Study on ethnoveterinary medicinal plants used by local people inhabiting char area, Kamrup District, Assam, North-East India

Chhan Kumar Kalita[1], Chiranjib Mili[1, 2,*], Manash Jyoti Deka[3], Pratisha Das[2], Sabebaro Namo Das[2]

[1]Institutional Biotech Hub, B.P. Chaliha College, Kamrup, Assam-781127, India
[2]Department of Botany, B.P. Chaliha College, Kamrup, Assam-781127, India
[3]Department of Chemistry, B.P. Chaliha College, Kamrup, Assam-781127, India

[*]Corresponding author e-mail: chiranjibmili@gauhati.ac.in

Received: 25 January 2024 / Accepted: 10 June 2024

Abstract. The inhabitants of char areas of Kamrup district, Assam (India) have relied on medicinal plants to treat various livestock diseases. Due to the lack of proper documentation, these plants have received little attention. Therefore, studying these plant species' diversity, utilisation, and phytochemistry is crucial. By doing so, we can preserve their traditional knowledge and comprehend the possibility of using these plants to develop new drugs. The present investigation documented 30 medicinal plant species belonging to 29 genera and 22 families. These plants were used against the treatment of 12 disease categories. The families Fabaceae and Zingiberaceae, with three species for each, were dominant, while the leaf (22%) and seed (16%) were the most frequently used plant parts. The informant consensus factor (F_{ic}) was found to be highest in neurological disorders and neglected tropical diseases (NTD) with a value of 1.0 each. In contrast, the relative frequency of citation (RFC) was found to be highest in *Curcuma longa* L. (0.41) and *Zingiber officinale* Roscoe (0.37). This study provides reliable data on medicinal plants and indigenous ethnoveterinary knowledge that could act as a reference for future researchers dealing with new drug discovery.

Keywords: Ethnoveterinary, char area, medicinal plants, livestock disease.

1. Introduction

Since the dawn of time, medicinal plants have been utilised in common treatment techniques for various human illnesses, and demand for their usage has persisted globally (Sofowora et al., 2013). Additionally, medicinal plants are a major component of traditional veterinary practices and have long been recognized as a rich source of botanicals in animals (McCorkle, 1995). A wide variety of plant compositions are employed in traditional medicines such as ayurvedic, homeopathy, allopathy, aromatherapy, naturopathy, and Chinese medicine. The Food and Agricultural

Organisation (FAO) reported that in many developing nations, the breeding industry suffers about 35% losses due to the unavailability of medications to treat infections and diseases (FAO, 2002). In these nations, poor animal health continues to be the main barrier to higher production. The precise way to find possible suppliers of new medications is by documenting how traditional veterinary medicine is used to control and manage livestock diseases (Usman, 2016).

Investigations into ethnoveterinary and ethnobotanical practices have long been of great concern to researchers. Many researchers around the globe have worked in ethnoveterinary research in the past years (Ali-Shtayeh et al., 2000; Ndou et al., 2023; Oda et al., 2024; Umair et al., 2024). In the context of India, numerous studies established that farmers and pastoralists belonging to different ethnic communities of different states widely used medicinal plants in the management of livestock health (Patil et al., 2010; Namsa et al., 2011; Panda & Dhal, 2014; Verma, 2014; Bhat et al., 2023). Ethnoveterinary is a system for managing various ailments and diseases of livestock based on traditional knowledge, methods, skills, beliefs, and practices (Kumari et al., 2011). In many underdeveloped remote areas, it can play a significant role in the growth of animal productivity and livelihoods and it frequently becomes the only available tool for farmers to treat illness of livestock (Shen et al., 2010).

In recent times, significant work has been made in documenting the medicinal plants that ethnic people in various parts of India including the Northeast have traditionally used to treat animal ailments, but meager information is available on ethnoveterinary medicinal plants used by people inhabited in char areas of Assam, India (Sharma & Sapcota, 2003; Das & Tripathi, 2009; Krishna et al., 2014; Dingsmit & Manohara, 2017). In Assam (India), "char areas" refer to the sandbars or river islands that form within the Brahmaputra River and its tributaries. These areas are characterized by their shifting nature due to the dynamic flow of the river and sediment deposition. Char areas are significant features of the Brahmaputra's landscape and have both ecological and socio-economic importance in the region. From a socio-economic perspective, char areas are often inhabited by communities known as "Char" dwellers. These communities rely on fishing, agriculture, and other livelihood activities linked to the river and its resources. However, char areas are also vulnerable to floods, erosion, and other natural hazards, posing challenges for the communities living there. Indigenous people who dwell in the char areas have extensive and unique traditional knowledge about how to use medicinal plants for raising and managing livestock. Despite orthodox medicine's advancements, they still rely on and believe in traditional

healing methods for their daily medical requirements. Therefore, it is very crucial to preserve their precious traditional knowledge of people inhabited in char areas. This study aimed to gather trustworthy data about ethnoveterinary knowledge of char areas in order to serve as a baseline for subsequent chemical and pharmacological research in the near future.

