Exploration of Traditional Plant Based Medicines Used as Potential Remedies for Livestock Aliments in Northeastern Ethiopia

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Abstract

Background

Livestock production is an integral part of the agricultural industry and to the livelihood of smallholder farmers in Ethiopia. However, livestock diseases and erosion of medicinal plants need urgent attention. Therefore this study was conducted to explore the ethnoveterinary plants and practices used to treat livestock ailments across varied agroclimatic zones in northeastern Ethiopia.

Methods

Information on the ethnoveterinary plants was collected between December 2019 and July 2020 across three districts using semi-structured questionnaire. The generated data included types of plants, parts used, preparations and routes of administration for treating livestock ailments. ANOVA and Chi-square were used to compute ethnoveterinarical indices among agroclimates.

Results

The present study revealed that there was a significant association (P = 0.001) between numbers of ethnoveterinary plant citations with sex, and age categories (P = 0.02), however, there were no considerable associations in educational status (P = 0.07). A total of 95 plants in 44 families were used by the healers for treatments of 45 livestock ailments. The ANOVA result showed that there was a significant difference in distribution of medicinal plant species (P < 0.01) in the agroclimatic zones. Irrespective of the variation, the most cited plant family with the largest number of species 10 (10.52 %) was Asteraceae and herbs 39 (42.8 %) were the dominant growth form reported. The most common plant part used for formulation of remedies was leaves 41 (39.05%) and crushing and pounding were the dominant mode of preparations. Most of plants were from the wild 65(70.65%) habitat. Considerable variations in Use Value (UV), Relative Frequency of Citations (RFC) and Fidelity Level (FL) were observed among the survived agroclimates. *Datura stramonium* (UV = 0.85; FL = 90.4 %; RFCs = 0.8) was the most often cited species to treat livestock ailments. The highest ICF was observed for bloating (0.87), bloody diarrhea (0.85) and eye infection (0.84), respectively.

Conclusions

The studied districts are rich in both medicinal floras and concomitant traditional knowledge for the treatment of livestock ailments and therefore further studies on the phytochemical screening of ethnoveterinary plants is vital for inventory of pharmacological active ingredients and production of drugs.

Background

Livestock production is one of the main economic sources for the livelihoods of smallholder farmers and tribal communities [1, 2]. It has sundry functions as a source of calories, income generation, medicine, rituals and ceremonies, input for crop production and raw material for industry [1, 3]. Thus, ethnoveterinary (EV) lore is important alternative to maintain animal healthcare system and productivity [4, 5]. It is concerned with the systematic investigation of the folk beliefs, knowledge, method and socio-cultural practices of the local community [6, 7]. It also explores the animal breeding and feeding system; traditional surgical techniques; magico-religious practices and so forth [8–10]. In fact, this practice has been experienced by the indigenous people for a century in a way of formulating and using herbal remedies to handle animal health care and increasing the quality of animal-based food products [7, 11]. As a result, the majority of the people in the world rely on folk medicine for mitigation of livestock diseases [3, 12]. This is because most people in the developing countries are resource-poor and cannot afford expensive synthetic drugs [3, 9, 13]. In addition, rural communities have easy access to medicinal plants suited for local diseases unlike synthetic drugs, which are inaccessible and expensive.

Various ethnoveterinary studies on indigenous knowledge of potential medicinal plants, isolation of bioactive compounds and prevention mechanisms have been reported in Europe [14–16], Asia [1, 2, 5], and is of raising importance in most developing countries [13, 17–23]. Despite these studies across the globe, the ailments; medicinal practices, nature of plants, frequency and mode of administration vary in relation to geography, time and knowledge [2]. In Ethiopia livestock production is an integral part of the agricultural industries [24], with an estimated population of 56.7 million cattle, 58.4 million sheep and goats, and 11.0 million equines (horses, donkeys, mules, camels) [25]. The sector contributes about 30–35 % to the agricultural GDP and generates 12–15 % of the total earnings [1]. However, the roles of livestock remain negligible because of epidemics and pandemics diseases [24, 26], coupled with erosion of ethnoveterinary plants and

practices [19, 21]. Diseases such as the anthrax, blackleg, lumpy skin disease (LSD), Sheep and Goat Pox, liver fluke etc., contribute to huge mortality, morbidity and great financial losses [27, 28]. According to FAO [1] in developing nation animal diseases and infections result in the huge production losses (30–35 %) and Ethiopia alone lost USD 35 million in the years 2010 to 2014. This study focused on areas that have huge potential of livestock resources which accounted to be about 978, 152.00 [26, 29]. Thus explorations of ethnoveterinary knowledge could contribute to developing sustainable livestock disease management; conserve medicinal plant resources and potential source for drug production. This study is therefore aimed at identifying and documenting the indigenous knowledge of medicinal plants used to treat livestock disease in northern eastern Ethiopia. The research addressed the following questions.

1. Which medicinal plant species are most commonly used for the livestock ailments across the agroclimates?
2. Is there variation in ethnoveterinarical medicinal plants, usage and practices across agroclimatic zones?
3. Which types of livestock disease (s) is/are most frequently occurring in the localities?
4. Which medicinal part (s) is/are mostly used to treat livestock disease in the study districts?

Materials And Methods

Description of the study districts

This explorative study was conducted in selected districts of North Wollo administrative zone, Amhara regional state northeastern Ethiopia (Table 1; Fig. 1). The districts where the research took place are Habru ($11^0$35' N and 39°46' E), Guba Lafto (12°00'and 39°19'E) and Meket (12°00'N and 38°44' E) areas (Fig. 1). These districts were selected based on the fact that agroclimatic zones support abundant medicinal floral and faunal resources composition and distribution [30, 31], which could influence the ethnoveterinary practices [2]. Thus Habru district belongs to the hot agroclimatic zone, Gubalafto and Meket districts are temperate and cool agroclimatic zones, respectively (Table 1). In addition the local people here predominantly use medicinal plants as a primary health care system for their livestock. Regarding with the climatic condition, Guba Lafto and Meket districts have bi-modial rainfall pattern with an erratic distribution where minimum precipitation is mostly distributed from late March to early October and maximum rain is received in late June, July and August [32], whereas Habru has unimodal rainfall pattern where the maximum rainfall is received from late June to August and hence characterized by warm sub-moist climatic condition [32]. The main land cover types (LCTs) of the study districts are cultivated lands, forested lands, grazing lands and settlements [30]. According to CSC [25], majority of inhabitants 168, 816 (80.1%) in Habru; 134, 939 (96.5 %) Gubalafto and 214894 (94.8%) Meket reside in the rural areas of the districts (Table 1), where poor facilities and inaccessibility of veterinary clinics and modern synthetic drugs and thus the rural communities chiefly depend on medicinal plant resources for the treatments of their livestock aliments. The communities in the rural areas of the districts are practicing mixed farming system that involves cultivation of crops (e.g. *Hordeum vulgare*, *Triticum aestivum, Linum usitatissimum, Zea mays, Sorghum bicolor*, *Eragrostis tef*) and livestock rearing. According to NWARD [29], the districts have a total of 818204 livestock population (Table 1), within the proportions of 396810 (48.5%) cattle; 202333 (24.73 %) goats; 127969(15.64 %) sheep; 68504 (8.37 %) donkeys; 17758 (2.17 %) camels; 2761(0.34 %) horses; and 2069 (0.25%) mules. In addition, the preliminary survey done between 2019 and 2020 and the information obtained from the districts veterinary centers and the local people indicated that the most common and prevalent livestock diseases are the abdominal pain, diarrhea, eye disease, unwanted abortion, retained placenta and wound.

Table 1
The geographical description of the study districts based on agroclimatic zones (n = 3)

Environmental Features	Study districts		
	Habru	**Gubalafto**	**Meket**
Agroclimates	Kolla	Woina dega	Dega
Altitudinal Range	700-1900m	1000–3000	1300-3900m
Rainfall Range	400–900 mm	500–1050 mm	500-1500mm
Temp. Range	18-28.7^{0}C	18^0 and 27^0	14^0-26^{0}C
Area coverage	1239.79 km^2	900.49 km^2	1909.25 km^2
Total Inhabitants	210830	151308	81284
Total livestock population	244715	231998	341491

(Hot (**Kolla**), temperate (**Woina Dega**), cool (**Dega**); NWARD [29] and Bekele [30]

Sampling methods and data collection tools

The study was carried between February and July 2020 after a reconnaissance survey was performed with the local people and districts veterinary clinics. In designing the survey, three-stage sampling procedures were used. The districts (Habru, Gubalafto and Meket) were first purposively selected based on having different agro-climatic zones namely hot (Habru), temperate (Gubalafto) and cool (Meket) (Table 1). Then four sites (Fig. 1) and 40 informants were identified for the survey in each of the district using random and snowball sampling techniques. The informants (Table 2) were selected based on recommendation by local authorities and religious leaders, and by their ethnoveterinary medicine practice and thus from the entire 120 sample informants (15) key informants were participated.

