Ethnoveterinary Practices of Medicinal Plants and Non-plant Remedies Used in Animal Health Management in Dawuro Zone, Southern Ethiopia

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Research

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Abstract

Background: Ethnoveterinary medicine is frequently used for treating various livestock diseases by many different ethnic groups in Ethiopia. To this end, the indigenous knowledge of medicinal plants and non-plant remedies has not been systematically documented and studied in the Dawuro zone. Therefore, a community based cross-sectional study design was conducted from November, 2017 to September, 2018 in order to identify and document medicinal plants and non-plant remedies used in animal health management.

Methods: Relevant information on ethnoveterinary practice was collected from purposively selected 115 key informants using semi-structured questionnaire, focus group discussions, observations and field guided walk methods. The obtained data were analyzed using descriptive statistics, quantitative ethnobotanical methods and t-test and significantly test was set to $p< 0.05$. The plants claimed having medicinal value were collected and botanically identified.

Results: The study revealed 103 plant species belong to 47 families and 11 non-plant remedies used to manage 36 different livestock ailments. Family Asteraceae accounted for 11.5% of the total species recorded. The majority of plants (56.2%) were harvested from wild habitat. Herbs (33.8%) were the main source of medicine followed by tree (30.6%). Leaves (43.6%) and roots (27.5%) were the main plant parts used while pounding was the major form in remedy preparation. The highest Informant Consensus Factor (0.83) value was scored for the disease of the reproductive system. Significant difference ($P<0.05$) was observed in average number of therapeutic plants reported by illiterate higher than literate groups. *Cyphostemma flavicans* (Baker) Desc. and *Pentas schimperi* were showed the highest Fidelity Level (100%) to treat disease of the reproductive system, and emaciation and bone fracture as plant materials whereas Bear faeces, sharp hot iron or wire/knife, and common salt were non-plant remedies used in the study area.

Conclusion: The study revealed that the local community of in the study areas was used with a rich of indigenous knowledge of ethnoveterinary medicinal plants. The loss of valuable medicinal plant resources of the area calls for urgent and coordinated actions to develop conservation strategies.

Background

Livestock industry provides for a major source of livelihood for many people worldwide in providing milk, meat, skin, manure and traction, particularly the rural poor in developing countries [1]. In Ethiopia, the economic benefits from livestock production remains low due to prevailing diseases which are among the principal bottlenecks of livestock performance and cause of high economic losses to resource poor farmers [2,3,4]. Modern veterinary services are not well developed, and the modern drug availability is inadequate to fight animal diseases in Ethiopia [5,6]. According to Wabe *et al*. [7,8] the majority of livestock keepers in Ethiopia are far away from animal clinic stations. The inadequate funding at the national level for the prevention and control of animal diseases adds to the burden, especially among pastoralists who live in the remote arid and semi-arid lowland parts of the country; and treatment cost. The studies of Edwards *et al.* [9] and Yirga *et al*. [10] estimated that the traditional remedies are sometimes the only source of therapeutics for nearly 90% of livestock in Ethiopia of which 95% are plant origin.

The indigenous people of different localities in the country have developed their own specific knowledge of plant resource uses, management and conservation [11]. In the same way, Ethiopia has a glorious tradition of health care system based on plants, which dates back to several millennia [12]. Ethiopian farmers and pastoralists rely on traditional knowledge, practices and plants to control livestock diseases [13,14], and have used traditional medicines for many centuries due to cultural acceptability, efficacy against certain diseases and economic affordability [15]. On the

other hand, some of the non-plant materials reported to be used by the Fullani pastoralists include wood ash, honey, oils, kerosene, kaolin, potassium, local soap, and spent engine oil which they believe are effective in ethnoveterinary management. They use spent engine oil in the management of wounds, kerosene for foot rot, and local soap as disinfectant in animals [16].

The studies of [17] pointed out that the impact of antimicrobial resistance is considerable with treatment failures associated with multidrug-resistant bacteria and it has become a global concern to public health, and the effectiveness of modern pharmacotherapy is still limited by the cost of treatment. Therefore, developing a socially acceptable and effective remedy from inexpensive resources that can complement modern medicine would be an attractive option [8]. However, traditional veterinary medicine like all other traditional knowledge systems is handed down orally from generation to generation and it may disappear because of rapid socio-economic, environmental, technological changes and as a result of cultural heritage under the guise of civilization [18], and limited written records of ethnoveterinary were encountered. Similarly, in many cases, individuals who are knowledgeable in traditional practices usually try to keep the knowledge secret and remain unwilling to openly teach to others. This is considered as a problem causing a loss of knowledge to the country, because such traditional peoples are becoming fewer and fewer in number [14,19]. According to [20] the studies conducted on the traditional remedies used in animal health care in Ethiopia are inadequate when compared with the multiethnic cultural diversity and the diverse flora of Ethiopia. The greatest concentrations of medicinal plants are found in the south and southwestern parts of the country following the concentration of biological and cultural diversity.

Moreover, the loss of valuable medicinal plants resource due to population pressure for settlement, agricultural expansion, which is aggravated by deforestation, burning forest, overgrazing and over harvesting is widely reported by different researchers in Ethiopia [19,21,22]. Thus, concerted ethnoveterinary research plays a vital role to document information on plants and related indigenous knowledge for conservation and sustainable utilization in the study area. Such documents are important to define and maintain cultural identity of the people, establishing people-centred natural resource management and potential for development of novel drugs stated by [19].

To the best of our knowledge, comprehensive and systematic study was not conducted on the use of ethnoveterinary medicinal plants and non-plant remedies in livestock health management in the Dawuro zone. Therefore, the aim of this study is to document indigenous knowledge of the people on ethnoveterinary medicinal plants; and their preparation and application methods used by traditional healers in the management of animal health problems in the Dawuro Zone. It also aims to identify non-herbal materials validated by fidelity level, and documented to add useful new remedies to the traditional veterinary medicine. The study could be used as a basis for phytochemical and pharmacological studies and identification of useful plants of the area for conservation.

Methods

Description of the study area

The present study was conducted in Dawuro zone, Southern Ethiopia. The zone is located between 6^0 59'- 7^0 34' N of latitude and 36^0 68'-37^0 52' E of longitude. It is bordered with the Oromia region in the northwest, Kembata Tembaro zone in the northeast, Wolaita zone in the east, Gamo Gofa zone in the south, and Konta Special woreda in the west. The Tarcha is the capital town of the zone that is about 491 km of Addis Ababa across Jimma and 319 km away from Hawassa. The altitude varies from 550-2820 meter above sea level with average maximum and minimum temperatures in the range of 22.5–30.3°C, respectively. Annual rainfall of the zone is reaching up to 1201– 1800 mm per year. The total population of the zone is 655,101, from this 599,096 is the rural population, which directly depends on agricultural activities for domestic use and exchange of commodities with urban residents [23,24]. About 41% of the zonal land is

lies under woyna dega (midland), kolla (lowland) covers about 38% and dega (highland) constitutes 21% of the total agro-ecological zones [23,25].

The present study was conducted in three selected districts of Dawuro zone: namely, Tocha, Loma, and Mareka. The map of study area districts as presented in (Figure 1). The majority of the people live in rural areas, and their livelihood is based on a mixed crop-livestock production system. The major crops cultivated in the districts were teff, barley, wheat, maize, sorghum, field pen, horse bean, lentils, pea bean, slite, telba, caster seed, groundnut, yam, sweet potato, potato, and cassava [25,26].

The term “Dawuro” is used to refer to both the people and their land. The indigenous people inhabiting the area belong to the Omotic ethnic group. Their language is “Dawurotsuwaa” which belongs to the Omotic language family. Dawuro’s southern, eastern, and northern strategic border positions were enclosed by vigorous defensive walls. The walls stretched from the borders of Gofa in its southwestern direction and extended to the borders of Wolaita, Kembata, Hadiya and Jimma zones in its northwestern direction [27,28]. About 57.71% of the people in Dawuro zone belongs to Protestants, 31.86% practiced Ethiopian Orthodox Christianity, 4.61% embraced Catholicism, and 4.9% observed others [23,24].

The diversified climate, topography, waters and forest resources in the zone have attributed a wide range of environments for supporting varieties of fauna and flora. Chebera-Churichura National Park was established since 1997 E.C at the standard of the National Park which is a place of perfect beauty located in Dawuro zone with aims to protect the wild animals and conserve biodiversity from major threats such as illegal hunting of wild animals, resettlement, wild fire and deforestation. The park is unique in its highly heterogeneous and hilly terrain, few flat lands, undulating to rolling plains with incised river and perennial streams, valley and gorges [23]. There are five small-sized lakes located at the south-east, west, north-west and north of the Park. The Park has rich faunal biodiversity, which consists of 37 species of large mammals, eighteen species of small mammals, and 137 bird species. The dominant vegetations grown in the zone include *Olea europaea L., Juniperus procera*, *Maessa lanceolata, Podocarpus falcatus*, *Hagenia abyssinica*, *Croton macrostachyus, Eucalyptus* spp., *Prunus africana*, and *Arundinaria alpine* [23,29].

Indigenous knowledge of local peopleand the status of veterinary services in the study area

The people of the study area give great value for their animal healthcare. The community expressed the value of their animal health by using different traditional animal health care systems. The local people exploit their shared knowledge in order to manage different animal health problems at home by using different medicinal plants in found their vicinity and non-plant remedies before looking for other options regardless of the type of ailment and its severity. Those homemade traditional herbalists are called “Wogaa D’aliya Eranchchaa” or Hilanchcha” in the local language which translated as ‘traditional practitioner’ or “healer”.