2. Methodology

2.2. Study area

Kamrup district of Assam covers a geographical area of about 4,345 km^2 and lies between 25°46′ to 26°49′ N latitude and 90°48′ to 91°50′ E longitude that located in the lower part of the state (Fig. 1). The climate of the study area is sub-tropical with a cold winter and semi-dry summer. The region experiences an annual rainfall of between 1500 and 2600 mm, temperature ranges from 7° to 38.5°C, and an average of 75% humidity and is very rich in forest diversity.

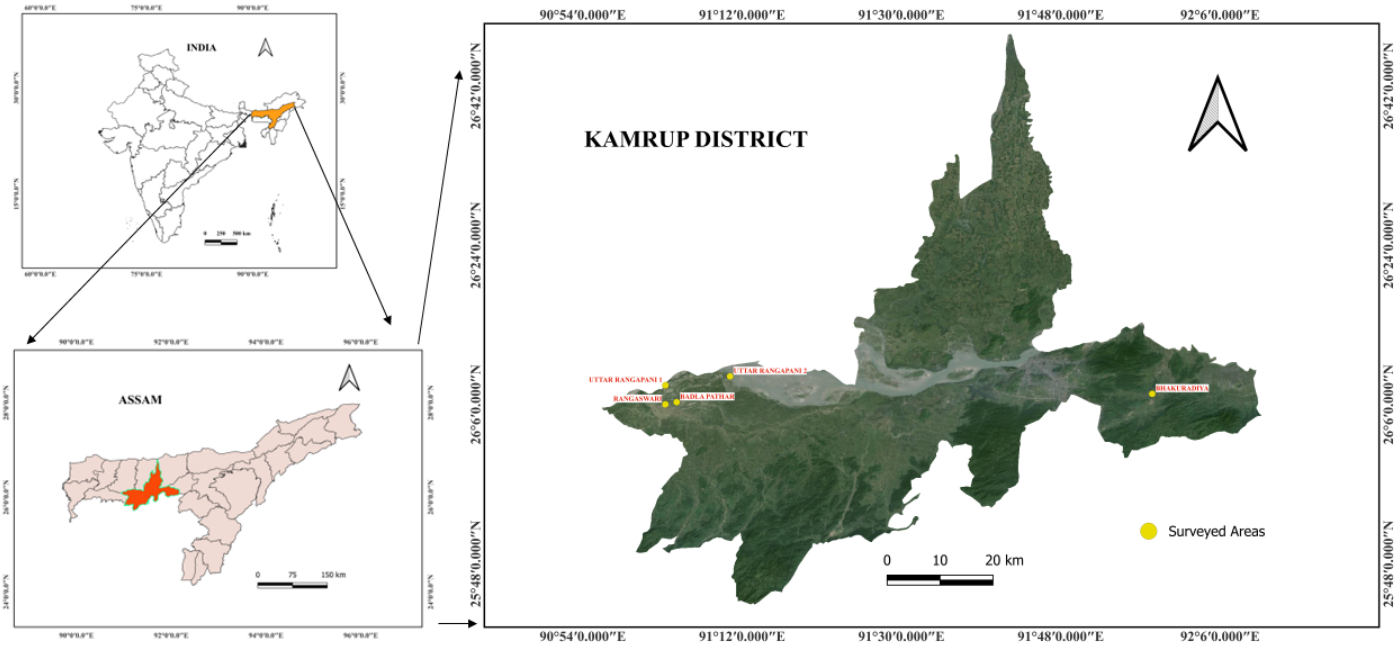

Figure 1. Location of the study area: Kamrup district, Assam, India

2.2. Ethnobotanical survey

The present study makes an effort to list the medicinal plants employed in traditional veterinary practices. Data about their usage was gathered from five rural villages situated in char areas: Badla Pathar, Bhakuradiya, Rangaswari, No.-1 Uttar Rangapani, and No.-2 Uttar Rangapani (Table 1). Before beginning the fieldwork, the village leaders were invited to a meeting to discuss the aims and objectives of the present study. In each village, livestock owners, traditional healers, knowledgeable elders, and farmers were selected as informants.

2.3. Data collection

A total number of 56 members (39 male and 17 female) aged between 22 to 65 years old were considered for the investigation and the survey was conducted from April to July 2023. The information about the usage of plants was gathered using semi-structured interviews and discussions with individuals living in the study areas. The questions were framed to obtain information on: (i) the kinds of medicinal plants utilized in traditional veterinary medications; (ii) the method of preparation and administration, as well as the efficiency of the treatments. The information was recorded in a notebook by preparing sheets containing: the local name of the plant, part used, mode of preparation, any other ingredient used, type of administration, and dosage for each taxon.

2.4. Plant identification

The medicinal plants mentioned by the informants of the study areas were verified using online databases such as WFO (2023), i.e. “The World Flora Online” (http://www.worldfloraonline.org), India Biodiversity Portal (https://indiabiodiversity.org), Medicinal Plant Names Services (http://mpns.kew.org), and Tropicos (https://www.tropicos.org). Because, the confirmation of taxonomic data from such sources enhances the robustness of a study as it follows established taxonomy and nomenclature, which lessens confusion caused by synonyms or outdated names (Mili et al., 2024).