Consent was obtained from all informants before starting the study.
Interviews and semi-structured questionnaire were used for data collection. Accordingly, informants were interviewed on types of ethnoveterinary plants, growth habits, parts used, methods of preparation, routes of administration, disease treated, and management options using their vernacular language (Amharic). Plants not known to the researchers were collected, pressed and transported to Wodia University where identification was made. Resources like natural database for Africa (NDA) version 2.0 (http://www.htmlexe.com/) and Flora of Ethiopia and Eritrea publications [33–36] were consulted specimen identification.

Table 2
Household characteristics of sample respondents (N = 120)

Household Characteristics		No of Respondents in each of Study Communities			Frequency	Percent	Cumulative %
		Habru (n = 40)	**Gubalafto (n = 40)**	**Meket (n = 40)**			
Sex	Male	35	32	31	98	81.67	81.67
	Female	5	8	9	22	18.33	100.00
Age	30–40 years	5	6	4	15	12.5	12.5
	41–50 years	8	11	10	29	24.17	36.67
	51–60 years	15	14	16	45	37.5	74.17
	> 61 years	12	9	10	31	25.83	100.00
Educational Status	Tertiary schoolings	6	7	5	18	15	15
	Secondary schoolings	10	7	11	28	23.33	38.33
	Primary schoolings	14	13	15	42	35	73.33
	No formal schoolings	10	13	9	32	26.67	100.00
Marital status	Married	36	32	35	103	85.83	85.83
	Unmarried	1	6	2	9	7.5	93.33
	Divorce	1	2	2	5	4.17	97.5
	Widowed	2	0	1	3	2.5	100.00
Occupational Status	Farmers	22	26	20	68	56.67	56.67
	TMP	7	4	5	16	13.33	70
	Others	11	10	15	36	30	100.00
No. of Livestock	None	3	6	3	12	10	10
	1–5	12	14	10	36	30	40
	6–10	16	15	16	47	39.17	79.17
	> 10	9	5	11	25	20.83	100.00

TMP, Traditional Medicinal practitioners

Statistical analysis

The collected quantitative ethnoveterinarical data were analyzed using descriptive statistics. Analysis of Variance (One –way- ANOVA) was employed to compare the effect of agroclimatic zones on the medicinal plants composition and related parameters using IBM SPSS (version 26, IBM, Armonk, NY, USA). In addition, Chi-square was employed to analyze the association of medicinal plants citations with selected socio-demographic factors. The ethnoveterinarical data analysis of Use Value (UV), Informant Consensus Factor (ICF), Fidelity Level (FL) and Relative Frequency of Citations (RFCs) were computed following the methods of Phillips et al. [37], Martin [38], Alexiades [39].

1. $UV = \frac{\sum U_i}{Ni}$ a quantitative method used to assess the relative importance of species known by the local people. Where Ui is the number of uses mentioned by each informant i for a given species sand Ni is the total number of informants interviewed.
2. ICF= Nur- Nt/ Nur-1 where Nt is number of taxa and Nur is number of use reports for each categories to check the level of homogeneity among the information provided by the practitioners.
3. FL (%)= $\frac{Np}{N} * 100$: analysis of percentage of informants claiming the uses of a certain plant species for the same ailment to treat. Where Np is the number of informants that claim a use of plant to treat a particular disease and Nis the number of informants that use the plant as a medicine to treat any ailments.
4. RFCs = FCs/N: the relative frequency of citation reveals the local importance of each medicinal plant species as used by the indigenous people to the area. Where FC, is the number of informants who use the taxa and N is the total number of respondents of in the study (n=40 each district); N= 120).

Results

The demographic characteristics of surveyed districts

The socio-demographic information (sex, age, educational status, occupation and number of livestock) of the respondents interviewed during the ethnoveterinary survey of medicinal plants in the study areas is shown in the Table 2. The results of the surveyed households illustrated that there were more male respondents, 98 (81.67 %) compared to females 22 (18.33%). Age is an important variable which could tell the ethnoveterinarical experience, knowledge and practices of the respondents and thus mean age was found to be 48.4 years which falls within the range of 30–80 years (Table 2). In terms of education status, the majority of the respondents 42 (35 %) have some schooling in primary education, but few respondents 18 (15 %) did attend tertiary education. Most of the surveyed respondents 68 (56.67 %) were farmers whereas numbers of sample traditional medicinal practitioners were only 16 (13.33 %). The result also unveiled that the average number of livestock in the study districts was 4.07, ranging from 0 to 14 (Table 2). We also observed that there is significant association between the numbers of medicinal plants species cited and sex $X^2(7) = 24.74$, $P = 0.001$ (Fig. 2). Despite the variation in the sample individuals in terms of sex (Table 2), both genders cited almost equal proportion of ethnoveterinary plants (Fig. 2). The cross tabulated chi square revealed there was significant association amongst the number of cited medicinal plant species with the age categories ($X^2(12) = 20.38$, $P = 0.02$, $r^2 = 0.65$), in which an increasing trends in the numbers or frequency of ethnoveterinary plants citation within increasing age categories was observed in this study (Fig. 2). However, lack of significant association has shown amongst the number of cited medicinal plant species and educational status ($X^2(15) = 13.74$, $P = 0.07$, $r^2 = 0.32$) (Fig. 2). Yet, in the study the local people with no formal schooling have been cited for relatively large numbers of ethnoveterinary plants compared to the other educational classes (Fig. 2).

Ethnoveterinary plants diversity, habits and habitats

The local people in the study districts are greatly dependent on the traditional medicinal plants for the treatment of animal diseases. Thus, out of the total surveyed individuals, more than 93(77.5%) relay on herbalists for the treatments of their livestock ailments, whilst very few 22 (18.33%) of the respondents preferred veterinary clinics and others 5 (4.17 %).

And their medicinal knowledge was acquired from their forefathers through experience which has been transmitted orally from generation to generation 68 (56.67 %), by spiritual institutions 32 (26.67 %), from close relatives 16 (13.33 %) and others 4 (3.33%).
Table 3 shows a total of 95 medicinal plant species distributed across 44families were used to treat 45livestock ailments in the surveyed agroclimatic zones. The ANOVA result revealed that there was a significant variation on medicinal plant species distribution ($F = 82.33$, $P < 0.01$) along the agroclimatic zones. Higher average medicinal plant species (60) were found in the hot agroclimatic zone (Habru) followed by temperate (53; Gubalafto) and cool (42; Meket) agroclimatic zonings (Table 4).Among the identified species, Asteraceae has the highest record of 10(10.52 %) species, followed by Fabaceae 9 (9.5%), Euphorbiaceae 6 (6.32%), Solanaceae 6 (6.32%),Brassicaceae and Lamiaceae with five (5.26 %) species each. The families Aloaceae, Amaranthaceae, Cucurbitaceae and Rosaceae had three (3.16%) species each whilst the remaining eight and twenty six plant families were represented by two (2.11%) and a single (1.05%) species, respectively (Fig. 3; Table 3).In terms of growth habits, the most common species were herbs 39 (41.05 %) followed by shrubs 27 (28.4 %) and tree 21(22.10 %) whilst the climbers and parasitic plants species were only 7(7.4 %) and 1 (1.05 %), respectively (Fig. 4; Table 3).Majority of

these medicinal plant resources were wild66 (69.47 %) in nature, followed by cultivated 19 (20 %) and very few (10, 10. 53 %) plant species were collected from both wild and cultivated habitats (Fig. 4; Table 3).

