



Documentation of veterinary practices from Gujjar and Bakarwal tribes of District Poonch, Jammu & Kashmir: A boon for animals from our ancestors

Abhishek Dutta, Kanwaljeet Singh, Bikarma Singh, Yash Pal Sharma and Rainer W. Bussmann

Research

Abstract

Background: Gujjar and Bakarwal tribal communities are a treasure trove of traditional veterinary knowledge as they have been using plants to keep their livestock healthy and free from diseases for centuries. However, this knowledge is declining day by day due to several factors. The present study was aimed at surveying and documenting the medicinal plants used traditionally by the tribal communities of Gujjar and Bakarwal in the Poonch district of Jammu and Kashmir (J&K), India to treat livestock ailments.

Methods: A systematic ethnobotanical survey was conducted in 12 villages between July 2018-March 2020. Data was gathered from the local inhabitants using semi-structured questionnaires and analyzed quantitatively using use-value (UV), relative frequency of citation (RFC), informant consensus factor (ICF) and fidelity level (FL).

Results: A total of 31 medicinal plant species belonging to 30 genera of 24 families, with herbs as the dominantly used plant habit (70.97%) were encountered. Roots were most frequently used for remedy preparation (35.14%) followed by leaves (32.43%), with oral administration as the main application mode. Use-value and Relative frequency of citation ranged from 0.03-0.72 and 0.03-0.48 respectively. Based on these values, *Rumex nepalensis* was found to be the most important ethnoveterinary species used. The reported Informant Consensus Factors were very high (0.81-

1.00), indicating a very broadly spread knowledge about ethnoveterinary plants in the communities. The use category with the greatest number of plant species (10 spp.) was gynecological / andrological problems.

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Conclusion: In the present study, novel ethnoveterinary uses for seven plant species, *Aconitum violaceum*, *Arisaema jacquemontii*, *Bistorta amplexicaulis*, *Clematis grata*, *Ranunculus bulbosus*, *Ulmus villosa* and *Viburnum grandiflorum* were recorded. The reported information can be used to

standardize active principles which can further lead to the development of more efficient veterinary medicines.

Keywords: Ethnoveterinary, Gujjars, Bakarwals, Novelty, Poonch, Jammu and Kashmir

Background

Ethnoveterinary knowledge is a holistic body of folk beliefs, skills, knowledge, experience, and practices employed by indigenous and local communities for curing ailments of livestock. This knowledge varies across countries, regions, and communities (McCorkle 1986, Xiong & Long 2020). This traditional knowledge and practices often a century old tradition (Dutta *et al.* 2021a, Gurib-Fakim 2006) and continue to be important especially in rural communities across the world as they are useful, readily available, with minimal side effects, and provide a sustainable and low-cost alternative to allopathic drugs (McCorkle & Green 1998).

In India, ethnoveterinary medications have been used since ancient times (Sikarwar & Tiwari 2020). Vedic literature, particularly Atharvaveda is a repository of traditional medicine that includes prescriptions to treat animal diseases. These ethnoveterinary traditions form an integral part of family life and have an important religious and economic social role. Local communities know the principles, operations, and skills of the administration of remedies for livestock, which contributes in many respects to the socio-economic growth of the rural population. The livestock sector has the potential to generate job opportunities, especially for marginal and small-scale farmers and landless workers, who own about 70% of the country's livestock. Communities living in rural areas and far away from towns and cities depend on plant-based medicines for common diseases, and the usage of medicinal plants for the treatment of diseases is a common practice (Fayaz *et al.* 2019, Singh *et al.* 2017). Ethno-veterinary knowledge is often conveyed mostly through oral transmission (Aziz *et al.* 2020, Dutta *et al.* 2021b, Nfi *et al.* 2001). This traditional oral knowledge is declining due to improper documentation, the death of elder members of the tribe or community, rapid modernization, and lack of interest of the younger generation towards traditional practices (Bhatia *et al.* 2014, Idu *et al.* 2011, Kala *et al.* 2006).

The Union Territory of Jammu & Kashmir (J&K) is part of the Indian Himalayan region lying in the lap of Western Himalayas and its indigenous communities rely heavily on traditional phytotherapies and traditional healers (Sharma *et al.* 2012). Literature reveals various studies that have documented the

traditional ethnoveterinary knowledge from J&K (Dutta *et al.* 2021a, Beigh *et al.* 2003, Khuroo *et al.* 2007, Rashid *et al.* 2007, Sharma & Singh 1989, Sharma *et al.* 2012, Shah *et al.* 2015). However, studies on the ethnoveterinary uses of plant are lacking in the district Poonch (J&K). Given this gap, an attempt has been made to document and describe various cattle diseases and their remedies practiced by Gujjar and Bakarwal communities. We hypothesized that due to the remote location these communities would have well preserved ethnoveterinary knowledge that would differ from other parts of the region.

Material and Methods

Study Area

District Poonch is one of the remote districts of Union Territory of J&K at an altitudinal range of 800-4750 masl. It lies between 73° 58'- 74 ° 35' E longitude and 33° 25'- 34° 01' N latitude. Situated on the southern foothills of Pir Panjal range of J&K, it is bordered by Kashmir in the northeast, Rajouri in the south and Pakistan occupied Jammu Kashmir (PoJK) in the west (Fig. 1). The area experiences a sub-tropical to temperate climate regime with an average temperature of 30°C during the summer, while winter months record on the average temperature of 2°C. The administrative area is distributed over 6 tehsils and 11 blocks comprising 178 villages and 51 panchayats. The total population is 475835 (Census 2011) in a total geographic area of 1674 km². About 96% of the population lives in isolated villages (Mughal *et al.* 2017).

Most of the rural population depends on agriculture and animal husbandry for their livelihoods. Gujjars and Bakarwals constitute the majority of the population. While Gujjars are semi-nomadic, the Bakarwals are truly nomadic communities. There is a huge dependence of these communities on the local flora for their basic needs, as they rear livestock on high pastures, lacking any modern conveniences (Shah *et al.* 2015). The district is rich in terms of biodiversity harboring many rare, endemic and threatened plants. The vegetation usually comprises coniferous forests (*Pinus roxburghii* Sarg., *Pinus wallichiana* A.B. Jacks., *Abies pindrow* (Royle ex D. Don) Royle, *Abies spectabilis* (D. Don) Mirb., *Cedrus deodara* (Roxb. ex D. Don) G. Don, *Picea smithiana* (Wall.) Boiss. and *Taxus wallichiana* Zucc.), broad-leaved evergreen forests (*Buxus wallichiana* Baill., *Ilex dipyrrena* Wall., *Quercus semecarpifolia* Sm., *Quercus incana* W.Bartram etc.), deciduous forests (*Aesculus indica* (Wall. ex Cambess.) Hook.; *Populus alba* L., *Platanus orientalis* L., *Acer caesium* Wall. ex Brandis etc.) and scrub forests, interspersed with frequent grassland patches and croplands.

