# Ethnoveterinary study of the medicinal plants of Dheri, Julagram, Khar, Tari, and Totakan Villages of Tehsil Batkhela, Malakand, Northern Pakistan

Heera, Naveed Akhtar, Shah Khalid, Hammad Ahmad Jan, Sobia Gul, Aiman Ali

**Correspondence**

**Heera[1], Naveed Akhtar[1], Shah Khalid[1,2,3], Hammad Ahmad Jan*[4], Sobia Gul[1], Aiman Ali[1]**

[1]Department of Botany, Islamia College Peshawar, Pakistan
[2]Department of Environmental System Sciences ETH Zurich, Switzerland
[3]WSL Cadenazzo, 6593, Switzerland
[4]Department of Botany, University of Buner, Swari, Pakistan

*Corresponding Author: hammadjan@ubuner.edu.pk

**Ethnobotany Research and Applications 25:45 (2023)** - http://dx.doi.org/10.32859/era.25.45.1-19
Manuscript received: 14/02/2023 – Revised manuscript received: 31/03/2023 - Published: 06/04/2023

## Research

## Abstract

*Background:* The current study was conducted to document the medicinal plants used commonly for the treatment of veterinary diseases in the study area.

*Methods:* The snowball sampling method was used for the selection of informants and the informants were interviewed through a semi-structured questionnaire. The documented data was quantified by indices UV (use value) and RFC (Relative Frequency of Citation).

*Results:* During fieldwork, about 51 plant species belonging to the 35 families were collected and ethnoveterinary data was documented for these plants. The most dominant family was Apiaceae and Solanaceae (5 Species each). The most dominant life form was herb (34 Species). The most commonly used plant part was the leaf (16 Species). The most common method of drug preparation was decoction (28 Species). The highest RFC value was calculated for *Trachyspermum ammi* (L.) Sprague (0.245) and the highest UV value was calculated for *Trachyspermum ammi* (L.) Sprague (0.28). The most commonly treated group of diseases was digestive system disorders.

*Conclusion:* Traditional communities still use medicinal plants for the treatment of various diseases of animals. But the knowledge of ethnoveterinary is at risk because the younger generations have no interest. Furthermore, due to deforestation and urbanization, the local medicinal flora is also at risk.

*Keywords:* Ethnoveterinary; Medicinal plants; Traditional knowledge; Local people perception

## Background

Pakistan is an agrarian country in Southeast Asia, located at the foothills of the Himalayas, and has multiple floristic zones. Out of the approximate 6,000 species, about 600 are part of folkloric medicines (Jan *et al.* 2020). Agriculture and animal husbandry are the main sources of income and nutrition for the majority of the rural residents of Pakistan. According to estimates, up to 80% of Pakistan's population depends on the agricultural and livestock sectors, with the majority of livestock producers owning five to six animals per home (Khan *et al.* 2019). The country's livestock population is very extensive, consisting of a variety of native varieties that are well adapted to local conditions. In particular, there are an estimated 30 million cattle, 54 million goats, 27 million sheep, 01 million

camels, 27 million buffaloes, 0.3 million horses, 0.2 million mules, 4 million asses, and 74 million poultry in Pakistan (Jan *et al.* 2020). The farmers residing in remote parts of the country, often financially- challenged fail to avail healthcare for their livestock. In such a scenario, the knowledge of locally-available medicinal plants serves a great purpose (Khan *et al.* 2019). Moreover, plant-based veterinary medicines or formulations are much cheaper (Raza *et al.* 2014).

The plant-based ethnoveterinary herbal medicine is one of the alternatives and most sustainable approaches that are easily adapted to rural livestock for the treatment of animal diseases in Pakistan. It has been serving as a treatment purpose for several years in the lack of modern veterinary practices (Abidin *et al.* 2021). Community members gave traditional knowledge of herbal medication services to their community with minimum cost or sometimes free of charge. However, communication and exchange of traditional knowledge between various ethnic communities are restricted, and sometimes traditional healers can only transfer knowledge to one son or pass away without transmitting their knowledge to anyone else. This condition is coupled with the fact that the awareness of ethnoveterinary is at risk because no resources are available for younger generations. The key explanation is that local people, especially those of younger generations, are not interested in the traditional knowledge of ethnoveterinary (Amjad *et al.* 2020). For that reason, ethnoveterinary medicinal knowledge may be lost soon unless researchers document the information and pass it from one generation to another generation (Aziz *et al.* 2018). Therefore, this study was conducted to document the ethnoveterinary knowledge about the plants used by the local population of the study area.

## Materials and Methods

### *Study area*

The present study was conducted in the villages Dheri, Julagram, Khar, Tari, and Totakan of Tehsil Batkhela. Batkhela is located in District Malakand lying in the Hindu-Kush range of Pakistan, between $34^0$ 35′ to $34^0$ 58′ N and $71^0$ 57′ to $71^0$ 95′ E (Fig. 1). Its projected area comprised 952 $km^2$ (Jan, 2014). The area is surrounded by small foothills of district Lower Dir in the north, Swat & Buner in the northeast, Mardan, and Charsadda in the south, Mohmand and Bajaur Agency in the west. As per the 2017 censuses, the estimated population was recorded to be 416,183 individuals. The area is mostly covered by exposed metamorphic and igneous rocks (Noor *et al.* 2022). The climate is moderate in both winter and summer with 600 to 650 mm of annual rainfall. The temperature normally ranges from 3°C to 41°C throughout the year, with temperatures rarely falling below 0°C or rising over 44°C. The probability of rainy days fluctuates throughout the year (Ahmad *et al.* 2016). Pashto is the predominant language spoken in the area. Another language called Gujro has also been noticed in mountainous villages. The common flora of the area is *Olea ferruginea* Wall. ex Aitch.*, Monotheca buxifolia* (Falc.)A. DC.*, Acacia modesta* Wall.*, Dodonaea viscosa* (L.) Jacq*, Pistacia integerrima* J. L. Stewart ex Brandis*, Melia azedarach* L.*, Acacia nilotica* (L.) Delile*, Ziziphus jujuba* Mill.*, Ziziphus nummularia* (Burm.f.) Wight & Arn.*, Morus alba* L.*, Pinus roxburghii* Sarg. The common wild animals found in the area are Jackal (*Canis aureus*), Rabbits (*Oryctolagus*), monkeys (*Macaques*), and wolves (*Canis lupus*). In addition, all community groups mostly use herbal drugs to cure different ailments of livestock as these groups are rich with plenty of indigenous knowledge about the use of medicinal plant species (Khan *et al.* 2019).

### *Collection and identification of plants*

Plant specimens were collected in different seasons from 2019-20. Randomly four to five field trips were arranged in each season for the collection of maximum plants. We take a local guide during each field trip to show us important medicinal plants for collection and after plant collection, we meet with the local informants for the documentation of the medicinal uses of the collected plants. The collected plant specimens were preserved according to the technique of Forman and Birdson, (1989). During fieldwork, appropriate photographs of the vegetative parts, fruits, and flowers were captured for future identification of each medicinal plant with the help of the Fuji digital camera. Furthermore, self and informants' photographs were also captured during interviews. The collected specimens were identified with the help of available literature and the Flora of Pakistan Tropicos. The botanical names were further confirmed from the databases International Plant Names Index, World Flora Online, and medicinal plants name service. All the collected specimens of medicinal plants were submitted to the Herbarium of the Department of Botany, Islamia College Peshawar, Pakistan for future reference.

### *Ethnoveterinary data documentation*

A semi-structured questionnaire was used as a tool for ethnoveterinary data collection. The informants were interrogated through face-to-face interviews and group discussions. The snowball and free listing methods were used for selecting the informants (Jan *et al.* 2022). Detailed interviews were mostly followed by free listing. We encouraged the local population to enlarge the free listing. The collected ethnoveterinary data was cross-checked among the informants to confirm the genuineness of the data. Prior verbal consent was always obtained from each informant (Abidin *et al.* 2022). We interviewed 86 local people of which 34 were male informants and 52 were

female informants. The interviews from the male informants were taken in the field, Hujra, or Baithaks, and the interviews from female informants were taken at home due to cultural restrictions. To document the present status of traditional knowledge the local herbalists (hakims) were also interrogated in their herbal shops. For the index used, the questionnaire was analyzed in two ways: firstly, responses of the informants have been documented and in the second step the binary values for the questions were considered, 0 value was allotted to answer "NO" and value 1 allotted to the answer "YES" (Andrade-Cetto, 2009).

For enhancing understanding of the gathered information on collected medicinal plants available in the study area un-ceremonious dialogues and walks in the field were held with key informants (13) comprising herdsmen, farmers, teachers, housewives, shepherds, and students (from school to university). The informants' age ranged from 20-97. The knowledge they delivered us was documented unerringly according to the technique of Mengistu and Hager, (2008). To verify the authenticity of the collected data about medicinal plants it was cross-checked at various communities either by presenting the plant's fresh or dry specimen, telling the local name/s of the plant, or displaying the photograph/s of the plant to the informants.

