# Ethno-veterinary practice for the treatment of cattle diseases in the Eastern highlands of Nigeria

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## Research

## Abstract

*Background:* Cattle rearing is the main means of livelihood for the Fulani people in the highlands of Gashaka Gumti National Park in Nigeria, however the remote location and inaccessible terrain prevent access to modern veterinary care. This puts both livestock and their keepers at risk. To survive, the inhabitants of this area rely on traditional methods to heal their animals. Regrettably, the Ethno-veterinary Medicine (EVM) knowledge in this region is jeopardized by the locals changing their preferences due to rapid socio-economic, environmental and technological changes taking place all over the world. Therefore, documenting the therapeutic knowledge of the medicinal plant is imperative to prevent it from being lost.

*Materials and Methods:* We conducted repeated field surveys and data were collected from sixty community members using semi-structured questionnaires through participatory rural appraisal (PRA) and rapid rural appraisal (RRA) approach.

*Results:* A total of eighty-eight (88) plant species belonging to 73 genera and 37 families, were recorded for the treatment of 24 cattle diseases. The most represented families were Fabaceae (17 species), and Asteraceae (7 species). Trees were the dominant plants recorded (49 species). *Pterocarpus erinaceous* was the most widely used therapeutic plant species. Leaves (27%) were the most widely used plant parts, followed by the whole plant (22%), stem bark (14%), and others. The most frequent route of medicinal administration was oral, followed by topical application. Out of the 24 ailments recorded, Bovine tuberculosis was the most reported ailments followed by Pneumonia.

*Conclusion:* Together, these data show that the Fulani people in the study area have a vast knowledge of medicinal plants useful for effective treatment of cattle illness where traditional veterinary care is unavailable. It is pertinent to say that our study has made an important contribution towards the preservation of EVM knowledge of the study area. Therefore, subjecting the most utilized species to a phytochemical and pharmacological investigation is imperative for possible novel discovery and the production of cheap drugs.

*Keywords:* Gashaka Gumti National Park, Chabbal Hendu, Afromontane, Fulani, Tuberculosis

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## Background

Montane regions are eco-geographic zones in mountain systems that are largely determined by bioclimatic criteria and altitude up to 1650 m (Sommer and Ross 2011; Grab and Knight 2018). Vegetation found in these regions is highly unique and widespread across the African highland (Abiem *et al.* 2020). In Nigeria, true montane vegetation is located at the Gotel peak of the mountainous Northeastern corner in Gashaka Gumti National Park (GGNP) (Akinsoji 2003 and 1996; Chapman and Chapman 2001; Chapman *et al.* 2014; Sommer and Gumnior 2011). The montane ecoregion is important because it contains high proportions of Afromontane endemic biodiversity and many threatened types of fauna and flora (Chapman and Chapman 2001; Chapman *et al.* 2004; Le´zine *et al.* 2013). The terrain is rocky and accessible mainly through footpath, although motorbike access has recently been introduced in some parts. Most of the area was covered by dense montane forest until the mid-1980s, when it was cleared for subsistence farming and grazing (Chapman *et al.* 2004). The remaining vegetation is characterized by an elevated montane grassland and a typical montane forest along the valleys. Most streams in the montane forest maintain a constant supply of water throughout the year, and the area is free of tsetse flies, similar to other African highlands reported in Cecchi *et al.* 2008; Grady *et al.* 2011; and de Gier *et al.* 2020. This makes it attractive to pastoralists for grazing.

There are very limited livelihood opportunities available for the people of this highland, with cattle rearing and subsistence farming as the primary occupation of most inhabitants. However, the remoteness of the area coupled with the inaccessible terrain severely limits access to modern veterinary information and healthcare services. Therefore, people rely on ancient traditional methods to heal their animals (Wazala *et al.* 2005). This inherent, centuries'-old knowledge has withstood the test of time in all aspects of human evolutionary life (McCorkle and Mathias-Mundy 1992) and is now referred to as ethnoveterinary medicine (EVM). The precise period for the practice of EVM is unknown, but it is believed to have started during the Neolithic periods when animals were first domesticated (Neils *et al.* 2008). Knowledge of EVM is usually maintained between lineages by verbal transfer from generation to generation with great secrecy (Khuroo *et al.* 2007; Tamiru *et al.* 2013; Eshetu *et al.* 2015). The knowledge of EVM in this region is now fast disappearing because inhabitants are changing their practices due to rapid socio-economic, environmental and technological changes (Tabuti *et al.* 2003) combined with lack of interest by younger generations, religious practices and lack of documentation (Nodza *et al.* 2020).

Specifically in Nigeria, there remains a dearth of information on EVM studies from the highlands of GGNP. Although there have been attempts at documentation of medicinal flora of this highland (Akinsoji 1996; Sommer and Ross 2011). These previous studies did not focus on the cattle of the study area (Chapman *et al.* 2004). Today this highland region is threatened by an influx of pastoralists due to civil unrest in most parts of Nigeria and the neighboring Cameroon Republic (Goyei 2018). With this influx, more anthropogenic activities are expected and could subsequently lead to further habitat fragmentation and loss of biodiversity. Therefore, documenting the knowledge of EVM is imperative to prevent it from being lost.

## Materials and Methods

### Study area

The study was conducted in the highland enclaves of the southern sector of Gashaka Gumti National Park namely Nyumti, Tale, Shirgu, Hendu and Delam (1220 - 2000 m asl.) as well as sub-montane enclaves of Sabere and Filinga (900 - 1200 m asl.) in Northeastern Nigeria. This area lies between latitude 06° 55′ N and longitude 11° 13′E (Fig. 1). The humidity level is high, and the area sees high rainfall up to 2500 mm (Dunn 1993). Average temperature ranges between 20.9 °C and 32.2 °C with the coolest day being 12 °C and the hottest day 42 °C throughout the year (Dunn, 1993, Sommer and Ross 2012).

The vegetation is characterized by elevated montane grassland and a typical montane forest along the valleys and escarpment. The trees here are usually shorter than those of the forest at lower altitudes and rarely form a canopy; this allows sufficient light to reach the ground level to support lush low vegetation rich in herbs and shrubs. They are generally covered by many climbers and epiphytes. Grasses in this area are characterized by many herbaceous species which rarely grow tall. Most streams in the area maintain water throughout the year. Grasses here are burnt during the dry season and sprout new greens to be grazed by cattle thereafter. Cattle grazing occurs across Chabbal Hendu and results in most of the vegetation being trampled thus reducing the rate of regeneration (Chapman and Chapman 2001).

The major ethnic group on the highlands are the Fulanis, a few Hausa-speaking traders, followed by Gbaya, Mambilla, Chamba (living at Chabbal Nyumti), Kaka, and Ndola who are predominantly farmers. There is no social

amenities in this area; of all the villages or settlements visited, only Selbe has a non-functional community primary school and a dilapidated health post. There are few petty trading stores at Selbe and Filinga, which are mostly serviceable only on a market day (Friday). The average household size is twenty. Fulfulde is the predominant language in the study area, and a few individuals speak pidgin French due to their interactions with northern Cameroon. Approximately 90% of residents are illiterate.

