Exploring conservation status and ethnoveterinary uses of medicinal plants in Upper-Haramosh, Gilgit-Baltistan, Pakistan

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Research

Abstract

Background: Ethnoveterinary practices are declining, depleting valuable knowledge over time in the Haramosh region. Therefore, the current study aimed to explore and document indigenous knowledge regarding ethno-veterinary plants in Upper Haramosh and simultaneously assess their conservation status.

Methods: Direct interviews were conducted with shepherds, farmers, and senior citizens possessing traditional knowledge. Semi-structured questionnaires were also developed for collecting knowledge from inhabitants. The conservation status of the species was checked referring to IUCN red list data.

Results: The current study revealed ethno-veterinary uses for 25 plant species spanning 24 genera and 22 families. The Polygonaceae and Asteraceae families dominate, with three and two species, respectively. Seven common ailments were reported, with injuries having the highest plant frequency. The most common administration method was decoction, followed by powder, paste, and direct consumption. RFC values ranged from 0.3 - 0.9, with *Berberis orthobotrys, Geranium pratense, Punica granatum*, and *Zea mays* depicting the highest values. Use values ranged from 0.3 to 1, with the highest reported for *B. orthobotrys, G. pratense*, and *Z. mays*. Fidelity levels (%) for disease categories varied, with *B. orthobotrys*, *G. pratense, Juniperus excelsa, Juglans regia*, Saussurea Simpsoniana, Delphinium brunonianum, and P. granatum all demonstrating 100% fidelity for their reported disease types. Conservation status is Least Concern for all species except *D. brunonianum, S. simpsoniana*, and *Ephedra gerardiana*, which are classified as vulnerable according to IUCN Red List data.

Conclusions: The study underscores the area's potential for medicinal plants, emphasizing the need for phytochemical studies to further validate their efficacy.

Keywords: Ethno-veterinary, Indigenous Knowledge, Conservation Status, Pets, Medicinal Plants

Background

Ethno veterinary practice encompasses all practices, approaches, complementary tools, and efforts that have enabled humans to protect animals from illness and bring healing in order to increase animal production at a lower cost. For a long time, medicinal plants have been used in preventative and therapeutic capacities for both human and animal disorders (Adeniran et al. 2020). Investigations on ethno-veterinary medicine (EVM) are normally considered as a part of the community-based method that aids in improving animal well-being and offers essential animal healthcare facilities in remote areas (Khan et al. 2015). Still today, remote areas lack modern healthcare facilities for livestock, and people in mountainous areas rely on livestock to fulfill the maximum of their needs, particularly for agriculture production. About 70% of the world's population is reliant on their livestock and its yields. In rural areas of Pakistan, the chief contributors to livelihood are livestock and agriculture (Gul et al. 2019). People in rural areas prefer traditional medicine because of its efficiency, reduced cost, cultural influence, and unavailability of alternate contemporary drugs (Ahmad et al. 2021). This folk wisdom is a result of trials and errors by native people of particular areas and has been transferred from one generation to another by oral means (Gulzar et al. 2019).

Traditional knowledge has a vital role in disease identification and healthcare practices. Indigenous knowledge about medicinal plants has been vital for disease management, and it has led to the discovery of many life-saving medicines (Rahman et al. 2011). Research-based on indigenous knowledge is thought to be the right method to find novel anti-infective agents from higher plants (Chhetri et al. 2010). Plants have been used as drugs and for the treatment of disorders and diseases from ancient times (OS et al. 2019). Most phytochemicals in plants have anti-microbial activity and they act as anti-microbial agents against pathogens, such as bacteria, viruses, and fungi (Ps Manash et al. 2016). The plants' healing potential is due to their phytochemicals, which have antioxidant, antimicrobial, and antipyretic effects (Madhu et al. 2016). Many plants are still unexplored phytochemically, and further research is needed to explore the chemical compounds of the medicinal plants used in different parts of the world (Wadood et al. 2013).

In Pakistan, most of the livestock farmers are poor and possess 5-6 domesticated animals per family. They are unable to afford contemporary allopathic medicine because of financial restraints, which eventually results in poor livestock production as well as economic damages due to the poor health of animals. EVM is highly recommended as an alternative to contemporary drugs under such circumstances, which will aid in alleviating poverty by allowing people to efficiently use their resources for the management of their livestock (Sindhu et al. 2010). Several issues are prevailing in Pakistan which restrict the development of the livestock sector including policy-making concerns, rapid destruction of rangelands, unhealthy eating habits, underprivileged trading setups, shortage of extension facilities, and inadequate resources (Aziz et al. 2020).
The information about ethno veterinary medicine is transferred from generation to generation in a descending manner just like a continuous series up to the first predecessor. Modern civilization favors recent tools and modern discoveries of medication, so the ancient traditions are dwindling day by day. Owing to these reasons, most investigators and organizations attempt to conserve this delicate information in written form. Due to easy access and lowered cost, livestock owners in distant areas utilize EVM plants as first aid for their animals (Saeed et al. 2015).

