

Review Article

Systematic Review on Herbal Plants Having Veterinary Ectoparasitic Importance in Ethiopia

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Introduction

Livestock plays an important role in the livelihoods of 70% of the world's resource-poor population, most of who live in rural areas [9]. In Ethiopia, the livestock industry is fundamental to the country's economic development. Livestock production is estimated at 52.13 million cattle, 24.2 million sheep, 22.6 million goats, 44.89 million poultry, 8.73 million horses and 0.99 million camels. CSA, 2012). Small ruminants make up about 30% of the country's total livestock herd and account for 46% of national meat production, 14% of dairy consumption, and 58% of hides production [35]. Animal diseases and poor management practices are major threats to the sustainable livelihoods of resource-poor rural communities [6]. External parasites such as scabies mites, lice, mites and ticks cause serious economic losses to smallholder farmers, the tanning industry and the country

Abstract

Parasitic skin disease in domestic ruminants caused by ticks, lice, fleas, and ticks is one of the serious diseases causing great economic losses to smallholder farmers, the industry tanning and the country in general. Invasion of ectoparasites causes blood loss, irritation leading to skin degeneration and rejection, poor growth, reduced production, reproduction and death. Although ruminant parasites can be controlled using commercial synthetic insecticides, their accessibility and affordability to poor farmers, the development of Their resistance status and profound environmental impact make them less desirable than other alternatives such as medicinal plants. Therefore, there is an urgent need to design an activity to evaluate the mite-killing efficacy of medicinal plants traditionally used against parasitic skin diseases in ruminants and domestic chickens in Ethiopia. The study was conducted from October 2020 to January 2021 using the different search engines. For this study, various ethno botanical and ethno medical survey reports on the ectoparasitic importance of medicinal plants, in veterinary practice conducted in Ethiopia were used. Out of a total of 102 studies, 20 were used in a systematic review. Descriptive statistics were used to analyze data collected. Among the parts of ectoparasitic plants, the leaves are the most frequently used. Sharpening and grinding are the main processing methods for preparation. Phytochemicals were not detected during the search. Therefore, further studies are needed to determine the dosage, concentration of the preparation, side effects and phytochemicals present in medicinal plants.

Keywords: Ectoparasites; Acaricides; Efficacy; Green pharmaceuticals; Medicinal plants

Abbreviations: CSA: Central Statistics Authority; EVM: EthnoVeterinary Medicine; SNNPRS: South Nation Nationality and People Regional State; WHO: World Health Organization

in general. They cause intense irritation leading to poor condition, weight loss, reduced milk production or damage to the skin or wool of the sheep and can lead to death. In addition, they are responsible for transmitting diseases to animals or are vectors of disease transmission to many people [52]. In cattle, the parasites cause skin irritation when they suck or feed on epithelial debris and secretions. Scratching and rubbing destroys their fur and damages their skin, and reduces their feeding time. Thumb sucking can cause animals to become anemic and inefficient. Especially malnourished cattle, young calves and calves are the worst affected. Heavy suction parasitic infections can also lead to lameness [53]. Damage caused by the parasite can be mechanical, but the situation is also complicated by the host's response to the presence of the specific parasite, its secretions

and excretions [33]. To some extent, the impact of ectoparasites in livestock and the diseases they transmit has been underestimated in the past compared to the impact of major pests such as the rinderpest, and even than the effects of endoparasitic species, as these tend to be more economically important in temperate regions [34].

Traditional medicine is a comprehensive interdisciplinary study of the local knowledge, socio-cultural and environmental structures associated with animal health care and breeding. So to keep animals healthy, traditional healing methods have been practiced for centuries and passed down orally from generation to generation [35]. Herbal medicine has become more popular in the treatment of many diseases because it is believed that green medicine is safe, readily available and has fewer side effects. Like other forms of traditional knowledge, ethnoveterinary knowledge about medicinal plants is not compiled. It is simply passed down orally from generation to generation and is therefore at risk of extinction as the elderly die and the younger generation loses interest in the traditional way of life [42].