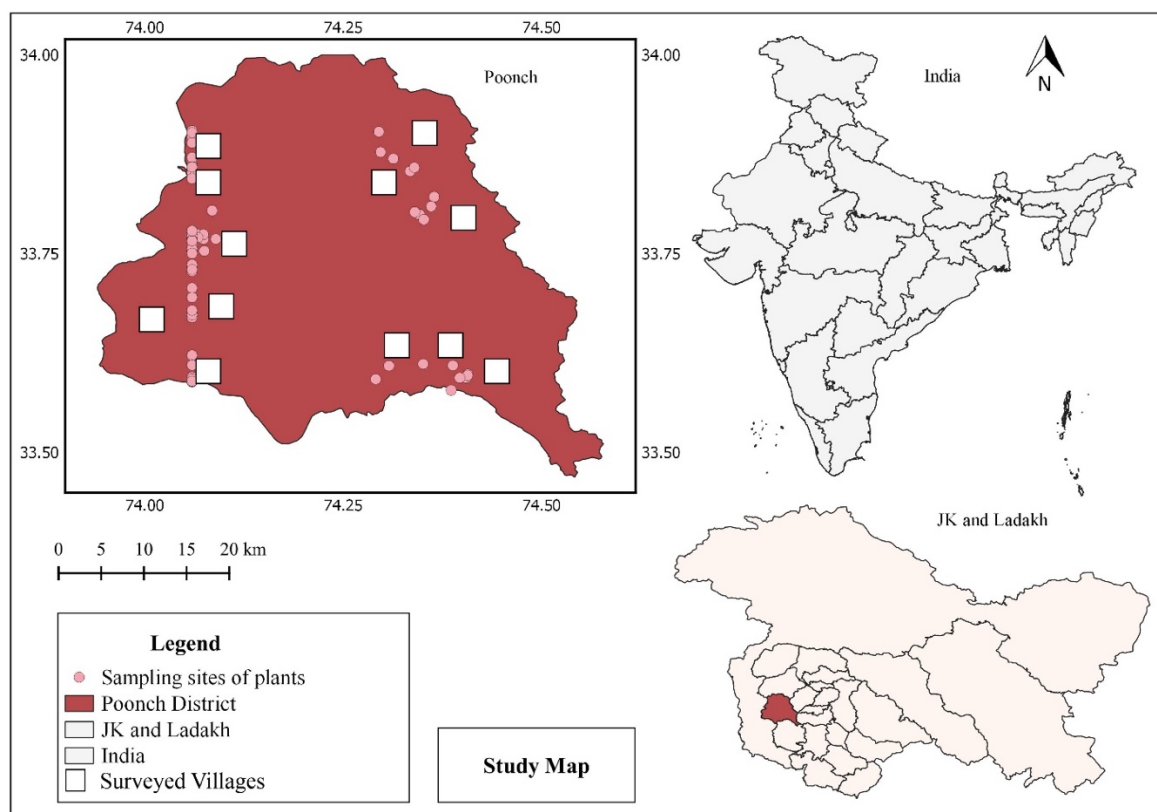


Figure 1. Map of the study area showing surveyed villages and collection sites of plants.

Survey and data collection

An extensive and systematic field exploration was conducted in the study area from July 2018 to March 2020 for the collection of plants that are being used by the local inhabitants to treat diseases in livestock. A total of 58 randomly selected participants, including traditional healers, shepherds, milkmen, elder people, and others belonging to Gujjar and Bakarwal tribes were interviewed using a semi-structured questionnaire. All interviews were conducted in local language, after receiving prior informed consent from the participants. In the interview's utmost attention was given to local veterinary knowledge of both wild as well as cultivated medicinal plants.

The medicinal plants were photographed, and vouchers of all species collected from the study area, and GPS coordinates of each voucher were recorded. The collected plants were dried, mounted on herbarium sheets, and identified in the herbaria of the Department of Botany, University of Jammu (HBJU), Jammu and Janaki Ammal Herbarium, Indian Institute of Integrative Medicine (RRLH), Jammu, and with the help of various regional floras (Sharma & Kachroo 1983, Singh & Kachroo 1994). For the latest accepted names and nomenclatural position of the taxa, Plants of the World Online was followed (POWO 2019). The voucher specimens were deposited at the herbarium, Department of Botany, University of Jammu, Jammu, J&K, India.

Data analysis

The interview data obtained were analyzed quantitatively using four indices viz., use-value (UV), Relative Frequency of Citation (RFC), Informant Consensus Factor (ICF), and Fidelity Level (FL%).

Use-value (UV)

Use-value (UV) was calculated to elucidate the types of uses associated with particular species and their relative importance to the participants (Phillips *et al.* 1994) as:

$$UVs = \sum U / n$$

where U refers to the number of use-reports cited by each informant for that plant species and n is the total number of the participants interviewed. When the plant is important, it has high use reports and high Use-value, and vice-versa.

Relative frequency of citation (RFC)

Relative frequency of citation (RFC) was used to determine the level of traditional knowledge about the use of ethnoveterinary plants in the study areas (Tardío & Pardo-De-Santayana 2008) using:

$$RFC = Fc/N$$

where Fc is the number of participants who mention the use of the plant and N is the number of participants that have participated in the survey.

Informant consensus factor (ICF)

To determine the homogeneity of uses for a particular plant species, all the diseases of the livestock were broadly classified into 9 categories and the Informant consensus factor (Heinrich *et al.* 1998) was calculated using the following equation:

$$ICF = \frac{nur-nt}{nur-1}$$

where nur is the total number of use-reports of a category, and nt is the number of species used for the category. ICF values approach 1 when there is the exchange of knowledge among the participants and is near 0, when there is no exchange of knowledge among the participants and chose plants randomly.

Fidelity level (FL)

FL compares fidelity of a species to one ailment vs. being reported for many and allows us to know whether this is a general or specific treatment (Friedman *et al.* 1986), Fidelity level was calculated using:

$$FL (\%) = (Np / N) \times 100$$

Where Np is the number of use-reports for a given species for a particular ailment category and N refers

to the total number of participants stating the plant useful for any ailment category.

Results and Discussion

Demographic description of participants and collection sites

The present study successfully documented the plant species with ethnoveterinary importance in the study area. In our survey, a total of 58 participants belonging to the age group between 25-84 were interviewed for the documentation of traditional veterinary knowledge in twelve villages of district Poonch (Table 1). Most of the participants were men (44, 75.86%), and the remaining 14 (24.14%), were women. All these participants were from the tribal community of Gujjar and Bakarwal of the study area. The majority of them belong to the age group 45-74 years. Most participants had received little education, i.e. up to primary standard. The number of participants below 45 years was limited, and older participants contributed the major portion of the knowledge, indicating their higher level of ethnoveterinary knowledge. We could only interview a very limited number of female participants due to cultural restrictions given that all interviewers were male.

Table 1. Demographic description of the participants.