The livestock population in the zone was estimated to 1,277,482 heads of cattle, 646,704 sheep, 466,280 goats, 41,327 horses, 70,810 donkeys, 70,551 mules, and 970,263 poultry. According to the Zone Livestock and Fisheries Development Department, there are about 4 animal health clinics and 17 health posts in the zone, which are being run by 240 animal health professionals (4 Doctors of Veterinary Medicine, 200 animal health professionals and 2 animal health technicians) [24,30]. Surprisingly, these clinics are poor in their facilities. In addition, the livestock sector faces with various problems like inadequate funding, lack of skilled manpower, lack of veterinary infrastructures like standardized veterinary clinic, laboratory, and heath posts. As the zone size and livestock population, the health services do not match and unable to support this major economic sector. Animal diseases remain among the principal constraints of livestock health and production in the study area. Due to these reasons, the local people in the area have

long been dependent on the ethnoveterinary practices accessed from their vicinity and non-plant original experiences to manage various animal health problems.

Study design

A community based cross-sectional study design was conducted with individual survey to assess and document the current status of the indigenous knowledge of community about medicinal plants and non-plant remedies. Relevant data were collected from the community by using semi-structured questionnaires, supplemented by an in-depth interview with the herbalists, and field observations were conducted. Specimen vouchers have given on the spot for each plant species and later identify using taxonomic keys in the relevant volumes of the flora of Ethiopia.

Selection of informants

In this study, a total of 115 key informants (107 males and 8 females) were purposively selected from three districts (Tocha, Mareka and Loma) based on the wide use of ethnoveterinary practices and availability of traditional healers. Selection of informants was performed according to [31] who stated that when recording indigenous knowledge controlled by ethnobotanical healers or by certain social groups, the choice of key informant is vital. The selections of the informants were carried out with the collaboration of districts and local governmental bodies, and community elders based on their rich indigenous knowledge and long-term experience on medicinal plants for animal disease management.

Ethnoveterinary data collection

Ethnoveterinary data were collected from November, 2017 to September, 2018. The face-to-face interview was made by using pre-tested semi-structured questionnaires prepared in English and was translated into “Dawurotsuwaa” local language. Medicinal plant samples were collected in blooming stages annually with the objective of collecting plant specimens during the respective flowering seasons. A questionnaire, interview addressed questions like local names of medicinal plants, ailments treated, habit of the species, marketability, sources (wild/cultivated or both), parts used, other ingredients or additives (if any), methods of preparation, dosage formulation, routes of administration, noticeable side effects of remedies, use of antidotes for side effects, taboos/beliefs related to collection and restriction on use of plants, source of knowledge, ways of indigenous knowledge transfer, and non-plant remedies. Other information, including the age, gender, level of education, occupation, and religion, background of informants were recorded. Each informant was separately interviewed in their local languages in order to keep the secrecy of their indigenous knowledge, for local appropriateness and easiness in approaching the study objectives.

In addition, 14 focus groups (one focus group per kebeles with an average number of 6-10 participants) discussions were undertaken to gain further information on medicinal plant knowledge of the community and prove the reliability of the data collected through semi-structured interviews [31,32]. Field trips were made with local herbalists for the collection of the reported medicinal plants. Voucher specimens of medicinal plants were collected in the field with the help of traditional healers and field assistants. Collected medicinal plants were dried, numbered, pressed and labeled were brought to the Ethiopian Herbarium for further botanical identification. Specimen identification and confirmation were undertaken by using Flora of Ethiopia. Finally, the specimens were deposited at the National Herbarium (ETH) in Addis Ababa University.

Ethical consideration

This study was approved by the Ethical and research review Board of Office of Jimma University, College of Agriculture and Veterinary Medicine. A brief discussion was held with the selected Districts governmental bodies and informants

prior to data collection in explaining the main objective of the study. In addition, the consent of each respondent was asked verbally to participate in the study. This was done in order to acknowledge informants' cooperation in preserving the traditional knowledge of the study area and build their confidence for providing reliable information. Consequently, the confidentiality of their traditional property owners was completely maintained during data collection.

Data management and analysis

Ethnoveterinary data were entered and coded using MS Excel, and was transferred to the Statistical Package for Social Sciences Software (SPSS) versions 20. A descriptive statistical method such as percentage, frequency and tables were employed to analyze and summarize the data on medicinal plants of species and families of ethnoveterinary medicinal plants, their growth forms, parts harvested; methods of preparation and routes of administration. Preferences ranking of ethnoveterinary plant species used to treat the commonly reported livestock ailments in the study area were ranked by adding the values/scores of preferences given by respective informants so as to identify the most-preferred medicinal plant species to treat the most frequently reported disease type in the area following the relevant standard methods [31,32].

Informant Consensus Factor (ICF) values [33,34] were calculated to determine the most important livestock ailment categories in the Districts and identify potentially effective medicinal plant species in respective disease categories. Accordingly, reported traditional remedies and corresponding livestock ailments occurring in the zone were categorized into six disease categories and the Informant Consensus Factor values were obtained by computing number of use citations in each disease category (Nur) minus the number of times species used (Nt), divided by the number of use citations in each category minus one.

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

Where, Nur = number of use reports from informants for a particular plant-use category; Nt = number of taxa or species that are used for that plant use category for all informants.

In this study, the fidelity level analytical approach was also used in evaluating the plants and non-plant remedies in the study area. The fidelity level is mathematically expressed as FL = Ip/Iu × 100, where FL is the fidelity level of each plant or non-plant material, Ip is the number of informants who mentioned that a plant or non-plant material has specific ethnoveterinary uses against a particular disease condition, and Iu is the total number of key informants who independently suggested that the same plant or non-plant material has any therapeutic uses [34,35]; and t-test with significantly test was set to $P < 0.05$, was used to evaluate significant differences in the mean of medicinal plants reported by different genders, ages and education levels.

Results

Socio-demographic profiles of respondents

A total of one hundred fifteen (115) key informants were interviewed; of which one hundred seven (93%) were males and eight (7%) were females. The age of male informants with a mean age of 5.34±2.44 years and female informants with a mean age of 5.63±3.98 years. The number of plants reported by females was ranging from two to eight and males from 2 to 29 medicinal plants. The average number of medicinal plants reported by males (5.53±3.74) was the same as females (5.88±2.10), and the difference was not significant ($p > 0.05$). The average number of plants reported by young to middle aged informants ($23 \leq 39$) was 5.34±2.44, old informants ($40 \leq 90$) were 5.63±3.98, and the

difference was not significant ($p > 0.05$). The average number of plants reported by illiterate informants was 4.69±2.43, a literate (completed at least primary education) was 6.57±4.50, and the difference was significant ($p < 0.05$). The difference among the study districts and different agro-ecology in the number of medicinal plants reported by each informant was not significant ($p > 0.05$). Regarding occupation, none of the informants practice traditional medicine as their only source of income. Most of the healers are farmers.

Indigenous knowledge and diversity of ethnoveterinary plants in Dawuro zone

The present study showed the rich knowledge of medicinal plants in Dawuro zone that was indicated by the number and diversity of medicinal plants reported. In this study, ethnoveterinary knowledge was acquired from different sources which include parents, friends and elders. Oral transfer of traditional knowledge of medicinal plants (90.4%) was the major source of knowledge acquisition; only 1.7% acquired knowledge through documenting and 7.8% kept secret their knowledge. The comparison between use frequency of medicinal plants and synthetic drugs showed that up to 50.4% of informants had frequently used the plants, especially for certain diseases which could not respond to modern drugs like mastitis and listeriosis; Just 45.2% answered that they use alternatively (both medicinal plants and modern drugs), and 4.3% confirmed that they depend on the modern antibiotics.

The local community utilizes a total of 103 ethnoveterinary medicinal plants belonging to 47 families and 11 non-botanical remedies for the treatment of 36 different livestock ailments. The reported medicinal plants and their respective indications, use-value, preparation and plant parts used for extraction of medicines as presented in (Table 2). Among all the families, Asteraceae was found to be dominant (13 species, 11.5%) been in uses as remedies in the study area followed by Fabaceae (8.8%) and Solanaceae (8.4%), respectively. Regarding the type of plants, there were more of the herbs (33.8%) followed by tree (30.6%), shrub (27.5%) and climbers (8.1%). About 56.2% of medicinal plants were harvested from the wild environment, whereas 34.3% of cultivation and the remaining 9.5% were claimed to be collected from wild and cultivated sources. Different factors are claimed to be the major threats affecting medicinal plant resources of the area include deforestation (reported by 89% of informants), agricultural expansion (80%), charcoal production and firewood collection (33% collectively) and overgrazing (29%).

Common livestock ailments and application of traditional remedies in the study area

In this study, a total of 36 veterinary ailments were identified in the study area for which informants reported to use one or more plant species to treat specific livestock ailments which categorized into infectious, non-infectious (grain overload, bloat and constipation), diseases of respiratory system, diseases of reproductive system, ectoparasites infestation and other ailments (bone broken, snake biting, trauma, poising and emaciation and fattening). A majority of (63.6%) veterinary ailments reported by the informant belongs to infectious, followed by other ailments (13.3%) as presented in (Figure 2). Out of total ailments,
blackleg is the most common livestock disease locally called “S’okka” (18.0%) followed by
trypanosomiasis “Goloba” (15.1%) (Table1).

Ethnoveterinary medicinal plants of the study area were affirmed to be applied for ailments affecting cattle, sheep, goats, equines, poultry and dogs. The majority of the medicinal plants (81.55%, 84 species) were found to be applied to treat one or more of the thirty-two (32) different cattle, sheep and goats’ ailments. A relatively few species (3.88%, 4 species) were mentioned to be used against poultry and equine ailments and the remained 14.56% (15 plant species) were used for all animals in common. Regarding to treated animal species, the highest medicinal plants used for 89% cattle followed by 3.35% sheep, 3.2% equines, 2.2% poultry, 0.9% goats and 0.5% dogs, respectively.

Most ethnoveterinary medications (93.4%) were claimed to comprise remedial parts of a single plant species. However, 6.6% was prepared using formulations from more than two plant species. Amongst all plants used as medicine, the

highest proportion of species was reported to treat blackleg (18.0%) and trypanosomiasis (15.1%), respectively. The highest number of multiple ethnoveterinary uses was recorded for *Capsicum frutescens* (treated against 12 ailments) and *Croton macrostachyus* and *Lepidium sativum* (10 ailments each) as presented in Table (2). Although different plant parts were reported to be used for treatment preparation by the community, commonly used plant parts are presented in Figure (3).