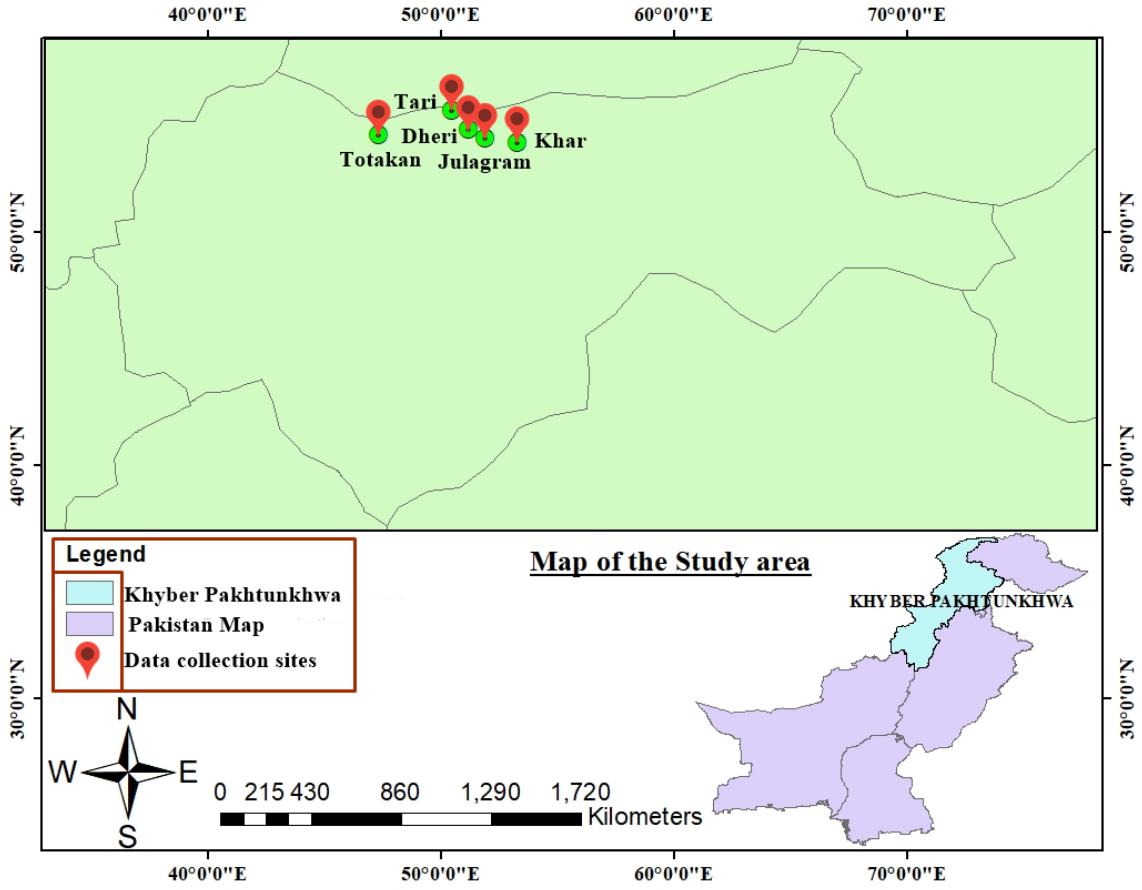


Figure 1. Map of the study area with data collection sites

**Quantification of ethnoveterinary data**

The quantification of ethnomedicinal data was done by using the following ethnobotanical indexes.

***Relative frequency citation (RFC)***

The local significance of every plant species was figured through the relative frequency of citation, which does not consider the variable *i.e.* use-category (Tardio & Pardo-De- Santayana, 2008; Ahmad *et al.* 2021). The RFC was calculated as follows:

$$RFC = FC/N$$

FC is the number of informants who mentioned the use of the species
N is the total number of informants participating in the study

***Use value (UV)***

The index is used to find out the relative importance of each species locally used as a remedy and is calculated with the help of the following formula (Phillips *et al.* 1994; Jan *et al.* 2021).

$$UV = \sum U/n$$

Where UV is the use-value, ∑U is the number of uses told by each informant for the given plant species, and n is the total number of informants interviewed for that particular plant. It is high when there are more uses reported for a plant and low when fewer uses are reported for a plant (Yabesh *et al.* 2014).

## Result and Discussion

***The socio-demographic distribution and characteristics of the local informants***

In this study, we interviewed a total of 86 indigenous people which includes dayiahs, drivers, farmers, housewives, labors, shepherds, teachers, students (school to university), shopkeepers, hakims, herbalists, and pansaries, etc. 34 were male informants and 52 were female. The age of the interviewed informants was from 20 years to 97 years. These respondents were further classified into seven age groups with the interval of the years and seven literacy groups. Most of the informants were belongs to the age group 61-70 and it was documented that this group has the highest ethnoveterinary knowledge about the medicinal plants followed by 51-60 age. In the groups of informants with ages below 41 years, there was a decline in ethnic knowledge, the informants of age group 20-30 have the least ethnoveterinary knowledge (Table 1). The possible reason behind this may be the modernization of lifestyle which leads young generations to give preference to allopathic medicines as compared to herbal medicines (Sargin, 2015). Furthermore, according to literacy classification, a decreasing trend was noted in the ethnoveterinary knowledge of informants with an increasing literacy rate. The reason for this is that educated people prefer a more modern healthcare system as compared to the traditional healthcare system (Jan *et al.* 2017). Moreover, the same results were reported by other authors (Bhatia *et al.* 2014; Jan *et al.* 2017). Additionally, it was documented that males and females both have almost equal ethnoveterinary knowledge. The reason behind this may be that men collect medicinal plants and women prepare herbal medicines and treat animals at home. Due to this both men and women are more or less likewise well aware of the uses of plants as medicines (Ahmad *et al.* 2015; Jan *et al.* 2017).

Table 1. Demographic information of the study area

| **Gender** | | **No. Informants** | |
|---|---|---|---|
| Male | | 34 | |
| Female | | 52 | |
| **Age Group** | **No. Informants** | **Medicinal Plants Reported** | **Complete Recipes** |
| 20-30 | 13 | 9 | 11 |
| 31-40 | 11 | 7 | 21 |
| 41-50 | 15 | 11 | 24 |
| 51-60 | 12 | 16 | 28 |
| 61-70 | 19 | 28 | 31 |
| 71-80 | 9 | 5 | 17 |
| 81-Above | 7 | 7 | 14 |

***Diversity of families and life form***

In the present study, 51 medicinal plants (Fig. 2) were collected which belong to 35 different families. The most dominant family in terms of the number of species is Apiaceae and Solanaceae with 5 species each followed by Brassicaceae with 3 species (Fig. 3). The possible reason may be the common distribution of the members of these families in the study area. Moreover, the members of Apiaceae and Solanaceae are widespread in the study area (Abbas *et al.* 2017). Additionally, the same results for the dominancy of the family Apiaceae and Solanaceae are reported from the surrounding areas by others (Bano *et al.* 2014; Barkatullah *et al.* 2015; Abbas *et al.* 2017; Haq *et al.* 2022). Brassicaceae as a dominant family was reported by other authors from surrounding areas (Ahmad *et al.* 2009).

The collected medicinal plants belong to different life forms. The most dominant life form was herb with 34 species than a tree with 11 species and shrub with 6 species (Table 2). The possible reason for the dominance of herbs may be the better adaptation to the climate and topography of the study area. Furthermore, herbs have more potency and fast regeneration as compared to shrubs and trees (Shah & Rahim, 2017). Moreover, the availability of herbs is easy (Malik *et al.* 2019). Additionally, herbs have different types of bioactive compounds which help them to adapt to any climatic condition easily (Zahor *et al.* 2017). Also, herbs have a higher concentration of various bioactive compounds than other life forms as well as herbs have high medicinal efficacy than shrubs and trees (Ullah *et al.* 2021). According to Amjad *et al.* (2017), high-altitude areas have dominant herbaceous flora as compared to shrubs and trees. Furthermore, a similar result was reported by other studies from surrounding areas (Barkatullah *et al.*

2015; Amjad *et al.* 2017; Jan *et al.* 2017; Shah and Rahim, 2017; Zahor *et al.* 2017; Wali *et al.* 2019; Ullah *et al.* 2021). During fieldwork, we observed that some plant species were not native to the study area but were still used by the people for the cure of various illnesses. Most of these non-native plants were cultivated by the local people.

