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.

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-
In another study, most of the members of the family Asteraceae and Lamiales were used against malaria and leishmaniasis parasites (Tariq et al., 2016). Further, the highest amount of artimisin, chemical compound used against malaria, was found in two different species of the genus Artimisia, 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 Kalah 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 (Akhatar 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 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 urological 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’S, 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 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 Quaiser, 2007; Ali et al., 1989; Ali and Quaiser, 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.

\[
RFCs = \frac{FCs}{N}
\]
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.

\[
FL (%) = \frac{Ip}{Iu} \times 100
\]

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

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**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  |

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**Fig. 1.** Map of the study area.
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 dependent 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 the recorded species includes 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.

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 nigalis, Corydalis govaniana, 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 millefolium, 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 nigalis contributing 13%, A. modesta 10%, Berberis species 14%, Hypericum perforatum 8% and Pinus wallichiana 8%. Likewise, Bergenia ciliata, Nasturtium officinale, Punica granatum, Dioscorea 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 Ayuga bracteosa, Juglans regia, Punica granatum, Ephedra intermedia, Nasturtium officinale and Berberis lyceum 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 wallachiana 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...
| S. # | Plant species and Accession number | Family | Local Name | Common Name | \(^A\) Life Habits/ Life forms | \(^B\) Mode of utilization | Application mode | Therapeutic uses | \(^C\) Quantitative indices |
|------|----------------------------------|--------|------------|-------------|--------------------------------|-------------------------|----------------|-----------------|------------------|
|      |                                  |        |            |             |                                |                         |                |                 |                   |
|      | Acer caesium 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 |     |
|      | Allium humile 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 |     |
|      | Allium griffithianum 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 | 46 | 56 | 68 | 78 |     |
|      | Artemisia scoparia Waldast. & Kit. HU-NO.174 | Asteraceae | Jawkai | Jawkai | P H W | SH. juice, cooked RT. decoction; ST. decoction | 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 |     |
|      | Artemisia absinthium L. HU-NO.172 | Asteraceae | Jawkey | Jawkey | P H W | SH. juice FL. decoction LE. Decoction and cooked RT. Decoction and cooked LE. Extraction, Juice, grinding WP. Decoction SG. Gum | Oral and Past keeping | Carminative, antispasmodic, hemorrhoids and leukorrhoea. | 13 | 0.10 | 18 | 3.6 | 2.9 | 53.8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |     |
|      | Ajuga integrifolia Buch.-Him. Ex D. Don HU-NO.190 | Labiatae | Buti | Buti | P H W | Oral and Pasting | 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 |     |
|      | Acacia modesta 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 | 52 |     |
