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Research Article

PLANT BASED ETHNOVETERINARY PRACTICES IN MIDDLE MOUNTAIN REGION, CENTRAL NEPAL

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ABSTRACT

Ethnoveterinary practices have long served as an important approach to managing the health of domestic animals in rural parts of the country. The main objective of this study was to document local knowledge on the use of various plants for treating livestock diseases in Konjyosom Rural Municipality, in the middle mountain region of Central Nepal. The primary data were collected by interviewing 90 informants who were rearing the domestic animals like cow, buffalo and goats. The study recorded 76 ethnoveterinary plants from 45 families and 71 genera, with Poaceae being the most prevalent family. These plants, primarily herbs, were often sourced from the forest, with leaves being the most dominantly used part. Notably, raw application was the preferred method for treating livestock diseases. Dermatological and gastrointestinal ailments had the highest Informants Consensus Factor, indicating a strong agreement among informants. *Cannabis sativa*, *Artemesia indica*, and *Ficus religiosa* were among the most frequently cited plants having highest Relative Frequency of Citation. Such traditional knowledge not only aids in livestock health but also contributes to plant diversity conservation. Documenting such practices is crucial to preserving this knowledge and further research into the bioactive compounds of these plants could help in the formulation of drugs for future use.

Key words: Ethnic groups, Informants, Livestock, Plant diversity

INTRODUCTION

Since the time immemorial, humans have relied on plants for treating both human and animal illnesses or for preventive measures. For centuries, plants have served as a vital source of food, fiber, and shelter along with the treatment of various diseases traditionally (McCorkle, 1986). Ethnoveterinary is a branch of ethnoecology which refers to the indigenous knowledge of local communities concerning the healthcare of animals (Martin, 1996). Livestock represents an essential means of livelihood and nourishment for rural communities, providing essential nutrients through meat, milk, and derived products. The people have strong awareness for the health of domestic animals and have relied on traditional herbal remedies for generations (Manandhar, 2002).

The discovery of uses for ethnoveterinary medicinal plants likely occurred through various means: trial and error, observations of animals consuming or interacting with specific plants when unwell, and subsequent adoption of these remedies. This knowledge was passed down through generations and shared among traditional ethnoveterinary practitioners (Galav et al., 2013) by oral means (Eshete & Molla, 2022). This practice remains prevalent among medical persons and local healers. Additionally, medicinal plants identified through traditional practices serves as a valuable practice in the formulation of the new therapeutic drugs (Pan et al., 2014).

Ethnoveterinary uses encompass the collective understanding, techniques, practices, and cultural beliefs regarding animal care (McCorkle, 1986). The rapid changes occurring within communities pose a significant threat to the preservation of this valuable knowledge, putting it at risk of extinction (Kubkomawa et al., 2013) and others factors are tendency of younger generation to abandon the traditional lifestyles (Galav et al., 2013), inadequate acknowledgment of traditional practitioner and easy access of allopathic drugs or health persons (Manandhar, 2002). Field veterinarians and trained professionals often overlook the effectiveness of traditional knowledge in treating livestock diseases, primarily because it lacks scientific validation. Despite its efficacy, traditional methods often go unused in their practices (Phondani et al., 2010).

Ethnobotanical research that records traditional knowledge plays a key role in conserving plant

species and promoting their sustainable use (Singh & Hamal, 2013). Many researchers have documented indigenous veterinary plant use traditions practiced by rural communities in various parts of Nepal (Chaudhary, 1994; Manandhar, 2001; Rajbhandary & Dhital, 2006; Acharya & Acharya, 2010; Acharya et al., 2010; Malla & Chhetri, 2012; Raut & Shrestha, 2012; Gyawali & Poudel, 2017; Shrestha & Khadgi, 2019; Dhakal et al., 2021). To date, there has been no extensive endeavor to document the ethnoveterinary plants in Lalitpur district, Central Nepal. In light of this gap, this research was done in Konjyosom Rural Municipality in Lalitpur of central Nepal. The aim was identification and documentation of ethnoveterinary plants along with their traditional wisdom regarding the treatment of livestock diseases.

