Fading but still existing: some new observations on *Santals'* Ethnoveterinary medicinal practices from the Purba and Paschim Bardhaman districts of West Bengal (India)

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Research

Abstract

Background: The *Santals* have innate expertise in managing their livestock's health and it is still actively practiced in the districts of rural West Bengal, India. Perusal of literature indicates that no research work exclusively on ethnoveterinary medicine has been carried out till date from Purba and Paschim Bardhaman districts of West Bengal. In this regard, indigenous therapeutic knowledge (ITK) for livestock health care is being studied among the *Santal* ethnic group inhabited in the various corners of these districts.

Materials and Methods: In the current study, data were gathered using both *in situ* and *ex situ* techniques after taking prior informed consent (PIC) from each of the 57 participants. Group discussion and semi-structured open-ended questionnaire was used to conduct the interviews. To identify the important folk-medicinal species, three quantitative indices like factor of informant consensus (F_{ic}), use-mentions factor (UM) and relative frequency of citation (RFC) have been employed here.

Results: Altogether 62 plant species have been documented here for 12 types of disease categories. In most of the cases, roots and underground parts (30%) were used. In 69.49% cases, remedies were applied orally. F_{ic} value ranges from 0.6 to 0.94, RFC value ranges from 0.79 to 8.7 and *Achyranthes aspera* L. has been identified as mostly exploited species. Impact of plants like *Aristolochia indica* L., *Pueraria tuberosa* (Willd.) DC. and *Strychnos nux-vomica* L. has also been found deep in the *Santal* people's culture of the studied area.

Conclusion: The collected ethnoveterinary medicinal datasets and the statistically analyzed information can contribute a lot to build up bioprospecting objectives, conservation strategies, and socioeconomic agendas.

Keywords: ITK, ethnoveterinary phytomedicine, quantitative ethnobotany, *Santals*, Purba and Paschim Bardhaman, West Bengal

Background

From the onset of human civilization, livestock have been a vital part of human existence, providing companionship, labor, and useful goods. (Cucchi and Arbuckle 2021, Rahman *et al*. 2023). Understanding the importance of pet animals in daily life, early people have developed skills to take care of their animals which is the basis of 'ethnoveterinary medicine' today (McCorkle 1986). Like all other forms of traditional knowledge, ethnoveterinary medicinal knowledge is still surviving as non-codified and orally transmitted form in most of the folk cultures. Due to the urbanization and ongoing modernization of the ethnic societies, the main stakeholders and their upcoming generations are silently losing their interest in folk medicinal practices (Buenz 2005, Ramirez 2007, Arjona-García *et al*. 2021). Realizing this alarming situation, scientists from different parts of the world have started documenting this folk medical heritage before its extinction forever (Xiong and Long 2020, Khan *et al*. 2021, Radha *et al*. 2022, Uprety *et al*. 2022, Khan *et al*. 2023). The custom of raising animals is ancient and sacred in Indian culture. In recent past, many research articles have been published on ethnoveterinary medicine from India which indicates the growing attitude towards this field of ethnobotany (Bhatt *et al*. 2019, Radha *et al*. 2022). Since last two decades, to get more objectivity in this branch of ethnobotanical studies different quantitative tools have been employed by various researchers throughout the world including India (Njoroge and Bussmann 2006, Kumar and Bharati 2013, Mandal and Rahaman 2014, Parthiban *et al*. 2016). A few research articles have been published earlier from different districts of West Bengal exclusively on ethnoveterinary medicine (Mandal and Chauhan 2000, Ghosh 2003, Bandyopadhyay and Mukherjee 2005, Saha *et al.* 2014, Mandal and Rahaman 2022). Perusal of literature on ethnobotany so far published from this state indicate that quite a good number of works on ethnomedicine have been published from the districts of Purba and Paschim Bardhaman but no research work exclusively on ethnoveterinary medicine has been carried out till date (Biswas 2013, Bouri and Mukherjee 2013). Rural economy of these districts is dependent mainly on agriculture and livestock farming. Large number of milk producing indigenous cattle and crossbred cattle has been found here (Livestock census 2012) and this zone is the 2nd highest milk producing area in West Bengal after West Medinipur (NDDB 2017).

The *Santals* are one of the oldest and largest ethnic stocks in India and a major tribal group of the state of West Bengal (Pal and Jain 1998). Like some other tribal communities, *Santal* people also have close association with the livestock and forest resources. Ill health of livestock seriously affects socio-economic condition of this marginalized ethnic group. So, they have a rich oral tradition of herbal therapies and practiced actively till now as the distal region of the state remains almost out-reached from the government-supported healthcare facilities for livestock. Present study has been undertaken to document the existing ethnoveterinary medicinal knowledge of the *Santal* tribe resides in various parts of Purba and Paschim Bardhaman, West Bengal.

Materials and Methods

Study area

On 7th April 2017, the district Burdwan has been bifurcated into Purba Bardhaman district and Paschim Bardhaman district. The district Burdwan is situated from 22^{o}56′ to 23^{o}53′ North Latitudes and from 86^{o}48′ to 88^{o}25′ East Longitudes. It is bordered on the north by the districts of Birbhum and Murshidabad, on the east by the district of Nadia, on the southeast by the district of Hooghly, on the southwest by the districts of Bankura and Purulia, and on the northwest by the district of Dhanbad in Jharkhand state. Burdwan district extends over the land area of about 7024 sq km within which 277 sq km belongs to forest area.

The survey has been conducted in 11 blocks from these two newly formed districts where *Santal* tribes are predominant than the other tribal groups. From Purba Bardhaman district, 5 blocks namely Khandaghosh, Galsi-I, Galsi-II, Ausgram-I, and Ausgram-II have been explored. On the other hand 6 blocks from Paschim Bardhaman namely Kanksa, Pandabeswar, Faridpur-Durgapur, Raniganj, Jamuria and Barabani have been visited for ethnoveterinary medicinal data collection (Fig. 1). Morphogenetically the selected area falls under the undulating lateritic agro-climatic region. The climatic condition belongs to 'Tropical Wet-Dry Savanna Region' as well as humid subtropical climate inclined by monsoonal rainfall. In last 100 years, this region contains annual average rainfall of 1380 mm with mean temperature is 25.8°C. The forest type is mostly wet deciduous type dominated by the species *Shorea robusta* C.F.Gaertn. though three types of forest categories are existed over the regions i.e., dry peninsula sal forest, northern dry mixed deciduous forest and dry deciduous scrub jungles (Dutta *et al*. 2020).

In Purba and Paschim Bardhaman, population of the *Santals* is nearly 7% of the state schedule tribe population and 76% of the district's total tribal population (Census 2011). Most of the economically underprivileged and small-landowner *Santals* in this area make a living primarily as a daily labourer, and via agriculture, cattle raising, and small-scale dairy production.

