Exploring Traditional Veterinary Practices from Gujjar and Bakarwal Tribes of District Poonch, Jammu & Kashmir: A Boon for Animals from Our Ancestors

Abhishek Dutta
University of Jammu
Kanwaljeet Singh
University of Jammu
Bikarma Singh
NBRI: National Botanical Research Institute CSIR
Yash Pal Sharma (yashdbm3@gmail.com)
University of Jammu https://orcid.org/0000-0003-3268-5588

Research

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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. However, this knowledge is getting diminished day by day due to several factors. The present study was aimed to survey and document 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 various livestock ailments.

Methods: A systematic and extensive ethnobotanical survey was conducted in 12 villages of district Poonch between July 2018-March 2020. Data was gathered from the tribals using semi-structured questionnaires and analysed 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 24 families of 30 genera with herbs as the dominantly used plant species (70.97%). The most commonly used plant part in the herb

al preparations was root (35.14%) and leaf (32.43%) with oral administration as the mode. Consensus methodology has been used as a statistical tool to identify the most potentially effective medicinal plant species. Use-value and Relative frequency of citation were reported to be in the range of 0.03-0.72 and 0.03-0.48 respectively. Based on values, *Rumex nepalensis* was found to be the most important and dominant species used by the tribes. The reported Informant consensus factor value was found to be very high (0.81-1.00) thereby establishing more authenticity of the study. Maximum number of plant species (10 spp.) were used to treat the gynaecological/ andrological problems.

Conclusion: In the present study, novel ethnoveterinary use for seven plant species *viz., 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.

Introduction

Ethnoveterinary knowledge is a holistic body of folk beliefs, skills, knowledge, experience, and practices employed by indigenous communities in curing various ailments of livestock This knowledge varies across countries, regions, and communities. Ethnoveterinary medicine deals with the plants or plant parts used to treat a spectrum of livestock diseases [1, 2]. These traditional knowledge and practices have been practiced since time immemorial in animal husbandry and animal healthcare facilities to keep livestock healthy [3, 4]. These traditions are still in vogue and are employed by various rural ethnic 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 [5].

In India, ethnoveterinary medications have been used since ancient times [6]. Vedic literature, particularly Atharvaveda is a repository of traditional medicine that includes prescriptions to treat animal diseases. There are rich and fruitful ethnoveterinary traditions that form an integral part of the family and have an important religious and economic social role. The tribals know the principles, operations, and skills of the administration

of health care and livestock. Livestock contributes in many respects to the socio-economic growth of the rural masses. Because of the inelastic labor absorption ability in other economic sectors, the livestock sector has the potential to generate more job opportunities, especially for marginal and small-scale farmers and landless workers, who own about 70% of the country's livestock. Living in the rural areas and far away from towns and cities, economically downtrodden tribal communities depend on plant-based medicines for common diseases. In the rural, economically, and educationally backward tribal communities of India, the usage of medicinal plants for the treatment of diseases is a common practice [7, 8]. Ethno-veterinary knowledge is often conveyed vertically or horizontally through centuries, like many other conventional knowledge structures, mostly through oral transmission, which leaves only a limited portion of it available to science [9, 10, 11]. This traditional oral knowledge is on the verge of getting extinct 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. Moreover, the young generation of the present era show little interest in learning traditional herbal practices and are therefore less knowledgeable [12–14].

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 tribal communities rely heavily on traditional phytotherapies and traditional healers [15]. Literature reveals various workers have documented the traditional ethnoveterinary knowledge from J&K [15–20, 4].Screening of literature suggested studies on the ethnoveterinary uses of plant species lack in the district Poonch (J&K). Given this, an attempt has been made to document and describe various cattle diseases and their remedies practiced by Gujjar and Bakarwal communities of district Poonch.

Material And Methods

Study Area

District Poonch, is one of the remote districts of Union Territory of J&K flanked at an altitudinal range of 800-4,750 masl. It lies between 73º 58'- 74 º 35' E longitude and 33º 25'- 34º 01' N latitude. Situated on the southerly foothills of Pir Panjal range of J&K, it is bounded by Kashmir in 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 having 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 within 6 tehsils and 11 blocks comprising of 178 villages and 51 panchayats. The total population of 4,75,835 (Census 2011) encompasses the total geographic area of 1674 Km^2. About 96% of the population lives in isolated villages [21]. Most of the rural population depends upon agriculture and animal husbandry. Gujjars and Bakarwals constitute the major chunk of the population, while Gujjars are semi-nomadic whereas Bakarwals are the true nomadic. There is a huge dependence of these communities on local flora for their basic needs as they rear livestock at high pastures and are devoid of modern conveniences [20]. The district is rich in terms of biodiversity nurturing various 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 dipyrena* 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 agricultural croplands.

Methodology

Survey and data collection

An extensive and systematic field exploration was conducted in the study area for the collection of plants that are being used by the local inhabitants to treat several disorders and diseases in livestock from July 2018 to March 2020. A total of 58 informants including traditional healers, shepherds, milkmen, elder people, and others belonging to Gujjar and Bakarwal tribes were interviewed using a semi-structured questionnaire. While interviewing informants, utmost attention was given to folk and indigenous veterinary knowledge of both wild as well as cultivated medicinal plants.