Preparation, routes of administration, and dosages variation of medicinal plants

Various methods of remedy preparations were reported to be used in the districts based on the type and severity of livestock diseases. Pounding the part in wooden or stone-made mortar and pestle, and homogenizing it with water is found to be the major method of preparation (77.88%), followed by crushing (7%) presented in Figure (4).

Traditional plant remedies are reported to be administered through oral, topical, nasal, fumes/smoking or auricular routes of the diseased animal. Oral application is reported to be the best-represented route of administration (72.35%), followed by nasal (16.11%), topical (9.64%), 1.26% fumes/smoking and 0.6% auricular routes. The results showed that traditional practitioners reported use of plastic jugs, glasses, bottles, cups, syringe, and gourd traditionally called “Buliyaa” to measure dosage for some medicinal recipes while others use a handful or numbers. About 58.3% practitioners use approximately to treat their animals.

Informants Consensus Factor (ICF), Fidelity Level, and Preference ranking of medicinal plants

Test for evaluation of medicinal plants, six major livestock ailment categories were identified from the total 36 veterinary ailments reported in the Zone. Highest Informants Consensus Factor (ICF) values were recorded for respiratory disease (0.83), infectious (0.78) and ectoparasites (0.74) categories presented in Table (3). In addition, highest plant use citation (57.34%) was recorded for infectious diseases.

Regarding Fidelity Level value, *Cyphostemma flavicans* (Baker) Desc. and *Pentas schimperi* showed the highest fidelity level value (100%) for reproductive disease; and fattening and bone fracture (Table 4).

Preference ranking exercise with 15 randomly selected key informants for medicinal plants that were reported to be used against Blackleg, the most frequently reported livestock disease under the infectious disease category, showed that *Azadirachta indica* and *Eucalyptus globulus* L. were most-preferred species to treat the reported disease (Table 5).

Non-plant remedies used in animal health management in the Dawuro zone

In this study, the community depend on traditional medicines due to primary healthcare system during outbreak and ailments rise, easy availability of medicinal plants, comparative effectiveness, inadequate modern drugs and veterinary infrastructures, long distance to clinic stations, affordability and low cost. The traditional non-botanical ethnoveterinary practices used in managing other cattle disease conditions are presented in (Table 6).

Discussion

Medicinal plants used in ethnoveterinary practices in Dawuro zone

The importance of livestock in mixed farming systems is indicated by the numerous indirect effects of animal diseases in the study area and at country whole. Animal diseases are a major constraint to income generation and asset acquisition by the poor, since poor people have limited cash to pay for disease treatments [2-4,36]. To manage this problem livestock keepers, particularly in rural areas frequently uses traditional remedies to get solutions for their ill-

health animals. Ethnoveterinary remedies are mainly made from plants, but also from animal body parts and by-products, kerosene, oil, common salt, and soaps [8,37-41].

Indigenous people in Dawuro zone are dependent on livestock is for supporting their livelihood. Medicinal plants have a vital role in the treatment of livestock's health problems in the area. Identification of specific livestock ailment types in the area was found to be made based on indigenous knowledge of symptoms and corresponding livestock illnesses held in the memories of local people. Similar was found true in selecting medicinal plants which were thought to be most appropriate to manage different veterinary health problems [19,42].

The rich knowledge of ethnoveterinary medicinal plants in Dawuro zone that was indicated by the number and diversity of plants reported. The results showed that there was no significant difference in the average number of plants reported either by female or male respondents indicated that both men and women members of the community have good ethnoveterinary knowledge. However, discordant to this finding, men had more knowledge of plant usage because they are naturally selected during childhood to be apprentices of ethnoveterinary practices [19,43,44,45]. In this study, the knowledge regarding the treatment of animal ailments did not show any difference between the age groups. In other studies, however, it was observed that the number of medicinal plants reported was increased with age, and the older informants reported more medicinal plants than younger individuals [46-49]. This could be related to a higher degree of cultural contact and experience of the elderly members with curative plants than that of younger members in the community. Comparison of medicinal plant knowledge held among community members of varying education level showed significant difference ($P<0.05$) in plant use by illiterate informants reported significantly more medicinal plants over literate ones. This was also observed in other ethnoveterinary survey [44,49,50].

In the present study, 90.4% of traditional healers responded that they acquired their knowledge from their parents or close relatives. Moreover, the traditional healers have a very high intention to keep their ethnoveterinary knowledge secrete and unwillingness to transfer their knowledge freely to new generations. In line with the present study, other studies have reported that the highest medicinal plant knowledge acquisition by the healers was from parents or close relatives and they have a very high intention to keep their traditional knowledge secret elsewhere in Ethiopia [14,49,51-54], and other countries [1,34,41,42] share a similar concern on the knowledge gap down generations in different cultural groups. On the other hand, deforestation (reported by 89% of informants) for agricultural expansion, charcoal production, firewood collection; and overgrazing (29%) were claimed as major factors affecting medicinal plant resources among the Dawuro society. Similarly, [19] reported that deforestation was principal threat to medicinal plants in Ankober area.

A total of 103 plant specimens having medicinal value were botanically classified and distributed into 34 families. In this study, the best representation of plant species having ethnoveterinary medicinal value was found in Asteraceae with 13 species has the highest species followed by Fabaceae (11 species), Lamiaceae (9 species) and Euphorbiaceae (7 species), respectively in the area. In line with this study, Asteraceae, Fabaceae, Lamiaceae and Euphorbiaceae, have also been reported as dominant families in other studies [55,56]. Moreover, herbs were the most commonly used plant habit in the study area. However, discordant to this finding, shrubs have been used as the most important ethnoveterinary medicinal plants in the other part of the country [57,58-61].

The degree of ethnobotanical richness of the Dawuro zone based on the number of plant species and medicinal uses per informant is higher compared with the studies conducted in Ethiopia [2,10,14,40,62], in Brazil [50], South Africa [63,64], Pakistan [34,65], and India [56,58]. This could reflect a cultural conservation in the ethnobotanical and medical knowledge in the area, as suggested by the relatively high number of species reported by single informants. The millennia-old interaction of indigenous people in the area within the vicinity available medicinal plants might have enabled them to develop an indigenous knowledge system best fit to select and use diverse curative medicinal plants to

treat frequently occurring livestock diseases. The study of [19] pointed out that knowledge on plant use is the result of many years of human interaction and selection of the most desirable and successful plants present in the immediate environment at a given time.

Traditional medicinal plants used by the people in Dawuro zone are also used in other parts of the country and other African countries as reports indicate. This has been proved by botanical identifications of the plant species and comparison with the reports of other scholars elsewhere. The studies commonly reported, examples *Croton macrostachyus* and *Ricinus communis L.* recorded for the Gilgel Ghibe area and Borana pastoralists [2,52]; *Syzygium guineense, Buddleja polystachya and Amaranthus caudatu*s L., reported for peoples of Ejaji area (Chelya Woreda) [60]; *Indigofera oblongifolia* Forsk and *Solanum incanum* L. used in Afar region [49]; *Vernonia amygdalina* Del., and *Juniperus procera* L. reported for Ankober district of Amhara region [19]; while *Withania somnifera* L., *Azadirachta indica* L. and *Allium sativum* L. recorded for Hills of Eastern Ghats, India [61]; *Ximenia americana* L.*,* and *Withania saminfera* L. recorded for the South Africa [64]; and *Erythrina abyssinica* and *Jatropha curcas* reported for Western Uganda [66]. The similarity could be common share of their cultural and traditional practices, and the distribution/availability of the species in use in the areas explored for their ethnoveterinary knowledge.

However, certain new plant species were used by Dawuro people compared to other studies conducted in Ethiopia, which are used as a treatment for different livestock diseases [2, 10,14,19,62,67,68,69]. *Clausena anisate, Clutia abyssinica, Solanecio mannii, Dracaena steudneri, Cyphostema* sp.*,Arisaema enneaphyllum, Haplocarpa* sp.*, Cynoglossum coeruleum, Colocasia esculenta* L.*, Lycopersicon esculentum* mill*,* and *Oxytenanthera abyssinica* were newly identified and reported plants used to treat the most prevalent animal health problems reported in the study area*.* The reason could be related to the age-old ethnoveterinary experiences of traditional healers and dominant vegetation of these species in the area.

The leaves were found to be the most harvested plant parts, followed by roots in remedies preparations. Our finding consistent with previous reports in Ethiopia and elsewhere [50,60,70-73]. This could be explained by traditional beliefs of the community about leaves having no difficulty in collection, preparation, and the main site of photosynthesis that could be a possible reason for their effectiveness and efficacy against animal health problems. However, in contrast to this study [19,73,74] have found that the root is as the most used part in their studies. The difference could be as the pharmaceutical value and concentration of active ingredients in each plant variety depending on climatic and edaphic factors. People inhabiting different ecological zones use different plants and plant parts in their treatment arsenal stated by [2,54]. The dominant practice of harvesting majority (56.2%) of ethnoveterinary plants of Dawuro zone is from wild sources. This would indicate the degree of anthropogenic pressure exerted on wild plant resources of the area. Overdependence on wild resources together with reduction of the wild resources due to ever-increasing population pressure poses a threat to medicinal plant riches of the area. Comparable trends in overharvesting medicinal plants from uncultivated sources were also reported in other parts of Ethiopia [19,43,51,52,69,76], in Pakistan [65,77], and Brazil [50].

About 93.4% ethnoveterinary medications were reported to comprise remedial parts of a single medicinal plant in the present study, which is in agreement with the findings of studies conducted elsewhere in Ethiopia [78,79]. However, 6.6% of the traditional medications were also prepared using formulations from two or more ethnoveterinary medicinal plant species either similar or different parts of the plants for treating livestock ailments may be attributed to the expected synergistic effect of combinations of parts and their bioactive ingredients to treat ailments. The therapeutic efficacy of combinations of medicinal plant parts used by other people living in northwest Ethiopia for treating various ailments has also reported by [33,79].