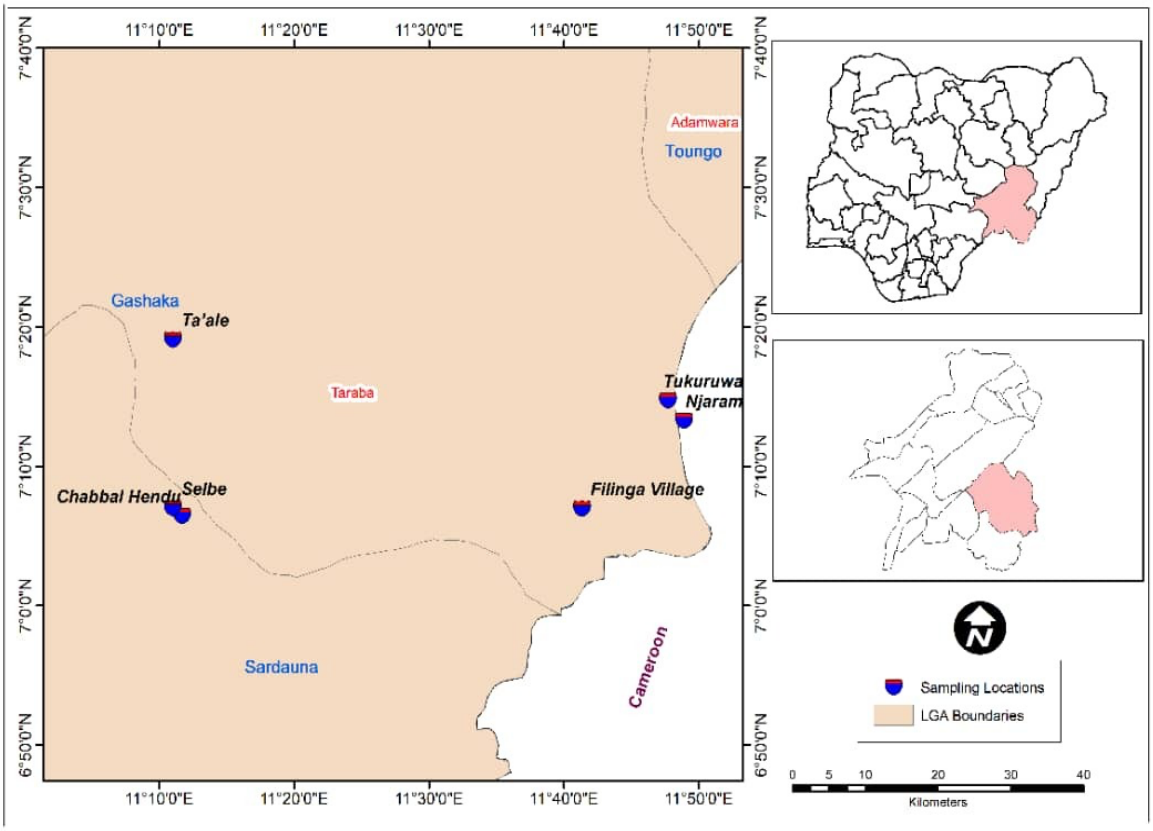


Figure 1. Location map of the study area

**Data collection**

This study is based on an extensive field survey and published literature on medicinal plants of Gashaka Gumti National Park (Akinsoji 1996; Sommer and Ross, 2012). Remote villages of GGNP enclaves were surveyed in 2019 in different seasons. The population of this highland is approximate 27090 (NPC 2007) scattered around the surrounding hills.

Participatory rural appraisal (PRA) approaches were adopted during fieldwork and prior informed consent was obtained before conducting interviews. We interviewed 60 persons, and information regarding ethnoveterinary practices was collected through semi-structured interviews and guided field trips with the help of traditional healers and experienced pastoralists. The interviews were conducted at various places and in the local language called "*Fulfulde and Hausa*". We focused on the highland enclaves of GGNP and most ethnoveterinary information came from the huge Fulani community, the predominant settlement of the study area.

We had challenges with interviewing women because their husband did not grant permission for their wives to be interviewed probably due to religion or cultural beliefs.

**Plant Identification and authentication**

Plant samples collected were identified using keys from Flora of Nigeria and other regional flora reports such as Hutchinson and Dalziel (1954); Keay (1989); Chapman and Chapman (2001). The vernacular names of the plants were verified using Akinsoji (1996 and 2015) and the authentication of samples was carried out by comparison with appropriate voucher specimens at the herbaria in the Department of Botany, University of Lagos (Lagos University Herbarium, LUH). Correct names of the identified species follow the plant list (http://www.theplantlist.org).

**Data Analysis**

Data obtained were analyzed using Microsoft Excel package 2010 and presented as frequency tables, charts, graphs, and percentage composition of data.

## Results and Discussion

**Socio-demographic information**

The study gathered information from both sexes: 45 (75%) male and 15 (25%) female, primarily from the livestock owners and farmers who are predominantly Fulani in age from 19 to 80 years. All informants belonged to the Fulani ethnic group who are the cattle owners in the study area. A detailed demographic profile is shown in Table 1. The respondents were mostly illiterate in formal education but had acquired verbal fluency in Islamic or Arabic. Information regarding the vernacular plant names, part(s) used, methods of preparation, mode/route of application and diseases treated was documented during each interview. It is likely that native people, although illiterate, have superior knowledge on the usage of medicinal plants because they use the plants daily and have a vested interest in their applications (Farooq *et al.* 2019). It was noted that the younger generation had relatively little knowledge of medicinal plants compared to older generations. This may be attributed to the prolonged or accumulated knowledge of plant use throughout their lives and/or to the oral transfer of medicinal plant knowledge to the selected senior family member from ancestors. Such information is typically passed from generation to generation with great secrecy (Nodza *et al.* 2020).

Table 1: Respondents profile

| | Category | No of respondents | Percent (%) |
|---|---|---|---|
| Gender | Male | 45 | 75 |
| | Female | 15 | 25 |
| Age | Young | 10 | 17 |
| | Elder | 50 | 83 |

The respondent profile indicates that men have more knowledge on livestock treatment than do women, as do older informants compared to younger. The former could be due to more involvement of men in mobile pastoralism, whereas the latter could be a result of accumulated experience practicing traditional treatments. This trend has been documented by other studies around the world such as Aziz *et al.* 2018; Sinmez *et al.* 2018; Tadesse *et al.* 2018 and Tefera and Kim 2019. Additional reasons could be the tradition of transfer of medicinal plant knowledge from fathers to their first son or the eldest male child that could keep the secret within the family (Yigezu *et al.* 2014).

***Medicinal plants used to treat livestock ailments in the montane region***

A total of 88 EVM plant species representing 73 genera and 37 families were recorded as being used to treat livestock diseases in this study (Fig. 2). The highest numbers of species were recorded for the family Fabaceae (17 species), followed by Asteraceae and Rubiaceae (7 species) and Euphorbiaceae (6 species). Three families (Guttiferae, Melastomataceae, and Moraceae) had four species each, seven families had two species each, while the remaining 21 families had a single species represented. The details of the species encountered are presented in Table 2. The predominance of Fabaceae agrees with several other global studies (Rahmatullah *et al.* 2010; Verma 2014; Eshetu *et al.* 2015; Adeniran *et al.* 2020) and a study from the Plateau state (Offiah *et al.* 2011), which is regarded as one of the submontane regions of Nigeria (Sanford 1969).

The prevalence of Fabaceae and Asteraceae could result from their abundance as the second and third largest plants families (Govaerts *et al.* 2021). This may also be explained by high bioactivity in the Asteraceae (Tariq *et al.* 2014). This observation is consistent with Monteiro *et al.* 2011 and Yigezu *et al.* 2014. Some of the picture for the species recorded are presented in plate 1.

Table 2. Information of medicinal plants recorded from the study

| Scientific Name | Family | Local Name | Habit | Diseases | Parts | Routes | Voucher No. |
|---|---|---|---|---|---|---|---|
| *Abrus precatorius* L. | Fabaceae | cicibodel | C | Ephemeral fever | Lf, Sd | Oral | LUH6850 |
| *Afzelia africana* Sm | Fabaceae | ngaayoohi(F) | T | Pneumonia, Fever, bovine, pasteurellosis, Colic, diarrhea | St- Bk | Oral | LUH5600 |
| *Albizia gummifera* (J.F.Gmel.) C.A.Sm. | Fabaceae | doruwa leinde(F) | T | Eye inflammation | St-Bk | Topical | LUH7380 |
| *Allophylus africanus* P. | Sapindaceae | Ítààcén baka(H) | H | Joint dislocation | Lf | Topical | LUH5443 |
| *Aneilema beninense* (P.Beauv.) Kunth | Commelinaceae | Ha'ako(H) | H | Liver disease | Wp | Oral | LUH7308 |
| *Anthonotha macrophylla* P. | Fabaceae | Furmu(F) | T | Pneumonia | St- Bk | Oral | LUH6559 |
| *Anthonotha noldeae* (Rossberg) Exell & Hillc. | Fabaceae | Furmu(F) | T | Pneumonia | St-bk | Oral | LUH5318 |
| *Aspilia africana* (Pers.) C. D. Adams. | Asteraceae | nyarki(F) | H | Pneumonia | Wp | Oral | LUH2030 |
| *Aubrevillea kerstingii* (Harms) Pellegr. | Fabaceae | kongoli(F) | T | Eye inflammation | St | Steaming | LUH3213 |
| *Beilschmedia mannii* (Meisn.) Benth. & Hook. f. | Lauraceae | konkoli(H) | T | sickness Gall | St-bk, Lf | Oral | LUH1691 |
| *Borreria verticellata* L. | Rubiaceae | Googamasu(H) | H | Wound | Wp | Topical | LUH161 |
| *Bridelia montana* (Roxb.) Willd. | Euphorbiaceae | Mburburumhi(F) | S | Pneumonia | Lf | Oral | LUH7330 |
| *Bridelia speciosa* Müll.Arg. | Euphorbiaceae | Mburburumhi(F) | T | Internal parasites | St-bk | Oral | LUH6681 |
| *Bridelia micrantha* (Hochst.) Baill. | Euphorbiaceae | Burumburum(F) | S | dysentery/diarrhea | St | Oral | LUH7445 |
| *Brillantaisia nitens* lindau. | Acanthaceae | Ha'ako(F) | H | Diarrhea | Wp | Oral | LUH7069 |
| *Calopogonium mucunoides* Desv. | Fabaceae | Nyanyare(F) | H | Vomiting | Lf | Oral | LUH2012 |
| *Carapa procera* DC. | Meliaceae | Carapaje(F) | T | Eye inflammation | St-bk, Lf | Steaming | LUH7069 |
| *Cephaelis peduncularis* Salisb. | Rubiaceae | Ciiwo ladde(F) | S | Wound | Lf | Topical | LUH1956 |
| *Citrullus colocynthis* L. Schrader | Cucurbitaceae | kwartowa(H) | T | Enteritis | Fr | Oral | LUH1642 |
| *Clerodendrum capitatum* (Willd.) Schumach. & Thonn. | Verbenaceae | Korlejigaahi(F) | H | Pneumonia | Wp | Oral | LUH1387 |
| *Clausena anisata* (Willd.) Hook. f. ex Benth. | Rutaceae | Ledde daneji(F) | S | Wound | Lf | Topical | LUH212 |
| *Clematis hirsuta* Guill. & Perr. | Ranunculaceae | Yamanza(F) | S | Constipation | Lf | Oral | LUH5334 |
| *Cochlospermum planchonii* Hook. f. | Cochlospermaceae | Ambulolooji gaaduru(F) | S | Liver disease | Lf | Oral | LUH7152 |
| *Cola gigantea* A Chev. | Sterculiaceae | Goro leinde(F) | T | Rabies | St-bk | Oral | LUH5075 |
| *Cordia millenii* Baker | Boraginaceae | Bokoko(H) | T | Rabies | Lf | Topical | LUH4678 |
| *Coreopsis barteri* Oliv. & Hiern. | Asteraceae | Ha'ako(F) | H | Pneumonia | Wp | Oral | LUH4223 |
| *Croton macrostachyus* Hochst. | Euphorbiaceae | Ledde daneji(F) | T | Ring worm, wound Rabies, Internal parasites | Lf | Oral, topical | LUH5362 |
| *Cussonia barteri* Seem. | Aracaceae | Bummalee-hi(F) | T | Pneumonia | Bk, St-bk | Oral | LUH7680 |
| *Cuviera nigrescens* (Elliott ex Oliv.) Wernham | Rubiaceae | Ha'ako(F) | S | Wound | St | Topical | LUH3988 |
| *Cyperus denudatus* L.f. | Cyperaceae | Ka'aye(F) | G | Constipation | Wp | Oral | LUH2099 |