The medicinal plants were photographed (Nikon D5300, 18–140 mm), plant samples collected from the study area, and GPS coordinates of the same (using Garmin Etrex30x) were recorded. Plants collected were dried using plant press, mounted on herbarium sheets, and identified by consulting the herbaria of 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 [22, 23]. For the latest accepted names and nomenclatural position of the taxa, Plants of the World Online was followed [24]. The voucher specimens were submitted to the herbarium, Department of Botany, University of Jammu, Jammu, J&k, India.

Data analysis

The data obtained by interviewing the informants was analyzed quantitatively using four indices *viz.*, use-value (UV), Relative Frequency of Citation (RFC), Informant Consensus Factor (IFC), and Fidelity Level (FL%).

Use-value (UV)

Use-value (UV) was calculated to know types of uses associated with particular species and their relative importance to the informants [25]. It was calculated by the equation:

$UVs = \Sigma U / n$

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 informants 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 [26] and was calculated using the below-given equation:

RFC = Fc/N

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

Informant consensus factor (ICF)

To determine the homogeneity for a particular plant species, all the diseases of the livestock were broadly classified into 9 categories and the Informant consensus factor [27] was calculated using the following equation:

$ICF = nur\text{-}nt/nur - 1$

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 informants and is near 0, when there is no exchange of knowledge among the informants and chose plants randomly.

Fidelity level (FL)

To know the percentage of informants showing a preference for a particular plant species over others in the treatment of ailment [28], Fidelity level was calculated using the below-given equation:

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

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 informants stating the plant useful for any ailment category.

Results And Discussion

Demographic description of informants 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 informants belonging to the age group between 25–84 were interviewed for the documentation of traditional veterinary knowledge from twelve villages of district Poonch (Table 1). Most of the informants were males, i.e., 44 (75.86%), and the rest 14 (24.14%), were females. All these informants were from the tribal community of Gujjar and Bakarwal of the study area. The majority of them belong to the age group 45–74 yrs. Moreover, poorly educated people, i.e., up to primary standard were dominant in the study. The informants' participation below 45 yrs was less, whereas; older informants contributed a major portion of the knowledge depicting higher possession of ethnoveterinary knowledge. Also, female informants' proportion was low because they are quite taciturn and interact comfortably only with a female researcher.

Table 1
Demographic description of the informants

INFORMANTS		
Female	14 (24.14%)	
Male	44 (75.86)	
Age Group	Female	Male
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	Female	Male
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 represents 31 plant species belonging to 30 genera and 24 families, which are being used by the tribal 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 single species. Ahmad *et al.* [29] previously documented 32 ethnoveterinary plants encompassing 19 families from the Kashmir Himalayan region. A comprehensive survey of Sharma *et al.* [15] from district Kathua of Jammu division (J&K) reported 72 ethnoveterinary plants, with Fabaceae being the most represented one. Similarly, plant species of Euphorbiaceae were found to be dominantly used in ethnoveterinary practices in Rajasthan [30]. The recent review article of Sikarwar and Tiwari [6] reported 270 plant species of 84 families used by rural tribes and Central India people for ethnoveterinary practices. 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 [31, 29]. However, some previous studies also reported trees to be mostly used for veterinary purposes [32, 33].

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
Achillea millefolium 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
Aconitum violaceum 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
Acorus calamus 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
Allium cepa 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
Allium sativum 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
Arisaema jacquemontii Blume/ Araceae	JUH004	H	Sapp ni makk	Corm	33°35'51.8"N 74°24'24.4"E	2073	Underground part is powdered and	14	0.24	0.14

							given orally to cattle to cure Pyrexia (8). A paste of same powder is applied on the affected part to treat snakebite (6).			
Berberis lycium 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**
Bistorta amplexicaulis (D.Don)	JUH032	H	Masloon	Whole plant, Root	33°36'32"N 74°23'17"E	1748	Rhizome given to animals as	20	**0.34**	**0.34**

Greene/ Polygonaceae							galactagogue (20)			
*Brassica rapa*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
Calotropis procera (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
Cannabis sativa 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
Capsicum annuum L./	JUH008	H	Merch	Fruit	33°40'15"N	1264	Mature fruits	14	0.24	0.14

Solanaceae					74°08'34"E		are powdered and given with butter milk (lassi) to cattle to cure cough (6). Fruits are given orally to treat pyrexia in cattle (8).			
Clematis grata 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
Cynodon dactylon (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
Ficus carica 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
Geranium wallichianum D.Don ex Sweet/ Geraniaceae	JUH111	H	Rattanjot	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

Girardinia diversifolia (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
Grewia optiva 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
Mentha longifolia (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
Phytolacca acinosa 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
Primula denticulata Sm./ Primulaceae	JUH134	H	Lattar-phul	Flower	33°51'31"N 74°20'31"E	2563	Flower is pounded and given to	5	0.09	0.09

							livestock on snakebite (5).			
Prunus armeniaca 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**
Punica granatum 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**
Ranunculus bulbosus 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**
Rumex nepalensis 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,	42	**0.72**	**0.48**

							powdered, and mixed with buttermilk for three days. After three days, it is given to cattle for three days to treat cough (14).			
Skimmia laureola (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**
Ulmus villosa 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 *Trigonella* sp. (in winter) to eat orally for	8	**0.14**	**0.14**

							treating prolapse in cattle (8).			
Urtica dioica 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**
Viburnum grandiflorum 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**
Vitex negundo 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**
Zea mays 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**