Table 3
Lists of ethnoveterinary plants used to treat livestock diseases by the local people in three surveyed agroclimatic zonings

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
1	Fabaceae	*Acacia mellifera* (M.Vahl)Benth		T	W	B	Appetite enhancer	Its bark crushed, pounded and mixed in water, then a mixture of it is given for cattle	O	K
2	Fabaceae	*Acacia nilotica* L. Delile	Gerare	T	W	R	Cough	Its root is crushed and mixed within water and then 2–3 glasses of fusion are given to the cattle	O	K ,WD
3	Amaranthaceae	*Achyranthes aspera*	Telenj	H	W	R	Bleeding	Crushed the roots and tied on bleeding part	D	WD
							Bone fracture	Crushed its root together with the roots of *Tragia brevipes, Justicia schimperiana*, mixed and tied with cloth at the injured parts of the livestock	D	
4	Fabaceae	*Albizia schimperiana* Oliv.		T	WC	R	Blackleg	Powdered the roots as well, mixed with water and provide a glass of the mixture to cattle	O	K,WD, D
5	Aloaceae	*Aloe macrocarpa*	Eret	H	W	Lx	Wound	Applied the creamy on the wound part of for cattle, sheep, goats and equines till recover.	D	K
6	Aloaceae	*Aloe pubescens* Reynolds		H	W	R	Anthrax	Pounded the root and mixed with cold water and half of a litter is given to cattle	O	K
7	Aloaceae	*Aloe vera* L. Burm.F.	Eret	H	W	R	Protect unwanted abortion	Dry roots are grounded and mixed with water and 1/2 litter of the mixture is given in every morning for cattle	O	K

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
8	Amaranthaceae	*Amaranthus caudatus* L.	Aluma	H	W	L	Diarrhea	Pound the leaves and boiled the pounded together with *Allium sativum* and given ten percent of its dose to the cattle	O	K
9	Papaveraceae	*Argemone mexicanal* L.	Yahyaeshoh	H	W	L	Neck pain	Crushed the fresh leaf, mixed with butter and applied the paste on the affected livestock part	D	K, WD, D
						R	Devil disease	Crushed the roots and mixed with two cup of tea and given for cattle	No	
10	Melianthaceae	*Bersama abyssinica*	Azamir	S	W	L	Internal Parasites	The twig part of leaf is crushed and powdered, then boiled with tea and drunk for livestock	O	K
11	Brassicaceae	*Brassica carinata*	Gomen Zer	H	C	Sd	Stomach ache	Ground, mixed with water as well, and then given to the cattle	O	K,WD, D
12	Brassicaceae	*Brassica nigra*	Senafich	H	C	Sd	Stomach worm	Seeds are crushed to powdery, mixed with water and then given in every morning to cattle	O	K,WD, D
13	Brassicaceae	*Bridella micrantha*	Gomen	H	C	B	Expel placenta	Crushed the barks, mixed with water and given a glass of the extract to the livestock	O	K,WD, D
14	Simaroubaceae	*Brucea antidysenterica*	yedaga abalo	H	W	L	Skin rash	Powdered the leaves mixed with butter and applied creamy on the rash part of cattle body	D	D
15	Fabaceae	*Calpurnia aurea*	Digita	S	WC	L	External parasites	Grained the leaves and then wash the cattle thoroughly until the parasites are removed	D	WD

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
16	Asteraceae	*Cirsium englerianium*	Yahya kusheshili	H	W	R	Bloating	Pound the root, mixed with water and given to cattle	O	K
17	Vitaceae	*Cissus quadrangularis*	Yezehon Anjet	C	W	R	Diarrhea	Grained the roots very well, mixed with water and provide half litter in every morning for three subsequent days	O	WD
18	Ranunculaceae	*Clematis simensis* Fresen	Azoareg	C	W	L	Wound	Crushed the leaves, creamed and applied the fluid to the affected parts for livestock	D	D
19	Euphorbiaceae	*Clutia abyssinica* Jaub.&Spanch	Fyelefej	S	W	L	Anthrax	Squeeze the fresh leaves, mixed with water, drenched and then given to the cattle	O	D
20	Euphorbiaceae	*Clutia lanceolata*	Fiyelefej	S	W	L	Bloating	Pound the leaves, mixed with water and given to cattle, sheep and goats	O	D
21	Rubiaceae	*Coffee* *abica* L.	Buna	S	C	Sd	Castration	Roasted seeds are crushed, pounded well, boiled with water and allow the camel to drink.	O	K, WD
22	Burseraceae	*Commiphora africana*	Ankeva	T	W	L	Tick	Crushed the leaves and made the juice to creamed on the skin of goats, sheep and cattle	D	K
23	Boraginaceae	*Cordia africana*	Wanza	T	WC	L	Ear mites	Pound, squeeze the crushed leaves and inserted into ear tube of cattle	ET	K,WD, D
24	Capparidaceae	*Crateva adansonii* Dc.		S	W	R	Anthrax	Its root with the leaf of *Croton macrostchyus* are pounded, mixed with water, and ½ litter is given to cattle	O	K

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
25	Asteraceae	*Crepis rueppellii*		H	W	R	Anthrax	Crushed, mixed with water, and applied a half litter to cattle	O	K
26	Fabaceae	*Crotalaria karagulensis*	Yeayt ater	H	W	L	Skin itching	Crushed into powdery and applied the butter mixed creamy leaves on to the affected body part of the cattle	D	WD
27	Euphorbiaceae	*Croton macrostachyus*	Bisana	T	W	L	Ringworms	Creamed the latex to the infected cattle	D	K,WD, D
							Wound	Squeeze fresh leaf, mixed with water and then half of a litter is given to cattle in every morning	O	
28	Cucurbitaceae	*Cucumis ficifolius* A.Rich	Yemdr Emboy	C	W	R	Bloody Diarrhea	Crushed, powdered, mixed with milk, and 1/3 of the mixtures is given to the cattle, goat and sheep	O	K,WD, D
							Bloating	Crushed, mixed with milk and allow to drink at once (cattle)	O	
29	Cucurbitaceae	*Cucurbita pepo*	Duba	C	C	F	Expel placenta	Chopped, boiled and half of litter is given to cattle, goat and sheep	O	K,WD, D
30	Amaranthaceae	*Cyathula prostrate*	Aregist	H	W	L	Anthrax	Crushed, squeezed and a litter of the mixture is given to the infected cattle	O	K
31	Boraginaceae	*Cynoglossum lanceolatum*	Chegogit	H	W	R	Mastitis	Chopped, crushed, mixed with butter and given to the cow	T	WD
32	Solanaceae	*Datura stramonium* L.	Astenagir	H	W	L	Wound	Crush the fresh leaves, chewed, applied the extracts on the affected body parts of all livestock	D	K,WD, D

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No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
33	Sapindaceae	*Dodinia angustifolia L.F*	Kitkta	S	W	S	Broken bone	The twig part of stem with its leaf are tied on to the broken part until recovery	D	D
34	Asteraceae	*Echinops kebericho* Mesfin.	Kebericho	H	W	R	Respiratory infection	Crushed the root parts, powdered and smoke the cattle until the respiratory infection or manifestations is stopped	No	WD
35	Lamiaceae	*Ekebergia capensis* sparrm	Senbo	T	WC	L	Thinning disease	Crushed together with the leaf of *Dodonaea angustifolia*, soaked for a week in water and given for 3–5 subsequent days	O	K
36	Fabaceae	*Erythrina abyssinica*	Kura	T	C	B	Fibril illness	Crushed together with leaf of *Ruta chalepensis* and bulb of *Allium sativum*, boil with water and fumigate the entire body of the cattle	D	WD, K
37	Fabaceae	*Erythrina brucei* Schweinf.	Korch	T	W	B	Bloating	Pounded the with the leaves of *Teclea nobilis*, mixed with water and a litter of the mixture is given to the equines	O	WD
						R	Eye disease	Its root with the leaf of *Premna resinosa* are pounded together, filtered and added once five drops of the filtrate to cattle eye	Oc	
38	Ebenaceae	*Euclea racemosa*	Dedeho	S	W	R	Eye disease	Pulverized into powdery, mixed the creamy with butter and applied on the infected eye of the cattle	Oc	WD

