Documentation of ethnoveterinary knowledge: Harnessing potential phytotherapy in high mountainous areas of Paddar, District Kishtwar (India)

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Research

Abstract

Background: Most people and livestock producers in rural India continue to rely on traditional medicine for health-care practices. The aim of the present study was to document important plant species employed by the people of Paddar to treat livestock ailments.

Methods: Reconnaissance surveys were conducted in Paddar from April 2020 to September 2021. A total of 65 informants (37 men and 28 women) were interviewed during the period. Ethnoveterinary data was collected employing semi-structured interviews and participatory observations. The data were analyzed using frequency of citation (FC) and Informant consensus factor (FIC).

Results: In total, 43 plant species were used to treat 11 livestock diseases. Herbs were the leading growth forms and leaves were the most used parts used for the treatment purposes. Powder form was the main herbal preparation, and the oral route was the main administration mode. *Aucklandia costus, Skimmia laureola*, *Picrorhiza kurroa*, *Rumex nepalensis*, and *Betula utilis* were the frequently cited plant species. The FIC value for disease categories ranged from 0.93 to 1. Fourteen plant species were used to treat gastrointestinal disorders.

Conclusion: The present study is conducted for the first time in the region. Novel uses were reported for *Achillea millefolium*, *Berberis lycium*, *Ototropis elegans, Desmostachya bipinnata*, *Lablab purpureus, Rheum webbianum,* and *Aucklandia costus.* These species should be the focus of phytochemical and pharmacological investigation, which might lead to the creation of more effective veterinary drugs.

Key words: Livestock disease, Traditional knowledge, Plant resources, Paddar, Jammu and Kashmir

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Background

Ethnoveterinary medicine emphasizes traditional animal health care and includes peoples' knowledge, methods, skills, practices, and beliefs concerning animal health care (McCorkle 1986). Research in this field is frequently conducted as part of a community-based strategy to improve animal health and provide basic veterinary health care in rural regions (Van der Merwe *et al.* 2001; McGaw & Eloff 2008). Ethnoveterinary procedures are influenced by the community or ethnic group and cultural traditions (Teka *et al.* 2020; Xiong & Long 2020). Because of its safety, efficacy, and affordability, rural communities are adopting plant-based traditional healing practices (Balamurugan *et al.* 2019). Growing scientific data demonstrates that combining ethnic knowledge with new scientific discoveries can provide socially acceptable and environment friendly strategies crucial to the sustainable growth of local communities (Ayeni & Basiri 2018). Researchers throughout the world have documented ethnoveterinary data on medicinal plants. Several studies have reported that the pastoralists and farmers in countries such as China, Nepal, Pakistan, Bangladesh and Eastern Ethiopia widely employ medicinal plants to safeguard livestock health (Shen *et al.* 2010; Malla & Chhetri 2012; Pakistan; Ali *et al.* 2019; Harun-or-Rashid *et al.* 2010; Feyera *et al.* 2017). The use of plants as ethnoveterinary medicine is frequent in the Himalayan region since livestock rearing is an important source of livelihood (Lans *et al.* 2007; Abbasi *et al.* 2013; Dar *et al.* 2018; Ali *et al.* 2019; Dhakal *et al.* 2021). Furthermore, traditional herbal remedies provide effective and affordable therapies and widespread accessibility compared to western allopathic medicines (Ganesan *et al.* 2008). Several previous studies have revealed pastoralists and farmers in India use plant species to safeguard livestock health (Ganesan *et al.* 2008; Veena *et al.* 2009; Phondani *et al.* 2010; Maiti *et al.* 2013; Pushpangadan *et al.* 2016; Ahmad *et al.* 2017; Radha *et al.* 2020; Dutta *et al.* 2021; Hassan *et al.* 2022).

Plants have long been used to treat diseases in the Indian subcontinent (Jaiswal *et al.* 2016). Ayurveda contains several references to animal ailments and their treatments (Rastogi & Kaphle 2011). The Vedas, Brahmanas, Puranas, and Epics of ancient India include a wealth of wisdom about animal care, disease cure and health management (Upadhyay *et al.* 2011). Furthermore, in the Indian agricultural system, animal husbandry plays an important role in the rural economy by generating income and employment opportunities for small-scale farmers and other vulnerable groups in addition to the rural transportation, fuel, milk and meat (Verma 2014). Most people especially in rural India, still rely on their own traditional therapies in case of illness (Devi Prasad *et al.* 2014). This traditional knowledge is gained through several years of experience and passed down verbally from generation to generation. However, this traditional knowledge is being lost due to rapid cultural changes and industrialization (Radha & Pundir 2019). As a result, there is an urgent need for scientific documentation of traditional information from India's rural areas (Mathias 2006).

The residents of Jammu and Kashmir, a hilly state in the Western Himalayas in India, rely primarily on traditional ethnoveterinary expertise to cure livestock diseases (Sharma *et al.* 2012). Several ethnoveterinary studies have been conducted in Jammu and Kashmir (Khuroo *et al.* 2007; Sharma *et al.* 2012; Khateeb *et al.* 2015; Sharma & Manhas 2015; Dar *et al.* 2018; Dutta *et al.* 2021). However, ethnoveterinary plants of Paddar, Jammu and Kashmir have not been explored due to its remoteness, harsh climatic conditions, and rough terrain. The rapid migration of the younger generation to cities for higher education and career prospects is causing a loss of local traditional knowledge. In this framework, it is imperative to perform extensive field surveys in unexplored regions to document ethnoveterinary knowledge. The objective of the present study was to document important plant species employed by the people of Paddar to treat livestock ailments.

Material and Methods

Study area

Paddar is located in the southeastern region of District Kishtwar, between 33˚15'10"N to 33˚30'10"N and 76˚02'10"E, with an elevation of 1500 to 4500 meters above mean sea level (Fig. 1) (Singh *et al.* 2021). It borders Zanskar (Ladakh) in the north and east, Pangi (Himachal Pradesh) in the south and the rest of Jammu and Kashmir in the west. It covers 55,152 hectares and is divided into two Tehsils (administrative divisions), i.e., Atholi and Machail. Paddar has a total population of 21,548 people and a literacy rate of 47.3% (Census of India 2011). It is well-known for its sapphire mining. Paddar is home to a diverse range of herbs, shrubs, and trees due to its diverse topography and micro-climatic conditions. Coniferous forests are the dominant forest type in the region. The average temperature in Paddar is between 20˚C and 27˚C from July to September during the day and 5˚C to 10˚C at night. During the winter, the valley receives heavy snowfall, and the average temperature decreases from -2˚C to -10˚C (Singh *et al.* 2021).

