especially for female	47	0.37	37	2.6	3.0	61.7	3♦41♦56♦11■
	<i>Polygonatum humile</i> Fisch. ex Maxim HU-NO.188	Asparagaceae	Noor Alam	Noor Alam	P	H	W	RH. Powder		Used as demulcent, tonic especially for female and increase milk in cattle	48	0.38	22	3.1	3.4	61.0	3♦41♦56♦11■
	<i>Primula denticulata</i> Smith. HU-NO.185	Primulaceae	Zangli Surma	Surma	P	H	W	LE. Whole RH. powder	Topical and Oral	Antiseptic, irritation of eye, and produce inflammation of the skin. The powdered is used against leeches	40	0.32	32	2.6	3.0	62.5	3♦41♦56■11■45♦
	<i>Pinus wallichiana</i> A. B. Jackson HU-NO.177	Pinaceae	Srup	Cheer	P	T	W	RE. Resine WD. Decoction	Oral	Asthma, cough, skin irritation and facial acne, healing of cracks in feet.	31	0.24	19	2.1	2.6	32.2	3♦45♦56■11♦8♦
	<i>Pteridium aquilinum</i> (L.) Khun HU-NO.176	Dennstaedtiaceae	Kownagy	Kowangy	P	T	W	SH. Cooked	Oral	Tonic, evacuation of bowel and used as soothing agent	28	0.22	13	2.6	2.8	25.0	3♦45♦56♦11♦8♦
	<i>Punica granatum</i> L. HU-NO.166	Punicaceae	Anar	Anar	P	T	W	SD. Powder, Juice FT. Decoction	Oral	Syphilis, jaundice and diarrhea, diabetic and nose bleeding	34	0.27	20	3.3	3.7	23.5	3♦56■45♦11■
	<i>Quercus alba</i> Lindl. ex Royle HU-NO.167	Fagaceae	Spin bunj	Banj	P	T	W	SD. Pried seeds and its bark	Oral	Respiratory disease, chronic diarrhea and dysentery.	25	0.20	23	3.2	3.5	28.0	3♦5■56♦45♦11■
	<i>Rumex hastatus</i> D. Don. HU-NO.173	Polygonaceae	Shalkhy	Shalkhy	P	H	W	LE. Cooked	Oral	Diuretic, preservative, cooling agent, reduce skin irritation, causing loose motion in cattle when eat in excesses	42	0.33	30	3.0	3.5	71.4	45♦3■11■45♦
	<i>Rheum webbianum</i> Royle	Polygonaceae	Chotial	Chotial	P	H	W	RH. Powder	Oral	Antibacterial, antiseptic and preservative.	29	0.23	27	3.3	3.5	41.3	56■3♦11♦45♦

(continued on next page)

Table 3 (continued)

S. #	Plant species and Accession number	Family	Local Name	Common Name	A Life Habits/ Life forms			B Part(s)/ Mode of utilization		Applicati- on mode	Therapeutic uses	C Quantitative indices						D Previo-usly used
					P	H	W	FC	RFC			UR	UV	RIL	FL%			
	HU-NO.171 <i>Ribes orientale</i> Desf.	Grassulariaceae	Hargul		P	H	W	BE. Juice and whole berries	Oral	Astringent, cooling agent, diarrhea, cold and sore throat	20	0.16	15	3.0	3.4	35.0	56■3◆11◆45◆	
	HU-NO.203 <i>Rosa webbiana</i> Wall.	Rosaceae	Jangli Gulab		P	S	W	FL- decoction	Oral	Mild astringent.	29	0.23	24	3.4	3.6	27.5	56■3◆11◆45■46■	
	HU-NO.205 <i>Rubus indica</i> L.	Rosaceae	karwara		P	S	W	BR. decoction	Topical	Softness of skin	30	0.24	27	3.8	4.0	50.0	3◆11◆45◆46◆	
	HU-NO.204 <i>Rubus sanctus</i> Schreb.	Rosaceae	Goraga	Goraga	P	S	W	FR. Decoction	Oral	Dysentery, whooping cough, heart tonic and used as laxative	34	0.27	34	3.4	3.6	47.0	3◆11◆45◆46◆5◆	
	HU-NO.206 <i>Sambucus wightiana</i> Wall. ex Wigh & Engl.	Sambucaceae			P	S	W	FL. Decoction	Oral	Used against sore throat and insect biting.	25	0.20	18	3.0	3.4	64.0	3◆11■45◆56◆5◆	
	HU-NO.209 <i>Thymus serpyllum</i> L.	Lamiaceae	Ghray sparkay	Ghray sparkay	P	H	W	LE. Decoction, Ribbing	Oral	Used as green tea, digestive agent, anti-oxidant and attraction of honey bees.	52	0.41	35	3.5	3.8	65.3	3■11■45■46■5◆	
	HU-NO.106 <i>Taxus wallichiana</i> Zucc.	Pinaceae	Banria		P	T	W	FR. Decoction	Oral	Pharyngitis, epilepsy, aphrodisiac, causing gastrointestinal disorders and clumping of erythrocytes	24	0.19	30	3.0	3.3	41.6	3◆11◆45◆46◆56◆	
	HU-NO.210 <i>Trillium govianum</i> (Royle) Knuth	Melanthiaceae	Lal Dana, Trepath	Lal Dana, Trepa-th	P	H	W	FR. Powder	Oral	Astringent, tonic, alterative and emetic.	27	0.21	33	2.7	3.0	37.0	3◆11◆45◆46◆56◆	
	HU-NO.209 <i>Viburnum cotinifolium</i> D. Don	Caprifoliaceae	Ghazmiva	Ghazmiva	P	S	W	FT. Juice or as such	Oral	Muscular contraction, soothing of nervous, contraction of tissues, tonic and control blood flow.	30	0.24	27	2.7	2.5	50.0	3◆11■45◆46◆56◆	
	HU-NO.208 <i>Verbascum thapsus</i> L.	Scrophulariaceae	Khardug		P	H	W	FL. Decoction and Powder	Oral	Cough, Arthritis, bronchitis, ear infections and hemorrhoids.	36	0.28	18	3.0	3.3	47	3■4■11◆45◆46◆56◆	
	HU-NO.220 <i>Valeriana jatamansi</i> Jones	Valerianaceae	Koindaru	Mushki-bala,	P	H	W	RT. Powder and decoction	Oral	Carminative, over exhaustion, controlling sudden constriction of muscles, mild mental disorder, insomnia and habitual constipation	46	0.36	14	2.3	3.0	54.3	3◆4■11◆45■46◆56◆	
	HU-NO.215 <i>Viola biflora</i> L.	Violaceae	Lilo, Banafsha	Lilo, Banafsha	P	H	W	WP. Powder and Topical	Oral	Skin problem, laxative, producing perspiration and antispasmodic.	43	0.34	20	3.3	3.7	69.7	2■4◆11◆45■46◆56◆	

Table 3 (continued)

S. #	Plant species and Accession number	Family	Local Name	Common Name	A Life Habits/ Life forms			B Part(s)/ Mode of utilization	Applicati- on mode	Therapeutic uses	C Quantitative indices						D Previo-usly used
					FC	RFC	UR				UV	RIL	FL%				
	<i>Viola canescens</i> Wall. ex Roxb. HU-NO.212	Violaceae	Lilo	Lilo	P	H	W	WP. powder	Oral	Emollient, laxative, emetic, diaphoretic, antispasmodic and pictorial	41	0.32	22	3.6	3.9	70.0	2■4◆11◆45■46◆56◆
	<i>Viola betonicifolia</i> Smith HU-NO.217	Vitaceae	Lilo	Lilo	P	H	W	WP. Powder	Oral	Emollient, laxative, emetic, diaphoretic, antispasmodic and pictorial	30	0.24	26	3.2	3.7	66.6	3◆2◆4◆11◆45■46◆56◆
	<i>Vitis Jacquemontii</i> Parker HU-NO.181	Vitaceae	Magrath	Ghedar Kawar	P	C	W	BE. Juice		Vine preparation, mental relaxation	34	0.24	15	3.0	3.4	58.8	3◆2◆4◆11◆45■46◆56◆

Note: Abbreviation and representation of characters and citations used in Table 2.