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
39	Euphorbiaceae	*Euphorbia tirucalii*	Kinchib	S	WC	Lx	Wound	Its latex is creamed on the wounded site of donkey	D	K
40	Rutaceae	*Fagaropsis angolensis*	—	T	W	B	Babesiosis	Chopped the bark, mixed with water, filtered and given to the cattle	O	K
41	Brassicaceae	*Fagropsis angoleusis*	Feto	H	C	Sd	Respiratory infection	Pounded, mixed with water and half of a litter is given to cattle for three days in every morning	O	K, WD, D
42	Apiaceae	*Ferula communis*	Dog	H	W	R	Increase sexual need	Pounded, mixed with butter and given the creamed bread to the cattle	O	D
43	Flacourtiaceae	*Flacourtia indica* (Burm. f) J Merr.	—	T	W	L	Pasteurollosis	Crushed leaves mixed with water, filtrated and given to cattle once a day	O	WD, K
44	Tiliaceae	*Grewia ferruginea*	Lenquata	S	W	B	Expel placenta	Crushed, powdered and then given 1/3 of watery mixture to livestock	O	D
45	Rosaceae	*Hagenia abyssinica* L.	Kosso	T	W	F	Tape worm	The female flowers crushed with its seed together, mixed in water and ½ litters is given for 2–3 days.	O	D
46	Asteraceae	*Inula confertiflora* A.Rich	Wenagft	S	W	L	Eye infection	Crushed, squeezed and applied tree drops of fluid on the infection eye surface for three days	Oc	WD
47	Acanthaceae	*Justicia schimperiana*	Sensel	S	W	L	External parasite	Directly wash the cattle with water	D	D
48	Crassulaceae	*Kalanchoe laciniata*	Endahula	H	W	S	Bloating	Pulverize and applied on the swollen or inflamed part of cattle	D	D
49	Crassulaceae	*Kalanchoe petitiana* A. Rich	Busike	S	W	St	Wound	Pounded, mixed with water, and then washed the sore	D	D

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
						R	Lack of appetite	Pounded, mixed with water and provide half a litter for two days	O	
50	Asteraceae	*Lactuca intermis*	Dememerarit	H	W	R	Bone broken	Tied the root on the broken part of cattle, sheep, goat	D	K
						Lx	Tick bite	Creamed the body of the cattle after the ticks are removed from the body		
51	Brassicaceae	*Lepidium sativum* L.	Feto	H	C	Sd	Diarrhea	Dry seeds are pulverized, mixed with oil and half of litter is given in morning for three days for cattle	O	K, WD, D
52	Lineaceae	*Linum usitatissimum* L.	Talba	H	C	Sd	Expel placenta	Powdered the seeds, mixed with water and given a glass of the blend for cow, goats and sheep	O	D
53	Fabaceae	*Millettia ferruginea*	Birbira	T	W	L	Leech	Crushed, mixed with water and 1/2 liters is given once for livestock to expel the leech	O	K, WD
						F	Ringworm	Crushed, mixed with little water and creamed on skin.	D	
54	Cucurbitaceae	*Momordica foetida*	Kurahareg	C	W	L	Sun stroke	Grained the leaves, mixed with water and creamed rash parts of the equines	O D	K
55	Myricaceae	*Myrica salicifolia*	Shinet	T	W	L	Eye infection	Powdered and applied on the infection site for three days	Oc	K
56	Solanaceae	*Nicotiana tabacum*	Tinbaho	H	WC	L	Cough	Crushed, pounded and smoked it with their nose (livestock)	N	WD

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
57	Lamiaceae	*Ocimum basilicum*	Ajuban	H	C	L	Bloating	Fresh leaves with the bulb of *Allium sativum* and salt grained together, mixed with water and given a single litter of the mixture for cattle	O	WD, K
58	Lamiaceae	*Ocimum lamiifolium* Benth	Damakase	S	WC	L	Respiratory infection	Pounded together with water, filtered and quarter of litter is given to cattle	T	K, WD, D
59	Oleaceae	*Olea capensis* L.Subsp. *macrocarpa*	Woyra	T	WC	L	Eye infection	Leaves are chewed and applied to eye (1 teaspoon/dose) for three days	Oc	K, WD, D
60	Oleaceae	*Olea europaea*	Weyra	T	W	St	Eye disease	Ground together with the leaves of *Jasminum abyssinicum*, mixed with water, and applied three drop on the infection site for five days	Oc	D, WD
61	Orobanchaceae	*Orobanche ramose*	Ye gebe shenkurte	P	W	S	Sun stroke	Pounded, mixed with little water and creamed the inflamed part of equines	D	K
62	Lamiaceae	*Otostegia integrifolia*	Tunjit	S	W	L	Stomach ache	Leaves are crushed well, mixed with one litter of water and then given a litter of the blend for two days to cattle	O	WD
63	Arecaceae	*Phoenix reclinata* Jacq.	Yehosaena zaf	T	C	S	Eye disease	Its leaf and stem are blended together with the leaf of *Premna resinosa*, and applied on the infected cattle eye	Oc	K, WD
64	Phytolaccacaceae	*Phytolacca dodecandra* L.	Endod	S	W	L	Leech	Fresh leaf is crushed, mixed with water and then 1/3 of liter is given for three days	No	K,WD,D

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
							Eye disease	Pounded and mixed with butter and added on an animal eye	Oc	
65	Lamiaceae	*Premna schimperi*	Chocho	S	W	L	Eye disease	Pulverized, mixed with little water and creamed to the cattle's eye	Oc	K
66	Rosaceae	*Prunus africana* (Hook.f.)Kalm.	Kok	T	C	B	Wound	Powdered and applied the watery mixture directly on wound of equines	D	WD, D
67	Rosaceae	*Prunus persica*	Kok	S	C	L	Diarrhea	Leaves are crushed, mixed with water and given to the calf	O	D, WD
68	Rhamnaceae	*Rhamnus prinoides* L. Herit	Gesho	S	C	L	Sudden disease	Crushed the leaves with *A. sativum* and *L. sativum*, mixed together and then given one litter to the cattle	O	K, WD, D
69	Anacardiaceae	*Rhus vulgaris*	Embs	S	W	R	Diarrhea	Its root with the bulb of *Allium sativum* are grounded, powdered, mixed with water and allowed a litter of the solution to drunk	O	D
70	Euphorbiaceae	*Ricinus communis*	Gulo	H	WC	F	Ear ache	Its fruit is crushed and applied three drop of the fluid in to ear tube of the cattle	ET	K, WD, D
71	Polygonaceae	*Rumex nepalensis* Spreng	Tult	H	W	R	Bloating	Roots are pounded, mixed with water and half of a litter is given twice for three days	No	D, WD

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
72	Polygonaceae	*Rumex nervosus*	Embuacho	S	W	L	External Parasite	Powdered, mixed with water and then wash the affected body in every morning for at least 5days	D	WD
73	Rutaceae	*Ruta chalepensis* L.	Tenadam	H	C	L	abdominal pain	Chopped the leaves, soaked with a litter of water for two days, filtered and given a single litter of the solution to cattle	O	K, WD, D
74	Anacardiaceae	*Schinus molle* L.	Qundo berbere	T	WC	L	Eye disease	Its leaf and fruits are squashed and directly applied on the infected eye of cattle, goat, and sheep and equines eye.	Oc	K
75	Pedaliaceae	*Sesamum orientale*	Selit	H	C	Sd	Sudden Sickness	Its seeds grounded, mixed with water, and then one litter of the mixture is given to the cattle	O	K
76	Asteraceae	*Solanecio gigas*	Shekoko Gomen	H	W	L	Bloating	Pounded and given with water	O	WD, K
							Sudden sickness	Leaves are crushed, mixed with water and then half of a litter is given for two days	O	
77	Solanaceae	*Solanum anguivi*	Zerchenby	S	W	R	Bloating	to cattle	O	WD, K
78	Solanaceae	*Solanum incanum* L.	Embauy	S	W	F	Leech	Juice is inserted in to cattle's nasal	N	K
						L	Leech	Fresh leaves are crushed, mixed with water and applied via oral or nasal	No	
79	. Solonaceae	*Solanum marginatum* L.F	Geberembay	S	W	Sd	Cough	Seeds are burned, and immediately allowed tar to fumigate the cattle and equines	N	K, WD, D