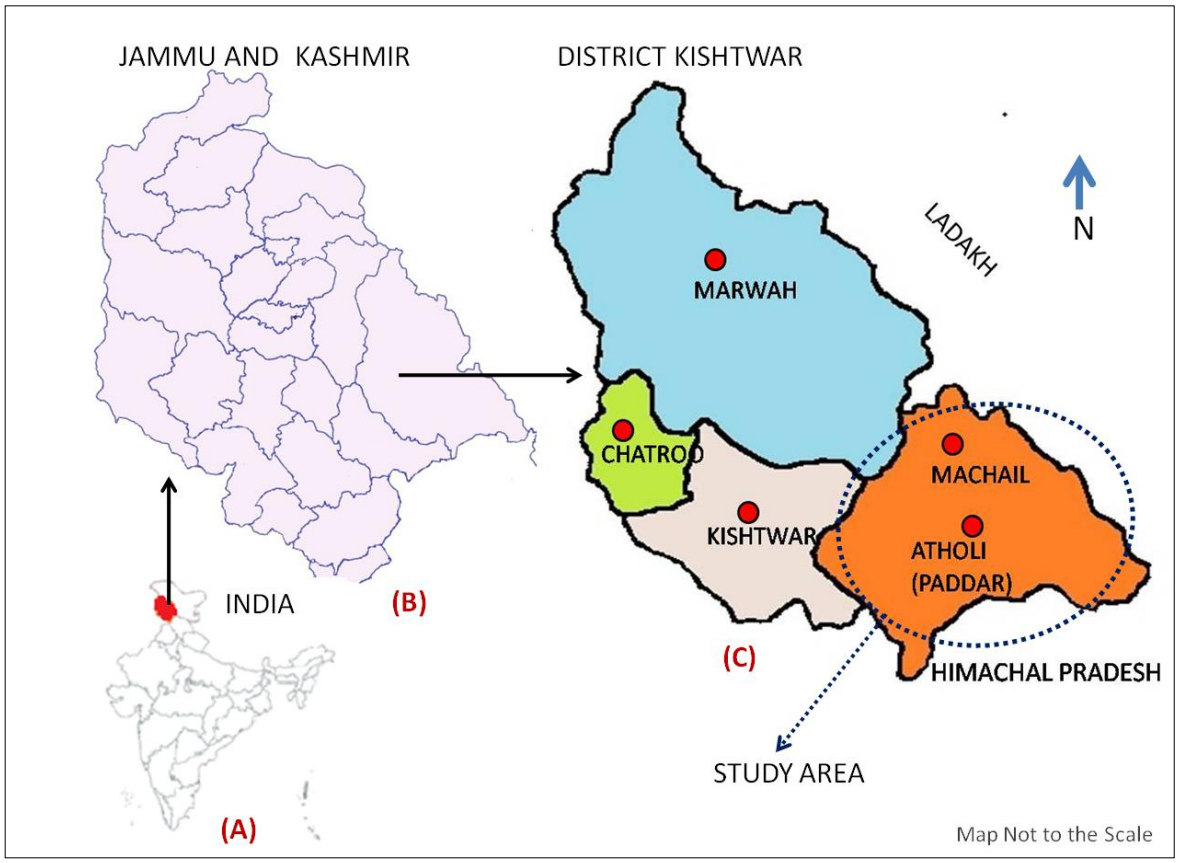

Figure 1. Location of the Paddar in Kishtwar District of Jammu and Kashmir.

The local inhabitants are known as '*Paddari*,' and speak the '*Paddari*' dialect. The principal occupations of the people of the study area are agriculture and animal husbandry. Most of Paddar's livestock owners migrate to transient summer settlements at higher altitudes. Shepherds and local villagers form two key collaborative structures known locally as ***Kajaar*** and ***Asniyal. Kajaars*** are temporary shelters that house cattle, sheep, goats and horses whilst ***Asniyals*** are temporary house-like structures to accommodate shepherds and villages. The animals such as sheep, goats, cows and buffalos, provide meat, milk and dairy products for rural people in the study area. Furthermore, livestock is sold during event of an economic crisis

Data collection

For the current study, twenty-six field surveys were conducted in rural and remote places from April 2020 to September 2021. The surveyed villages include Kundal, Affani, Atholi, Layee, Gulabgarh, Jar, Ladar, Ligri, Mati, Sohal, Kundal, Machail and Haloti. The total number of respondents interviewed in the current study was 65 (37 male and 28 female) and the individuals were in the age range between 21 to 80 years (average 47) (Table 1). The objectives of the current study were clearly stated to the participants, and Prior Informed Consent (PIC) was obtained from all of them as per guidelines set forth by the Convention on Biological Diversity (CBD). We strictly adhered to the Code of Ethics by 'Ethical standards International Society of Ethnobiology' (2006) for the present research. During the interview, informant's age and educational backgrounds were recorded to know the area's demographic profile. To collect ethnoveterinary information from the informants, semi-structured interviews were conducted. The informants were also questioned about the mode of preparation and the routes of administration of the herbal preparation. Field observations were conducted with the assistance of local guides and some local informants in the study area (Fig. 2).

The plant species were collected and identified using regional floras (Sharma & Kachroo 1981; Kapur & Sarin 1990; Sharma & Jamwal 1988; Sharma 2010; Chopra & Vishwakarma 2018). Photographs of some of the ethnoveterinary plant species are presented in Fig. 3. Furthermore, verification of the plant's species is done by comparison with the herbarium samples housed in the Janaki Ammal Herbarium Jammu (acronym RRLH) (Thiers 2020). Plant specimens were collected and prepared according to Jain & Rao (1977) protocols before being submitted to the internationally recognized Janaki Ammal Herbarium (RRLH) at Council for Scientific and Industrial Research- Indian

Institute of Integrative Medicine (CSIR-IIIM), Jammu. The currently accepted botanical names of the reported species were confirmed using World Flora Online (2022).

Table 1. Demographic details of the informants in the study area.

Variables	Category of informants	Number of Informants	Percentage (%)
Gender	Male	37	57
	Female	28	43
Age group	21-40	20	27
	41-60	30	40
	61-80	15	20
Educational level	Illiterate	22	29
	1st-5th class	24	32
	6th-10th class	10	13
	11th-12th class	4	5
	Above 12th class	5	7
Occupation	Farmers	25	33
	Shepherds	30	40
	Govt. Employees	10	13

Figure 2. (A) Photograph of the study area (B) Field survey and collection of ethnoveterinary information from the informants.

Data analysis

Frequency of citation

The primary data was examined using Use Reports (URs). UR denotes the citation of a single plant or plant part by a single informant. For the frequency of citations, the total citations or UR for a species were summed together (FC) (Khajuria *et al.* 2021).

Informant consensus factor (FIC)

Informant Consensus Factor (FIC) was calculated to measure the homogeneity of acquired knowledge about the use of a plant to treat a certain condition using the formula proposed by Trotter & Logan (1986)

$$\mathrm{FIC} = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

Where N_{ur} is the number of used report in each category; N_t is the number of plant species used. The high FIC values imply that there is strong agreement on the use of specific plants for a specific illness category (Heinrich *et al.* 1998). Furthermore, the index focuses on the cultural compatibility of a group of plants used to treat a specific disease category (Heinrich *et al.* 2009).

Results and Discussion

Diversity of the ethnoveterinary plants

The current study reported 43 medicinal plants belonging to 23 families (Fig. 3-4, Table 2), that were used for treating 11 livestock ailments categories. Asteraceae and Fabaceae were the dominant families and contributed 6 species each, followed by Apiaceae (4 species), Caprifoliaceae, Caryophyllaceae, Lamiaceae, Plantaginaceae, Poaceae, Polygonaceae, Ranunculaceae (3 species each). The remaining 12 families were represented by one species each.