Materials and Methods

Study area

The study was conducted in the upper Haramosh Valley, located at approximately 35°53'428" N, 074°44'892" E, at an elevation ranging from 1696 to 2105 meters above sea level (Fig. 1). Haramosh, situated north of the Indus River, features unique vegetation shaped by its diverse topography. Renowned for its medicinal plants and fruits, the valley lies 65km from Gilgit city en route to Skardu in the Baltistan region (Begum et al., 2019). The valley is home to over 1000 households distributed across approximately 12 villages. With its high alpine meadows, glacier deposits, snow-covered slopes, forest patches, and diverse climatic conditions, the area presents a unique potential for floral diversity. Additionally, the region is abundant in medicinal plants and fruits (Alam et al., 2022).

Though there are many villages in Upper Haramosh, but the main villages are Dasso and Barchi. These villages share the common pasture of Kutwal valley, a vital area for livestock grazing and rich in medicinal plants. Situated at a high altitude, Kutwal is renowned for its stunning scenery and features prominent landmarks such as Mani glacier (11km), Baska glacier (9km), Kutwal Lake, and Haramosh Peak (7409m). Ownership of the area rests with the people of Dasso and Barchi villages. Every June, villagers migrate with their livestock to Kutwal valley, returning to their homes by October or November. The region offers abundant pastures crucial for feeding cattle, goats, and sheep. The local language spoken by the residents is 'Shina,' widely used throughout the Gilgit-Baltistan region. Mountain communities here rear cows, goats, sheep, donkeys, and mules to meet their daily needs, relying heavily on indigenous plants (Ali et al., 2022). The area's main crops include wheat, maize, and potatoes, alongside various types of vegetables. Wood from juniper, pine, birch, mulberry, apricot, Russian olive, and other trees serves as the primary fuel source. Agriculture and livestock are the primary sources of income.

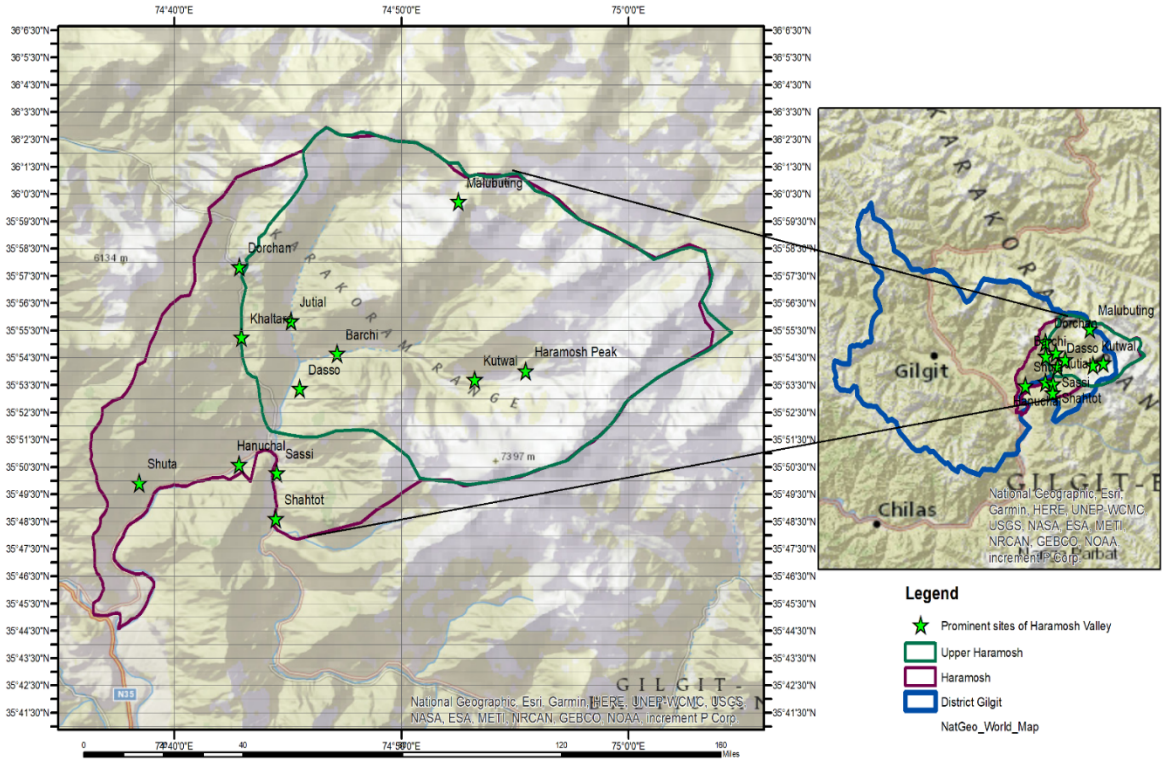

Figure 1. Map of upper Haramosh Valley, Gilgit-Baltistan, Pakistan.

Field surveys and data collection

The method described by (Berhanu et al. 2020, Hussain et al. 2023) was used to collect data. Briefly, field visits were conducted in Upper Haramosh (Dasso and Barchi villages). About 100 well-informed respondents from Upper Haramosh were intentionally selected for interviews. Information was gathered during July 2022 and June 2023. Information regarding ethno-veterinary plants was recorded by direct interviewing and through a semi-structured questionnaire. Interviews were taken in the Shina language, which is the native and commonly spoken language of the area. Knowledge was collected regarding the demographic features of the informants, vernacular names of plants being practiced in the area, plant parts used, modes of preparation, applying methods, and ailment types treated (Noor et al. 2014). Data related to availability and habitats was also collected. Plant specimens of the respective species were collected and verified by local people. The plant specimens were identified following the method mentioned in (Khan & Khatoon 2008, Noor et al. 2012) and deposited in the Herbarium of Karakoram International University, Gilgit.