Parts used, preparation form, and route of administration

The most used plant part in herbal preparation was root (35.14%), followed by leaf (32.43%), fruit (10.81%), seed, and whole plant (5.41% each), and bulb, corm, flowers, and stem (2.7% each) (Fig. 2). In contrast, most of the previous studies carried out in J&K and other states of India reported leaves as the significant plant parts used in the ethnoveterinary practices [34–36, 15,). In the present study, the oral mode was observed to be the dominant mode for the administration of the herbal preparations, with 24 species exclusively consumed in oral form, which concurs with Mandal and Rahaman [37] reports. Topical, as well as both oral and topical administration methods were recorded for two and five species each, respectively. The Gujjars and Bakarwals tribes mostly believe that the herbal preparation's concentrated dose depends upon the severity of an ailment and animal size; therefore, the doses of the remedies were found highly variable in the present investigation.

Therapeutic values

Livestock is an integral part of tribal communities of Gujjar and Bakarwal in the study area and plays an important social and economic role in their life. Therefore, these communities still rely on ethnoveterinary medicine for the treatment of various ailments *viz*., pneumonia, pyrexia, constipation, vermicidal, stomach pain, accouchement, galactagogue, inability to inseminate, prolapse, wounds, retention of placenta, general weakness, fracture, FMD, hemorrhagic septicemia, maggots in wounds, body pain, cold, cough, and snakebite. Most of the ailments belong to gynecological/ andrological, dermatological, gastrointestinal, and liver-related issues. The treated animals documented in the present study were buffalo, ox, horse, cows, sheep, and goat.

The majority of plant species in the present investigation have been used to cure a single disease, showing these species' usefulness and reliability for treatment purposes. The reported plant species in the present study are either cultivated or collected from the forests as these communities spent most of their time in the forests, therefore providing cost-effective treatment to the cattle compared to the modern drugs. Except for the herbal preparation *A. calamus* and *U. villosa* in which fruit of *C. annum* and seeds of *Trigonella sp.* are mixed, plant parts of all the species were used solitarily for the treatments.

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

Following use-value (UV), 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. Relative frequency of citation shows the maximum used therapeutic plants used by the local populace to treat various ailments regarding the number of informants mentioning them as useful. 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 informants cited these. In the present study, RFC ranges from 0.48 – 0.03 (Table 2).

Informant Consensus Factor

All the ailments reported from the study area, which were cured using traditional remedies, were broadly classified into 09 different ailment categories. The highest consent of the informants 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.* [15] who reported the highest ICF for urological disorders (0.95) and lowest for nutritional diseases (0.80). In another study, ICF value in the range of 0.75–0.95 was reported by Meen *et al.* [38] 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 informants share the information among themselves. The maximum number of plant species used for treating the Gynecological/Andrological disorders were 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
Gynaecological/ 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

Fidelity level (FL%)

The importance of plant species in the particular ailment category was accessed through fidelity level (FL %), ranging from 24–100%. 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%).

Similarly, fever was mainly treated by *Allium sativum*, *Mentha longifolia*, and *Vitex negundo* (FL = 100% each); Gastrointestinal disorders by *Acorus calamus*, *Prunus armeniaca*, and *Viburnum grandiflorum* (FL = 100% each), *Cannabis sativa* (55.56%), and so on. Gynecological/Andrological disorders by *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 are *Berberis lycium* (FL = 40%), *Skimmia laureola* (Fl = 32%) to cure Muscular-skeletal disorders; *Calotropis procera*, *Zea mays* (FL = 100% each), *Rumex nepalensis* (FL = 66.67%) for Miscellaneous disorders; *Cannabis sativa* (FL = 44.44%) for Physical pains; *Capsicum annuum* (FL = 42.86%), *Rumex nepalensis* (FL = 33.33%), for Respiratory disorders and *Achillea millefolium*, *Aconitum violaceum*, *Allium cepa*, *Primula denticulata* (FL = 100% each), *Arisaema jacquemontii* (FL = 42.86%) for snake bite. In the search for novel bioactive compounds, plants with high FL values should be further studied in vitro, and younger generations could be trained in ethnoveterinary activities. (Table 4)