Figure 3. Photographs of some of the ethnoveterinary plants of the study area: (A) *Aucklandia costus* (B) *Picrorhiza kurroa* (C) *Betula utilis*; (D) *Cichorium intybus* (E) *Bergenia ciliata* (F) *Ototropis elegans* (G) *Artemisia maritima* (H) *Rheum webbianum* (I) *Bunium persicum* (J) *Taraxacum campylodes* (K) *Geranium wallichianum* (L) *Mentha longifolia* (M) *Aquilegia vulgaris* (N) *Aconitum heterophyllum* (O) *Dipsacus inermis* (P) *Silene vulgaris.*

The widespread usage of plants belonging to Asteraceae and Fabaceae families in the study area suggests that the families have a vast distribution in the region or that the plant species are widely recognized for their therapeutic benefits. Previous studies in the Indian Himalayan region (Bhat *et al.* 2021; Khajuria *et al.* 2021) and other parts of the world (Pieroni *et al.* 2006; Tufail *et al.* 2020; Bhandari *et al.* 2021) have also reported the dominant use of these families in ethnomedicine. Barboza *et al.* (2007) termed use of folk medicines to cure animals disorders by treating similar or identical human conditions as "human models for animal diseases''. From this perspective, the close affinity between ethnoveterinary and human ethnomedicine is easily explained because the principal stock animals such as sheep, cattle, goats, horses etc. are mammals and have similar health issues and symptoms to humans (Confessor *et al.* 2009). According to Huffman (2003), this scenario reflects the fact that ethnoveterinary approaches and human ethnomedicine have evolved along two different paths: one rooted in observations of animal self-medication and the other on traditional human folk remedies.

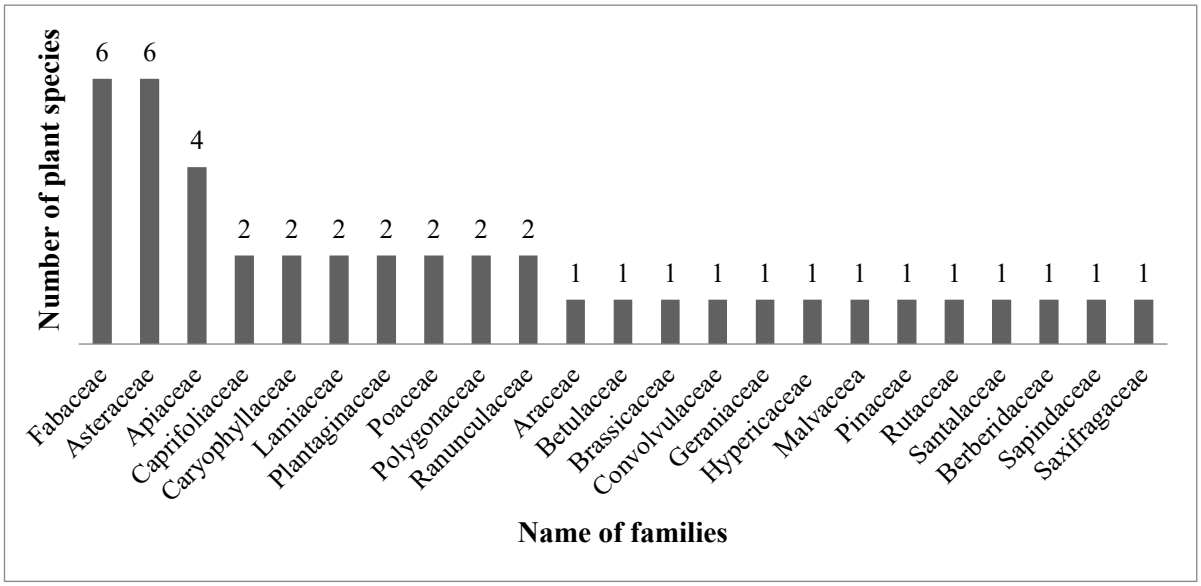

Figure 4. Contribution of the plant families in ethnoveterinary medicine.

Habit, Habitat and Source

Of the various life-forms, the most frequently used were herbs with 82% contribution followed by shrubs and trees (9% each) (Fig. 5). This agrees with the findings of earlier studies in J&K and other Himalayan regions (Sharma *et al.* 2012; Reang *et al.* 2016; Dar *et al.* 2018; Khan *et al.* 2021). The ethnoveterinary plants in the present study area thrive in different altitudinal ranges and grow luxuriantly in the temperate forests to alpine regions. The source of ethnoveterinary plants used in the present study was mainly wild (86%). The remaining plant species (14%) are the commonly cultivated. These results are similar to those reported in earlier ethnoveterinary investigations in J&K and other parts of Western Himalaya (Sharma *et al.* 2015; Prakash et al. 2021; Hassan *et al.* 2022). According to Ganie *et al.* (2019), harvesting of plant species from the wild puts tremendous pressure on forest resources. Thus conservation measures should be implemented to ensure sustainable resource use.

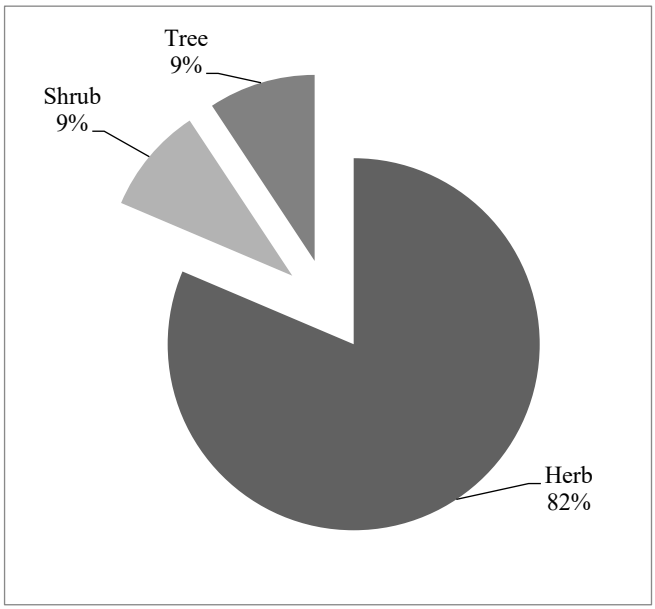

Figure 5. Habit of the ethnoveterinary plants.