Conservation status of medicinal plants

The Conservation status of ethnomedicinal plants was studied using IUCN criteria (version 3.1). This type comprised nine groups (Bano et al. 2013). The species were enumerated as Vulnerable and Least concerned as per criteria. The global conservation status of species was also checked by referring IUCN Red List data (https://www.iucnredlist.org).

Data Analysis

The primary data was tabulated in MS Excel 2013, and frequencies were calculated for each plant family. Comparisons were made by calculating relative percentages for habit, parts used, and disease categories. IBM SPSS 22 was used to calculate descriptive statistics like mean, standard deviation of UVs, and RFC values. The Pearson coefficient of correlation was calculated for RFC and UV values as done in (Bano et al. 2014).

Relative frequency of citation

This index indicates the local significance of each species, which is calculated by dividing the frequency of citation (FC) by the total number of informants (N) involved in the survey. It does not consider the specific use-categories mentioned by the informants.

$$RFC = Fc/N$$

where Fc = number of informants who mentioned the use of the species, and N = divided by the total number of informants (Adeniran et al. 2020, Bano et al. 2014)

Use values

Use values were calculated by using the formula given in (Batool et al. 2017, Shaheen et al. 2017) to find out the relative significance of medicinal plant species.

$$UV = \Sigma Ui/ni.$$

Where, Ui represents the count of uses mentioned by individual informants for a specific species, while ni represents the total number of informants.

Fidelity level percentage (FL %)

Fidelity Level Percentage shows the percentage of informants claiming the given plant for the same major disease (Ur et al. 2016). FL % was calculated following the method given in (Ch et al. 2013, Ur et al. 2016).

$$FL\% = Np/N\times 100,$$

where, Np = No. of respondents citing a plant species for a particular disease. And N = no. of respondents citing the plant for any disease.

Results

Demographics of the respondents and ethno-medicinal knowledge

A total of 100 respondents were interviewed, comprising 90% males and 10% females. Among them, 78% were illiterate, while 22% were literate. The respondents were divided into four age groups: 26 in the 20-40-year group, 34 in the 40-60-year range, 24 aged 60-80, and 16 aged 80 and above. The majority of participants were farmers and shepherds (58), followed by retired military personnel (10), government employees (8), businessmen (4), and 18 individuals in various other occupations such as teaching and masonry. All participants were engaged in livestock rearing and agriculture as their primary livelihood, relying heavily on local plants. They demonstrated adequate knowledge in these areas, with those over 40 exhibiting particularly strong understanding of medicinal plants and their applications. Individuals in this age group were also more knowledgeable about livestock diseases and management practices. The interviewees expressed a strong belief in the efficacy of these plants and frequently employed ethno-veterinary remedies. Overall, all respondents utilized medicinal plants as their primary means of managing livestock illnesses.

Reported plant taxa used for treating different ailments

A total of 25 plant species belonged to 22 families were being used in the area for veterinary purposes. Polygonaceae had the most (3 spp.), followed by Asteraceae with (2 spp.), and the remaining families had only (one species each) being used for veterinary purposes. Fig. 2 shows comparative number of species in each family for veterinary purposes. Scientific names, families, vernacular names, habit categories, parts of plant used, along with their medicinal usage has been described in the below (Table 1). The Scientific families have been arranged in alphabetical order.

Table 1. Detailed List of medicinal plants used for the treatment of livestock

					Wild				
S. No	**Botanical name**	**Family Name**	**Vernacular name**	**Habit**	**Part used**	**Medicinal uses**	**RFC**	**UV**	**Status**
1	*Bunium Persicum* L.	Apiaceae	Hayaoo	H	Seed	The decoction of seeds is used to treat constipation.	0.5	0.7	LC
2	*Sassurea simpsoniana* (Fielding and Gardener) Lipschitz	Asteraceae	Booshi fonar	H	Aerial part	The decoction of aerial part is given for treating general illness and cough.	0.7	0.8	Vu
3	*Artemisia absinthium* L.	Asteraceae	Kakamos	H	Aerial part	Powder of aerial part is made, and applied on injuries	0.6	0.6	LC
4	*Berberis orthobotrys* Bien. ex Aitch	Berberidaceae	Ishkeen	Sh.	Root	The powder of roots is used for internal pain, and also applied on external cuts and injuries.	0.9	1	LC
5	*Juniperus excelsa* M. Bieb.	Cupresaceae	Chilli	T	Leaves, Bark	The soft bark of the plant is used as bandages when animals get injured. While paste of leaves is applied on injuries and for pain relief. It is believed that the fume of leaves is effective for evil/diseases repulsion.	0.7	0.9	LC
6	*Ephedra gerardiana* Wall ex Stapf.	Ephedraceae	Soom	Sh.	Aerial part	The decoction of aerial parts is used for the treatment of diarrhea	0.3	0.4	Vu
7	*Euphorbia cornigera* Bioss.	Euphorbiaceae	Fotan	H	Milk of leaves	A milky liquid is secreted when the leaf is cut down and is very effective for Constipation. It is believed that the plant is highly reactive, so, excessive consumption should be prohibited.	0.7	0.4	LC
8	*Gentiana tianschanica* Rupr ex Kush.	Gentianaceae	Palamas	H	Aerial part	The Aerial part is either given directly or drink is used against Cough.	0.4	0.5	LC
9	*Geranium pratense* L.	Geraniaceae	korat kacho	H	Aerial part	The paste of aerial part is applied on cuts and injuries. The plant is very effective for the healing of external wounds.	0.9	1	LC
10	*Ribes alpestre* Decne.	Grossulariaceae	Shongloo	Sh.	Root	Both the paste and powder of roots is used on cuts and injuries.	0.4	0.4	LC
11	*Salvia nubicola* Wall ex Sweet.	Labiateae	Koropo	H	Aerial part	The drink of aerial parts is made and is used for swelling of feet.	0.3	0.2	LC
12	*Linum usitatissimum*L.	Linaceae	Homan	H	Aerial part	When a female animal is in pregnancy, the aerial part is given directly to the animal, as it helps easiness in pregnancy.	0.4	0.2	LC
13	*Trigonella foenum graecum* L.	Papalionaceae	Ishkar kooch	H	Aerial part	The powder of aerial part is made and is applied on cuts and Injuries.	0.5	0.6	LC
14	*Rheum emodi* Wall	Polygonaceae	Jaro chotal	H	Aerial part	The aerial part of the plant is given to livestock and is considered as a tonic for physical weakness.	0.6	0.5	LC