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No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
						F	Cough	Squeezed the fruit juice, mixed with goats milk and provide via nasal	N	
							Eye disease	Pounded, mixed with the leaf *Phytolaca dedecondra* and butter and applied on the eye	Oc	
80	Solonaceae	*Solanum nigrum*	Tikur awit	H	W	L	Lung disease	Pounded the leaf, mixed with water and given to drink	O	WD, D
81	Poaceae	*Sorghum bicolor* L.	Mashila	H	C	Sd	Retained placenta	Dry seeds mixed with salt and water, and a litter of it is given to cattle.	O	K
82	Menispermaceae	*Stephania abyssinica*	Chewchwit	H	W	R	Anthrax	Crushed, mixed with water and then given to cattle	O	K, WD
83	Bignoniaceae	*Stereospermum kunthianum* Cham		T	W	R	Snake bite	Powdered its root with dried leaf of *Calpurina aurea*, mixed with water and then given to cattle	O	K
84	Scrophulariacee	*Striga hermonthica*	Gelmit	H	W	St	Bloating	Crushed the stem, powdered, mixed with water and half a litter is given to the cattle	O	K, WD
85	Asteraceae	*Tarchonanthus camphoratus* L.		S	W	L	Abdominal disorders	Leave is crushed, pounded and mixed with water, and then a half litter of it is given for three days for cattle, sheep, goats and equines	O	K,WD, D
86	Euphorbiaceae	*Tragia cinerea*	Aleblabit	H	W	L	Sudden Disease	Ground, powdered and mixed with water, then 1/3 of a litter is given for four subsequent days for livestock	O	K

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
87	Fabaceae	*Trigonella foenumgraecum* L.	Abish	H	C	Sd	Eye infection	Dry seed are grounded into powder and then added to the eye of cattle, goats, sheep, donkey	Oc	WD, D
88	Utricaceae	*Urera hypselodendron*	Lankusso	C	W	St	Anthrax	Crushed, mixed with water and then one third of a litter is given to cattle	O	K
89	Utricaceae	*Urtica simensis*	Sama	H	W	R	Sudden Sickness	Its root alone or with leaves are crushed together, mixed with water and half of a litter is given for two days	O	D
90	Scrophulariaceae	*Verbasum sinaticum*	Ketetina	H	W	R	Evil eye	Pounded, boiled, allowed to cool down and then half of a litter is given for three days in every morning	No	K, WD
91	Verbenaceae	*Verbena officinalis* L	Atuch	H	W	L	Snake bite	Its squeezed fluid is creamed on the infected site	D	D
92	Asteraceae	*Vernonia amygdalina* Delile.	Grawa	T	W	Sd	Abdominal pain	Crushed seed mixed with water, filtered and half of it is given to the livestock	No	WD
93	Asteraceae	*Vernonia auriculifera* Hiern		S	W	L	Internal parasite	Pounded together; mixed with 1 litter of water and given to livestock once	O	K
94	Asteraceae	*Zehneria scabra*	Heregresa	C	W	St	Wound	Rubbed and creamed on the wound site of the livestock	D	WD, D
						R	Thinning	Fresh root crushed, mixed with water, and half of litter is given for two days to the cattle	O	

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No	Family Name	Botanical Name	Vernacular Name	GH	Ha	PU	Ethnoveterinary Use	Traditional usage	Ra	PAZ
95	Zingiberaceae	*Zingibar officinale*	Jingibl	H	C	L	Eye infection	Pounded, mixed with water and then three to five drops of the fusion is given to the cattle	T	K

Note: GH, Growth Habits (T, Tree; H, Herb; S, Shrub; C, Climbers and P, Parasitic); **Ha, Habitats** (W, Wild; C, Cultivated and WC, Wild and Cultivated); **PU, Parts Used** (L, Leaves; Sd, Seed; B, Bark; F, Fruits; S, Shoot; St, Stem; R, Root; Lx, Latex); **RA, Routs of Applications** (O, Oral; D, Dermal; ET, Ear Tube; Oc, Ocular; N, Nasal; Oral and Nasal (No) and T, Topical); **PAZ, Preferred Agroclimatic Zone** (K, Kolla or Hot, WD, Woina Dega or temperate, D, Dega or cool)

Table 4
ANOVA on the most common medicinal plant species (n = 20) used as a potential remedies for livestock diseases in the three agroclimatic zonings (n = 3)

Variable	Source	DF	F	P
Number of Species	Agroclimate	2	82.33	0.00
Numbers of Families	Agroclimate	2	11.69	0.179
Use value	Agroclimate	2	5.41	0.007
Fidelity Level	Agroclimate	2	3.95	0.025
Relative Frequency of Citations	Agroclimate	2	3.55	0.035

DF, Degree of Freedom; F, Fisher test; P, Probability of Significance

Ethnoveterinarical approach for the treatments of livestock ailments

The highest livestock remedies of using plants as interventions in the three agroclimatic zones were for the treatment of eye disease (13taxa; 11.82%), bloating (10taxa; 9.1%), wound (8taxa; 7.27%), anthrax (7taxa;6.36 %), diarrhea/ bloody diarrhea (6taxa; 5.45%); cough (4taxa; 3.64%); abdominal disorder (3taxa; 2.73%), external parasites (3taxa; 2.73%), respiratory infections (2taxa; 1.82) whilst lung disease and heart disease have the least (1; 0.91 %) number of plant species cited as being used for each disease treatment. In the same way, the Asteraceae was found to be the most preferred with eleven therapeutic values of veterinary diseases followed by the Fabaceae (10), Euphorbiaceae (7), Solanaceae (6) and Brassicaceae treated four veterinary diseases (Table 3). In terms of medicinal species, *Erythrina brucei*, *Inula confertiflora*, *Solanum marginatum*, *Zehneria scabra*, *Datura stramonium*, *Croton macrostachyus* and *Cucumis ficifolius* were the most frequently documented species used to treat eye infection, bloating, wound and bloody diarrhea (Table 3). The leaves 41 (39.05 %) were identified as the most often used plant part for the formulation of traditional remedies and the next important medicinal plants parts for the treatment of livestock ailments wereroots28 (26.66 %), seeds 11 (10.48 %), barks 7 (6.67%) and fruits 6 (5.71%) (Fig. 4).In addition, the local people in the surveyed communities prepared livestock remedies from the natural and plant products by employing varied techniques. Thus the most frequently applied recipe was crushing and pounding the plant part (s) and administered via oral 59 (54.63 %), dermal 24(22.22%), ocular 9 (8.33 %), oral and nasal 7 (6.5%), nasal 4 (3.70%), topical 3 (2.77%) and ear tube 2(1.85 %) (Fig. 4).

Values of ethnoveterinary indices across the surveyed agroclimates

The present study revealed that there was a significant difference ($F = 5.41$, $P < 0.01$) in the use value (UV) of medicinal plants to treat livestock disease among agroclimatic zones (Table 4), which ranged from 0.05 to 0.85. The highest use values were obtained for *Datura stramonium* (UV = 0.85), *Brassica nigra* (UV = 0.75) and *Albizia schimperiana* (UV = 0.77) whilst the lower values were found to be in *Ricinus communis* (UV = 0.27), *Argemone mexicana* (UV = 0.15) and *Cucurbita pepo* (UV = 0.05) plant species of the Habru, Gubalafto and Meket districts respectively (Table 5). In this study, we also found considerable differences in FL ($F = 3.95$, $P < 0.05$ and RFCs ($F = 3.55$, $P < 0.05$) among the studied agroclimatic zones (Table 4). Thus eleven, six and five potential traditional plant remedies for livestock diseases having greater FL values (ranges from 50–100%) were identified in the hot (Habru; Kolla), temperate (Gubalafto; Woina Dega) and cool (Meket; Dega) agroclimatic zones, respectively. Correspondingly, *D. stramonium* was found the highest FL (90.4 %) in hot (Kolla) agroclimate whist *C. macrostachyus* (75 %) and *B. nigra* (73.9 %) were recorded as the highest FL species in temperate (Woina Dega) and cool (Dega) agroclimates, respectively (Table 5). In terms of RFCs, *D. stramonium* (0.8), *S. marginatum* (0.57) and *O. capensis* (0.55) medicinal plant species were highest RFCs for the treatments of livestock diseases but *S. marginatum* (0.07), *R. prinoides* (0.05) and *C. ficifolius* (0.02) are

observed lower RFCs values in Habru, Gubalafto and Meket districts, respectively (Table 5). Furthermore, Informant Consensus Factor (ICF) results have shown a high degree of agreement for bloating (0.87), bloody diarrhea (0.85), eye infection (0.84), wound (0.84) and anthrax (0.81) livestock ailments whilst relatively lower for sudden sickness, abdominal disorder and evil eye (0.5 each) (Table 6), whereby the highest plant use citation was for eye infection (74) followed by bloating (69) and wound (45) ailments (Table 6).