In Africa, up to 80% of the population uses traditional medicine for primary health care and more than a third of the population in developing countries do not have access to essential medicines. In Ethiopia about 80% of the population depends on traditional medicine for health care [27]. Lack of veterinary specialists, scarce and irregular supply of veterinary drugs, high cost of equipment and drugs, lack of government veterinary policy, presence of veterinary policy. Counterproductive practices and poor infrastructure are mentioned as some of the main factors leading to farmers in developing countries relying more on ethno botanical medicine than on the current health system [10].

The use of synthetic pesticides in the management or treatment of parasites is becoming a serious global problem due to the development of resistance, non-specific residue products and environmental pollution. The growing concern about environmental pollution due to chemical waste from some synthetic pesticides has paved the way for a "green pharmaceutical" [4]. Researchers are now increasingly cautious about the use of synthetic pesticides and are making considerable efforts to design environmentally friendly research processes to develop safe drugs. Therefore, there is an urgent need for effective chemical control agents that can be used safely to treat animals and humans [42].

The prevalence of parasitic infections varies depending on various factors. In Ethiopia, the reported prevalence of ectopic parasites has ranged from 13.8% to 68.69% in sheep and 7.80% to 58% in goats, respectively [29,31,52]. Furthermore, most modern medicines are expensive and inaccessible to the majority of farmers and ranchers in Ethiopia. Most of them rely on traditional knowledge and locally available materials (mostly botanicals) to control disease in livestock [45]. However, this approach does not work in developing countries. EVP, adopted since ancient times by rural people in many indigenous communities, has been successful in controlling many human and animal diseases, including tick infestations [39].

However, the country's ethno-veterinary practice is affected by acculturation and plant decline due to environmental degradation, deforestation and over-exploitation of medicinal plants [49]. The main variable factors affecting the distribution of plant parasites are agroecology, age, sex, and livestock management/handling. High temperature, humidity and sunlight create con-

ditions for lice to enter. Poor management, nutrition and hygiene conditions as well as poor farmer awareness of the effects of parasites are thought to contribute to the widespread occurrence of infection (Pangui *et al.*, 1994). However, to date, very little ethno-veterinary knowledge in Ethiopia regarding the use of medicinal plants has been properly documented and analyzed. Knowledge on the use of ethno-veterinary drugs is transmitted orally and is at risk of being lost due to technical, socio-economic changes.

- Therefore, the objectives of this study were: Overview of traditional medicinal plants in the treatment of ectoparasites in animals.
- Profile and transfer identified plants to the next generation.
- Record the parts of the plant used for medicinal purposes and the method of preparation

Literature Review

Overview of Traditional Medicinal Plants for Animals

Ethnobotany is a branch of science that studies the knowledge, methods, skills and practices traditionally used to treat various diseases in animals [24]. According to the World Health Organization (WHO), a medicinal plant is any plant which in one or more of its organs contains substances that can be used for medicinal purposes or are precursors of semi-synthetic processes. Such plants shall have parts, including leaves, roots, rhizomes, stems, bark, flowers, fruits, seeds or seeds, which are used to control or treat disease and will therefore contain medically active chemical fraction. These non-nutritive phytochemicals or bioactive components are often referred to as phytochemicals or phytonutrients and are responsible for the defense of plants against bacterial infections or pests [8]. Ethno-Veterinary Medicine (EVM) is important in Africa and other developing countries because the majority of herders are small-scale farmers and most of them live in rural areas where cultural practices are common (Madge, 1998). In traditional practice, plant extracts are developed by farmers rather than scientists due to lack of funds to purchase synthetic pesticides, forcing them to depend on pest control methods [22].

In traditional veterinary practice, among different plants used in traditional medicinal practice, crushed leaves of the plant *Calpurnia Aurea* and chopped *Dodonea Angustifolia* leaves, mixed with water and filtered to treat residual fetal membranes, are used to treat mastitis, dermatophytosis, and dermatophytosis and ectopic parasites [11,46]. The leaf powder of *Azardracha Africana* is crushed and mixed with indica water applied topically to treat parasites [14].

