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Ethno-veterinary medicinal plants and modes of their traditional application to cure animal ailments in Adaa'Liben district, Ethiopia

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ABSTRACT

Cross-sectional survey of ethno-veterinary medicinal plants was carried out from November 2016 to April 2017 in Ada'a-Liben district, Ethiopia. The purposes of the study were to identify and document medicinal plants, animal ailments treated by the medicinal plants, and modes of preparation of the medicinal plants for the treatment of animals in the study area. Rapid appraisal methods were used to gather relevant information to select study kebeles and identify the 31 informants including traditional healers. Information about the medicinal plants and their usage to cure various animal ailments were gathered through a semi-structured questionnaire, field observation, group discussion and market survey. Thirty one ethnoveterinary medicinal plant species belonging to 23 families were used to treat 24 livestock ailments in the study area. Among the medicinal plants, *Zingibera officinale, Solanium incanum, Withania somnitera*, and *Allium sativum* were used to treat blackleg and respiratory diseases whereas *Cypresnivies, Cordia africana, Celtisa africana,* and *Vernonia amygdalina* serve for deworming animals. Fresh moist medicinal plants (51.6 %, n = 16/31) were the most frequently used in preparing remedies comparing to dry plants (48.4 %, n = 15/31). The widely used plant part was leaf (51.6 %) followed by fruit, seed and root (each 9.7 %) and leaf/fruit/root mixed, seed/pods, leaf/seed/stem, leaf/root, stem and bulb (each 3.2 %). The modes of preparation of medicinal plant remedies were found to be chopping (35.5 %), grinding (25.8 %), crushing (19.4 %) , decoction and using medicinal plants without processing (6.5 % each), and socking and crushing/shopping (3.2 % each). The most widely used route of administration of these remedies was oral (77.4 %) followed by topical (19.4 %) and nasal (3.2 %). Eighteen species of the medicinal plants were used to traditionally treat more than one animal ailment while the remaining 13 were used to cure only one ailment each. Agricultural expansion was the highest threat for the ethnoveterinary medicinal plants (51.6 %, n = 16/31) followed by drought (19.4 %, n = 6/31), soil erosion and deforestation (9.7 %, n = 3/31 each). In conclusion medicinal plants and remedies derived from them are still important and readily available source of livestock health-care to rural people in the study area. Awareness creation work for traditional healers and further research on formal *in-vivo* and *in-vitro* experimental trails are suggested for a sustainable and efficient utilization of these medicinal plants.

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INTRODUCTION

The use of plants as medicine goes back to early man. Evidences of this early association have been found in the grave of a Neanderthal man buried 60,000 years ago. Pollen analysis indicated that the numerous plants buried with the corpse were all of medicinal value. The earliest known medical document is a 4000-year-old Sumerian clay tab let that recorded plant remedies for various illnesses (Kong et al., 2003). The recorded uses of plants as medicine are also found in Babylon around 1770 BC in the Code of Hammurabi and in ancient Egypt approximately 1550 BC. Among the remedies prescribed were mandrake for pain relief and garlic for the treatment of heart and circulatory disorder. In fact, ancient Egyptians believed medicinal plants to have uses even in the afterlife of their pharaohs. In 77 AD, the Greek surgeon Dioscorides published "*De material medica*", a catalog of about 600 plants in the Mediterranean. It also included information on how the Greeks used the plants, especially for medical purposes (Acharya and Anshu, 2008).

The various climatic and topographic conditions of Ethiopia contribute to a rich biological diversity. Ethiopia is believed to be home for about more than 6,500 species of higher medicinal plants with approximately 12 % endemism (Vivero et al., 2006). Although modern veterinary medicine usage is gradually growing in rural Ethiopia, many people are still using ethnoveterinary medicinal plants to treat their livestock ailments. This is attributed to the insufficient number of veterinarians, inadequate health facilities, and the high cost of most of the available drugs which is out of the reach of the farmers and pastoralists (Giday et al., 2003). Absence of response to some antimicrobial and parasitic treatment coupled with lack of adequate awareness to the usefulness of modern pharmacotherapy also compel livestock keepers particularly in rural areas to frequently visit traditional healers for getting solutions for their ill-health animals. Similar to all other parts of the country, majority of the community in the study area use traditional medicines for generations to treat human and livestock ailments. Still now the dependence on the traditional medicine is continuing because of its acceptability, accessibility and availability at little or no cost to the farmer. It is also believed that it is safe for it has been practiced for centuries.

The use of traditional healing systems has evolved over a long period of time and the knowledge of selection of plant species for their medicinal value is not obtained over night but after many trial and error practices. Those knowledgeable people don't easily transfer their knowledge on medicinal plants usage to community where they live. Instead, they want their knowledge to remain as secret and the knowledge of plant remedies remained in their hands (Giday et al., 2003). When the knowledge of healing by traditional medicinal plants is passed from generation to generation, the original and valuable information passed in an incomplete fashion (Elujoba et al., 2005). In addition, the knowledge is very often passed only verbally and most of this knowledge has not been comprehensively documented yet it is rapidly diminishing due to changing cultures (Kedir et al., 2012). Therefore, scientific research on medicinal plants enables to document the verbally passed knowledge and provides additional evidence to the present knowledge of medicinal plants which has been

handed down from generation to generation (WHO, 1998). In addition, research results provide scientific based evidences on the efficacy and safety of traditional medicinal plants before using them for therapeutic purposes. This is what the modern health professionals and some of the consumers ask for.