MATERIALS AND METHODS

Study area

This study was carried out in Konjyosom Rural Municipality of Lalitpur District, encompassing an elevation gradient ranges from 1,053 to 2,619 m above sea level (Fig. 1). Located in the southern part of Lalitpur District, Konjyosom Rural Municipality covers a total area of 44.16 sqkm. Its coordinates extend from 27°28´36" to 27°33´39" N and 85°18´27" to 85°24´23" E. The area experiences a mean annual temperature of 14.8°C and receives an average annual rainfall of 1,697 mm (DoHM, 2021). This Rural Municipality comprises five wards namely Bhardew, Nallu, Chaughare, Sankhu and Dalchoki. The population totals 8989, comprising 4398 males and 4591 females. The ethnic composition includes Tamang (75.78%), Brahmin (13.91%), Chhetri (2.83%), Newar (2.24%), Magar (2.30%), and Pahari (1.44%) (NPHC, 2021).

Most part of the Konjyosom Rural Municipality belongs to hilly area and the cultivable fertile land is much less. Important crops and cereals are Maize, Millet, Wheat, Barley, Mustard, Paddy, Potatoes, Pea, Gram, Soyabeans etc. The rural community relies on forests and natural vegetation not just for basic necessities like firewood and fodder but also for accessing medicinal herbs used in treating illnesses and diseases. Animal husbandry is one of the major occupation in the study area. Buffalo, cow and goats are important animals for the domestication. The domestic animals in the villages are Buffalo (3304), Cattle (988), Goat (8771), Pig (138) and sheep (2) (Source:www.mold.gov.np) .

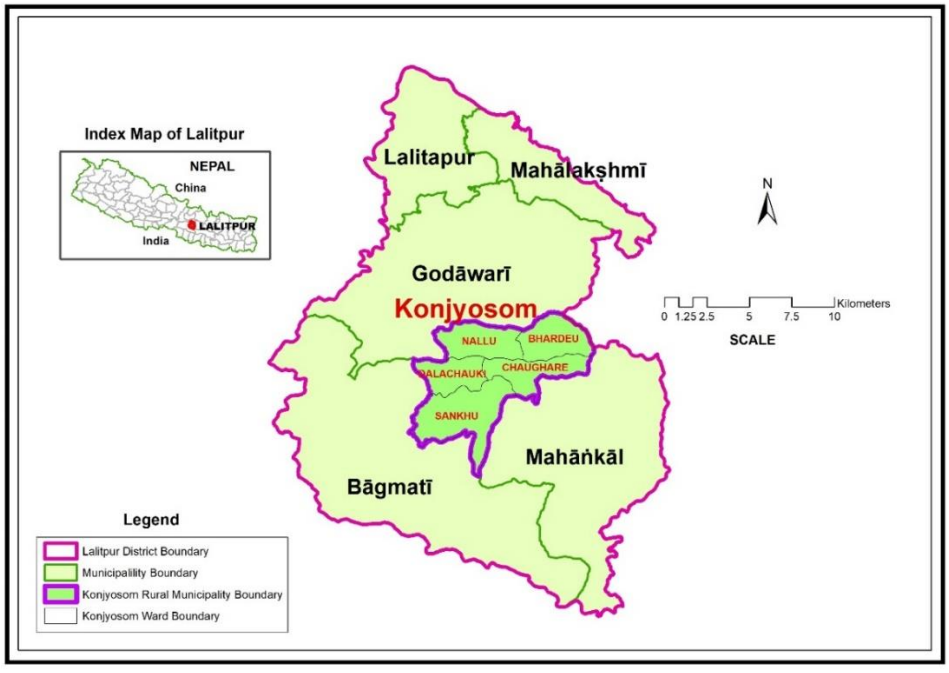

Figure 1. Study area map illustrating five wards of Konjyosom Rural Municipality in Lalitpur District