Participants		
Women	14 (24.14%)	
Men	44 (75.86%)	
Age Group	Women	Men
25-34	2 (14.28%)	3 (6.81%)
35-44	2 (14.28%)	2 (4.55%)
45-54	4 (28.57%)	6 (13.64%)
55-64	5 (35.71%)	20 (45.45%)
65-74	1 (7.14%)	8 (18.18%)
75-84	-	5 (11.36%)
Educational Level	Women	Men
Never attended school	5 (35.71%)	11 (25%)
Attended school for 1–5 classes	3 (21.42%)	13 (29.54%)
Attended school for 6–10 classes	4 (28.57%)	7 (15.9%)
Intermediate (12th class)	2 (14.28%)	6 (13.63%)
Graduate	-	5 (11.36%)
Postgraduate	-	2 (4.54%)

Diversity of ethnoveterinary flora

The present investigation found 31 plant species belonging to 30 genera and 24 families, used by the tribal population as ethnoveterinary plants (Table 2). Ranunculaceae was the most dominant family, represented by three species, followed by Amaryllidaceae, Lamiaceae, Poaceae, Polygonaceae, and Urticaceae (2 species each), whereas the rest of the families were represented by a single species. Ahmad *et al.* (2017) previously documented 32 ethnoveterinary plants encompassing 19 families from the Kashmir

Himalayan region. A comprehensive survey of Sharma *et al.* (2012) from district Kathua of Jammu division (J&K) reported 72 ethnoveterinary plants, with Fabaceae being the most represented one. Euphorbiaceae were found to be dominantly used in ethnoveterinary practices in Rajasthan (Galav *et al.* 2013). The recent review article of Sikarwar and Tiwari (2020) reported 270 plant species of 84 families used by rural tribes and Central India people for ethnoveterinary practices.

Table 2. List of ethnoveterinary plants used by Gujjars and Bakarwals along with UV and RFC.

Botanical name - Family	Voucher Number	Habit	Local name	Part used	GPS Coordinates	Altitude (masl)	Ethnoveterinary use	Use reports	UV	RFC
<i>Achillea millefolium</i> L. - Asteraceae	JUH125	H	Rainthal - Chau	Root	33°36'31"N 74°18'27"E	2064	Root is ground and given to cattle on snakebite. (4)	4	0.07	0.07
<i>Aconitum violaceum</i> Jacquem. ex Stapf - Ranunculaceae	JUH105	H	Patrees	Root	33°51'29"N 74°20'22"E	2534	About 50- 80 gram powdered or crushed root is given to buffaloes, ox and horse against snake bite (2)	2	0.03	0.03
<i>Acorus calamus</i> L. - Acoraceae	JUH040	H	Bach	Root	33°48'14"N 74°05'05"E	1061	The root is mixed with salt and mirch and given to horses to cure stomach pain (2)	2	0.03	0.03
<i>Allium cepa</i> L. - Amaryllidaceae	JUH085	H	Payaz	Bulb	33°46'27"N 74°03'57"E	1018	The bulb is powdered and given orally to animals to treat snake bite (5)	5	0.09	0.09
<i>Allium sativum</i> L. - Amaryllidaceae	JUH115	H	Thoom	Bulb	33°46'26"N 74°04'25"E	1002	Bulbs are powdered and given with milk and ghee to cure pyrexia (5)	5	0.09	0.09
<i>Arisaema jacquemontii</i> Blume - Araceae	JUH004	H	Sapp ni makk	Corm	33°35'51.8"N 74°24'24.4"E	2073	Underground part is powdered and given orally to cattle to cure Pyrexia (8). A paste of same powder is applied on the affected part to treat snakebite (6).	14	0.24	0.14
<i>Berberis lycium</i> Royle - Berberidaceae	JUH005	S	Simblu	Stem, Root	33°35'47.4"N 74°24'23.6"E	2097	The stem bark is dried and powdered. This powder is used externally to treat maggots in wounds (5). Outer bark of the root is dried, powdered and a paste is prepared and applied on wounds in cattle (7). Root bark powder is also given orally in small doses to treat Fractures (8).	20	0.34	0.14

<i>Bistorta amplexicaulis</i> (D. Don) Greene - Polygonaceae	JUH032	H	Masloon	Whole plant, Root	33°36'32"N 74°23'17"E	1748	Rhizome given to animals as galactagogue (20)	20	0.34	0.34
<i>Brassica rapa</i> L. - Brassicaceae	JUH084	H	Sareyaan - khal	Leaves	33°45'11"N 74°04'29"E	942	The residue of seeds left after extraction of oil (khal) is fed to animal as galactagogue (6).	6	0.10	0.10
<i>Calotropis procera</i> (Aiton) W.T. Aiton - Apocynaceae	JUH143	H	Akk	Leaves	33°45'47"N 74°03'37"E	964	Hemorrhagic septicemia (HS): Two and a half leaves along with 375 g of butter are given to eat orally. Two and a half leaves with latex are tied on swellings (4)	4	0.07	0.07
<i>Cannabis sativa</i> L. - Cannabaceae	JUH015	H	Pangg	Leaves	33°40'21"N 74°03'34"E	1180	The whole plant is ground and given orally to treat body pains in cattle (4). Powdered leaf balls (peda) are given to cattle to treat intestinal worms (5).	9	0.16	0.09
<i>Capsicum annuum</i> L. - Solanaceae	JUH008	H	Merch	Fruit	33°40'15"N 74°08'34"E	1264	Mature fruits are powdered and given with butter milk (lassi) to cattle to cure cough (6). Fruits are given orally to treat pyrexia in cattle (8).	14	0.24	0.14
<i>Clematis grata</i> Wall. - Ranunculaceae	JUH097	C	beladi	Leaves	33°35'18"N 74°17'27"E	2856	Juice of leaf is used to expel worms from wounds in cattle. (5)	5	0.09	0.09
<i>Cynodon dactylon</i> (L.) Pers. - Poaceae	JUH016	H	Khabbal	Root, Whole plant	33°43'39.6"N 74°02'24.6"E	978	A paste prepared from the whole herb is applied on wounds to treat them in cattle (8).	8	0.14	0.14
<i>Ficus carica</i> L. - Moraceae	JUH070	S	Tarkkani kembri	Leaves	33°35'19"N 74°17'29"E	2149	3 leaves are given to pregnant cattle for easy delivery (5).	5	0.09	0.09
<i>Geranium wallichianum</i> D. Don ex Sweet - Geraniaceae	JUH111	H	Rattan jot	Root	33°51'38"N 74°20'07"E	2337	Root is directly given to animals to cure pyrexia (4) and as galactagogue (6)	6	0.10	0.17