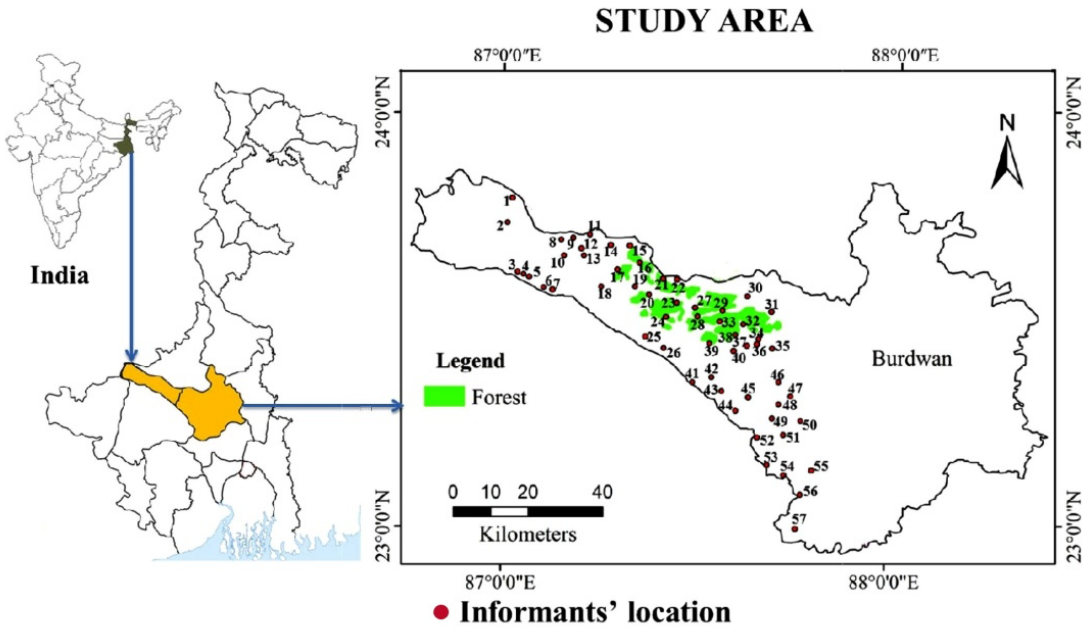

Figure 1. Study area shows GPS coordinates of 57 informants of Purba and Paschim Bardhaman districts

Ethnographic composition and Ethnomedicinal data collection

The survey was conducted for a period from September 2022 to November 2022. Before collection of the data, prior informed consent (PIC) has been taken from the informants to protect the intellectual property right of those traditional people. Altogether 57 informants were interviewed, of which 23 were women and 34 men. Forty-one informants are aged between 60 to 85 years, 11 are of 40 to 60 years and only 5 informants are found to be aged bellow 40 years. Among 57 informants, 80.7% informants have no primary education, 14.03% have school education and only 5.26% have higher education and engaged in government services. Among the 57 informants, 26 people were locally known as '*Go-Vaidya*' or herbal healer for cattle diseases. The folk healers gather their knowledge mainly from their ancestors and knowledgeable persons of the same or other localities. The flow of this traditional knowledge is found very much vertical coexisted with transverse way of knowledge dissemination. In few cases it has been found that the knowledge transfer is restricted within the family descendants. The member of the family, who is genuinely interested in traditional healing system as well as capable of doing so, becomes the right choice to whom the knowledge is conveyed.

Both *in situ* and *ex situ* methods of data collection were applied in the present study. In the "walk-in-the-wood" (*in situ*) method, informants were taken to the field individually to identify the plants that they use to cure the diseases or ailments which produces much reliable data. Sometimes freshly collected plant specimens (*ex situ* method) were shown to the informants (mainly women and aged persons) for proper identification of the plants of relevant medicinal uses (Thomas *et al*. 2007). Interviews were taken with the help of semi-structured and open-ended questionnaire, and it was done in a very informal way (Martin 2004). Sometimes interaction with the tribal people had been made with the help of local interpreter.

The survey was executed following the best field practice proposed earlier (Heinrich and Verpoorte 2014, Heinrich *et al*. 2018), and maintaining Code of Ethics suggested by International Society of Ethnobiology (ISE, 2008). Sample specimens have been collected following the national guidelines (NMPB, 2015). Collected plant specimens have been identified with the help of different Floras (Sanyal 1994, BSI 1997, Paul *et al*. 2015, Ranjan *et al*. 2016) and confirmed the identification of few plants consulting the herbarium specimens housed at Central National Herbarium (CAL), Howrah, India. The collected plant species have been preserved as herbarium specimen following standard herbarium techniques and kept in the Department of Botany, Krishna Chandra College, Hetampur, India for future references (Jain and Rao 1977). Updated botanical names of the documented plant specimens were provided according to a standard websites like Plants of the World Online (https://powo.science.kew.org/).

Quantitative tools for ethnomedicinal data analysis

Three quantitative indices have been employed here for analyzing the collected data on ethnoveterinary medicinal plants used by the *Santal* community of the study area. The indices used here are factor of informant consensus (F_{ic}), use mention factor (UM), and relative frequency of citation (RFC).

Factor of informant consensus (F_{ic})

Factor of informant consensus, an extensively popular quantitative ethnobotanical tool have been used globally to determine the consensus between the informants for the treatment of certain illness and it also helps to identify the most potential medicinal plant species used by the people of the study area (Heinrich *et al*. 1998). F_{ic} is expressed by the formula:

$$F_{ic} = \frac{\mathrm{Nur} - \mathrm{Nt}}{\mathrm{Nur} - 1}$$

where, Nur is the number of use-reports in each disease category, a use-report is a single record for use of a plant taxa mentioned by an informant, and Nt refers to the total number of plants used in each disease category. The value of F_{ic} ranges from 0 to 1. For F_{ic} analysis, similar type of health conditions and ailments are grouped into a particular 'disease category'. It gives a value for a certain group of ailments/diseases treated by a set of medicinal plants. The higher value indicates that very limited numbers of plants are used frequently in curing particular disease or ailment and the lower value indicates the disagreement regarding the use of variable phyto-remedies for a particular disease or ailment.

The use-mentions factor (UM)

The UM is defined as the number of mentions for one plant given by all of the informants for a specific health condition (Andrade-Cetto and Heinrich 2011).

Relative frequency of citation (RFC)

For each medicinal plant used to treat a particular ailment/disease, the frequency of citation is determined, and it is compared with all other medicines cited by all of the informants in the study through relative frequency of citation (RFC). Value of RFC provides additional information about the relative value of the informants' consensus for a particular medicine for a health condition (Kumar and Bharati 2013).

$$\text{Relative frequency of citation (RFC)} = \frac{\text{Frequency of citation}}{\Sigma\ \text{Frequency of citation for all plants}} \times 100$$

$$\text{Frequency of citation} = \frac{\text{Number of informants who cited the medicinal plants}}{\text{Total number of informants interviewed}} \times 100$$

Results and Discussion

Ethnomedicinal data

The investigated plant taxa spread over 62 species, 60 genera and 43 families of the flowering plants. Two of the reported plant families like *Convolvulaceae* and *Euphorbiaceae* were found represented by the highest number of species (4 species each), followed by the families *Amaranthaceae*, *Apocynaceae*, *Compositae* and *Leguminosae* (3 species each), then *Acanthaceae*, *Apiaceae*, *Sapotaceae*, *Vitaceae* and *Zingiberaceae* (2 species each), whereas rest of the 32 families were represented by only one species.