Management of Skin Diseases in Animals with Conventional Medicine

Parasitic skin diseases in animals can be prevented and controlled by various synthetic antiparasitic drugs that affect the nervous system of the parasites. Although currently available parasite-killing compounds are classified into different categories based on their chemical structure, most of them have limitations when it comes to targeting the nervous system [8]. Therefore, it is important to look for other drugs with different mechanisms of action. In addition, conventional drugs currently on the market have a number of disadvantages, including an increase in drug resistance and concerns about human and environmental safety. These issues have prompted researchers to

seek to develop safe alternative antiparasitic compounds with variable targets of action [44]. Traditional medicine can be used as an alternative to overcome this problem.

The Role of Herbal Medicine in Management of Ectoparasitic Skin Disease of Animals

Traditional medicine has been used in the management of various livestock diseases around the world, especially in developing countries. The use of medicinal plants by traditional medicine practitioners in developing countries has increased. Developed countries are also showing increasing interest in and use of herbal medicines due to public dissatisfaction with the cost of prescription drugs and an interest in reverting to natural remedies. In addition, in Africa, access to insecticides is limited due to unstable economic conditions, leading to higher prices for imported products. In addition, improper use of tick-killers by untrained or unauthorized persons facilitates the development of resistance [17]. If only synthetic pesticides are used, there is a risk of losing the traditional knowledge of using native plants. Although several experimental trials involving in vitro and in vivo studies have been documented on the importance of herbal medicines for the treatment of parasitic skin diseases in animals, this review summarizes only the drugs commonly used by herbalists.

Medicinal Plants Used for the Treatment of Ectoparasite

(Table 1)

Table 1: List of medicinal plants used for the treatment of ectoparasite.

Scientific name	Family name	Part used	Preparation methods	Target parasites	Availability	References
Aloeexelsa A. Berger.	Aloaceae	Stem, leaves	Crush leaves, mix with water for 24 h & spray	Fleas, ticks	Seasonal	[12]
Eucalyptus globules	Myrtaceae	Leaf	Aqueous Extract	external parasite	Always	[12]
Syzygiumunineense	Myrtaceae	Leaf	aqueous extract	sheep ked	Always	[12]
Croton acrotaschys	Euphorbiaceae	Leaf	aqueous extract	External parasite	Always	[12,19]
BersamaabyssinicaFresen	Melanthaceae	Leaves	Leaf aqueous extract	Sheep ked		[12]
Vernoniaauriculifera-Hiern.	Asteraceae	Leaves	Leaf aqueous extract	Sheep ked	Always	[12]
Capsicum annum L.	Solanaceae	Fruits	Crush the fruits and mix with soot in water and spray	Ticks	Always	[36]
Nicotianatabacum L.	Solanaceae	Leave	Break and mix with water	Ticks	Always	[7]
Solanumincanum L.	Solanaceae	Fruits	Crush fruits and mix with water	Ticks	Seasonal	[36]
Guizotascabra	Asteraceae	Leave	powder paint	Ticks	Always	[25]
Azadirachtaindica A. Juss	Meliaceae	Leaf	powder on topical	Ticks	Always	[11,20]
Citrus aurantifolia (Christm)	Rutaceae	Fruit	Fruit paste is applied to the affected area		Sesonal	[7]
Aloe megalacantha	Aloaceae	Leaf	Latex	Ticks and lice	Always	Teklay Abera AB and Giday, 2007
MeliaazedarachL.	Meliaceae	Leaf and fruit	Aqueous and organic extract	Ticks and lice	Always	[5]
Otostegiaintegrifolia-Benth	Lamiaceae	Whole plants	Fumigate the plant in the house where the animals are kept	Ticks and lice	Always	[3,30]
Calpurinia aurea (Ait)	Fabaceae	Fresh leaves	Leaf aqueous extract	Lice and ticks	Always	Ketema et al., 2013
PremnaschimperiEngl	Lamiaceae	Root	root hot aqueous extract	Tick and mite infestations		Ketema, et al., 2013
Euphorbia obovalifolia	Euphorbiaceae	Leaves	Latex	Ticks	Always	Kabore et al., 2012; [15]
Cucumis dipsaceus Ehrenb	Cucurbitaceae	Root	Crushing root	Insecticide		[7]
Daturastramonium L.	Solanaceae	Leaves and fruit	Aqueous extract	Mange mites		[7]
Euphorbia abessinica	Euphorbiaceae	Leaves	Latex	Ectoparasite		[11]
Acacia melanoxylon R.Br	Fabaceae	Leaves	Crushed leaf mixed with water	Mange mites		Kabore et al., 2012
Cucurbitapepo L	Cucurbitaceae	Seeds	Fruit cooked and rubbed	Ectoparasite		Ketema et al., 2013
Phytolaccadodecandra. L	Phytolacaceae	Leaves	Aqueous leaf extract	Ectoparasite		[47]
Calpurnia decandra	Fabaceae	Leaves	Aqueous leaf extract	Ectoparasite		[47]
Commiphoraerythraea (Ehrenb.) Engl.	Bruseraceae	Leaves	Latex	Ticks		[12]
Daturainnoxia Mill	Fabaceae	Leaves	Pounded leaves	Ectoparasite		[47]