<i>Girardinia diversifolia</i> (Link) Friis - Urticaceae	JUH007	H	Kayari	Root, Leaves	33°35'39.4"N 74°24'33.0"E	2172	Roots are dried, powdered, and given with milk to cattle to cure Retention of the placenta (8). A paste prepared from powdered leaves is applied externally to treat wounds in cattle (6)	14	0.24	0.14
<i>Grewia optiva</i> J.R. Drumm. ex Burret - Malvaceae	JUH009	T	Dhamman	Leaves	33°40'10"N 74°08'34"E	1257	Fresh leaves are given orally to treat Retention of the placenta in cows and buffaloes (5).	5	0.09	0.09
<i>Mentha longifolia</i> (L.) L. - Lamiaceae	JUH011	H	Pootna	Leaves	33°44'028"N 74°05'25.2"E	1122	A decoction of leaves in lipton tea is given to cattle to cure pyrexia (7).	7	0.12	0.12
<i>Phytolacca acinosa</i> Roxb. - Phytolaccaceae	JUH103	H	Kafal	Root	33°51'32"N 74°20'19"E	2488	Root given to animals to cure inability to inseminate (8).	8	0.14	0.14
<i>Primula denticulata</i> Sm. - Primulaceae	JUH134	H	Lattar-phul	Flower	33°51'31"N 74°20'31"E	2563	Flower is pounded and given to livestock on snakebite (5).	5	0.09	0.09
<i>Prunus armeniaca</i> L. - Rosaceae	JUH055	T	Haari - Charota	Fruits, Seeds	33°42'23"N 74°11'02"E	1501	Dried seeds are powdered and given to cattle to kill intestinal worms (8)	8	0.14	0.14
<i>Punica granatum</i> L. - Lythraceae	JUH010	T	Darunni	Fruit	33°41'41"N 74°06'46"E	1347	The fruit rind is dried, powdered, and given orally to cattle to treat Prolapse (10).	10	0.17	0.17
<i>Ranunculus bulbosus</i> L. - Ranunculaceae	JUH013	H	Maleen	Root	33°40'22"N 74°03'34"E	1792	Roots are dried, powdered, and given orally to diseased cattle to treat Pneumonia (10). Roots are ground in water and given orally to expel intestinal worms in cattle (8).	18	0.31	0.17

<i>Rumex nepalensis</i> Spreng. - Polygonaceae	JUH006	H	Hula - halfali	Root, Leaves	33°35'31.3"N 74°24'39.6"E	2153	Roots are dried, powdered and given to cattle with buttermilk to treat general weakness (28). Roots are dried, powdered, and mixed with buttermilk for three days. After three days, it is given to cattle for three days to treat cough (14).	42	0.72	0.48
<i>Skimmia laureola</i> (DC.) Decne. - Rutaceae	JUH142	H	Nera - patla	Leaves, Root	33°37'18"N 74°24'05"E	2310	Leaves are boiled and are given to cattle to cure pyrexia (11). Leaves are dried, powdered, and given with milk to cattle to treat cold (6). A paste prepared from powdered roots is applied externally to treat fractures in animals (8).	25	0.43	0.19
<i>Ulmus villosa</i> Brandis ex Gamble - Ulmaceae	JUH002	T	Manu	Leaves	33°44'08.6"N 74°00'48.3"E	930	Leaves are given with butter (in summer) - seeds of <i>Trigonella</i> sp. (in winter) to eat orally for treating prolapse in cattle (8).	8	0.14	0.14
<i>Urtica dioica</i> L. - Urticaceae	JUH037	H	kayari	Root	33°36'34"N 74°23'17"E	1735	Roots are given to cattle as galactagogue (12)	12	0.21	0.21
<i>Viburnum grandiflorum</i> Wall. ex DC. - Viburnaceae	JUH046	S	kilmish	Seeds	33°54'07"N 74°18'02"E	2157	Fresh leaves are given orally to treat constipation (6)	6	0.10	0.10
<i>Vitex negundo</i> L. - Lamiaceae	JUH001	S	Bana	Leaves	33°43'46.6"N 74°00'55.1"E	959	Leaves are given orally to cattle to cure pyrexia (8)	8	0.14	0.14
<i>Zea mays</i> L. - Poaceae	JUH072	H	Makk	Fruit	33°35'21"N 74°17'01"E	1888	Maize flour is given with water to treat Foot and mouth disease (FMD) in cattle (3)	3	0.05	0.05

In the present study, the maximum plant species used were herbs (70.97%), followed by trees and shrubs (12.9% each), and climbers (3.23%), indicating that herbs are the primary source of ethnoveterinary medicine for the Gujjar and Bakarwal tribes in the region, which is in line with the earlier

studies conducted in J&K and India (Ahmad *et al.* 2017, Punjani & Pandey 2015). Studies in lower areas reported trees to be most frequently used for veterinary purposes (Nigam & Sharma 2010, Rajakumar & Shivanna 2012).

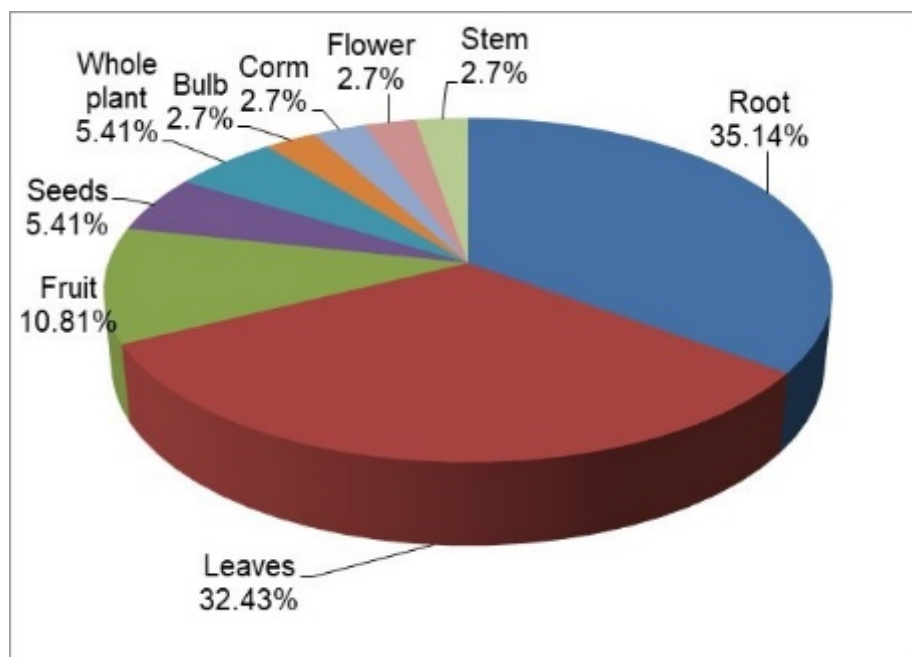


Figure 2. Percentage of plant parts used in ethnoveterinary remedies.

Therapeutic values

Livestock is an integral part of tribal communities of Gujjar and Bakarwal and plays an important social and economic role in their life. Ethnoveterinary medicine is an integral part of daily life and applied especially for the treatment of pneumonia, pyrexia, constipation, as vermicide, stomach pain, accouchement, galactagogue, inability to inseminate, prolapse, wounds, retention of placenta, general weakness, fractures, hemorrhagic septicemia, maggots in wounds, body pain, cold, cough, and snakebite. Most of these ailments belong to gynecological/ andrological, dermatological, gastrointestinal, and liver-related issues. The animals found to be treated in the present study were buffalo, ox, horse, cows, sheep, and goat.