Plant part used, mode of preparation and administration

Leaves were the most used parts (40%) followed by root (25%), stem (15%), seeds (8%), whole plant (4%), aerial parts (4% each), bark and flowers (2% each) (Fig. 6). The use of these plant parts has been reported previously in several other studies in India (Upadhyay *et al.* 2011;Usha *et al.* 2016; Venugopalan *et al.* 2012; Kalpna *et al.* 2021) and other parts of the world (Alemneh 2021; Shoaib *et al.* 2020). The prominence of leaves may be attributed to their ease of collection, or the several metabolites produced in the leaves during photosynthetic activity (Tariq *et*

al. 2014). Furthermore, the usage of leaves poses no threat to the survival of these plant species (Sharma *et al.* 2012). For ethnoveterinary uses, the local people of Paddar prepared different herbal formulations, including powder, raw, paste, and oil (Table 2). Similar use of such formulations for ethnoveterinary purposes has been reported from J&K (Khateeb *et al.* 2015; Dutta *et al.* 2022; Hassan *et al.* 2022), and other Himalayan regions (Ali *et al.* 2019; Prakash *et al.* 2021).

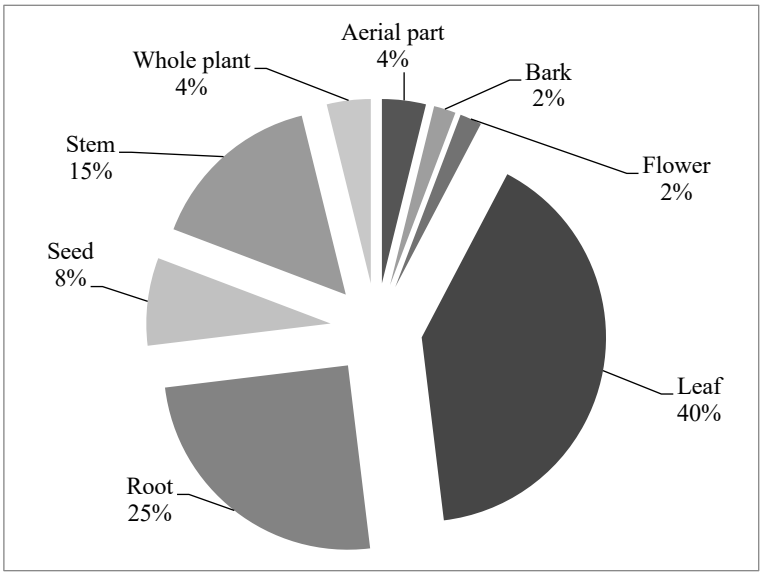

Figure 6. Plant parts used in ethnoveterinary medicine.

In the present study, the most common mode of administration is oral application (73%). A similar mode of administration was documented in previous ethnoveterinary studies from J&K (Sharma *et al.* 2013; Sharma and Manhas 2015; Dutta *et al.* 2021) and other Indian Himalayan regions (Khadda *et al.* 2018; Kalpna *et al.* 2021). In neighboring countries such as Nepal, China, and Pakistan, the oral application of herbal formulations in ethnoveterinary medicine is common (Raut and Shrestha 2012; Xiong and Long 2021; Rehman *et al.* 2022).

Frequency of citations

The present study reported 758 use-reports (UR) for the plant species used in ethnoveterinary practices. The most frequently cited species was *Aucklandia costus* (FC51) for treating cough followed by *Skimmia laureola* (cold and gastrointestinal, FC41), *Picrorhiza kurroa* (gastrointestinal; FC38), *Rumex nepalensis* (gastrointestinal and inflammation; FC36), *Betula utilis* (injuries; FC32), *Aesculus indica* (gastrointestinal and general health issues; FC26), *Rheum webbianum* (inflammatory; FC25), *Angelica glauca* (cold, cough and gastrointestinal; FC23), *Aconitum heterophyllum* (gastrointestinal; FC22). The high FC values highlight the cultural importance of the plant species (Namukobe *et al.* 2011). The high use values for these species are in line with the earlier studies conducted in Western Himalaya (Khan *et al.* 2015; Khan *et al.* 2021; Dutta *et al.* 2021).

Informant consensus factor

The ailments were grouped into 11 categories based on the information provided by the informants (Table 3). The maximum plant species (14 species; 32.5%) were used to cure gastrointestinal disorders followed by dermatological disorders (8), lactation (8), general health issues (7), cold and cough (4), and inflammatory (3) (Table 3). Maximum species used to treat gastrointestinal problems indicate that the incidences of such diseases among livestock were relatively high in the study area. Utilization of high number plant species to treat gastrointestinal issues in livestock has also been reported previously from J&K (Khateeb *et al.* 2015; Dutta *et al.* 2021) and the neighboring country Pakistan (Shoaib *et al.* 2020). Poor sanitation practices followed by the inhabitants in closed environments responsible for gastrointestinal disorders (Sharma *et al.* 2012; Xiong & Long 2020). The plant species used to treat gastrointestinal problems in the livestock includes *Aconitum heterophyllum, Aesculus indica, Angelica glauca Artemisia maritima, Bergenia ciliata, Bunium persicum, Coriandrum sativum, Malva neglecta, Picrorhiza kurroa, Rumex nepalensis, Skimmia laureola, Stellaria media* and *Cichorium intybus.* The FIC value ranges for these disease categories ranged from 0.93 to 1 (Table 3).

Table 2. Ethnoveterinary uses of the plants used in Paddar, District Kishtwar(India).

Family Plant species/Voucher Number	**Vernacular name**	**Part used**	**Form of consumption**	**Route of Administration**	**Habit**	**Status**	**Altitudinal range in the study area**	**Threat status**	**Ethnoveterinary use**	**Frequency of Citation (FC)**	**Similar ethnoveterinary uses reported in previous studies**
Apiaceae *Angelica glauca* Edgew./26786	Chaura	Root	Powder	Oral	Herb	Wild	2400-3600	EN	Dried root powder is orally given to sheep to treat cold, cough (13) and acidity (10).	23	Khateeb *et al.* 2015; Phondani *et al.* 2010
Bunium persicum B. Fedtsch /26794	Zeera	Seed	Powder	Oral	Herb	Wild	1700-2200	NE	Dried seed powder is mixed with sodium chloride salt and given to lambs and baby goats to treat diarrhea (17).	17	Pande *et al.* 2007
Coriandrum sativum L./26795	Dhadiyan	Leaf	Paste	Oral	Herb	Cultivated	1700-2300	NE	Fresh leaf paste mixed with salt is given to calves to treat flatulence (10).	10	Pande *et al.* 2007
Trachyspermum ammi Sprague/26823	Ajwain	Seed	Powder	Oral	Herb	Wild	180-2100	NE	The seed powder is mixed with sugar and given to lambs and baby goats to treat stomach pain (14).	14	Sharma *et al.* 2012
Araceae *Arisaema jacquemontii* Blume/26788	Jyajbooti	Root	Paste	Topical	Herb	Wild	2300-2600	LC	Fresh leaf paste is applied on the skin of cows and buffalos to treat snake bite (12).	12	Dutta *et al.* 2021; Rahman *et al.* 2020
Asteraceae *Achillea millefolium* L./26783/Asteraceae	Ghanand	Root	Powder	Oral	Herb	Wild	2300-3200	LC	Root powder is mixed with *Prunus armeniaca* (Khurmani) seed powder along with 'gud' and given orally to sheep and goats to treat cold and cough (14).	14	Not reported
Artemisia maritima Kitag./26789	Sesam	Leaf	Powder	Oral	Herb	Wild	1800-2400	NE	Leaf powder along with Gud (Jaggery) is given to young goats and sheep for stomach pain (21).	21	Pande *et al.* 2007
Cichorium intybus L./26822	Haand	Root	Paste	Oral	Herb	Wild	1700-2300	NE	Root paste is used to treat diarrhea in Goats (16).	16	Wani *et al.* 2021
Aucklandia costus (Falc.) Syn *Saussurea costus* (Falc.) Lipsch./ 26813	Kuth	Root	Powder	Oral	Herb	Wild	2800-3500	CR	The dried root powder is mixed with milk and consumed for treating cough in humans, cattle, sheep, and goats (51)	51	Not reported
Sonchus asper (L.) Hill/26816	Dodhyil	Leaf, Stem	Raw	Topical	Herb	Wild	1800-2300	NE	Fresh stem is crushed to paste form and applied on the affected part of the skin to treat rashes* (11).	11	Not reported