In this study, some medicinal plants were used to treat more than two ailments, while others are used to manage one ailment. The highest number of multiple ethnoveterinary uses were recorded for *Capsicum frutescens* (treated against 12 ailment types) and *Lepidium sativum* (10 ailment types); however, in contrast to this study, [19,51] have found that *Allium sativum* and *C. guianensis* were highest number of multiple ethnoveterinary uses, respectively.

Pounding the remedial part in wooden or stone-made mortar and pestle; and homogenizing it with cold water was found to be the most common method of local drugs extraction (78.8%), which is in line as documented in other studies [19,60,80] who reported pounding the remedial part and homogenizing it with water was found to be the major mode of remedy preparation. However, it is generally believed that the potency of the treatments can be enhanced when used in concoction form described by [34]. Oral (72.35%) administration is reported to be the best-represented route of administration as in the finding of [81,82] who reported oral as the most commonly used administration routes of medicine used in Eastern and Western Ethiopia. It is also in agreement with the result of various ethnobotanical studies conducted elsewhere in Ethiopia [19,80,83] which indicates oral as the predominant route of administration used by the herbalists. Besides, the majority of herbalists were administered the preparations for three consecutive days or keep treating until the animal recovers if the disease is not acute case.

Most of the recipe was prepared using a single plant in different formulations and administered in different routes depending upon the type of the disease needed to be treated as reported by (78,79,81]. Even though healers used various units of measurements to estimate doses of local medicines such as numbers (e.g., for seeds, fruits,), and cups and glass (e.g., for water during preparation and liquid form of the prepared medicine), plastic jugs, bottles, syringe and guard local called ”Buliyaa“, no strictly standardized doses of herbal preparations as known for modern veterinary medicine were reported by traditional healers for any of the preparations used to treat livestock ailments in the present study areas. The same findings were also reported from other studies conducted in different parts of the world [34,50,65,72,84] who found that the lack of precision and standardization in traditional prescriptions of livestock traditional medicine. Hence, further studies on the active ingredients and their dosage measurements in ethnoveterinary preparations scientifically required as to guide their application.

The highest percentage of (63.4%) medicinal plants were used to treat cattle ailments could also be related to long experience rearing of cattle and the most prevalent diseases affecting cattle populations in the area. In a similar observation, Lulekal *et al.* [19] indicated that the largest use of ethnoveterinary plants for treating cattle ailments in Ankober District, Amhara Region. However, *Sida schimperiana* and *Artemisia annua* L. are being used as medicinal plants for treatment of rabies in dogs. The utilization of relatively few medicinal plants for treatment of poultry, small ruminants, equines and dogs could be associated with the low perception, the low occurrence of diseases affecting and less experience of the herbalists to these species. Like numerous reports on medicinal plants in Ethiopia [14,19,85], this study revealed also that infectious diseases like trypanosomiasis and blackleg were the most cited by informants. Listeriosis and coenuruses were treated by plant species which were uncommon to the usual list of medicinal plants from Ethiopia. The eight species *Jatropha curcas, Carduus chamaecephalus, Datura stramonium, Arisaema enneaphyllum, Pycnostachyus abyssinica, Becium obovatum, Justica schimperiana,* and *Glycine wightii*, showed to heal listeriosis and coenuruses in cattle and sheep.

Values Informant Consensus Factor (Fic) of different use categories of illnesses from this study showed that Fic values of reproductive system, infectious diseases, ectoparasite infestation and miscellaneous (snake biting, poising, bone fracture, fattening and constipation) categories were much higher than Fic value of the two illnesses (non-infectious and respiratory problems). This indicates that people had a greater agreement for plants used to treat diseases related to reproductive problems, infectious diseases and ectoparasite infestations. Consistent with this study, the highest share of similar plant use information within a community for disease of reproductive system and infectious category

of [34]; however, in contrast to this study, Lulekal *et al*. [19] have reported that high ICF in the gastrointestinal disease category in their studies.

The present study determined different plants like *Cyphostemma flavicans*, *Pentas schimperi*, *Eucalyptus globulus* L., *Croton macrostachyus*, and so forth, scored highest fidelity values and should be further subjected to phytochemical and pharmacological investigation to prove their medicinal efficacy. The highest FL might be related to which the cited plant species has more healing power contributed to the presence of bioactive compounds for the respective ailments. Analysis of the preference ranking exercise also indicated that *Azadirachta indica* and *Eucalyptus globulus* L. were the most preferred ethnoveterinary medicinal plants used to treat blackleg, the most commonly reported disease in the study area. This could be attributed to the presence of bioactive compounds against the causative agents of blackleg in these species.

Non-ethnobotanical remedies used in animal disease management

The study found that other products than plants used by the Dawuro people in animal health management. In no case was the whole animals used, but rather body parts or by-products such as, the products and parts of a porcupine, hyena, cattle, bear and aphids (insects) were used by the community in ethnoveterinary practices. Eleven (11) non-plant remedies were used as source of veterinary therapeutic agents include hyena faece, wood ash, honeydew, oils, kerosene, local soap, salt, porcupine meat, dear faece, sharp hot iron or knife, milk, fermented kocho, porridge and the end product of *Ensete ventricosum* fluid traditionally called “Zaalima”. Porcupine meat and honey dew (aphids by product) are by far the main source of veterinary remedies: used to treat blackleg.

Nearly similar ethnoveterinary studies conducted elsewhere [35,39,92,93,94] share a similar concern on the knowledge of non-medicinal plant practices found that sharp hot iron or branding for treatment of blackleg and inflammation due to trauma, minerals from bones and salt are used to treat nutritional deficiencies, appetite promotion, and vegetable oil for managing bloat and dermatomycosis. However, hyena feaces, wood ash, dear faeces, porcupine meat, fermented kocho (C’aalaa unc’c’a), the end product of local kocho fluid (Zaalima), and honeydew were new or rarely reported non-plant remedies used in ethnoveterinary medicine in Ethiopia. The study undertaken by [92] indicated that traditional knowledge on the use of animals in traditional medicine (ethnomedicine or folk veterinary medicine) needs to be approached as an integrated and holistic structure by various branches of science in order to achieve a truly interdisciplinary understanding of the phenomenon of traditional medicine.

Generally, the documented ethnoveterinary remedies were the promising sources for the discovery of new low-cost drugs that are harmless to the environment and could help in conservation of biodiversity. Also, this study could help for program planners and policy makers to design their development strategy for animal health care policies and food sustainability; and overall socio-economic development of the poor rural people through cultivation and conservation of potential medicinal plant species in the area.

Conclusion

The results of this investigation revealed that the study area has plenty of medicinal plants and non-plant remedies used to treat a wide range of livestock health problems. The average informant consensus factor of (0.614) is high indicating that different treatments are cited for different ailments and the degree of agreement was high. Knowledge of traditional practitioner has to be encouraged and protected from the wrong perception. Strong government policy support, creating successful awareness and training to the herbalists in particular and local community in general to grow medicinal plants which promote sustainable utilization, conservation and application is very crucial. Progressive efforts are vital to integrate modern veterinary health care with ethnoveterinary medicine. Further researches need to be

conducted to validate the biological ingredients and test the safety, efficacy, and toxicity since herbal preparations are crude.

Declarations

Ethics approval and consent to participate

Prior to conducting the study, verbal consent was obtained from all participants. No additional ethics approval was required.

Consent for publication

This manuscript does not contain any individual person's data and further consent for publication is not vital.

Availability of data and materials

The raw data contain the list of all informants' name, and cannot be public in this form.

Competing interests

The authors declare that they have no conflict of interests

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Author's contributions

TD performed field data collection, carried out the main survey work and prepared first draft of the paper. FB, and TT were separately providing constructive comments to develop final draft of the paper. All authors involved, read and approved the final manuscript.

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Tables

Table 1 List of common livestock health problems in the study area

Ailments treated	Local name	No of respondents	%	Rank
Blackleg	S'okkaa	103	18.0	1
Trypanosomiasis	Gollobaa	86	15.1	2
Emaciation	Gilk'aanne d'iikuwa	37	6.47	3
Internal parasitism	Uluwa gus'uniya	36	6.3	4
Anthrax	S'ilkiya	32	5.6	5
Tick	Dank'uwa	30	5.3	6
Bovine Pastueriollosis	Miizzaa Shulullaa	29	5.1	7
Leech	Ulletsaa	26	4.6	8
Diarrhea	Gusuwa	19	3.3	9
Bloat, Hematuria /babesiosis	Shifiraaruwa/zaaguwa, Zuluwa/wuliwushshaa	18	3.2	10
Foot and Mouth Disease	Maassiya	16	2.8	12
Listeriosis	Biic'uwa hargiya	14	2.5	13
Mastitis/evil eye	D'antsaa harggiya/Asayfiya	13	2.3	14
Ovine pastueriollosis, Tsetse fly infestation	Dorsaa shulullaa, Gollobaa ahiya uduns'iya	10	1.8	15
Coenurosis, Bone broken	Dorsaa Yiic'uwa, Mek'etsaa me'uwa	8	1.4	17
Dermatophilosis and Lumpy Skin Disease, Lice, Rabies	Galbaa harggiya, C'uuchchaa, Wora kanaa hargiya	5	0.9	19
Arthritis, retained placenta, Snake bite, Newcastle Disease	Karshshuwaa, Guyyebaa/Du'aa is'uwa, Shoshshaa satsaa, Kuttuwa hargiya	4	0.7	22
African Horse Sickness, Epizootic lymphangitis, Eye disease, Wound	Paraa harggiya, Paraa bollaa d'uussaa, Ayfiya harggiya, Maytsaa	3	0.5	25
Kidney problem/urine retention, Trauma/yolk, Papillomatosis, Plant poising, Constipation, Coccidiosis/Poultry	Kilaahuwa harggiya or Sheeshsha is'uwa Sadiyan gakiya qohuwan, Dad'd'uwa, Mitsaa marziya, Uluwa meluwa, Kuttuwa gusuwa hargiya	2	0.4	29
Grain overload	Katsaa darssi muussaa	1	0.2	34