Thus, unraveling the information and documentation of ethno-veterinary medicinal plants, recording the indigenous ethno-veterinary medicinal knowledge, and associated skills, practices and beliefs pertaining to animal health care builds up a strong platform for further researches aimed at developing easily accessible and affordable medicines for animal ailments. However, such information is missing in some parts of the country. To the best of our knowledge, this study is the first of its kind in the study area. Therefore, the objectives of this study were to identify and document ethno-veterinary medicinal plants, the way medicinal plants are prepared and route of administration, and animal ailments treated by the medicinal plants in Ada'a-Liben district, Ethiopia.

MATERIALS AND METHODS

Description of Ada'a Liben district

Ada'a Liben district is one of the 12 districts in East Shoa zone and is located about 45 kms south-east of the capital Addis Ababa and is very close to the other major urban centers. The district covers an area of 1750 km2 , stretching east of the Bole International Air Port to the North West of the Koka dam. It is located at 38° 58′E to 39° 22′E longitude, 08° 22′N to 8° 56′ N latitude and at an altitude ranging from 1500 to over 2000 meter above sea level. Sedentary farming dominated by extensive type of management system is a feature of the highlands and midlands of the districts. The human population in Addis Ababa, Adama and Bishoftu create a large market for most agricultural commodities produced in the district. About 78 % of the household population who are over 10 years of age are engaged in full agricultural activities, 19.5 % in partial and 2.6 % in non-agricultural activities (Gebremedhin et al., 2013).

Study design and methodology

A cross-sectional study was carried out from November 2016 to April 2017 to identify and document the ethno-veterinary medicinal plants and the threats currently affecting medicinal plants in the study area. Rapid rural appraisal (Beebe, 1995) was made by conducting meetings with traditional leaders, elders, and the kebele administrators, and the state veterinary service officers at the beginning of the study to explain the purpose of the research and to gather relevant information that helps to select study kebeles (the smallest administrative unit of the country) and indentify the knowledgeable traditional healers in the study area. Thus, the study sites were selected based on the availability of traditional medicinal practice as per the recommendations of the elders and local authorities in the study area. In addition, the agro-climatic zones were taken into consideration to select the study sites (kebeles). Accordingly, six (Qaaxilla, Hiddi, Qaaliti, Gandagorba, Calalaqa, Caffee) out of 27 kebeles of the Ada'a Liben district were selected for ethnobotanical data collection. All the traditional healers in the selected kebeles were

included in the study. Ethno-botanical data were collected using semi-structured interviews, field observations, market observations, and group discussion.

Ethno-veterinary medicinal plant data collection

The semi-structure questionnaire was prepared and the interview was carried out according to the method of Cotton (1996). Field observation on the study kebeles including the market survey was done with the help of local guide and interpreter. At the time of observation, important points including culture of the community, market value and cultivation practices of the medicinal plants were recorded. Group discussions were made with 31 purposefully selected traditional healers and knowledgeable elders. The discussions were made at each study kebele in order to correct, harmonize and share the information among the respondents. Those smallholder farmers, traditional healers, and knowledgeable elders who were individually interviewed were members of the group discussion. Each group had five to seven members. The group discussion focused on the application of ethno-veterinary medicinal plants to cure animal ailments, parts of the plants that have medicinal values, methods of medicament preparation, routes of administration, and animal ailments treated by the medicinal plants. During the guided field walk, the traditional healers came together with the researchers to the place where the medicinal plants are found. They indicated local names and shared their ethno-medicinal knowledge, practice and beliefs on the medicinal plants. In addition, market survey and interview for herbal drug distributors and sellers was also made to distinguish the type of herbal drugs sold in the market and for which disease(s) they are indicated.

Moreover, semi-structured questionnaires were used to document knowledge and skills of traditional healers and knowledgeable elders about the plants used for treatment of livestock diseases. An interview was also held with a professional veterinarian to confirm diseases referred to by the farmers and traditional healers. Then, the medicinal plants were collected after recording all the important information obtained from the traditional healers and farmers.

In order to confirm the reliability of the information, each informant was contacted at least twice and if the responses that were given at different times contradict to each other, the information was considered to be unreliable and was rejected. In addition, reliability of the information was assessed and confirmed when information given by different informants on the same issue was similar.

Plant specimen collection and identification

Medicinal plant species were collected under the guidance of the traditional healers from the wild and home gardens. Pictures of the plants were taken with a digital camera. One specimen of each plant species was collected and pressed according to the methods of Fish (1999). The collected plants and the necessary recorded information were taken to the National Herbarium of Biology Department in Addis Ababa University, Ethiopia (Annex 1 & 2). After the specimens were taken to the Department, plant species were identified using taxonomic keys following protocol mentioned on The Flora of Ethiopia and Eritrea (Edwards

et al., 2000; Hedberg et al., 2006) and by making a comparison with the already identified specimens that were deposited at the Biology Department National Herbarium.

Data analysis

Descriptive statistical methods (Proportions or percentiles) were used to summarize the collected ethno-veterinary medicinal plants data. Microsoft Excel and SPSS (Statistical Package for Social Science) Version 20 software were used for the data analysis.

RESULTS

Informants and their characters

Out of the 31 informants, 27 (87.1 %) were male, whereas 4 (12.9 %) were females. Twelve (38.7 %) were traditional healers and 18 (58.1 %) were farmers (Table 1).