* Plants species which are newly reported in this study.

(■) = Plant with similar use(s); (●) = Plant with dissimilar use (s); (◆) = Plant not reported in previous study.

^A Life Habits/ Life forms: C, Cultivated; W, Wild; G, Grass; S, Shrubs; H, Herbs; T, Trees; P, Perennial; B, Biennial; A, Annual.

^B Plant Parts: RH, Rhizome; BA, Bark; FL, Flower; SD, Seed; WP, Whole Plant; SH, Shoot; ST, Stem; RT, Root; FR, Fruit; LE, Leaf.

^C Quantitative indices: FC, Frequency of Citation; RFC, Relative Frequency of Citation; UR, Use Report; UV, Use Value, RIL, Relative Importance Level; FL, Fidelity Level; CFL, Corrected Fidelity Level.

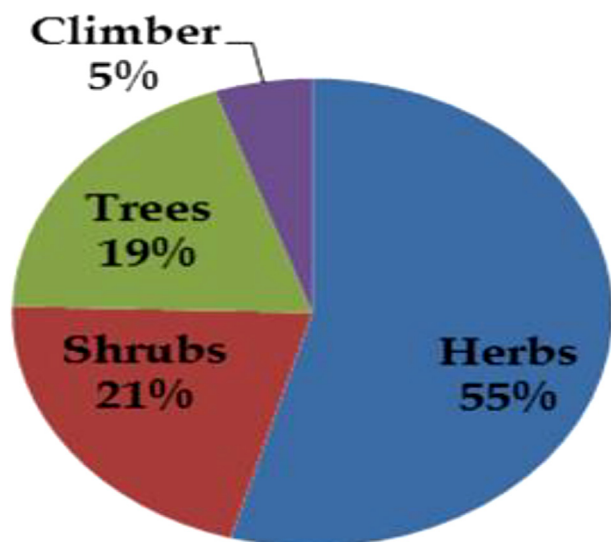


Fig. 2. Classification based on habit and life forms.

concern species. During field surveys, it has been observed that only few mature individuals of *Taxus wallichiana* were observed, seedling and vegetative reproduction was almost absent. Similarly, *Aconitum heterophyllum* is frequently used for medicinal purpose. The continuous observation revealed that the major causes of extension of threatened species are overexploitation, conversion of land to agricultural land, habitat loss, fragmentation and environmental stochasticity or may be genetic stochasticity. Therefore, conservation measures are extremely needed in order to protect these species from local extinction.

3.5. Novelty and future perspective of the study

Palas Valley is remote area and has hard, tuff communication system. Therefore, exploration of its natural resources, indigenous knowledge and traditional knowledge of plant natural resources, especially medicinal plants is very difficult work. Present research project was an attempt to explore medicinal plants species, their local uses for various ailments, indigenous and traditional knowledge related to medicinal plants. A comparative literature review on medicinal plants species and their indigenous and local uses from different parts of Pakistan revealed that, Palas valley possess 15 medicinal plant species which have not been reported from other parts in Pakistan. Among these, *Acer caesium* is used for skin problem, stem and bark extraction. Further, due to the light weight property of its stem, different kinds of kitchen pots and agriculture utensils are made from its wood. *Heracleum candicans* is endemic to this region and its root is used for healing of broken joints and specifically used for enhancing sexual desire in cattle. The decoction of root and stem bark of *Berberis pseudumbellata* and *B. lycium* were used for external and internal healing of wounds, for jaundice, for normalization of body temperature and reducing obesity. Due to its excessive use for medicinal purpose, in the near future, they will be facing serious threats especially *Berberis pseudumbellata*. Another valuable species, *Ajuga integrifolia* was used for different ailments, such as antibacterial agent, for jaundice, for external and internal ulcers, for abdominal worms and for blood purification. Similarly, *Inula rosamarinifolia* and *Hypericum perforatum* were used as blood and lung purifier and also used for stomach ache. Similarly, *Malus himalaica* is only reported from the study area in the region and the locals used as alternative of the domesticated *Malus* species. Moreover, its nursery is developed for better scion production. Similarly, the bulb of *Polygonatum verticillatum* and

Corydalis govaniiana were used as strong source of tonic and aphrodisiac. *Allium griffithianum*, *Achillea millefolium* and *Rheum webbianum* are commonly used as preservatives, carminatives, antispasmodic and for stomach disorders. The two species of *Viola*, *Viola canescens* and *Viola betonicifolia* used as emollient, laxatives, diaphoretic and antipyretic and reported only from the current study area. The present work is primary research and provide base line information for further exploration of the valley with respect to medicinal plants, its traditional uses and the indigenous knowledge of the communities related to biological resources of the valley.

4. Discussion

The basic source of medicinal plants identification, their specific part and their mode of uses for various disease dependent upon the local knowledge of the inhabitants of the respective region. In the present study, the inhabitants of Palas valley using 65 medicinal plants for various ailments, belonging to 41 families and 56 genera (Table 2). The recorded data showed that the highest number of family occurrence are Rosaceae (9%), Asteraceae (7%), Polygonaceae (6%), Violaceae (4%) and Salicaceae (4%) (Fig. 3). Similar study was conducted by Kidane et al. (2018) and Abbas et al. (2017) in which Fabaceae, Lamiaceae and Solanaceae were the leading families while Asteraceae has the highest occurrence in the work conducted by Ashfaq et al. (2019) and Shaheen et al. (2017). In another study 65 medicinal plants of different families, were used for various ailments by the local inhabitants of the Shawar valley (Islam et al., 2006).

A list of 65 medicinal plants including their habit, local uses, part used and mode of utilization were described in (Table 3). Among these, the highest frequency of citation (52) was recorded for *Thymus serpyllum* followed by *Polygonatum* sp, *Dioscorea deltoidea* (48) and *Valeriana jatamansi* (46). There are a number of medicinal plants having more than 20 medicinal uses. For example, *Aconitum* species was used for twenty different disease, *Dioscorea* sp, *Berberis* species and *Acacia modesta* have seven different uses each. Similar finding and multiples uses were also cited by Shaheen et al. (2017) for *Berberis lyceum* and *Ajuga bracteosa*. So these species are collected at high frequency for medicinal purposes and become threatened. Our finding related to frequent use, their over exploitation and threats are similar to the finding of (Akhtar et al., 2013).