2.5. Data analysis and statistical evaluation

Informant consensus factor (F_{ic}): The Use Report (UR) was used to assemble the data that was obtained in the survey. Informant consensus factor (F_{ic}) was used to analyze the data and determine

the homogeneity of the information gleaned from the informant regarding the use of particular plants. It was calculated using the following formula:

$$F_{ic} = (N_{ur} - N_t)/(N_{ur} - 1)$$

where N_{ur} is the number of UR in each disease category, N_t is the number of taxa used in each disease category. The range of F_{ic} value is 0 to 1, and when it approaches 1 it denotes a high level of unanimity among the informants (Trotter & Logan, 2019).

Relative frequency of citation (RFC): RFC whose value ranges from 0 to 1, was used to determine the relative importance of the medicinal plants. This value represents how significant each plant species is to the local healers. It was estimated by the following formula:

$$RFC = FC/N$$

where FC is the number of informants who have mentioned a specific plant and N is the total number of informants. RFC value close to 0 indicates that relatively few informants have mentioned the species whereas, the value goes to 1, which means that the majority of the informants have mentioned the specific species (Tardío & Pardo-de-Santayana, 2008).

3. Results

3.1. Socio-demographic status

The five studied areas altogether comprised a total number of 18,702 population as per the census 2011, Government of India (Table 1). Since the population was relatively homogeneous i.e., individuals are quite similar in the study area, a small random sampling (n=56) was considered to represent the population in the present study. These char areas were inhabited by Muslim community and their main occupation were cultivation and fishing while females were mainly housewives. Although some respondents were found to be literate, the literacy rate is very low in the surveyed areas. The local healers were quite knowledgeable about ethnobotany and the traditional use of medicinal plants in ethnoveterinary practices was unique.

Table 1. Population (Census, 2011, Govt. of India) (https://censusindia.gov.in/census.website/) and geographical coordinates of the surveyed areas**.**

Sl. No.	Villages	Population	GPS Coordinates
1	Badla Pathar	5,028	26°6′16.164″N Latitude

			91°4′36.012″E Longitude
2	Bhakuradiya	6,785	26°7′12.54″N Latitude
			91°58′20.064″E Longitude
3	Rangaswari	4,719	26°6′1.2564″N Latitude
			91°3′19.4292″E Longitude
4	No-1 Uttar Rangapani	794	26°8′9.96″N Latitude
			91°3′20.376″E Longitude
5	No-2 Uttar Rangapani	1,376	26°9′10.839″N Latitude
			91°5′38.148″E Longitude

3.2. Taxonomic category of plant species

In the present survey, a total number of 30 species of medicinal plants fall under 29 genera, and 22 families were recognized, which are used in the treatment of various disorders of livestock by local people of the studied areas (Table 2). The most represented families were Fabaceae and Zingiberaceae with 3 species each followed by Euphorbiaceae and Liliaceae having 2 species each, while the remaining 18 families were recorded with only one species each.

3.3. Used of medicinal plant parts

The present investigation reveals that the plant parts such as leaf, bark, stem, root, rhizome, seed, fruit, and sometimes latex as well as whole plants are used in ethnoveterinary practices by the local people. A critical analysis reflected that leaves account for 22% followed by seed (16%), and bark, fruit, stem, rhizome, and whole plant 9% for each. The utilization of bulb, endosperm, and latex was only 3% for each (Fig. 2).