According to the plant habit, it has been observed that most of the recorded plants are herbaceous in nature (50%) which is followed by the trees (24.19%), climbers (19.35%) and shrubs (6.45%). The probable reason for using the herbs in highest number may be due to their abundant growth in the locality and easy accessibility (Albuquerque *et al*. 2005). Out of 62 recorded plant species, parts of 58 species were collected from wild, materials of 3 plants procured from local market and 1 plant from their cultivation. Dominance of wild herbaceous medicinal plants in most of the ethnobotanical studies has been evident from other parts of the state as well as the country (Phondani *et al*. 2010, Prakash *et al*. 2021, Mandal and Rahaman 2022).

The present study revealed that 59 types of ethnomedicinal preparations were used to cure 28 types of health conditions. All these recorded health conditions have been grouped into 12 disease categories. Among these disease categories four

disease categories were reported most of the times by the informants. The category of gastro-intestinal disorders was mentioned maximum numbers of time (39 times) by the informants, followed by the category of dysentery and diarrhea (35 times), reproductive organ disorders (35 times) and musculoskeletal disorders (34 times). The results here clearly indicated that incidence of all the health conditions grouped under these 4 disease categories is very common among the domesticated animals in the study area (Jas and Pandit 2017, Shit *et al*. 2017). *Santal* people of the study area have effective knowledge of herbal therapy which helps in combating all those diseases and ailments.

From the present investigation it has been evident that the *Santal* people of the studied area use different plant parts like leaf, bark, whole plant, fruit, stem, seed, latex, root and other underground parts in the preparation of 59 types of phyto-remedies for livestock health care. Among the plant parts, the root and other underground parts were used in highest percentage (30%) followed by leaf (17%), bark (13%), whole plant (13%), etc. (Fig. 2). The underground parts of the plants are known as one of the major sites where many of the bioactive compounds are synthesized and / or accumulated (Signs and Flores 1990) which highlights their inherent knowledge of effective plant parts used for its medicinal purposes.

Some ingredients like particulated rice, rice bran, rice gruel, molasses, coconut oil, mustard cake, common salt, soil collected from the mouth of crab hole, paddy straw and bamboo sticks were used during remedy preparation and/or its application.

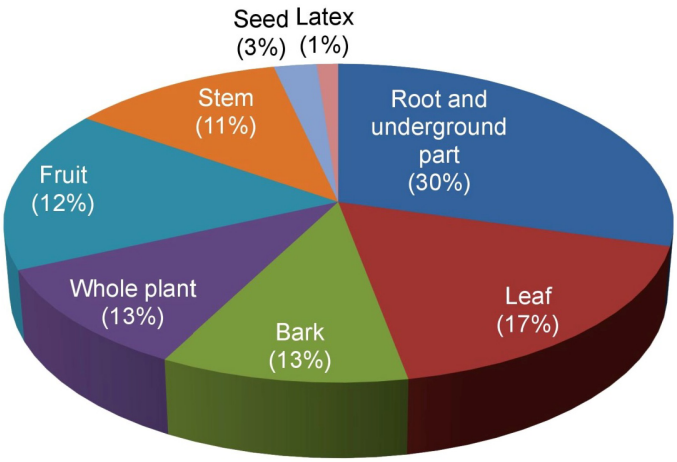

Figure 2. Percentage proportion of plant parts used in the preparation of ethnoveterinary medicine

Regarding mode of administration, the most common route of remedy application is oral (69.49%) and remedies are administered in the forms of fresh juice, paste, infusion, water emulsion, etc. In 30.51% cases, remedies were administered topically in the form of poultice, eye drop and as surface disinfectant (Fig. 3).

Examining pertinent literature on ethnoveterinary medicine indicates that most of the reported taxa's uses are quite similar to how *Santals* of Purba and Paschim Bardhaman's neighbouring areas prescribe medicinal plants for livestock diseases (Ghosh 2002, Dey and De 2010, Mandal and Rahaman 2016).

Quantitative analysis

The collected ethnomedicinal data of each plant species have been statistically analyzed with the help of use-mentions factor (UM) and relative frequency of citation (RFC) to figure out the range of importance of a medicinal species for a particular health condition (Table 1). All the diseases and health conditions documented here have been grouped into 12 disease categories and their F_{ic} scores have been determined (Table 2).

The present study reveals that the F_{ic} value of different disease categories varies from 0.6 to 0.94 which indicates high level of consensus among the informants regarding the usages of ethnoveterinary medicinal plants. Dysentery and diarrhea, retention of milk, poisonous animal bite, fever and related problems, these four disease categories show higher F_{ic} value which ranges from 0.85 to 0.94. High level of consensus regarding a plant used in the treatment of a disease or disease

category highlights the cultural importance of that ethno-species which is consistently associated with the tribal people's culture in the area.

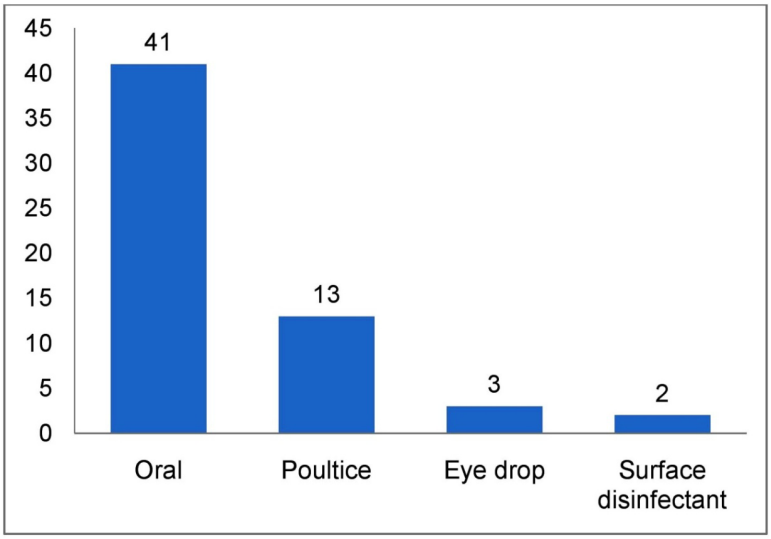

Figure 3. Modes of administration of remedies and its number of mentions

Value of RFC for all the 62 recorded species varies from 0.79 - 8.7. In case of plants with multipurpose uses, RFC value of the species has been calculated for each separate use considering it as an individual event. Eight plant species, namely *Achyranthes aspera* L., *Pueraria tuberosa* (Willd.) DC., *Aristolochia indica* L., *Strychnos nux-vomica* L., *Amaranthus spinosus* L., *Rivea hypocrateriformis* Choisy, *Soymida febrifuga* (Roxb.) A. Juss., *Bryophyllum pinnatum* (Lam.) Oken. having RFC value greater than three (>3) indicates their popularity as a frequently cited species in the studied area. In the contrary, there is a most possible chance of their overharvesting which may be one of the causes that some of the plants like *Strychnos nux-vomica, Soymida febrifuga, Aristolochia indica* gradually become rare in the study area but still local people are very familiar with their usefulness.

Value of use mention factor (UM) varies from 2 to 22. The highest value assigned to the plant *Achyranthes aspera* L. (UM=22) followed by *Pueraria tuberosa* (Willd.) DC. (UM=13), *Aristolochia indica* L. (UM=11) and *Strychnos nux-vomica* L. (UM=11) which indicate their wide acceptance regarding disease curing ability. So, the plants which are cited frequently having maximum RFC value and greater use mentions can be considered as potent candidate for pharmacological investigations (Heinrich 2000, Miller 2011). So, all these 8 ethnoveterinary medicinal plants with higher RFC and UM value can be considered as culturally valuable and promising medicinal plants in the studied area, side by side an attempt should be prioritized for their local level conservation.