|      | Aconitum heterophyllum 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 |     |
|      | Aquilegia nivalis (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 |     |
|      | Berberis lycium Royle | Berberidaceae | Kawri, Zyarlargi | P S W | LE. 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 | ^Life Habits/ Life forms | ^Part(s)/ Mode of utilization | Application mode | Therapeutic uses | Quantitative indices | ^Previou-sly used |
|------|-----------------------------------|--------|------------|-------------|-------------------------|-----------------------------|-----------------|-------------------|---------------------|---------------------|
|      | Berberis pseudumbellata R.Parker HU-NO.199 | Berberidaceae | Shugloo | Zyarlargi | P S W and decoction | RT. Decoction St. Powder | Oral | Joints, aphrodisiac, body coldness and antiseptic. | FC 25 RFC 0.20 UR 35 UV 3.9 RIL 80 FL% 62 | Previous-ly used |
|      | Bistorta alpine HU-NO.132 | Polygonaceae | Shalkhay | The ghra Sharsham | P H W RT. Powder | Oral | Anti-inflammatory and astringent | CArmminative, stimulating agent, laxatives | FC 18 RFC 0.14 UR 30 UV 3.5 RIL 88.8 FL% 63 | Previous-ly used |
|      | Brassica tournefortii HU-NO.133 | Brassicaceae | R.Parker HU-NO.199 | Shugloo | Zyarlargi | P S W and decoction | Oral | Joints disorder, maintaining body temperature, external and internal body wound healing, Jaundice and contraction of muscles | FC 23 RFC 0.18 UR 33 UV 2.7 RIL 78.2 FL% 66 | Previous-ly used |
|      | Bistorta amoplexicaulis HU-NO.134 | Polygonaceae | Rain | Anjabar, | P H W | RH. Powder | Ornamental | Against sore throat, mouth washing or tongue and laryngitis. | Previous-ly used |
|      | Bergenia stracheyi HU-NO.140 | Saxifragaceae | Koarat | Koarat | P H W | RH. Powder | Oral | Increase the flow of urine, demulcent and constrict muscles, kidney stone | FC 34 RFC 0.27 UR 22 UV 2.7 RIL 55.5 FL% 72 | Previous-ly used |
|      | Bergenia cilata (Haw) Sternb. HU-NO.143 | Saxifragaceae | Gat Panra | Koarat | P H W | RH. Powder | Oral | Healing of ulcer, loose motion, as anti-cancer, tonic, backache, healing of wounds and piles. | FC 31 RFC 0.24 UR 13 UV 2.1 RIL 64.5 FL% 69 | Previous-ly used |
|      | Corydalis govaniana Wall. HU-NO.144 | Fumariaceae | Mamera | Mamera | P H W | LE. Juice, Powder | Oral | Tonic, diuretic, opthalmatic | Previous-ly used |
|      | Cuscuta reflexa Roxb. HU-NO.150 | Cuscutaceae | Neladaray | Neladaray | A C W | WP, Juice, powder | Oral | Jaundice, diuretic, carminative, Used as vermifuge in cattle | FC 30 RFC 0.24 UR 27 UV 3.8 RIL 71.4 FL% 2 | Previous-ly used |
|      | Clematis vitalba L. HU-NO.151 | Ranunculaceae | Zeali | Zeali | P C W | LE. Powder and juice | Oral | Topica | Previous-ly used |
|      | Cotoneaster microphyllus Wall. ex Lindl HU-NO.149 | Rosaceae | Loni | Kharwara | P S W | LE. Powder and decoction | Oral | Strong analgesic, Applied for arthritic joints, relieve pain, removal of waste products, juice is reported to relieve headache. Constriction of tissues | FC 42 RFC 0.33 UR 30 UV 3.0 RIL 71.4 FL% 11 | Previous-ly used |
|      | Crataegus songarica C. Koch HU-NO.148 | Rosaceae | Shenthal | Shenthal | P S W | FL. Decoction FR. Juice, whole SD. Whole seed or powder and topical powder | Oral | Heart tonic, enhance blood circulation, various heart diseases. | FC 28 RFC 0.22 UR 23 UV 2.5 RIL 53.3 FL% 60 | Previous-ly used |
|      | Delphinium roylei Munz HU-NO.155 | Ranunculaceae | Legony | Legony | P S W | Powder and topical powder | Oral | Paralyzing agent, mostly in the form of ointment, neuralgia and causing cardiac depressant. | FC 20 RFC 0.16 UR 30 UV 2.7 RIL 75.3 FL% 8 | Previous-ly used |
|      | Dioscorea deltoides 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, | FC 48 RFC 0.38 UR 45 UV 3.2 RIL 52.0 FL% 3 | Previous-ly used |