Table 5. The quantitative ethnoveterinarical indices of the most common occurring medicinal plant species (n=20) in each of surveyed
(n=40) agroclimatic conditions at Kolla (hot agroclimate zone), Woina Dega (temperate agroclimate zone) and Dega (cool agroclimate zone)

Botanical Name	Therapeutic value	KoKolla			Woina Dega			Dega		
		UV	FL	RFCs	UV	FL	RFCs	UV	FL	RFCs
Albizia schimperiana	Blackleg	0.67	25.9	0.12	0.20	32.1	0.12	0.77	25.0	0.22
Argemone mexicanal	Devil disease	0.40	42.8	0.47	0.15	20.0	0.07	0.25	58.3	0.20
Brassica carinata	Stomachache	0.70	86.4	0.70	0.40	30.8	0.42	0.45	32.1	0.25
Brassica nigra	Stomach worm	0.72	54.5	0.72	0.75	36.0	0.47	0.70	73.9	0.32
Bridella micrantha	Expel placenta	0.60	35.7	0.20	0.52	37.5	0.47	0.50	36.4	0.47
Cordia africana	Ear mite	0.35	26.1	0.22	0.67	32.0	0.15	0.52	23.8	0.15
Croton macrostachyus	Ringworms; Wound	0.47	44.0	0.30	0.22	75.0	0.20	0.27	13.6	0.10
Cucumis ficifolius	Bloody Diarrhea, Bloating	0.57	60.0	0.75	0.22	73.9	0.37	0.27	28.0	0.02
Cucurbita pepo	Expel Placenta	0.50	26.1	0.40	0.15	18.2	0.17	0.05	15.4	0.52
Datura stramonium	Wound	0.85	90.4	0.80	0.42	33.3	0.45	0.55	8.3	0.42
Fagropsis angoleusis	Respiratory disease	0.55	53.8	0.42	0.67	58.3	0.12	0.42	60.9	0.10
Lepidium sativum	Diarrhea	0.82	57.1	0.32	0.52	73.9	0.57	0.20	36.4	0.40
Ocimum lamiifolium	Respiratory infestation	0.32	73.9	0.22	0.50	52.0	0.45	0.47	48.0	0.10
Olea capensis	Eye infection	0.47	66.7	0.20	0.27	35.7	0.15	0.12	35.7	0.55
Phytolacca dodecandra	Eye disease; Leech	0.67	34.6	0.35	0.45	16.7	0.17	0.10	66.7	0.05
Rhamnus prinoides	Sudden disease	0.30	33.3	0.37	0.45	21.7	0.05	0.27	20.0	0.07
Ricinus communis	Ear infection	0.27	46.1	0.40	0.20	50.0	0.10	0.37	30.0	0.12
Ruta chalepensis	Abdominal pain	0.45	50.0	0.45	0.45	23.1	0.22	0.17	15.4	0.52
Solanum marginatum	Eye disease; cough	0.6	69.6	0.07	0.32	24.1	0.57	0.15	68.2	0.15
Tarchonanthus camphoratus	Abdominal disorders	0.35	60.0	0.27	0.45	27.6	0.10	0.32	16.0	0.07

UV, Use Value; FL, Fidelity Level; RFCs, Relative Frequency of Citations

Table 6. Informant Consensus factor for the treatment of different livestock diseases in the tree agroclimatic zonation (n= 120)

Types of Diseases	Nt	Nur	ICF
Abdominal pain/ disorder	3	5	0.5
Anthrax	7	33	0.81
Eye Disease/ infection	13	74	0.84
Bloating	10	69	0.87
Bone broken/ Fracture	3	7	0.67
Cough	4	16	0.80
Devil disease/ Evil Eye	2	3	0.5
Diarrhea/ Bloody Diarrhea	6	35	0.85
Expel placenta	3	9	0.75

External parasite	5	14	0.69
Internal parasite	3	10	0.78
Stomachache	3	7	0.67
Sudden sickness	4	7	0.5
Thinning disease	2	3	0.5
Wound	8	45	0.84

ICF, Informant Consensus Factor; Nt, number of taxa; Nur, number of use reports

Discussion

Ethiopia hosts a large diversity of plant species [30], coupled with varied types of traditional plant based medicine and cultural heritage stemming from the treatments of livestock ailments [1, 11, 19, 24]. More than 80 % of the rural communities in Ethiopia use these plant remedies for livestock healthcare systems [1, 40]. In this study, the majority (77.5%) of the respondents were found to be using ethnoveterinary plants for treatments of their livestock ailments. The cross tabulated chi square confirms that a considerable association in medicinal plants citation among sex and age categories whilst there was no significant association with the educational status (Fig. 2). Irrespective of the association, males, elders and participants with no formal education enumerated relatively greater numbers of ethnoveterinary plants and this could be ascribed to these informants as having more experience to the plants and lores found in the localities. Similarly, Kidane et al. [13], Yirga et al. [20], Estomba et al. [41], Yineger et al. [42], Yigezu et al. [43] have reported that medicinal plant knowledge and species citation increase with age and in academic illiterate people, while the ancient knowledge is decreasing in the young generations. In the present study a total of 95 medicinal plant species and 44 families were found to treat 45 livestock ailments in the surveyed agroclimatic zones (Table 3). This is probably an indication of the study districts are rich in ethnoveterinary plant species compared to other research reports in neighboring areas. For instance, Assefa and Bahiru [23] and Yigezu et al. [43] have reported 53 and 74 species belonging to 31 families for treatment of 22 livestock ailments in Jimma zone and Abergelle, Sekota and Lalibela districts of Ethiopia. In other similar studies in Ethiopia by Luleka et al. [12], Kidane et al. [13], Yirga et al. [20], Feyera et al. [22] have documented 51, 46, 24 and 49 ethnoveterinary plant species to treat animal diseases, respectively.

Among 44 botanical families used to treat livestock diseases in our study, Asteraceae has the highest record (10) of species, followed by Fabaceae (9), Euphorbiaceae (6) and Solanaceae (6) (Fig. 3). In fact, the Asteraceae, Fabaceae, Lamiaceae and Solanaceae are large, mostly cosmopolitan families that are known to be medicinal values worldwide because of being rich in essential oils and other secondary metabolites [44]. The findings were in agreement with previous studies reported in Ethiopia by Luleka et al. [12], Yigezu et al. [43], Yineger et al. [45], Mesfin et al. [46] and in other countries by Tariq et al. [4] and Khan et al. [47] in which Asteraceae was the commonly used plant family by traditional healers for livestock diseases remedy. However, in this study we also found that a significant difference in the ethnoveterinary species ($P < 0.01$) across agroclimatic zones (Table 4), in which relatively the highest numbers of species were found in hot (Kolla) agroclimatic zones followed by temperate and cool agroclimatic zones. This could be due to the fact that in hot area disease prevalence is very high and hence the local communities are familiar and relied on varied types of medicinal plants to treat their livestock ailments. Similar results were reported in lowlands (hot) of Konta (southern Ethiopia) that came up with 120 plant species for medicinal purposes [48]. In contrast, Khan et al. [2] noted that the diversity of ethnoveterinary plant species decreased with decreasing elevation from high altitude (cool) to plain area. As far as the usage across growth habits and habitats, herbs were the most commonly used growth forms for the treatments of livestock ailments (Fig. 4), which were widely growing in the wild habitats (Fig. 4). This greater reliance on herbs in livestock remedies might be due to the presence of potent chemicals of high curative efficiency but needs further phytochemical screening to validate the local knowledge. Similar studies on the local communities' use of herbs for the treatments of livestock ailments were reported by Khan et al. [2], Tariq et al. [4], Hassen et al. [49]. In terms of plant parts, leaves were the most frequently used part for livestock remedy formulation (Fig. 4), which was prepared mostly by crushing and pounding, mixed with water as vehicles for application via oral followed by dermal and ocular routes. Studies conducted by Tariq et al. [4], Feyera et al. [22], Hunde et al. [40], Hassen et al. [49], showed that leaves are the most considerable part used for preparation of livestock remedies. The present study is also in lines with the findings of Feyera et al. [22] and Eshetu et al. [50], who asserted that oral and dermal are the main routes of administration for livestock disease remedies. The majority of the ethnoveterinary plants reported are utilized to treat eye infection, followed by bloating and wound while a single medicinal species (*Solanum nigrum*) was cited for the treatment of lung livestock diseases. Also Assefa and Bahiru [23] in the adjacent agroclimatic zone to Gubalafto and Meket described that pasteurellosis and wound are the most frequently cited animal diseases. However, Kidane et al. [13] and Yineger et al. [45], reported blackleg followed by anthrax diseases seems to affect most frequently the cattle. The dissimilarity in the kind of livestock diseases could be ascribed to the variation in agroclimatic zonings. Medicinal plants with high informants report to a particular attribute always also have higher UV value and vice versa [51]. In this study considerable difference ($P < 0.01$) was observed in UV among the studied agroclimatic zone (Table 5).