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

Ailment category	Plant	NP	N	FL%= NP/N×100
Dermatological	*Clematis grata* Wall./ Ranunculaceae	5	5	100.00
	Cynodon dactylon (L.) Pers./ Poaceae	8	8	100.00
	Girardinia diversifolia (Link) Friis/ Urticaceae	6	14	42.86
	Berberis lycium Royle/ Berberidaceae	12	20	60.00
Fever	*Allium sativum* L./ Amaryllidaceae	5	5	100.00
	Arisaema jacquemontii Blume/ Araceae	8	14	57.14
	Capsicum annuum L./ Solanaceae	8	14	57.14
	Geranium wallichianum D.Don ex Sweet/ Geraniaceae	4	6	66.67
	Mentha longifolia (L.) L./ Lamiaceae	7	7	100.00
	Ranunculus bulbosus L./ Ranunculaceae	10	18	55.56
	Skimmia laureola (DC.) Decne./ Rutaceae	11	25	44.00
	Vitex negundo L./ Lamiaceae	8	8	100.00
Gastrointestinal	*Acorus calamus* L./ Acoraceae	2	2	100.00
	Cannabis sativa L./ Cannabaceae	5	9	55.56
	Prunus armeniaca L./ Rosaceae	8	8	100.00
	Ranunculus bulbosus L./ Ranunculaceae	8	18	44.44
	Viburnum grandiflorum Wall. ex DC./ Viburnaceae	6	6	100.00
Gynaecological/ Andrological	*Bistorta amplexicaulis* (D.Don) Greene/ Polygonaceae	20	20	100.00
	Brassica rapa L./ Brassicaceae	6	6	100.00
	Ficus carica L./ Moraceae	5	5	100.00
	Geranium wallichianum D.Don ex Sweet/ Geraniaceae	6	6	100.00

	Girardinia diversifolia (Link) Friis/ Urticaceae	8	14	57.14
	Grewia optiva J.R.Drumm. ex Burret/ Malvaceae	5	5	100.00
	Phytolacca acinosa Roxb./ Phytolaccaceae	8	8	100.00
	Punica granatum L./ Lythraceae	10	10	100.00
	Ulmus villosa Brandis ex Gamble/ Ulmaceae	8	8	100.00
	Urtica dioica L./ Urticaceae	12	12	100.00
Muscular-skeletal disorders	*Berberis lycium* Royle/ Berberidaceae	8	20	40.00
	Skimmia laureola (DC.) Decne./ Rutaceae	8	25	32.00
Miscellaneous	*Calotropis procera* (Aiton) W.T.Aiton/ Apocynaceae	4	4	100.00
	Rumex nepalensis Spreng./ Polygonaceae	28	42	66.67
	Zea mays L./ Poaceae	3	3	100.00
Physical pains	*Cannabis sativa* L./ Cannabaceae	4	9	44.44
Respiratory	*Capsicum annuum* L./ Solanaceae	6	14	42.86
	Rumex nepalensis Spreng./ Polygonaceae	14	42	33.33
	Skimmia laureola (DC.) Decne./ Rutaceae	6	25	24.00
Snake bite	*Achillea millefolium* L./ Asteraceae	4	4	100.00
	Aconitum violaceum Jacquem. ex Stapf/ Ranunculaceae	2	2	100.00
	Allium cepa L./ Amaryllidaceae	5	5	100.00
	Arisaema jacquemontii Blume/ Araceae	6	14	42.86
	Primula denticulata Sm./ Primulaceae	5	5	100.00

Comparative assessment of traditional uses with the previous studies

To find out the novelty in the conventional usage of plant parts for various types of ethnoveterinary diseases use of the documented medicinal plant species were therefore comparatively analyzed with the literature reports in different regions of the J&K and available data from other states of India. The present study reported using root powder of *Achillea millefolium* to be given to cattle on snakebite (Table 2). Besides, a previous study from district Rajouri (J&K) has reported the use of shoots and leaves for urinary disorders in cattle [39]. In Himachal Pradesh, the dried powder of the whole plant of *A. millefolium* is given orally with hot water to treat wound heal, skin allergy, and sunburn [40]. The root powder of *Aconitum violaceum* is given to Buffalos, Ox, and Horse in case of snakebite (Table 2). From India, ethnoveterinary use reports for this plant species lack in the literature.

As per the study area respondents, the root powder of *Acorus calamus* is given orally to treat stomach pain in horses. Previous literature survey revealed many other important ethnoveterinary uses for different parts of this plant. The tribal and rural communities in Uttar Pradesh is previously reported to use the leaf pastes and rhizome powder of *A. calamus* to treat wounds in animals [41]. An amalgamation of rhizome powder of *A. calamus* and *Artemisia scoparia* prepared in *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's [36]. A study carried out previously in the Shivalik Hilly zones of Himachal Pradesh reported the ethnoveterinary use of *A. calamus* rhizome powder and included to treat epilepsy, urinary problems, hydrocele, and expelling out the worms [42]. 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 [43, 44].

The bulb powder of *Allium cepa* is given orally to animals to treat snakebite in the study area (Table 2). The people in the Bandipora district of Jammu and Kashmir used the softballs prepared by crushed bulbs of *A. cepa* and salt as a remedy for cattle against cold, anorexia, and cows stimulate the oestrus cycle. These balls are also given to horses to cure the frothy bloat caused due to the grazing of (*Trifolium repens*) [45]. The oral intake of 100g paste of *Allium cepa* is also reported to alleviate cattle swelling [39]. The mixture of powdered bulbs of *Allium cepa* with black salt is given along with water to cure the mouth's infection and hoops in cattle in Hassan District of Karnataka [46]. 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 poisoning [47]. In Orissa, the bulb paste of *A. cepa* is reported to cure fever [48], whereas the tribal society in Rajasthan gives the whole plant's oral decoction to sheep and goats as a tonic and febrifuge [38].