| Scientific Name | Family | Local Name | Habit | Diseases | Parts | Routes | Voucher No. |
|---|---|---|---|---|---|---|---|
| *Datura metel* L. | Solanaceae | Zakamihi(F) | H | Cold | Sd | Oral | LUH7521 |
| *Desmodium gangeticum* (L.) DC. | Fabaceae | Takamahi(F) | H | Vomiting | St-bk, Lf | Oral | LUH4467 |
| *Desmodium repandum (Vahl) Poir* | Fabaceae | Takamahi(F) | H | Vomiting | Lf | Steaming | LUH1237 |
| *Dissotis bamenda* Brenan & Keay. | Melastomataceae | Kil'lare(F) | H | Dysentery/diarrhea | Lf | Oral | LUH5332 |
| *Dissotis decumbens* (P. Beauv.) Triana | Melastomataceae | Gba chi(F) | H | Wound | Wp | Topical | LUH1921 |
| *Dissotis rotundifolia* (Sm.) Triana. | Melastomataceae | Kil'lare(F) | H | Wound | Wp | Topical | LUH4933 |
| *Dissotis theifolia* (G. Don) Hook. f. | Melastomataceae | Kil'lare(F) | H | Eye inflammation | Wp | Topical | LUH5607 |
| *Echinops giganteus* A. Rich. | Asteraceae | Ha'ako(F) | H | Pneumonia | Wp | Oral | LUH338 |
| *Emilia coccinea* (Sims) G.Don. | Asteraceae | Ha'ako mayo(F) | H | Pneumonia | Wp | Oral | LUH5373 |
| *Euphorbia abyssinica* J.F.Gmel. | Euphorbiaceae | Ha'ako(F) | H | Swelling | St-bk | Topical | LUH4710 |
| *Faurea speciosa* Welw. | Proteaceae | Wútsííyàr̃ bírì(H) | T | Constipation | St-bk | Oral | LUH3720 |
| *Ficus polita* Vahl | Moraceae | Durumi(H) | T | Horn fracture | St-bk | Topical | LUH1040 |
| *Ficus sur* Forssk. | Moraceae | Rima becehi(F) | T | Horn fracture | St-bk | Topical | LUH5077 |
| *Ficus vallis-choudae* Delile | Moraceae | Kàmasagi(F) | T | Horn fracture | St-bk, Lf | Steaming | LUH6290 |
| *Ficus vogelii* (Miq.) Miq. | Moraceae | Nòònòn gwánkíí(F) | T | Horn fracture | Lf | Oral | LUH5077 |
| *Garcinia acuminata* Planch. & Triana | Guttiferae | Goro leinde(F) | T | Swelling | St-bk | Topical | LUH6791 |
| *Garcinia smeathmannii* (Planch. & Triana) Oliv. | guttiferae | Bura lainde(F) | T | Cold/Coughing/Cold | St-bk, Lf | Nasal | LUH7251 |
| *Harungana madagascariensis* Lam. | Guttiferae | Alíllìbár rààfíí(H) | S | Cold/Coughing | Lf | Oral | LUH6112 |
| *Hibiscus surattensis* Linn. | Malvaceae | Baskoji ladde(F) | H | Tongue disease | Lf | Oral | LUH3097 |
| *Indigofera pulchra* Willd. | Fabaceae | Bákín búúnúú(H) | H | Vomiting | Wp | Oral | LUH6644 |
| *Kigelia africana* (Lam.) Benth. | Bignoniaceae | Killaare(F) | T | Poisonous bite | St-bk | Topical, Oral | LUH4143 |
| *Lecaniodiscus cupanioides* Planch. | Sapindaceae | Kaa-fi-naamaa-zaakii(H) | T | Joint dislocation | St-bk | Topical | LUH4314 |
| *Mimosa pundica* L. | Fabaceae | Ge'nee(F) | H | Wound | Lf, Fl | Oral | LUH5834 |
| *Mimusops kummel* Bruce ex A. DC.Bruce. | Sapotaceae | Ha'ako na'i(F) | T | Joint dislocation | St-bk | Topical | LUH4990 |
| *Monodora myristica* (Gaertn.) Dunal. | Annonaceae | Gújíyár̃ dan miya(H) | T | Pneumonia | Sd, Rt | Oral | LUH4751 |
| *Mucuna pruriens* (L.) DC | Fabaceae | Nyanyare kaduuru(F) | C | Wounds | Sd | Oral | LUH6660 |
| *Musa paradisiaca* L | Musaceae | kondongji(H) | T | Food and mouth disease, Constipation | Fr | Oral | LUH7362 |
| *Newtonia aubrevillei* (Pellegr.)Keay. | Fabaceae | Ledde manga(F) | T | Eye inflammation | Lp | Steaming | LUH7359 |
| *Nuxia congesta* R.Br. ex Fresen. | Rubiaceae | Kongal ladde(F) | T | Pneumonia | St-bk | Oral | LUH5408 |
| *Olax subscorpioidea* Oliv | Olacaceae | Gwàànón rààfìì(H) | T | Vomiting/Constipation | St-bk, Lf | Oral | LUH4750 |
| *Panicum maximum* Jacq. | Poaceae | Buurɗi(F) | G | Constipation | Wp | Oral | LUH2658 |
| *Pennisetum purpureum* Schum. | Poaceae | Tolore(F) | G | Constipation | Lf | Oral | LUH2124 |
| *Piliostigma thonningii (*Schum.) Milne-Redh. | Fabaceae | Barkeeje(F) | S | Conjunctivitis | Lf | Steaming | LUH7548 |
| *Polyscias fulva* (Hiern) Harms | Rubiaceae | Ciiwo(F) | T | Bleeding, Pneumonia | Bk, Lf | Oral, topical | LUH7505 |
| *Prunus africana* Hook.f. | Rosaceae | Dan kamaru(H) | T | Pneumonia | Lf | Topical | LUH3718 |