15	*Rheum webbianum* Royle.	Polygonaceae	Chotal	H	Aerial part	The aerial part is considered as tonic for weakness, so, this is either given to cattle or they directly consumed in the wild.	0.6	0.5	LC
16	*Aconocogon turtuosum* D (Don).	Polygonaceae	Shayni	H	Seed	The decoction of seeds is served for constipation.	0.4	0.4	LC
17	*Delphinium brunonianum* Royle.	Ranunculaceae	Makhoti	H	Aerial part	The drink of aerial part is administered to treat Cough.	0.7	0.7	Vu
18	*Bergenia stracheyi Hook & Thomson.*	Saxifragraceae	Sapsar	H	Root	The powder of roots is given to animals for treating Diarrhea and also applied on injuries.	0.4	0.8	LC
19	*Daphne mucronata Royle.*	Thymelaceae	Nirkoo	Sh.	Leaves	The paste of leaves is applied on cuts and injuries, while drink of leaves is used as anti-toxin and for constipation.	0.4	0.5	LC
20	*Urtica dioca L.*	Urticaceae	Jami	H	Root	The root paste is applied on external injuries and wounds.	0.3	0.3	LC
					Cultivated				
21	*Lepidium sativum* L.	Brassicaceae	Zaachik	H	Seed	The decoction of seeds is used for Digestive purposes.	0.6	0.5	cultivated
22	*Juglans regia* L.	Juglandaceae	Acho	T	Leaves	The drink of leaves is used as anti-toxin, especially when any animal consumes toxic substance or a poisonous plant.	0.6	0.7	cultivated
23	*Zea mays* L.	Poaceae	Makai	H	Aerial part, Grains	The aerial part is used as fodder and grains as Tonic in winter. It is normally given to the livestock individuals which are very weak.	0.8	1	cultivated
24	*Punica granatum* L.	Punicaceae	Dano	T	Fruit peels	Peels of the fruit are dried and grinded, and then decoction is made, and administered to the livestock.	0.8	0.9	cultivated
25	*Salix denticulata* Andersson.	Salicaceae	Braow (chitti)	T	Leaves	The drink of leaves is used for inflammation as well as diarrhea.	0.3	0.3	cultivated

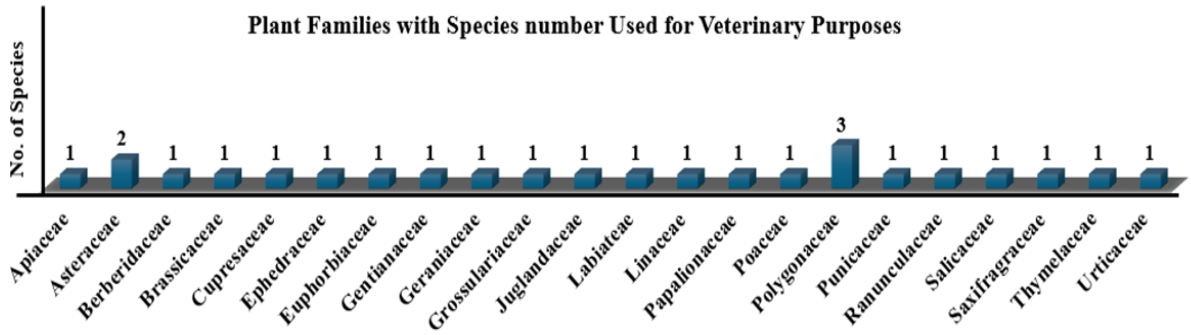

Figure 2. List of major plant families for veterinary purposes in upper Haramosh Valley, Gilgit-Baltistan, Pakistan.

Plant habits and frequency of parts used

Out of 25 plant species used, 17 (68%) are herbs, 4 (16 %) are shrubs and 4 (16%) are trees as shown in Fig. 3A. The highest frequency of plant parts usage is aerial parts (44%), followed by leaves (18%), roots (15%), seeds (15%), bark (4%), and fruit peels (4%) respectively (Fig. 3B).