Ethnoveterinary data collection

The primary data was collected in May 2021 to January 2022. Prior to data collection, a meeting was arranged with Rural Municipality authorities and ward representatives to seek consent for the study. The Free, Prior and Informed Consent (FPIC) was orally obtained from informants for the collection of primary data. A total of 90 knowledgeable and experienced informants representing approximately 1% of the total population of Konjyosom Rural Municipality who were actively involved in domestic animal care were interviewed. The age distribution of the 90 informants showed that the majority belonged to the 51-60 year age groups (38%) followed by the 30-40 and 41-50 year age groups, each comprising 28% while the informants number more than 60 years were only 6% of the sampled population. Male informants predominated (n=53) compared to female informants (n=37). Regarding the educational status, 29% (n=26) of the informants had no formal education whereas the majority, 53% (n=48) had completed only primary level of education. Remaining 11% (n=10) had completed secondary level of education and only 6% (n=6) had completed higher secondary level of education (Table 1). The open-ended, semi-structured questionnaires were designed to gather ethnoveterinary informations through the interviews with informants. In addition to individual interviews, two Focus Group Discussions (FGDs) were conducted with groups of 5-7 livestock rearing informants to further document ethnoveterinary knowledge. The data collected comprised plant names, utilized plant parts, methods of preparation and associated medicinal uses.

Table. 1 Demographic profile of local informants providing ethnoveterinary information

Indicators	Group	Informants	Percentage
Age	30-40	25	27.78
	41-50	25	27.78
	51-60	34	37.78
	Above 60	6	6.67
	Total	90	100
Gender	Male	53	58.89
	Female	37	41.12
	Total	90	100
	Illiterate	26	28.89
Education	Primary	48	53.34
	Secondary	10	11.12
	Higher secondary and above	6	6.67
	Total	90	100

Data analysis

All the information collected during field survey was organized, classified and analysed using Microsoft Excel 2010. The data were categorized by their names, families, life forms, preparation techniques and disease categories. The findings were summarized and displayed through tables, bar charts, pie charts and chord diagrams. Tables, bar graphs and pie charts were generated in Microsoft Excel, 2010 and chord diagrams were prepared using Power BI, 2023. To examine the relationship between informants age and their knowledge of ethnoveterinary plants, Spearman correlation were performed. In addition, a chi-square test of independence was applied to assess gender wise differences in ethnoveterinary knowledge. Statistical analyses were carried out by using R version 4.0.3 (R Core Team 2020).

The veterinary diseases documented in the study were categorized in nine disease categories namely Reproductive, Osteological, Gastrointestinal, Urinary problems, Antipyretic, Parasitic, Eye problem, Dermatological and General weakness following Dhakal et al. (2021). The usage patterns and significance of ethnoveterinary plants for treating these disease categories were quantitatively analysed using the Informant Consensus Factor (ICF) and Frequency of Citation (Cf %).

Informant consensus factor (ICF)

In various ethnoveterinary studies, the agreement among informants regarding plant usage is assessed

by calculating the ICF (Heinrich et al., 1998) and followed by Tariq et al. (2014); Adeniran et al. (2020) and Dhakal et al. (2021).

$$ICF = \frac{Nur\text{-}Nt}{Nur\text{-}1}$$

Where, Nur denotes total use reports, Nt denotes the total species. The ICF range between 0 and 1. The lower value indicates more random selection of plant species. ICF values approach one when the community exhibits a clear and consistent preference for certain plant species (Sharma et al., 2012).

Citation frequency (Cf %)

The Citation frequency (Cf %) is computed to determine the commonly used ethnoveterinary plants (Tardío & Santayana 2008; Dhakal et al., 2021).

$$Cf\ \% = \frac{n}{N} \times 100$$

Here, *n* represents the frequency of specific species mentioned, and *N* denotes overall mentions of all species**.**

Plant collection and herbarium preparation

Ethnoveterinary plant species were collected from Konjyosom Rural Municipality with the assistance of local informants during primary data collection. The plants were identified in the field using their local names and subsequently scientifically verified through herbarium of National Herbarium and Plant Laboratories (KATH). The accepted botanical names and author citations were confirmed from World Flora Online database and Shrestha et al. (2022). The herbarium of some ethnoveterinay plant specimens were submitted to the Department of Botany, Patan Multiple Campus, Patan Dhoka, Lalitpur.