The majority of plant species in the present investigation were used to cure a single disease only, suggesting species' usefulness and reliability in this cultural context for a specific treatment purpose. A herbal preparation of *Acorus calamus* and *Ulmus villosa* with fruits of *Capsicum annum* and seeds of *Trigonella sp.* was the only herbal mixture applied. Otherwise the local communities used only single species treatments. The reported plant species were either cultivated or collected from the forest, providing cost-effective treatment to the cattle compared to the modern drugs.

Use-value (UV) and Relative Frequency of Citation (RFC)

Relative frequency of citation showed the maximum used therapeutic plants used by the local population. The dominant species in the study area were *Rumex nepalensis* (RFC=0.48), *Bistorta amplexicaulis* (RFC=0.34), *Urtica dioica* (RFC=0.21), and *Skimmia laureola* (RFC=0.19), as the maximum number of participants cited these. In the present study, RFC ranged from 0.48-0.03 (Table 2). Based on use-value (UV), which takes the diversity of uses into account, the most important plant species reported were *Rumex nepalensis* (UV=0.72), followed by *Skimmia laureola* (UV=0.43), *Berberis lyceum*, and *Bistorta amplexicaulis* (UV=0.34 each), and *Ranunculus bulbosus* (UV=0.31). *Aconitum violaceum* and *Acorus calamus*, with minimum use-value (UV=0.03 each), were the least used species in the study area.

Informant Consensus Factor

The ailments reported from the study area were classified into nine (9) different ailment categories. The highest consensus of the participants was obtained for the treatment of Physical pains (ICF=1), followed by Miscellaneous disorders (ICF=0.94), Muscular-skeletal disorders (ICF=0.93), Respiratory (ICF=0.92), and Dermatological and gynecological/ andrological disorders (ICF=0.9 each). The documented ICF value in the present study is in line with the previous report of Sharma *et al.* (2012) who

reported the highest ICF for urological disorders (0.95) and lowest for nutritional diseases (0.80). In another study, ICF ranged from 0.75-0.95 (Meen *et al.* 2020) with higher values for respiratory, gastrointestinal, and reproductive. The ICF values were mostly on the higher side in the present study, which suggests that the participants share the information widely. The maximum number of plant species used for treating the Gynecological/Andrological disorders was 10 (with 88 use reports), followed by Fever (8 species), Gastrointestinal disorders and Snakebite (5 species each), Dermatological disorders (4 species), Miscellaneous and Respiratory disorders (3 species each). (Table 3).

Table 3. Informant Consensus Factor for different livestock diseases.

Ailment category	No. of Species used (nt)	Use Citations (nur)	ICF=nur-nt/ nt-1
Gynecological / Andrological	10	88	0.90
Fever	8	61	0.88
Gastrointestinal	5	29	0.86
Snake bite	5	22	0.81
Dermatological	4	31	0.90
Miscellaneous disorders	3	35	0.94
Respiratory	3	26	0.92
Muscular-skeletal disorders	2	16	0.93
Physical pains	1	4	1.00

Table 4. Fidelity level of plants used in the treatment of various veterinary diseases.

Ailment category	Plant species	NP	N	FL%= NP/N×100
Dermatological	<i>Clematis grata</i> Wall. Ranunculaceae	5	5	100.00
	<i>Cynodon dactylon</i> (L.) Pers. Poaceae	8	8	100.00
	<i>Girardinia diversifolia</i> (Link) Friis Urticaceae	6	14	42.86
	<i>Berberis lycium</i> Royle Berberidaceae	12	20	60.00
	Fever	<i>Allium sativum</i> L. Amaryllidaceae	5	5
<i>Arisaema jacquemontii</i> Blume Araceae		8	14	57.14
<i>Capsicum annuum</i> L. Solanaceae		8	14	57.14
<i>Geranium wallichianum</i> D. Don ex Sweet Geraniaceae		4	6	66.67
<i>Mentha longifolia</i> (L.) L. Lamiaceae		7	7	100.00
<i>Ranunculus bulbosus</i> L. Ranunculaceae		10	18	55.56

Fidelity level (FL%)

The importance of plant species in the particular ailment category was elucidated using the fidelity level (FL %), which ranged from 24% to 100%. To cure the dermatological ailments, the species with the highest fidelity level were *Clematis grata* and *Cynodon dactylon* (FL =100% each), *Berberis lycium* (FL=60%), and *Girardinia diversifolia* (FL =42.86%).

Species with a high FL that were used to treat fever were *Allium sativum*, *Mentha longifolia*, and *Vitex negundo* (FL =100% each); Gastrointestinal disorders with *Acorus calamus*, *Prunus armeniaca*, and *Viburnum grandiflorum* (FL=100% each), and *Cannabis sativa* (55.56%). Gynecological/Andrological disorders were treated with *Bistorta amplexicaulis*, *Brassica rapa*, *Ficus carica*, *Geranium wallichianum*, *Grewia optiva*, *Phytolacca acinosa*, *Punica granatum*, *Ulmus villosa*, and *Urtica dioica* (FL=100% each). Some of the other important species with high fidelity level were *Berberis lycium* (FL =40%) and *Skimmia laureola* (FL=32%) to cure Muscular-skeletal disorders; *Calotropis procera*, *Zea mays* (FL =100% each), and *Rumex nepalensis* (FL =66.67%) for Miscellaneous disorders; *Cannabis sativa* (FL =44.44%) for Physical pains; *Capsicum annuum* (FL =42.86%) and *Rumex nepalensis* (FL =33.33%) for Respiratory disorders, and *Achillea millefolium*, *Aconitum violaceum*, *Allium cepa* and *Primula denticulata* (FL =100% each), *Arisaema jacquemontii* (FL =42.86%) for snake bites. Plants with high FL values should be further studied in vitro test possible effective compounds (Table 4).