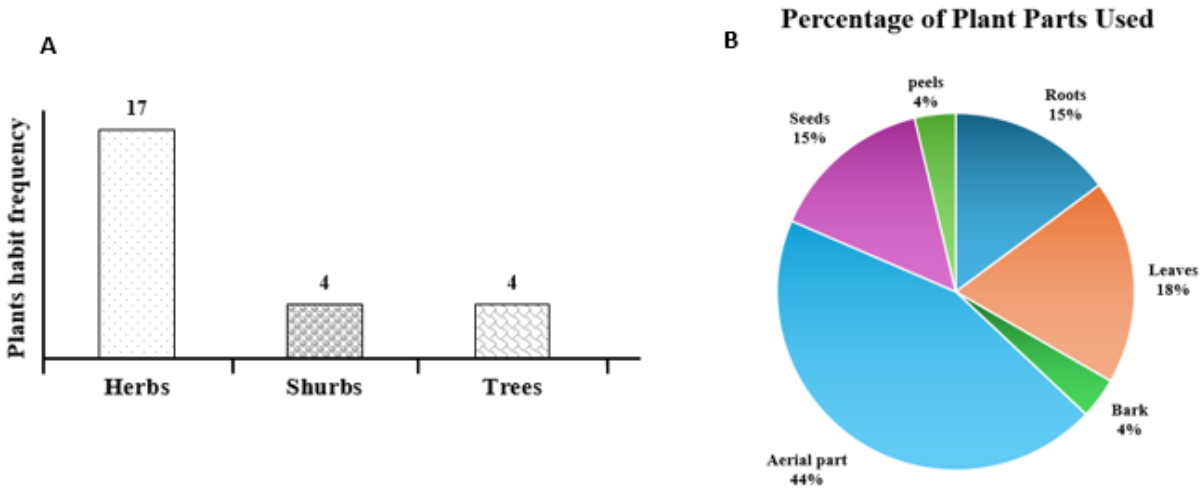

Figure 3. (A) Different Plant Habit Categories. (B) comparative frequency of plant parts used in upper Haramosh Valley, Gilgit-Baltistan, Pakistan.

Diseases Categories and frequency of plant species used

Various ailments are treated by the reported species. Among 25 species reported in the present study 18 species are used for a single disease, while the rest 7 species are used for two or more than two diseases (Fig. 4). The frequency of plants for injuries is (7) which is highest, followed by cough (4 species), constipation (4), weakness (3), diarrhea (3), evil repulsion (2), inflammation (2), illness (1), and as anti-poison (1).

Relative frequency of citation (RFC) and Use Values (UVs)

To reveal the importance of species, RFC values of individual species was calculated. The results depicted that the RFC values ranged from 0.3-0.9. *Geranium pratense* and *Berberis orthobotrys* showed the highest RFC with a value of (0.9) each, followed by *Punica granatum* and *Zea mays* (0.8) each Table (1). *Delphinium brunonianum*, *Saussurea simpsoniana*, *and Euphorbia cornigera* with values of (0.7) each, and *Artemisia absinthium* (0.6), while the least value was depicted by *Daphne mucronata* and *Urtica dioca* with values of (0.3).

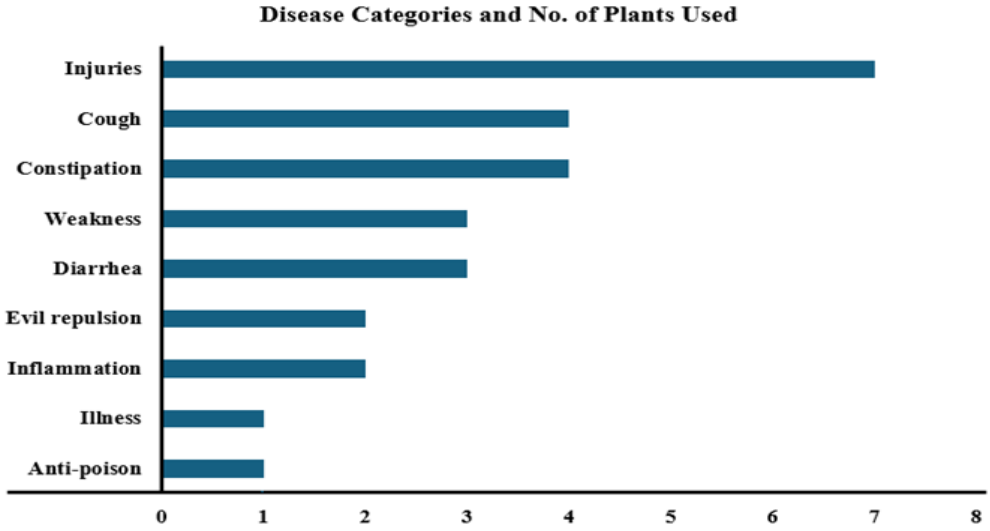

Figure 4. Number of species used for different ailment categories in upper Haramosh Valley, Gilgit-Baltistan, Pakistan.