RESULTS AND DISCUSSION

Ethnoveterinary knowledge

Many informants acquired the understanding of the ethnoveterinary use of plants from their parents, while others gained it from neighbors, relatives, newspapers, and social media. The study showed elderly people were rich in ethnoveterinary knowledge than young. Elderly people were particularly more concerned to use ethnoveterinary plants to cure livestock health issues and actively cultivated such species on their farmland. Some informants were found to cultivate ethnoveterinary plant species on their own land, as observed during field visits. A poorly positive association was observed between informants age and their knowledge of ethnoveterinary plants they were familiar with as shown by Spearman correlation ($r = 0.181$, $p < 0.001$). Dhakal et al. (2021) also observed a positive correlation of respondents age and their ethnoveterinary knowledge in Arghakhachi district, western Nepal. Similar type of result was observed in the study of ethno medicinal plants of middle mountain region of Nepal (Joshi et al., 2020; Gautam et al., 2023).

Furthermore, out of the total 76 recorded ethnoveterinary plants, male mentioned all and females described only 72 ethnoveterinary plants. The four plant species mentioned by males and not mentioned by females were *Colebrookea oppositifolia, Euphorbia royleana, Morus australis* and *Stephania glandulifera*. The Chi-square test showed non-significant relation between gender and number of ethnoveterinary plant species they described ($\chi^2 = 15.476$, $p = 0.749$). Both men and women shared a comparable number of ethnoveterinary plant species which indicated similar level of knowledge of using ethnoveterinary plants to cure domestic animals across the gender (Table 2). In contrast, regarding ethnomedicinal knowledge for the treatment of human diseases, women in Konjyosom Rural Municipality showed significantly higher knowledge of ethnomedicinal plant use than men (Gautam et al., 2023).

Table 2. Relation of gender and number of plants

	Men	**Women**	
Number of plants described	76	72	
Number of plants undescribed	0	4	$\chi^2 = 15.476$, p Value= 0.749
Total	76	76	

Ethnoveterinary plant diversity

The study recorded 76 ethnoveterinary plant species from 45 families and 71 genera. The list of documented ethnoveterinary plants and other collected information are shown in Annex 1. Dhakal et al. (2021) found 103 ethnoveterinary plants belonging to 56 families in Chhatradev Rrural Municipality of Arghakhachi district, western Nepal. Acharya and Acharya, 2010 found 18 species from 17 families in Kaski district, Central Nepal. The documented plants were compared with Shrestha and Joshi (1993), Manandhar (2001), Rajbhandary and Dhital (2006), Acharya and Acharya (2009), Malla and Chhetri (2012), Raut and Shrestha (2012), Acharya et al. (2015), Gyawali and Poudel (2017), Shrestha and Khadgi, (2019) and Dhakal et al. (2021). The result found that five ethnoveterinary plant species namely *Bauhinia variegata* L., *Cissampelos pareira* L., *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb., *Solanum nigrum* L. and *Woodfordia fruticosa* (L.) Kurz were new addition to the available ethnoveterinary plant species for Nepal. These newly added ethnoveterinary plant species were recorded in the treatment of stomach disorder of livestock.