Taraxacum campylodes G.E.Haglund/26817	Chipad	Leaf	Powder	Oral	Herb	Wild	1600-1900	NE	Dried root powder is mixed with jaggery and is given to lambs and baby goats to strengthen their bones (16).	16	Khateeb *et al.* 2015
Berberidaceae *Berberis lycium* Royle/26791	Keemal	Leaf	Drop	Topical	Shrub	Wild	1800-2400	LC	The leaves are crushed and squeezed. The drop of the extract obtained put into the eye of livestock for curing eye allergy (22)	22	Not reported
Betulaceae *Betula utilis* D. Don/26792	Bhuj	Bark	Raw	Topical	Tree	Wild	2400-2800	LC	Bark is wrapped around the injured part for fast healing (32).	32	Bharti & Sharma 2012; Phondani *et al.* 2010
Brassicaceae *Brassica juncea* (L.) Czern./26793	Shariyun	Seed oil	Oil	Topical	Herb	Cultivated	1600-2300	NE	Oil is rubbed on the skin of cattle's to get rid of the ticks and lice (Pediculosis) (7).	7	Khateeb *et al.* 2015
Caprifoliaceae *Dipsacus inermis*Wall./26799	Leaf	Stem, Leaf	Raw	Oral	Herb	Wild	1650-2300	NE	Fresh leaves and stem are given to cows and buffalos and acts as galactagogue (24).	21	Mir *et al.* 2014
Nardostachys jatamansi (D.Don) DC./26804	Bhootcassi	Rhizome	Powder	Oral	Herb	Wild	3200-4500	CR	Dried root powder is given to cows and ox to treat epilepsy (13).	13	Pushpangadan *et al.* 2016
Caryophyllaceae *Silene vulgaris* (Moench) Garcke/26814	Takid	Leaf, Root	Paste	Oral	Herb	Wild	2100-2700	LC	Semi solid paste of dried rhizome and wheat flour is given to goats and cows to increase milk production (6)	6	Khuroo *et al.* 2007
Stellaria media (L.) Vill./26820	Losud	Aerial part, Leaf	Powder	Oral, Topical	Herb	Wild	1600-3200	NE	Dried powder of aerial part is given to treat stomach problems (5)* while leaf paste is used to treat skin burn caused by frost or burning (13)*	18	Not reported
Convolvulaceae *Cuscuta reflexa* Roxb./26796	Lehynd	Whole plant	Powder	Oral	Herb	Wild	1600-2300	LC	Dried plant powder is given to Cow and Mare for easy placental detachment (7).	7	Veena *et al.* 2009
Fabaceae *Ototropis elegans* (DC.) H. Ohashi & K. Ohashi Syn /26797	Kelar	Leaf	Raw	Oral	Shrub	Wild	1900-2700	LC	Fresh leaves are given to sheep and goat for increased milk production (15).	15	Not reported
Lablab purpureus (L.) Sweet/26801	Kulath	Leaf, Stem	Raw	Oral	Herb	Cultivated	1700-2800	NE	Dried leaves and stem are given to cows for increased lactation (17).	17	Not reported
Phaseolus vulgaris L.26806	Rajmah	Leaf, Stem	Raw	Oral	Herb	Cultivated	1700-2300	LC	Dried aerial part of the plant is cut into small pieces and given to calves to promote their good health (13).	13	Not reported

Vigna mungo (L.) Hepper/26807	Maash	Leaf, Stem	Raw	Oral	Herb	Cultivated	1700-2300	NE	Dried aerial part of the plant is cut into small pieces and given to calves to promote their good health (17).	17	Not reported
Trifolium repens L./26818	Ghaas	Aerial part	Raw	Oral	Herb	Wild	1750-2200	NE	The aerial parts of the plant are given to cattle's to increase the lactation (9).	9	Ahmad *et al.* 2017
Fagaceae *Quercus baloot* Griff./26810	Yirr	Leaf	Raw	Oral	Tree	Wild	1900-2500	LC	Tender leaves of the plant are given to sheep's and goats fodder to increase milk production (16).	16	Not reported
Geraniaceae *Geranium wallichianum* D. Don ex Sweet/26821	Phyud	Root	Paste	Topical	Herb	Wild	2200-3500	LC	Root paste is used to treat broken horns (12).	12	Pande *et al.* 2007
Hypericaceae *Hypericum perforatum* L./26800	Basant	Root	Powder	Topical	Shrub	Wild	1600-2000	NE	The powder of dried roots powder is mixed with mustard oil and applied on skin allergy in cattle's and buffalo (9).	9	Radha *et al.* 2020
Lamiaceae *Mentha longifolia* (L.) L./26803	Muhandi	Leaf	Paste	Topical	Herb	Wild	1600-2300	LC	Fresh leaf paste is applied on the skin of cows and horses to prevent skin infection* (9).	9	Not reported
Thymus serphyllum L./24013	Thasur	Flower	Powder	Topical	Herb	Wild	2400-3100	NE	The fresh flowers are crushed and mixed with water. The filtrate is used to treat eye infection* (9)	9	Not reported
Malvaceae *Malva neglecta* Wallr./26802	Sochal	Leaf	Powder	Oral	Herb	Wild	1600-2500	NE	Dried leaf powder is given to cattle's to treat swelling (3) and diarrhea (7).	10	Sofi *et al.* 2019; Dutta *et al.* 2021
Pinaceae *Cedrus deodara* (Roxb. ex D. Don) G. Don/26620	Deodar	Wood oil	Oil	Topical	Tree	Wild	1900-2450	LC	Wood oil is applied to the skin of horses, cows and buffalos to prevent tick infestation (Pediculosis) (14).	14	Khateeb *et al.* 2015; Phondani *et al.* 2010; Prakash *et al.* 2021
Plantaginaceae *Picrorhiza kurroa* Royle ex Benth./26808	Kaur	Root	Powder	Oral	Herb	Wild	2800-3700	EN	Dried root powder of *Picrorhiza kurroa*is used to treat stomach problems in cattle's (38).	38	Khateeb *et al.* 2015
Plantago lanceolata L./26809	Gull	Leaf	Paste	Oral	Herb	Wild	1600-2300	NE	Fresh root paste is applied to treat skin allergy in cattle's* (10).	10	Not reported
Poaceae *Desmostachya bipinnata* (L.) Stapf/26798	Neela	Leaf, Stem	Raw	Oral	Herb	Wild	1700-2400	LC	The aerial part of the plant in fresh or dry form is given to ox as energy booster (9),	21	Not reported