| Scientific Name | Family | Local Name | Habit | Diseases | Parts | Routes | Voucher No. |
|---|---|---|---|---|---|---|---|
| *Pseudarthria hookeri* Wight & Arn. | Fabaceae | Wada wurohi(H) | S | Constipation | Lf | Oral | LUH2045 |
| *Psorospermum febrifugum* Spach. | Guttiferae | Sawalki(F) | T | gall sickness | St,bk | Oral | LUH4502 |
| *Pterocarpus erinaceus* Poir | Fabaceae | Madobiiya | T | FMD, Gastrointestinal, pasteurellosis ,Wound, Trypanosomiasis, dysentery | Bk, lf | Oral/Topical | LUH1548 |
| *Rauvolfia vomitoria* Afzel. | Apocynaceae | Nyakamji(F) | H | food and mouth disease | Lf, Fr | Topical | LUH4040 |
| *Ricinus communis* L. | Euphorbiaceae | Zurmaje(F) | S | Retained Placenta, Hematuria | Rt | Oral | LUH5896 |
| *Rothmannia urcelliformis* (Hiern) Bullock | Rubiaceae | Ledde burkalihi(F) | T | Pneumonia | St, bk | Oral | LUH1551 |
| *Solanum giganteum* Jacq. | Solanaceae | Ngite na'i(F) | H | Rabies | Lf, Fr | Oral | LUH7271 |
| *Solanum incanum* L. | Solanaceae | Huytaare fowru(F) | H | Pastuerellosis | Lf, Fr | Oral | LUH1547 |
| *Sterculia tragacantha* L. | Sterculiaceae | Kûkkúúkìn rààfíí(F) | T | Pneumonia | St-bk | Body bath | LUH7390 |
| *Stereospermum kunthianum* Cham | Bignonaceae | Golombi(F) | T | Pneumonia | Lf | Topical | LUH6623 |
| *Symphonia globulifera* | Clusiaceae | Chabbole lainderi(F) | T | Vomiting | St-bk | Oral | LUH6110 |
| *Syzygium guineense* Wall. | Myrtaceae | Sumsum(F) | T | Vomiting | St-bk | Oral | LUH2000 |
| *Tabernaemontana pachysiphon* Stapf. | Apocynaceae | Asurahi(F) | T | FMD | Rt | Topical | LUH2076 |
| *Tagetes erecta* L. | Asteraceae | Aduuwa(H) | H | Pneumonia | Wp | Body bath | LUH7147 |
| *Tephrosia purpurea* L. | Fabaceae | Báábáá móórèè(F) | H | Pneumonia | Lf, Sd | Oral | LUH2538 |
| *Tephrosia vogelii* Hook.f. | Fabaceae | Tokke liɗɗi(F) | T | Constipation | Lf | Oral | LUH2542 |
| *Terminalia glaucescens* Planch. | Combretaceae | Kuulahi(F) | T | Liver disease | St-bk | Oral | LUH3507 |
| *Terminalia laxiflora* Engl. | Combretaceae | Fárín báushèè(F) | T | Liver disease | St-bk | Oral | LUH5602 |
| *Trema orientalis* L. | Ulmaceae | Ajenana(F) | T | Pneumonia | Bk | Oral | LUH7301 |
| *Tridax procumbens* L | Asteraceae | Ciiyawa zomo(F) | H | Wound | Wp | Topical | LUH1817 |
| *Vernonia guineensis* Benth. | Asteraceae | Gene naira(F) | H | Pneumonia | Lf | Body bath | LUH4649 |
| *Vitex doniana* Sweet. | Verbenaceae | Ngalbije (F) | T | Retained Placenta, Hematuria | Bk | Oral | LUH3295 |
| *Woodfordia fruticosa* (L.) Kurz. | Lythraceae | kafaffi(F) | T | Fractures | St-bk | Topical | LUH7369 |

**Key:** *F= Fulani, H=Hausa, T=tree, C=climber, G=grass, H=herb, S=shrub, T=tree, F=fruit, Lf=leaf, St-bk, stem-bark, Sd=seed, Wp= whole plant*

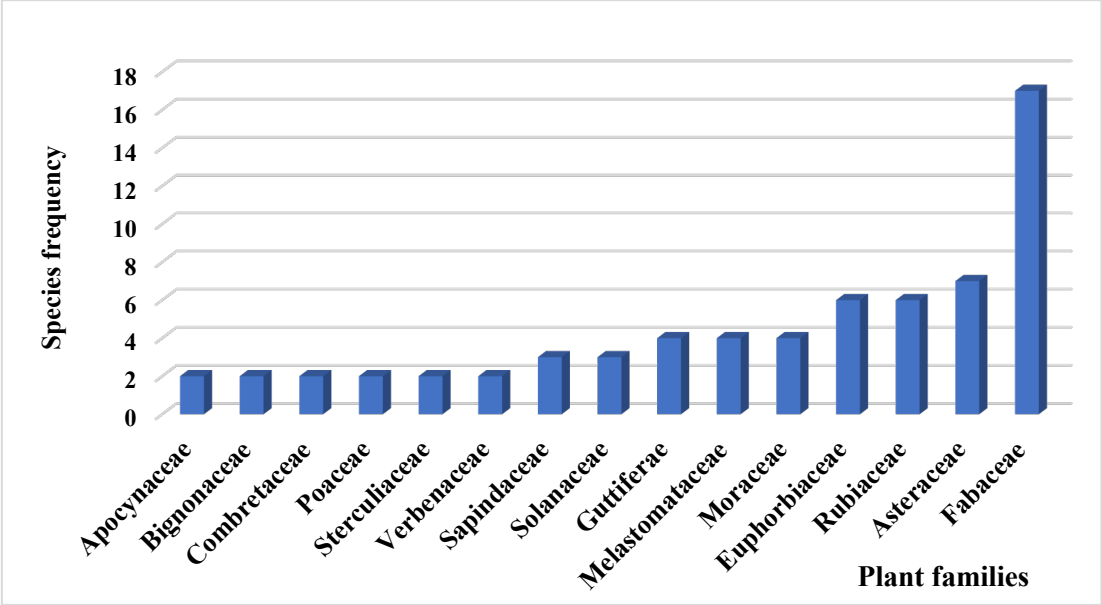


Figure 2. Plant families with more than one species recorded in the study

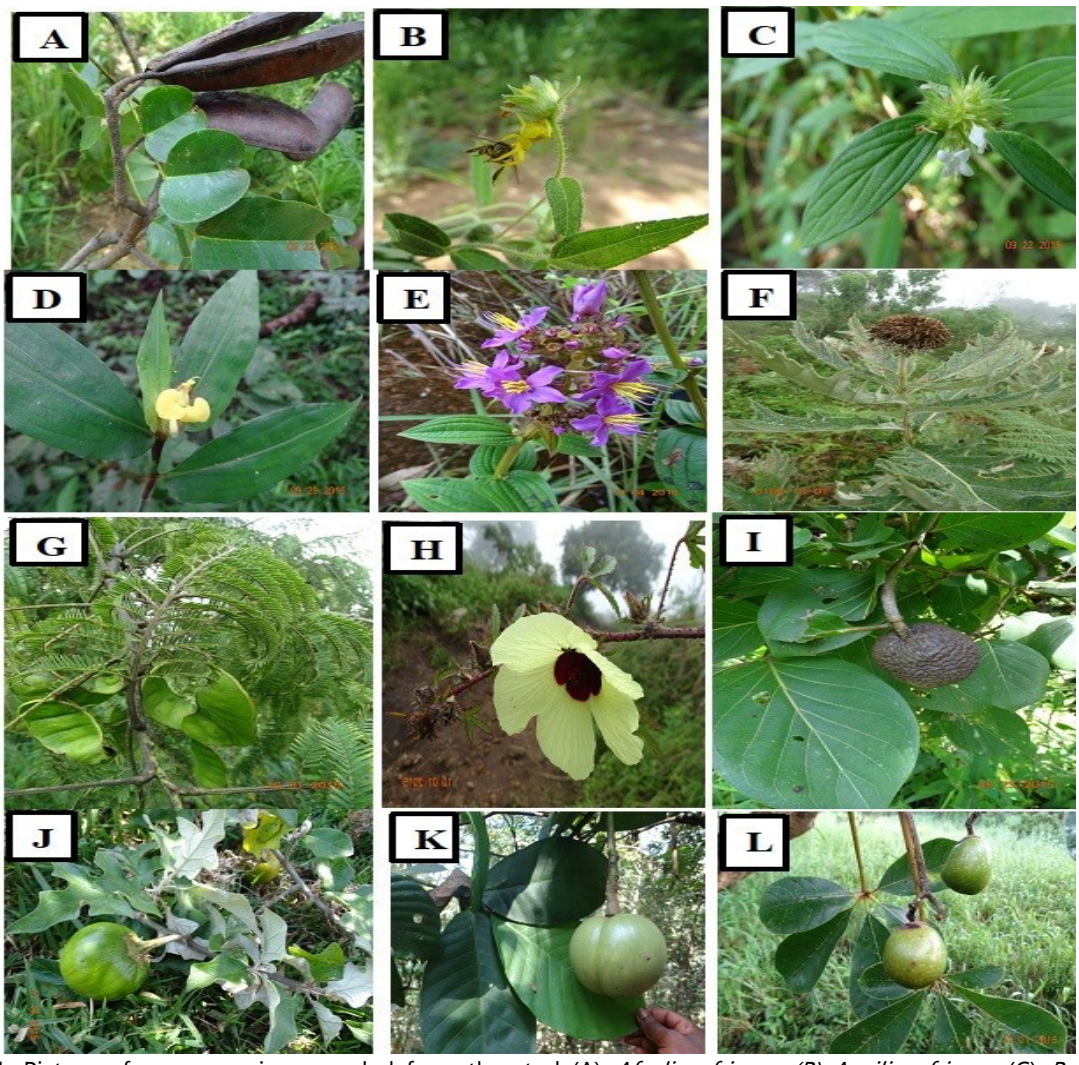


Plate 1. Picture of some species recorded from the study(A) *Afzelia africana (B) Aspilia africana* (C) *Borreria verticillata* (D) *Commelina africana* (E) *Dissotis rotundifolia* (F) *Echinops giganteus* (G *Entanda africana* (H) *Hibiscus surratensis* (I) *Sarcocephalus latifolius* (J) *Solanum giganteum* (K) *Tabernaemontana pachysiphon* (L) *Vitex doniana*