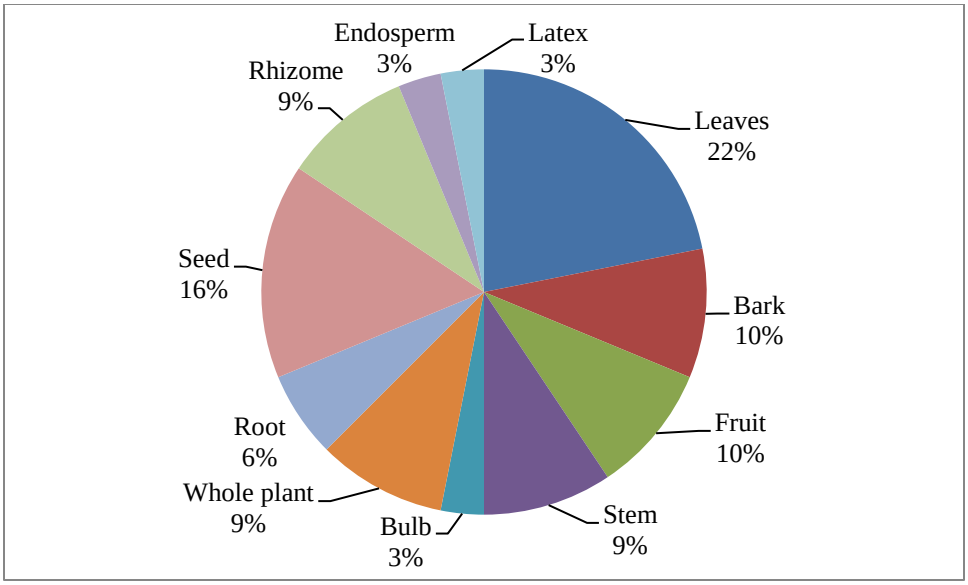

Figure 2. Plant parts (%) used in ethnoveterinary practice by local healers

3.4. Analysis of usage based on different disease treatments

The diseases and plants used for managing them were compiled. We concentrated on the healers' knowledge of the various diseases they can manage with medicinal plants, instead of beginning with a precise list of diseases. Data gathered during the survey only was used to prepare the final table. Altogether 91 user reports have been documented for various diseases/disorders. It was found that the majority of plant species were used for intestinal disorders (N_t=7) followed by reproductive (N_t=5), and renal (N_t=4) disorders. The remaining plants were administrated in many disorders including physical injuries, neurological, dermatological, parasitic, renal, orthopedic, viral, and NTD (Table 3).

Table 2. Use report (UR) of medicinal plants against various livestock diseases in the char areas of Kamrup district.

Sl. No.	Botanical Name (Family)	Habit	Local Name	Part used	Livestock	Effective against	Formulation and administration
1	*Achyranthes aspera* L. (Amaranthaceae)	Herb	Ubhat kata	Root	Cow	Bone fracture	Fresh root is ground and the paste is applied externally to the injured portion

2	*Ageratum conyzoides* L. (Asteraceae)	Herb	Gendheli bon	Leaf	Goat	Wounds	A paste of fresh leaf is applied externally
3	*Allium cepa* L. (Liliaceae)	Herb	Piyaj	Bulb	Cow, sheep, goat	• Painkillers for bug bites. • Hoof and mouth disease.	• The bulb paste is prepared by grinding and applied to the bitten marks. • Bulb is grinded and combined with black salt before being consumed with water
4	*Aloe vera* (L.) Burm.f (Liliaceae)	Herb	Sal kuwori	Leaf	Cow, oxen	Senseless	Paste is prepared from leaf pulp and administrated
5	*Bombax ceiba* L. (Bombaceae)	Tree	Simalu	Bark	Goat	Constipation	Crushed the bark with water to make a solution and allowed to drink
6	*Brassica compestris* L. (Brassicaceae)	Herb	Hariyoh	Seed	Cow, oxen	Pustules on the back	Oil extracted from seed is used externally
7	*Cassia fistula* L. (Fabaceae)	Tree	Hunaru	Bark	Cow	• Fever • Gastrointestinal disorder	Fruits are boiled with milk and allowed to be taken orally for 3 days
8	*Chenopodium album* L. (Chenopodiaceae)	Herb	Jilmil haak	Whole plant	Cow, oxen, sheep	Stomach disorder	Leaves are boiled with mustard oil and jaggery and allowed to be taken orally

9	*Christella parasitica* (L.) H. Lev. (Thelypteridaceae)	Herb	Bih-langani	Stem, Leaf	Cow, goat	Primary antivenin	Stem and leaf are ground together and applied on the bitten spot
10	*Cocos nucifera* L. (Araceae)	Tree	Narikol	Coconut water	Goat, sheep	Leucorrhea	The coconut water is allowed to be taken orally.
11	*Convolvulus arvensis* L. (Convolvulaceae)	Herb		Root	Goat	Wounds	A powder of dry root is prepared and applied to the injured spot
12	*Cucumis sativus* L. (Cucurbitaceae)	Climber	Tiyah	Fruit	Cow	Harmful parasites extrude inhale	A slice of the fruit is made and allowed to be consumed
13	*Curcuma domestica* L. (Zingiberaceae)	Herb	Bon haldhi	Rhizome	Oxen, cow	Broken horns at the base	Rhizome paste is prepared and applied externally on the injured spot.
14	*Curcuma longa* L. (Zingiberaceae)	Herb	Haldhi	Rhizome	Cow	Genital infection	Powder of rhizome is prepared and boiled with ghee and allowed to be consumed orally and topically for a week at 2 times per day.
15	*Cynodon dactylon* (L.) Pers. (Poaceae)	Herb	Dubari-Bon	Whole plant	Horse, cow	• Discharge of blood in urine • Dysentery	The juice of the plant is prepared and allowed to drink.
16	*Datura metel* L. (Solanaceae)	Undershrub	Dhatura	Fruit	Goat	Coughs	Roasted fruits are allowed to be eaten.