The plant part which is significantly used for medicinal purposes in the current study are leaves (17%), followed by underground parts (15%), fruits (14%) and their contribution toward local health care system is presented in Fig. 5. So the documented data are in consistence with other studies (Shaheen et al., 2017; Abbas et al., 2017; Akhtar et al., 2013). In the current work, the local uses of whole plant (15%) are used as source of drug and mostly these plants species belong to the herbaceous group and their contribution to the local community is presented in (Fig. 2). Similarly, Abbas et al. (2017) cited that herbs medicinal plants are major contributor (69%) to the local health care system. In the current investigation, 5% bark of stem and root were used (*Berberis* species, *Juglans* sp, *Acer ceasum* etc) for various ailments especially the root and stem bark of *Berberis* were used for internal and external wound healing and as antiseptic. Similarly, the decoction of these part was orally administered for various medical purposes such as for obesity and urinary infection etc. The current finding are in accordance with the other regionally reported works (Hussain et al., 2006; Abbas et al., 2017). The enlisted and described plant species in Table.3 were used for various ailments, ranging from nutrition to curing complex diseases such as gastrointestinal disorders, diabetes, cancer, skin problems, rheuma-

Table 4
Used values.

S. No	Species	$\sum U_i$ (Total number of use report cited by each informant)	N (Total number of informant interviewed for given plant species)	UV
1	<i>Acer caesium</i> Wall. ex. Brandis	20	6	3.3
2	<i>Allium humile</i> Knuth.	22	7	3.1
3	<i>Allium griffithianum</i> Boiss.	26	7	3.7
4	<i>Artemisia scoparia</i> Waldast. & Kit.	15	5	3.0
5	<i>Artemisia absinthium</i> L.	8	3	2.6
6	<i>Achillea millefolium</i> L.	18	5	3.6
7	<i>Ajuga integrifolia</i> Buch.-Him. Ex D. Don	22	7	3.1
8	<i>Acacia modesta</i> Wall.	19	9	2.1
9	<i>Aconitum heterophyllum</i> Wall. ex Royle	26	9	2.8
10	<i>Aquilegia nivalis</i> (Baker) Falc. ex B.D. Jacks	12	5	2.4
11	<i>Berberis lycium</i> Royle	40	11	3.6
12	<i>Berberis pseudumbellata</i> R. Parker	35	10	3.5
13	<i>Bistorta alpine</i>	30	9	3.0
14	<i>Brassica tournefortii</i> Gouan	33	11	2.7
15	<i>Bistorta amplexicaulis</i>	27	10	2.7
16	<i>Bergenia stracheyi</i>	13	6	2.1
17	<i>Bergenia ciliata</i> (Haw) Sternb.	22	8	2.7
18	<i>Corydalis goviana</i> Wall.	30	10	3.0
19	<i>Cuscuta reflexa</i> Roxb.	27	7	3.8
20	<i>Clematis vitalba</i> L.	30	10	3.0
30	<i>Cotoneaster microphyllus</i> Wall. ex Lindl	32	12	2.6
31	<i>Crataegus songarica</i> C. Koch	38	15	2.5
32	<i>Delphinium roylei</i> Munz	30	11	2.7
33	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	45	7	3.2
34	<i>Duchesnea indica</i> (Andr.) Focke	47	15	3.1
35	<i>Daphne papyracea</i> Wall. ex Steud.	18	6	3.0
36	<i>Datura stramonium</i> L.	30	10	3.0
37	<i>Ephedra intermedia</i> Schrenk and C.A Mey	24	9	2.6
38	<i>Hypericum perforatum</i> L.	27	8	3.3
38	<i>Heracleum candicans</i> Wall. ex DC.	21	6	3.5
39	<i>Inula rosmarinifolia</i> (Labill.) Less.	20	6	3.4
40	<i>Inula</i> sp	12	3	4.0
41	<i>Juniperus communis</i> L.	34	10	3.4
42	<i>Juglans regia</i> L.	32	8	3.8
43	<i>Lathyrus lanegatus</i> L.	35	10	3.5
44	<i>Lathyrus pratensis</i>	30	9	3.0
45	<i>Malus himalaica</i> (Max) Schn.	33	11	2.7
46	<i>Nasturtium officinale</i> R. Br.	27	10	2.7
47	<i>Nerium oleander</i> L.	16	6	2.6
48	<i>Oleae ferruginea</i> Royle	12	6	2.0
49	<i>Punica protopunica</i> Balf.	30	10	3.0
50	<i>Polygonatum verticillatum</i> All.	37	14	2.6
51	<i>Polygonatum humile</i> Fisch. ex Maxim	22	7	3.1
52	<i>Primula denticulata</i> Smith.	32	12	2.6
53	<i>Pinus wallichiana</i> A. B. Jackson	19	9	2.1
54	<i>Pteridium aquilinum</i> (L.) Khun	13	5	2.6
55	<i>Punica granatum</i> L.	20	6	3.3
56	<i>Quercus alba</i> Lindl. ex Royle	23	7	3.2
57	<i>Rumex hastatus</i> D. Don.	30	10	3.0
58	<i>Rheum webbianum</i> Royle	27	8	3.3
58	<i>Ribes orientale</i> Desf.	15	5	3.0
59	<i>Rosa webbiana</i> Wall.	24	7	3.4
60	<i>Rubus indica</i> L.	27	7	3.8
61	<i>Rubus sanctus</i> Schreb.	34	10	3.4
62	<i>Sambucus wightiana</i> Wall. ex Wigh & Engl.	18	6	3.0
63	<i>Thymus serpyllum</i> L.	35	10	3.5
64	<i>Taxus wallichiana</i> Zucc.	30	9	3.0
65	<i>Trillium govianum</i> (Royle) Knuth	33	11	2.7
67	<i>Viburnum cotinifolium</i> D. Don	27	10	2.7
68	<i>Verbascum thapsus</i> L.	18	6	3.0
69	<i>Valeriana jatamansi</i> Jones	14	6	2.3
70	<i>Viola biflora</i> L. HU-NO.214	20	6	3.3
71	<i>Viola canescens</i> Wall. ex Roxb. HU-NO.212	22	6	3.6
72	<i>Viola betonicifolia</i> Smith HU-NO.217	26	8	3.2
73	<i>Vitis jacquemontii</i> Parker HU-NO.181	15	5	3.0

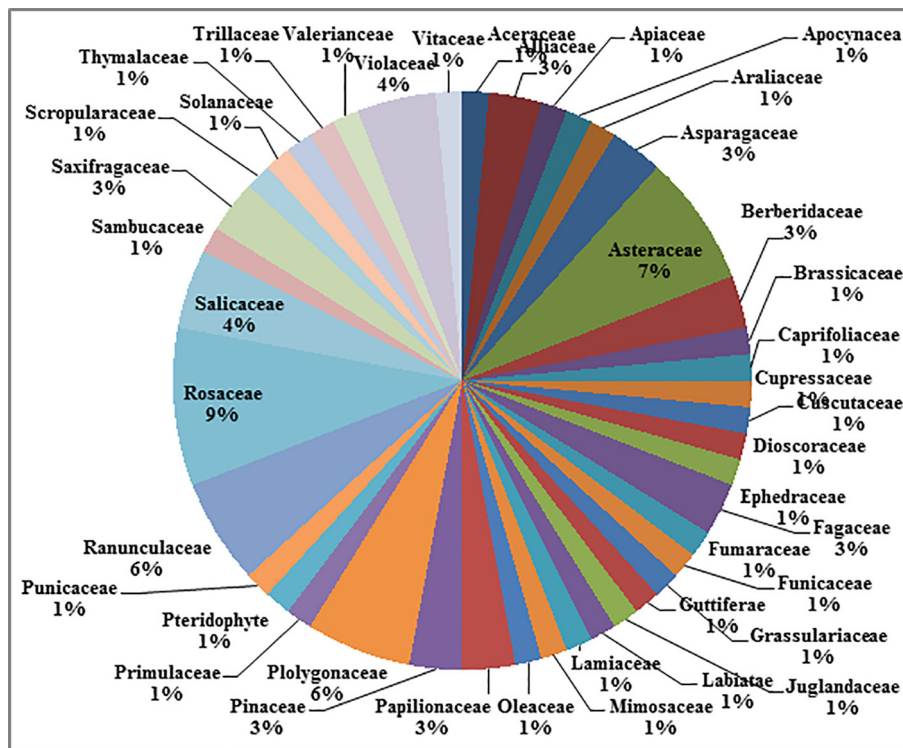


Fig. 3. Rate of occurrence of families.