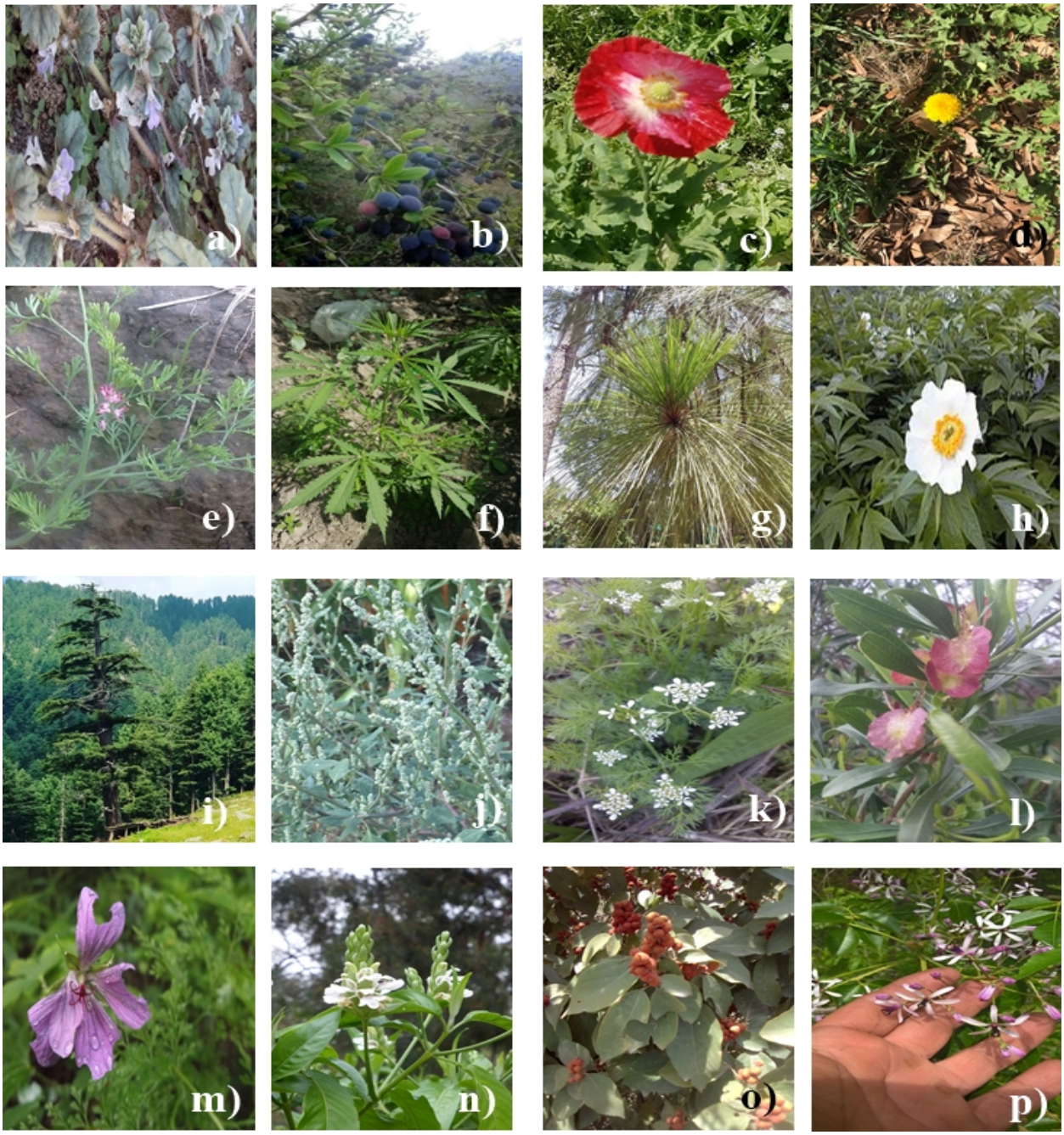


Figure 2. Pictures of the collected medicinal plants
(a) *Ajuga integrifolia* Buch.-Ham. (b) *Berberis lycium* Royle (c) *Papaver somniferum* L. (d) *Taraxicum officinale* (L.) Weber ex F.H.Wigg. (e) *Fumaria indica* (Hausskn.) Pugsley (f) *Cannabis sativa* L. (g) *Pinus roxburghii* Sarg. (h) *Paeonia emodi* Royle (i) *Cedrus deodara* (Roxb. ex D.Don) G.Don (j) *Chenopodium album* L. (k) *Coriandrum sativum* L. (l) *Dodonaea viscosa* (L.) Jacq. (m) *Geranium wallichianum* D. Don ex. Sweet (n) *Justicia adhatoda* L. (o) *Mallotus philippensis* (Lam.) Moll. Arg. (p) *Melia azedarach* L.

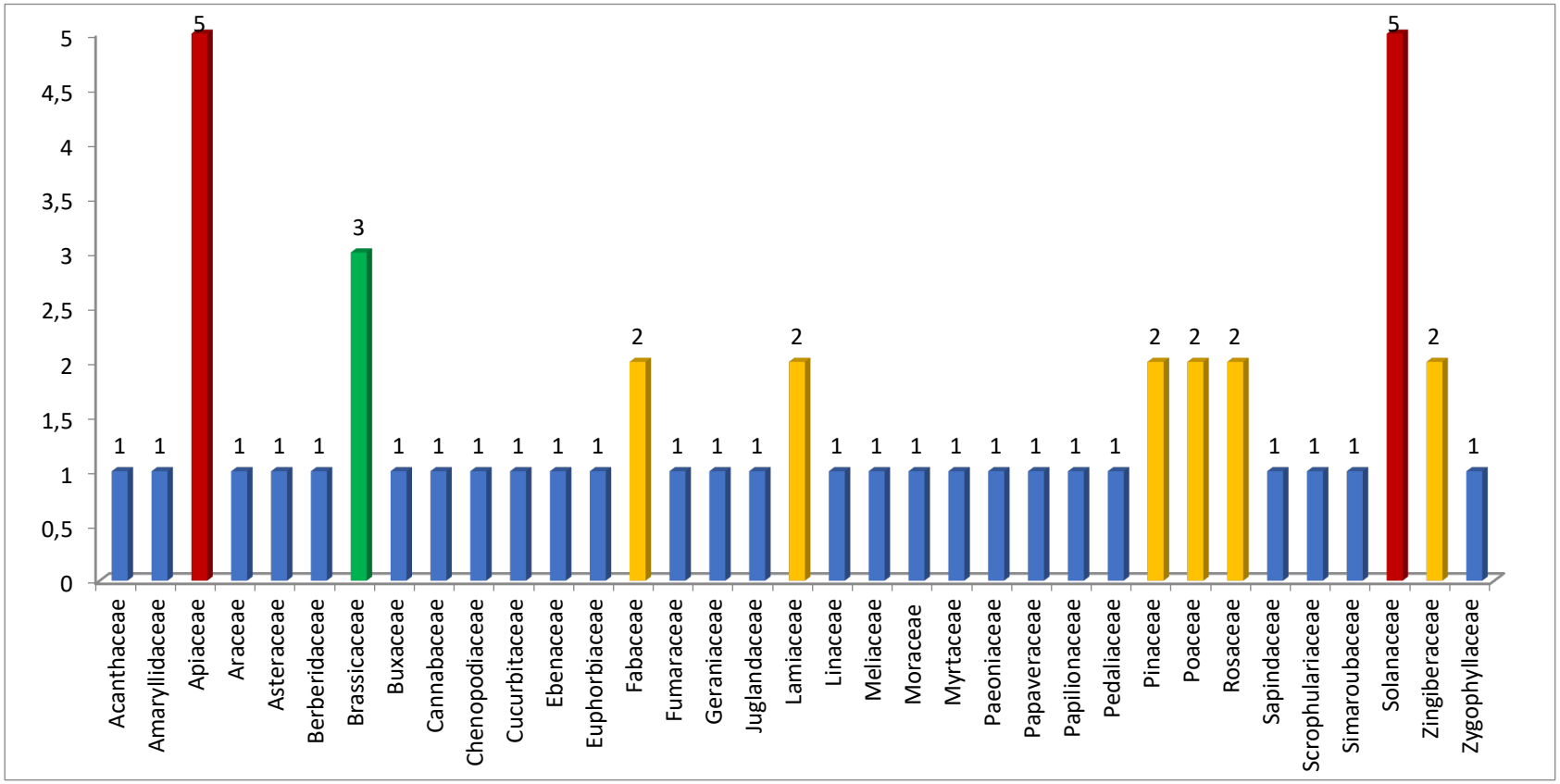

Figure 3. Medicinally important families of the study area

Table 2. Medicinal plants used for the treatment of veterinary diseases by the local population of Dheri, Julagram, Khar, Tari, and Totakan Villages of Tehsil Batkhela