17	*Euphorbia prostrata* Aiton (Euphorbiaceae)	Herb	keyaraj	Stem	Sheep	Infection of the urinary tract	Decoction of stem allowed to be consumed.
18	*Lawsonia inermis* L. (Lythraceae)	Shrub	Jetuka	Leaf	Cow	Hematuria	Fresh leaves are allowed to be consumed directly.
19	*Melia azedarach* L. (Meliaceae)	Tree	Ghora neem	Leaf	Goat, sheep	Gastric disorders	The leaves are powdered and mixed with a sugar solution and allowed to be taken orally for 2-3 days.
20	*Musa paradisiaca* L. (Musaceae)	Shrub	Kol	Fruit	Cow, goat	• Galactagogues. • Worms	• Juice of mature fruit is prepared and allowed to be taken orally. • Root juice is allowed to be swallowed.
21	*Papaver somniferum* L. (Papaveraceae)	Herb	Aphing	Latex	Sheep	Analgesic blood clotting	Dried latex is boiled in black tea and allowed to be drunk.
22	*Ricinus communis* L. (Euphorbiaceae)	Shrub	Era	Seed coat	Cow, oxen	Sterility.	The powder of the seed coat is mixed with water and allowed to be drunk.
23	*Senegalia catechu* (L.f.) Willd. (Mimosaceae)	Tree	Kher	Bark	Cow, sheep, goat	Hoof and mouth disease	Bark is boiled in water and the decoction is allowed to drink.
24	*Sesamum orientale* L. (Pedaliaceae)	Herb	Til	Seed	Goat, sheep	Poisoning	Seeds are crushed with water and

							allowed to be consumed directly.
25	*Sesbania sesban* L. (Fabaceae)	Shrub or tree	Jayanti phul	Seed	Cow	Diarrhea	Seeds are crushed and allowed to be consumed directly.
26	*Tagetes erecta* L. (Asteraceae)	Herb	Genhe maloti	Whole Plant	Goat	Foot ulcer	The paste of the whole plant is prepared and applied to the infected part.
27	*Vigna mungo* (L.) Hepper (Fabaceae)	Herb	Mati mah	Seed	Cow, goat	Galactagogues	Seeds are soaked in water overnight then ground with water and allowed to be drunk.
28	*Vitex negundo* L. (Verbenaceae)	Shrub or small tree	Posotia	Leaf	Cow	Flatulence	Leaf juice is prepared and allowed to be drunk directly.
29	*Zingiber officinale* Roscoe (Zingiberaceae)	Herb	Ada	Rhizome	Cow, goat, sheep	• Digestive disorders • Flatulence • Appetizers	The rhizome is ground and boiled with jaggery solution and allowed to be consumed.
30	*Ziziphus jujuba* Mill. (Rhamnaceae)	Tree	Bogori	Leaf	Cow, goat	• Galactagogues • Dysentery	The decoction of leaves or fresh leaves is allowed to be consumed directly.

3.5. Informant consensus factor (F_{ic})

The F_{ic} for the disease under the category was found to be highest in neurological disorders and NTD with a value of 1.0 for each followed by physical injuries (0.87), respiratory and orthopedic disorders (0.83 for each), and parasitic disease (0.8) (Table 3). However, low F_{ic} values reveal that

the healers have divergent opinions regarding the species that should be utilized to treat a certain type of disease.

Table 3. Used report (%) and informant consensus factor (F_{ic}) against various diseases.

Disease category	**Number of taxon (N_t)**	**Number of used report (N_{ur})**	**Percentage of used report (%)**	**Informant consensus factor (F_{ic})**
Dermatological	1	5	5.49	0
Parasitic	2	6	6.59	0.8
Physical injury	2	9	9.89	0.87
Reproductive	5	11	12.08	0.6
Intestinal	7	9	9.89	0.25
Respiratory	3	13	14.28	0.83
Neurological	1	2	2.19	1.0
Orthopedic	2	7	7.69	0.83
Viral	3	3	3.29	0
Renal	4	9	9.89	0.63
Neglected Tropical Disease (NTD)	1	6	6.59	1.0
Unspecified diseases	4	11	12.08	0.7

3.6. Relative frequency of citation (RFC)

The total of informants (N) was 56 in the present study. The value of RFC was found to be highest in *Curcuma longa* (0.41) followed by *Zingiber officinale* (0.37), *Curcuma domestica* (0.33), and *Aloe vera* (0.23) (Fig. 3). This suggests that the majority of traditional healers believe these species as valuable medicinal plants. The values of RFC for the remaining species are relatively very low i.e. up to 0.02. This implies a disagreement among traditional healers over the application of a certain plant species for its therapeutic properties.