	<i>Skimmia laureola</i> (DC.) Decne. Rutaceae	11	25	44.00	
Gastrointestinal	<i>Vitex negundo</i> L. Lamiaceae	8	8	100.00	
	<i>Acorus calamus</i> L. Acoraceae	2	2	100.00	
	<i>Cannabis sativa</i> L. Cannabaceae	5	9	55.56	
	<i>Prunus armeniaca</i> L. Rosaceae	8	8	100.00	
	<i>Ranunculus bulbosus</i> L. Ranunculaceae	8	18	44.44	
	<i>Viburnum grandiflorum</i> Wall. ex DC. Viburnaceae	6	6	100.00	
	Gynecological/ Andrological	<i>Bistorta amplexicaulis</i> (D. Don) Greene Polygonaceae	20	20	100.00
<i>Brassica rapa</i> L. Brassicaceae		6	6	100.00	
<i>Ficus carica</i> L. Moraceae		5	5	100.00	
<i>Geranium wallichianum</i> D. Don ex Sweet Geraniaceae		6	6	100.00	
<i>Girardinia diversifolia</i> (Link) Friis Urticaceae		8	14	57.14	
<i>Grewia optiva</i> J.R. Drumm. ex Burret Malvaceae		5	5	100.00	
<i>Phytolacca acinosa</i> Roxb. Phytolaccaceae		8	8	100.00	
<i>Punica granatum</i> L. Lythraceae		10	10	100.00	
<i>Ulmus villosa</i> Brandis ex Gamble Ulmaceae		8	8	100.00	
Muscular-skeletal disorders		<i>Urtica dioica</i> L. Urticaceae	12	12	100.00
		<i>Berberis lycium</i> Royle Berberidaceae	8	20	40.00
		<i>Skimmia laureola</i> (DC.) Decne. Rutaceae	8	25	32.00
Miscellaneous		<i>Calotropis procera</i> (Aiton) W.T. Aiton Apocynaceae	4	4	100.00
		<i>Rumex nepalensis</i> Spreng. Polygonaceae	28	42	66.67
		<i>Zea mays</i> L. Poaceae	3	3	100.00
Physical pains	<i>Cannabis sativa</i> L. Cannabaceae	4	9	44.44	
Respiratory	<i>Capsicum annuum</i> L. Solanaceae	6	14	42.86	
	<i>Rumex nepalensis</i> Spreng. Polygonaceae	14	42	33.33	
Snake bite	<i>Skimmia laureola</i> (DC.) Decne. Rutaceae	6	25	24.00	
	<i>Achillea millefolium</i> L. Asteraceae	4	4	100.00	
	<i>Aconitum violaceum</i> Jacquem. ex Stapf Ranunculaceae	2	2	100.00	
	<i>Allium cepa</i> L. Amaryllidaceae	5	5	100.00	
	<i>Arisaema jacquemontii</i> Blume Araceae	6	14	42.86	
	<i>Primula denticulata</i> Sm. Primulaceae	5	5	100.00	

Comparison of traditional uses with previous studies

The comparison with available literature showed novel uses of ethnoveterinary plants in the study

region. The present study reported using the root powder of *Achillea millefolium* given to cattle to treat snakebites (Table 2). A previous study from district Rajouri (J&K) reported the use of shoots and leaves

for urinary disorders in cattle (Jamwal & Kant 2008). In Himachal Pradesh, the dried powder of the whole plant was given orally with hot water to treat wounds, skin allergy, and sunburn (Radha *et al.* 2020). The root powder of *Aconitum violaceum* was given to buffalos, oxen, and horses in case of snakebite (Table 2). We could find no other ethnoveterinary uses of this species from India.

As per the study area respondents, the root powder of *Acorus calamus* is given orally to treat stomach pain in horses. Previous studies reported many other ethnoveterinary uses for different parts of this plant. The tribal and rural communities in Uttar Pradesh use the leaf paste and rhizome powder of *A. calamus* to treat wounds in animals (Gautam *et al.* 2015). An amalgamation of rhizome powder of *A. calamus* and *Artemisia scoparia* prepared with *Brassica campestris* (mustard) or *Sesamum indicum* (sesame) is used by the indigenous oil people in Himachal Pradesh for massage therapy in case of fever, joint pain, and arthritics in livestock (Bhatti *et al.* 2017). A study from the Shivalik Hilly zones of Himachal Pradesh reported the ethnoveterinary use of *A. calamus* rhizome powder to treat epilepsy, urinary problems, hydrocele, and as anthelmintic (Kumar & Chander 2018). Similarly, the leaves, roots, and the whole plant of *A. calamus* is used to treat various gastrointestinal issues in sheep, cows, buffalos, and goats in the West's Darjeeling subdivision Bengal and district Doda of Jammu and Kashmir (Khateeb *et al.* 2015, Mondal 2012).

The bulb powder of *Allium cepa* was given orally to animals to treat snakebites in the study area (Table 2). The people in the Bandipora district of Jammu and Kashmir used soft balls of crushed bulbs of *A. cepa* with salt as a remedy against cold and anorexia in cattle, and in cows to stimulate the estrus cycle. These balls are also given to horses to cure frothy bloat caused due to the grazing of (*Trifolium repens*) (Bhardwaj *et al.* 2013). An oral intake of 100g paste of *Allium cepa* has also been reported to alleviate cattle swelling (Jamwal & Kant 2008). The mixture of powdered bulbs of *Allium cepa* with black salt is given along with water to cure foot and mouth disease in cattle in Hassan District of Karnataka (Kumar & Nagayya 2017).). The mixture of *A. cepa* bulb with black salt and water is given to cows, buffalos, oxen, goats, and sheep by the traditional herbal healers in Uttarakhand to remedy poisoning (Phondani *et al.* 2010). In Orissa, the bulb paste of *A. cepa* is reported to cure fever (Satapathy 2010), whereas the tribal societies in Rajasthan a decoction of the whole plant is given orally to sheep and goats as a tonic and febrifuge (Meen *et al.* 2020).

The bulbs of *Allium sativum* were powdered and given with milk and ghee to cure pyrexia (Table 2). A

previous study reported garlic used to treat diarrhea in sheep, cows, goats, buffaloes (Khateeb *et al.* 2015). In the Kalakote range of Jammu and Kashmir, a bulb paste of *A. sativum* and curd is given to female buffalos and is considered an aphrodisiac (Jamwal & Kant 2008). A paste of the bulb is administered once daily for five days to treat cough in Andhra Pradesh (Pragada & Rao 2012). In Haryana, the oral intake of garlic and elaichi mixed with jaggery is reported to cure cold and fever (Yadav *et al.* 2014). Many ethnoveterinary properties such as efficacy against cough and cold, bronchitis, brain disease, earache, indigestion, food poisoning, diarrhea, injuries, snake bite have been reported from Central India, with the population using the juice of bulbs of *A. sativum* or the bulbs in multiple combinations with mustard oil or mustard oil and ash of cow dung, or the bulb paste and beeswax as well as the bulb paste, milk, and cooking oil (Sikarwar & Tiwari 2020). A paste prepared by mixing the bulbs of *A. sativum* with the bark of *Oroxylum indicum* and *Terminalia bellirica* in rice-soaked water is used to treat black quarter disease in cattle in Karnataka (Rajakumar & Shivanna 2012). In the Marwar region of Rajasthan, the stem of *Allium sativum* is mixed with flowers of *Punica granatum* and milk and used against gastrointestinal infection (Meen *et al.* 2020). The animal owners and housewives in Uttarakhand use *A. sativum* for various ethnoveterinary uses such as food poisoning, tympany, sterility, skin infection, arthritis, internal parasites, foot mouth disease, stomachache (Tiwari & Pande 2010). Anthelmintic properties of garlic have been reported for from West Bengal (Saha *et al.* 2014).