It has been also found that the change in the score of RFC is proportionally related to the value of UM i.e., there is a linear correlation between them (Fig. 4). For example- for the treatment of fever of domesticated animals, *Achyranthes aspera* L. has been mentioned maximum numbers of times (UM- 22) by the informants and thus produce highest RFC value of 8.7 among all the documented taxa. Similarly for the treatment of corneal opacity, leaf juice of *Careya arborea* Roxb. as eye drop has been recorded only 2 times (UM=2) and very minimum value of RFC has been calculated for that species (RFC=0.79).

Throughout the survey few plants have been mentioned only once or twice. We have considered those plants which were cited at least twice. It is a matter of concern that few commonly growing medicinal herbs got very low (UM=2) use mention, such as *Blumea lacera* (Burm.f.) DC., *Colocasia antiquorum* Schott, *Datura stramonium* L., *Portulaca oleracea* L., *Senna occidentalis* (L.) Link, and *Xanthium strumarium* L. On the other hand plants like *Argyreia nervosa* (Burm. f.) Bojer, *Careya arborea* Roxb., *Curculigo orchioides* Gaertn., *Dillenia pentagyna* Roxb., *Echinops echinatus* Roxb., *Ipomoea obscura* (Linn.) Ker.-Gowl., *Jatropha nana* Dalzell & A. Gibson, *Manilkara hexandra* (Roxb.) Dubard, *Nerium oleander* L., and *Phoenix acaulis* Roxb. which are becoming rare in the studied area also having very low (UM=2) use mention (Fig. 5). In both the cases, sustenance of the ethnoveterinary medicinal knowledge in the *Santal* community directed towards its gradual extinction. The fact can be crosschecked by executing more extensive field studies on ethnoveterinary medicinal knowledge of the studied area.

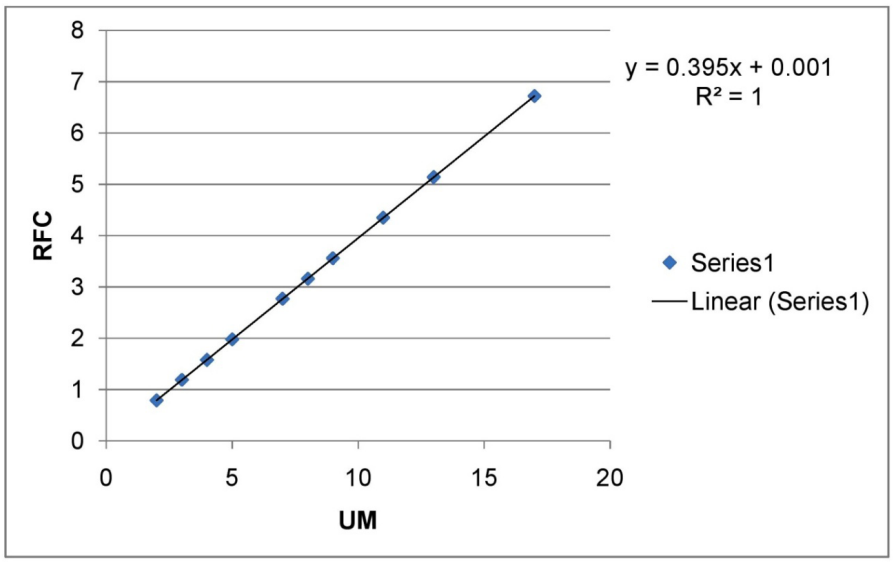

Figure 4. Linear correlation between Relative Frequency of Citation (RFC) and Use Mention factor (UM)

Conclusion

From the present study it can be concluded that identification of efficacious plant is equivalent to the identification of promising source of effective bioactive agents. Plants like *Achyranthes aspera* L., *Pueraria tuberosa* (Willd.) DC., *Aristolochia indica* L., *Strychnosnux-vomica* L., *Amaranthus spinosus* L., *Rivea hypocrateriformis* Choisy, *Soymida febrifuga* (Roxb.) A. Juss., *Bryophyllum pinnatum* (Lam.) Oken. showed very good efficacy against a wide range of diseases occurred among the domesticated animals in the studied area. Most of these reported plant species are used in different traditional systems of medicine and also by various ethnic communities throughout the world. Some of them have already been established by the researchers as good source of bioactive agents; further research may lead towards identification of new bioactive compounds and drug development.

The present study witnessed that the traditional herbal knowledge regarding domesticated animal's health care still exists in the *Santal* community of that region but to some extent in a fragile form. The preservation of this traditional knowledge and its accompanying ethno-flora is a major priority for us right now. The first step should be to raise awareness of herbal knowledge and associated plant resources among the district's indigenous youth. Simultaneously, to improve the knowledge base, the homogeneity of ethnoveterinary medicinal knowledge should be maintained by establishing an oblique knowledge transmission network through recurring group discussions, workshops, and seminars that include community members of all ages. Furthermore, sustainable utilization of local flora should be promoted. As the majority of traditional knowledge is linked to local biodiversity, if the local flora is preserved, the accompanying traditional knowledge will be preserved as well.

Table 1. Enumeration of the recorded ethnoveterinary medicinal plants with their respective quantitative analyses (UM- use-mentions factor; FC- frequency of citation and RFC- relative frequency of citation)

Tribal/local name, botanical name, family and voucher no.	**Parts used**	**Diseases/ailments cured, mode of remedy preparation and its administration**	**Treated animal**	**UM**	**FC**	**RFC**
"Chir-chiti/ Sitakanta" *Achyranthes aspera* L. [Amaranthaceae] SS-19	Root	(i) Fever- root paste+ black pepper; oral; twice/day; 5-7 days. (ii) Liver trouble- root paste; oral; once/day; 3 days	Bullock, Goat and calf	22	38.59	8.7
"Lupani-ara" *Aerva lanata* (L.) Juss. [Amaranthaceae] SS-23	Whole plant	Gastric ulcer, liver trouble, stomachache- whole Plant paste+ turmeric+ black cumin; oral; twice/day; 7 days	Cow, buffalo, goat, sheep	3	5.26	1.19