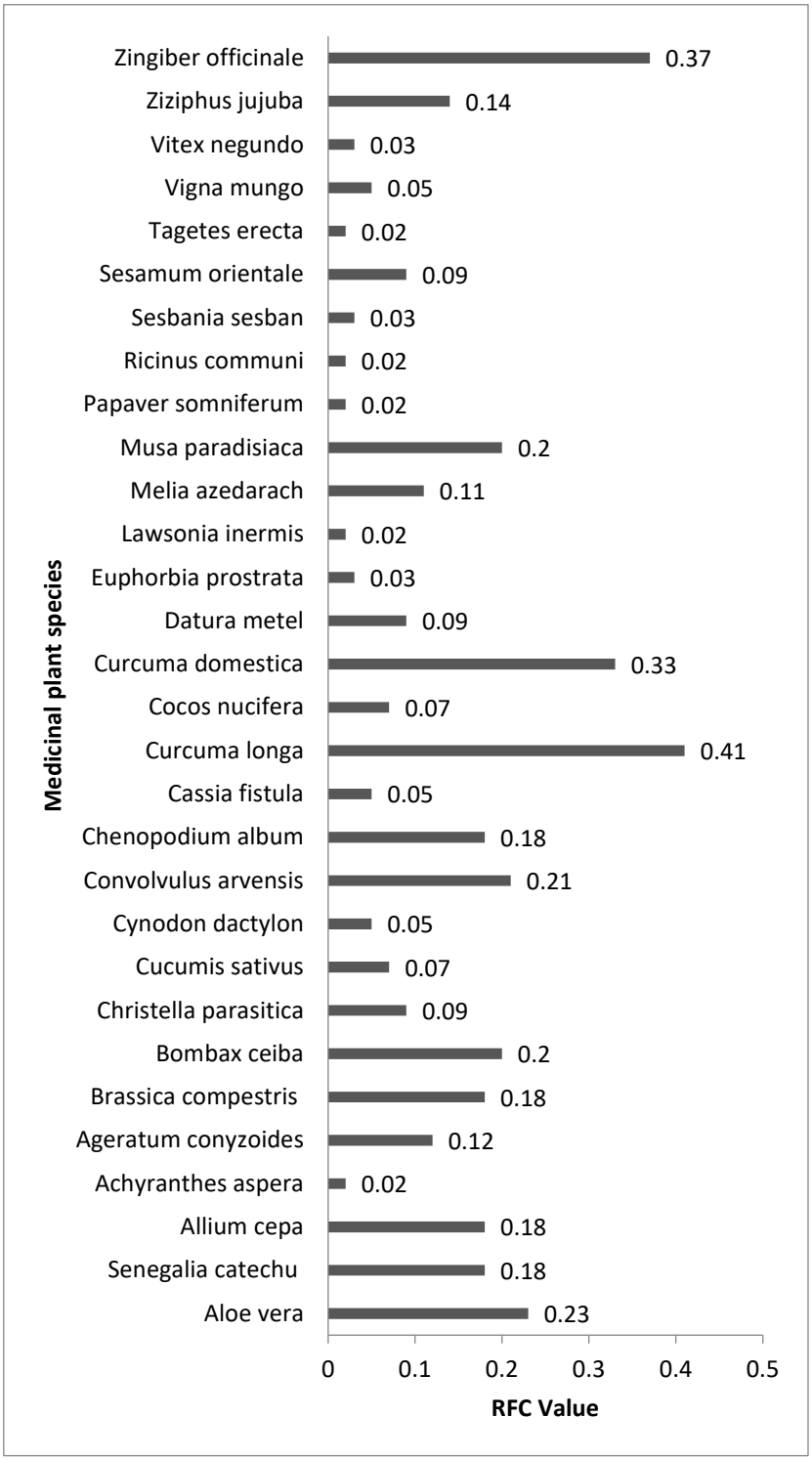

Figure 3: Relative frequency of citation (RFC) of different ethnoveterinary medicinal plant species used in treatments of various ailments.

4. Discussion

This study is concentrated on the medicinal plant species used in ethnoveterinary practices which was analysed using information gathered from the native population of the studied areas. The present findings displayed a total number of 30 species belonging to 29 genera, and 22 families. Most of the species mentioned by informants belonged to Fabaceae, Zingiberaceae, Liliaceae, and Euphorbiaceae. This might be due to the abundance of these families in the char areas. However, the present findings reflected that most of the medicinal plants were pulses and condiments which could be attributed to their antimicrobial, anti-oxidant, anti-inflammatory, and nutritional properties. Thus, these plant resources are important in treating a wide range of animal health issues, ensuring sustainable and holistic veterinary care.

The leaves and seeds were the most used parts for the formulation and medication of livestock. The use of leaves mostly in the formulation of medicines by practitioners is likely due to the accessibility of leaves at any time, easier to collect, handle, process, and store (Chaachouay et al., 2022). Moreover, the effectiveness of leaves and seeds against a broad spectrum of diseases might be one of the notable reasons that implied most secondary bioactive metabolites present in the leaves and seeds (Bhattacharjya et al., 2023).

In char areas, 12 disease categories were reported to be managed with 30 medicinal plant species. The informant consensus factor (F_{ic}) obtained for the reported categories shows the level of common understanding regarding the usage of medicinal plants against various diseases. F_{ic} values of medicinal plants in our study ranged from 0.0 to 1.0. The highest F_{ic} was recorded for neurological (F_{ic}= 1.0) and NTD (F_{ic}= 1.0) while the lowest value was recorded for dermatological and viral disease (F_{ic}= 0.0). In pursuit of bioactive chemicals, one can employ high F_{ic} values to identify interesting species. The lowest F_{ic} value might be because of the lack of knowledge among study participants. Moreover, low values are linked to numerous plant species with almost equal or high-use reports, indicating a lower level of consensus among the informants on the use of these plant species to treat a certain illness category (Amjad et al., 2017).