The underground parts of *Arisaema jacquemontii* were powdered and given orally to cattle to cure pyrexia and snakebite in the study area. No ethnoveterinary uses have been reported in literature for this plant species. The powder of stem bark and paste prepared from the outer bark of roots *Berberis lycium* was used externally to treat wounds, whereas the oral decoction of the root is given to treat fractures in cattle (Table 2). In contrast, the root decoction of *B. lycium* was previously reported to treat jaundice in cows, goats, and buffaloes from the Doda district of J&K (Khateeb *et al.* 2015). The bark of *B. lycium* was also used to treat foot and mouth disease of cattle in Western Himalaya (Shoaib *et al.* 2020). The present study reported the use of rhizomes of *Bistorta amplexicaulis* as a galactagogue. The residue left after extracting the seed oil from *Brassica rapa*, locally known as 'Khal' was also used as a galactagogue (Table 2). The seed oil *B. rapa*, in combination with the paste of bulb of *Allium cepa* has previously been reported for treating wounds in Madhya Pradesh (Singh & Sudip 2014).

The leaf of *Calotropis procera* was used to treat hemorrhagic septicemia and swellings in the study area (Table 2). The literature survey found various other ethnoveterinary properties for this plant species. The people in the tribal regions of Andhra Pradesh apply the milky leaf latex of *Calotropis procera* on inflamed areas to relieve inflammation, and on snake bite to neutralize the poison (Pragada & Rao 2012). People in Central India use the roots, leaves, and flowers of this plant species either in powder form or in combination with milk or mustard oil to treat bone fractures, tumors, for the healing of wounds, swellings, conjunctivitis, earache, skin diseases, urine retention, to ease delivery, for snake bite, indigestion, diarrhea and dysentery, stomachache, and falling of the tail (Sikarwar & Tiwari 2020). The leaves and leaf latex have been reported to remove intestinal worms in sheep, act as a galactagogue, and are employed in the detachment of the placenta after delivery (Yadav *et al.* 2014). The indigenous people in Himachal Pradesh apply the milky leaf latex on the bitten part of the body to neutralize the snake poison and dog bites (Bhatti *et al.* 2017).

The present study documented the use of the whole plant powder of *Cannabis sativa* given orally to treat body pains in cattle whereas balls made from powdered leaves, locally known as 'Peda' were given to cattle to treat intestinal worms (Table 2). The Karbi tribe in Assam and the vaidyas, hakims, sadhus, and tribal people in the Jhansi district of Uttar Pradesh have been previously reported to use the leaf and leaf mixture of *C. sativa* with whey and water to treat diarrhea in animals (Kumar *et al.* 2020, Nigam & Sharma 2010). Using the leaves and seeds of *C. sativa* people in the Shivalik Hills of Himachal Pradesh were reported to treating reddishness, cough, cataract, urinogenital disorders (Kumar & Chander 2018). Pastoralist communities in Jammu and Kashmir use the whole plant powder for improving poor reproductive performance in cattle and buffaloes (Khateeb *et al.* 2017), while in the Kalakote range of J&K, the leaf powder is given orally for anorexia in cattle (Jamwal & Kant 2008). In Orissa, balls made from *C. sativa* and seeds of *Cicer arietinum* were given orally once a day against chronic dysentery in cattle (Satapathy 2010). In the Sikkim Himalaya stem pieces of *C. sativa* are fed to livestock to treat inflammation and act as a tonic to cattle (Bharati and Sharma 2012). In Uttarakhand, the traditional herbal healers apply the boiled leaves of *Cannabis sativa* with the ash of *Pinus roxburghii* and black salt externally to treat sprains in animals such as cow, buffaloes, sheep, goats, and dogs (Phondani *et al.* 2010).

The fruits of *Capsicum annuum* were given orally to treat pyrexia in cattle, and the mature fruits powder

with buttermilk (lassi) were given to cattle to cure cough in the study area. The fruit paste has been reported earlier to be useful against foot and mouth disease in animals (Pragada & Rao 2012). The mixture of *C. annuum* fruit and salt was reported by the pastoralists of J&K to be useful against endoparasites (Khateeb *et al.* 2017). In Jhansi District of Uttar Pradesh, the paste of seeds of *Allium sativum*, *Piper nigrum*, *Cuminum cyminum*, and alum is given to alleviate dullness in animals (Nigam & Sharma 2010). In Uttarakhand, the healers were reported to use the powdered mixture of the pod of *C. annuum* and the bark of *Zanthoxylum armatum* to treat fasciolosis in buffaloes, cows, and oxen (Phondani *et al.* 2010). Other reported ethnoveterinary properties of fruits and stem of this plant species include hoof infection, skin disease, dog bite, wounds blisters, eczema, hemorrhagic septicemia, foot and mouth disease, and burns (Tiwari & Pande 2010).

The present study documented the anthelmintic property of the leaf juice of *Clematis grata* in cattle. No literature reports on ethnoveterinary uses of this species could be found for (Table 2). A paste prepared from the whole herb or roots of *Cynodon dactylon* was applied to cattle wounds in the study area. In J&K, the whole plant is generally given as feed, and the plant paste made with water is applied to the pelvic region to treat the problem of oliguria in cows, buffaloes, sheep, and goats (Khateeb *et al.* 2015). In Andhra Pradesh, the whole plant of *C. dactylon* is known as 'Garika' and mixed with pepper along with toddy and given orally twice a day for one week to treat rheumatism in cattle, buffaloes, goats, and sheep (Ramana 2008), whereas in Assam it is used to treat vomiting in goats, pigs, and cow (Kumar *et al.* 2020). Ethnoveterinary uses as galactagogue and to treat conjunctivitis were also reported previously from Central India (Sikarwar & Tiwari 2020), and use for gastric troubles, bone fracture, sprains, mastitis, and clotting of internal blood injury has been reported from Uttarakhand (Pande *et al.* 2007).

The leaf juice of *Ficus carica* was used to expel worms from wounds in cattle. The tribal communities in Todgarh-Raoli Wildlife Sanctuary of Rajasthan use the latex of *Ficus carica* for treating eczema and carbuncles in animals (Galav *et al.* 2013). The ethnic tribal communities in Darjeeling District of West Bengal use the leaves and fruits of *F. carica* to treat diabetes and gastric problem in domestic animals (Mondal 2012).

The roots of the *Geranium wallichianum* were directly given to animals to cure pyrexia and as galactagogue. Previous studies in J&K reported the use of crushed fresh roots against weakness, inflammation of hooves, warts, and abscessions in

cows (Bhardwaj *et al.* 2013, Khuroo *et al.* 2007), while the use to treat bone fractures and broken horns was reported from Uttarakhand (Pande *et al.* 2007, Phondani *et al.* 2010). The dried root powder of *Girardinia diversifolia* was given with milk to cattle to cure retention of the placenta, while the leaf paste was applied externally to treat wounds. The root paste of *G. diversifolia* has been previously reported to be used in pimples and boils in domestic animals in Uttarakhand (Tiwari & Pande 2006). The fresh leaves of *Grewia optiva* were given orally to treat retention of placenta in cows and buffaloes. In Uttarakhand the species is used to remedy throat infection, indigestion, dysentery, constipation, diarrhea, bone fracture, sprains, tonsils, pregnancy, and to increase lactation (Pande *et al.* 2007).