Table 2. Pearson correlation coefficient between RFC and UV

Correlations			
		RFC	UV
RFC	Pearson Correlation	1	0.815**
	Sig. (2-tailed)		0.000
	n	25	25
UV	Pearson Correlation	0.815**	1
	Sig. (2-tailed)	0.000	
	n	25	25

** Correlation is significant at the 0.01 level (2-tailed)

The use values of the species ranged from 0.2 to 1. *B. orthobotrys, G. pratense*, and *Z. mays* had the highest use value (1), followed by *Juniperus excelsa* and *P. granatum* with use value of (0.9), *Bergenia stracheyi and S. simpsoniana* with use value of (0.8), and use values of about 13 species fall in between 0.4 to 0.7 while the lowest values were obtained for U. *dioca* and *S. denticulata* (0.3), and *Salvia nubicola* and *Linum usitatissimum* with use values of 0.2 (table 1). The correlation coefficients between two variables, RFC and UV were tested. In this case, the correlation coefficient between RFC and UV is .815. This indicates a strong positive correlation between the two variables. The sample size for both variables is reported as *n*=25, indicating that the correlation analysis was conducted based on a dataset with 25 observations for each variable. The p-value associated with the correlation coefficient is reported as .000, which is less than the conventional threshold of .01. This correlation provides the evidence of a high positive significant association between the local importance of each species and relative importance of the use of plants.

Percent fidelity level of reported species

A total of seven disease categories were identified in the present survey. For Constipation, the highest fidelity level (97%) was exhibited by *Euphorbia cornigera*, followed by *Bunium persicum* (91%), *Daphne mucronata* (70%), whereas, the least value (62%) was calculated for *Aconogonon turtuosum*. For general illness, only a single species (*Saussurea simpsoniana*) was used, and it had a fidelity level of 50%. However, for cough related problems, *S. simpsoniana*, *D. brunonianum*, and *P. granatum* all had shown a fidelity level of 100%, indicating that the species are very effective for the mentioned disease, while *Gentiana tianschanica* had shown a fidelity level of 40%. The highest No. of species (7 spp.) were used to deal with external injuries and wounds, *Berberis orthobotrys* and Geranium pratense had the highest frequency of (100%), followed by *Bergenia stracheyi*, *Trigonella foenum graceum*, and *Juniperus excelsa* (95%) each, *Ribes alpestre* (90%) and the least value (70%) was shown by *Artemisia absinthium*. *Ephedra gerardiana* showed the highest value (80%) for Diarrhea, followed by *B. stracheyi* (70%), and *Salix denticulata* (65%). *Zea mays* was the leading specie to be used as tonic, followed by Rheum *emodi* (80%), and *R. webbianum* (75%). *S. denticulata* was used for inflammation and has showed a fidelity level of 50%. *Juglans*

regia with a fidelity level of 100% was practiced as an effective anti-toxin for livestock. *J. excelsa* with a fidelity level of 100% was practiced as a cultural plant with the belief that fume of the plant can repel evils and diseases.

Table 3. Fidelity levels of plant species for different diseases

Disease category	**Species name**	**FL%**
Constipation	*A. turtuosum*	62%
Constipation	*B. persicum*	91%
Constipation	*D. mucronata*	70%
Constipation	*E. cornigera*	97%
Illness	*S. Simpsoniana*	50%
Cough	*D. brunonianum*	100%
Cough	*G. tianschanica*	40%
Cough	*P. granatum*	100%
Cough	*S. Simpsoniana*	100%
Injuries	*A. absinthium*	70%
Injuries	*B. orthobotrys*	100%
Injuries	*B. stracheyi*	95%
Injuries	*G. pratense*	100%
Injuries	*J. excelsa*	95%
Injuries	*R. alpestre*	90%
Injuries	*T. foenumgraceum*	95%
Diarrhea	*B. stracheyi*	70%
Diarrhea	*E. gerardiana*	80%
Diarrhea	*S. denticulata*	65%
weakness	*R. emodi*	80%
weakness	*R. webbianum*	75%
weakness	*Z. mays*	100%
Inflammation	*S. denticulata*	50%
Anti-poison/Tonic	*J. regia*	100%
Evil repulsion	*J. excelsa*	100%

Conservation status of medicinal plants

Out of total 25 species, 5 (20%) were cultivated species, and 20 (80%) were wild. Conservation status of the cultivated species was not evaluated, because they are not found in the wild of the study area. The conservation status of wild species was checked, and the results revealed that 3 (12%) medicinal plants namely *S. simpsoniana*, *D. brunonianum*, and *E. gerardiana* were vulnerable in the study area, as their population trend is declining due to overharvesting, grazing, and natural hazards. While the rest 17 (68%) species were Least Concerned (Fig. 7), as they are frequent and abundantly found in the study area. However, the threats faced by these species are grazing, overexploitation and natural hazards. Figure 5 represent some important medicinal plants used for veterinary purpose in Upper-Haramosh.

Geranium pretense Saussurea simpsoniana Bergenia stracheyi

Figure 5. Some important medicinal plants used for veterinary purposes in Upper-Haramosh.