The bulbs of *Allium sativum* are 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, buffalo [44]. In the Kalakote range of Jammu and Kashmir, bulb paste of *A. satium* and curd is given to female buffalos and is considered an aphrodisiac [39]. A paste of bulb is administered once daily for five days to treat cough by the tribal in Andhra Pradesh [49]. In Haryana, the oral intake of garlic and elaichi mixed with jaggery is reported to cure cold and fever [50]. A plethora of ethnoveterinary properties such as cough & cold, bronchitis, brain disease, earache,

indigestion, food poisoning, diarrhea, injuries, snake bite is reported from Central India using the juice of bulbs of *A. satium* and using the bulbs in multiple combinations with mustard oil or mustard oil and ash of cow dung cake or bulb paste and beeswax or bulb paste, milk, and cooking oil [6]. 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 [33]. 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 [38]. 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 [51]. Anthelmintic property is reported for these plants' bulbs from West Bengal [52].

The underground part of *Arisaema jacquemontii* is powdered and given orally to cattle to cure pyrexia and snakebite in the study area. No ethnoveterinary uses have been found in the literature for this plant species. The powder of stem bark and paste prepared from the outer bark of root *Berberis lycium* is 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* is previously reported to treat jaundice in Cow, Goats, and Buffalo from the Doda district of J&K [44]. The bark of *B. lycium* is also used to treat mouth and foot disease of cattle in Western Himalaya [53]. The present study reported the use of rhizome of *Bistorta amplexicaulis* as a galactagogue. The residue left after extracting the seed oil from *Brassica rapa* is locally known as 'Khal' in the study area and is used as a galactagogue (Table 2). The seed oil *B. Rapa*, in combination with the paste of bulb of *Allium cepa* is previously reported to be used in treating wounds in Madhya Pradesh [54].

The leaf of *Calotropis procera* is used to treat hemorrhagic septicemia and swellings in the study area (Table 2). Literature survey revealed 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 the inflamed areas to relieve inflammation and on snake bite to neutralize poison [49]. The people in Central India used the roots, leaves, and flowers of this plant species either in powder form or in combination with milk or mustard oil to treat a bone fracture, tumor, healing of wounds, swelling, conjunctivitis, earache, skin diseases, urine retention, easy delivery, snake bite, indigestion, diarrhea and dysentery, stomachache, falling of tail [6]. The leaves and leaf latex are reported to remove intestinal worms in sheep, act as a galactagogue, and be employed in the detachment of the placenta after delivery, respectively [50]. The indigenous people in Himachal Pradesh apply the milky leaf latex on the bitten part of the body to neutralize the poison snake and dog [36].

The present study documented the whole plant powder of *Cannabis sativa* to be given orally to treat body pains in cattle's whereas the powdered leaves balls locally known as 'Peda' are given to cattle to treat intestinal worms (Table 2). The Karbi tribe in Assam and the Vaidya's, 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, respectively [32, 55]. The ethnoveterinary properties such as reddishness, cough, cataract, urinogenital disorders using the leaves and seeds of *C. sativa* are also reported from the Shivalik Hills of Himachal Pradesh [42]. The pastoralists in Jammu and Kashmir use the whole plant powder for improving the poor reproductive performance in cattle and buffalos [57], while in the Kalakote range of J&K, the leaf powder is given orally for anorexia in cattle [39]. In Orissa, balls made from the *C. sativa* and seeds of *Cicer arietinum* is given orally once a day against chronic dysentery in cattle [48]. In Sikkim Himalaya, the stem pieces of *C. sativa* are fed to the livestock to treat inflammation and act as a tonic to

cattle [56]. In Uttarakhand, the traditional herbal healers apply the boiled leaves of Cannabis sativa with the ash of *Pinus roxburghi* and black salt externally to treat sprain in animals such as cow, buffalo, sheep, goats, dog [47].

The fruits of *Capsicum annuum* are given orally to treat pyrexia in cattle, and the mature fruits powder is given with buttermilk (lassi) to cattle to cure cough in the study area. The fruit paste is reported earlier to be useful against mouth disease in animals [49]. The mixture *of C. annum* fruit and salt was reported by the pastoralists of J&K to be useful against endoparasites [57]. 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 [32]. In Uttarakhand, the healers are reported to use the powdered mixture of the pod of C. annum and bark of *Zanthoxylum armatum* to treat fasciolosis in Buffalo, Cow, and Oxen [47]. 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 [51].

The present study documented the anthelmintic property of leaf juice of *Clematis grata* in cattle. Literature reports concerning its ethnoveterinary uses have not been reported hitherto in India (Table 2). A paste prepared from the whole herb or roots of *Cynodon dactylon* is reported to be applied to cattle wounds in the study area. Previous literature reports documented besides various other ethnoveterinary uses of this plant from India. In J&K, the whole plant is given as feed, and also the plant paste made with water is applied to the pelvic region to treat the problem of oliguria in Cow, Buffalo, Sheep, and Goats [44]. In Andhra Pradesh, the whole plant *C. dactylon* is known as 'Garika' and is mixed with pepper along with toddy and given orally twice a day for one week to treat rheumatism in cattle, buffalo, goat, and sheep [58], whereas in Assam the whole plant of *C. dactylon* is used to treat vomiting in goat, pig, and cow [55]. The ethnoveterinary uses, i.e., to increase lactation and treat conjunctivitis of the leaf juice and aerial plant part of this species, are also reported previously from Central India [6]. Various ethnoveterinary uses for this plant have been reported from Uttarakhand and include gastric troubles, bone fracture, sprains, mastitis, and clotting of internal blood injury [59].