The leaf decoction *Mentha longifolia* made in tea was given to cattle to cure pyrexia. No such use reports have been found in literature. The roots of *Phytolacca acinosa* were given to animals in the study area to cure the inability to inseminate. A previous study from District Doda, J&K reported a powdered mixture from the whole plant with whey and milk given to cows, buffaloes, sheep, and goats to treat hematuria (Khateeb *et al.* 2015). The indigenous people in Himachal Pradesh use the leaves and twigs to treat cough, cold, and constipation in livestock (Radha *et al.* 2020), while the tribal communities in Uttarakhand give seeds orally to domestic animals to treat pneumonia, and leaves to treat fever (Juyal & Ghildiyal 2013, Tiwari & Pande 2006). Fever and joint pain in Yak were reported to be treated using the roots of *P. acinosa* by the Monpa tribe in Arunachal Pradesh (Maiti *et al.* 2013).

The pounded flowers of *Primula denticulata* were given orally to cattle to treat snakebite, and the same use has been reported earlier from Poonch district (Khan and Kumar, 2012).

The respondents gave the dried fruit rind powder of *Punica granatum* to cattle to treat uterus prolapse (Table 2). The comparative literature included various other ethnoveterinary uses for other parts of this plant from J&K and other Indian states. In Jammu and Kashmir, the local inhabitants give the fruit paste and seeds of *P. granatum* orally to animals to treat urinary problems, hemorrhagic enteritis, and liver problems (Jamwal & Kant 2008, Khateeb *et al.* 2015). A paste prepared by mixing chopped leaves of *P. granatum*, root bark powder of *Ficus religiosa*, and *Sesamum indicum* oil has been reported from the rural women Banaskantha district of Gujrat to treat skin infections in animals (Khandelwal 2017). The indigenous people in the Garhwal Himalayan Region give the ground leaves of *P. granatum* to animals twice a day for three days to treat diarrhea (Bhatt *et al.* 2013).

The root powder and root decoction of *Ranunculus bulbosus* was given orally to cattle to treat pneumonia and to expel intestinal worms. This use was reported for the first time from India (Table 2). The present study reported the use of powdered roots of *Rumex nepalensis* combined with buttermilk to treat general weakness and cough in cattle. The Gujjar tribe in Kashmir Himalaya was reported to prepare semi-solid balls from the roots of *R. nepalensis* by boiling the root powder in milk along with salt, which then was given to newborn calves to protect them from juvenile infections (Khuroo *et al.* 2007). The mixture of roots of *R. nepalensis* and *Piper nigrum* has been reported to treat fever, tympany, and bloat in cows, buffaloes, sheep, and goats (Khateeb *et al.* 2015). This plant species has also been reported to treat diarrhea and dysentery from Uttarakhand (Pande *et al.* 2007).

According to the participants, the boiled leaves *Skimmia laureola* were given to cattle to cure pyrexia, while the leaf powder was mixed with milk and given to cattle to treat cold. The root paste was applied externally to treat fractures in animals also. In J&K, the oral administration of leaves twice a day for seven days has been reported previously to treat anemia in cows, buffaloes, sheep, and goats (Khateeb *et al.* 2015).

The use of leaves of *Ulmus villosa* to treat prolapse in cattle in the present study was for the first time reported from India (Table 2). *Urtica dioica* roots were given to cattle as a galactagogue. Pande *et al.* (2007) reported the ethnoveterinary use of this species from Uttarakhand to treat abdominal pain wounds, bone fracture sprains, hematuria, rheumatism, neck sore, lactation, and regulate fertility. The present study found the fresh leaves of *Viburnum grandiflorum* given orally to treat constipation, which has never before reported from India.

The leaves of *Vitex negundo* were given orally in the study area to cattle to cure pyrexia. In other studies the leaves were used to treat stomachache, reddening eyes, and diarrhea in milk-yielding animals and camels (Sharma *et al.* 2012, Sharma & Manhas 2015). The leaves and twigs of this species were used as an appetizer and against mastitis in livestock Himachal Pradesh (Sehgal & Sood 2013), while in Uttarakhand and Karnataka the same plant part was used as antidote against snake bites in animals (Harsha *et al.* 2005). The chiru tribe in Manipur uses the leaves to treat dermatitis in domestic animals (Rajkumari *et al.* 2014), antibacterial and anthelmintic properties in cattle, were reported from Tamil Nadu (Kiruba *et al.* 2006).

In the present study, flour of *Zea mays* was given with water to treat foot and mouth disease (FMD) in cattle,

whereas previous studies from India showed the seeds and flour of *Zea mays* useful against constipation in livestock in the Hamirpur district of Himachal Pradesh (Sehgal & Sood 2013). Sharma *et al.* (2012) reported the use of maize seeds as a galactagogue in milk-yielding animals from District Kathua of J&K. In Karnataka the stamina of the species are used to treat urinary inflammation in livestock (Kumar & Nagayya 2017), while in Andhra Pradesh's people use the corns of maize were reported for treating reproductive disorders (Pragada & Rao 2012).

Novelty of the study

The current study reported novel ethnoveterinary uses for seven species (*Aconitum violaceum*, *Arisaema jacquemontii*, *Bistorta amplexicaulis*, *Clematis grata*, *Ranunculus bulbosus*, *Ulmus villosa* and *Viburnum grandiflorum*.)

Conservation perspective

Of the 31 reported species, only ten species (*Allium cepa*, *Allium sativum*, *Brassica rapa*, *Capsicum annum*, *Grewia optiva*, *Mentha longifolia*, *Prunus armeniaca*, *Punica granatum*, *Vitex negundo*, *Zea mays* have been brought under cultivation. There is great need for the cultivation and conservation of the remaining plant species to improve their sustainable use.

Conclusion

This current study's findings show the extent of information among the Gujjar and Bakarwal tribes living in the Poonch district of Jammu and Kashmir, India, regarding medicinal plants and their usefulness in livestock care. The congruence between the ethnoveterinary uses documented in the present study and the uses reported found in literature for most plant species supplement information on the traditional ethnoveterinary uses of the respective plants. The present study found no specific herbal remedy for the cows, buffaloes, oxen, and horses - the same treatments were given to different animals. However, the dose of the preparation varied according to the animals' species and age. Proper scientific validation would be an essential step for the standardization and wider utilization of ethnoveterinary species, and the possible development of allopathic ethnoveterinary drugs from this resources. The lack of cultivation of most plant species in the study area is a concern and needs to be addressed by the relevant authorities so that proper initiatives could be developed.

Declarations

Abbreviations: N/A

Ethics approval and consent to participate: Prior informed consent was obtained from the participants before conducting interviews.

Competing Interest: The authors declare that they have no competing interests.

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