Discussion

Ethnoveterinary practices play a big role in Pakistan, particularly in the most remote regions of the country (Aziz et al. 2020). The present study area (Upper Haramosh) is one of the remotest regions in Gilgit-Baltistan Pakistan, and lacks modern facilities and infrastructure. The remoteness of the area integrating with the inaccessible topography strictly limits access to contemporary veterinary knowledge and healthcare facilities. Therefore, people rely on traditional approaches to heal their animals (Isaac & Olabisi 2022). Although, most of the times people also use Tetracycline and Penicillin, when an animal gets ill, but natural remedies are preferred for managing veterinary ailments. This indigenous treatment offers a substitute as well as low-cost cure to rural dwellers (Gul et al. 2019). The groups involved in the present study were traditionally rural. Consequently, the farmers were relatively rich in information about a variety of ethnoveterinary plants for animal well-being and production. We observed during surveys that the local shepherds and farmers were well-familiar with the symptomatic diagnosis of diseases in different livestock categories like goats, sheep, cows, mules, donkeys, and horses. Also, they designated the plant species that can be used in the controlling of such illness conditions (Adeniran et al. 2020).

So far, very few studies have been done in the Gilgit-Baltistan region regarding ethnoveterinary practices. An ethnoveterinary survey in this regard was necessary to record and preserve the nearly diminished folk wisdom of the communities. In this study, we recorded the plant-based ethnoveterinary remedies being practiced from ancient times. (Abbas et al. 2013) reported 27 species from Naltar Valley for ethnoveterinary uses, (Khan et al. 2015) reported 13 species from the Deosai plateau for their veterinary uses. Similarly, the findings of this research revealed that 24 plant species belonging to 20 families were being used for treating animal ailments in Dasso and Barchi villages of Upper Haramosh. Polygonaceae family was dominant for ethno-veterinary uses similar to that in (K. U. Khan et al. 2015, Muhammad et al. 2021). The reason why Polygonaceae contributed the most no. of species might be due to the high medicinal potential that exists in the plants of this family. Asteraceae was ranked 2nd, as is the most dominant plant family in Haramosh Valley (Abbas et al. 2014) In comparison with the plants reported by (Gul et al. 2019), we found that a few species like *B. orthobotrys, P. granatum, T. foenum-graecum, B persicum* were reported in both studies for veterinary purposes but with slightly different uses. The overall similarity was low, as the difference might be due to the nature of diseases occurring in the area, and the difference in folk knowledge transferred from generation to generation. Ethnoveterinary practices differ from place to place and is determined by the cultural differences, customs of the folks as well as the vegetative characteristics of that specific place. (Adeniran et al. 2020) They reported various species for their veterinary uses; although the disease categories were almost similar but the species reported in that study were quite different. This shows that a huge difference exists in cultural, climatic and topographic conditions of their study area and the present study area. Unlike other studies, injuries were the highest disease category as it can be attributed to the rugged topography of the area, natural hazards and wildlife predation (Snow Leopard and wolf). Conservation studies of medicinal plants have been less studied in the region of Gilgit-Baltistan. The present study examined the conservation status of about 20 medicinal plants in the study area and found *D. brunonianum*, *S. simpsoniana*, and *E. gerardiana* as vulnerable species, which were overharvested due to their high medicinal values, and in addition to that they were having grazing pressure, as well as natural hazards are posing a great threat to the species. The rest of the 17 species also face similar pressures but they are relatively abundant in the study area. Numerous studies like (Abbas, et al. 2014, S. W. Khan et al., 2018, Shedayi & Gulshan 2012, Bano et al. 2014) have attributed the anthropogenic activities, unsustainable harvesting techniques, grazing and climate changes as major threats to the plants.

Usually, different plant parts like roots, bark, wood, leaves, stem, flowers, fruit, juice, resin, latex, grains, buds, bulbs and seeds are used in EVM practices. But the administration of dosage is not standardized yet. In fact, the practitioners and farmers choose the dosage method in according with the disease severity and size of the animal (Sindhu et al. 2010). Practice of leaves for medication has a lesser effect on the survival of the plants in their natural habitation. But the utilization of roots for therapeutics would be lethal and can cause loss or extinction of the plants from their natural habitat and also can be destructive (Abebe 2022). However, we found in the present study that roots of only a few species like Bergenia, Berberis, Ribes and Urtica were practiced for veterinary ailments. The roots of *B.* orthobotrys and *B. stracheyi* were overexploited as compared to *R. alpestre* and *U. dioca*. In this study, we observed that in case of injuries the local people had their own ways to cure the animals. Local experts and shepherds apply powder of *Berberis* spp., or paste of *Geranium* spp. on the wound and tie the fractured part with a bandage, and monitor with time to time. In case of constipation, a very unique local plant *Euphorbia cornigera* is used. It is believed that this plant is highly reactive, and whenever an organism even smells this plant can suffer from diarrhea. So, therefore the plant is only used when an organism suffers from constipation. But in the case of diarrhea, Salix and Ephedra are preferred. For cough cases, the peel of *P. granatum* is used as a decoction. In the present study, different statistical indices were employed to elucidate the relative importance of ethnobotanical important plants such as Use value (UV) is an index widely used to quantify the relative importance of useful plants. It combines the frequency of species mentions with the number of uses attributed to each species. It is commonly employed to identify important species and highlight their significance. This approach is particularly useful in determining which plants are most valued by a specific group of individuals, assessing the potential uses of a plant, and gauging the level of knowledge about it within the group. The Pearson correlation coefficient between RFC and UV was 0.815, which showed a highly positive correlation similar to that of (Bano et al., 2014) with a correlation value of 0.732 in their study. For RFC, the mean value was obtained as .552 and the standard deviation is 0.1896, which indicates the average amount of variability or dispersion of the values of RFC around the mean. For the variable UV, the mean was calculated as 0.592, and the standard deviation was 0.2482, indicating that the values of UV tend to vary by approximately 0.2482 from the mean.