Leaf juice of *Ficus carica* is used to expel worms from wounds in cattle. The tribals in Todgarh-Raoli Wildlife Sanctuary of Rajasthan uses the latex of *Ficus carica* for treating eczema and carbuncles in animals [30]. 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 [43].

The roots of the *Geranium wallichianum* are directly given to animals to cure pyrexia and galactagogue. Previous studies in J&K reported the use of crushed fresh roots against weakness, inflammation of hooves, warts, and abscissions in cows [18, 45], while bone fracture and broken horns are reported to be treated by the traditional healers using this plant in Uttarakhand [59, 47]. The dried root powder of *Girardinia diversifolia* is given along with milk to cattle to cure retention of the placenta, while the leaf paste is 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 [60]. The fresh leaves of *Grewia optiva* is given orally to treat retention of placenta in cows and buffaloes. Previous reported ethnoveterinary uses from Uttarakhand for this plant include throat infection, indigestion, dysentery, constipation, diarrhea, bone fracture, sprains, tonsils, pregnancy, lactation [59].

The leaf decoction *Mentha longifolia* made in tea is given to cattle to cure pyrexia. No such use reports have been found in the literature. The roots of *Phytolacca acinosa* are given to animals to cure the inability to inseminate in the study area. A previous study from District Doda, J&K reported the whole plant's powdered mixture with whey and milk given to Cow, Buffalo, Sheep, and Goat to treat hematuria [44]. The indigenous people in Himachal Pradesh use the leaves and twigs to treat cough, cold, constipation in livestock [40], while the tribals in Uttarakhand give seeds orally to the domestic animals to treat pneumonia and leaves to treat fever [60, 61]. Fever and joint pain in Yak is reported to be treated using the roots of *P. acinosa* by the Monpa tribe in Arunachal Pradesh [62]. The pounded flowers of *Primula denticulata* are given orally to cattle to treat snakebite, and the same user has been reported earlier by Khan and Kumar [63] from Poonch district.

The respondents give the dried fruit rind powder of *Punica granatum* to cattle to treat prolapse (Table 2). The comparative literature review revealed various other ethnoveterinary uses for other parts of this plant from J&K and other Indian states. In Jammu and Kashmir, the local inhabitants and tribals give the fruit paste and seeds of *P. granatum* orally to animals to treat urinary problems, hemorrhagic enteritis, and liver problems, respectively [39, 44]. A paste prepared by mixing chopped leaf of *P. granatum*, root bark powder of *Ficus religiosa*, and *Sesamum indicum* oil has been reported to be used by the rural women Banaskantha district of Gujrat to treat skin infections in animals [64]. The indigenous people in Garhwal Himalayan Region gives the grounded leaves of *P. granatum* to the animal twice a day for three days to treat diarrhea [65].

The root powder and root decoction of *Ranunculus bulbosus* given orally to cattle to treat pneumonia and to expel intestinal worms, respectively, in the study area are reported for the first time from India (Table 2). The present study reported using roots powder *Rumex nepalensis* combined with buttermilk to treat general weakness and cough in cattle (Table 2). Besides, the Gujjar tribe in Kashmir Himalaya prepared semi-solid balls from the roots of *R. nepalensis* by boiling the root powder in milk along with salt and give it to the newly born calf to protect them from juvenile infections [18]. In Cows, buffalos, sheep, and goats, the mixture of roots of *R. nepalensis* and *Piper nigrum* has been reported to treat fever, tympany, and bloat [44]. This plant species has also been reported to treat diarrhea and dysentery in Uttarakhand animals [59].

According to the informants, the boiled leaves *Skimmia laureola* are given to cattle to cure pyrexia, while the leaf powder is given with milk to cattle to treat cold. Besides, root paste is applied externally to treat fractures in animals also (Table 2). In J&K, the oral administration of leaves twice a day for seven days has been reported previously to treat anemia in Cow, Buffalo, Sheep, and Goats [44]. The use of leaves of *Ulmus villosa* to treat prolapse in cattle in the present study is the first reported from India (Table 2). *Urtica dioica* is commonly known as "stinging nettle". The roots of this plant are given to cattle as a galactagogue (Table 2). Pande *et al.* [59] reported various ethnoveterinary uses of this plant from Uttarakhand and include abdominal pain wounds, bone fracture sprains, hematuria, rheumatism, neck sore, lactation, and regulate fertility. The present study reported the fresh leaves of *Viburnum grandiflorum* to be given orally to treat constipation (Table 2) and is reported for the first time from India.