Methods

Search Strategies

Herbal ethno-veterinary ectoparasitic plants were used as the key words in searching different peer reviewed journals as literature search strategy.

Inclusion and Exclusion Criteria

The following inclusion and exclusion criteria were used.

- Ethno-botanical and ethno-medicinal surveys reporting on medicinal importance of ethno-veterinary herbal plant on ectoparasites.
- Written in English, conducted in Ethiopia, year of publication of study that describes method of preparation and route of administration.
- Articles focused on ectoparasitic ethnoveterinary practice.
- The following research data were excluded from analysis.
 - Data from ethno-botanical and ethno medicinal survey reporting on this selected medicinal plants lacking information about method of preparation and route of administration.
 - Data from partially accessed articles (abstract only).
 - Research conducted before 2000 G.C outside Ethiopia.

Table 2: Lists of studies included in the systematic review from Ethiopia.

Ethiopia				
Investigator	Year of study	Region	Zone	District/study area
Regessa et al., 2000	2000	Tigray	-	-
Megrssa et al., 2013	2013	Oromia	East Wellega	Wayuwaku
Gebremariam et al., 2013	2013	Tigray	-	-
Damtew et al., 2014	2014	Addis Ababa	Shewa	Akaki
Teklay et al., 2013	2013	Tigray	-	Kilte, Awuabelo
Araya et al., 2015	2015	Tigray	-	Seharti, Samara
Ketemaet al., 2013	2013	SNNPR	South Omo	-
Mekuria et al., 2010	2010	SNNPR	Woliata Sodo	-
Assefa et al., 2017	2017	Oromia	Jimma	-
Seyoum and zerihun., 2014	2014	Addis Ababa	-	Debre Libanos
Gideyet al., 2007	2007	Amhara	Agewi-awi	-
Tekle, 2014	2014	SNNPR	Gedeo	Kochore
Kebede, B., 2004	2004	Somalia	Liben	Moyale
Tesfaye et al., 2015	2015	Tigray	-	-
Gemdo et al., 2005	2005	Oromia	Borana	-
Yakob et al., 2008	2008	SNNPR	Woliata Sodo	-
Nibret et al., 2012	2012	Amhara	-	Lay- Arimacho
Kalayou et al., 2012	2012	Tigray	-	-
Mulugeta et al., 2010	2010	Tigray	-	-
Negessa et al., 2011	2011	Addis Ababa	-	-

Data Collection

The data used in the systematic review were extracted for the actual studies: the first author, year of publication, year of study, study area, method of preparation, route of administration and veterinary ectoparasitic diseases treated by traditional medicinal plants.