Relative frequency of citation (RFC) values ranges from 0.3 to 0.9. The highly cited plant species G. pratense and *B. orthobotrys* showed the highest RFC with a value of (0.9), followed by P. granatum and Z. mays (0.8), *D. brunonianum, S. simpsoniana*, and *E. cornigera* with values of (0.7) each, and Artemisia absinthium (0.6). Higher relative frequency citations of these species elucidate the truths that the mentioned plants species are well familiar to the number of traditional drivers. Medicinal plants having the highest RFC values should be further assessed through pharmacognostic approaches (Majid et al. 2019, Bahadur et al. 2020). Plant species with the lowest RFC values were *L. usitatissimum* and *B. stracheyi* (0.4) each, followed by *D. mucronata* and *U. dioca* (0.3) each. The species with lower RFC values can't be ignored, as these species also offer an assessment so that scientific validation may be done to develop novel drugs. The fidelity level is a crucial factor that identifies medicinal plants with the greatest curative properties, as they exhibit the highest fidelity level of 100%. This measure is employed to identify the most preferred species used in treating specific ailments, considering that multiple plant species may be used for treating the same category of ailments. A higher fidelity level indicates a greater frequency of using a particular plant species for treating a specific ailment category, as reported by the informants. The recent findings demonstrate a fidelity level range spanning from 30% to 100%. The species with highest FL (100%) were *S. simpsoniana, D. brunonianum, P. granatum, B. orthobotrys, G. pratense, J. regia, and J. excelsa* indicating that the species are very effective for the mentioned disease.

As, traditional medicine contains of a big part of precious practical knowledge, and a combination of the healing principles and usage of resources including herbs, animal parts and non-living materials as therapeutic tools. Several drugs have been discovered based on folk knowledge about medicinal plants (Mirzaee et al. 2017). However, the knowledge of EVM in the study area is now vanishing rapidly because dwellers are shifting their practices due to the hasty socio-economic, environmental as well as technological changes coupled with the dearth of attention by younger groups, spiritual practices and lack of documentation (Isaac & Olabisi 2022). Thus, the preservation of this knowledge is necessary for future generations for the disease management of livestock. It is emphasized that the true healing potency of the Ethnoveterinary medicine information can only be understood and validated when experimental studies would be conducted in the study area and on breeds of livestock (F. M. Khan 2009). Exploration of phytochemicals of medicinal plants is vital to explore their efficacy, as only traditional knowledge without scientific validation fails to elucidate and resolve the issues related to diseases and their treatment. In conclusion of the present study, traditional knowledge is still practiced in the remote villages of Upper Haramosh for the treatment of livestock. The primary needs are met by natural resources and the basic source of income is livestock and agriculture. The areas still lack modern facilities, and the majority are herders and farmers. The local people of the area rear pets like cattle, goats, sheep, and donkeys to fulfill their basic needs. However, traditional medicine is preferred over modern medication for managing ailments in pets. The folks have valuable knowledge regarding ethnoveterinary

medicine, which might be helpful in discovering efficient drugs. The prevailing threats for the medicinal flora were overexploitation, overgrazing, and habitat shifting of species due to climatic changes. Exploration of active components is highly recommended to further reveal their importance of documented plant species. Conservation of these species for future generations and their sustainable usage is also highly recommended to prevent the loss of valuable plants. Moreover, to safeguard the medicinal plants essential for ethnoveterinary practices, we recommend the implementation of community-based conservation projects, such as establishing community-managed herbal gardens and organizing educational workshops on sustainable harvesting techniques. Additionally, collaboration between local authorities and traditional healers can lead to the development of regulations that support the sustainable use of natural resources while protecting vulnerable species. By promoting sustainable harvesting techniques and establishing protected areas for vulnerable species, both local residents and the government can contribute to the preservation of biodiversity while ensuring the continuation of traditional healing practices.

Conclusion

The study has provided significant insights into the region's flora and the traditional knowledge of local communities. The Indigenous practices continue to play a vital role in managing animal ailments, even in this modern era. Our study identified a range of medicinal plants that are integral to the ethnoveterinary practices of the area, emphasizing their crucial role to sustain the health of livestock and supporting local livelihoods. The documentation of these plants and their uses highlights the rich cultural heritage and traditional knowledge systems that have been preserved over generations. However, our findings also reveal a concerning trend: some of these valuable plant species are facing threats from overharvesting, habitat destruction, and climate change. The conservation status of several key species is precarious, therefore demands an immediate attention to ensure their sustainability. By fostering a collaborative approach among researchers, policymakers, and local communities, we can ensure the long-term sustainability of these vital natural resources, thereby protecting both biodiversity and cultural heritage for future generations.

Declarations

List of abbreviations: RFC- Relative frequency of citation; UV- Use values; FL- Fidelity level; EVM- Ethnoveterinary medicine; IUCN- International Union for Conservation of Nature; N –Number; Vu- Vulnerable; LC- Least Concerned

Ethics approval and consent to participate: Before conducting interviews, explicit oral consent was obtained from each participant. The study adheres to the Nagoya Protocol under the Convention on Biological Diversity, ensuring fair and equitable benefit sharing.

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