The leaves of *Vitex negundo* are given orally to cattle to cure pyrexia in the study area. Comparative literature review from J&K and other states of India revealed various other uses for the same plant part. The leaves are used to treat stomach ache, reddening eyes, and diarrhea in milk-yielding animals and camels, respectively, in J&K [15, 66]. The leaves and twigs of this plant are used as an appetizer and against mastitis in livestock in

H.P [67], while in Uttarakhand and Karnataka, the same plant part as an antidote against snake bites in animals [68]. The chiru tribe in Manipur uses the leaves to treat dermatitis in domestic animals [35], while the same plant part shows antibacterial and anthelmintic properties in cattle, as reported from Tamil Nadu [69].

In the present study, the *Zea mays* flour is reported to be given with water to treat foot and mouth disease (FMD) in cattle (Table 2), whereas a previous literature survey from India revealed other ethnoveterinary also uses for this plant species. The seeds and flour of *Zea mays* are useful against constipation in livestock in the Hamirpur district of Himachal Pradesh [67]. Besides, Sharma *et al.* [12] reported the seeds as a galactagogue in milk-yielding animals from District Kathua of J&K. In Karnataka, the flowers of this species are used to treat urinary inflammation in livestock [46]. In contrast, Andhra Pradesh's people use the corns of this species to treat reproductive disorders [49].

The comparative comparison of the recorded plant components used in the related literature analysis confirms some of our results. Further research on these plant species is also needed to investigate their potential from a drug production perspective and extend their current therapeutic potential.

Novelty of the study

The current work is the first of its nature in the study area and Seven species (*Aconitum violaceum, Arisaema jacquemontii, Bistorta amplexicaulis, Clematis grata, Ranunculus bulbosus, Ulmus villosa and Viburnum grandiflorum*.) were documented for the first time from India for their ethnoveterinary practices.

Conservation perspective

Of all the 31 reported species, only ten species namely *A. cepa*, *A. sativum*, *B. rapa*, *C. annuum*, *G. optiva*, *M. longifolia*, *P. armeniaca*, *P. granatum*, *V. negundo*, *Z. mays* have been brough under cultivation. Therefore, there is an ardent need of the cultivation and conservation of the remaining plant species for 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 documented ethnoveterinary uses in the present study and the uses reported after the literature survey for most plant species supplemented the traditional ethnoveterinary uses of the plants by the tribe. The present study also revealed no specific herbal remedy for the cows, buffalo, ox, and horses; however, the same treatments for different animals were given, but the dose of the preparation varied according to the animals' age. Proper scientific validation is an essential step for the standardization and optimum utilization of the therapeutic claims in drug discovery from natural products. The lack of cultivation practices for most plant species in the study area is a concern and needs to be highlighted before the relevant authorities so that proper initiatives can be taken in this regard. Further studies on these plant species are also required to validate their potential from a drug development perspective and broaden their existing therapeutic potential.

Declarations

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Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing Interest

The authors declare that they have no competing interests.

Affiliation

[1] Department of Botany, University of Jammu, Jammu- 180006, J&K, India

[2]Botanic Garden, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow 226001, Uttar Pradesh, India