Three medicinal plant species commonly found in the three agroclimatic zones, *Datura stramonium*, *Brassica nigra* and *Albizia schimperiana*, were registered with higher UV values in hot, temperate and cool agroclimatic zones, respectively (Table 5).This implies that the species with greater UV are indispensable for the treatment of numbers of livestock diseases compared to the species with lower UV values. According to, Martin [38] and Trotter and Logan [51], plants with some repetitive manner are likely to be biologically active. In the same ways of considerable difference in FL and RFCs could be ascribed to the relative abundances of the ethnoveterinary plant species in the study provinces. Accordingly, the *Datura stramonium*, *Croton macrostachyus* and *Brassica nigra* were revealed higher FL values which are greater than 50 % (Table 5) and in terms of RFCs, the *Cucumis ficifolius*, *Solanum marginatum* and *Olea capensis* found to be higher values in hot, temperate and cool climatic zonings, respectively (Table 5). The highest agreements (ICF = 0.87) in using ten taxa of the 68 reported events was observed to cure bloating (Table 6) and this might indicate the ailment is common to the surveyed agroclimatic zones and the ethnoveterinary plants found to be conventionally effective in treating the ailment. This agrees with Ahmed and Murtaza [9], Aziz et al. [10], Luleka et al. [12], who observed that a high ICF value is allied to a few target plant species with high use reports in in treating a specific disease category and for screening bioactive compounds. In general the UV, FL (%), RFCs and ICF values vary depending on locality, nature of vegetation and geo-climate [47, 51] and therefore their higher medicinal citations for a particular livestock disease treatment, for example, as observed in hot agroclimatic zone, could be ascribed to higher disease prevalence in this area which probably boosts the awareness of the traditional healers to formulate plant remedies for their livestock diseases than the witchdoctors in temperate and cool climatic zones.

Conclusion

Ethnoveterinary lore is becoming even more vital to maintain the animal healthcare system, productivity and sustainability of the people mainly in the area where modern veterinary clinics and experts are inaccessible. This explorative study exhibited the values of medicinal plants used by the local people in the three surveyed agroclimatic zonation (hot, temperate and cool) to treat their livestock ailments. In this survey, 95 medicinal plant species distributed across 44 families are documented against 45 livestock ailments, in which the traditional medicinal lore and practices have been orally transmitted from generation to generation. *Datura stramonium*, *Erythrina brucei*, *Inula confertiflora*, *Solanum marginatum*, *Zehneria scabra*, *Croton macrostachyus* and *Cucumis ficifolius* were the most widely used plant species for the treatments of most prevalent livestock diseases such as eye disease, bloating, and wound. The herbs and leaves were the most frequently used medicinal growth forms and parts for the formulation of traditional remedies which mostly are applied via oral route of administration. This study also showed that relatively greater ethnoveterinary plant species distribution was observed in hot agroclimatic zones and this could correspond to the high prevalence of diseases in the area. In addition, considerable difference in the UV, RFCs and FL were observed among the agroclimatic zonation and thus the ethnoveterinary plant species reported with higher UV, FL, IFC and RFCs values should be used for additional investigation and screening of the potential bioactive compounds for the synthesis of modern pharmaceutical products. In broad-spectrum, the surveyed districts are rich in ethnoveterinary plant resources compared to other research findings and it’s therefore essential to conduct studies on the sustainable management and conservation of these plant genetic resources.

Declarations

Competing interests

The Authors of this manuscript have no conflicts of interest to declare

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Availability of data and materials

All data are presented in this article

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Authors’ contributions

Ahmed Hassen and Meseret Muche: involved in designing, data collection, analysis, interpretations, and writing of the manuscript. Muthama Muasya and Berhanu Aberha: participated in manuscript organization and grammar editors. Both authors read and approved the final manuscript.

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Figures

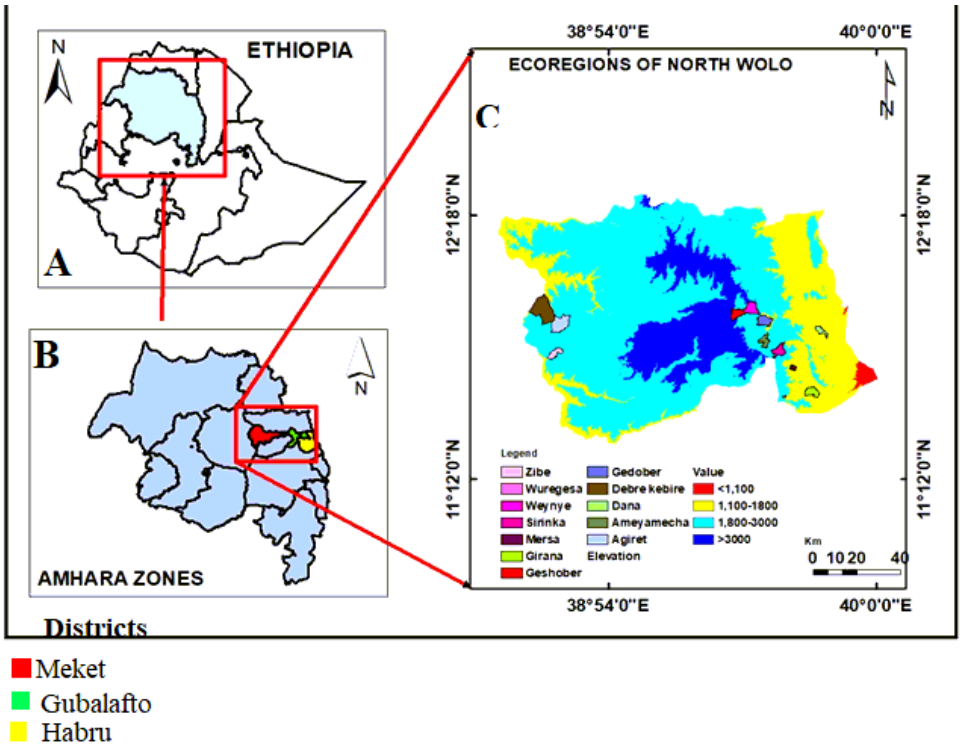

Figure 1

Geographical location of the study area (A) political map of Ethiopia, (B) North Wollo administrative zone of the Amhara regional state by agroclimatic zonation (study provinces) and (C) the study sites (12) in each of the district (4) by agroclimatic conditions

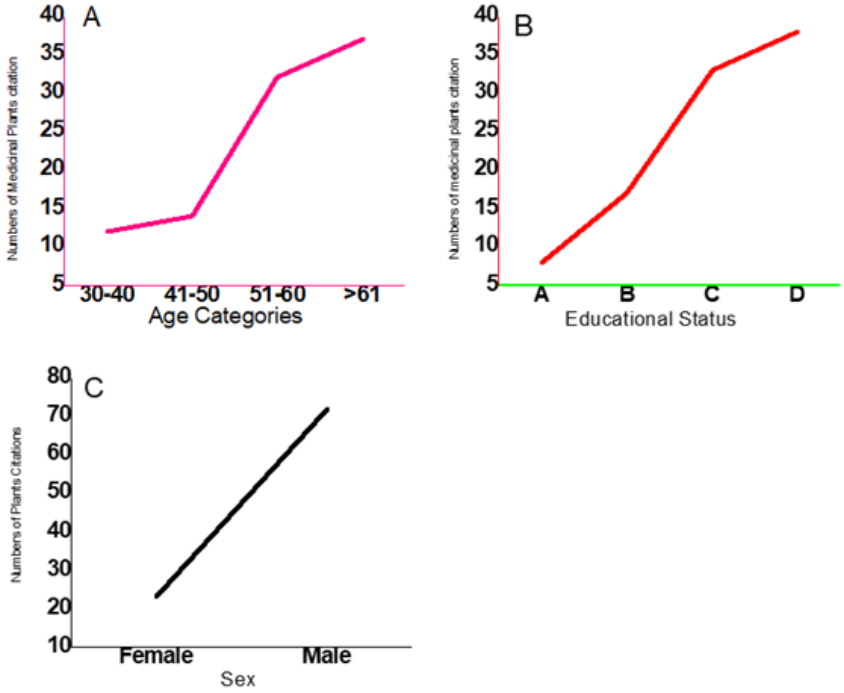

Figure 2

The cross tabulation chi-square on the numbers of ethnoveternary plants citation versus (A) age categories, (B) educational status (whereby the letter “A” indicates literate, “B” secondary education, “C” able to read and write and “D” no formal education) and (C) sex categories