**Habits of growth and plant parts used**

The data collected show that the primary medicinal plants used to treat livestock ailments were trees 43(49 %), herbs 28 (32 %), and shrubs 11(13 %), while grasses and climbers were represented with three species each (Fig. 3). This corroborates Jernigan (2009) and Tekle (2015), yet conflicts with other studies (Eshetu *et al.* 2015; Farooq *et al.* 2019; Khan *et al.* 2019) that reported the dominance of herbaceous species elsewhere. The predominance of tree species in our utilization data could be attributed to increased availability of the trees in almost all season (de Albuquerque 2006).

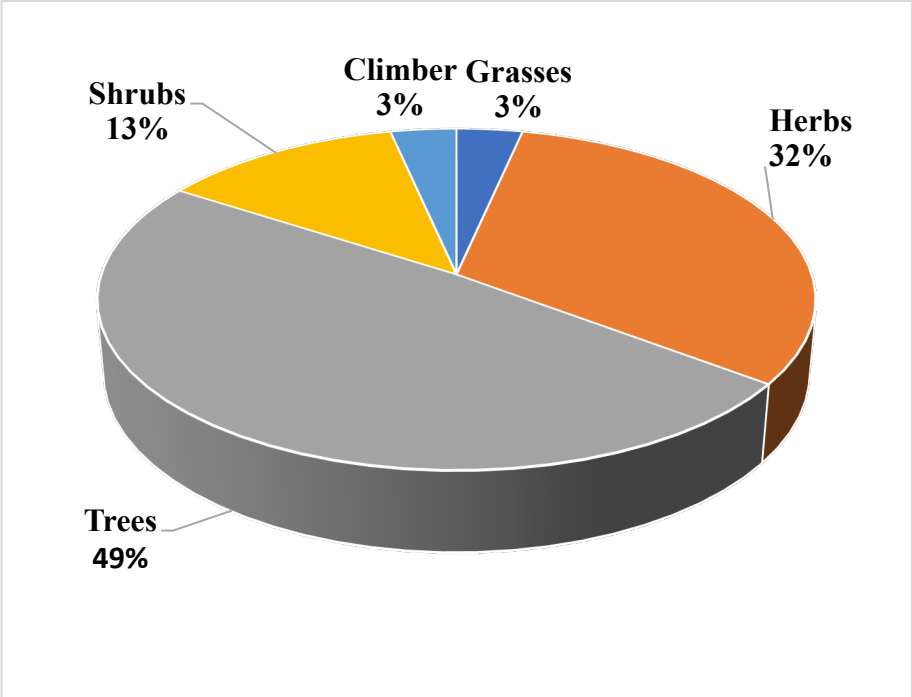


Figure 3. Growth forms (or habits) of the plants encountered in the study

**Plant parts utilized**

This study identified several plant parts used to prepare EVM recipes. The most commonly used parts were leaves (22 species), followed by whole plants (16 species) as indicated in Figure 4. This result is consistent with the findings of Tariq *et al.* 2014; Eshetu *et al.* 2015; and Nyahangare *et al.* 2015. The plants identified in the whole plant usage category included herbaceous species, grasses, and climbers, all of which are usually uprooted. Also, leaf utilization might be associated with the animal feeding behavior where leaves, stems, and seeds are most plant parts being foraged (Xiong and Long 2020). The prevalence of the use of leaves could be due to ease of collection (Tariq et al., 2014) and/or the several metabolites produced in the leaves during the process of photosynthesis (Tariq et al., 2014). The least used plant part in recipes was the root, possibly because of its underground location, where harvesting could be labour intensive and may permanently damage the plant (Yirgu *et al.* 2019). This observation corroborates the findings of Xiong and Long 2020. Finally, in some instances, two or more plant parts of the same plant species were used in preparations of EVM recipes for different or similar ailments. This finding is consistent with previous studies from Ethiopia and Nigeria (Tilahun *et al.* 2019; Niels *et al.* 2008; Offiah *et al.* 2011). The use of two or more plant parts could be a strategy to combine different chemical constituents to achieve a highly concentrated mixture. However, it is also believed that one plant species/part can treat various types of disease due to its diverse chemical constituents.

**Route of administration of the EVM identified from the study area**

The medicinal plant preparations were administered through different routes including oral, topical, steaming, body bath and nasal. Also, two or more methods of recipe preparations were observed from a single plant depending on the type of disease treated. Of all the methods, oral administration was the most frequently used route of administration (56%), whereas only a few (28%) are administered topically as shown in (Fig. 5). This result is consistent with the findings of Tariq *et al.* (2014) and Kebede *et al.* (2018), who reported that the oral route of administration was the most common means of administering EVM in livestock in Pakistan and Ethiopia. However, this is dependent on the type of ailment treated. Topical application was the second most widely practiced mode

of EVM administration. This corroborates Yigezu *et al.* 2014 who reported oral and topical routes of administration as the most popular mode of EVM administration in some districts in Ethiopia, while burning plant parts to create smoke around animals to repel insects were less common (1%).