Data Analysis

The collected data were entered in to excel spreadsheet and summarized using descriptive statistics. The spreadsheet data was employed to determine the frequency and the percentages so as to identify the ectoparasitic medicinal plant, geographical distribution of studies site, and method of remedy preparation, parts of plant used and route of administration in the study area.

Results

Literature Search Results

A total of 102 studies were identified, 22 by BMC, 30 by PubMed, 40 by Google Scholar and 10 by Google Search. From these 20 were considered for systematic review.

Characteristics of the Studies

The studies included for this systematic review were conducted between 2000 and 2020 in Ethiopia. In Ethiopia this review performed in 5 regional and in 1 administration city: namely Oromia, South Nations Nationalities and Peoples of Region (SNNPR), Somalia, Tigray, Amhara, Addis Ababa. The detailed characteristics of the studies were presented below.

Geographical Distribution of Study Sites

(Table 3)

From the total of 20 studies included in the systematic re-

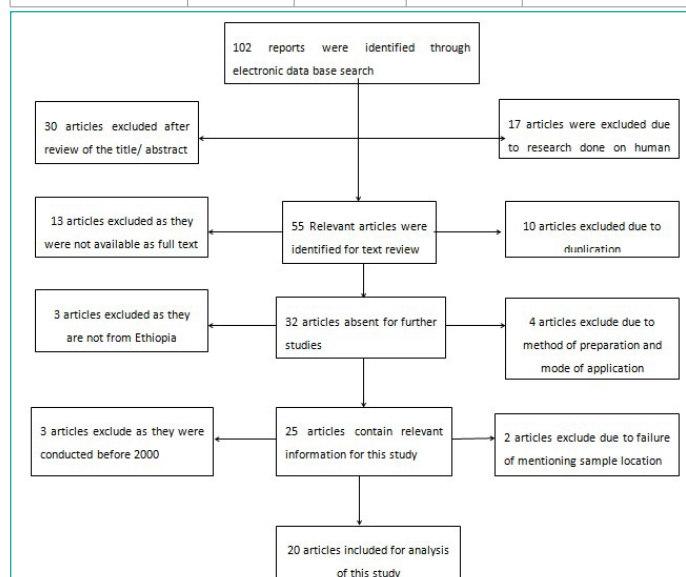


Figure 1: Results and the method of inclusion, exclusion criteria and the selection techniques.

Table 3: Geographical distribution of study site in Ethiopia.

Study Area	Frequency	Percentage%
Tigray	7	35%
Oromia	3	15%
Addis Ababa	3	15%
SNNPR	4	20%
AMHARA	2	10%
Somalia	1	5%

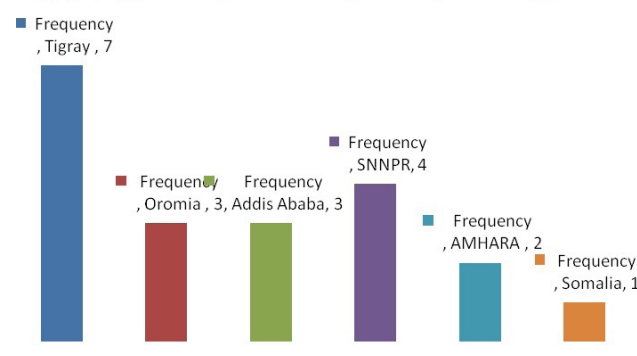


Figure 2: The study sites in Ethiopia.

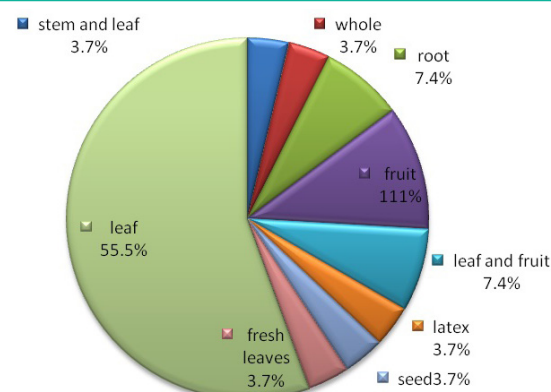


Figure 3: Parts of plant used for remedies preparation.