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone

Scientific name	Family name	Local name	Part	Type	Preparation	Route	Veterinary uses	Voucher number
Clerodendrum myricoides	Lamiaceae	Algaa	L, R	S	Pounding and mix with salt	O	Heamaturia/Babesiosis, Fattening, Blackleg	DZ10
Croton macrostachyus	Euphorbiaceae	Ankaa	R, L	Tr	Dried and powdering, direct apply	Tp, O	Blackleg, Wound healing, Snake bite, Leech, Bloat, Listeriosis/encircling disease, Constipation, Bovine pastueriollosis, GIT parasitism, Heamaturia	DZ19
Artemisia annua L.	Asteraceae	Ars'imiiziya	L	H	Pounding and homogenizing with water	O	GIT Parasitism, Ovine Pastueriollosis, Rabies	DZ78
Jatropha curcas	Euphorbiaceae	Atiya	L	S	Pound and homogenize with water and thoroughly strained	O	Listeriosis/encircling disease	DZ98
Vigna sp.	Fabaceae	Bak'aliya haytsaa	L	Cl	Pounding	O	Leech	DZ70
Abrus precatoris	Fabaceae	Badalluwa	Sd	Cl	Roasted, powdered	O	Heamaturia/ Babesiosis, Snake bite	DZ79
Cyperus articulatus Linn	Cyperaceae	Bidaaraa	R	H	Pounding	O	Stomach ailments, Bloat, Arthritis (Both human and animal)	DZ7

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Nephrolepis undulata (Afzel. ex Sw.) J. Sm.	Davalliaceae	Bisaa	L	H	Cutting the leaf and place on the barn as bedding	as bedding	Tick expulsion	DZ45
Erthrina abyssinica	Fabaceae	Bortuwa	B	Tr	Pounding	O, Tp	Diarrhea, Tick, Lice	DZ34
Eriosema sp.	Fabaceae	Boshuwa	R	Cl	Chopped, pound, as bedding material	O	Blackleg, Tick, Lice	DZ66
Eucalyptus globulus L	Myrtaceae	Bootsa Baaliazaafiya	L, S	Tr	Pounding	O, N	Blackleg, Bovine Pastueriollosis, GIT Parasitism, Bloat	DZ65
Clerodendrum cordifolium	Lamiaceae	Boyye maataa	L	Cl	Pounding	N	Leech	DZ64
Cofe arabica	Rubiaceae	Bunaa/tukkiya haytsaa	L	S	Pounding and boil, decoction	O	Retained Placenta, Fattening	DZ51
Echinops kebericho	Asteraceae	Bursaa	R	H	Put together with *Hagnia abyssinica* on the fire, pounding	Fum/sk, O	Snake bite, Blackleg, Trypanosomosis, Bloat Arthritis (Karshuwa) (both human and animal)	DZ80
Premna schimperiana	Lamiaceae	C'aawula	L, S	Tr	Ground	O	Stomach ailment or Bloat (Both human and animal)	DZ8
Clutia abyssinica	Euphorbiaceae	C'ac'c'awuwa	L	S	Pounding	O	Fattening, GIT Parasitism, Leech	DZ27

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Clausena anisata (Willd.) Benth.	Rutaceae	C'iik'otiya/s'alk'imaallo	L	S	Pounding	O	Coccidiosis, NCD (poultry)	DZ52
Conyza pyrrhopapa	Asteraceae	D'oniya	L	H	Pounding	O	Edema, Kidney problem/urine retention, Stomach ailment or bloat	DZ48
Clutia abyssinica Jaub. Spach	Euphorbiaceae	Dada shooliya	Br	S	Pounding	O	Heamaturia/Babesiosis	DZ56
Sida rhombifolia L.	Malvaceae	Danduretsaa	L, Sm	H	Pounding	O	Fattening, Constipation	DZ15
Schefflera abyssinica (Hochst. ex A. Rich.) Harms	Araliaceae	Darguwa	Br	Tr	Pounding	O, Tp	Heamaturia/ Babesiosis	DZ76
Pentas schimperi	Rubiaceae	Dawuridamaa/Dalbantsaa	L, Sm	S	Pounding	O	Fattening, Bone broken, Appetizer, Constipation	DZ53
Lannea fruticosa	Annacardiaceae	Dechimarac'c'iya	R	Tr	Pounding	O, N	Bloat, Trypanosomiasis, Anthrax, Wound, Back leg, Arthritis (human and animal)	DZ90
Plectranthus ornatus	Lamiaceae	Dissaa	L, R	H	Pounding	O	GIT Parasitism, Arthritis (human and animal)	DZ82
Solanecio mannii (Hookf)C. Jeffery	Asteraceae	Don'arkiya	R	S	Wash slightly and Pounding	O	Blackleg	DZ11
Cyanthula cylindrical	Amaranthaceae	Dorsa k'archochcha/gumpullaa	R	H	Pounding	O	Anthrax, Blackleg, Dermatophilosis, Skin infection	DZ1

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Rhoicissus tridentata (L. f) Wild & Drummond	Vitaceae	Illallaa	L	Tr	Pounding fresh leaf	O	Snake bite, Epizootic Lymphangitis (Equine)	DZ73
Fiscas vastas	Moraceae	Esaa/Ettaa	Br	Tr	Pounding	O	Diarrhea, GIT Parasitism	DZ24
Carduus chamaecephalus	Asteraceae	Gezziya kashiya	R	H	Pounding	O, N	Listeriosis, Heamaturia/Babesiosis	DZ96
Amaranthas caudatus L.	Amaranthaceae	Gaggabaa	Sd	H	Roast and ground	O	Heamaturia/Babesiosis, bloody Diarrhea	DZ62
Vernonia amygidalina	Asteraceae	Garaa	L	Tr	Pounding and mix with salt	O, Tp	Trypanosomiasis, Fattening, Tsetse fly control, Lice	DZ16
Acacia sp.	Fabaceae	Garigaaruwa	L	Tr	Pounding	O, spraying	Bloat, Trypanosomiasis, GIT Parasitism, Wound	DZ5
Maessa lanceolata Forssk.	Myrsinaceae	Geggec'uwa	L, Sd	Tr	Pounding, grinding	O	Leech	DZ21
Dracaena steudneri Engler	Dracaenacae	Geggeluwa	R	Cl	Chopped, dried, powdering and mix with barely, *Lepidium sativum* and salt	O	GIT Parasitism, Body building, Trypanosomosis, AHS (Equine)	DZ75
Entada abyssinica	Fabaceae	Gelc'eec'aa	L	Tr	Dried, powdering	Tp, N	Wound, Leech	DZ25
Aloe otallensis Baker	Xanthorrhoeaceae	Godare uutsaa	L	H	Fresh leaf exudates, pounding, squeezing	Tp, N	FMD, Wound, Constipation, Bloat, Blackleg, Bovine Pastueriollosis	DZ74

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Gnewia mollis	Tiliaceae	Gomariya/Monok'uwa	Br	Tr	Enclose the bark with fiber and pound and then mix water	O	Constipation, Removal of foreign material	DZ29
Chenopodium murale L.	Chenopodiaceae	Goono Sibikkaa	Sd	H	Pounding	O	Blackleg	DZ55
Phytolacca dodcandra	Phytolacaceae	Hanc'c'ic'aa	Sd, L, R	S	Pounding, ground only 2 cup	N	Leech, Heamaturia/Babesiosis, tick, Blackleg	DZ37
Cyphostemma adenocaule (Steud. ex A. Rich.) Desc. ex Wild & Drummond	Vitaceae	Higishshaa d'aliya/Turaa	R	Cl	Wash and pound	O	Mastitis, Dermatitis, Dermatophilosis	DZ60
Cyphostemma flavicans (Baker) Desc.	Vitaceae	Higishsha d'aliya/Ba''o	R	H	Pounding and mix with milk	N	Mastitis, Promote milk yield, Dermatophilosis,	DZ72
Embelia schimperi Vatke	Poaceae	K'ank'k'uwa	Sd, L	S	Grinding	N	Blackleg, Tick, Tapeworm	DZ54
Momordica foetida schumach	Cucurbitaceae	K'ec'aa	L	Cl	Pounding	O, Tp	Bloat, Blackleg	DZ13
Piper nigrum	Piperaceae	K'unddobambbariyaa	L	Tr	Pounding	O	Blackleg, Abdominal pain	DZ4

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Buddleja polystachya	Luganiaceae	Kanfaaraa	L	Tr	Pounding together with *Piper capense*, *Eucalyptus globulus* L., *Justica schimperiana* and mixed with water	O	Fattening, GIT Parasitism, Blackleg,	DZ36
Echinops amplexcaulis	Asteraceae	Gad'aa kashiya/Wora burssa	R	S	Pounding	O	Anthrax, Snake bite, Emaciation/Fattening	DZ58
Sida schimperiana Hochst. ex A. Rich.	Malvaceae	Kindichchuwa	R, L Sm	S	Pounding, mixed with milk for dogs	O	Constipation in cattle, Rabies, as rabies vaccine in dog, Rickets in human, Blackleg	DZ50
Tragia sp.	Euphorbiaceae	Kinkilishuwa	R, L	Cl	Pounding and mix with water	O, N	GIT Parasitism, Snake bite, Fattening, Blackleg	DZ104
Ageratum conyzoides L.	Asteraceae	Kirkissaa/Puk'ak'iya	L	H	Pounding	O	Diarrhea, Blackleg, Leech, Promote milk and butter yield	DZ47
Carrisa spinarum	Apocyanaceae	Laadiya	R	S	Pounding	O	Blackleg	DZ107
Datura stramonium	Solanaceae	Lafilafuwa	L, Sm	H	Pounding	O	Listeriosis	DZ18

of ethnoveterinary medicinal plants used for treatment of livestock ailments (***Continued***)