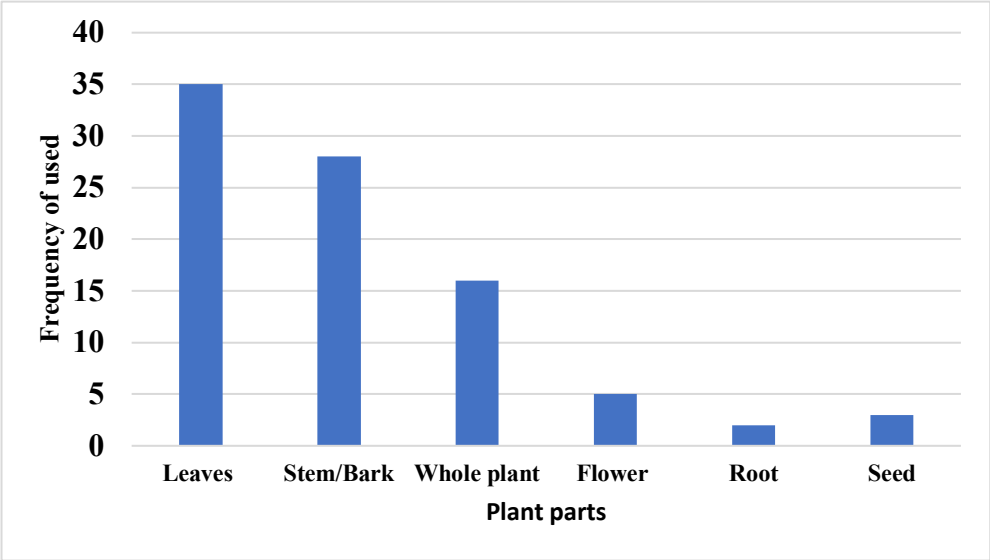


Figure 4. Plant parts used in preparation of EVM recipes

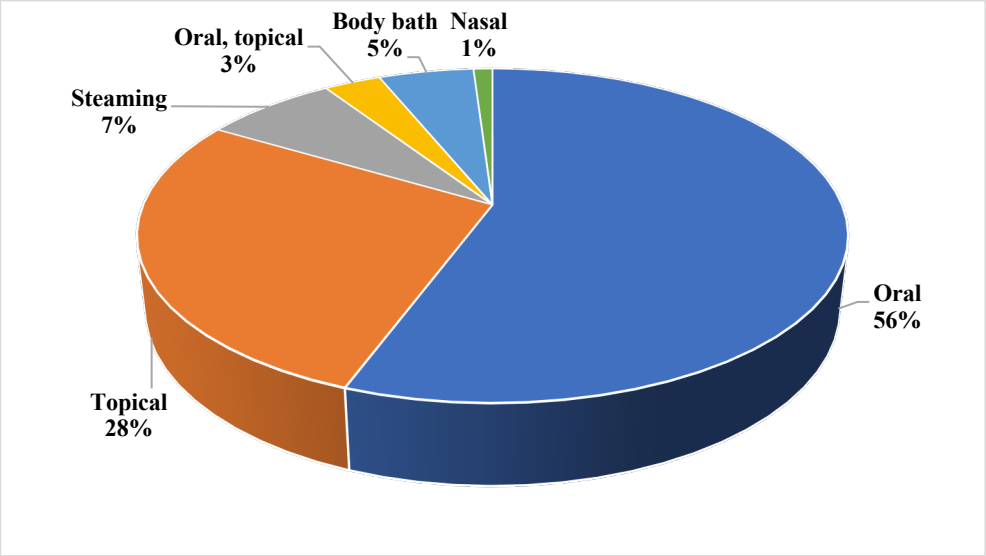


Figure 5. Mode of administration of EVM treatments

**Categories of major cattle ailments and some medicinal plants**

This study recorded 24 different ailments of cattle in the study area (Fig. 6). Several of these diseases have been reported to be common cattle diseases in many studies in Nigeria (Alawa and Aku 2002; Neils *et al.* 2008; Offiah *et al.* 2011; Alhaji and Babalobi 2015; Majekodunmi *et al.* 2018) and other parts of the world such as Ethiopia, Pieracci *et al.* (2016), India Eswaran *et al.* (2013); Verma 2014; Jayakumar *et al.* (2018). Of the diseases recorded, *Bovine Tuberculosis* was the most frequent ailment of cattle in the study area, followed by pneumonia. Importantly, Bovine tuberculosis (bTB) is caused by *Mycobacterium bovis,* which is reported to be endemic to Cameroon (Egbe *et al.* 2017). This observation may be explained by the proximity of the study area to Cameroon, and the fact that there have been transboundary cattle migrations between the two countries (Zieba *et al.* 2017). The high rate of pneumonia in this study corroborates the reports of Masiga *et al.* (1996); Mekibib *et al.* (2019); and Dzoyem *et al.* (2020) who reported pneumonia as one of the major livestock diseases restricting the development of animal production in the tropics. This prevalence could be associated with cold temperature and high altitude which increased occurrence of respiratory tract infections (Mäkinen *et al.* 2009; Caswell 2014). Of all the plant species recorded, *Pterocarpus erinaceus* Poir was reported to be the most used plant in the study area. The ailments

reported to be treated by *P. erinaceus* Poir in this study corroborates findings elsewhere in China for wound healing in cattle (China and Francis 2014), gastrointestinal pasteurellosis in Benin Republic (Ouachinou *et al.* 2019), trypanosomiasis, foot and mouth disease (Noudèkè *et al.* 2017), tooth and mouth troubles, and severe diarrhea or dysentery (Tuo *et al.* 2020). *Afzelia africana* is reported to be the second most used plant species in this study. The species was reported to treat various ailments including *bovine pasteurellosis* and gastrointestinal disorder. This observation confirms the findings of Ouachinou *et al.* (2019) and Ogni *et al.* (2016) which reported *A. africana* to treat gastrointestinal disorder in Benin Republic. However, few of the plant species recorded in this study are Afromontane endemic (Chapman and Chapman 2001), such as *Anthonotha noldeae*, *Nuxia congesta, Prunus africana, Solanum giganteum* and *Polyscias fulva*. Of these, *Prunus africana* which is reported in this study to treat pneumonia, has also been reported in Ethiopia to treat similar ailment (Tadesse *et al.* 2014; Hassen *et al.* 2021). Also, *Nuxia congesta* reported to treat pneumonia has also been reported elsewhere (Minja 1994; Lulekal *et al.* 2014) to treat similar ailments. *Polyscias fulva* has been reported to treat minor bleeding in livestock (Lulekal *et al.* 2014).

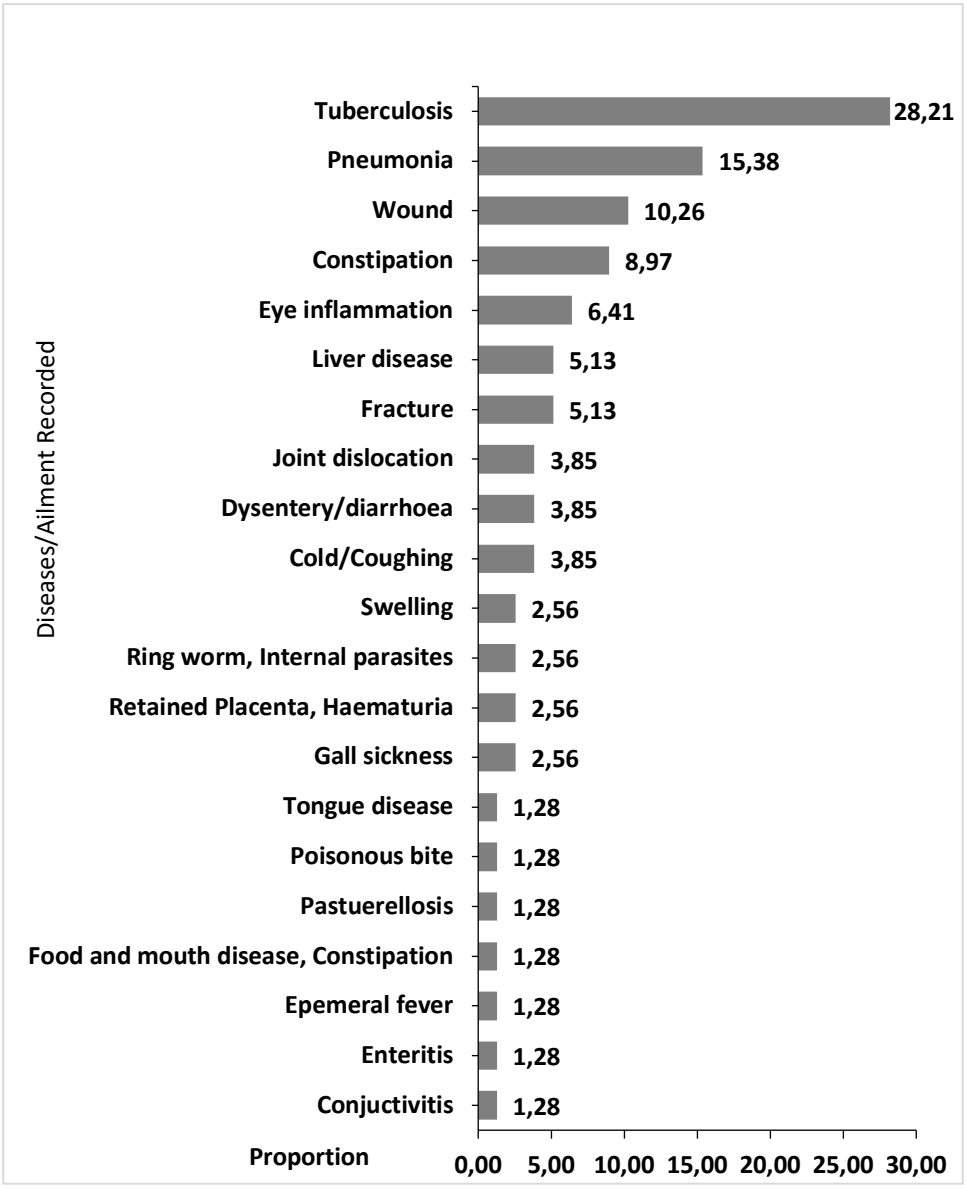


Figure 6. Ailment/ diseases recorded in the study area

Also, *Solanum giganteum* was reported by Berhanu *et al.* (2020) to treat cough in Ambo District of Oromia Regional State of Ethiopia, while *Croton macrostachyus* has been reported to treat ringworms in districts of Jimma zone, Ethiopia (Yigezu *et al.* 2014). *Ficus sycomorous,* used in EVM in the study area, agrees with the study of Alawa and Aku (2002) and several others. The widespread use of some of these plant species could be related to the chemical

compounds they contain (such as sterols, carbohydrates, proteins, amino acids, alkaloids coumarins, saponins, tannins, flavonoids, phenols, and saponins) and/or their antimicrobial, digestive or laxative capacity. These chemicals are also known to have important anthelmintic activities or contribute to healing of the ailments mentioned above (Akinpelu *et al.* 2009; Aliyu and Chedi 2010; Noufou *et al.* 2016; Ouachinou *et al.* 2019).