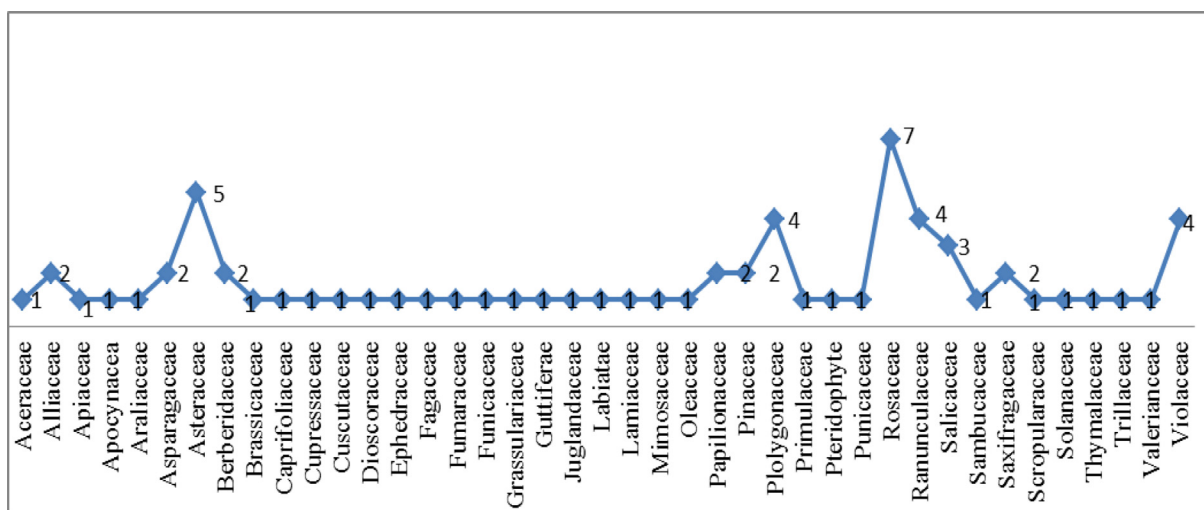


Fig. 4. Total number of species per family.

tism and sexual tonic. Similar work and uses of medicinal plants have also been documented by various authors in different parts of the country and our findings are in accordance with their work (Mahmood et al., 2011, Shinwari and Qaiser, 2011, Azhar et al., 2014).

The present application and services of medicinal plants not only restricted to the locals and community health care but also supplied to the commercial market. Unfortunately, due to lack of awareness and proper training, the mode and time of collection were unscientific and unwise which not only damage medicinal plants but also reduce the quality of materials. Therefore, proper training and skill development of the local inhabitants of Palas valley is needed for collection, preservation and processing of medicinal plants. Likewise, the inhabitants of the valley are mostly

livestock and forest dependent. Therefore, due to lack of grazing management system, animals freely graze to the extent of over grazing that severely damage medicinal plants in particular and other plants in general. As a result, medicinal plants are under severe pressure for existence both from overgrazing and sixth extinction. Our investigations and findings are in accordance with the work of others (Ahmad et al., 2008; Alam and Ali, 2009; Ali and Qaiser, 2011; Patel et al., 2012)

The valley is highly diversified with respect to altitude, ranging from 788 to 4370 m, ecological zones, ranging from tropical to alpine, sub alpine climate. The climate in the bottom of the valley is very hot while in the upper parts is cool and spring like. Therefore, diverse climatic conditions of the valley provide good opportunity for cultivation of off-season vegetables and their marketing

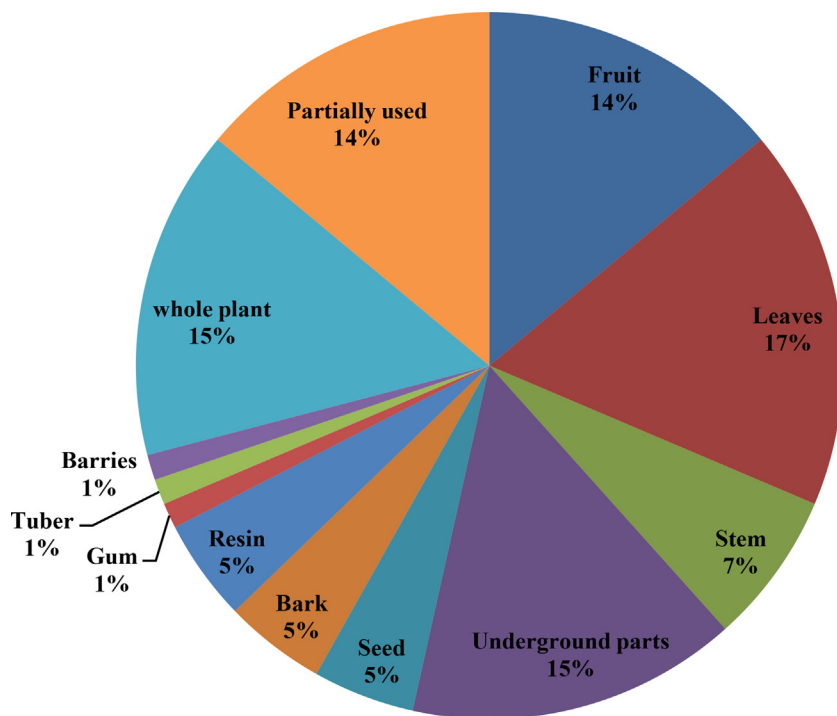


Fig. 5. Parts used in percent.