Cucurbita pepo L.	Cucurbitaceae	Leekiya	Sd	H	Ground	O	Constipation, GIT Parasitism	DZ88
Ensete ventricosum (Welw.).cheeman	Musaceae	Looc'ingiya uutsaa	L	S	Chopped, direct feeding	O	Retained placenta	DZ71
Citrus aurantifolia	Rutaceae	Loomiya	Fr	Tr	Chopped, squeezing the juice	O	Blackleg, Bloat, Constipation, Coccidiosis/Poultry, GIT Parasitism, Emaciation/Fattening	DZ122
Brassica carinata A.Br	Brassicaceae	Maas'iya santsaa	L	H	Direct feeding	O	Retained placenta	DZ2
Arisaema enneaphyllum Hochst.exA. Rich. Rich	Araceae	Mahe mak'k'a/K'ols's'uwa/Babark'ee badalaa	L, R	H	Pounding	O, N	Listeriosis/encircling disease, Blackleg	DZ26
Sonchus sp.	Asteraceae	Maas'olliya	L, R	H	Pounding	O	Heamaturia/babesiosis, Gonorrhea (human)	DZ63
Calpurnia aurea (Ait.) Benth	Fabaceae	Mayluwa	R	S	Pounding	Tp, O	Tick, Lice, Fleas, Listeriosis	DZ32
Hypericum quartinianum A. Rich.	Hypericaceae	Migiraa	R	S	Wash thoroughly pounding	O	Blackleg	DZ69
Azadirachta indica	Meliaceae	Miimmiya mitsaa	L	Tr	Pounding	O, Tp	Blackleg, Tick, Lice, GIT Parasitism, Bloat, Wound	DZ12

of ethnoveterinary medicinal plants used for treatment of livestock in Dawuro zone (***Continued***)

Capsicum frutescens	Solanaceae	Mis'imis'uwa	Sd	H	Pounding, enclosed in the wilted inset leaf	O	Blackleg, Trypanosomosis GIT parasitism, Appetizer, Emaciation/Fattening, FMD, Grain overload, Kidney problem/urine retention, Bovine Pastueriollosis, Leech, Bloat, Mineral deficiency	DZ77
Plectranthus caninus	Lamiaceae	Mud'd'a/Gaalimentsuwa	L	H	Wilt the leaf in the fire, squeezing and tincture	Tp	Traumatic injury/yolk in oxen	DZ43
Ximenia caffra	Olacaceae	Mulahuwa	R	Tr	Pounding	O	Coccidiosis/poultry	DZ112
Syzygium guineen	Myrtaceae	Ochchaa	Br	Tr	Pounding	O	Stomach ailment, Arthritis, Trypanosomosis, GIT parasitism	DZ30
Lobelia giberroa	Lobeliaceae	Odooduwa	R	S	Pounding	O, N	Blackleg	DZ125
Acacia abyssinica Hochst. ex Benth.	Fabaceae	Odooruwa	Br	Tr	Pounding	O	Bloody diarrhea	DZ23
Rumex abyssinicus Jacq.	Polygnaceae	Oogi c'o'l''iya	R	H	Pounding	O, N	Heamaturia/Babesiosis	DZ61
Pycnostachyus abyssinica	Lamiaceae	Olomuwa	L	S	Pounding	O	Listeriosis/encircling disease	DZ40
Prunus africana (Hook. f) Kalkm.	Rosaceae	Ontsaa	Br	Tr	Pound and mix with water	Tp	Papillomatosis, LSD	DZ59
Carica papaya	Caricaceae	Paappaa	R	S	Pounding	O	Blackleg	DZ33
Withania saminfera L.	Solanaceae	S'eemushaa	L,R,Sm	H	Pounding	O, N Fum/sk	GIT parasitism, Diarrhea, Blackleg, Trypanosomiasis (Equine)	DZ155

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Juniperus procera	Cupressaceae	S'iiddaa	Sd	Tr	Pounding	O	Blackleg, Bloat	DZ9
Haplocarpa sp.	Asteraceae	S'okkaa d'aliya	R	H	Pounding	O	Blackleg	DZ39
Becium obovatum (E.Mey. ex Benth. in E. Mey.) N.E. Br.	Lamiaceae	Sa'a tuussaa/C'am'ashiya	R	H	Pound and mix with salt	N	Listeriosis/ encircling disease, Mastitis, Blackleg, Diarrhea	DZ31
Vernonia karagnensis	Asteraceae	Saggaa	L	Tr	Pounding	O	Bovine Pastueriollosis, Trypanosomosis, Blackleg	DZ35
Maerue oblongifolia	Capparidaceae	Sangaanaa	R, Br	S	Pounding	O, N	Bloat, Snake bite, Trypanosomosis, Stomach problem (human), Blackleg, Arthritis, Listeriosis	DZ68
Justica schimperiana	Acanthaceae	Sansalliya	L, R	S	Pounding	O	Listeriosis/encircling disease, Rabies, Blackleg	DZ41
Indigofera spicata Forssk.	Fabaceae	Sheekkaa/Dangarsak'uuruwa	R, Sm	H	Pounding	O	Arthritis, Stomach disease, Snake bite, Diarrhea (Both human and animal)	DZ3
Cynoglossum coeruleum Hochst.exA.DC.in DC	Boraginaceae	Shiddo	Sd	H	Collect the ripped seed, squeezing and apply on contaminated wound, pound	Tp	Contaminated wound, Tick	DZ20
Plectranthus sp.	Lamiaceae	Shooggaa/Shuyk'aa	Wp	H	Pounding	O	Fattening, body building (Emaciation)	DZ120
Brucea artidysentrica	Simaraubaceae	Shuushalliya	L, Sd	Tr	Pounding	N	Trypanosomosis, Epizootic Lymphangitis (equine), Listeriosis	DZ57

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Lepidium sativum		Sibikkaa	Sd	H	Grinding, mix the seed with butter and direct feeding(poultry)	O	Blackleg, Stomach disorder (human), Emaciation/Fattening, Mastitis, Diarrhea, Anthrax, Leech, Trypanosomiasis, Arthritis/Bloat, Coccidiosis/poultry)	DZ94
Hagenia abyssinica	Rosaceae	Soyd'uwa	Sd	Tr	Put together with *Echinops kebericho* on the fire	Fum/Sk,O	Snake bite, Bovine Pastueriollosis, Heamaturia/Babesiosis, Blackleg, Tapeworm (human)	DZ38
Linum usitatissimum	Linaceae	Talbaa	Sd	H	Grinding	O	Constipation, Emaciation/Fattening	DZ99
Nicotiana tabacum	Solanaceae	Tambuwa	L	H	Wilt on the sun/fire, pounding, make a bread	N, O	Leech, Emaciation/Fattening, Blackleg, Anthrax	DZ89
Colocasia esculenta L.	Araceae	Teebbiya boynaa	R, L	H	Pounding	N, O	Blackleg	DZ14
Lycopersicon esculentum mill	Solanaceae	Timaatimiya	L	H	Pounding	N	Leech	DZ87
Glycine wightii (Weight&Anu) Verde	Fabaceae	Toogguwa turaa	L	Cl	Pounding	N	Listeriosis/Babesiosis	DZ28
Allium sativum	Alliaceae	Tuummuwa	Bb	H	Pounding	O, N	Anthrax, Blackleg, Leech, Bloat, Arthritis (human and animal)	DZ102
Piper capense	Piperaceae	Tunjaa	Sd	H	Pounding	O	Blackleg, Arthritis (human and animal)	DZ9
Oxytenanthera abyssinica	Poaceae	Uusuuntsaa	L	S	Pounding	O	Diarrhea	DZ133
Tagetes patula L.	Asteraceae	Wontik'amma/Derek'aa	L	H	Pounding	Tp	Tick, Blackleg, Stomach problems	DZ67

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Arundinaria alpine	Poaceae	Wooshshaa	L	S	Pounding	O	Diarrhea	DZ6
Solanum incanum L.	Solanaceae	Wora buluwa	Fr	H	Chop the ripped one with sharp knife, remove seed through straining and use fruit fluid	N, O	Leech, GIT Parasitism, Bovine Pastueriollosis, Snake bite	DZ17
Zingiber officinale	Zingiberaceae	Yanjeeluwa	Rm	H	Pounding	N, O	Leech, GIT Parasitism, Trypanosomosis	DZ85
Gnidia involucrata Steud ex A. Rich.	Thymelaeaceae	Yesheeshshuwa	R	H	Pounding	O, N	Blackleg, Fattening	DZ46
Millettia ferruginea (Hochst.) Bak.	Fabaceae	Zaagiya	L	Tr	Pound and place on the river overnight and remove at morning	Tp	Leech, Tick	DZ44
Eucalphytus camaldulencis Dehnh	Myrtaceae	Zo'o balizaafiya	L	Tr	Pounding	O, N, Tp	Blackleg, Leech	DZ95
Ricinus communis L.	Euphorbiaceae	Zo'o S'eemaa	R	S	Wash thoroughly, pounding	O	Blackleg, GIT Parasitism	DZ42
Allium cepa	Alliaceae	Sunk'uruutuwa	Bb	H	Pounding	O	Heamaturia/Babesiosis, Lice, Tick, Detoxify toxin	DZ144
Bridelia micrantha (Hochst.) Baill.	Euphorbiaceae	Zuuziya	R, Br	Tr	Pounding	N	Mastitis, GIT Parasitism	DZ49

of ethnoveterinary medicinal plants used for treatment of livestock ailments in Dawuro zone (***Continued***)

Dichondra repens	Convolvulaceae	Ec'ere haytsa	R	H	Pound together with root of *Indigofora spicata*, *Sonchus* sp. and *Acacia* sp. leaf	O	Diarrhea, Snake bite	DZ100
Pentas lanceolata (Forssk.) Defiers	Rubaceae	Shid'i bid'aa	R	H	Pounding	O	Dysentery/bloody Diarrhea (both human and animal)	DZ200

Key: Plant parts; R = Root, Bb = Bulb, Br = Bark, Rm = Rhizome, Sm = Stem, Wp = Whole plant, Sd = Seed, Fr = Fruit
Plant types; H = Herb, Tr = Tree, S = Shrub, Cl = Climber
Routes; O = Oral, N = Nasal, Tp = Topical, Fum/sk=Fumigate/smoking
DZ = Dawuro Zone
Veterinary uses; AHS= Africa Horse Sickness, FMD= Foot and Mouth Disease, GIT= Gastro Intestinal Tract, LSD = Lumpy Skin Disease, NCD= New Castle Disease

Table 3 Informant Consensus Factor (ICF) values of medicinal plants for treating livestock ailments in Dawuro zone

No	Disease category	No. of plant sp.	% of all species	Use citations	% all use citations	ICF
1	Non-infectious	13	12.62	17	2.68	0.25
2	Infectious	81	78.64	363	57.34	0.78
3	Respiratory disease	11	10.67	17	2.68	0.375
4	Reproductive disease	7	6.8	36	5.68	0.83
5	Ectoparasites	24	23.3	89	14	0.74
6	Miscellaneous	33	32	111	17.53	0.71

ICF = Informant Consensus Factor

Table 4 Fidelity level (FL) value of medicinal plants commonly reported against a given veterinary ailment category.