Table- 1: General characteristic of the informants at the study area

Variable	Character	Count/response	Percentage (%)
Sex	Male	27	87.1 %
	Female	4	12.9 %
Age	Young	3	9.7 %
	Adult	28	90.3 %
Educational status	Illiterate	21	67.7 %
	Literate	10	32.3 %
Marital status	Married	24	77.4 %
	Single	7	22.6 %
Occupation	Traditional Healers	12	38.7 %
	Farmers	18	58.1 %
	Others	1	3.2 %

Sources, type, and seasonal availability of medicinal plants

The data collected from the study sites showed that most of the ethnoveterinary medicinal plants were collected from the wild (n = 16/31; 51.6 %) and others were from home gardens (n = 15/31; 48.4 %). In addition, regarding the type of the plants, 13 (49.9 %) were herbs and 10 (32.3 %) were trees. Ethno-veterinary medicinal plants found in the study area were affected by season; many of the plants were available in every season (81.3 %, n = 28/31) while some are available seasonally (12.5 %, n = 2/31), and the rest are difficult to find at any season (6.3 %, n = 1/31).

Medicinal plant parts used as a medicament, mode of preparation, and route of administration

The study showed that the widely used plant part for the preparation of the remedies in the study area was leaves (51.6 %) and followed by other parts of the plant (fruit, seed and root) or a combination of these parts (Table 3). The study

revealed that the highest mode of preparation of medicinal plants for animal treatment was in the form of chopping (35.5 %); followed by grinding (25.8 %), crushing (19.4 %), and other methods (Table 2).

Table- 2: Modes of preparation of the ethnoveterinary medicinal plants for animal treatment

No;	Scientific name	Family name	Local name	Preparations
1	*Cypresnivies*	Cypraceae	Quunii	Grinding
2	*Euphorbia ampliphyllapex*	Euphorbiceae	Adaamii	Grinding
3	*Cordia africana*	Boraginaceae	Wadeessa	Chopping
4	*Achyranthes bidentata*	Amaranthaceae	Maxxaanee	Chopping
5	*Azadiracta indica*	Meliaceae	Mimii	Grinding
6	*Calpurnia aurea*	Fabaceae	Ziigixaa	socking
7	*Allium sativum*	Alliaceae	Qullubiiadii	Grinding
8	*Brassica carinata*	Brassicaceae	Gomeenzera	Chopping
9	*Ocimum lamifolium*	Lamifoliumceae	Masoobila	Decoction
10	*Celtis africana*	Ulmaceae	Ceekkata	Chopping
11	*Withania somnitera*	Solanaceae	Mimmiixa	Grinding
12	*Carrissa spinarum*	Apocynaceae	Hagamsaa	Crushing
13	*Coffea arabica*	Rubiaceae	Buna	Grinding
14	*Croton macrostachyus*	Euphorbiaceae	Makaniisaa	Grinding
15	*Dracaena steudneri*	Draceanaceae	Afarfattuu	Chopping
16	*Rhammus prinoides*	Rhamnaceae	Geeshe	Chopping
17	*Justicia schimperiana*	Acanthaceae	Dhumugaa	Chopping
18	*Nicotiana tabacum*	Solanaceae	Taamboo	Chopping
19	*Aloe vera*	Asphodeiaceae	Harmagusaa	Crushing/chopping
20	*Phragmanthera macrosolen*	Loranthaceae	Dheertuu	Chopping
21	*Ricinus communis*	Euphorbiaceae	Qobboo	Crushing
22	*Solanium incanum*	Solanaceae	Hiiddii	Grinding
23	*Achyranthes aspera*	Amarantaceae	Daarguu	Chopping
24	*Vernonia amygdalina*	Asteraceae	Eebicha	As it is
25	*Ocinum lamifolium*	Lamifoliumceae	Damakase	Crushing
26	*Carica papaya*	Caricaceae	Papaya	Crushing
27	*Sorghum bicolar*	Poaceae	Mishingaa	As it is without
28	*Citrus aurantifolia*	Rutaceae	Loomii	Crushing
29	*Vernonia auriculifera*	Asteraceae	Giraawa	Chopping
30	*Clausena anisata*	Rutaceae	Uluma'ii	Decoction
31	*Zingibera officinale*	Zingebiraceae	Jinjiibila	Crushing

Fresh moist medicinal plants (82.5 %) were the most frequently used to prepare remedies comparing to dry medicinal plants (17.5 %). The most widely used route of administration was oral, which accounted for 77.4 % followed by topical (19.4 %) and other routes (3.2 %) (Table 3).

Table -3: The use of ethnoveterinary plants for the treatment of animal ailments

i. Herbs

Scientific name	Local name	Part	Routes	Indications
Cypresnivies	*Quunii*	*Root*	*Oral*	*Deworming of equidae*
Euphorbia ampliphyllapex	*Adaamii*	*Stem*	*Topical*	*Blackleg*
Achyranthes bidentata	*Maxxannee*	*Fruit*	*oral*	*Blackleg, Mastitis and Bleeding*
Allium sativum	*Qullubbiiadii*	*Bulb*	*oral*	*Abdominal pain, Blackleg, Leech, Respiratory disease and Bloat*
Brassica carinata	*Gomeenzeraa*	*Seed*	*Oral*	*Bloat*
Ocimum lamifolium	*Masobiilaa*	*Leaf*	*Oral*	*Appetizer and Spice*
Withania somnifera	*Miimmiixaa*	*seed/pods*	*Oral*	*Abdominal pain, Bloat, Black leg, Respiratory disease, Leech infestation*
Rhammus prinoides	*Geeshee*	*Leaf*	*Oral*	*Leech and Tick infestation*
Aloe vera	*Harmaguusaa*	*Leaf*	*Topical*	*Weaning of calf*
Solanium incanum	*Hiiddii*	*leaf/root and fruit*	*Oral*	*Black leg, Respiratory disease and Dermatophilosis*
Ocimum lamifolium	*Damakaase*	*Leaf*	*Oral*	*Blackleg and 'Dingetegna'*
Sorghum bicolar	*Miishingaa*	*Seed*	*Oral*	*Retained placenta*
Zingibera officinale	*Jinjibiilaa*	*Root*	*oral*	*Blackleg, Respiratory disease, Abdominal pain and Leech*