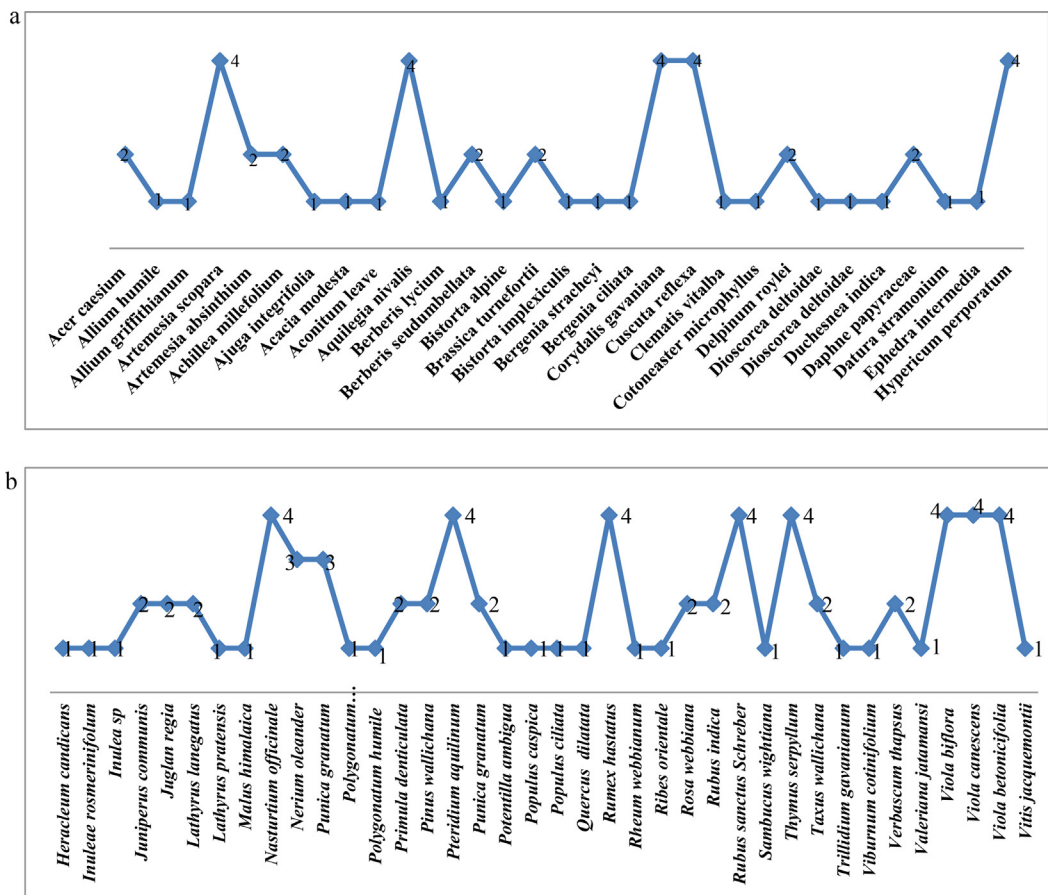


Fig. 6. A. Number of parts used per species. B. Number of parts used per species.

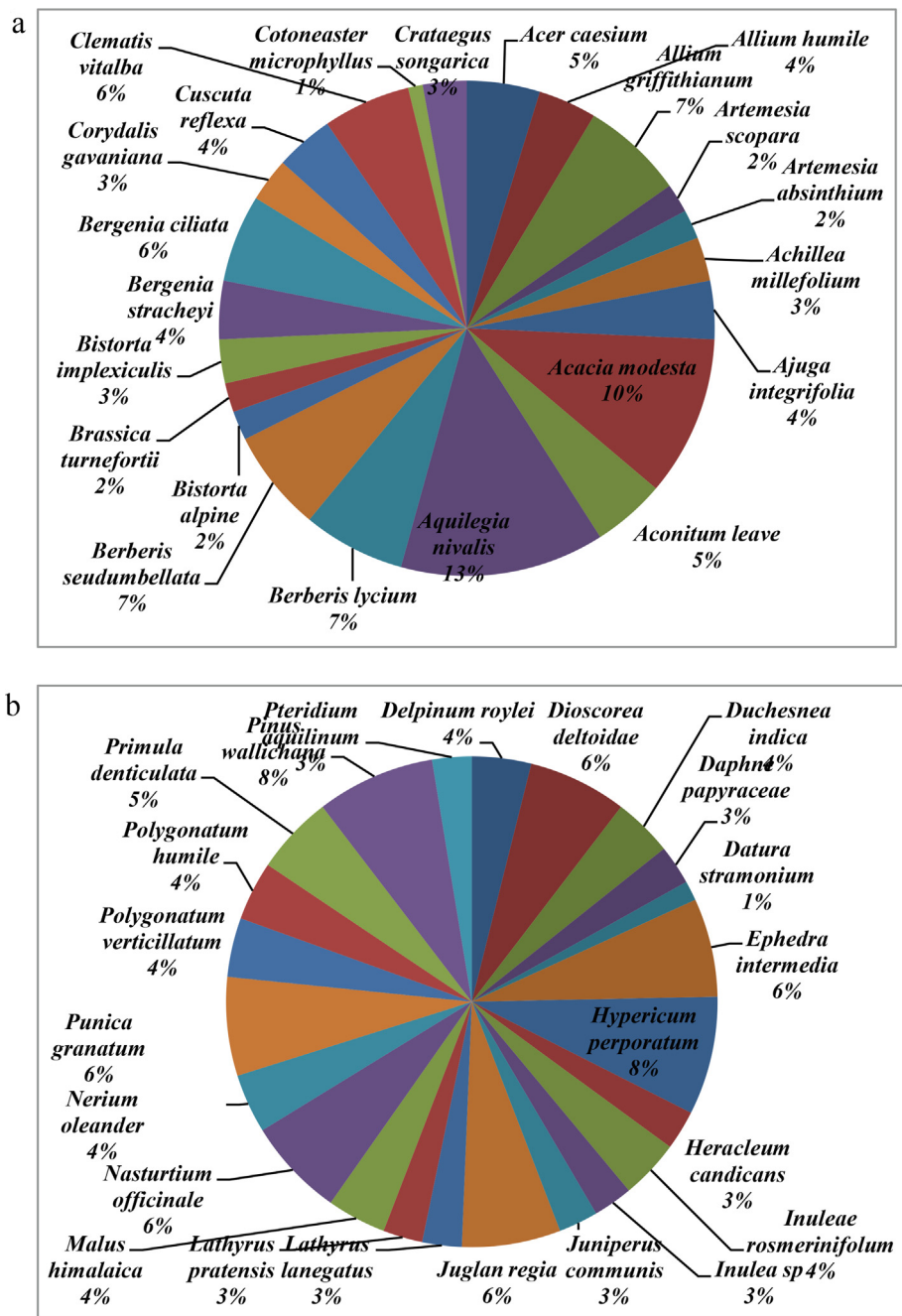


Fig. 7. Species wise contribution (%) as source of drug. b Species wise contribution (%) as source of drug.

to other parts of the country, especially members of the families Brassicaceae, Papilionaceae and Solanaceae.

The valley possesses wild fruit plants which are source of nutrients for the local inhabitants, source of medicine, nectars for honeybees and fodder for cattle. These plants include *Vitis* sp, *Juglans regia*, *Malus* sp., *Vibernum* sp., *Morus* sp., *Crataegus* sp. and *Berberis* sp. The fruits of *Berberis* sp are used against jaundice; fruit of *Juglans regia* are used as brain and sexual tonic, bark of the fruit is used as antiseptic. The fruits of *Malus*, *Juglans regia*, Date palm and Banana are mixed in milk and orally taken for enhancing feeding capacity in women for fulfilling the nutritional need of child.

5. Conclusion

The current study was conducted to explore the medicinal flora, their medicinal and local uses in the Palas Valley, Indus Kohistan, Pakistan. A total of 65 medicinal plants were recorded with the help of the indigenous knowledge of the local people. The different parts of these medicinal plants were used by the local peoples for different medical problems. Moreover, the life style of the local people is directly and indirectly dependent on plant natural resources. Due to excessive uses and over exploitation, 09 medicinal plant species are internationally reported as threatened species.