No	Scientific name	Local name	Therapeutic category	IP	IU	FL%
1	*Azadirachta indica*	Mimmiyaa mitsa	Infectious/Blackleg	25	29	86.2
2	*Aloe otallensis* Baker	Godare utsa	Respiratory disease	9	11	72.72
3	*Cyphostemma flavicans* (Baker) Desc	Higishsha d'aliya	Reproductive disorders	22	22	100
4	*Dracaena steudneri Engler*	Gegelluwa	Equine GIT parasite	8	10	80
5	*Croton macrostachyus*	Anka	Wound and traumatic injury	20	22	90.9
6	*Ageratum conyzoides*	Kirkissa	Diarrhea and dysentery	9	11	81.81
7	*Capsicum frutescens*	Mis'imis'uwa	Internal parasitism	14	16	87.5
8	*Eucalyptus globulus* L.	Botsa barzaafiya	Infectious/Blackleg	22	24	91.67
9	*Pentas schimperi*	Dawuridama/Dalbantsaa	Fattening and bone broken	22	22	100
10	*Eriosema* sp.	Boshuwa	Infectious/Blackleg	10	17	58.82
11	*Vernonia amygdalina*	Gara	Trypanosomiasis and tsetse fly control	14	21	66.67

FL= the fidelity level, IP = the number of informants who mentioned that a plant has specific ethnoveterinary uses, IU = the total number of key informants

Table 5 Results of preference ranking of medicinal plants reported for treatment of Blackleg

Medicinal plants for treatment of Blackleg	Respondents															Total score	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15		
Maerue oblongifolia	4	5	6	5	5	4	3	3	4	4	5	6	5	6	4	69	4
Eriosema sp.	5	6	4	5	5	4	5	7	6	4	3	6	4	5	7	76	3
Azadirachta indica	7	5	6	6	7	5	6	5	7	7	6	5	6	7	5	90	1
Eucalphytus globules	6	4	6	5	6	5	6	5	6	5	5	6	5	6	6	82	2
Capsicum frutescens	1	2	1	1	2	3	2	3	2	3	3	1	4	2	1	31	7
Croton macrostachyus	4	3	2	4	5	6	7	4	5	6	4	3	2	1	5	61	5
Citrus aurartifolia	2	1	3	5	2	1	3	4	3	5	2	1	3	4	2	40	6

R= Respondents

Table 6 Fidelity level (FL) value of non-plant remedies used by the community to treat livestock ailments in Dawuro zone

S/N	Materials	Local name	Ethnoveterinary uses	IP	IU	FL (%)
1	Hyena faeces, wood ash	Babark'iya shi'aa, bidintsaa	Listeriosis, evil eye	8	10	88
2	Kerosene	Laambbaa	Tick expulsion	6	8	75
3	Dear feaces	Babantsaa shi'aa	Blackleg	5	5	100
4	Hot wire/knife	Ho'oo biraata/Mashaa)	Blackleg	10	10	100
5	Porcupine meat	K'us's'ariya ashhuwa	Blackleg	17	19	89.5
6	Milk	Maatsaa	Plant poising	6	6	100
7	Fermented kocho	C'aalaa unc'c'a	Stomatitis, Foot and Mouth Disease	5	10	50
8	Porridge and the end product of local kocho (*Ensete ventricosum (Welw.) Cheesman*)	Shendeerannee Zaalima	Antidotes, antitoxic for plant poising	8	9	88.9
9	Oil, soap	Zaayttiya	Blackleg, bloat	4	6	66.7
10	Honey dew	Degeriya eesaa	Blackleg	9	10	90
11	Common salt	Mas's'inniya/as'uriyaa	Mineral deficiency, fattening, appetite promotion	6	6	100