ii. Trees, shrubs and climbers

Scientific name	Local name	Part	Routes	Indications
Cordia africana	*Wadeessa*	Leaf	oral	Deworming of equidae
Azadiracta indica	*Miimii*	Leaf	Oral	Blackleg, Trypanosomosis and Abortion
Calpurnia aurea	*Ziigixaa*	Seed	Topical	Lice infestation
Celtis Africana	*Ceekkataa*	Leaf	Oral/topical/nose	Lice infestation, Leech, Diarrhea and GIT parasite
Carrissa spinarum	*Hagamsa*	Root	Oral	Ring worm, Wound
Coffea arabica	*Buna*	Fruit	topical	Wound
Croton macrostachyus	*Makkanniisa*	Leaf	oral/topical	Ring worm, Bloat, Wound
Dracaena steudneri	*Afarfattuu*	Leaf	Oral	Rabies
Justicia schimperiana	*Dhummuugaa*	root/leaf	Oral	Black leg, Rabies
Nicotiana tabacum	*Taamboo*	Leaf	Oral	Leech infestation and Bloat
Phragmanthera macrosolen	*Dheertuu*	Leaf	Oral	Bloat, Blackleg
Ricinus communis	*Qobboo*	Friut	Oral	Retained fetal membrane, Rabies, Headache(human)
Achyrentes aspera	*Daarguu*	Leaf	Oral	Abdominal discomfort & Febrile disease
Vernonia amygdalina	*Eebiichaa*	Leaf	Oral	Increase milk production
Carica papaya	*Papayaa*	Leaf	Topical	Wound treatment
Citrus aurantifolia	*Loomii*	Fruit	Topical	Tick infestation and Wound
Vernonia auriculifera	*Giiraawa*	Leaf	Oral	Anti parasite and Abdominal pain
Clausena anisata	*Uluma'ii*	Leaf	Oral	Poultry Coccidiosis

Livestock diseases treated and plant families frequently used for the treatment

According to our findings, there are a total of 23 known livestock ailments/diseases in the study area, which are treated by traditional healers. Of the diseases, blackleg was treated by 32.3 % of the medicinal plants (n = 10), leech by 19.4 % (n = 6), bloat by 19.4 % (n = 6), wound by 16.1 % (n = 5), abdominal pain or colic by 16.1 % (n = 5), respiratory disease by 12.9 % (n = 4), GIT helminthes by 12.9 % (n = 4), ectoparasites by 12.9 % (n = 4) (Table 4).

Table -4: Livestock ailments and number of ethnoveterinary plants used to treat them

Diseases treated	Local name of the disease	No of ethnoveterinary plant used
Deworming of GIT helminthes	*Ciniintobeylada*	*2*
Wound	*Madaa*	*5*
Blackleg	*Abba gorba*	*10*
Ring worm	*Roobbii*	*2*
Abdominal Pain	*Garaaciinina*	*2*
Bleeding	*Lola'udhiiga*	*1*
Respiratory diseases	*Gororsaa*	*4*
Trypanosomosis	*Gaandii*	*1*
Mastitis	*Dhiita'uu guru*	*1*
Leech	*Ulaandhula*	*6*
Bloating	*Bokoksaa*	*5*
Dermatophilosis	*Gogaaharcaas*	*1*
Rabies	*Sareemaraatu*	*3*
Lice infestation	*Hinjiran*	*2*
Coccidiosis	*Mugsiisalukku*	*1*
GIT parasites	*Maxxantoota*	*1*
Diarrhea	*Garaakaasa*	*1*
Tick infestation	*Silmiihorii*	*2*
Fuminant ailment	*Dhukkubatasa*	*1*
Febrile disease	*Ho'iinsaqaama*	*1*
Delayed weaning of calves	*Harmaadhabsiisu*	*1*
To increase milk production	*Anaandabaluf*	*1*
Abortion	*Gatachiisa*	*1*

In this ethnoveterinary medicinal plant survey, thirty one medicinal plants species belonging to twenty three families were recorded in the study area. Of the plants Solanaceae and Euphorbiaceae families constituted the highest proportion (10.9 % n = 3/23 each) and followed by Rutaceae, Amaranthaceae, Asteraceae and Lamifoliumceae with the same proportion (7.3 %, 2/23 each), all the rest seventeen families constituted a proportion of 3.7% (n = 1/23 each) (Table 5).

Table- 5:Medicinal plant families frequently used by traditional healers

Family name	No of ethno-veterinary plant species used	Proportion (%)
Cypraceae	1	3.7 %
Boraginaceae	1	3.7 %
Apocynaceae	1	3.7 %
Euphorbiaceae	3	10.9 %
Amaranthaceae	2	7.3 %
Rubiaceae	1	3.7 %
Lamifoliumceae	2	7.3 %
Acanthaceae	1	3.7 %
Asteraceae	2	7.3 %
Poaceae	1	3.7 %
Caricaceae	1	3.7 %
Loranthaceae	1	3.7 %
Draceanaceae	1	3.7 %
Asphodeiaceae	1	3.7 %
Rhamnaceae	1	3.7 %
Ulmaceae	1	3.7 %
Meliaceae	1	3.7 %
Fabaceae	1	3.7 %
Rutaceae	2	7.3 %
Brassicaceae	1	3.7 %
Alliaceae	1	3.7 %
Zingebiraceae	1	3.7 %
Solanaceae	3	10.9 %

Threats to ethnoveterinary plants and necessity of their conservation

In the group discussion, it was revealed that agricultural expansion is the highest threat for the ethnoveterinary medicinal plants (51.6 %, n = 16/31) followed by drought (19.4 %, n = 6/31), soil erosion and deforestation (9.7 %, n = 3/31 each). Over grazing (3.2 %, n = 1/31) was the least threat for ethno-veterinary medicinal plants in the study area (Table 6). The study indicated that many of the informants who have knowledge on traditional medicine usage give priority to the immediate use of the medicinal plants than to its sustainable future uses, as a result their harvesting style is destructive. However, some medicinal plants have been protected because they are multipurpose. In addition to ethno-veterinary remedies, they also serve as spices, cash crop, food, live fence, or other purposes.