									and as galactagogue in cows (12).		
Oryza sativa L./26805	Dhaan	Leaf, Stem	Raw	Oral	Herb	Cultivated	1800-2300	NE	Dried aerial part is given to promote good health of ox (16).	16	Not reported
Polygonaceae *Rheum webbianaum* Royle/26811	Panchalad	Leaf	Raw	Topical	Herb	Wild	2600-4000	NE	Leaf along with cow urine applied on injured part to treat swelling (like iodex) (25).	25	Not reported
Rumex nepalensis Spreng./26812	Ajobal	Root	Powder	Oral	Herb	Wild	1600-2700	NE	Roots powder mixed with goat milk and boiled and given to sheep in case of foaming from mouth of cattle's (12) and to treat swelling in cattle's (24).	36	Not reported
Ranunculaceae *Aconitum heterophyllum* Wall. ex Royle/26784	Patees	Root	Powder	Oral	Herb	Wild	2400-3500	EN	Root powder is given to the Sheep, Goats, Cows, Buffalo, and Ox to treat stomach pain (22).	22	Bisht *et al.* 2006; Malik *et al.* 2015
Aquilegia vulgaris L./26787	Dhoodjad	Whole plant	Powder	Oral	Herb	Wild	1800-2500	NE	Dried whole plant powder is given to young sheep and goats to treat weakness (9).	9	Mir *et al.* 2014
Rutaceae *Skimmia laureola* (DC.) Decne/26815	Shangyil	Leaf	Powder	Oral	Herb	Wild	2400-2700	NE	Dried leaf powder is mixed with sodium chloride (common salt) to treat cold in cattle's (22) and flatulence in goats (19).	41	Dutta *et al.* 2021
Santalaceae *Viscum album* L./26819	Mushrood	Leaf	Raw	Oral	Shrub	Wild	1600-2100	NE	Fresh leaves are given to cattle for increased milk production (17).	17	Not reported
Sapindaceae *Aesculus indica* Wall ex. Cambess./26785	Gugtaak	Seed	Powder	Oral	Tree	Wild	1900-2600	LC	Seeds are given to horses in colic pain (15) as well as improve power (11).	26	Phondani *et al.* 2010; Khan *et al.* 2021
Saxifragaceae *Bergenia ciliata* (Haw.) Sternb./26790	Shipatri	Rhizome	Powder	Oral	Herb	Wild	2100-3200	LC	Crushed to powder form and mixed with wheat flour, boiled in water and then given to cow, goat and sheep for curing diarrhea (16).	16	Bharti & Sharma 2012; Radha *et al.* 2020

Abbreviations: CR-Critically Endangered, EN-Endangered, LC- Least Concern, NE-Not Evaluated

Table 3. Informant consensus factor (FIC) for the veterinary diseases.

Ailment categories	Nt	Nur	Nur-Nt	Nur-1	FIC
Cold, cough	3	49	46	48	0.96
Dermatological	8	73	65	72	0.90
Epilepsy	1	13	12	12	1.00
Galactagogue	8	113	105	112	0.94
Gastrointestinal	13	206	193	205	0.94
General health	7	91	84	90	0.93
Inflammatory	3	52	49	51	0.96
Injuries	2	44	42	43	0.98
Ophthalmic	1	9	8	8	1.00
Poisoning	1	12	11	11	1.00
Reproductive	2	15	13	14	0.93

The informants agreed more for curing epilepsy, poisoning, and reproductive issues (FIC=1 each), injuries (FIC=0.98), ophthalmic (FIC=0.97), cold and cough (FIC=0.97), inflammatory (FIC =0.96), gastrointestinal (FIC=0.94), lactation issues (FIC=0.94). The species used in the treatment of epilepsy, poisoning, and reproductive issues were *Nardostachys jatamansi, Arisaema flavum* and *Cuscuta reflexa* respectively. Previous research studies conducted in other regions also agreed on a high level of local consent for traditional animal therapies related to reproductive, gastrointestinal, and galactagogue disorders (Parthiban *et al.* 2015; Sharma *et al.* 2015; Ali-Shtayeh *et al.* 2016; Aziz *et al.* 2018). According to Heinrich et al. (1998), high FIC values are important for identifying plants of particular interest in the quest for bioactive compounds.

Comparative assessment with previous regional studies

The novelty and originality of the informants claim was assessed by comparing these with the earlier research in the Indian Himalayan region, other parts of India, and adjacent nations. The literature review revealed similarities (Table 2) and differences (Table 4) in the usage of the reported plants species for ethnoveterinary practices.

The present study reported using *Aucklandia costus* roots in treating cough in cattle, sheep, and goats (Table 2). However, the villagers in Tamil Nadu use the roots of *A. costus* in combination with fruits of *Phyllanthus emblica*, and roots of *Withania somnifera* to treat infertility in cows (Ganesan *et al.* 2008). In China, people use the whole plant of *A. costus* to treat fever, colds and heat in livestock (Shen *et al.* 2010). According to the informants, the dried leaf powder of *Skimmea laureola* treats cold in goats and flatulence in cattle. Earlier research from J&K reported the application of *S. laureola* leaf in treating pyrexia and anemia in sheep and goats, and root paste in treating fracture in cattle (Table 4). In Pakistan, the leaves of *S. laureola* are used to treat lung infection in cattle (Shoaib *et al.* 2020). The present study reported the usage of *Picrorhiza kurroa* root powder to treat gastrointestinal issues in cattle. Traditional herbal healers on the other hand in Uttarakhand use the dried roots of *P. kurroa* to cure Foot and Mouth disease in livestock (Phondani *et al.* 2010). The rhizome and leaves of *P. kurroa* are used by the nomadic shepherds in Himachal Pradesh and J&K to treat cold, cough, food poisoning, and body ache (Table 4). In the present study area, the root powder of *Rumex nepalensis* is administered orally to the cattle to treat gastrointestinal and inflammatory issues. In contrast, this plant species root paste and powder is employed in treating cough and weakness to avoid juvenile infection in the calf (Table 4). In the neighboring country Nepal, the roots of *R. nepalensis* are employed as an antidote to cattle poisoning (Malla & Chhetri 2012). On the contrary, the rural inhabitants in Muzaffarabad, Pakistan, use *R. nepalensis* to cure malarial fever, hepatitis, red urination, and dysuria in cattle (Ahmed & Murtaza 2015).