Relative frequency citation (RFC) reflects the importance of each plant species to the traditional healers. RFC values ranged from 0.02 to 0.23 in the present study. The highest RFC was recorded for *Curcuma longa* (RFC=0.41), *Zingiber officinale* (RFC=0.37), and *Curcuma domestica* (RFC=0.33) while the lowest values were obtained for *Achyranthus aspera* (RFC=0.02) and *Cynodon dactylon* (RFC=0.05). The medicinal plants with the highest RFC are said to be the

most beneficial (Pandikumar et al., 2011). Therefore, plants with the highest RFC may be a sign of good therapeutic potential for a certain disease (Ayyanar & Ignacimuthu, 2011). Conversely, plant species with low RFC suggest that they were not as popular. Additionally, it is not advisable to abandon low RFC plants when they are diminishing in order to preserve them for the next generation because doing so increases the chance that information will gradually vanish (Chaudhary et al., 2006).

5. Conclusion

The present study indicates that local people of char areas of Kamrup district, Assam (India) may cure livestock ailments with natural remedies instead of prescription drugs. Most local people rely on their well-regarded healthcare system, due to the unavailability of veterinary hospitals. The medicine obtained from natural resources is considered malleable and sustainable by the indigenous people because of its easy accessibility, formulation, and use on animals. However, deforestation, land sliding during the flood, overgrazing, overexploitation, rising agricultural needs, and the tendency of villagers to acculturate themselves pose serious threats to ethnoveterinary knowledge. Therefore, it is very crucial to preserve their traditional knowledge at the earliest. In addition, the plants are used against a particular disease in the form of crude or with the addition of ingredients. However, several bioactive metabolites may be engaged in the activity; nevertheless, not all the constituents are in charge of the healing abilities. Therefore, future research focusing on the phytochemicals of these medicinal plants should be made and subsequently, identification of such bioactive metabolites may open the doors for new drug discovery.

Acknowledgments

The authors are grateful to the Department of Biotechnology, Ministry of Science & Technology, (NER-Programme), Government of India, for financial assistance under the project entitled “DBT-NER Institutional Level Biotech Hub at B.P. Chaliha College, Kamrup, Assam (Phase-II)” (No.: BT/NER/143/SP44333/2021). The authors are also thankful to the local informants of the studied area for loyally sharing their traditional knowledge and active cooperation.

Statement and Declarations

Ethical approval and consent to participate: All the participants gave their consent orally during the survey.

Consent for publication: Not applicable.

Availability of data: All the information is available within this manuscript itself.

Competing interest: The authors declare that there is no potential conflict of interest.

Authors' contributions: CKK: Field study and writing of the original draft, PD and SND: Preparation of tables and figures, MJD and CM: Review, corrections and critical inputs added to the manuscript.

References

Ali-Shtayeh M.S., Yaniv Z. & Mahajna J., 2000, Ethnobotanical survey in the Palestinian area: a classification of the healing potential of medicinal plants. Journal of Ethnopharmacol 73(1-2): 221-232.

Amjad M.S., Qaeem M.F., Ahmad I., Khan S.U., Chaudhari S.K., Zahid Malik N., Shaheen H. & Khan A.M., 2017, Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: a case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLoS One 12 (2), e0171896.

Ayyanar M. & Ignacimuthu S., 2011, Ethnobotanical survey of medicinal plants commonly used by Kani tribals in Tirunelveli hills of Western Ghats, India. Journal of Ethnopharmacol 134(3): 851-864.

Bhat N.A., Jeri L., Karmakar D., Mipun P., Bharali P., Sheikh N., ... & Kumar Y., 2023, Ethnoveterinary practises of medicinal plants used for the treatment of different cattle diseases: A case study in East Khasi Hill district of Meghalaya, North East India. Heliyon 9(7), e18214. https://doi.org/10.1016/j.heliyon.2023.e18214

Bhattacharjya D.K., Akhtar J., Deka P. & Bharadwaj A., 2023, An ethnobotanical survey on phytomedicines based on traditional knowledge in the Barpeta district, Assam, India. Journal of Ayurveda and Integrative Medicine 14(4): 100763.

Chaachouay N., Azeroual A., Bencharki B., Douira A. & Zidane L., 2022, Ethnoveterinary medicinal plants for animal therapy in the Rif, North of Morocco. South African Journal of Botany 147: 176-191.

Chaudhary N.I., Schnapp A. & Park J.E., 2006, Pharmacologic differentiation of inflammation and fibrosis in the rat bleomycin model. American Journal of Respiratory and Critical Care Medicine 173 (7): 769-776.

Das S.K. & Tripathi H., 2009, Ethnoveterinary practices and socio-cultural values associated with animal husbandry in rural Sunderbans, West Bengal. Indian Journal of Traditional Knowledge 8(2): 201-205.