In the study area, 76 ethnoveterinary plant species were documented and majority were collected from wild (64 spp) followed by cultivated (9 spp) and from market (3spp). It showed the dependency of local communities to the forest resources for traditional veterinary health care system. The 76 recorded plant species were categorised into 45 families. Poaceae family was most prevalent succeeded by Asteraceae, Fabaceae, and Moraceae, each represented by five species (Fig. 2). Ericaceae and Menispermaceae were represented by three species each while Amaranthaceae, Apiaceae, Araceae, Asparagaceae, Solanaceae, Euphorbiaceae, Lamiaceae and Meliaceae included two species. The remaining 31 families was represented by only one species, indicating a high diversity of families with limited species richness per family. Acharya et al. (2015) and Dhakal et al. (2021) recorded the Poaceae as second dominant family followed by Fabaceae. Similarly, Raut and Shrestha (2012) found Liliaceae family as dominant in western Morang but in the present study only one species from Liliaceae family was found. This differences might be due to the differences in physiography and vegetation type of the study area. Another reason might be the culture and traditional beliefs of local people.

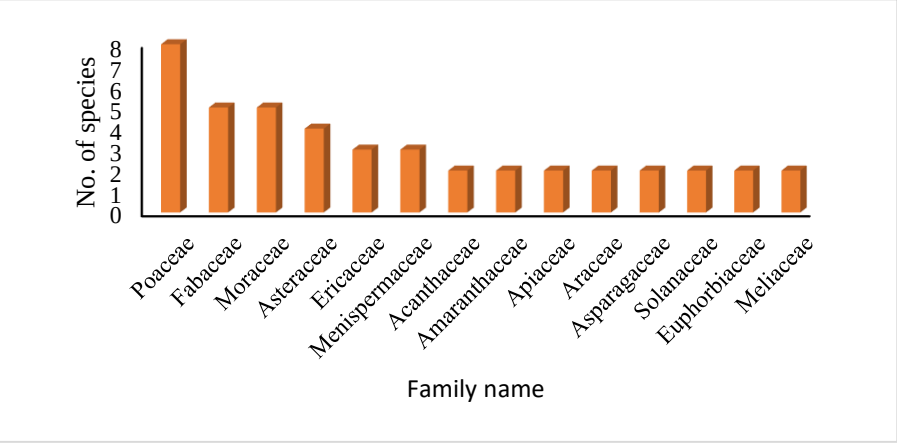

Figure 2. Families of ethnoveterinary plants having more than one species

Life forms and parts used

Herbs constituted the dominant lifeforms (46%) in the study area. This was succeeded by trees (30%), shrubs (16%) and climbers (8%) (Fig. 3). It shows that herbs were more commonly used in traditional veterinary therapy in the study area. The predominance of herbs may be attributed to their rapid and extensive growth, as well as their ease of harvesting and storage (Bogale et al., 2023; Shrestha & Dhillon, 2003). Similar results have been reported in other researches, where herbs were identified as the prevalent growth form of ethnoveterinary plants (Dar et al., 2018; Dhakal et al., 2021). Contrary to these findings, Acharya and Acharya (2010) reported climbers as the prevalent and Rajbhandary and Dhital (2006) recorded trees as the most prevalent growth form. These differences might be due to the traditional or cultural practices as well as the geographical distribution of the study area.