## Conclusion

With the number of species recorded and ailments treated, it is obvious that Fulani people in the study area have a vast knowledge of medicinal plants. The analysis of this study suggests that their ethnoveterinary knowledge is derived from daily practices of rearing their cattle for sustainability and the absence of adequate conventional animal health care systems in the rural communities. There is a critical need to isolate active compounds from the acclaimed medicinal plants and ascertain their clinical efficacy. Additionally, subjecting the identified plant species to a phytochemical and pharmacological screening tests is warranted to develop novel drugs for veterinary use.

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## Declarations

**Abbreviations: EVM:** Ethnoveterinary medicine**; FMD:** Foot and mouth disease**; GGNP:** Gashaka Gumti National Park**; IAD: Igbari, Aramide Dolapo; LUH:** Lagos University Herbarium**; OOT: Ogundipe, Oluwatoyin Temitayo; OTO: Onuminya, Temitope Olabisi ; NGI: Nodza George Isaac; TETFUND:** Tertiary Education Trust Fund

**Ethics statement:** The Code of Ethics of the International Society of Ethnobiology (2008) was followed during data collection http://ethnobiology.net/code-of-ethics. Informants were briefed on the purpose of this research work and verbal consents were taken from all the localities where data was collected. As most of the informants were illiterate, it was not possible to obtain written consent.

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**Declaration of competing interest:** The authors declare that there is no conflict of interest.

**Authors' contributions:NGI** designed the study, conducted the field work, and wrote the original draft and the final manuscript. **IAD** carried out data analysis. **OTO** assisted with design, data analysis, and interpretation. While **OOT** source the fund for field data and provided logistics. All authors read and approved the final draft.

## Literature Cited

Abiem AG, Kenfack D, Chapman H. 2020. Afromontane Forest Diversity and the Role of Grassland-Forest Transition in Tree Species Distribution. Diversity 12(1):30.

Adeniran LA, Okpi S, Anjorin TS, Ajagbonna OP. 2020. Medicinal plants used in ethnoveterinary practices in the Federal Capital Territory, North-Central Nigeria. Journal of Medicinal Plants Research 14(8):377-388.

Akinsoji A. 1996. Vegetation types and Ethnobotanical studies of Gashaka Gumti National Park-Nigeria. Report in conjunction with Department of biological sciences (Botany Unit), University of Lagos, Nigeria to: Nigeria conservation foundation (NCF-Gashaka Gumti project) and WWF-UK, p. 76.

Akinsoji A. 2003. Montane vegetation of Chabbal Hendu in Gashaka Gumti National Park Nigeria. Journal of Pure and Applied Science 6:80-88.

Akinsoji A. 2005. A survey of montane epiphytes in Gashaka-Gumti National Park, Nigeria. Nigerian Journal of Botany 18:35-45.

Alawa JP, Jokthan GE, Akut K. 2002. Ethnoveterinary medical practice for ruminants in the subhumid zone of northern Nigeria. Preventive Veterinary Medicine 54(1):79-90.

Alhaji NB, Babalobi OO. 2015. Participatory Epidemiology of Ethnoveterinary Practices Fulani Pastoralists Used to Manage Contagious Bovine Pleuropneumonia and Other Cattle Ailments in Niger State Nigeria. Journal of Veterinary Medicine 2015(1):1-10.

Aliyu M, Chedi B. 2010. Effects of the ethanolic stem bark extract of Pterocarpus erinaceus Poir (Fabaceae) on some isolated smooth muscles. Bayero Journal of Pure and Applied Sciences 3(1):34-38.

Aziz MA, Khan AH, Pieroni A. 2020. Ethnoveterinary plants of Pakistan: a review. Journal of Ethnobiology and Ethnomedicine 16(25):1-18.

Berhanu M, Tintagu T, Fentahun S, Giday M. 2020. Ethnoveterinary Survey of Medicinal Plants used for Treatment of Animal Diseases in Ambo District of Oromia Regional State of Ethiopia Evidence-Based Complementary and Alternative Medicine 2020:1-12.

Caswell JL. 2014. Failure of respiratory defenses in the pathogenesis of bacterial pneumonia of cattle. Veterinary Pathology 51(2): 93-409.

Cecchi G, Mattioli R, Slingenbergh J, De La Rocque S, Feldmann U. 2008. Standardizing land cover mapping for tsetse and trypanosomiasis decision making, Vol. 8. Rome, Italy: Food and Agriculture Organization of the United Nations, p. 106.

Chapman H, Olson S, Trumm D. 2004. An assessment of changes in the montane forests of Taraba State, Nigeria, over the past 30 years. Oryx 38(3):282-290.

Chapman JD, Chapman HM. 2001. The Forests of Taraba and Adamawa States, Nigeria: An Ecological Account and Plant Species Checklist. University of Canterbury, Christ church, New Zealand, p. 146.

de Albuquerque, U.P. (2006). Re-examining hypotheses concerning the use and knowledge of medicinal plants: a study in the Caatinga vegetation of NE Brazil. Journal of Ethnobiology and Ethnomedicine 2:30 https://doi.org/10.1186/1746-4269-2-30

de Gier J, Cecchi G, Paone M, Dede P, Zhao W.2020. The continental atlas of tsetse and African animal trypanosomiasis in Nigeria. Acta Tropica 204:105328.

Dulo F. 2017. Ethnoveterinary Medicine Practices in Ethiopia: Review. Advances in Biological Research 11(3):154-160.

Dunn A. 1993. A Preliminary Survey of the Forest Animals of Gashaka Gumti National Park, Nigeria. WWF UK and Nigerian Conservation Foundation, Nigeria. (Unpublished report), p. 22.

Egbe NF, Muwonge A, Ndip L, Kelly RF, Sander M, Tanya V, Ngwa VN, Handel IG, Novak A, Ngandalo R, Mazeri S, Morgan KL, Asuquo A, de C Bronsvoort BM. 2017. Molecular epidemiology of *Mycobacterium bovis* in Cameroon. Scientific Reports 7(1):4652.

Eshetu GR, Dejene TA, Telila LB, Bekele DF. 2015. Ethnoveterinary medicinal plants: Preparation and application methods by traditional healers in selected districts of southern Ethiopia. Veterinary World 8(5):674-684.

Eswaran S, Boomibalag P, Rathinavel S. 2013. Ethnoveterinary Medicinal Practices of the Villagers of Usilampatti Taluk of Madurai District, India. *International Journal of Botany 9*.37-43.

Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. 2019. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir Pakistan. Journal of ethnobiology and ethnomedicine 15(1):45.

Govaerts, R., Nic Lughadha, E., Black, N., Turner, R., & Paton, A. (2021). The World Checklist of Vascular Plants, a continuously updated resource for exploring global plant diversity. Scientific Data 8(1):215. doi:10.1038/s41597-021-00997-6

Goyei FG (2018): Nigeria's Boko Haram and its Security Dynamics in the West African Sub-Region. *Journal of Language, Technology & Entrepreneurship in Africa 9*.102-130.

Grab SW, Knight J. 2018. Southern African montane environments. In: Holmes, P. and Boardman, J. (eds) Southern African Landscapes and Environmental Change. Routledge, in press, p. 328.

Hutchinson J, Dalziel JM. 1954. Flora of West Tropical Africa. The white Friars press Ltd, London, p. 539.

Jayakumar S, Baskaran N, Arumugam R, Sathiskumar S, Pugazhenthi M. 2018. Herbal medicine as a live practice for treating livestock ailments by indigenous people: A case study from the Konar community of Tamil Nadu. *South African Journal of Botany 118*:23-32.

Jernigan KA. 2009. Barking up the same tree: a comparison of ethnomedicine and canine ethnoveterinary medicine among the Aguaruna. Journal of Ethnobiology and Ethnomedicine 5:33.

Kebede E, Mengistu M, Serda B. 2018. Ethnobotanical knowledge of pastoral community for treating livestock diseases in Somali regional state, eastern Ethiopia. Tropical animal health and production 50(6): 1379-1386.

Keay RW. 1989. Trees of Nigeria. Claredon Press Oxford, p. 400.

Khan K, Rahman IU, Calixto ES, Ali N, Ijaz F. 2019. Ethnoveterinary Therapeutic Practices and Conservation Status of the Medicinal Flora of Chamla Valley, Khyber Pakhtunkhwa, Pakistan. Frontiers in Veterinary Science 6:122.

Khuroo AA, Malik AH, Dar AR, Dar GH, Khan ZS. 2007. Ethnoveterinary medicinal uses of some plant species by the Gujjar tribe of the Kashmir Himalaya. Asian Journal of Plant Sciences 6(1):148-152.

Lézine AM, Assi-Kaudjhis C, Roche E, Vincens A, Achoundong G. 2013. Towards an understanding of West African montane forest response to climate change. Journal of Biogeography 40(1):183-196.