| S. # | Plant species and Accession number | Family | Local Name | Common Name | Life Habits/ Life forms | Part(s)/ Mode of utilization | Application mode | Therapeutic uses | Quantitative indices | Previous-Usly used |
|------|-----------------------------------|--------|------------|--------------|-------------------------|----------------------------|-----------------|-------------------|---------------------|------------------|
|      | Duchesnea indica (Andr.) Focke HU-NO.168 | Rosaceae | Jangli toot | Jangli toot | P S W | FR. Whole and juice | Oral | strong vermifuge and hormone production | 23 0.18 47 3.1 3.5 30 11●18●1● |  |
|      | Thymus papparea Wall. ex Steud. HU-NO.169 | Daphne | Kutilal | Legony | P S W | FR. Whole, Juice | Oral | Used as an narcotic, paralyzing tongue | 27 0.21 18 3.0 2.8 29.6 19●29●45● |  |
|      | Datura stramonium L. HU-NO.146 | Solanaceae | Mahu | Mahu | P S W | Br. Powder WP. Powder and decoction | Oral | Used for various skin problems, poisonous and rarely used for oral administration | 36 0.28 30 3.0 3.6 55.5 56●3●4●11● |  |
|      | Ephedra intermedia Schrenk and C. A Mey HU-NO.147 | Ephedraceae | Shna Chai | Green Tea | P H W | LE. Decoction, ST. Decoction FL. Decoction RH. Powder, decoction and Topical RH. Powder | 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●4● |  |
|      | Guttiferae HU-NO.153 | Asteraceae | The ghra nawarpars | Sunflower | P H W | LE. Powder, decoction and Topical RH. 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● |  |
|      | Heracleum candicans Wall. ex DC. HU-NO.154 | Apiaceae | Shkhawara | Shkhawaja | P H W | LE. Dry 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● |  |
|      | Inula rosmarinifolia (Labill.; Less. HU-NO.175 | Asteraceae | The ghra nawarpars | Sunflower | 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● |  |
|      | Inula sp HU-NO.179 | Asteraceae | The ghra nawarpars, Kut Googar | Sunflower | P H W | LE. Powder, decoction and Topical RH. Powder | Oral | Enhancing gastric secretions, increase food, drink, and increase the flow of urine. | 24 0.19 34 3.4 3.5 29.1 3●3●4□11● |  |
|      | Juniperus communis L. HU-NO.178 | Cupressaceae | Atchoy, Akhrote | Walnut | P T W | BR. Solid piece, husk bark FR. Whole Powder SD.Powder | Oral | Brain and health tonic, antiseptic, antimicrobial, teeth cleaner and cosmetic | 40 0.32 32 3.8 4.0 75.0 11●46●4●3 |  |
|      | Juglans regia L. HU-NO.125 | Juglandaceae | Zangli Mater | Wild Pea | P H W | LE. Powder SD.Powder | Tropic, Past | Healing agent, wound healing and antiseptic. | 33 0.26 35 3.5 3.8 21.2 3●73●4●11● |  |
|      | Lathyrus pratensis HU-NO.191 | Papilionaceae | Zangli Mater | Wild Pea | P H W | LE. Powder SD.Powder | Tropic, Past | Healing agent for external wound | 30 0.24 30 3.0 3.4 30.0 4●11●3●73● |  |
|      | Malus himalaica (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●11● |  |
| S. # | Plant species and Accession number | Family | Local Name | Common Name | Life Habits/ Life forms | Mode of utilization | Application mode | Therapeutic uses | Quantitative indices |
|------|----------------------------------|--------|------------|-------------|------------------------|-------------------|-----------------|------------------|---------------------|
|      | *Nasturtium officinale* R. Br. HU-NO.196 | Brassicaceae | Thalmera | Thalmera | P H W | Juice | Oral, Past | Blood purifier, diuretic, anti-inflammatory, expectorant, tonic for anemia and removing skin roughness | FC 0.32, RFC 27, UR 2.7, UV 3.0, RIL 75.0, FL% 3
|      | *Nerium oleander* L. HU-NO.194 | Apocynaceae | Myswak boty | Myswak boty | P S W | LE. Powder | Oral | Heart disorder, increasing the flow of urine, evacuating the bowels and scorpion biting | FC 0.24, RFC 16, UR 2.6, UV 2.8, RIL 3.3, FL% 3