"Jenum-leper-ara" *Amaranthus spinosus* L. [Amaranthaceae] SS-7	Whole plant	Retention of milk- boiled plant+ particulate rice; oral; once/day; 15-20 days	Cow	9	15.79	3.56
"Ijer/Angur-lata" *Ampelocissus latifolia* (Roxb.) Planch. [Vitaceae] *SS-17*	Root	Snake bite- root paste; oral; twice/day; 3 days	All ruminants	4	7.02	1.58
"Kaalmegh/ Bhuin-nim" *Andrographis paniculata* (Burm.f.) Nees [Acanthaceae] SKM-54	Aerial part	Foot and mouth disease- dried aerial part paste+ fresh turmeric+ molasses; oral; once/day; 7 days	Large ruminants	4	7.02	1.58
"Panespu/ Marang-haru" *Argyreia nervosa* (Burm. f.) Bojer [Convolvulaceae] SS-29	Leaf	Safe delivery- fresh leaves (9-11 in nos.); oral; once/day; 15 days (before the estimated time of parturition)	Cow and buffalo	2	3.51	0.79
"Gond/ Ishwarmul" *Aristolochia indica* L. [Aristolochiaceae] SS-13	Root	Snake bite- root paste+ black pepper (21 grains); oral; twice/day (after an interval of 8 hours); 3 days	All types of ruminants	11	19.29	4.35
"Dant-rese/ Kanta-jhanti" *Barleria prionitis* L. [Acanthaceae] SKM-11	Shoot	Post partum debility- plant paste+ black pepper (21 grain); oral; twice/day; one month.	Cow	3	5.26	1.19
"Kukshime" *Blumea lacera* (Burm.f.) DC. [Compositae] SS-15	Leaf	Retention of placenta- leaf juice; oral; twice/day; 3 days	Cow	2	3.51	0.79
"Kichu-ara" *Boerhavia diffusa* L. [Nyctaginaceae] SS-25	Stem	Post parturition bleeding- stem paste+ black pepper (9-11 grains); oral; once/day; 3 days	Cow and buffalo	5	8.77	1.98
"Patharkuchi" *Bryophyllum pinnatum* (Lam.) Oken [Syn. *Kalanchoe pinnata* (Lam.) Pers.] [Crassulaceae] SS-5	Leaf	Retention of urine- leaf paste; poultice on the lower abdomen; once a day for 3 days	Goat and sheep	8	14.04	3.16
"Akan" *Calotropis procera* (Aiton) Dryand. [Apocynaceae] SS-35	Bark	Swelling- bark paste+ leaves of *Jatropha curcas* L. + fresh turmeric; poultice; once/day; 5-7 days	All types of ruminant	5	8.77	1.98
"Laiputki" *Cardiospermum halicacabum* L. [Sapindaceae] SKM-72	Root	Dysentery- root paste as water emulsion; oral; once/day; 3 days	young ruminant	7	12.28	2.77
"Kumbhi-dari" *Careya arborea* Roxb. [Lecythidaceae] SKM-118	Leaf	Corneal opacity- leaf juice; eye drop (2-3 drops); till the cure	Sheep	2	3.51	0.79

"Hanrumala" *Cascuta reflexa* Roxb. [Cascutaceae] SKM-19	Whole plant	Food poisoning- plant paste (250 gm); water emulsion; oral; once	Large ruminant	3	5.26	1.19
"Chorchi-dari" *Casearia tomentosa* Roxb. [Salicaceae] SKM-157	Bark	Dysentery- bark extract; oral; once/day; 3 days	Small ruminants	3	5.26	1.19
"Har-jora" *Cissus quadrangularis* L. [Vitaceae] SS-76	Stem	Helminthiasis- stem paste+ black pepper (9 grains); oral; once/day in morning; 5-7 days	Bullock, buffalo	3	5.26	1.19
"Kiduri" *Coccinia grandis* (L.) Voigt [Cucurbitaceae] SS-48	Leaf	Whitening of eyes and watering of eyes- leaf juice; eye drop; once/day; 3 days	Cow, bullock, buffalo	5	8.77	1.98
"Jalerkachu" *Colocasia antiquorum* Schott [Araceae] SKM-81	Corm	Tumor/swelling- corm paste+ table salt; poultice; once/day; 5-7 days	Buffalo, bullock	2	3.51	0.79
"Bon-piyaz" *Crinum asiaticum* L. [Amaryllidaceae] SKM-93	Bulb	Swelling warts- tuber paste; poultice; twice/day, 3 days	All types of ruminants	3	5.26	1.19
"Tos-kati" *Croton persimili*s Müll. Arg. (Syn. *Croton oblongifolius* Roxb.) [Euphorbiaceae] SKM-127	Root	Galactagague- root paste; oral; once/day in evening; 15-20 days	Cow	3	5.26	1.19
"Tal-muli" *Curculigo orchioides* Gaertn. [Hypoxidaceae] SKM-133	Root	Foot and mouth disease- dried root powder+ rice bran; oral; once/day; 5-7 days	Cows, bullock, buffalo	2	3.51	0.79
"Bon-haldi" *Curcuma aromatica* Salisb. [Zingiberaceae] SKM-139	Rhizome	Food poisoning- rhizome paste+ black pepper (9-21 grains); oral; twice/day; 2 days	Cow, bullock, buffalo	5	8.77	1.98
"Dhutro" *Datura stramonium* L. [Solanaceae] SS-69	Root	Watering of eyes- root paste+ roots of *Chrysopogon zizanioides* (L.) Roberty ("Bena") and *Cyperus rotundus* L. ("Mutho"); oral; once/day; 3 days	Bullock and buffalo	2	3.51	0.79
"Sim" *Dendrophthoe falcata* (L.f.) Ettingsh. [Loranthaceae] SS-91	Leaf	Prolapsed uterus- leaf extract; surface disinfectant; oozed out uterus is washed immediately and then replacement is done	Cow	3	5.26	1.19
"Sarha-dari" *Dillenia pentagyna* Roxb. [Dilleniaceae] SKM-17	Bark and leaf	(i)Helminthiasis- bark powder; oral; once/day (night); 7 days (ii) Gastrointestinal problems- leaves paste (5-6 pieces)+ black pepper (11 grains); oral; once/day; 3 days	Small and large ruminant	4	7.02	1.58

"Panshunt/ Marang-konga" *Dregea volubilis* (L.f.) Benth. exHook.f. [Syn. *Wattakaka volubilis* (L. f.) Stapf.] [Apocynaceae] SKM-51	Stem and leaf	(i) Liver trouble- stem paste+ ajwain; oral; once/day; 5 days (ii) Tumours- leaves paste+ table salt; lukewarm poultice; twice/day; 3 days (iii) Unusual urination- fresh stems are boiled with particulated rice ("Jewli"); oral; once/day; 7 days. (iv) Mastitis- leaf paste (4-5 pieces)+ fresh turmeric; poultice; once a day till the cure	Cow, bullock, milching buffalo, small ruminant	12	21.05	4.75
"Tandi-jenum" *Echinops echinatus* Roxb. [Compositae] SS-72	Tender shoot	Infertility- finely grounded tender twigs; oral; once/day (fed along with paddy straw after the onset of normal heat period)	Barren cow	2	3.51	0.79
"Teshira/ Etke" *Euphorbia antiquorum* L. [Euphorbiaceae] SKM-66	Latex	Whitening of eyes- fresh latex; eye drop; 2 drops are applied once in the first morning till cure	Bullock	3	5.26	1.19
"Ratin" *Glochidion multiloculare* (Rottler ex Willd.) Voigt [Phyllanthaceae] SKM-11	Bark	Stiffness of shoulder- bark paste+ bark of *Madhuca longifolia*; poultice; thrice/day; 3-4 days	Bullock and buffalo	3	5.26	1.19
"Siming-sam-ara" *Gloriosa superba* L. [Colchicaceae] SS-91	Tuber	Prolapsed uterus- tuber extract; applied externally as surface disinfectant; once	Cow	4	7.02	1.58
"Vacha-ara" *Ipomoea obscura* (Linn.) Ker.-Gowl. [Convolvulaceae] SS-59	Leaf	Broken horn- leaf paste+ coconut oil; lukewarm poultice; once/day; 5-6 days (lukewarm paste is applied at the base of the broken area and tightly wrapped with cloth)	Bullock	2	3.51	0.79
"Bir-eradom" *Jatropha nana* Dalzell & A. Gibson [Euphorbiaceae] SS-149	Tuber	Retention of milk- dried root powder; oral; once/day; 10-15 days (fed along with finely grounded mustard cake)	Cow	2	3.51	0.79
"Baghlaal/Ponjo" *Litsea glutinosa* (Lour.) C.B.Rob. [Lauraceae] SS-109	Bark	Dislocation of joints- bark paste; poultice; once (bark paste is applied on the affected area and tied with bamboo stick)	Cattle	5	8.77	1.98
"Khir-kul" *Manilkara hexandra* (Roxb.) Dubard [Sapotaceae] SKM-133	Bark	Tonsillitis- bark paste+ mud of crab hole; lukewarm poultice; twice/day; till the cure (applied on the outer side of lower jaws)	Cow, bullock	2	3.51	0.79
"Jamjuri ara" *Merremia tridentata* (L.) Hallier f. [Convolvulaceae] SKM-70	Whole plant	Stomachache- plant paste+ black pepper (21 grains); water emulsion; oral; once/day (morning); 3 days	Goat and sheep	3	5.26	1.19