Lulekal E, Asfaw Z, Kelbessa E, Van Damme P. .2014. Ethnoveterinary plants of Ankober District, North Shewa Zone, Amhara Region, Ethiopia. Journal of Ethnobiology and Ethnomedicine 10:21.

Majekodunmi AO, Dongkum C, Idehen C, Langs DT, Welburn SC. 2018. Participatory epidemiology of endemic diseases in West African cattle - Ethnoveterinary and bioveterinary knowledge in Fulani disease control. One health (Amsterdam, Netherlands) 5:46-56.

Makinen TM, Juvonen R, Jokelainen J, Harju TH, Peitso A, Bloigu A, Silvennoinen-kassinen S, leinonen M, Hassi J. 2009. Cold Temperature and low humidity are associated with increased occurrence of respiratory tract infections. Respiratory Medicine 103(3):456-462.

Masiga WN, Domenech J, Windsor RS. 1996. Manifestation and epidemiology of contagious bovine pleuropneumonia in Africa. Revue scientifique et technique (International Office of Epizootics) 15(4):1283-1308.

McCorkle C, Mathias-Mundy E. 1992. Ethnoveterinary Medicine in Africa. Africa. Journal of the International African Institute 62(1):59-93.

Mekibib B, Mikir T, Fekadu A, Abebe R. 2019. Prevalence of Pneumonia in Sheep and Goats Slaughtered at Elfora Bishoftu Export Abattoir, Ethiopia: A Pathological Investigation. Journal of veterinary medicine 7:1-10.

Minja MM. 1994. Medicinal plants used in the promotion of animal health in Tanzania. Revue scientifique et technique (International Office of Epizootics) 13(3):905-925.

Monteiro MV, Bevilaqua C, Palha M, Braga R, Schwanke K, Rodrigues ST, Lameira O. 2011. Ethnoveterinary knowledge of the inhabitants of Marajó Island, Eastern Amazonia, Brazil. Acta Amazonica 41:233-242.

National Population Commission (2007) Population Census of the Federal Republic of Nigeria, Taraba State Statistical Table.

Neils JS, Nzalak JO, Sackey AKB, Okpara JO. 2008. Ethno- veterinary practices: The perception among the Fulani cattle reares in Adamawa State, Nigeria. Sokoto Journal of Veterinary Sciences 7(2):38-41.

Nodza GI, Onuminya TO, Ogbu P, Agboola OO, Ogundipe OO. 2020. Ethnobotanical Survey of Medicinal Plants used in Treating Snakebites in Benue, Nigeria. Annals of West University of Timisoara Series Biology 23(2):147-158.

Noudeke ND, Dotche I, Ahounou GS, Karim IYKA, Farougou S. 2017. Inventory of medicinal plants used in the treatment of diseases that limit milk production of cow in Benin. Journal of Advanced Veterinary and Animal Research 4(1):1-14.

Noufou O, Anne-Emmanuelle H, Claude WO, Richard SW, Andre T, Marius L, Nikiema J, Jean K, Marie-Genevieve D, Pierre GI. 2016. African Journal of Traditional, Complementary and Alternative Medicines 14(1):187-195.

Nyahangare ET, Mvumi BM, Mutibvu T. 2015. Ethnoveterinary plants and practices used for ecto-parasite control in semi-arid smallholder farming areas of Zimbabwe. Journal of Ethnobiology and Ethnomedicine 11:30.

Offiah NV, Dawurung CJ, Oladipo OO, Makoshi MS, Makama S, Elisha I, Gotep J, Samuel AL, Shamaki D. 2012. Survey of herbal remedies used by Fulani herdsmen in the management of animal diarrhoea in Plateau State, Nigeria. *Journal of Medicinal Plants Research 6*:4625-4632.

Ouachinou JM, Dassou GH, Idohou R, Adomou AC, Yedomonhan H. 2019. National inventory and usage of plant based medicine to treat gastrointestinal disorders with cattle in Benin (West Africa). South African Journal of Botany 122: 432-446.

Pieracci EG, Hall JA, Gharpure R, Haile A, Walelign E, Deressa A, Bahiru G, Kibebe M, Walke H, Belay E. 2016. Prioritizing zoonotic diseases in Ethiopia using a one health approach. One Health 2:131-135.

Rahal A, Ahmad AH, Prakash A, Mandil R, Kumar A T. 2014. Environmental attributes to respiratory diseases of small ruminants. Veterinary medicine international 2014:853627.

Rahmatullah M, Mollik AH, Alam J, Ahmmed B, Jahan FI, Sintaha M, Khaleque HN, Chowdhury MH, Noor F A, Rahman S, Jahan R, Seraj S. 2010. An ethnoveterinary survey of medicinal plants used by folk medicinal practitioners to treat cattle diseases in randomly selected areas of Bagerhat district, Bangladesh. American-Eurasian Journal of Sustainable Agriculture 4(3):386-396.

Sanford WW. 1969. The distribution of epiphytic orchids in Nigeria in relation to each other and the geographic location and climate, type of vegetation and tree species Biological. Journal of the Linnean Society 1(3):247-285.

Sinmez ÇÇ, Aslim G, Yasar A. 2018. An ethnoveterinary study on plants used in the treatment of dermatological diseases in Central Anatolia, Turkey. Journal of Complementary Medicine Research 8:71-84.

Sommer V. 2011. Primates of Gashaka: Socioecology and conservation in Nigeria's biodiversity hotspot. Berlin Springer, p. 450.

Suroowan S, Javeed F, Ahmad M, Zafar M, Noor MJ, Kayani S, Javed A, Mahomoodally MF. 2017. Ethnoveterinary health management practices using medicinal plants in South Asia - a review. Veterinary research communications 41(2):147-168.

Tabuti JR, Dhillion SS, Lye KA. 2003. Ethnoveterinary medicines for cattle (Bos indicus) in Bulamogi County, Uganda: plant species and mode of use. Journal of Ethnopharmacology 88(2-3):279-286.

Tadesse B. 2014. Survey on Ethno-Veterinary Medicinal Plants in Selected Woredas of East Wollega Zone, Western Ethiopia. *Journal of Biology, Agriculture and Healthcare 4*:97-105.

Tefera BN, Kim YD. 2019. Ethnobotanical study of medicinal plants in the Hawassa Zuria District, Sidama zone, Southern Ethiopia. Journal of Ethnobiology and Ethnomedicine 15(1):25.

Tamiru, F, Terfa, W, kebede, E, Dabessa, G. 2013. Ethnoknowledge of plants used in veterinary practices in Dabo Hana District. West Ethiopia Journal of Medicinal Plant Research 7(40):2960-2971.

Tariq A, Mussarat S, Adnan M, AbdElsalam NM, Ullah R, Khan AL. 2014. Ethnoveterinary study of medicinal plants in a tribal society of Sulaiman range. The Scientific World Journal 2014:127526.

Tekle Y. 2015. Medicinal Plants in the Ethno Veterinary Practices of Bensa Woreda, Southern Ethiopia. Open Access Library Journal 2:1-12.

Tilahun M, Etifu M, Shewage T. 2019. Plant diversity and ethnoveterinary practices of Ethiopia: A systematic review. Evidence-Based Complementary and Alternative Medicine 2019:1-9.

Tuo K, Bolou GE, N'docho AF, Chevillot A, Mammeri M, Vallee I, Adjou J, Toure AO, Polack B, Jambou R. 2020. Ethnobotanical Study of Plants Used in Traditional Treatment of Diarrhoea in Humans and Cattle in Two Regions of Ivory Coast. European Journal of Medicinal Plants 31(16):24-33.

Verma RK .2014. An ethnobotanical study of plants used for the treatment of livestock diseases in Tikamgarh District of Bundelkhand, Central India. Asian Pacific Journal of Tropical Biomedicine 4(1):S460-S467.

Wazala W, Zessin KH, Kyule NM, Baumann MPO, Mathias E, Hassanali A. 2005. Ethnoveterinary medicine: a critical review of its evolution, perception, understanding and the way forward. Livestock Research for Rural Development 17:11.

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 16:46.

Yigezu Y, Haile DB, Ayen WY. 2014. Ethnoveterinary medicines in four districts of Jimma zone, Ethiopia: cross sectional survey for plant species and mode of use. BMC Veterinary Research 10:76.

Yukawa T. 2004. *Conservation Status of Threatened Japanese Indigenous Plant Species. In Japanese Botanical Gardens and Future Initiatives.* Japan Association of Botanical Gardens Magazine 38:39-44.

Zieba FW, Yengoh GT, Tom A. 2017. Seasonal Migration and Settlement around Lake Chad: Strategies for Control of Resources in an Increasingly Drying Lake. Resources 6(3):41.