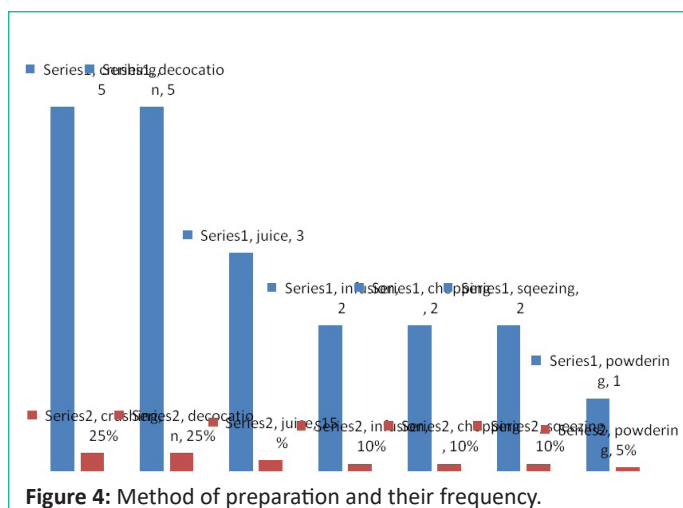


Figure 4: Method of preparation and their frequency.

view from research conducted in Ethiopia, most studies were performed in Tigray, SNNPR, Oromia, Addis Ababa, Amhara, and the least research is conducted in Somalia region.

The distribution of study sites where ectoparasitic ethnoveterinary activity conducted on the use of different herbs ranged among states are; Tigray (35%), Oromia (15%), SNNPR (20%), Addis Ababa (15%), Amhara (10%) and Somalia (5%).

Data Analysis Results

The 20 selected study areas depict the use of veterinary ectoparasitic herbal medicine practice in Ethiopia was reviewed in details about method of preparation, plant parts used and mode of application. A total of 27 ethno-veterinary medicinal plant species belonging to various 13 families were documented with details on their importance, mode of application, plant parts used.

Parts of Plants Used For the Preparation of the Remedies

Leaves were the most frequently used plant parts and accounted for leaf (55.55%) of the total, fruit (11.11%), root (7.4%), both leaf and fruit (7.4%), whole parts (3.7%), stem and leaf (3.7%), seed (3.7%), fresh leaves (3.7%) and the latex covers (3.7%).

Method of Remedy Preparation: Various method of ectoparasitic veterinary medicinal plants preparation was documented. In this study decoction and crushing were found to be the major method of remedial preparation and both are accounted (25%), followed by juice (15%), infusion, chopping and squeezing each accounted (1%), powdering was the least method of remedial preparation and accounted for (5%).

Discussion

This study indicates that the systematic review of plant species is of importance for veterinary parasitology. This study shows that a large portion of the Ethiopian population depends on ethno medical practices and locally available ingredients, mainly medicinal plants used to cure and prevent health problems in livestock. A total of 20 research areas were reviewed and analyzed in detail in terms of regional and national distribution, preparation methods, routes of administration and plant parts used.

This systematic review reveals differences in the distribution of medicinal plants across regions and countries. The differences between the distributions of these exotic veterinary medicinal plants depend on soil fertility, suitable climatic conditions and good conservation strategies. Data analysis shows that the

highest proportions of ethnographic economic practices are practiced in the Tigray region among the states of Ethiopia. Similar results were also reported by Suleman and Alemu (2012).