|      | *Oleae ferruginea* Royle HU-NO.198 | Oleaceae | Khona | Zithoon | P T W | LE. Powder | Oral, Topical | Gonorrhea, fever, and debility. Oil is used for rubefacient, relieving joint pain and used for digestive disorder. | FC 0.28, RFC 12, UR 2.0, UV 2.5, RIL 5.5, FL% 3
|      | *Punica protopunica* 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. | FC 0.25, RFC 30, UR 3.0, UV 3.5, RIL 46.8, FL% 3
|      | *Polygonatum verticillatum* All. HU-NO.201 | Asparagaceae | Noor Alam | Noor Alam | P H W | RH. Powder | Oral | Used as demulcent, tonic especially for female and increase milk in cattle | FC 0.37, RFC 37, UR 3.6, UV 3.0, RIL 61.7, FL% 3
|      | *Polygonatum humile* Fisch. ex Maxim HU-NO.188 | Asparagaceae | Noor Alam | Noor Alam | P H W | RH. Powder | Oral | Used as demulcent, tonic especially for female and increase milk in cattle | FC 0.38, RFC 22, UR 3.1, UV 3.4, RIL 61.0, FL% 3
|      | *Prumula denticulata* 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 | FC 0.32, RFC 32, UR 2.6, UV 3.0, RIL 62.5, FL% 3
|      | *Pinus wallichana* A. B. Jackson HU-NO.177 | Pinaceae | Shalkhy | Cheer | P T W | RE. Resin | Decoction | Asthma, cough, skin irritation and facial acne, healing of cracks in feet. | FC 0.24, RFC 19, UR 2.1, UV 2.6, RIL 32.2, FL% 3
|      | *Pteridium aquilinum* (L.) Khun HU-NO.176 | Dennstaedtiaceae | Kownagy | Kowangy | P T W | SH. Cooked | Oral | Tonic, evacuation of bowel and used as soothing agent | FC 0.22, RFC 13, UR 2.6, UV 2.8, RIL 25.0, FL% 3
|      | *Punica granatum* L. HU-NO.166 | Punicaceae | Anar | Anar | P T W | SD. Powder, Juice FT. Decoction | Oral | Syphilis, jaundice and diarrhea, diabetic and nose bleeding | FC 0.27, RFC 20, UR 3.3, UV 3.7, RIL 23.5, FL% 3
|      | *Quercus alba* Lindl. ex Royle HU-NO.167 | Fagaceae | Spin bunj | Banj | P T W | SD. Fried seeds and its bark | Oral | Respiratory disease, chronic diarrhea and dysentery. | FC 0.20, RFC 23, UR 3.2, UV 3.5, RIL 28.0, FL% 3
|      | *Rumex hastatus* 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 | FC 0.33, RFC 30, UR 3.0, UV 3.5, RIL 71.4, FL% 45
|      | *Rheum webbianum* Royle | Polygonaceae | Chotial | Chotial | P H W | RH. Powder | Oral | Antibacterial, antiseptic and preservative. | FC 0.23, RFC 27, UR 3.3, UV 3.5, RIL 41.3, FL% 56

(continued on next page)
| S. # | Plant species and Accession number | Family | Local Name | Common Name | Life Habits/ Mode of utilization | Application mode | Therapeutic uses | Quantitative indices | Previo-usly used |
|------|-----------------------------------|--------|------------|-------------|-------------------------------|-----------------|-----------------|-------------------|-----------------|
| 1    | Ribes orientale HU-NO.203          | Rosaceae | Jangli Gulab | P S 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|11|45|46 |
| 2    | Rosa webbiana Wall. HU-NO.205      | Rosaceae | karwara    | P S W       | Fluor. Decoction and berries | Oral            | Mild astringent. | 29 0.23 24 3.4 3.6 27.5 | 56|11|45|46 |
| 3    | Rubus indica L HU-NO.204           | Rosaceae | Goraga     | P S W       | Oral | Mild astringent. | 34 0.27 34 3.4 3.6 47.0 | 3|11|45|46 |
| 4    | Sambucus wightiana Wall. HU-NO.209 | Sambucaceae | Ghazmiva | P S W       | Oral | Mild astringent. | 25 0.20 18 3.0 3.4 64.0 | 3|11|45|56 |
| 5    | Thymus serpyllum L HU-NO.106       | Lamiaceae | Ghray sparkay | P H W       | Oral | Mild astringent. | 52 0.41 35 3.5 3.8 65.3 | 3|11|45|46 |
| 6    | Taraxacum officinale Zucc. HU-NO.210 | Asteraceae | Lal Dana, Trepang | P H W       | Oral | Mild astringent. | 24 0.19 30 3.0 3.3 41.6 | 3|11|45|46 |
| 7    | Viola biflora L HU-NO.214          | Violaceae | Lilo, Banafsha | P H W       | Oral | Mild astringent. | 43 0.34 20 3.3 3.7 69.7 | 2|11|45|46 |

*FC, RFC, UR, UV, RIL, FL%* indicate the percentage of respondents who reported the use of the plant for the respective therapeutic use. *Previous usage* indicates the local practice of using the plant for the reported therapeutic use.