| Botanical name | Local name | Part used | Intake mode | Disease(s) treated | UV | RFC | Dheri | Julagram | Khar | Tari | Totakan |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Acanthaceae** | | | | | | | | | | | |
| *Justicia adhatoda* L. | Baikarn | Leaf | Decoction | Mastitis | 0.024 | 0.059 | Y | Y | Y | Y | Y |
| **Amaryllidaceae** | | | | | | | | | | | |
| *Allium cepa* L. | Pyaz | Bulb, Fruit | Raw, Paste | Gaseous bloating, Indigestion | 0.024 | 0.012 | Y | Y | Y | Y | Y |
| **Apiaceae** | | | | | | | | | | | |
| *Anethum graveolens* L. | Sowa | Seed | Decoction, Paste | Enhance milk production, Kill liver fluke, Fever, Cold | 0.024 | 0.012 | Y | Y | N | Y | N |
| *Coriandrum sativum* L. | Shna daniya | Leaf | Raw | Laminitis | 0.024 | 0.012 | Y | Y | Y | Y | Y |
| *Cuminum cyminum* L. | Zeera | Seed | Decoction | Abdominal pain, Enhance milk production | 0.07 | 0.07 | N | N | Y | Y | N |
| *Foeniculum vulgare* Mill. | Kago | Seed | Paste, Decoction | Fever, Rheumatism, Enhance milk production, Constipation | 0.105 | 0.117 | Y | Y | Y | Y | Y |
| *Trachyspermum ammi* (L.) Sprague | Sparkii | Seed | Decoction, Paste | Meningitis, Enhance milk production, Kill liver fluke, Fever, Rheumatism, Abdominal pain, Constipation, Cold | 0.094 | 0.024 | Y | Y | Y | Y | Y |
| **Araceae** | | | | | | | | | | | |
| *Acorus calamus* L. | Skhawaja | Rhizome, Leaf | Decoction, Extract | Meningitis, Urinary tract infection | 0.012 | 0.035 | Y | Y | N | N | Y |
| **Asteraceae** | | | | | | | | | | | |
| *Taraxicum officinale* (L.) Weber ex F.H.Wigg. | Zyar gulay | Whole plant | Paste, Decoction | Indigestion | 0.047 | 0.024 | Y | Y | Y | Y | Y |
| **Berberidaceae** | | | | | | | | | | | |
| *Berberis lycium* Royle | Kwarii | Stem, Root | Decoction, Poultice, Infusion | Gaseous bloating, Heat stress, Gastritis, Chills | 0.035 | 0.012 | Y | Y | Y | Y | Y |
| **Brassicaceae** | | | | | | | | | | | |
| *Brassica rapa* L. | Sharshm | Seed | Decoction, Raw | Heat stress, Tympany, Foot and mouth disease, Antiseptic, Injury, Muscle cramps | 0.012 | 0.012 | Y | Y | Y | Y | Y |
| *Eruca vesicaria* (L.) Cav. | Jamama | Oil | Decoction | Loss of appetite | 0.035 | 0.047 | Y | Y | Y | N | Y |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lepidium sativum* L. | Alam | Seed | Decoction, Paste | Meningitis, Enhance milk production, Laxative, Rheumatism, Constipation, Fever | 0.012 | 0.012 | Y | N | Y | Y | N |
| **Buxaceae** | | | | | | | | | | | |
| *Sarcococca pruniformis* Lindl. | Ladda | Whole plant, Root, Leaf | Decoction, Extract | Placental retention, Analgesic, Fever | 0.012 | 0.012 | N | N | N | Y | Y |
| **Cannabaceae** | | | | | | | | | | | |
| *Cannabis sativa* L. | Bang | Leaf | Extract | Wounds healing | 0.024 | 0.012 | Y | Y | Y | Y | Y |
| **Chenopodiaceae** | | | | | | | | | | | |
| *Chenopodium album* L. | Sarmii | Leaf | Decoction | Colic pain | 0.012 | 0.012 | Y | Y | Y | Y | Y |
| **Cucurbitaceae** | | | | | | | | | | | |
| *Cucurbita maxima* Duchesne | Acharri kado | Fruit | Decoction | Jaundice | 0.047 | 0.07 | Y | Y | N | Y | Y |
| **Ebenaceae** | | | | | | | | | | | |
| *Diospyros lotus* L. | Toor amlok | Fruit | Raw | Constipation, Diarrhea | 0.117 | 0.024 | Y | N | N | N | Y |
| **Euphorbiaceae** | | | | | | | | | | | |
| *Mallotus philippensis* (Lam.) Moll. Arg. | Kambella | Flower, Whole Plant, Seed | Powder, Infusion, Poultice, Decoction, Powder | Diarrhea, Kill liver fluke, Foot and mouth disease, Diarrhea, Colon cleansing, Deworming, For health restoration | 0.012 | 0.012 | N | N | N | Y | Y |
| **Fabaceae** | | | | | | | | | | | |
| *Trigonella foenum-graecum* L. | Makvazi | Seed | Decoction | Kill liver fluk | 0.035 | 0.082 | N | N | N | Y | N |
| *Vigna radiata* (L.) R.Wilczek | Maye | Seed | Decoction | Heat stress | 0.024 | 0.047 | Y | Y | Y | Y | Y |
| **Fumaraceae** | | | | | | | | | | | |
| *Fumaria indica* (Hausskn.) Pugsley | Papra | Stem | Paste | Mange | 0.059 | 0.035 | Y | Y | Y | Y | Y |
| **Geraniaceae** | | | | | | | | | | | |
| *Geranium wallichianum* D. Don ex. Sweet | Sra zilla | Root, Stem | Paste, Raw | Pyrexia, Diarrhea | 0.012 | 0.035 | N | Y | Y | N | N |
| **Juglandaceae** | | | | | | | | | | | |
| *Juglans regia* L. | Ghwz | Fruit | Powder | Burn wounds | 0.012 | 0.012 | N | N | Y | Y | N |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lamiaceae** | | | | | | | | | | | |
| *Ajuga integrifolia* Buch.-Ham. | Bottii | Leaf | Decoction, Infusion | Gaseous Bloating, Foot and mouth disease | 0.082 | 0.035 | Y | Y | Y | Y | Y |
| *Mentha longifolia* (L.) L. | Enalli | Leaf, Whole plant | Decoction, Raw, Paste | Rheumatism, Enhance milk production, Colic pain, Abdominal pain | 0.012 | 0.024 | Y | Y | Y | Y | Y |
| **Linaceae** | | | | | | | | | | | |
| *Linum usitatissimum* L. | Alsi | Seed | Decoction, Paste | Kill liver fluk, Fever, Enhance milk production | 0.024 | 0.035 | Y | Y | Y | Y | Y |
| **Meliaceae** | | | | | | | | | | | |
| *Melia azedarach* L. | Tora shandii | Leaf, Stem | Paste, Raw | Prolapse anusia, Gaseous bloat | 0.024 | 0.082 | Y | Y | Y | Y | Y |
| **Moraceae** | | | | | | | | | | | |
| *Ficus carica* L. | Enzar | Leaf | Powder | Burn wounds | 0.012 | 0.012 | Y | Y | Y | N | Y |
| **Myrtaceae** | | | | | | | | | | | |
| *Syzygium aromaticum* (L.) Merr. & L.M.Perry | Lawang | Flower | Raw | Mastitis | 0.117 | 0.105 | Y | Y | Y | Y | Y |
| **Paeoniaceae** | | | | | | | | | | | |
| *Paeonia emodi* Royle | Mamaaikh | Rhizome | Infusion, Paste, Decoction, Powder | Chills, Colic pain, Loss of appetite, Gaseous bloating, Dysentery, Fever, Rheumatism | 0.059 | 0.024 | Y | Y | Y | Y | Y |
| **Papaveraceae** | | | | | | | | | | | |
| *Papaver somniferum* L. | Qalqash | Stem | Decoction | Analgesic | 0.152 | 0.117 | Y | Y | Y | Y | Y |
| **Papilionaceae** | | | | | | | | | | | |
| *Dalbergia sissoo* DC. | Shawa | Stem bark | Decoction | Jaundice | 0.024 | 0.012 | N | N | Y | N | Y |
| **Pedaliaceae** | | | | | | | | | | | |
| *Sesamum indicum* L. | Kwanzali | Seed | Raw | Mastitis, Enhance milk production | 0.082 | 0.035 | Y | Y | Y | Y | Y |
| **Pinaceae** | | | | | | | | | | | |
| *Pinus roxburghii* Sarg. | Nakhtar | Male cones | Poultice | Mastitis | 0.07 | 0.07 | N | Y | Y | N | Y |
| *Cedrus deodara* (Roxb. ex D.Don) G.Don | Diyar (Ranzra) | Seed | Raw, Poultice | Stomach burning, Gaseous bloat, Heat stress | 0.012 | 0.024 | N | Y | Y | N | N |
| **Poaceae** | | | | | | | | | | | |
| *Cenchrus ciliaris* L. | Sargrii | Whole plant | Decoction, Infusion | Constipation, Chills, Rheumatism | 0.024 | 0.012 | Y | Y | N | Y | Y |
| *Zea mays* L. | Jewar | Seed | Powder | Diarrhea | 0.024 | 0.024 | Y | Y | Y | Y | Y |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rosaceae** | | | | | | | | | | | |
| *Cotoneaster nummularius* Fisch. & C.A.Mey. | Kharrava | Leaf | Infusion | Foot and mouth disease | 0.012 | 0.012 | Y | N | Y | Y | N |
| *Prunus persica* (L.) Batsch | Shaltalo | Leaf | Extract, Decoction | Deworming, Urine retention | 0.012 | 0.012 | Y | Y | N | N | Y |
| **Sapindaceae** | | | | | | | | | | | |
| *Dodonaea viscosa* (L.) Jacq. | Ghwarskii | Stem, Leaf | Powder, Extract, Poultice | Burn wounds, Constipation, Swelling (injury), Sprained body parts | 0.035 | 0.024 | Y | Y | Y | y | Y |
| **Scrophulariaceae** | | | | | | | | | | | |
| *Verbascum thapsus* L. | Khwar ghog | Leaf | Poultice | Foot and mouth disease | 0.012 | 0.024 | Y | Y | Y | Y | Y |
| **Simaroubaceae** | | | | | | | | | | | |
| *Ailanthus altissima* (Mill.) Swingle | Shandii | Stem | Powder | Tympany | 0.024 | 0.059 | Y | Y | N | N | Y |
| **Solanaceae** | | | | | | | | | | | |
| *Capsicum annuum* L. | Marchakii | Fruit | Raw, Paste | Gaseous bloating, Indigestion, Rheumatism | 0.28 | 0.245 | Y | y | Y | Y | Y |
| *Datura innoxia* Mill. | Batorra | Leaf | Raw | Fever, Gaseous bloating | 0.024 | 0.012 | N | Y | Y | Y | N |
| *Solanum lycopersicum* L. | Tamator | Fruit | Raw | Fever | 0.035 | 0.024 | Y | Y | Y | Y | Y |
| *Solanum surattense* Burm. f. | Trakha hendvana | Fruit | Paste | Abdominal pain (colic pain), Indigestion, Diarrhea | 0.012 | 0.012 | Y | N | Y | Y | Y |
| *Withania somnifera* (L.) Dunal | Kotti lal | Root | Decoction | Fever, Mastitis, Placental Retention and other antiseptic wash | 0.012 | 0.012 | Y | Y | Y | Y | Y |
| **Zingiberaceae** | | | | | | | | | | | |
| *Curcuma longa* L. | Kurkaman | Rhizome | Decoction, Infusion, Cooked, Poultice, Powder | Meningitis, Chills, Antiseptic, Injury, Muscle cramps, Antiseptic, Wound healing, Analgesic | 0.047 | 0.012 | Y | Y | Y | Y | Y |
| *Zingiber officinale* Roscoe | Adrak | Rhizome | Poultice, Decoction, Powder | Indigestion, Kill liver fluke, Chills, Enhance milk production, Fever, Foot and mouth disease | 0.012 | 0.047 | Y | Y | Y | Y | Y |
| **Zygophyllaceae** | | | | | | | | | | | |
| *Tribulus terrestris* L. | Azghakii | Leaf | Paste | Respiratory infections | 0.094 | 0.059 | Y | Y | N | Y | Y |

**UV**=Use Value: **RFC**=Relative Frequency Citation: **Y**=Medicinal use(s) reported: **N**=Medicinal use(s) not report

***Diversity of the parts and formulation methods***

To treat various diseases different plant parts are used in herbal medicines. In the current study, 11 different vegetative and reproductive plants parts of the collected medicinal plants were used for medicinal purposes. The most dominant plant part used as a medicine of different plants species was the leaf (16 Species) followed by seed (14 Species each) (Fig. 4). The common use of leaves in herbal medicines is due to the presence of different types of metabolites in larger quantity as it is the main photosynthetic organ of the plant (Jan *et al.* 2017; Ullah *et al.* 2021). Moreover, leaves are the only plant part that is easy to collect and also produced in large amounts (Ahmad *et al.* 2015). Additionally from the conservation point of view, the use of leaves is sustainable and safe for the survival of plants (Jan *et al.* 2017). The use of seeds in herbal recipes frequently is due to the presence of bioactive compounds in a high proportion (Shah *et al.* 2017). Similar result to this study was also reported by other researchers from the surrounding areas (Shah *et al.* 2017; Rashid *et al.* 2022).