Table -6:Priority ranking of factors perceived as threat to Ethno-veterinary plants

Factors	Frequency	Percentage (%)	Rank
Agricultural expansion	16	51.6 %	1
Drought	6	19.4 %	2
Soil erosion	3	9.7 %	3
Deforestation	3	9.7 %	3
Low cultivation	2	6.5 %	4
Over grazing	1	3.2 %	5
Total	31	100 %	

Transfer of knowledge about the ethno-veterinary medicinal plants and practices

In the group discussion, the highest number of attendants/respondents agreed that the transfer of knowledge of traditional medicine is to trusted eldest son (36%, n = 11/31) followed by trusted sons (25.5%, n = 8/31), all members of the family (18.5%, n = 6/31), relatives (12%, n = 4/31), and friends (8%, n = 2/31). During the group discussion, it was evidenced that as people become older and older their knowledge of traditional medicine becomes better and better. It was also observed that there was no much trading on medicinal plants in the study area though very few practitioners and women sell some medicinal plants in the market and at their homes for medical purposes with a very low price. Some of the medicinal plants that are grown at home gardens and often sold as ethnoveterinary remedies, spices and other purposes are *Allium sativum*, *Nicotiana tabacum*, *Zingiber officinale*, *Capsicum annum*, *Coffea arabica*. The group discussion also revealed that there is no standardized known unit of measurements of the plant remedies. This means that the same types of ethno-veterinary medicinal remedies for the same types of ailments were given with different measurements in the same or different kebeles of the study area. But, higher dosage was given for severe diseases.

DISCUSSION

Medicinal plants belonging to 23 families and 31 species were being used extensively for curing 24 animal ailments commonly found in the study area. These ethnoveterinary medicinal plants were documented with their scientific, local, and family names. Their type, traditional preparation methods, and route of administration for treating animal ailments were also recorded. Medicinal plant species belonging to Solanaceae and Euphorbiaceae families were relatively abundant in the study area followed by Rutaceae, Asteraceae, Lamifoliumceae and Amaranthaceae. Plants under the families Solanaceae, Euphoraceae, Rutaceae, Asteraceae were also used as ethnoveterinary remedies in Zimbabwe (Nyahangare et al., 2015), whereas Solanaceae and Euphorbiaceae in South Africa (Luseba and Van Der Merwe, 2006), and Solanaceae, Asteraceae, Zingiberaceae, and Rutaceae in India (Phondani et al., 2010). Acording to Yigezu et al. (2014), Asteraceae, Cucurbitaceae and Solanaceae make up larger proportion of medicinal plants used in Jimma zone, Ethiopia.

The study revealed that medicinal plants are still important, readily available, and cheap source of animal health-care remedies to livestock raisers in the study area. The high cost of pharmaceutical products and limited access to veterinary services probably were among the reasons for farmers to use the traditional ethnoveterinary medicinal plants as means of keeping their animals healthy and productive. The same species of medicinal plants found in the study area were also used to cure animal ailments elsewhere in the world. Farmers in the study area used *Nicotiana tabaccum* for the treatment of leech infestation and bloat whereas, in Zimbabwe, Kenya, and Appalachia of Rural North America, it was used as acaricide to treat ectoparasites mainly ticks, lices, and bots (Gakuubi and Wanzala, 2012; Nyahangare et al., 2015; Terrel, 2015, respectively). In Jimma zone, south west Ethiopia, *Nicotiana tabaccum* is widely used by farmers for the treatment of snake bite, blackleg and for fattening purpose (Yigezu et al., 2014). *Zingibera officinale* was remedies for abdominal pain or colic in the study area. It was also used in India (Singh et al., 2012) and Appalachia of USA (Terrel, 2015) for the same purpose;. Herbalists in the study area and India (Singh et al., 2012) applied *Allium sativum* for the treatment of colic and bloat among others while in Ghana, Mali, Niger, and Nigeria it was used for the cure of fever (Adedeji et al., 2013). There was similar usage of *Solanum incanum* as a remedy for blackleg in the study area, Ghana, Nigeria, Niger, and Mali (Adedejiet al., 2013), and skin disease in the study area and Kenya (Gakuubi and Wanzala, 2012). Another ethnoveterinary medicinal plant, *Azadiracta indica* was used for curing blackleg in the study area and India (Sajal et al., 2016). On the other hand, the same medicinal plant was used in Kenya (Gakuubi and Wanzala, 2012) and Senegal (Adedeji et al., 2013) to deworm animals. *Aloe verae* was used for deworming animals in Zimbabwe (Matekaire and Bwakura, 2004) and for treating diarrhea in Somalia (Adedeji et al., 2013), and for delayed weaning of calves in the study area. Diarrhea and delayed weaning of calves may mostly be connected with helminthiasis because most of the calves in the rural areas of the said countries totally depend on grazing as source of their feed where they can easily acquire parasites.