| S. # | Plant species and Accession number | Family | Local Name | Common Name | Life Habits/ Life forms | Part(s)/ Mode of utilization | Application mode | Therapeutic uses | Quantitative indices | Previo-usly used |
|------|-----------------------------------|--------|------------|-------------|------------------------|-----------------------------|----------------|------------------|---------------------|-----------------|
| 41   | Viola canescens Wall. ex Roxb. HU-NO.212 | Violaceae | Lilo | Lilo | P H W | WP, powder | Oral | Emollient, laxative, emetic, diaphoretic, antispasmodic and pictorial | FC 41 RFC 0.32 UR 22 UV 3.6 RIL 3.9 FL% 70.0 | 2 | 4 | 11 | 4 | 46 | 56 |   |
| 30   | Viola betonicifolia Smith HU-NO.217 | Violaceae | Lilo | Lilo | P H W | WP, Powder | Oral | Emollient, laxative, emetic, diaphoretic, antispasmodic and pictorial | FC 30 RFC 0.24 UR 26 UV 3.2 RIL 3.7 FL% 66.6 | 3 | 2 | 4 | 11 | 45 | 46 | 56 |   |
| 34   | Vitis jacquemontii Parker HU-NO.181 | Vitaceae | Magrath Ghedar Kawar | P C W | BE. Juice | Vine preparation, mental relaxation | FC 34 RFC 0.24 UR 15 UV 3.0 RIL 3.4 FL% 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.
- Plants species which are newly reported in this study.
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- Plants species which are newly reported in this 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.
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. Slightly, *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 agriculture 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 form 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 rosmarinifolia* and *Hypericum perforatum* were used as blood and lung purifier and also used for stomach ache. Similarly, *Malus himalaina* 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 govaniana* 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 Solanaceae (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 Shauwar 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 caesium* etc) for various aliments 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-
| S. No | Species                                      | $\sum T_i$ (Total number of use report cited by each informant) | N (Total number of informant interviewed for given plant species) | UV |
|-------|---------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----|
| 1     | Acer caesium Wall. ex. Brandis              | 20                                                            | 6                                                            | 3.3|
| 2     | Allium humile Knuth.                       | 22                                                            | 7                                                            | 3.1|
| 3     | Allium griffithianum Boiss.                 | 26                                                            | 7                                                            | 3.7|
| 4     | Artemisia scoparia Waldast. & Kit.          | 15                                                            | 5                                                            | 5.0|
| 5     | Artemisia absinthium L.                     | 8                                                             | 3                                                            | 2.6|
| 6     | Achillea millefolium L.                     | 18                                                            | 5                                                            | 3.6|
| 7     | Ajuga integrifolia Buch.-Him. Ex D. Don     | 22                                                            | 7                                                            | 3.1|
| 8     | Acacia modesta Wall.                        | 19                                                            | 9                                                            | 2.1|
| 9     | Aconitum heterophyllum Wall. ex Royle       | 26                                                            | 9                                                            | 2.8|
| 10    | Aquilegia nivalis (Baker) Falc. ex B.D.     | 12                                                            | 5                                                            | 2.4|
| 11    | Berberis lycaena Royle                     | 40                                                            | 11                                                           | 3.6|
| 12    | Berberis pseudumbellata R. Parker          | 35                                                            | 10                                                           | 3.5|
| 13    | Bistorta alpine                            | 30                                                            | 9                                                            | 3.0|
| 14    | Brasica tournefortii Coul.                  | 33                                                            | 11                                                           | 2.7|
| 15    | Bistorta amplexicaulis                      | 27                                                            | 10                                                           | 2.7|
| 16    | Berenia stracheyi                          | 13                                                            | 6                                                            | 2.1|
| 17    | Berenia ciliata (Haw) Serrnb.               | 22                                                            | 8                                                            | 2.7|
| 18    | Corydalis govaniana Wall.                   | 30                                                            | 10                                                           | 3.0|
| 19    | Cuscuta reflexa Roxb.                       | 27                                                            | 7                                                            | 3.8|
| 20    | Clematis vitulaf L.                         | 30                                                            | 10                                                           | 3.0|
| 21    | Cotoneaster microphyllus Wall. ex Lindl     | 32                                                            | 12                                                           | 2.6|
| 22    | Crataegus songarica C. Koch.                | 38                                                            | 15                                                           | 2.5|
| 23    | Delphinium roylei Munz                      | 30                                                            | 11                                                           | 2.7|
| 24    | Dioscorea deltoides Wall. ex Griseb.        | 45                                                            | 7                                                            | 3.2|
| 25    | Duchesnea indica (Andr.) Focke              | 47                                                            | 15                                                           | 3.1|
| 26    | Daphne papyracea Wall. ex Steud.            | 18                                                            | 6                                                            | 3.0|
| 27    | Datura stramonium L.                        | 30                                                            | 10                                                           | 3.0|