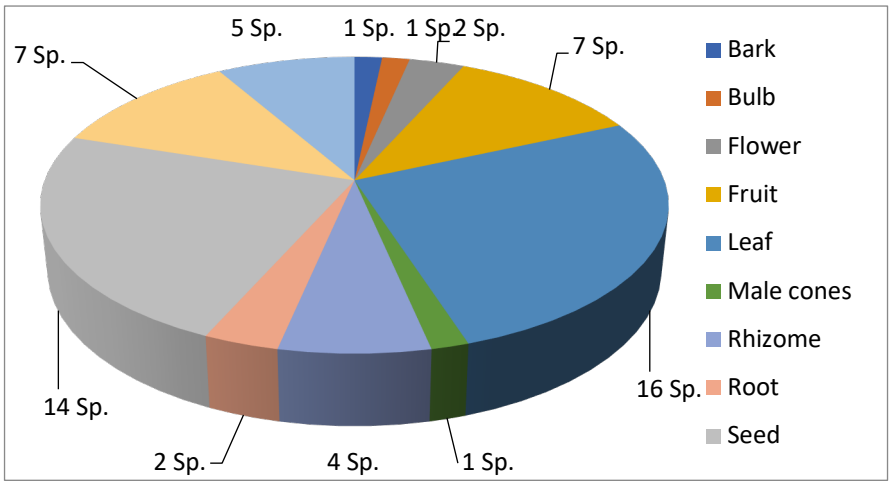


Figure 4. Plant parts used in the preparation of medicines

All the formulation methods were classified into 8 groups. The results showed that the most prominent herbal formulation method was decoction (28 Species) followed by paste (15 Species) and raw (13 Species) (Fig. 5). Decoction is one of the most common methods in the preparation of herbal medicine the possible reason maybe it is an easy method of drug preparation (Amjad *et al.* 2017). Another reason is that boiling plant(s) in water speed up the biochemical reactions which leads to the extraction and availability of different compounds for the cure of diseases (Zhang *et al.* 2009). Also, similar findings are reported by other authors (Ahmad *et al.* 2015; Ijaz *et al.* 2017; Jan *et al.* 2017; Singh *et al.* 2017; Ullah *et al.* 2018; Singh *et al.* 2020; Sulaiman *et al.* 2020).

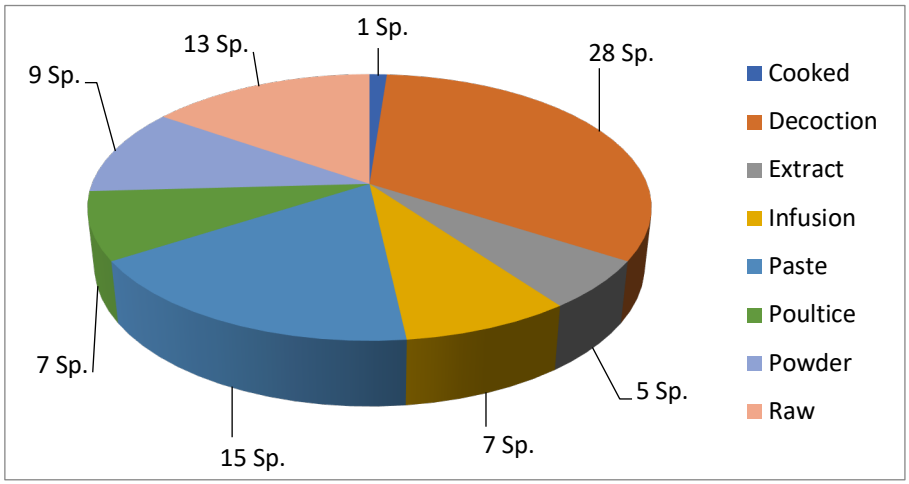


Figure 5. Mode of administration of medicine

***Cross-villages ethnoveterinary data***

In the current study, a total of 51 medicinal plant species were reported from Dheri, Julagram, Khar, Tari, and Totakan. The result clearly shows among all the villages the highest number of medicinal plants were reported from Totakan (42 species) followed by Dheri, Julagram, and Tari (41 species) and Khar (40 species) (Table 2). The result demonstrates that the people of these villages share their ethnoveterinary knowledge (Fig. 6). Haq *et al.* (2021)

from the Ladakh region and Aziz *et al.* (2020) from the Pakistan Himalayas conducted a similar cross-cultural analysis and concluded that ethnicity and cultural practices have shaped traditional herbal knowledge among the local inhabitants. Abidin *et al.* (2021) from southwest Pakistan revealed similar findings, which confirm our findings from the Kashmir Himalayan region. Mir *et al.* (2022) also conducted a similar study in the northern regions of Jammu and Kashmir, India.

***Relative frequency citation (RFC)***

To determine the local importance of each medicinally important plant species with the help of frequency of citation, the RFC ethnobotanical index was used. In our study, the highest RFC value was calculated for *Trachyspermum ammi* (L.) Sprague (0.245), *Mallotus philippensis* (Lam.) Moll. Arg (0.117), and *Lepidium sativum* L.( 0.105) (Table 2). The plant has a high RFC value showing that it is widely distributed in the study area and also the ethnoveterinary knowledge about the uses of plants is widespread in the local population. The plant species with low RFC value does not mean that it is medicinally less important, but it means the plant is restricted in its distribution to certain parts of the study area, therefore, fewer people know about the medicinal uses of the plants (Ahmad *et al.* 2015; Jan *et al.* 2017; Shah and Rahim, 2017). Almost similar results were reported in other studies (Amjad *et al.* 2017; Shinwari *et al.* 2017; Zahoor*et al.* 2017; Ali *et al.* 2018; Rahman *et al.* 2019; Sulaiman *et al.* 2020).

***Use value (UV)***

The Use Value (UV) index is commonly used by ethnobotanists to quantify the relative medicinal importance of a particular plant species. It is used to highlight the most prominent ethnobotanically important plant species of the study area. The value of UV ranges between 0-1. In this study, the highest UV was calculated for *Trachyspermum ammi* (L.) Sprague (0.28), *Mallotus philippensis* (Lam.) Moll. Arg.(0.152) and *Lepidium sativum* L.( 0.117) (Table 2). The high UV means the plant species are uniformly distributed in the area and the local population has more knowledge about the medicinal uses of the species. The low UV value does not mean that the plant species is medicinally less important, but there may be other reasons for low UV like the restriction of plant species to particular parts of the study area and/or the plant has one or few medicinal uses (Ahmad *et al.* 2015; Jan *et al.* 2017).

## Conclusion

The results of the current work clearly show that the study area has rich floristic and cultural diversity due to which the local population has rich ethnoveterinary knowledge. Furthermore, most of the study area is mountainous and remote which lacks modern health facilities, therefore local people rely on medicinal plants. The present study mainly highlights the important indigenous ethnoveterinary knowledge associated with local medicinal flora. It was noted that the valuable indigenous ethnoveterinary knowledge in the study area is at risk of extinction because the younger generation does not take interest in it. Moreover, the local population transfers this valuable treasure of knowledge orally from generation to generation which is a major factor in the loss of this valuable knowledge. Most of the knowledge was shared by the age group 61-70. The documentation of traditional knowledge will be used for a wide variety of purposes, including its preservation for future generations, it is safeguarding by putting the information in the public domain, and its use as the baseline for further research and conservation strategies. We recommend that future research projects should be designed to develop awareness in the local community about the conservation of medicinal plants. Furthermore, phytochemical and pharmacological evaluation of these medicinal plants should be carried out for the exploration of new medicines.

## Declarations

**Ethic statement:** Prior verbal consent was taken from all the participants.

**Data availability:** The original data is presented in the article. There is no supplementary data.

**Funding:** This reseaerch did not receive fiunding.

**Contribution of Authors:** All authors declare to have equal, direct, and intellectual contributions and have approved the current work for publication in this journal.

**Conflict of interest**: Not applicable

## Acknowledgments

All the authors are thankful to the local people for sharing their valuable ethnoveterinary data and facilitation during research work. Furthermore, we are thankful to all those who help us directly or indirectly during the research work.