Most of the medicinal plants in the study area were available always, while some were found seasonally mainly during the rainy season. About 6% of the medicinal plants were at the verge of extinction probably due to expansion of agriculture in which most of the bushes and forests were destroyed to grow crops and the remaining land was overgrazed. Traditional healers in the study area gather medicinal plants of different plant group (41.9 % herbs and 32.3 % tree) from the wild and/or home gardens. Increased number of medicinal plants was collected from the wild comparing to the home garden. Similar finding was recorded by Tamene (2000), Giday (2003), and Awas and Demissew (2009). This may indicate the necessity of conserving medicinal plants because those plants in the wild are at the risk of extinction. According to Demisse (2001), the biodiversity of Ethiopia is eroding by natural and anthropogenic pressures, the later being predominant in urban and peri-urban areas.

Most medicinal plants were collected when needed but some were dried, ground and stored in the form of powder. In general, fresh moist medicinal plants were the most frequently used in preparing remedies comparing to dried plants.

This is in agreement with the finding of Balemie et al. (2004). This might be because fresh moist medicinal plants were more effective remedy than dried ones and drying probably decreased active ingredients and hence the efficacy of remedies extracted from medicinal plants. Leaves, roots, seeds and fruit from the documented medicinal plants were used to prepare remedies. Leaves were the most frequently used parts in the study area particularly for 18 medicinal plants used, followed by roots for five, and seeds for four and fruits for other four medicinal plants. This finding is in agreement with the finding of Giday et al. (2003), Mesfin (2007), Yigezu et al. (2014) and Abera and Mulate (2019) . Leaves of most medicinal plants were used to process remedies probably because they are collected without affecting sustainability of the medicinal plants and further they may contain more medicinally valuable ingredients that make them more effective than the other plant parts. Moreover, the use of leaves compared to their roots is advantageous to protect the plants from extinction. The end products of the traditional medicinal remedies were prepared by grinding, crushing decoctions, chopping, roasting, and pounded forms. Then, most of the plant remedies were administered orally (77.4%) followed by topical (19.4%) and intra nasal (3.2%). Similar route of administration of medicinal plant remedies was registered by Abebe and Ayehu (1993), Teklehaymanot and Giday (2007), Teshale et al. (2004), Yigezu et al. (2014). The group discussion revealed that there was no standardized known unit of measurements of the plant remedies. This means that the same types of ethno-veterinary medicinal remedies may be given for the same types of ailments perhaps with different measurements in the same or different kebeles of the study area. However, respondents of the current study and reports on previous studies argued that higher dosage was given for severe diseases.

Most of the traditional ethnoveterinary knowledge is not yet documented particularly in the study area and the country at large. It is passed on orally from generation to generation. The healers pass the knowledge to the family member only when they are unable to prepare the remedies by their own particularly when they get very old or critically sick. This might be the reason why elders are important source of the ethno-veterinary knowledge in this study.

CONCLUSION

Thirty one medicinal plants species belonging to 23 families were used to traditionally treat 24 livestock ailments including blackleg, wounds, leeches and rabies among others. Most of the medicinal plants, majorly their leaves, were gathered by traditional healers from the wild and about 6% of the medicinal plants are at the verge of extinction. Crushed leaves of fresh moist medicinal plants mixed with water were primarily administered through oral route as a preferred ethno-veterinary remedies. However, there was no standardized known unit of measurements (dose) of the plant remedies for the treatment of animal diseases in the study area. Although, medicinal plants are still important, readily available, and cheap source of animal health-care remedies to livestock raisers, they have not yet received good attention by the researchers. Their efficacy has not been tested through formal *in-vivo* and *in-vitro* experimental trails on which more work is required. For efficient and sustainable use of these plants,

particularly those endangered, awareness creation is required for traditional healers.

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References

Abebe D. and Ayehu A. 1993. Medicinal plants and enigmatic health practices of Northern Ethiopia. B.S.P.E. Addis Ababa.

Abera Y. and Mulate B. 2019. Ethno-veterinary medicine: A potential alternative to animal health delivery in Wolmera district, Oromia Region, Ethiopia. *Ethiop. Vet. J.* **23** (1): 111-130.

Acharya D. and Anshu S. 2008. Indigenous herbal medicines: Tribal formulations and traditional herbal practices. Avishkar Publishers Distributor, Jaipur, India. ISBN 978–81–7910–252–7, 2008, p. 440.

Adedeji O. S.,Ogunsina T.K.,Akinwuni A.O., Ameen S.A., Obebiyi O.O., Akinlade. J. A. 2013. Ethnoveterinary medicine in Africa Organic Poultry Production. *Int. Food Res. J.*, 20 (2): 527–532.

Awas T. 2007. Plant diversity in Western Ethiopia: Ecology, ethnobotany and conservation. PhD Dissertation, Faculty of Mathematics and Natural Sciences, University of Oslo, Norway.

Balemie K, Kelbessa E, Asfaw Z (2004). Indigenous medicinal plant utilization, management and threats in Fentalle area, Eastern Shewa, Ethiopia. *Ethiop. J. Bio. Sci*. 3:37-58.

Beebe J. 1995. Basic concepts and techniques of rapid appraisal. *Human Organization*, 54: 42–51.

Cotton C. M. 1996. Ethnobotany: Principles and Applications. John Wiley and Sons, Chichester, England, p. 347.

Demissie A. 2001. Biodiversity conservation of medicinal plants: problems and prospects. In: conservation and sustainable use of medicinal plants in Ethiopia, 2001, p. 56 –64, (Medhin Zewdu and Abebe Demissie eds.). Proceeding of the National Workshop on Biodiversity Conservation and Sustainable use of medicinal plants in Ethiopia, 28 April-01 May 1998, IBCR, Addis Ababa.