[3]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India

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Figures

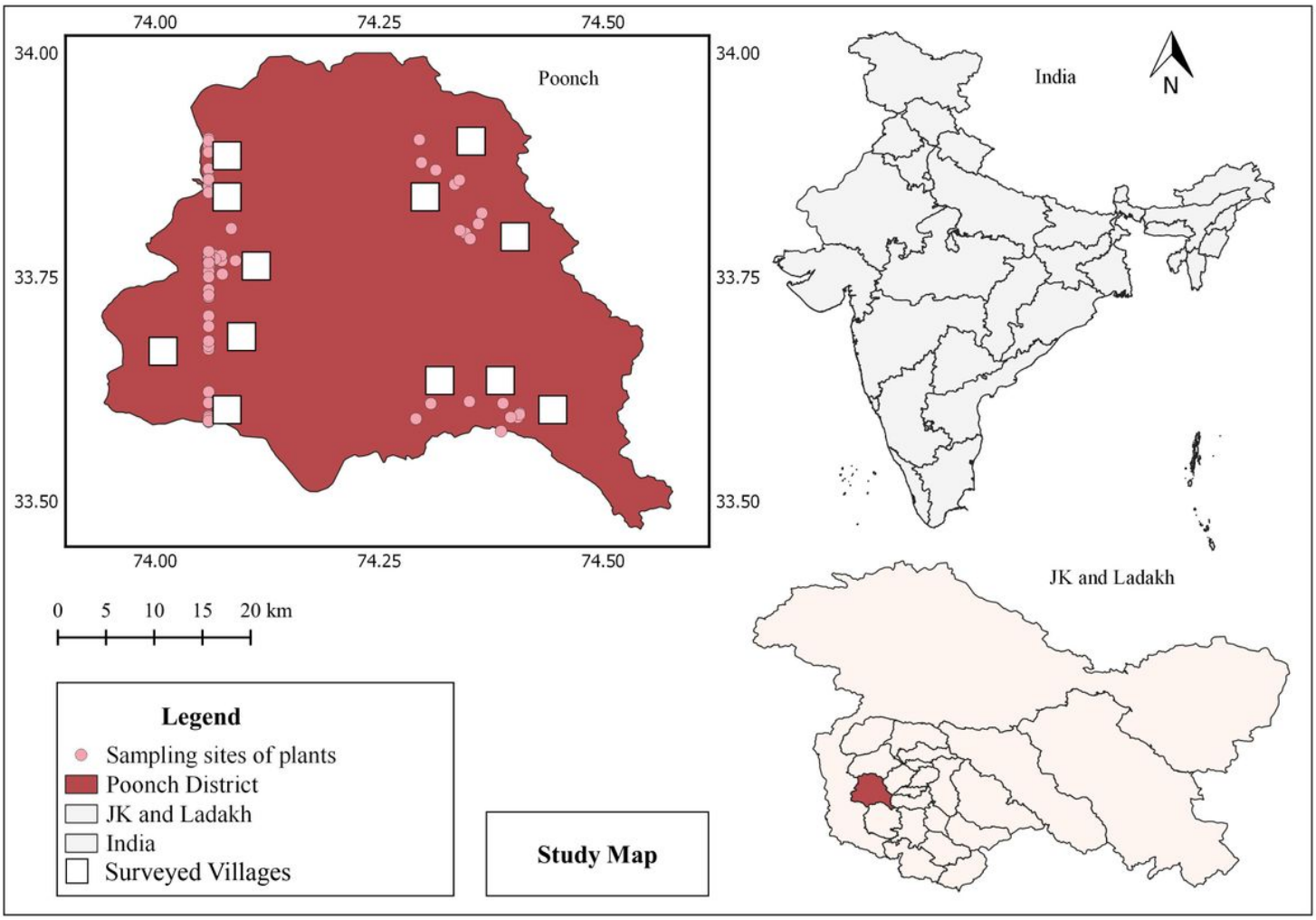

Figure 1

Map of the study area showing surveyed villages and collection sites of plants. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

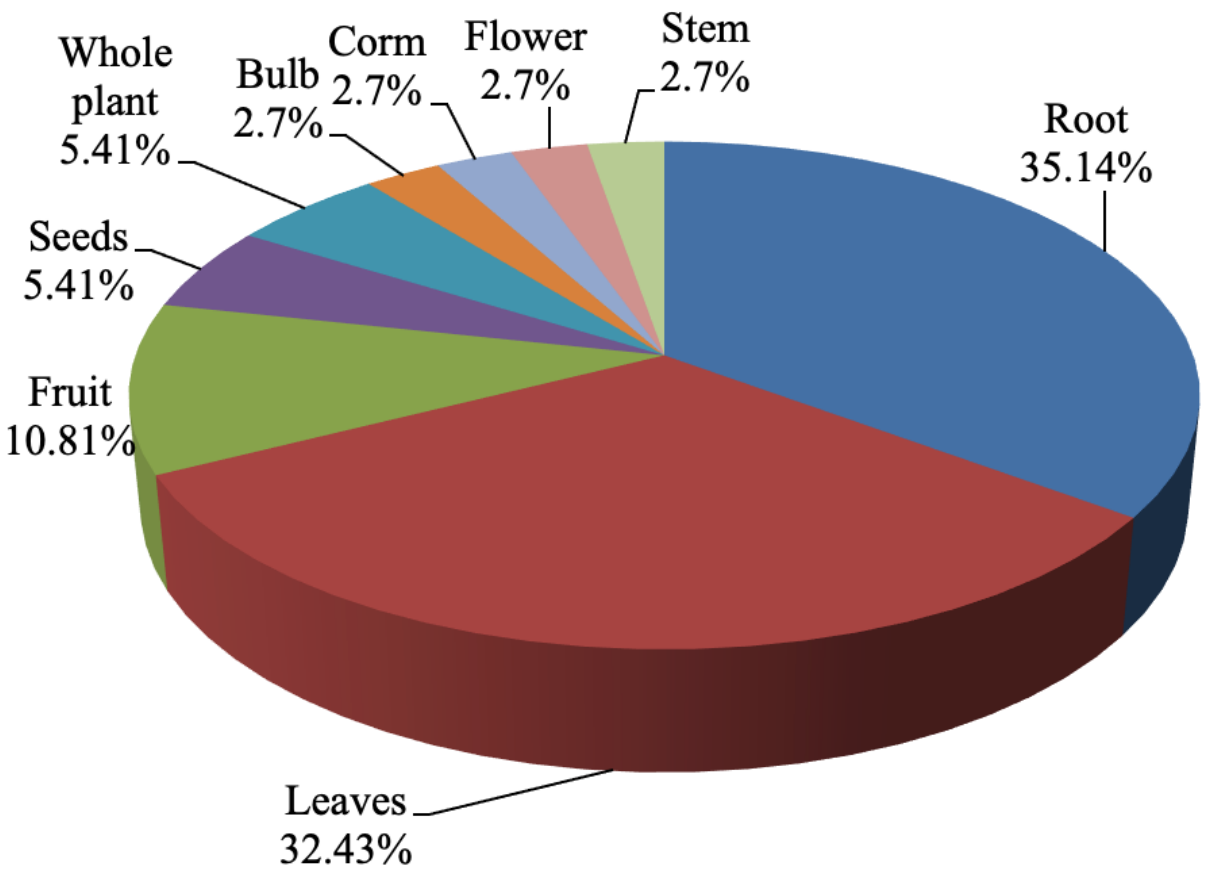

Figure 2

Percentage of plant parts used in ethnoveterinary remedies