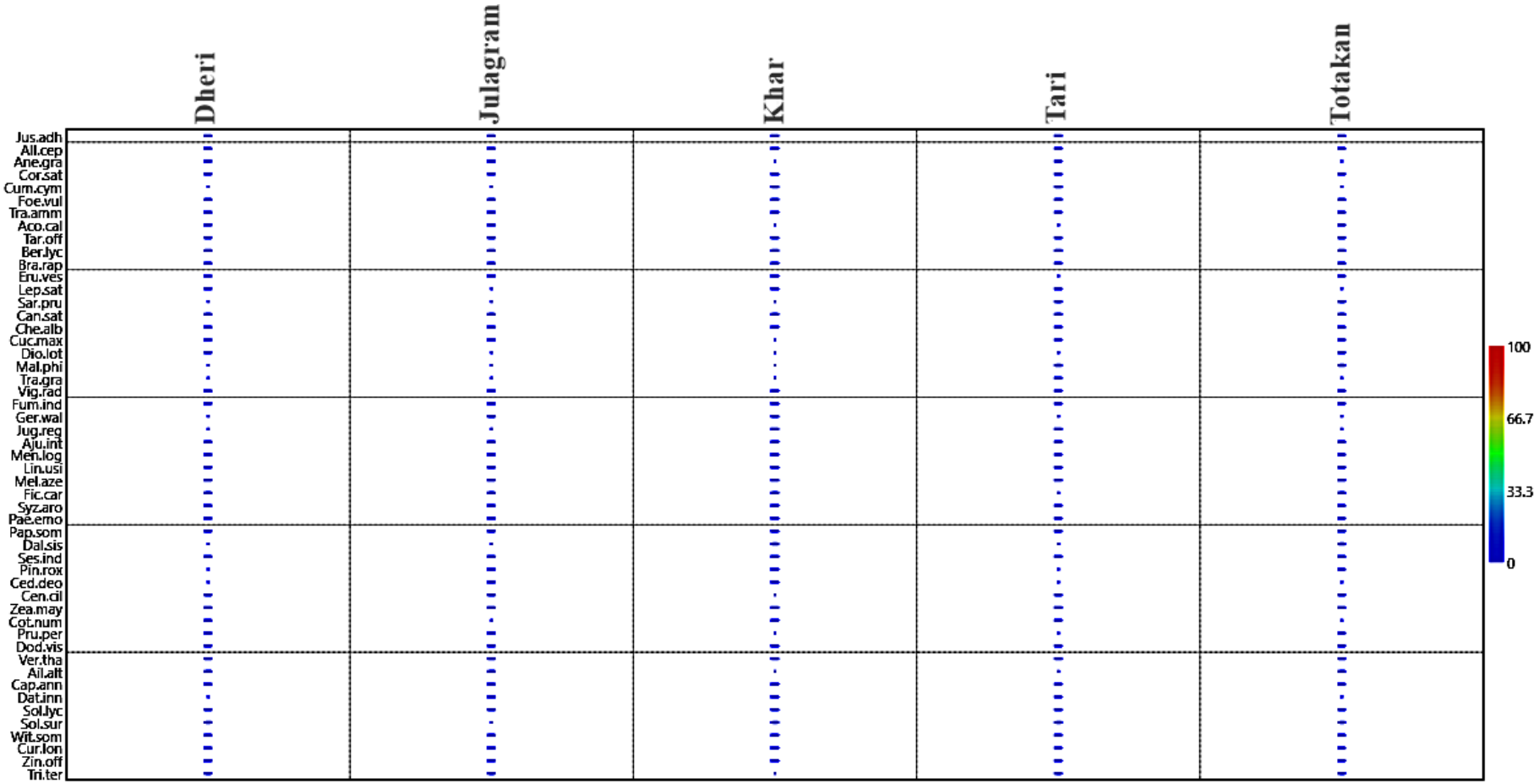


Figure 6. Cross-villages ethnoveterinary data of medicinal plant

## Literature Cited

Abbas W, Hussain W, Hussain W, Badshah L, Hussain K, Pieroni A. 2020. Traditional wild vegetables gathered by four religious groups in Kurram District, Khyber Pakhtunkhwa, North-West Pakistan.Genetic Resources and Crop Evolution 67(6):1521-1536.

Abbas Z, Khan SM, Alam J, Khan SW, Abbasi AM. 2017. Medicinal plants used by inhabitants of the Shigar Valley, Baltistan region of Karakorum range-Pakistan.Journal of Ethnobiology and Ethnomedicine 13(1):1-15.

Abbasi AM, Khan MA, Ahmad M, Zafar M, Jahan S, Sultana S. 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province, Pakistan. Journal of Ethnopharmacology 128(2): 322-335.

Abbasi AM, Khan MA, Shah MH, Shah MM, Pervez A, Ahmad M. 2013. Ethnobotanical appraisal and cultural values of medicinally important wild edible vegetables of Lesser Himalayas-Pakistan. Journal ofEthnobiology and Ethnomedicine 9(1):1-13.

Abdin SZU, Khan R, Ahmad M, Jan HA, Zafar M, Shah AH. 2022. A Cross-cultural ethnobotanical knowledge comparison about local plants among Pashto, Punjabi and Saraiki communities living in Southwest Pakistan. Ethnobotany Research and Applications 23:1-16.

Abidin SZU, Munem A, Khan R, Batiha GES, Amhad M, Zafar M, Bhatti MZ. 2021. Ethnoveterinary botanical survey of medicinal plants used in Pashto, Punjabi and Saraiki communities of Southwest Pakistan. Veterinary Medicine and Science 7(5):2068-2085.

Adhikari M, Thapa R, Kunwar RM, Devkota HP, Poudel P. 2019. Ethnomedicinal uses of plant resources in the machhapuchchhre rural municipality of kaski district, nepal. Medicine 6(2): 69.

Adnan M, Ullah I, Tariq A, Murad W, Azizullah A, Khan AL, Ali N. 2014. Ethnomedicine use in the war affected region of northwest Pakistan. Journal of Ethnobiology and Ethnomedicine 10(1): 1-16.

Ahmad L, Riaz M, Jan HA, Semotiuk AJ, Ahmad I, Khan I, Bussmann RW. 2021. An ethnobotanical survey of wild food plants used by the local communities of Kumrat Valley in District Upper Dir, Pakistan.Ethnobotany Research and Applications 22.

Ahmad L, Semotiuk A, Zafar M, Ahmad M, Sultana S, Liu QR, Yaseen G. 2015. Ethnopharmacological documentation of medicinal plants used for hypertension among the local communities of DIR Lower, Pakistan. Journal of Ethnopharmacology 175:138-146.

Ahmad M, Khan MPZ, Mukhtar A, Zafar M, Sultana S, Jahan S. 2016. Ethnopharmacological survey on medicinal plants used in herbal drinks among the traditional communities of Pakistan. Journal of Ethnopharmacology 184:154-186.

Ahmad M, Qureshi R, Arshad M, Khan MA, Zafar M. 2009. Traditional herbal remedies used for the treatment of diabetes from district Attock (Pakistan). Pakistan Journal of Botany 41(6): 2777-2782.

Ahmad S, Khan N, Hadi F, Ali M, Ahmad W. 2016. Structure and natural dynamics of Dodonaeaviscosa communities in Malakand division, Pakistan. Journal of Biodiversity and Environmental Sciences 9(1): 257-273.

Akerele O. 1991. Medicinal plants and primary health care: an agenda for action. *Eastern* Mediterranean Region Drugs Digest 8(2), 11-25.

Akhtar N, Begum S. 2009. Ethnopharmacological important plants of Jalala, district Mardan, Pakistan. Pakistan Journal of Plant Science 15(2): 95-100.

Akhtar N, Rashid A, Murad W, Bergmeier E. 2013. Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. Journal of Ethnobiology and Ethnomedicine 9(1):1-14.

Alam N, Shinwari ZK, Ilyas M, Ullah Z. 2011. Indigenous knowledge of medicinal plants of Chagharzai valley, District Buner, Pakistan. Pakistan Journal of Botany 43(2):773-780.

Ali A, Badshah L, Hussain F. 2018. Ethnobotanical appraisal and conservation status of medicinal plants in Hindukush Range, District Swat, Pakistan. Journal of Herbs, Spices & Medicinal Plants 24(4): 332-355.

Ali S, Perveen A, Qaiser M. 2015. Vegetation structure, edaphalogy and ethnobotany of Mahaban and Malka(District Buner) KPK, Pakistan. Pakistan Journal of Botany 47.SI (2015): 15-22.

Amjad MS, Qaeem MF, Ahmad I, Khan SU, Chaudhari SK, Zahid MN, Khan AM. 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. Plosone 12(2):0171896.

Amjad MZ, Zahoor U, Bussmann RW, Altaf M, Gardazi SMH, Abbasi AM. 2020. Ethnobotanical survey of the medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 16(1):1-28.

Andrade-Cetto A. 2009. Ethnobotanical study of the medicinal plants from Tlanchinol, Hidalgo, México. Journal of Ethnopharmacology 122(1):163-171.

Awan AA, Akhtar T, Ahmed MJ, Murtaza G. 2021. Quantitative ethnobotany of medicinal plants uses in the Jhelum valley, Azad Kashmir, Pakistan. Acta Ecologica Sinica 41(2):88-96.

Ayyanar M, Ignacimuthu S. 2011. Ethnobotanical survey of medicinal plants commonly used by Kanitribals in Tirunelveli hills of Western Ghats, India. Journal of Ethnopharmacology 134(3):851-864.

Aziz A, Abbasi AM, Ullah Z, Pieroni A. 2020. Shared but threatened: The heritage of wild food plant gathering among different linguistic and religious groups in the Ishkoman and Yasin Valleys, North Pakistan. Foods 9(5):601.

Aziz MA, Adnan M, Khan AH, Sufyan M, Khan SN. 2018. Cross-Cultural Analysis of Medicinal Plants commonly used in Ethnoveterinary Practices at South Waziristan Agency and Bajaur Agency, Federally Administrated Tribal Areas (FATA), Pakistan. Journal of Ethnopharmacology 210:443-468.