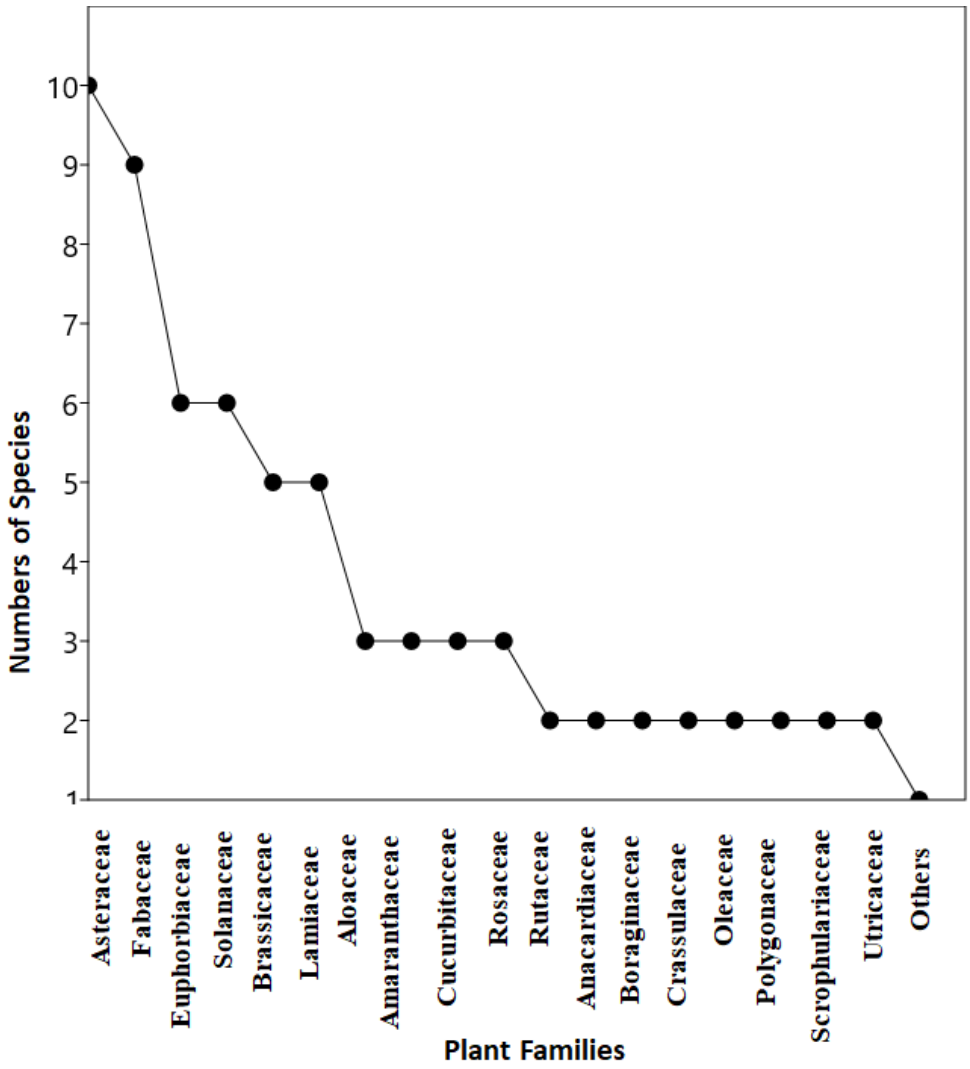

Figure 3

The distribution of ethnoveternary plants along with different plant families

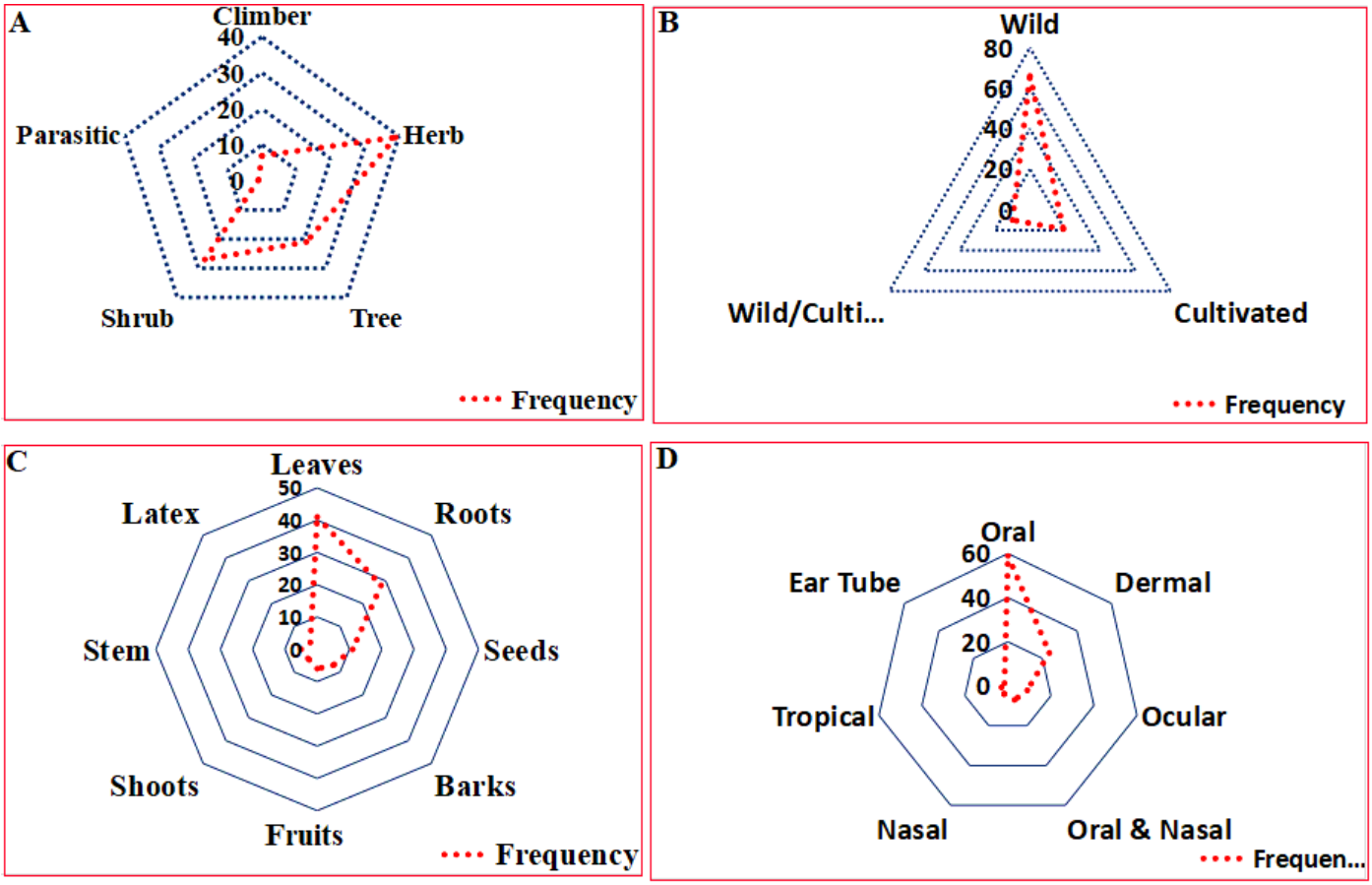

Figure 4

Radar charts used to show (A) the growth habits of the ethnoveternary plants collected and used by the local people in the surveyed agroclimatic zones, (B) the main habitats of the medicinal plants resource in the three provinces, (C) frequently used medicinal plant parts for herbal formulation to treat livestock diseases and (D) the most common routes of administration of the livestock remedies

Supplementary Files

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