Edwards S., Mesfin Tadesse, Sebsebe Demissew, Hedberg, I. 2000. Magnoliaceae to flacourtiaceae. In: Flora of Ethiopia and Eritrea vol. 2 (1), 2000. The National Herbarium Addis Ababa, Ethiopia and Uppsala, Sweden.

Elujoba A.A., Odeleye O.M., Ogunyemi C.M. 2005. Traditional medicine for medical and dental primary healthcare delivery systems in Africa. *Afri. J. Trade.*. 2: 46 – 61.

Fish L. 1999. Preparing herbarium specimens. Pretoria: National Botanical institute.

Gakuubi Wanzala. 2012. A survey of plants and plant products traditionally used in livestock health management in Buuri district, Mery Country, Kenya. *J. Ethnobiol. Ethnomedic.*. 8: 39.

Gebremedhin E.Z., Agonafir A., Tessema T.S., Tilahun G., Medhin G., Vitale M., Di Marco V., Cox E., Vercruysse J. and Dorny P. 2013. Seroepidemiological study of ovine toxoplasmosis in East and West Shewa Zones of Oromia Regional State, Central Ethiopia. *BMC Vet Res.* 9:117 (2013). https://doi.org/10.1186/1746-6148-9-117

Giday M. 2003. An ethnobotanical survey on plants of veterinary importance in two *woredas*of Southern Tigray. Northern Ethiopia. SINET: *Ethiop. J. Sci.*. 26:. 123–136.

Giday M., Zemede A., Thomas E. and Zerihun W. 2003. An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. *J. Ethnopharmacology.* 85: 43—52.

Hedberg I., Ensermu K., Edwards S., Sebsebe Demissew and Persson E. 2006. Gentianaceae to cyclocheiaceae. In: Flora of Ethiopia and Eritrea, Vol.5. .The National Herbarium Addis Ababa, Ethiopia and Uppsala, Sweden.

Kadir M.F., Bin Sayeed M.S., Shams T., Mia M.M. 2012. Ethnobotanical survey of medicinal plants used by Bangladeshi traditional health practitioners in the management of diabetes mellitus. *J. Ethnopharmacol*. 144(3): 605-11.

Kong J.M., Goh N.K., Chia L.S., Chia T.F. 2003. Recent advances in traditional plant drugs and orchids. Acta Pharmacol Sin. 24(1):7-21.

Luseba D. and Van der Merwe D. 2006. Ethnoveterinary medicine practices among Tsonga speaking people of South Africa'. *Onderstepoort J. Vet. Res.*73(2): 115–122.

Matekaire T. and Bwakura T.M. 2004. Ethnoveterinary medicine: A potential alternative to orthodox animal health delivery in Zimbabwe. *Int. J. Appl. Res. Vet. Med*., 2 (4): 269–273.

Mesfin F. 2007. An Ethnobotanical study of medicinal plants in Wonago Woreda, SNNPR, Ethiopia. M.Sc. Thesis. Addis Ababa University. Addis Ababa.

Nyahangare E. T., Mvumi B. M. and Mutibvu T. 2015. Ethnoveterinary plants and practices used for ecto-parasite control in semi-arid smallholder farming areas of Zimbabwe. *J. Ethnobiol. Ethnomed.* 11(1): 30. http://dx.doi.org/10.1186/s13002-015-0006-6. PMid:25925402.

Phondani P.C., Mhakuri R.K. and Kale C.P. 2010. Ethnoveterinary uses of medicinal plants among traditional herbal healers in Alaknanda Catchment of Utarakh and, India. *Afr J Tradit Complement Altern Med* ..7: 195–206.

Sajal K., Kulkarni D.K., Deo A.D., Pande A.B. and Bhagat R.L. 2014. Use of Ethno-Veterinary medicines (EVM) from Vidarbha Region (MS) India. *Biosci. Disc*. 5(2):180-186.

Tamene B. 2000. A floristic analysis and ethnobotanical study of the semi- wetland of Cheffa area, South Wolo, Ethiopia. M.Sc. Thesis. Addis Ababa.

Teklehaymanot T. and Giday M. 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. *J. Ethnobiol. Ethnomed*. 3:12. doi: 10.1186/1746-4269-3-12. PMID: 17355645; PMCID: PMC1852296.

Terrel S.L. 2015. Ethnoveterinary medicine in the Blue–Ridge Community based Animal health care in South Appalchia. MA thesis Appalachia State University. USA. pp 10–17.

Teshale S., Merga B., Girma A. and Ensermu K. 2004. Medicinal plants in the ethno veterinary practice of Borena Pastoralists, Southern Ethiopia. *Int J Appl Res Vet Med*. **2**(3):220–225.