Azizullah A, Khattak MNK, Richter P, Hader DP. 2011. Water pollution in Pakistan and its impact on public health—a review. Environment international 37(2):479-497.

Bahadur S, Khan MS, Shah M, Shuaib M, Ahmad M, Zafar M, Hussain F. 2020. Traditional usage of medicinal plants among the local communities of Peshawar valley, Pakistan. Acta Ecologica Sinica 40(1):1-29.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine 10(1):1-18.

Barkatullah, Ibrar M, Rauf A, Hadda TB, Mubarak MS, Patel S. 2015. Quantitative ethnobotanical survey of medicinal flora thriving in Malakand Pass Hills, Khyber Pakhtunkhwa. Pakistan. Journal of Ethnopharmacology 169:335-46.

Bhatia H, Sharma YP, Manhas RK, Kumar K. 2014. Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India. Journal of Ethnopharmacology 151(2):1005-1018.

Bibi F, Abbas Z, Harun N, Perveen B, Bussmann RW. 2022. Indigenous knowledge and quantitative ethnobotany of the Tanawal area, Lesser Western Himalayas, Pakistan. Plosone 17(2):0263604.

Bibi T, Ahmad M, Tareen NM, Jabeen R, Sultana S, Zafar M, Zain-ul-Abidin S. 2015. The endemic medicinal plants of Northern Balochistan, Pakistan and their uses in traditional medicine. Journal of Ethnopharmacology 173:1-10.

Butt MA, Ahmad M, Fatima A, Sultana S, Zafar M, Yaseen G, Kayani S. 2015. Ethnomedicinal uses of plants for the treatment of snake and scorpion bite in Northern Pakistan. Journal of Ethnopharmacology 168:164-181.

Byg A, Balslev H. 2001. Diversity and use of palms in Zahamena, eastern Madagascar. Biodiversity and Conservation 10(6):951-970.

Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. 2019. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 15(1):1-30.

Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. 2019. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 15(1):1-30.

Faruque MO, Uddin SB, Barlow JW, Hu S, Dong S, Cai Q, Hu X. 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. Frontiers in Pharmacology 9:40.

Forman L, Birdson D. 1989.The herbarium hand book. UK: Royal botanical gardens, Kew.

Gwalwanshi DR, Salunkhe O, Shukla A, Bishwas AJ, Vyas D. 2014. Indigenous Knowledge and Documentation of Ethno-Medicinal Plants of Panna District, Central India: A Case Study. Journal of Ethnobiology and Traditional Medicine Photon 122:868-876.

Hamayun M, Khan A, Afzal S, Khan MA. 2006. Study on traditional knowledge and utility of medicinal herbs of district Buner, NWFP, Pakistan.Indian Journal of Traditional Knowledge 5(3):407-412.

Hamayun M, Khan A, Khan MA. 2003. Common medicinal folk recipes of District Buner, NWFP, Pakistan. Ethnobotony Leaf 2005(1):45.

Haq SM, Hassan M, Jan HA, Al-Ghamdi AA, Ahmad K, Abbasi AM. 2022. Traditions for Future Cross-National Food Security—Food and Foraging Practices among Different Native Communities in the Western Himalayas. Biology 11(3):455.

Haq SM, Singh B. 2020. Ethnobotany as a Science of Preserving Traditional Knowledge: Traditional Uses of Wild Medicinal Plants from District Reasi, J&K (Northwestern Himalaya), India. In Botanical Leads for Drug Discovery ( 277-293). Springer, Singapore.

Haq SM, Yaqoob U, Calixto ES, Rahman IU, Hashem A, Abd_Allah EF, Ijaz F. 2021. Plant resources utilization among different ethnic groups of Ladakh in Trans-Himalayan Region. Biology 10(9):827.

Hassan N, Din MU, Hassan FU, Abdullah I, Zhu Y, Jinlong W, Zeb U. 2020. Identification and quantitative analyses of medicinal plants in Shahgram valley, district swat, Pakistan.Acta Ecologica Sinica 40(1):44-51.

Hassan N, Din MU, Hassan FU, Abdullah I, Zhu Y, Jinlong W, Zeb U. 2020. Identification and quantitative analyses of medicinal plants in Shahgram valley, district swat, Pakistan.Acta Ecologica Sinica 40(1):44-51.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: Healers' consensus and cultural importance.Socio Science and medicine 47(11):1859-1871.

Heinrich M. 2000. Ethnobotany and its role in drug development. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives 14(7):479-488.

Hoft M, Baril SK, Lykke AM. 1999. Quantitative ethnobotany, applications of multivariate and statistical analyses in ethnobotany, people and plants. Ork. Pap. 6:3-3.

Hussain M, Khalid F, Noreen U, Bano A, Hussain A, Alam S, Habiba U. 2021. An ethno-botanical study of indigenous medicinal plants and their usage in rural valleys of Swabi and Hazara region of Pakistan. Brazilian Journal of Biology 82.

Ijaz F, Iqbal Z, Rahman IU, Alam J, Khan SM, Shah GM, Afzal A. 2016. Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan. Journal of Ethnopharmacology 179:208-233.

Ishtiaq M, Mahmood A, Maqbool M. 2015. Indigenous knowledge of medicinal plants from Sudhanoti district (AJK), Pakistan. Journal of Ethnopharmacology 168:201-207.

Jan HA, Abidin SZU, Bhatti MZ, Ahmad L, Alghamdi AK, Alkreathy HM. 2022. Medicinal Plants and Related Ethnomedicinal Knowledge in the Communities of Khadukhel Tehsil, Buner District, Pakistan. Sustainability 14(20):13077.

Jan HA, Ahmad L, Bussmann, RW, Jan S, Wali S, Haq SM, Romman M. 2021. Medicinal plants used for veterinary diseases by the local inhabitants of the Teshil Tangi, District Charsadda, Pakistan. Indian Journal of Traditional Knowledge 20(4):990-1001.

Jan HA, Jan S, Bussmann RW, Ahmad L, Wali S, Ahmad N. 2020. Ethnomedicinal survey of the plants used for gynecological disorders by the indigenous community of District Buner, Pakistan. Ethnobotany Research and Applications 19:1-18.

Jan HA, Jan S, Bussmann RW, Wali S, Sisto F, Ahmad L. 2020. Complementary and alternative medicine research, prospects and limitations in Pakistan: a literature review. Acta Ecologica Sinica 40(6):451-463.

Jan HA, Jan S, Wali S, Ahmad L, Sisto F, Bussmann RW, Romman M. 2021. Ethnomedicinal study of medicinal plants used to cure dental diseases by the indigenous population of district Buner, Pakistan. Indian Journal of Traditional Knowledge 20(2):378-389.

Jan HA, Wali S, Ahmad L, Jan S, Ahmad N, Ullah N. 2017. Ethnomedicinal survey of medicinal plants of Chinglai valley, Buner district, Pakistan. European Journal of Integrative Medicines 13:64-74.

Jan M, Mir TA, Jan HA, Khare RK. 2022. Medicinal plants diversity and their uses for Gynecological Disorders of District Baramulla, Jammu and Kashmir, India. Vegetos 1-15.

Kayani S, Ahmad M, Sultana S, Shinwari ZK, Zafar M, Yaseen G, Bibi T. 2015. Ethnobotany of medicinal plants among the communities of Alpine and Sub-alpine regions of Pakistan. Journal of Ethnopharmacology 164:186-202.

Kayani S, Ahmad M, Zafar M, Sultana S, Khan MPZ, Ashraf MA, Yaseen G. 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies–Abbottabad, Northern Pakistan. Journal of Ethnopharmacology 156:47-60.

Kayani S, Ahmad M, Zafar M, Sultana S, Khan MPZ, Ashraf MA,Yaseen G. 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies–Abbottabad, Northern Pakistan. Journal of Ethnopharmacology 156:47-60.

Khan A, Nasrallah KA, Rauf A, Patel S. 2019. Quantitative Ethno-Veterinary Usage of Plants in the Outskirts of District Malakand, Khyber Pakhtunkhwa, Pakistan. Acta Scientific Veterinary Sciences 1(2).

Khan A. 1996. Policy-making in Pakistan's population programme. Health Policy and Planning 11(1):30-51.

Khan K, Rahman IU, Calixto ES, Ali N, Ijaz F. 2019. Ethnoveterinary therapeutic practices and conservation status of the medicinal flora of Chamla Valley, Khyber Pakhtunkhwa, Pakistan.Frontiers in Veterinary Science 6:122.

Khan SM, Page S, Ahmad H, Shaheen H, Ullah Z, Ahmad M, Harper DM. 2013. Medicinal flora and ethnoecological knowledge in the Naran Valley, Western Himalaya, Pakistan. Journal of Ethnobiology and Ethnomedicine 9(1):1-13.

Ladio AH, Lozada M. 2004. Patterns of use and knowledge of wild edible plants in distinct ecological environments: a case study of a Mapuche community from northwestern Patagonia. Biodioversity& Conservation 13(6):1153-1173.

Malik K, Ahmad M, Zafar M, Sultana S, Tariq A, Rashid N. 2019. Medicinal plants used for treatment of prevalent diseases in Northern Pakistan of Western Himalayas. In Medicinal Plants-Use in Prevention and Treatment of Diseases. IntechOpen.

Mangestu F, Hager H. 2008. Wild Edible Fruit Species Culture Domain, Informant Species Competence and Preference in Three Districts of Amhara Region, Ethiopia.Ethnobotany Research and Applications 6:487-502.

Mir TA, Jan M, Jan HA, Bussmann RW, Sisto F, Fadlalla IMT. 2022. A Cross-Cultural Analysis of Medicinal Plant Utilization among the Four Ethnic Communities in Northern Regions of Jammu and Kashmir, India. Biology 11(11):1578.