"Bishalyakarabi/ Kanaili" *Nerium oleander* L. [Syn. *Nerium indicum* Mill. (Apocynaceae)] SS-136	Leaf	Mastitis- leaf paste; poultice; twice/day; till the cure	Cow	2	3.51	0.79
"Bir-khejuri" *Phoenix acaulis* Roxb. [Arecaceae] SKM-194	Leaf and root	(i) Retention of milk- finely chopped fresh tender leaves; oral; once/day; 10-15 days (ii) Safe delivery- soft root paste+ rice gruel; oral; once a day	Cow, buffalo	7	12.28	2.77
"Bhuin-okra" *Phyla nodiflora* (L.) Greene [Verbenaceae] SS-111	Whole plant	Dyspepsia- finely chopped fresh plants; oral; once/day; 15-20 days (fed along with any cattle feed)	Calf	3	5.26	1.19
"Nuni-ara" *Portulaca oleracea* L. [Portulacaceae] SS-89	Whole plant	Mastitis- plant paste; oral; once a day for 7 days	Goat, sheep	2	3.51	0.79
"Bhuinkumro/ Patalkondha" *Pueraria tuberosa* (Willd.) DC. [Leguminosae] SKM-169	Tuber	Retention of milk- sliced pieces of tuber (fresh or dried form); oral; once/day (morning); 3 days (fed along with rice gruel).	Cow	13	22.81	5.14
"Bon-pui" *Rivea hypocrateriformis* Choisy [Convolvulaceae] SKM-160	Aerial part	Fractured bone- plant paste+ table salt; poultice; once (paste is applied on the affected area and wrapped tightly with bamboo sticks)	Cow, bullock, buffalo	9	15.79	3.56
"Berela" *Scoparia dulcis* L. [Plantaginaceae] SKM-158	Whole plant	Retention of placenta- plant paste (two or three plants)+ tender shoot of *Ziziphus jujube* Mill., + ajwain + turmeric; water emulsion; oral; once/day (morning); 3 days	Cow, buffalo	3	5.26	1.19
"Bhela" *Semecarpus anacardium* L.f. [Anacardiaceae] SS-144	Seed	Liver disorder- mature seeds (2-3 pieces); oral; once/week	Bullock	4	7.02	1.58
"Veradiring" *Senna occidentalis* (L.) Link [Leguminosae] SS-138	Root	Diarrhoea- root paste+ black pepper (9 grains); water emulsion; oral; once/day; 5-7 days	Sheep	2	3.51	0.79
"Bon-jowan" *Seseli diffusum* (Roxb. ex Sm.) Santapau &Wagh [Apiaceae] SKM-165	Whole plant	Drop wise continuous urination- freshly collected plant; oral; once/day; till the cure	Goat, sheep	3	5.26	1.19
"Raj-pan / Ram-pan" *Smilax ovalifolia* Roxb. ex D.Don [Smilacaceae] SS-141	Root	Blood dysentery- root paste+ black pepper (11 grains); oral; once/day; 3 days	Cow, bullock, buffalo, goat, sheep	7	12.28	2.77

"Rahet- rahim / Rohin" *Soymida febrifuga* (Roxb.) A. Juss. [Meliaceae] SKM-172	Bark	Post partum debility- dried bark of *S. febrifuga* + dried plants of *Cocculus hirsutus* (L.) W.Theob.; infusion; oral; once/day; 15 days	Cow	9	15.79	3.56
"Kuchila" *Strychnos nux-vomica* L. [Loganiaceae] SKM-77	Bark	Dysentery- stem bark paste with+ table salt; water emulsion; oral; once/day; till the cure	Cow, bullock, buffalo	11	19.29	4.35
"Tentul / Jojo" *Tamarindus indica* L. [Leguminosae]	Fruit	Food poisoning- fruit pulp mixed in water; oral; once as soon as possible	Cow, bullock, buffalo	5	8.77	1.98
"Gokhur" *Tribulus terrestris* L. [Zygophyllaceae] SKM-45	Leaf	Colic pain- fresh leaves; oral; twice/day; 3 days	Sheep	3	5.26	1.19
"Okra" *Xanthium strumarium* L. [Compositae] SS-44	Leaf	Retention of urine- leaf paste+ table salt; poultice; once/day; 5-7 days (applied on the lower abdomen)	Cattle	2	3.51	0.79
"Jenum-dari" *Ziziphus jujube* Mill. [Rhamnaceae] SS-13	Tender shoot	Diarrhoea- shoot paste+ black pepper (9–21 grains); water emulsion; oral; twice/day; 3 days	Cattle	5	8.77	1.98

Table 2. Factor of informant consensus (F_{ic}) value for the recorded disease categories

Disease categories	**Number of plant taxa used (Nt)**	**Number of use reports (Nur)**	**F_{ic}**
Fever and related problems	02	19	0.94
Poisonous animal bite	02	15	0.93
Retention of milk	05	32	0.87
Dysentery & diarrhea	06	35	0.85
Foot and mouth disease	02	06	0.8
Musculoskeletal disorders	08	34	0.79
Urinary disorders	04	15	0.79
Helminthiasis	02	05	0.75
Gastro-intestinal disorders	11	39	0.74
Reproductive organ disorders	10	35	0.74
Diseases of sensory organ	04	12	0.73
Mastitis	03	06	0.6

Declarations

Ethical approval: The present study was carried out in accordance with the terms of the convention on biological diversity's Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits resulting from their utilization.

Participants' consent: Before interviewing a verbal consent was taken each time from the participating individuals.

Data availability: All the data curetted during the study presented in the article and there is no supplementary data.

Funding: There is no financial support for the research, and/or publication of this article.

Data and materials accessibility: The raw data without disclosing the names of informants can be provided by the corresponding author.

Author's contributions: SS and SKM conceptualized and designed the research, collected and analyzed the data, wrote the manuscript and agreed to submit it.

Conflict of interests: We have no competing or conflict of interest.