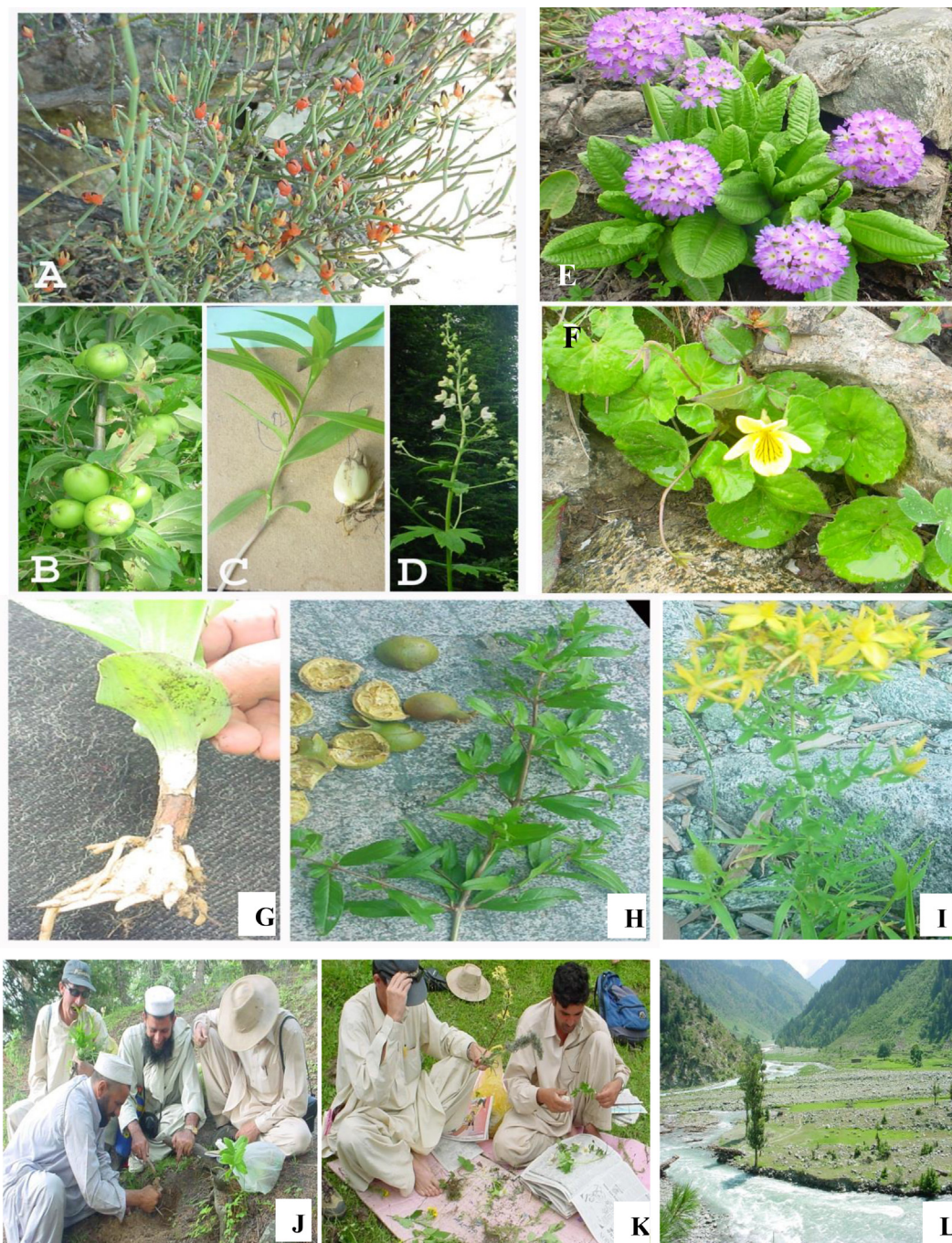


Fig. 8. A. *Ephedra intermedia* B. *Malus himalaica* C. *Polygonatum verticillatum* D. *Aconitum heterophyllum* E. *Primula denticulata*, F. *Viola betonicifoli*, G. *Polygonatum humil.*, H. *Punica granatum*, I. *Hypericum perforatum*, J. Searching the Bulb of *Polygonatum*, K. Plants pressing and L. A scenic view of the upper Palas Valley.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Abbas, H., 2010. Ex-situ conservation of some threatened endemic and rare plants of southern Pakistan through tissue culture Ph.D. Thesis. University of Karachi, Pakistan.

Abbas, Z., Khan, S.M., Alam, J., Khan, S.W., Abbasi, A.M., 2017. Medicinal plants used by inhabitants of the Shigar Valley, Baltistan region of Karakorum range-Pakistan. *J. Ethnobiol. Ethnomed.* 13 (1), 53–60.

Ahmad, I., Ibrar, M., Ali, N., 2011. Ethnobotanical study of Tehsil Kabal, Swat District, KPK, Pakistan. *J. Bot.*, 1–9

Ahmad, R., Srivastava, S.P., Maurya, R., Rajendran, S., Arya, K., Srivastava, A.K., 2008. Mild antihyperglycaemic activity in *Eclipta alba*, *Berberis aristata*, *Betula utilis*, *Cedrus deodara*, *Myristica fragrans* and *Terminalia chebula*. *Ind. J. Sci. Technol.* 1 (5), 1–6.