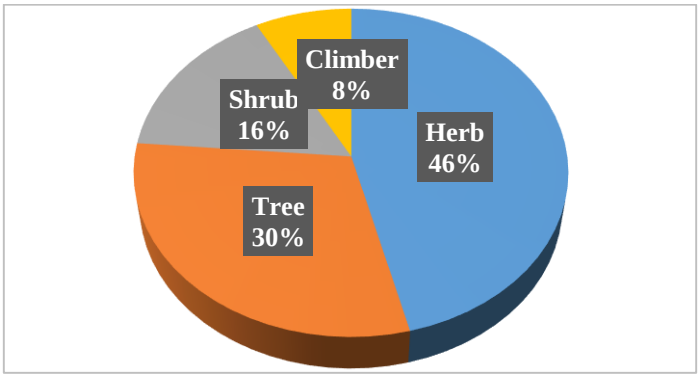

Figure 3. Life forms of ethnoveterinary plants

The Information obtained from the informants indicated that various parts of ethnoveterinary plants are utilized to cure livestock health issues. Leaves were most frequently used parts (20 species) followed by leafy twigs (12 species) whole plant (11 species) underground parts (11 species) and other parts like bark, flower etc. in very small numbers (Fig. 5). The study of Dhakal et al., (2021) also found leaf as most important part to treat the animal diseases. The predominance of leaves in ethnoveterinary remedies could be due to their rich concentration of bioactive substances including alkaloids, phenolics and terpenoids (Muluye & Ayicheh, 2020). Additionally, the frequent use of leaves and other aerial parts is likely related to sustainability, as harvesting these parts is less destructive to the plant compared to the removal of roots, bark, or entire individuals (Giday *et al*., 2003; Poffenberger *et al*., 2010). The chord diagram (Fig. 4) shows the utilization of parts of ethnoveterinary plants across the different life forms. Leaves were most frequently used particularly in herbs, climbers and trees followed by fruits, leafy twigs and bark. In contrast, underground parts, stem and seeds are used less often. Similarly, the underground parts and sometimes the whole plant of herbs were frequently used as ethnoveterinary remedies.

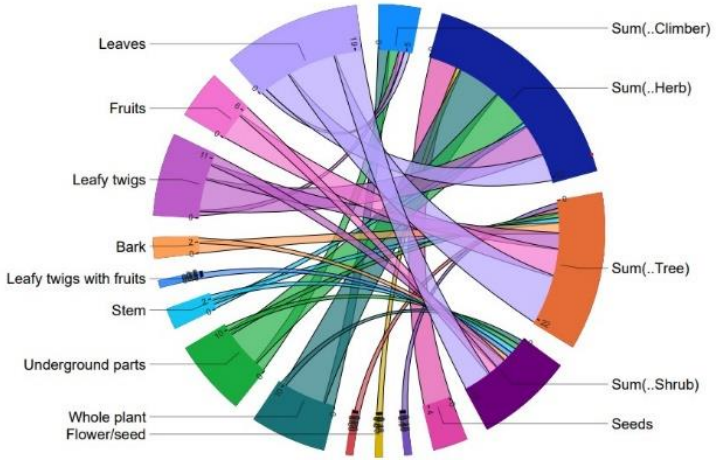

Figure 4. Chord diagram showing the relation of life forms and parts of ethnoveterinary plants

Preparation and use of ethnoveterinary remedies

The study documented the ethnoveterinary emedies prepared in several forms, including raw (29 species), juice (13 species), paste (12 species), decoction (9 species), infusion (5 species), and powder (4 species) (Fig. 5). In most cases, the preparations involved a single plant species. However, a combined remedy was recorded in which the bulb of *Allium sativum* and fresh twigs of *Mentha spicata* were crushed together and administered to

livestock suffering from dysentery. The frequent use of raw preparations reflects a preference for simple and readily accessible treatment methods. Paste formulations were mainly applied for external ailments such as ectoparasite infestations, cuts, and wounds. For example, a leaf paste of *Azadirachta indica* was used on wounds caused by broken horns and to control ectoparasites. Decoctions were predominantly employed for internal conditions, including fever as illustrated by the oral administration of a root decoction of *Berberis asiatica*. Raw plant parts were commonly fed directly to livestock for gastrointestinal disorders, such as the use of fresh twigs of *Colebrookea oppositifolia* to eliminate endoparasites. Details of preparation methods and uses are provided in Table S1. The remedies were administered via oral, topical, ocular, and nasal routes with oral administration being the most prevalent (Fig. 5). Previous studies from other regions of Nepal reported juice as the most frequently used preparation technique (Acharya & Acharya, 2010; Raut & Shrestha, 2012; Dhakal et al., 2021). In the present study, local communities preferred simpler treatment methods, often administering raw plant parts directly to livestock for disease treatment.

The chord diagram (Fig. 6) illustrates the association between habit (trees, shrubs, herbs, and climbers) and methods of preparation used in ethnoveterinary remedies. Herbs showed the strongest linkage with multiple preparation methods, particularly paste, juice, and decoction, indicating their predominant role in ethnoveterinary formulations. Trees and shrubs were also widely utilized, mainly in raw and paste forms, whereas climbers contribute comparatively fewer remedies. Overall, the diagram highlighted both the dominance of herbs and prevalence of raw use mode in traditional livestock healthcare.