Consent for publication: Not applicable

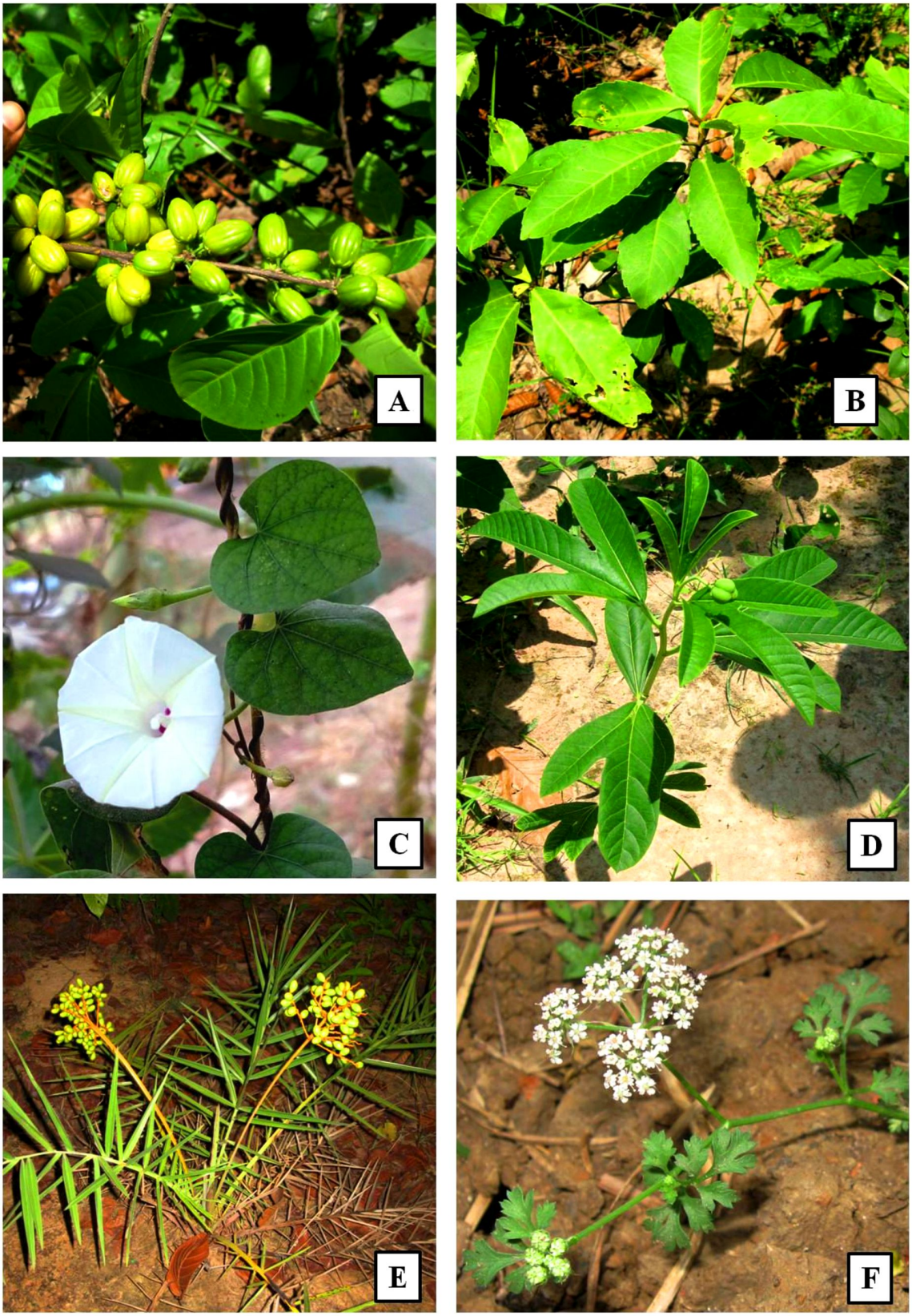

Figure 5. Photographs of some less known ethnoveterinary medicinal plants of Purba and Paschim Bardhaman districts (**A.** *Casearia tomentosa* Roxb., **B.** *Croton persimilis* Müll. Arg., **C.** *Ipomoea obscura* (L.) Ker.-Gowl., **D.** *Jatropha nana* Dalzell & A.Gibson **E.** *Phoenix acaulis* Roxb. and **F.** *Seseli diffusum* (Roxb. ex Sm.) Santapau &Wagh

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Literature Cited

Albuquerque UP, Andrade LHC, Silva ACO. 2005. Use of plant resources in a seasonal dry forest (northeastern Brazil). Acta Botanica Brasilica 19(1):27-38.

Andrade-Cetto A, Heinrich M. 2011. From the field into the lab: useful approaches to selecting species based on local knowledge. Frontiers in Pharmacology 2(2011):00020

Arjona-García C, Blancas J, Beltrán-Rodríguez L, López Binnqüist C, Colín Bahena H, Moreno-Calles A.I, Sierra-Huelsz JA, López-Medellín X. 2021. How does urbanization affect perceptions and traditional knowledge of medicinal plants? Journal of Ethnobiology and Ethnomedicine 17(1):48.

Bandyopadhyay S, Mukherjee SK. 2005. Ethnoveterinary medicine from Koch Bihar district, West Bengal. Indian Journal of Traditional Knowledge 4(4):456-461.

Bhatt PR, Patel UD, Patel HB, Modi CM. 2019. Survey on ethnoveterinary practices around Junagadh, Gujarat, India. Indian Journal of Pharmaceutical Sciences 81(1):161-167.

Biswas CK. 2013. Medicinal plants and human health care- a preliminary case study from Raniganj block, Burdwan District, West Bengal. Journal of Environment and Sociobiology, 10(2):213-216.

Bouri T, Mukherjee A. 2013. Documentation of traditional knowledge and indigenous use of non-timber forest product in Durgapur forest range of Burdwan District, West Bengal. The Ecoscan 3:69-74.

BSI. 1997. Flora of West Bengal. Ranunculaceae to Moringaceae. Vol. I. Botanical Survey of India, Calcutta, India.

Buenz EJ. 2005. Country development does not presuppose the loss of forest resources for traditional medicine use. Journal of Ethnopharmacology 100(1-2):118–123.

Census of India. 2011. West Bengal, Series-20 Part XII-B. District Census Handbook, Burdwan - Village and Town wise Primary Census Abstract (PCA). Directorate of Census Operations, West Bengal.

Cucchi T, Arbuckle B. 2021. Animal Domestication: from Distant Past to Current Development and Issues. Animal Frontiers 11(3):6–9.

Dairying in West Bengal- A Statistical Profile. 2017. National Dairy Development Board. India.

Dey A, De JN. 2010. Ethnoveterinary uses of medicinal plants by the aboriginals of Purulia district, West Bengal, India. International journal of Botany 6(4):433-440.

Dutta S, Dutta I, Das A, Guchhait SK. 2020. Quantification and mapping of fragmented forest landscape in dry deciduous forest of Burdwan Forest Division, West Bengal, India. Trees, Forests and People 2:100012.

Ghosh A. 2002. Ethnoveterinary medicines from the tribal areas of Bankura and Medinipur districts, West Bengal. Indian Journal of Traditional Knowledge 1(1):93-95.