- Ahmad, S.S., Husain, S.Z., 2008. Ethno medicinal survey of plants from salt range (Kallar Kahar) of Pakistan. *Pak. J. Bot.* 40 (3), 1005–1011.
- Akhtar, N., Rashid, A., Murad, W., Bergmeier, E., 2013. Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. *J. Ethnobiol. Ethnomed.* 9 (1), 25.
- Alam, J., Ali, S.I., 2009. Conservation status of *Astragalus gilgitensis* Ali (Fabaceae). A critically endangered species in Gilgit District, Pakistan. *Phyton (Horn, Austria)* 48, 211–223.
- Alam, J., Ali, S.I., 2010. Contribution to the red list of the plants of Pakistan. *Pak. J. Bot.* 42 (5), 2967–2971.
- Ali, H., 2010. Floristic studies of Chitral: threatened plants and conservation strategies [Ph.D dissertation]. University of Karachi, HEC-Pakistan, Archive, <http://pr.hec.gov.pk.3251H>.
- Ali, S., Qaiser, M., 2007. Flora of Pakistan. (Fascicles). Department of Botany, University of Karachi, Karachi 1995.
- Ali, S.I., 2008. Significance of flora with special reference to Pakistan. *Pak. J. Bot.* 40 (3), 967–971.
- Ali, S.I., Nasir, Y.J. (Eds.), 1989–1991. Flora of Pakistan Nos: 191–193. Karachi and Islamabad.
- Ali, S.I., Qaiser M., 1993–2015. (Eds.): Flora of Pakistan Nos. 194–220. Karachi.
- Ali, H., Qaiser, M., 2011. Contribution to the red list of Pakistan: a case study of narrow endemic *Silene longispela* (Caryophyllaceae). *Fauna Flora Int. Oryx* 45 (4), 522–527.
- Ali, S.I., Qaiser, M. (Eds.). Flora of Pakistan Nos. 194–220. Karachi 1993–2015.
- Anonymous, 2020. District Census report of District Kohistan. In: Edited by Bureau of Statistics GoP.
- Ashfaq, S., Ahmad, M., Zafar, M., Sultana, S., Bahadur, S., Abbas, N., 2019. Medicinal plant biodiversity used among the rural communities of arid regions of northern Punjab, Pakistan. *18 (2)*, 226–241.
- Azhar, M.F., Siddiqui, M.T., Ishaque, M., Tanveer, A., 2014. Study of ethnobotany and indigenous use of *Calotropis procera* (Ait.) in cholistan desert, Punjab, Pakistan. *J. Agric. Res.* 52 (1), 117–126.
- 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. *J. Ethnopharmacol.* 168, 164–181.
- IUCN Redlist Categories and Criteria: Version 3.1., 2001. IUCN Species Survival Commission IUCN, Gland, Switzerland and Cambridge, U.K.
- IUCN, 2018. IUCN Redlist of Threatened species: Summary Statistics; Table 5.
- Hussain, F., Islam, M., Zaman, A., 2006. Ethnobotanical profile of plants of Shawar Valley, District Swat, Pakistan. *Int. J. Biol. Biotechnol.* 3 (2), 301–307.
- Islam, M., Ahmad, H., Rashid, A., Razaq, A., Akhtar, N., Khan, I., 2006. Weeds and medicinal plants of Shawar valley, district Swat. *Pak. J. Weed Sci. Res.* 12 (1–2), 83–88.
- Islam, M.K., Saha, S., Mahmud, I., Mohamad, K., Awang, K., Uddin, S.J., Rahman, M.M., Shilpi, J.A., 2014. An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. *J. Ethnopharmacol.* 151 (2), 921–930.
- Jin, B., Liu, Y., Xie, J., Luo, B., Long, C., 2018. Ethnobotanical survey of plant species for herbal tea in a Yao autonomous county (Jianghua, China): results of a 2-year study of traditional medicinal markets on the Dragon Boat Festival. *J. Ethnobiol. Ethnomed.* 14 (1), 58.
- Khan, A.W., Khan, A.U., Muhammad, S., Shah, M., Ullah, A., Faheem, M., Saleem, M., 2019. An updated list of Neuroimedicinal plants of Pakistan, their uses and Phytochemistry. *Evid. Hindawi: Based. Compl. Altern. Medic.* 2019 (27). [10.1155/2019/6191505](https://doi.org/10.1155/2019/6191505).
- Khan, S.M., Ahmad, H., Ramzan, M., Jan, M.M., 2007. Ethnomedicinal plant resources of Shawar Valley. *Pak. J. Bio. Sci.* 10 (10), 1743–1746.
- Kidane, L., Gebremedhin, G., Beyene, T., 2018. Ethnobotanical study of medicinal plants in Ganta Afeshum District, Eastern Zone of Tigray, Northern Ethiopia. *J. Ethnobiol. Ethnomed.* 14, 64.
- Lawal, I., Amao, A., Lawal, K., Alamu, O., Sowunmi, I., 2013. Phytotherapy approach for the treatment of gynaecological disorder among women in ido local government area of Ibadan, Oyo State, Nigeria. *J. Advan. Sci. Res.* 4 (3).
- Mahmood, A., Mahmood, A., Hussain, I., Jabeen, S., 2011. Indigenous medicinal knowledge of medicinal plants of Barnala area district Bhimber, Pakistan. *Int. J. Med. Arom. Plants.* 1 (3), 294–301.
- Mannan, A., Ahmed, I., Arshad, W., Asim, M.F., Qureshi, R.A., Hussain, I., Mirza, B., 2010. Survey of artemisinin production by diverse *Artemisia* species in northern Pakistan. *Malaria J.* 9 (1), 310.
- Nasir E., Ali S.I., (Eds.), 1970–89. Flora of Pakistan. Nos. 1–190. Karachi and Islamabad.
- Patel, D.K., Patel, K., Dhanabal, S., 2012. Standardization of *Berberis aristata* extract through conventional and modern HPTLC techniques. *Asi. Pacif. J. Trop. Disease.* 2, S136–S140.
- Sadeghi, Z., Mahmood, A., 2014. Ethno-gynecological knowledge of medicinal plants used by Baluch tribes, southeast of Baluchistan, Iran. *Revista Brasileira de Farmacognosia.* 24 (6), 706–715.
- Salim, M.A., Ranjitar, S., Hart, R., Khan, T., Xu, C., 2019. Regional trade of medicinal plants has facilitated the retention of traditional knowledge: case study in Gilgit Biltistan Pakistan. *J. Ethnobiol. Ethnomed.* 15, 6.
- Shinwari, M.I., Khan, M.A., 2000. Folk use of medicinal herbs of Margalla hills national park, Islamabad. *J. Ethnopharmacol.* 69 (1), 45–56.
- Shinwari, Z.K., Qaiser, M., 2011. Efforts on conservation and sustainable use of medicinal plants of Pakistan. *Pak. J. Bot.* 43 (1), 5–10.
- 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* 12, (9) e0183956.
- Talukdar, S., Gupta, A., 2018. Ethnomedicinal knowledge of the Garo community of two villages in western Assam, India. *J. Herb. Medic.* <https://doi.org/10.1016/j.hermed.08.004>.
- Tardio, J., Pardo-de-Santayana, M., 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of southern Cantabria. *J. Econ. Bot.* 62 (1), 24–39.
- Tariq, A., Adnan, M., Amber, R., Pan, K., Mussarat, S., Shinwari, Z.K., 2016. Ethnomedicines and anti-parasitic activities of Pakistani medicinal plants against *Plasmodium* and *Leishmania* parasites. *Ann. Clin. Microbiol. Antimicrob.* 15 (1), 52.
- Umair, M., Altaf, M., Bussmann, R.W., Abbasi, A.M., 2019. Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. *J. Ethnobiol. Ethnomed.* 15, 7.
- Wagh, V.V., Jain, A.K., 2018. Ethnopharmacological survey of plants used by the Bhil and Bhilala ethnic community in dermatological disorders in Western Madhya Pradesh, India. *J. Herb. Medic.* <https://doi.org/10.1016/j.hermed.2018.09.005>.
- 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. *J. Ethnobiol. Ethnomed.* 13 (1), 27.