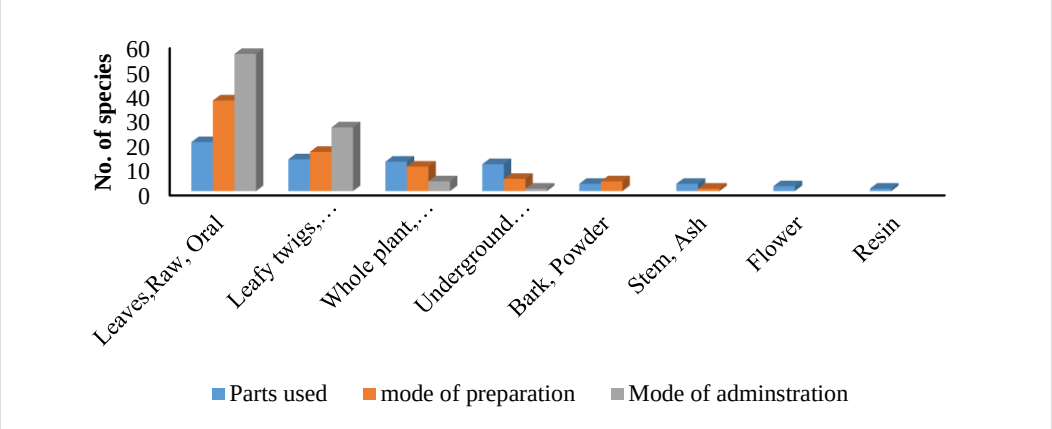

Figure 5. Plant parts utilized, preparation techniques and application mode of ethnoveterinary plants

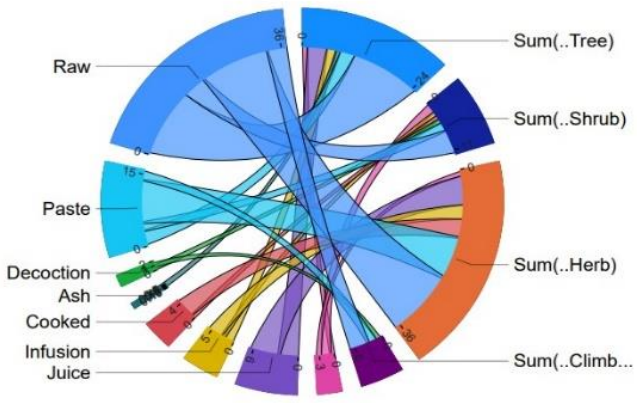

Figure 6. Chord diagram showing the relation of plant growth forms and mode of use

Informant consensus factors (ICF)

The ethnoveterinary plants in this study were employed to manage nine categories of livestock ailments: gastrointestinal, dermatological, reproductive, urinary problem, osteological, parasitic, eye disorders, general weakness and antipyretic. Across all disease categories, the ICF values varied between 0.91 and 0.98 with an average of 0.96 (Table 3). The highest consensus was observed for remedies used to treat general weakness (ICF = 0.98), followed by reproductive, gastrointestinal, parasitic and dermatological ailments (each ICF = 0.97), eye disorders (ICF = 0.96), while antipyretic conditions showed the lowest consensus (ICF = 0.91). These high ICF values indicated a high consensus among local people on the use of ethnoveterinary plants. The general weakness category having highest ICF indicating its prevalence among the livestock in the study area. Bharati and Sharma (2012) and Khattak et al. (2015) recorded the gastrointestinal diseases were commonly treated by ethnoveterinary plants in different parts of India. In contrary to this, Dhakal et al. (2021) found reproductive diseases common in Chhatradev RM of Arghakhachi district of West Nepal. Furthermore, 61 species were utilized exclusively for a single disease category, 14 species for two ailment category and single species (*Asparagus filicinus*) for three ailment category (Antipyretic, gastrointestinal and reproductive). Dhakal et al. (2021) have recorded similar results in which 63 species out of 103 species were found to treat single ailment category in Chhatradev rural municipality of Arghakhachi district.