Ghosh AK. 2003. Herbal veterinary medicine from the tribal areas of Midnapore and Bankura district, West Bengal. Journal of Economic and Taxonomic Botany 27(3):573-575.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Social Science Medicine 47(11):1859–1871.

Heinrich M, Lardos A, Leonti M, Weckerle C, Willcox M, Applequist W, Ladio A, Long CL, Mukherjee P, Stafford G. 2018. Best practice in research: consensus statement on ethnopharmacological field studies–ConSEFS. Journal of Ethnopharmacology 211:329-339.

Heinrich M, Verpoorte R. 2014. Good Practice in Ethnopharmacology and Other Sciences Relying on Taxonomic Nomenclature. Journal of Ethnopharmacology 152(3):385–386.

Heinrich M. 2000. Ethnobotany and its role in drug development. Phytotherapy Research 14(2000): 479–488.

ISE. 2008. International Society of Ethnobiology Code of Ethics (With 2008 Additions).

Jain SK, Rao RR. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi, India.

Jas R, Pandit S. 2017. Seasonal variation in prevalence of gastrointestinal helminthoses in cattle of New Alluvial zone of West Bengal, India. Biological Rhythm Research, 48(4):631-637.

Khan K, Jan G, Irfan M, Jan FG, Hamayun M, Ullah F, Bussmann RW. 2023. Ethnoveterinary use of medicinal plants among the tribal populations of District Malakand, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 25:1–24.

Khan SMR, Akhter T, Hussain M. 2021. Ethno-veterinary practice for the treatment of animal diseases in Neelum Valley, Kashmir Himalaya, Pakistan. PLoS ONE 16(4):e0250114.

Kumar R, Bharati KA. 2013. New claims in folk veterinary medicines from Uttar Pradesh, India. Journal of Ethnopharmacology 146:581–593.

Livestock Census. 2012. All India Report. Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi.

Mandal MK, Chauhan JPS. A survey on ethnoveterinary medicine practices in West Bengal. Indian Journal of Veterinary Medicine 20(2):90-91.

Mandal SK, Rahaman CH. 2014. Determination of informants' consensus and documentation of ethnoveterinary practices from Birbhum district of West Bengal, India. Indian Journal of Traditional Knowledge 13(4):742-751.

Mandal SK, Rahaman CH. 2016. Documentation and consensus analysis of traditional knowledge about ethnoveterinary medicinal plants of Birbhum district, West Bengal (India). International Journal of Livestock Research 6(1):43-56.

Mandal SK, Rahaman CH. 2022. Inventorization and consensus analysis of ethnoveterinary medicinal knowledge among the local people in eastern India: perception, cultural significance, and resilience. Frontiers in Pharmacology 13:861577.

Martin GJ. 2004. Ethnobotany: A Methods Manual. Earthscan Publications, UK.

McCorkle CM. 1986. An introduction to ethnoveterinary research and development. Journal of Ethnobiology 6(1):129-149.

Miller JS. 2011. The discovery of medicines from plants: a current biological perspective. Economic Botany 65(4):396–407.

Njoroge GN, Bussmann RW. 2006. Herbal usage and informant consensus in ethnoveterinary management of cattle diseases among the Kikuyus (Central Kenya). Journal of Ethnopharmacology, 108(3):332–339.

NMPB. 2015. Standard for Good Field Collection Practices of Medicinal Plants. New Delhi, India: National Medicinal Plants Board, Department of AYUSH, Ministry of Health and Family Welfare, Government of India.

Pal DC, Jain SK. 1998. Tribal Medicine. Kolkata, Naya Prokash.

Parthiban R, Vijayakumar S, Prabhu S, Yabesh J. 2016. Quantitative traditional knowledge of medicinal plants used to treat livestock diseases from Kudavasaltaluk of Thiruvarur district, Tamil Nadu, India. Brazilian Journal of Pharmacognosy 26:109–121.

Paul TK, Lakshminarasimhan P, Chowdhery HJ, Dash SS, Singh P. 2015. Flora of West Bengal. Leguminosae to Aizoaceae. Vol. II. Botanical Survey of India. Calcutta, India.

Phondani PC, Maikhuri RK, Kala CP. 2010. Ethnoveterinary uses of medicinal plants among traditional herbal healers in Alaknanda catchment of Uttarakhand, India. African journal of traditional, complementary, and alternative medicines 7(3):195–206.

Plants of the World Online (https://powo.science.kew.org/) (accessed on 08.04.2023).

Prakash P, Radha, Kumar M, Pundir A, Puri S, Prakash S, Kumari N, Thakur M, Rathour S, Jamwal R, Janjua S, Ali M, Bangar SP, Singh C, Chandran D, Rajalingam S, Senapathy M, Dhumal S, Singh S, Samota MK, Damale RD, Changan S, Natta S, Alblihed M, El-kott AF, Abdel-Daim MM. 2021. Documentation of Commonly Used Ethnoveterinary Medicines from Wild Plants of the High Mountains in Shimla District, Himachal Pradesh, India. Horticulturae 7(10):351.

Radha PS, Sharma N, Kumar A, Kumari N, Puri S, Pundir A, Kumar V, Sharma AK, Rais N, Dey A, Lorenzo JM, Mekhemar M, Kumar M. 2022. A survey on ethnoveterinary medicines used by the tribal migratory shepherds of Northwestern Himalaya. Journal of Ethnopharmacology 296:115467.

Rahman IU, Ijaz F, Bussmann RW. 2023. Ethnoveterinary practices in livestock: Animal production, healthcare, and livelihood development. Frontiers in Veterinary Science 9:1086311.

Ramirez CR. 2007. Ethnobotany and the Loss of Traditional Knowledge in the 21st Century. Ethnobotany Research and Applications 5:245–247.

Ranjan V, Lakshminarasimhan P, Dash SS, Chowdhery HJ. 2016. Flora of West Bengal. Apiaceae to Boraginaceae. Vol. III. Botanical Survey of India. Calcutta, India.

Saha MR, De Sarkar D, Sen A. 2014. Ethnoveterinary practices among the tribal community of Malda district of West Bengal, India. Indian Journal of Traditional Knowledge 13(2):359-367.

Sanyal MN. 1998. Flora of Bankura District, West Bengal. Bishen Singh Mahendra Pal Singh, Dehradun, India.

Shit N, Hajra DK, Baidya S, Debbarma A. 2017. Seasonal occurrence of gastrointestinal helminth parasites in cattle and buffaloes in Bankura district, West Bengal, India. Exploratory Animal and Medical Research *7*(1):58-63.

Signs MW, Flores HE. 1990. The biosynthetic potential of plant roots. BioEssays 12(1):7-13.

Thomas E, Vandebroek I, Van Damme P. 2007. What Works in the Field? A comparison of different interviewing methods in ethnobotany with special reference to the use of photographs. Economic Botany 61(4):376–384.

Uprety Y, Karki S, Poudel RC, Kunwar RM. 2022. Ethnoveterinary use of plants and its implication for sustainable livestock management in Nepal. Frontiers in Veterinary Science 9:930533.

Xiong Y, Long C. 2020. An ethnoveterinary study on medicinal plants used by the Buyi people in Southwest Guizhou, China. Journal of Ethnobiology and Ethnomedicine 16(1):46.