Noor S, Rashid A, Javed A, Khattak JA, Farooqi A. 2022. Hydrogeological properties, sources provenance, and health risk exposure of fluoride in the groundwater of Batkhela, Pakistan.Environmental Technology and Innovation 25:102239.

Phillips O, Gentry AH, Reynel C, Wilkin P, Galvez-Durand B C.1994.Quantitative ethnobotany and Amazonian conservation. Conservation of Biology 8(1):225-248.

Popović Z, Matić R, Bojović S, Stefanović M, Vidaković,V. 2016. Ethnobotany and herbal medicine in modern complementary and alternative medicine: An overview of publications in the field of I&C medicine 2001–2013. Journal of Ethnopharmacology 181:182-192.

Rahman IU, Afzal A, Iqbal Z, Hart R, Abd_Allah EF, Hashem A, Calixto HS. 2019. Herbal teas and drinks: Folk medicine of the Manoor valley, Lesser Himalaya, Pakistan.Plants 8(12):581.

Rahman IU, Afzal A, Iqbal Z, Ijaz F, Ali N, Shah M, Bussmann RW. 2019. Historical perspectives of ethnobotany.Clinics in dermacology 37(4):382-388.

Rahman SU, Ullah Z, Ali A, Aziz MA, Alam N, Sher H, Ali I. 2022. Traditional knowledge of medicinal flora among tribal communities of Buner Pakistan.Phytomedicine Plus 2(3):100277.

Rashid N, Gbedomon RC, Ahmad M, Salako VK, Zafar M, Malik K. 2018. Traditional knowledge on herbal drinks among indigenous communities in Azad Jammu and Kashmir, Pakistan. Journal of Ehnobiology and Ethnomedicine 14(1):1-20.

Rashid S, Ahmad M, Zafar M, Sultana S, Ayub M, Khan MA, Yaseen G. 2015. Ethnobotanical survey of medicinally important shrubs and trees of Himalayan region of Azad Jammu and Kashmir, Pakistan. Journal of Ethnopharmacology 166:340-351.

Rashid S, Pathan NA, Jan HA, Majeed LR, Nisar B. 2022. Study of Perceptional Attitude of Resource Limited Uri Populace of District Baramullah Toward Traditional Medicinal Usage in the Kashmir Himalayas. Journal of Herbs, Spices & Medicinal Plants 1-19.

Raza MA, Younas M, Buerkert A, Schlecht E. 2014. Ethno-botanical remedies used by pastoralists for the treatment of livestock diseases in Cholistan desert, Pakistan. Journal of Ethnopharmacology 151(1):333-342.

Rehman MN, Ahmad M, Sultana S, Zafar M, Edwards S. 2017.Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. Revista Brasileira de Farmacognosia 27:751-775.

Renckens CNM. 2002. Alternative treatments in reproductive medicine: much ado about nothing: The fact that millions of people do not master arithmetic does not prove that two times two is anything else than four': WF Hermans. Human reproduction. 17(3):528-533.

Sargin SA. 2015. Ethnobotanical survey of medicinal plants in Bozyazı district of Mersin, Turkey. Journal of Ethnopharmacology 173:105-126.

Shah A, Rahim S. 2017.Ethnomedicinal uses of plants for the treatment of malaria in Soon Valley, Khushab, Pakistan. Journal of Ethnopharmacology 200:84-106.

Shah A, Sarvat R, Shoaib S, Ayodele AE, Nadeem M, Qureshi TM, Abbas A. 2018. An ethnobotanical survey of medicinal plants used for the treatment of snakebite and scorpion sting among the people of Namal valley, Mianwali district, Punjab, Pakistan. Applied Ecology and Environment Research 16(1):111-143.

Shah AH, Khan SM, Shah AH, Mehmood A, Rahman IU, Ahmad H. 2015.Cultural uses of plants among Basikhel tribe of district Tor Ghar, Khyber Pakhtunkhwa, Pakistan. Pakistan Journal of Botany 47:23-41.

Shah SA, Shah NA, Ullah S, Alam MM, Badshah H, Ullah S, Mumtaz AS. 2016. Documenting the indigenous knowledge on medicinal flora from communities residing near Swat River (Suvastu) and in high mountainous areas in Swat-Pakistan. Journal of Ethnopharmacology 182:67-79.

Sher H, Bussmann RW, Hart R, De Boer HJ. 2016. Traditional use of medicinal plants among Kalasha, Ismaeli and Sunni groups in Chitral District, Khyber Pakhtunkhwa province, Pakistan. Journal of Ethnopharmacology 188:57-69.

Sher H, Inamuddin I, Khan Z, Bussmann RW, Rahman IU. 2020. Medicinal plant diversity of Hindubaig Mountain, Lalku Valley, District Swat, Pakistan.Ethnobotany Research and Applications 20:1-13.

Sher Z, Khan Z, Hussain F. 2011.Ethnobotanical studies of some plants of Chagharzai valley, district Buner, Pakistan. Pakistan Journal of Botany 43(3):1445-1452.

Shinwari S, Ahmad M, Luo Y, Zaman W. 2017. Quantitative analyses of medicinal plants consumption among the inhabitants of Shangla-Kohistan areas in Northern-Pakistan. Pakistan Journal of Botany 49(2):725-734.

Shuaib M, Ahmed S, Ali K, Ilyas M, Hussain F, Urooj Z, Hussain F. 2019. Ethnobotanical and ecological assessment of plant resources at district dir, tehsil timergara, khyberpakhtunkhwa, Pakistan. Acta Ecologica Sinica 39(1):109-115.

Singh A, Nautiyal MA, Kunwar RM, Bussmann RW. 2017. Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India. Journal of Ethnobiology and Ethnomedicine 13(1):1-29.

Singh B, Singh B, Kishor A, Singh S, Bhat MN, Surmal O, Musarella CM. 2020. Exploring plant-based ethnomedicine and quantitative ethnopharmacology: Medicinal plants utilized by the population of Jasrota Hill in Western Himalaya. Sustainability 12(18):7526.

Sulaiman SS, Khan S, Bussmann RW, Ali M, Hussain D, Hussain W. 2020. Quantitative ethnobotanical study of indigenous knowledge on medicinal plants used by the tribal communities of Gokand Valley, District Buner, Khyber Pakhtunkhwa, Pakistan. Plants 9(8).

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany 62(1):24-39.

Tareen NM, Rehman MA, Shinwari ZK, Bibi T. 2016. Ethnomedicinal utilization of wild edible vegetables in district Harnai of Balochistan Province-Pakistan. Pakistan Journal of Botany 48(3):1159-1171.

Tariq A, Mussarat S, Adnan M, Abd_Allah EF, Hashem A, Alqarawi AA, Ullah R. 2015. Ethnomedicinal evaluation of medicinal plants used against gastrointestinal complaints. BioMed research international 2015.

Teklehaymanot T, Giday M. 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. Journal of Ethnobiology and Ethnomedicine 3(1):1-11.

Ullah A, Hassan N, Amin R, Khan A, Shi LIM. 2018. Quantitative ethnobotanical survey of medicinal plants used as remedy in Mera, District Charsadda, KP, Pakistan. Journal of Biology Environmental Science 12(5):163-173.

Ullah N, Siraj-Ud-Din, Bussmann RW, Jan HA, Wali S. 2021. A step towards the documentation of indigenous knowledge about the medicinal plants in mollagori: A tribal war affected area of Fata, Pakistan. Pakistan Journal of Botany 53(5):1779-1789.

Ullah S, Khan MR, Shah NA, Shah SA, Majid M, Farooq MA. 2014. Ethnomedicinal plant use value in the LakkiMarwat District of Pakistan. Journal of Ethnopharmacology158:412-422.

Ullah S, Muhammad N. 2018. Evaluation of informant consensus factor of medicinal plants used in Shamozai valley SWAT, KPK, Pakistan. Intertational Journal of Medicine Plant 4(2):1-7.

Umair M, Altaf M, Abbasi AM. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. PloSone 12(6):0177912.

Wali R, Khan MF, Mahmood A, Mahmood M, Qureshi R, Ahmad KS, Mashwani ZUR. 2022. Ethnomedicinal appraisal of plants used for the treatment of gastrointestinal complaints by tribal communities living in Diamir district, Western Himalayas, Pakistan. PloSone 17(6):0269445.

Wali S, Jan HA, Bussmann RW. 2019. Quantitative ethnomedicinal study of indigenous medicinal plants used for digestive disorders of Laspur Valley, Chitral, Northern Pakistan. Ethnobotany Research and Applications 18:1-18.

Wali S, Jan HA, Haq SM, Yaqoob U, Bussmann RW, Rahim F. 2021. The Traditional phyto-recipes used to cure various ailments by the local people of Shishi Koh valley, Chitral, Pakistan. Ethnobotany Research and Applications 22.

Yabesh JM, Prabhu S, Vijayakumar S. 2014. An ethnobotanical study of medicinal plants used by traditional healers in silent valley of Kerala, India. Journal of Ethnopharmacology 154(3):774-789.

Zahoor M, Yousaf Z, Aqsa T, Haroon M, Saleh N, Aftab A, Ramazan H. 2017. An ethnopharmacological evaluation of Navapind and ShahpurVirkanin district Sheikupura, Pakistan for their herbal medicines. Journal of Ethnobiology and Ethnomedicine 13(1):1-26.

Zheng XL, Xing FW. 2009. Ethnobotanical study on medicinal plants around Mt. Yinggeling, Hainan Island, china. Journal of Ethnopharmacology 124(2):197-210.