According to the study, the bark of *Betula utilis* is used to treat injuries in Paddar. Locals in Uttarakhand, on the other hand, employ the seeds of this species to get rid of stomach worms while in Nepal, the bark of *B. utitlis* is used to heal sprains and internal pain in animals (Table 4). The local people use *Aesculus indica* seeds to relieve colic pain and muscle strength in horses (Table 2). In contrast, locals in Kashmir Himalaya use *A. indica* fruit powder mixed with water to heal skin fissures and cracks in cattle (Table 4). On the other hand, fresh leaves of the plant are fed to animals in Central Nepal to rid them of intestinal parasites (Table 4). The leaves of *Rheum webbianum* are crushed with urine and applied to damaged parts of cattle, goats, and sheep in Paddar to cure swelling. On the other hand, in Kashmir Himalaya, rhizome powder of this plant is used to heal wounds and scabies, and rhizome decoction is used to treat mumps in sheep (Table 4). The present research study reported the use of *Aconitum heterophyllum* roots in treating stomach pain in sheep, goats, cows, buffalo, and oxen. However, this plant has been used to cure fever, intestinal worms, dysentery, and diarrhea in animals in Uttarakhand (Pande *et al.* 2007). The difference in use patterns might be due to cultural and biological differences as well as geographic separation of the regions (Gairola *et al.* 2014; Haq *et al.* 2022).

Table 4**.** Comparison of the ethnoveterinary uses of the reported plant species with the previous studies.

Name of species	**Part used**	**Usage form**	**Region, State/Union Territory**	**Ethnoveterinary uses**	**References**
Achillea millefolium L.	Root	Powder	Poonch, Jammu and Kashmir (J&K)	Snakebite	Dutta *et al.* 2021
	Whole plant	Powder	Kinnaur, Himachal Pradesh (HP)	Skin allergy, wound healing and sunburn	Radha *et al.* 2020
	Aerial part	Paste	Kashmir Himalaya	Anthelmintic	Dar *et al.* 2018
Aconitum heterophyllum Wall. ex Royle	Root	Powder	Doda, J&K	Dysentery, cough,	Khateeb *et al.* 2015
	Root	Powder	Pakistan	Flu and fever	Shoaib *et al.* 2020
Aesculus indica (Wall. ex. Cambess.) Hook.	Fruit	Decoction	Kashmir Himalaya, Pakistan	As a tonic and indigestion in horses	Khan *et al.* 2021
	Leaf	Whole leaf	Central Nepal	Anthelmintic	Acharya & Acharya 2010
	Fruit	Powder	Kashmir Himalaya	Heal skin fissures and cracks in cattle	Beigh *et al.* 2004
Angelica glauca Edgew.	Root	Powder	Doda, J&K	Tympany or bloating in cattle, buffalo, goats Acidity in Oxen, Horse, Mule	Khateeb *et al.* 2015 Phondani *et al.* 2010
	-	-	Uttarakhand	Internal injuries, anorexia, and loss of appetite in animals	Pande *et al.* 2007
Arisaema jacquemontii Blume	Root	Powder	Poonch, J&K	Snakebite and pyrexia in cattle	Dutta *et al.* 2021
Artemisia maritima Kitag.	-	-	Uttarakhand	Loss of appetite, indigestion and sun stroke	Pande *et al.* 2007
Berberis lycium Royle	Stem bark	Powder	Poonch, J&K	Maggots in wounds	Dutta *et al.* 2021
	Root bark	Powder and Decoction	Shimla, HP	Bone fractures, wounds and stomach infection	Prakash *et al.* 2021
	Root	Decoction	Doda, J&K	Jaundice	Khateeb *et al.* 2015
Bergenia ciliata (Haw.) Sternb.	Root and leaf	Paste	Doda, J&K	Wound healing	Khateeb *et al.* 2015
	-	-	Uttarakhand	Lactation, intestinal worms, mastitis, hematuria, hydrophobia	Pande *et al.* 2007
	Root	Extract	Sikkim	Diarrhea and dysentery in cattle	Bharti and Sharma 2012
	Rhizome, leaves and flowers	Powder	Kinnaur, HP	Cough, food poisoning, dysentery, diarrhea, skin diseases, lactation	Radha *et al.* 2020
	Root, leaf	Paste	Shimla, HP	Wound	Prakash *et al.* 2021
Betula utilis D. Don	Seed	-	Uttarakhand	Protection from worms	Kumari *et al.* 2009
	Bark	-	Jumla, Nepal	Heal sprains and internal pain in animals	Gyawali & Paudel 2017

Brassica juncea (L.) Czern.	Flower	Oil	Doda, J&K	Massaged on yolk gall to get relief Internal parasites	Khateeb *et al.* 2015 Pande *et al.* 2007
Bunium persicum B. Fedtsch.	Seed	Powder	Uttarakhand	Internal injuries, cough, dysentery, painful outgrowth below tongue, wounds, cuts, alimentary disorders	Pande *et al.* 2007
	Seed	Powder	Pakistan	Mixed with wheat flour to treat Mastitis	Amber *et al.* 2018
Cedrus deodara (Roxb. ex D. Don) G. Don	Stem	Oil	Doda, J&K	Pleuritis in cows	Khateeb *et al.* 2015
	-	-	Uttarakhand	Hoof and skin disease, external parasites, scabies, broken horns	Pande *et al.* 2007
	Stem	Oil	Uttarakhand	Skin disease in Sheep, Goat	Phondani *et al.* 2010
Cichorium intybus L.	Leaf	Paste	Shimla, HP	Urinary disorders and hematuria in Goats	Khadda *et al.* 2018
Coriandrum sativum L.	-	-	Uttarakhand	Indigestion, constipation, fever, chickenpox, hematuria, tympany, giddiness	Pande *et al.* 2007
Cuscuta reflexa Roxb.	-	-	Uttarakhand	Bone fracture,	Pande *et al.* 2007
	-	-	Madhya Pradesh (MP)	Uterine prolapse	Veena *et al.* 2009
	-	-	Satna, MP	Skin diseases	Gautam *et al.* 2015
	Stem	Powder	Kashmir Himalaya	As astringent in lambs and calves	Dar *et al.* 2018
Desmostachya bipinnata (L.) Stapf	Root	Extract	Solan, HP	Prolapse of uterus	Kalpna *et al.* 2021
	Aerial part	Mixed with feed	Central Punjab, Pakistan	Dysentery and digestive disorders	Harun *et al.* 2017
*Dipsacus inermis*Wall.	Leaf	Decoction	Kupwara, J&K	Good health after delivery and enhance their milk production in cows, sheep's, and goats	Mir *et al.* 2014
Geranium wallichianum D.Don	Root	Paste	Poonch, J&K Kashmir Himalaya	Directly used as galactagogue and pyrexia Inflammation of hoofs, warts and abscissions	Dutta *et al.* 2021 Khuroo *et al.* 2007
	Root	Cooked	Neelum Valley, Pakistan	As a tonic to cattle	Khan *et al.* 2021
Hypericum perforatum L.	Leaf, Root	Juice	Kinnaur, HP	Allergy	Radha *et al.* 2020
	Aerial part	-	Shimla, HP	Nerve pain	Prakash *et al.* 2021
Malva neglecta Wallr.	Leaf	Whole leaf	Kulgam, J&K	Fever and diarrhea	Sofi *et al.* 2019
	Aerial part	Paste	Kashmir Himalaya	General tonic for the calves	Dar *et al.* 2018
	Leaf	Powder	Khurram, Pakistan	Colic pain	Ali *et al.* 2019
Mentha longifolia (L.) L.	Leaf	Decoction	Poonch, J&K	Pyrexia in cattle	Dutta *et al.* 2021
Nardostachys jatamansi (D. Don) DC.	Root	Oil	Arunachal Pradesh	Combined with oil of *Hyoscyamus niger* and used as an antineurotic	Pushpangadan *et al.* 2016
	Leaf		Arunachal Pradesh	Inflammation and fever	Maiti *et al.* 2013