| 28    | Ephedra intermedi Schrenk and C.A Mey       | 24                                                            | 9                                                            | 2.6|
| 29    | Hypericum perforatum L.                     | 27                                                            | 8                                                            | 3.3|
| 30    | Heracleum ciancians Wall. ex DC.            | 21                                                            | 6                                                            | 3.5|
| 31    | Inula rosmarinifolia (Labill.) Less.        | 20                                                            | 6                                                            | 3.4|
| 32    | Inula sp                                   | 12                                                            | 3                                                            | 4.0|
| 33    | Juniperus communis L.                       | 34                                                            | 10                                                           | 3.4|
| 34    | Juglans regia L.                            | 32                                                            | 8                                                            | 3.8|
| 35    | Lathyrus lanegatus L.                       | 35                                                            | 10                                                           | 3.5|
| 36    | Lathyrus pratensis                          | 30                                                            | 9                                                            | 3.0|
| 37    | Malus himalica (Max) Schn.                  | 33                                                            | 11                                                           | 2.7|
| 38    | Nasturtium officinalis R. Br.               | 27                                                            | 10                                                           | 2.7|
| 39    | Nerium oleander L.                          | 16                                                            | 6                                                            | 2.6|
| 40    | Olea ferruginea Royle                       | 12                                                            | 6                                                            | 2.0|
| 41    | Punica protopinifica Balf.                  | 30                                                            | 10                                                           | 3.0|
| 42    | Polygonatum verticillatum All.              | 37                                                            | 14                                                           | 2.6|
| 43    | Polygonatum humile Fisch. ex Maxim          | 22                                                            | 7                                                            | 3.1|
| 44    | Primula denticulata Smith.                  | 32                                                            | 12                                                           | 2.6|
| 45    | Pinus wallichana A. B. Jackson              | 19                                                            | 9                                                            | 2.1|
| 46    | Petriodium aquilium (L.) Khun               | 13                                                            | 5                                                            | 2.6|
| 47    | Punica granatum L.                          | 20                                                            | 6                                                            | 3.3|
| 48    | Quercus alba Lindl. ex Royle                | 23                                                            | 7                                                            | 3.2|
| 49    | Rumex hastatus D. Don.                      | 30                                                            | 10                                                           | 3.0|
| 50    | Rheum webbianum Royle                       | 27                                                            | 8                                                            | 3.3|
| 51    | Ribes orientale Desf.                       | 15                                                            | 5                                                            | 3.0|
| 52    | Rosa webbianum Wall.                        | 24                                                            | 7                                                            | 3.8|
| 53    | Rubus indica L.                             | 27                                                            | 7                                                            | 3.8|
| 54    | Rubus sanctus Schreb.                       | 34                                                            | 10                                                           | 3.4|
| 55    | Sambucus wightiana Wall. ex Wigh & Engl.    | 18                                                            | 6                                                            | 3.0|
| 56    | Thymus serpyllum L.                         | 35                                                            | 10                                                           | 3.5|
| 57    | Toxus wallichiana Zucc.                     | 30                                                            | 9                                                            | 3.0|
| 58    | Trillium govanianum (Royle) Knuth           | 33                                                            | 11                                                           | 2.7|
| 59    | Viburnum coinfulium D. Don                 | 27                                                            | 10                                                           | 2.7|
| 60    | Verbenaceum thepas L.                       | 18                                                            | 6                                                            | 3.0|
| 61    | Valeriana jatamansi Jones                   | 14                                                            | 6                                                            | 3.3|
| 62    | Viola biflora L. HU-NO.214                  | 20                                                            | 6                                                            | 3.6|
| 63    | Viola betonicifolia Smith HU-NO.217         | 26                                                            | 8                                                            | 3.2|
| 64    | Vitis jacquemonti Parker HU-NO.181          | 15                                                            | 5                                                            | 3.0|
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 overgrazing 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.
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., *Viburnum* 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. 7. Species wise contribution (%) as source of drug. a Species wise contribution (%) as source of drug. b Species wise contribution (%) as source of drug.
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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