Further reading

- Abbet, C., Mayor, R., Roguet, D., Spichiger, R., Hamburger, M., Potterat, O., 2014a. Ethnobotanical survey on wild alpine food plants in Lower and Central Valais (Switzerland). *J. Ethnopharmacol.* 151 (1), 624–634.
- Abbet, C., Mayor, R., Roguet, D., Spichiger, R., Hamburger, M., Potterat, O., 2014b. Ethnobotanical survey on wild alpine food plants in Lower and Central Valais (Switzerland). *J. Ethnopharmacol.* 151 (1), 624–634.
- Ahmad, H., Bhatti, G.R., Latif, A., 2006. Medicinal flora of the Thar Desert: an overview of problems and their feasible solutions. *Zonas Áridas* 8 (1), 73–84.
- Ali, H., Ahmad, H., Ghafoor, S., Amin, F., 2003. Marketable Fluctuation in trade of Medicinal plants in Swat. In: *Proc Conservation and Sustainable uses of Medicinal Plants of Pakistan. Swat, Pakistan.* pp. 143–149.
- Ali, A., Akhtar, N., Khan, B.A., Khan, M.S., Rasul, A., Khalid, N., Waseem, K., Mahmood, T., Ali, L., 2012. *Acacia nilotica*: a plant of multipurpose medicinal uses. *J. Medic. Pl. Res.* 6 (9), 1492–1496.
- Andola, H.C., Rawal, R., Rawat, M., Bhatt, I., Purohit, V.K., 2010. Variations of berberine contents in *Berberis pseudumbellata*. A high value medicinal shrub of west Himalaya, India. *Medic. Pl. Int. J. Phytomedic. Related. Indus.* 2, 111–115.
- Beigh, S.Y., Nawchoo, I.A., Iqbal, M., 2006. Cultivation and conservation of *Aconitum heterophyllum*: a critically endangered medicinal herb of the northwest Himalayas. *J. Herbs, Spices Med. Plants.* 11 (4), 47–56.
- Bhandari, M.R., Jong-Anurakkun, N., Hong, G., Kawabata, J., 2008. α -Glucosidase and α -amylase inhibitory activities of Nepalese medicinal herb *Pakhanbhed* (*Bergenia ciliata*, Haw.). *Food Chem.* 106 (1), 247–252.
- Chen, S.L., Yu, H., Luo, H.-M., Wu, Q., Li, C.F., Steinmetz, A., 2016. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chinese Med.* 11 (1), 37.
- Cotton, C.M., 1996. *Ethnobotany: Principles and Application.* John Wiley & Sons. <https://doi.org/10.1186/s13002-018-0281-0>.
- Jabeen, A., Khan, M.A., Ahmad, M., Zafar, M., Ahmad, F., 2009. Indigenous uses of economically important flora of Margallah hills national park, Islamabad, Pakistan. *African J. Biotechnol.* 8 (5).
- Kala, C.P., 2006. Medicinal plants of the high altitude cold desert in India: diversity, distribution and traditional uses. *The Int. J. Biodiv. Sci. Manage.* 2 (1), 43–56.
- 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 Complem. Alternat. Med.*, 1–21.
- Khan, S.W., Khatoon, S., 2008. Ethnobotanical studies on some useful herbs of Haramosh and Bugrote valleys in Gilgit, northern areas of Pakistan. *Pak. J. Botany.* 40 (1), 43.
- Klein, J.A., Harte, J., Zhao, X.Q., 2007. Experimental warming, not grazing, decreases rangeland quality on the Tibetan Plateau. *Ecol. Appl.* 17 (2), 541–557.
- Klein, J.A., Harte, J., Zhao, X.Q., 2008. Decline in medicinal and forage species with warming is mediated by plant traits on the Tibetan Plateau. *Ecosystems* 11 (5), 775–789.
- Korkmaz, M., Karakuş, S., 2015. Traditional uses of medicinal plants of Üzümlü district, Erzincan, Turkey. *Pak. J. Bot.* 47 (1), 125–134.
- Kujur, R., Singh, V., Ram, M., Yadava, H.N., Singh, K., Kumari, S., Roy, B., 2010. Antidiabetic activity and phytochemical screening of crude extract of *Stevia rebaudiana* in alloxan-induced diabetic rats. *Pharmacogn. Res.* 2 (4), 258–265.
- Martin, G., 2004. *Ethnobotany. In: A methods manual. Peoples and plants conservation series, wwwf.Earthscan publication.*
- Murad, W., Ahmad, A., Gilani, S.A., Khan, M.A., 2011. Indigenous knowledge and folk use of medicinal plants by the tribal communities of Hazar Nao Forest, Malakand District, North Pakistan. *J. Medic. Pl. Res.* 5 (7), 1072–1086.
- Nasir, E., Ali, S.I., 1971. Flora of Pakistan. Pakistan Agric. Res. Council, Islamabad.
- Pieroni, A., Giusti, M.E., 2009. Alpine ethnobotany in Italy: traditional knowledge of gastronomic and medicinal plants among the Occitans of the upper Varaita valley, Piedmont. *J. Ethnobiol. Ethnomed.* 5 (1), 32.

- Potdar, D., Hirwani, R., Dhulap, S., 2012. Phyto-chemical and pharmacological applications of *Berberis aristata*. *Fitoterapia*. 83 (5), 817–830.
- Qureshi, R., Ghufuran, M., Sultana, K., Ashraf, M., Khan, A., 2007. Ethnomedicinal studies of medicinal plants of Gilgit District and surrounding areas. *Ethnobot Res Applic.* 5, 115–122.
- Qureshi, R.A., Ghufuran, M.A., Gilani, S.A., Yousaf, Z., Abbas, G., Batool, A., 2009. Indigenous medicinal plants used by local women in southern Himalayan regions of Pakistan. *Pak. J. Bot.* 41 (1), 19–25.
- Rai, L., Prasad, P., Sharma, E., 2000. Conservation threats to some important medicinal plants of the Sikkim Himalaya. *Biol. Conserv.* 93 (1), 27–33.
- Razaq, A., Rashid, A., Haidar, A., Ahmad, H., Islam, M., 2010. Ethnomedicinal potential of plants of Changa Valley District, Shangla, Pakistan. *Pakistan J. Bot.* 42, 3463–3475.
- Razaq, A., Rashid, A., Islam, M., 2008. Medicinal weeds from changa valley, district, Shangla, Pakistan. *Pak. J. Pl. Sci.* 14 (1), 41–46.
- Rehman, M., Ahmad, H., Khan, A., 2003. Marketable medicinal plants of Mankial Valley, Distt; Swat. WWF. In: *Proc Int Workshop, Islamabad*, pp. 90–96.
- Romano, D., Tribulato, A., Toscano, S., Scuderi, D., 2012. Ethnobotanical uses of Brassicaceae in Sicily. In: *VI International Symposium on Brassicas and XVIII Crucifer Genetics Workshop*, 1005.
- Saqib, Z., Sultan, A., 2005. Ethnobotany of Palas valley, Pakistan. *Ethnobotanical Leaflets* 2004 (1), 11.
- Shabbir, A., Shahzad, M., Arfat, Y., Ali, L., Aziz, R.S., Murtaza, G., Waqar, S.A., 2012. *Berberis lycium* Royle: a review of its traditional uses, phytochemistry and pharmacology. *Afr. J. Pharm. Pharma.* 6 (31), 2346–2353.
- Sher, H., Aldosari, A., Ahmad, S., 2012. Ethnoecological appraisal of *Acacia modesta* Wall. common tree of dry ecosystem in Pakistan. *African J. Agric. Res.* 7 (36), 5083–5091.
- Tafesse, T.B., Hymete, A., Mekonnen, Y., Tadesse, M., 2017. Antidiabetic activity and phytochemical screening of extracts of the leaves of *Ajuga remota* Benth on alloxan-induced diabetic mice. *BMC Complem. Alternat. Med.* 17 (1), 243.
- Tardio, J., Pardo-De-Santayana, M., Morales, R., 2006. Ethenobotanical review of wild edible plants in Spain. *Bot. J. Linn. Soc.* 152 (1), 27–71.
- Uniyal, S.K., Singh, K., Jamwal, P., Lal, B., 2006a. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. *J. Ethnobiol. Ethnomed.* 2 (1), 14.
- Uniyal, S.K., Singh, K., Jamwal, P., Lal, B., 2006b. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. *J. Ethnobiol. Ethnomed.* 2 (1), 14.