Oryza sativa L.	-	-	Doda, J&K	Hematuria in cow, sheep, buffalo, goat	Khateeb *et al.* 2015
	Seed	Boiling	Uttarakhand	Fascioliasis	Phondani *et al.* 2010
	Seed	Boiling	Kathua, J&K	Mange i.e. hair-fall especially in cattle, galactagogue, retention of placenta after abortion	Sharma et al. 2012
Phaseolus vulgaris L.	Seed	Paste	West Bengal	Inflammation	Das and Tripathi 2009
Picrorhiza kurroa Royle ex Benth.	Root and Leaf	Juice	Kinnaur, HP	Cold, cough, food poisoning, and body ache	Radha *et al.* 2020
	Root	Powder	Doda, J&K	Stomachache	Khateeb *et al.* 2015
Plantago lanceolata L.	Aerial part	Paste	Kashmir Himalaya	Digestive disorders and as a general tonic to young calves, skin rashes	Dar *et al.* 2018
Rheum webbianum Royle	Rhizome	Powder	Kashmir Himalaya	Scabies	Dar *et al.* 2018
	Rhizome	Decoction	Doda, J&K	Internal injury, anemia, wound, mumps in sheep	Khateeb *et al.* 2015
Rumex nepalensis Spreng.	Root	Powder	Poonch, J&K	Cough and weakness in cattle	Dutta *et al.* 2021
	Root	Paste	Kashmir Himalaya	Juvenile infection in calves	Khuroo *et al.* 2007
Aucklandia costus Falc.	Root	Bolus	Garhwal, Uttarakhand	Combined with wheat flour to treat pneumonia in animals	Bhatt *et al.* 2013
	Root	Powder	Tamil Nadu	Combination with fruits of *Phyllanthus emblica*, and roots of *Withania somnifera* to treat infertility in cows	Ganesan *et al.* 2008
Silene vulgaris (Moench) Garcke	Root	Powder	Kashmir Himalaya	Galactagogue	Khuroo *et al.* 2007
	Root	Decoction Liquid extract	Shimla, HP	Vomiting, poisoning and constipation Skin infections	Prakash *et al.* 2021
Skimmia laureola Franch.	Leaf, root	Decoction, powder, paste	Poonch, J&K	Pyrexia, cold, and fracture in cattle	Dutta *et al.* 2021
	Leaf	Powder, Decoction	Muzaffarabad, Pakistan	Dysentery, diarrhea, shivering (ague) cold, to remove worms	Ahmed and Murtaza (2015)
Taraxacum campylodes G.E.Haglund	Leaf	Whole leaf	Doda, J&K	Colic in horse	Khateeb *et al.* 2015
	Aerial part	Decoction	Himalaya	Relax muscle contraction, ligaments, bones and weakness in cows and goats	Khuroo *et al.* 2007
Thymus serpyllum L.	Leaf and seed	Juice	Kinnaur, HP	Cough, cold, body pain, foot and mouth diseases	Radha *et al.* 2020

Trachyspermum ammi Sprague	Seed	Whole seed	Kathua, J&K	Diarrhea, indigestion, constipation, fever, general weakness, and as galactagogue	Sharma *et al.* 2012
	Seed	Paste	Lesser Himalayas, Pakistan	Stimulate their appetites and enhance milk productivity	Abbasi *et al.* 2013
Trifolium repens L.	Whole plant	Fresh plant	Kashmir Himalaya	Galactagogue	Ahmad *et al.* 2017
Vigna mungo (L.) Hepper	Seed	Whole seed	Kathua, J&K	Galactagogue	Sharma *et al.* 2012
	Seed	Powder	Uttarakhand	Poisoning in Buffalo, Cow, Oxen, Sheep, and Goat	Phondani *et al.* 2010
Viscum album L.	Fruit	-	Uttarakhand	Heart and faint problem in calves	Bhatt *et al.* 2013
	Stem	Paste	Nepal	Inflammation	Dhakal *et al.* 2021

-Not available

According to the International Union for Conservation of Nature (IUCN), *Nardostachys jatamansi,* and *Aucklandia costus* are critically endangered, while *Aconitum heterophyllum, Angelica glauca, Picrorhiza kurroa* are in endangered category. Unfortunately none of the above-mentioned species have been brought under cultivation in the study area thereby posing threat to their survival. Species such as *Achillea millefolium, Aesculus indica, Arisaema jacquemontii, Bergenia ciliata, Berberis lycium, Betula utilis, Cedrus deodara, Cuscuta reflexa, Ototropis elegans, Desmostachya bipinnata, Mentha longifolia, Phaseolus vulgaris, Silene vulgaris, Geranium wallichianum* are in the IUCN least concern category. The remaining twenty-four species are not assessed for threat status. The existing indigenous ethnoveterinary knowledge in the study area is under threat of extinction due to several constraints. For example, the nature of traditional knowledge makes it more challenging to learn and then accurately transfer it. Furthermore, traditional therapies are not appreciated by the younger generation. Other constraints include inadequate documentation of traditional knowledge, the advent of new allopathic medications, rapid technological progress, and environmental degradation.

New records for the plant species

The literature analysis revealed similarity in the most of the ethnoveterinary uses with the past studies that validated our findings and established the novelty of the present study. The study reported new use reports for *Achillea millefolium*, *Berberis lycium*, *Ototropis elegans, Desmostachya bipinnata*, *Lablab purpureus*, *Mentha longifolia*, *Plantago lanceolata, Sonchus asper*, *Thymus serpyllum, Stellaria media*, *Quercus baloot, Rheum webbianum, Aucklandia costus,* and *Viscum album.*

Conclusions

The present study is a pioneer attempt to document the traditional ethnoveterinary knowledge of the local people of Paddar, District Kishtwar (India). The study revealed that the local people possess significant ethnoveterinary knowledge which needs to be conserved. Majority of the plant species were used to treat gastrointestinal and dermatological diseases among the livestock. *Aucklandia costus*, *Skimmia laureola*, *Picrorhiza kurroa*, *Rumex nepalensis, Betula utilis, Aesculus indica*, *Rheum webbianum*, and *Angelica glauca* were the highly cited plant species. The species with new uses should be subjected to phytochemical, pharmacological and toxicological studies.

Declarations

Abbreviation: CR-Critically Endangered, EN-Endangered, LC- Least Concern, NE-Not Evaluated

Ethics approval and consent to participate. Ethics approval was not required by the Institute of the principal author. Prior verbal informed consent was taken from all the participants before collecting the information from them.

Consent for publication: All authors read the final manuscript and approved it for publication.

Availability of data and materials: All data related to the manuscript is present within the paper.

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