Table 3. ICF values and disease categories of Konjyosom Rural Municipality

S.no	Disease category	Nur	Nur-Nt	Nur-1	Nt	ICF
1	Reproductive	679	656	678	23	0.97
2	Gastrointestinal	455	442	454	13	0.97
3	Antipyretic	184	174	183	10	0.91
4	Parasitic	416	401	415	15	0.97
5	General weakness	130	127	129	3	0.98
6	Eye problem	76	72	75	4	0.96
7	Dermatological	702	682	701	20	0.97
8	Osteological	39	36	38	3	0.95
9	Urinary problems	25	23	24	2	0.96

Citation of frequency (Cf %)

All species were cited a total of 2,067 times (N). Among them, *Curcuma longa* had highest citation frequency, mentioned 86 times (4.17%) followed by *Zea mays* 84 (4.07%), Cannabis sativa 83 (4.02%), *Datura metal* 77 (3.73%) and so on. The plants having highest citation of frequency were most commonly used plants to treat livestock ailments. Dhakal *et al*. (2021) have found *Zea mays*, *Cannabis sativa* and *Artemisia indica* among the top ten highest citation frequency plants in the Arghakhachi district. The top ten plants having highest citation of frequency are given in Table 4.

Table 4. The ten plants with the most frequent citations

Plant names	N	Cf %
Curcuma longa	86	4.17
Zea mays	84	4.07
Cannabis sativa	83	4.02
Datura metel	77	3.73
Melia azedarach	74	3.59
Schima wallichii	72	3.49
Ageratum conyzoids	71	3.44
Ficus religiosa	67	3.25
Drepanostachyum falcatum	66	3.2
Artemisia indica	64	3.1

CONCLUSION

It was found that traditional ethnoveterinary practices were well known in Konjyosom Rural Municipality, Lalitpur, Nepal. Most of the documented ethnoveterinary plant species were herbs, with leaves being the most frequently utilized part. The ICF value showed the great agreement for curing the different diseases of domesticated animals by using plant parts. *Cannabis sativa, Artemesia indica, Curcuma longa, Ficus religiosa, Zea mays, Datura metel* are the commonly used ethnoveterinary plants. The ethnoveterinary plants recorded in the present study are comparable with the list documented by previously documented studies except *Bauhinia variegata* L., *Cissampelos pareira* L., *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb., *Solanum nigrum* L. and *Woodfordia fruticosa* (L.) Kurz. These five species are a new addition to the ethnoveterinary plant species for Nepal. The present study thus indicates that the people are practicing the age-long traditional ethnoveterinary medication for curing the different diseases of their domesticated animals, which is appreciable and also helps in biodiversity conservation. Preservation of such knowledge through documentation is crucial to prevent its loss and further researches on the bioactive compounds of those ethnoveterinary plant species are needed to develop the herbal veterinary drugs.

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AUTHORS CONTRIBUTION

Conceptualization: RSG, IS; Participated in fieldwork: RSG, SJS, IS; Methodology: RSG, IS; Data analysis: RSG, SJS; Writing-original draft: RSG, SJS, IS; Writing-review & editing: RSG, IS.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

ETHICAL STATEMENT

This research represents original work and has not been published elsewhere. Written permission to conduct the study and collect plant specimens was obtained from the Ministry of Forest and Environment, Babarmahal, Kathmandu and Konjyosom Rural Municipality. Furthermore, prior informed verbal permission was obtained from local informants following International Society of Ethnobiology Code of Ethics (2008).

DATA AVAILABILITY STATEMENT

The data underlying this study are accessible from the corresponding author on reasonable request.

SUPPLEMENTARY INFORMATION

Table S1. List of ethnoveterinary plants documented in the study area

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