Figures

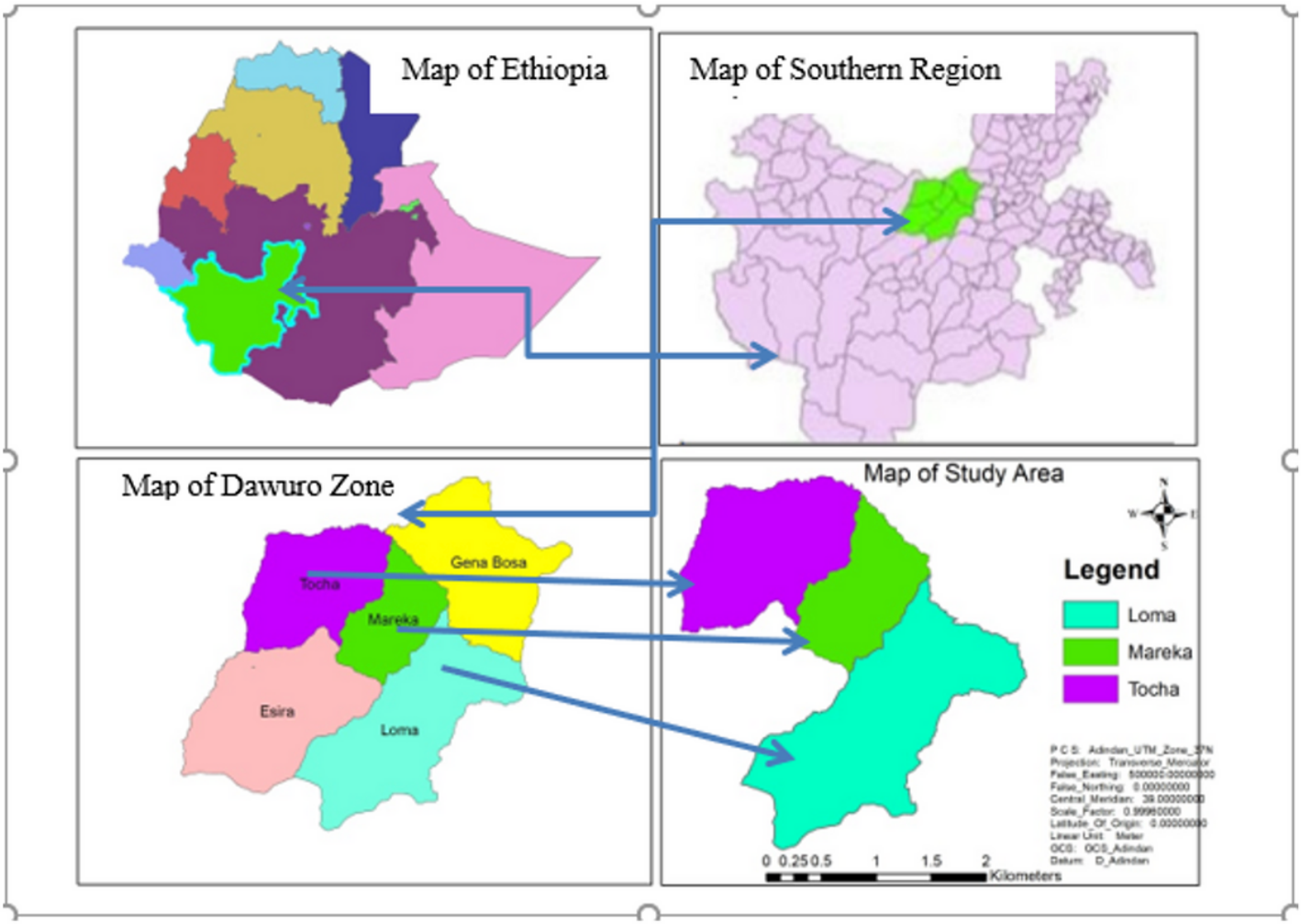

Figure 1

Study area map. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

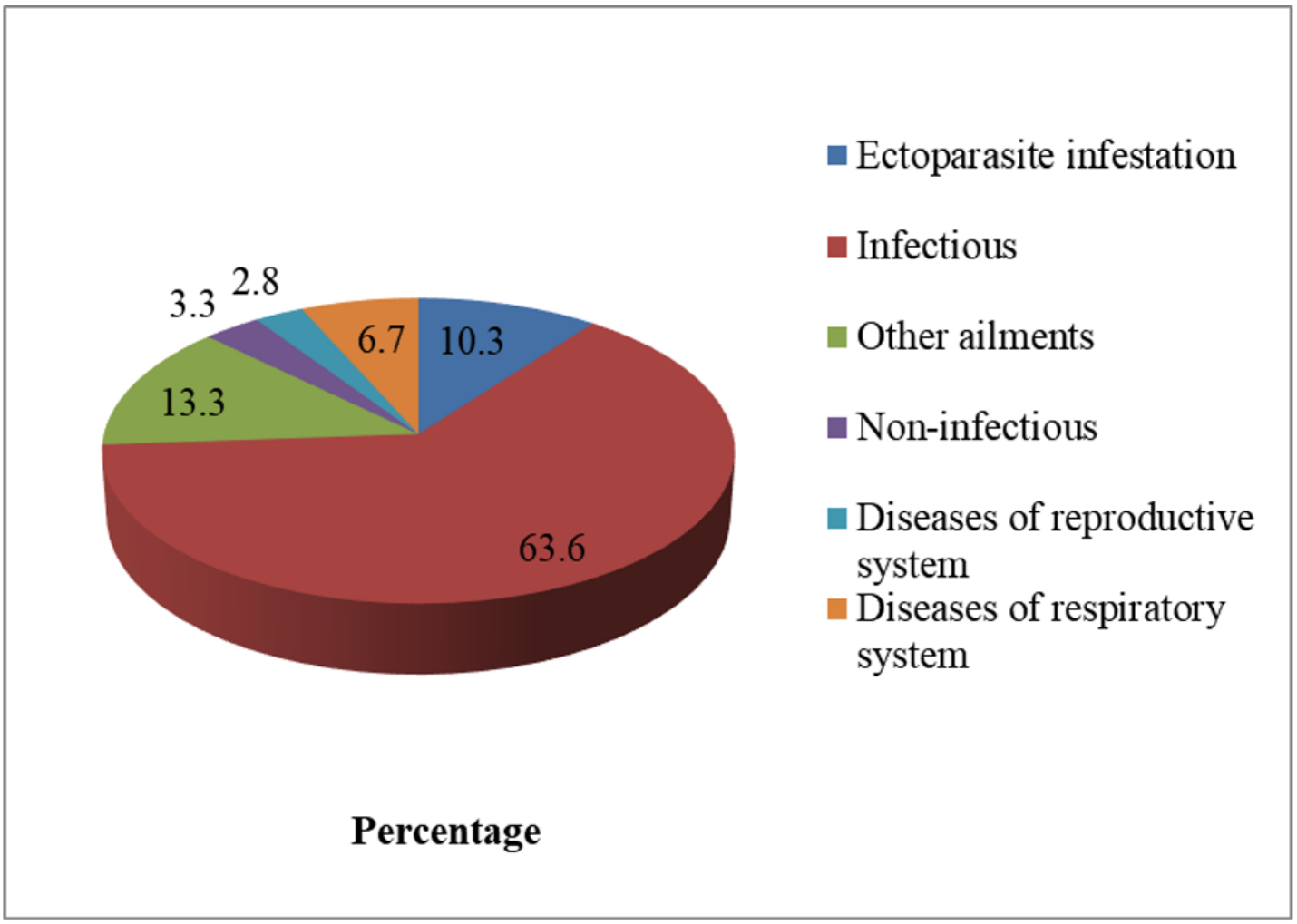

Figure 2

Livestock disease categories treated in the study area

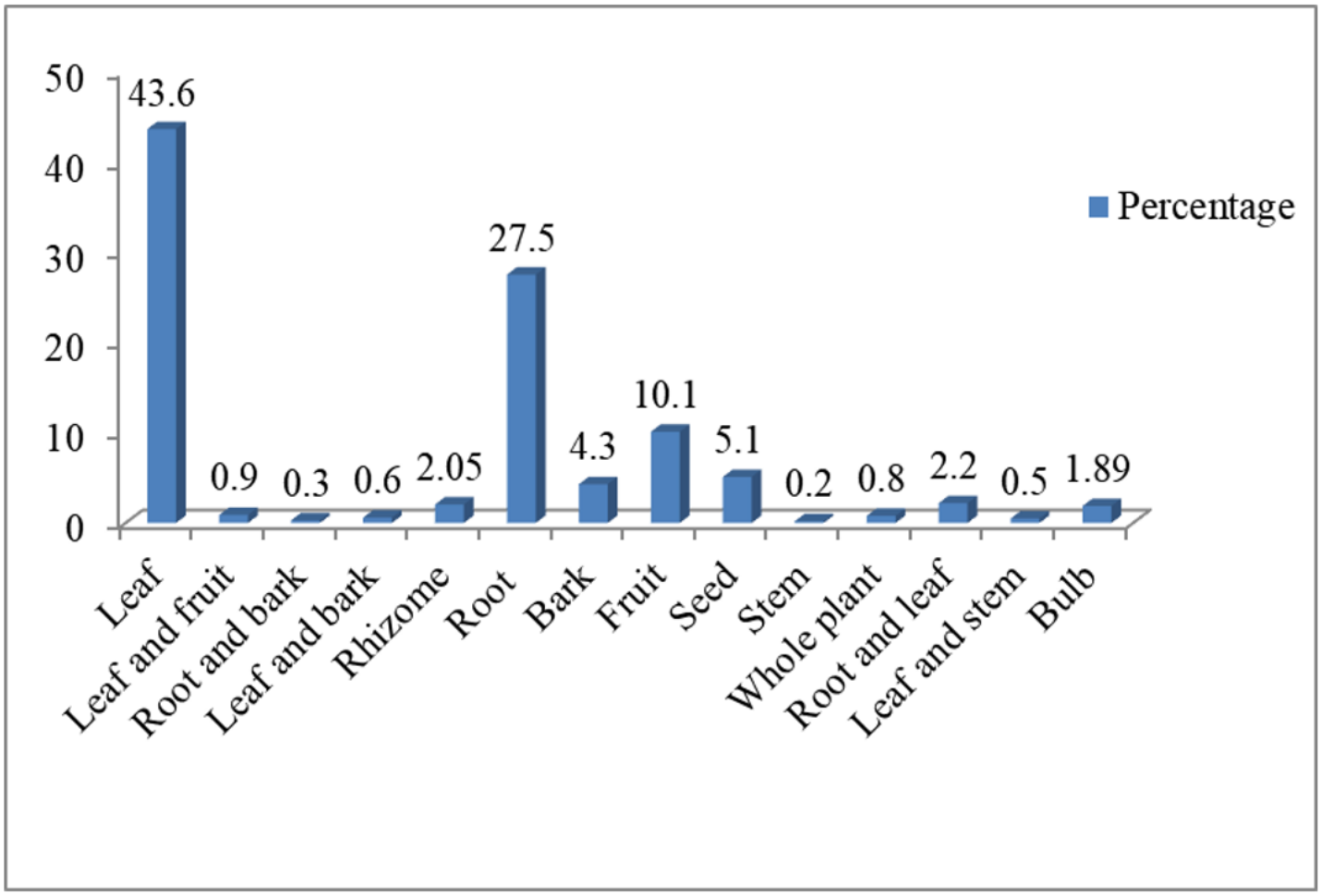

Figure 3

Percentage of different parts of plants for remedy preparation in Dawuro zone

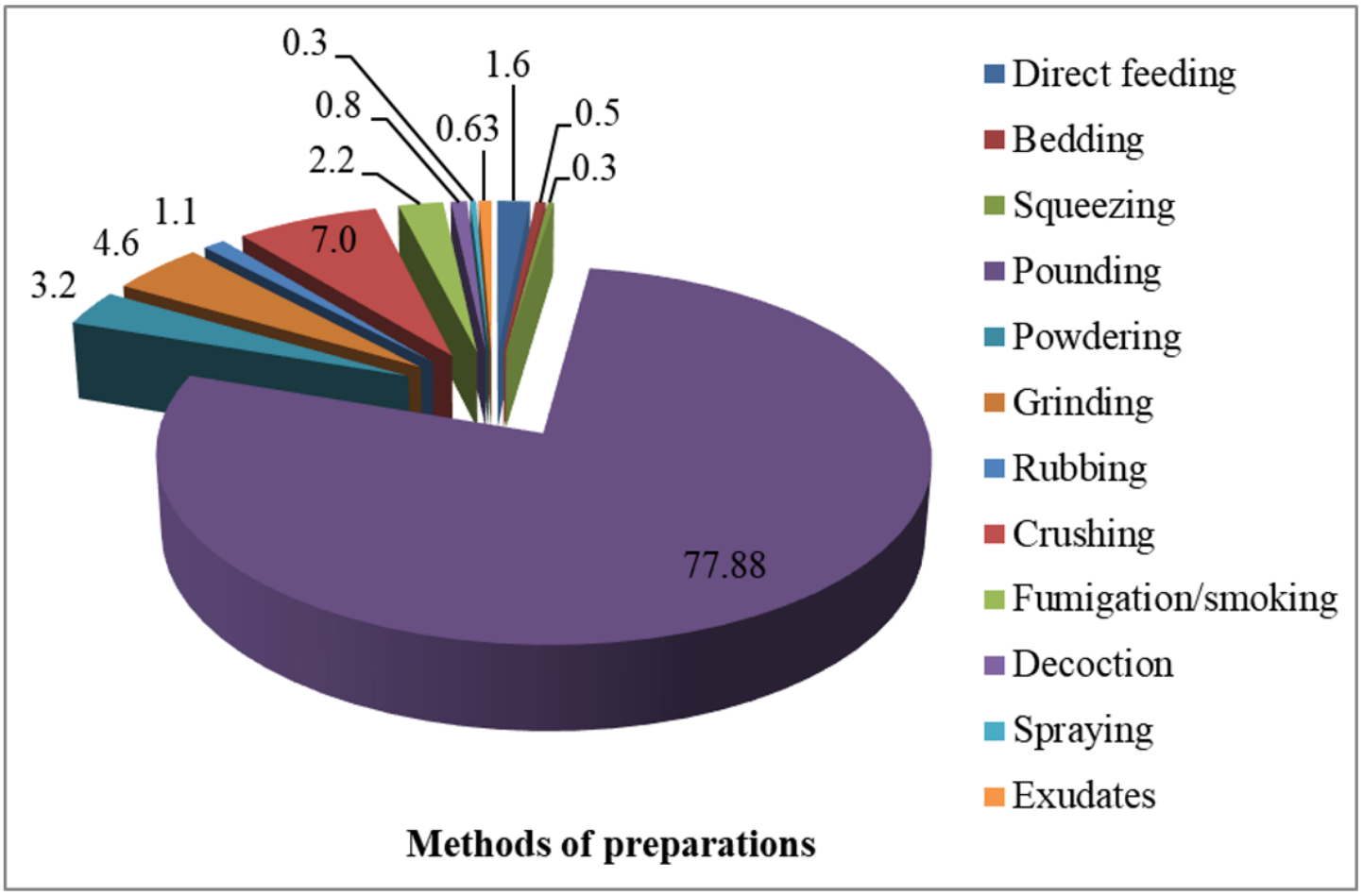

Figure 4

Methods of treatment preparation in the study area