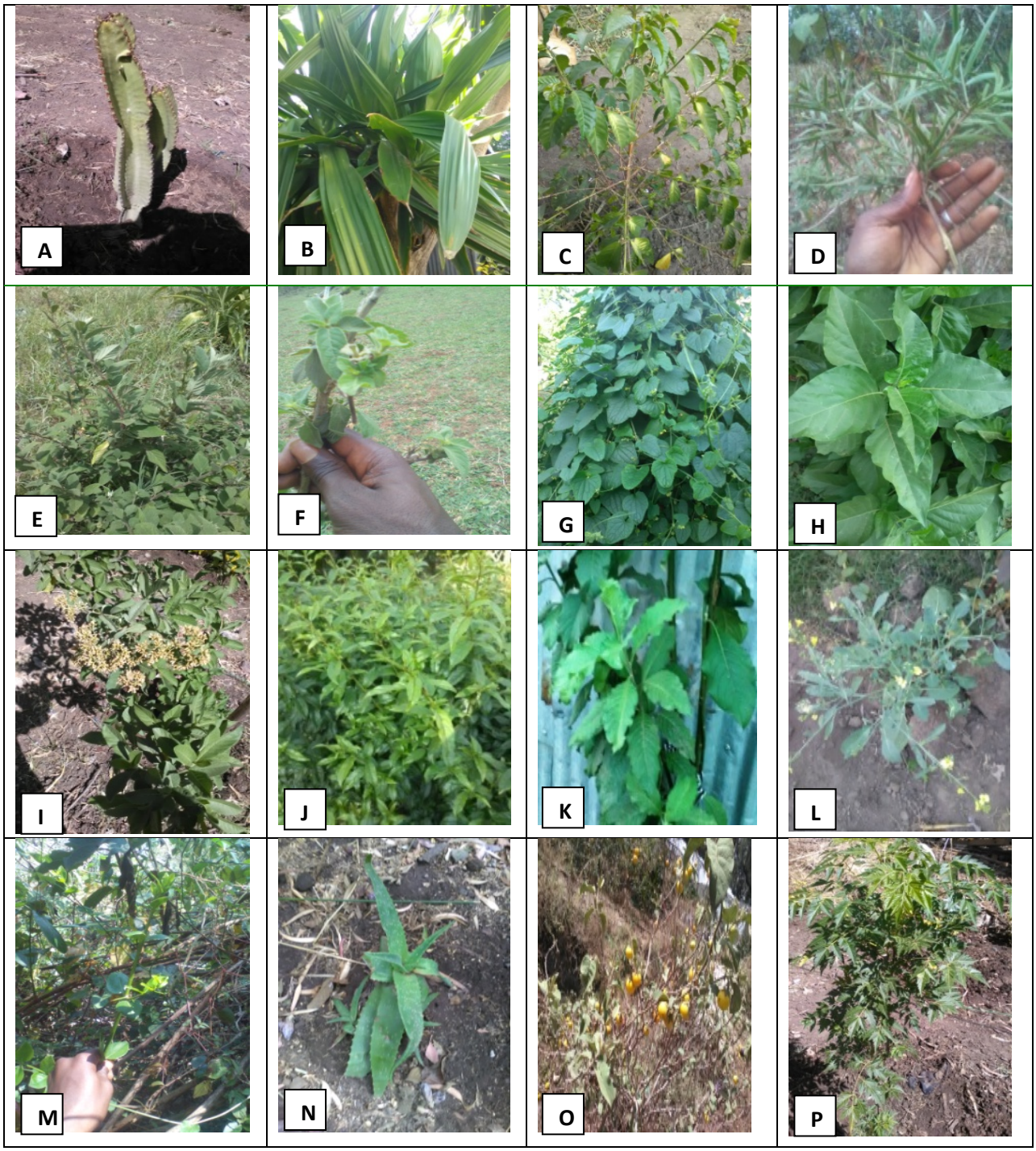
Tiwari P. 2010. An ethnobotanical survey of medicinal plants used in Terai forest of western Nepal. *J. Ethnobiol. Ethnomed*. 8: 19.

Singh A.G., Kumar A. and Tewari D.D. 2012. An ethnobotanical survey of medicinal plants used in Terai forest of western Nepal. *J. Ethnobiol. Ethnomed*. 8: 19. https://doi.org/10.1186/1746-4269-8-19

Vivero J.L., Ensermu K. and Sebsebe D. 2006. Progression the Red List of Plants of Ethiopia and Eritrea.Conservation and bio-geography of endemic flowering taxa. In: Ghazanfar S.A. and Beentje H.J. (eds.) Taxonomy and ecology of African plants, their conservation and sustainable use. Proceedings of the 17th AETFAT congress. Addis Ababa, Ethiopia, pp 761–778,. Royal Publishing, Kew.

World Health Organization (WHO) 1998. Regulatory situation of herbal medicines: A World wide review,Geneva, pp 1—9.

Yigezu Y., Haile D.B. and Ayen W.Y. 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. http://www.biomedcentral.com/1746-6148/10/76



Annex 1: Different medicinal plants commonly used by traditional healers in Adaa'Liben District

(A) Euphorbia ampliphyllapex L; (B) *Dracaena steudneri* L; (C)*Coffe arabica* L; (D)*Celtisa africana* L; (E) *Achayrentes bidentata* L; (F) *Ocinum lamifolium* L; (G) *Phragmanthera macrosolen* L; (H) *Justicia schimperina* L; (I) *Vernoni amygdalina* L; (J) *Rhammus pirnoides* L; (K) *Vernoni amygdalina* L; (L) *Brassica carinata* L; (M) *Carrisas pinarum* L; (N) *Aloe vera* L; (O) *Solanium incanum* (L); (P)*Azadiracta indica*

Annex 2: Different medicinal plants commonly used by traditional healers in Adaa'Liben District

(Q)*Zingibera officinale* L; (R) *Citrus aurantifolia* L; (S)*Ocimum lamifolium* L; (T) *Achyranthes bidentata* L; (U) *Croton macrostachyus* L; (V) *Clausena anisata* L; (W) *Withania somnitera* L; (X) *Sorghum bicolor* L; (Y) *Carica papaya* L; (Z) *Ricinus communis* L; (A1) *Allium sativum* L; (A2) *Cypresnivies* L; (A3) *Nicotiana tabacum*L; (A4) *Cordia africana*L; (A5)*Calpurnia aurea* L.