Dingsmit B.S. & Manohara T.N., 2017, Ethnoveterinary practices of Garo tribes from West Garo Hills district of Meghalaya, India: perspective and future prospects. Journal of Traditional and Folk Practices 5(2). https://jtfp.jntbgri.res.in/index.php/jtfp/article/view/89

FAO, 2002, Genetics and Animal Health-Splotlight, 1st ed. United Nations, p. 32.

Census, 2011, Government of India. Retrieved July 27, 2023, from https://censusindia.gov.in/census.website/

India Biodiversity Portal. Retrieved August 16, 2023, from https://indiabiodiversity.org/

Krishna N.R., Varma Y.N.R. & Saidulu C., 2014, Ethnobotanical Studies of Adilabad District, Andhra Pradesh, India. Journal of Pharmacognosy and Phytochemistry 3(1): 18-36.

Kumari R., Tiwary B.K., Prasad A. & Ganguly S., 2011, Immunomodulatory effect of herbal feed supplement in normal and immunocompromised broiler chicks. Indian Journal of Animal Sciences 81(2): 158.

McCorkle C.M., 1995, Back to the future: lessons from ethnoveterinary RD&E for studying and applying local knowledge. Agric. Human Values 12(2): 52-80.

Medicinal Plant Names Services. Retrieved August 16, 2023, from https://mpns.science.kew.org/

Mili C., Saha S., Mishra P.K. & Tayung K., 2024, Exploring bioactive metabolites produced by endophytes associated with the genus *Curcuma* L.: A pharmaceutical prospect. Pharmacological Research-Natural Products 100054.s

Namsa N.D., Mandal M., Tangjang S. & Mandal S.C., 2011, Ethnobotany of the Monpa ethnic group at Arunachal Pradesh, India. Journal of Ethnobiology and Ethnomedicine 7(1): 1-15.

Ndou R.V., Materechera S.A., Mwanza M., Otang-Mbeng W. & Ijane M.F., 2023, Indigenous knowledge and use of medicinal plants for ethnoveterinary within the North West Province, South Africa. Frontiers in Veterinary Science 10. https://doi.org/10.3389/fvets.2023.1273562

Oda B.K., Lulekal E., Warkineh B., Asfaw Z. & Debella A., 2024, Ethnoveterinary medicinal plants and their utilization by indigenous and local communities of Dugda District, Central Rift Valley, Ethiopia. Journal of Ethnobiology and Ethnomedicine 20(1), 32.

Panda S.S. & Dhal N.K., 2014, Plants used in ethno-veterinary medicine by native people of Nawarangpur District, Odisha, India. World Journal of Pharmacy and Pharmaceutical Sciences 3(7): 787-798.

Pandikumar P., Chellappandian M., Mutheeswaran S. & Ignacimuthu S., 2011, Consensus of local knowledge on medicinal plants among traditional healers in Mayiladumparai block of Theni District. Journal of Ethnopharmacology 134(2): 354-362.

Patil D.A., Patil P.S., Ahirrao Y.A., Aher U.P. & Dushing Y.A., 2010, Ethnobotany of Buldhana district (Maharashtra: India): plants used in veterinary medicine. Journal of Phytology 2(12): 22-34.

Sharma U.K. & Sapcota D., 2003, Studies on some ethno-veterinary practices in Dhemaji district of Assam. Journal of Natural Remedies 3(1): 73-77.

Shen S., Qian J. & Ren J., 2010, Ethnoveterinary plant remedies used by Nu people in NW Yunnan of China. Journal of Ethnobiology and Ethnomedicine 6(1): 1-10.

Sofowora A., Ogunbodede E. & Onayade A., 2013, The role and place of medicinal plants in the strategies for disease prevention. African Journal of Traditional, Complementary and Alternative Medicines 10(5): 210-229.

Tardío J. & Pardo-de-Santayana M., 2008, Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany 62: 24-39.

WFO, 2023, World Flora Online. Published on the Internet. http://www.worldfloraonline.org [Accessed on: August 16 2023]

Tropicos. Retrieved August 16, 2023, from https://www.tropicos.org/

Trotter R.T. & Logan M.H., 2019, Informant consensus: a new approach for identifying potentially effective medicinal plants. Plants in indigenous medicine & diet. Bedford Hills, NY: Routledge. Publishers, p. 91-112.

Umair M., Altaf M., Ahsan T., Bussmann R.W., Abbasi A.M., Gatasheh M.K. & Elrobh M., 2024, Study of medicinal plants used in ethnoveterinary medical system in riverine areas of Punjab, Pakistan. Journal of Ethnobiology and Ethnomedicine 20(1), 48.

Usman I.S., 2016, Ethno-veterinary care amongst the nomadic Fulani herdsmen in southern zone of Adamawa State, Nigeria. Journal of Animal Science and Veterinary Medicine 1: 108-117.

Verma R.K., 2014, An ethnobotanical study of plants used for the treatment of livestock diseases in Tikamgarh District of Bundelkhand, Central India. Asian Pacific Journal of Tropical Biomedicine 4: S460-S467.