Ethiopia is an area where ethnography is practiced mainly. This shows that local people are not only dependent on modern medicines, the existence of abundant medicinal plant species and high incidence of diseases. Analysis of the data from this study indicates that the parts of the plant most commonly used to make remedies and widely used by local healers are the leaves, followed by the fruit. Similar results were also reported by Lusebal and Tshisikhawe (2012) from South Africa, Stasi *et al* (2002) from Brazil who reported that leaves were the most dominant part of the plant in their study. However, unlike this study, Ribeiro *et al* (2012) from Mozambique found that plant roots were a major part of their study. In most studies, leaves were used more as plant parts than roots. The main reason many practitioners of traditional medicine use the leaf part for healing is its accessibility and the desire to prevent the extinction of the plant.

According to Abiyu *et al* (2014), leaves are a renewable part of a plant and using the plant for medicinal purposes is unlikely to affect plant survival and cause no serious stress problems. Other studies in Ethiopia have shown that leaves are the most preferred plant part for the treatment of livestock diseases due to the presence of pharmacologically active phytochemicals capable of activating biological activity [48].

Herbal medicines have different preparation methods for different diseases and they come in different dosage forms such as decoction, grinding, pressing, infusion, chopped, powdered and pressed. Crushing and decoction were the most frequently used preparation methods, followed by juice. Snowplowing is the least used drug preparation method in the study area. The use and management of medicinal plants varies depending on the type of disease [51]. A similar practice was carried out in the study of Hassan *et al* (2014), who stated that grinding is the most common method for preparing herbal remedies in Pakistan. However, unlike these studies, Mesfin *et al.* (2014) reported that powder was the most frequently used method in drug formulation. All these indicate that the methods of preparing traditional medicinal plants are not yet popular in the whole country.

Abrha *et al.* (2013) report that knowledge of medicinal plants is in the hands of a few healers and that knowledge of medicinal plants is declining or even unable to be transferred from the elderly to the next generation due to the loss of attention of the younger generation. Unless there is effective conservation and recording of these medicinal plants, there is a risk that their role will be lost over time.

Conclusion and Recommendation

The incidence of skin diseases in animals and the use of herbal medicines have been shown to be increasing worldwide, especially in developing countries. More than 80% of people living in developing countries depend on medicinal plants for their health and the health needs of their livestock. The medicinal plants reported in this study are parasitic plant agents that have been scientifically studied and used in traditional Ethiopian medicine. Therefore, current and future researchers in this field need to conduct studies on the safety and efficacy of other published traditional herbal medicines and generate the information needed to preserve Veterinarian guard.

• To save the next generation and solve the present problem, we must take care of the natural products available around us.

• Observations and findings provide enough evidence that older adults have a better knowledge of traditional herbal medicine than this generation. Therefore, the recording of these plants must be continued to preserve indigenous knowledge and pass it on to the next generation.

This study has not been completed; in further work, confirmation through in vitro and in vivo evaluation of their antiparasitic properties is needed to better inform traditional healers about their use.

References

1. Abiyu E, Zemed A, Ensermu K, Raja N. Status of medico-cultural plants at Fiche town market, Ethiopia. *Ethnobotanical study of medicinal plants in and around Fiche district, central Ethiopia*. *Curr Res J Biol Sci*. 2014; 6: 154-67.
2. Braha AT, T Mirutse G. An ethnobotanical study of medicinal plants used in Kilte Awulaelo District, Tigray Region of Ethiopia. *J Ethnobiol Ethnomed*. 2013; 65: 9.
3. Araya S, Abera B, Giday M. Study of plants traditionally used in public and animal health management in Seharti Samre District, Southern Tigray, Ethiopia. *J Ethnobiol Ethnomed*. 2015; 11: 22.
4. Assefa A, Abebe T. Ethnobotanical study of wild medicinal trees and shrubs in Benna Tsemay District, Southern Ethiopia. *J Sci Dev*. 2014; 2: 1-17.
5. Borges LMF, Ferri PH, Silva WJ, Silva WC, Silva JG. In vitro efficacy of extracts of *Melia azedarach* against the tick *Boophilus microplus*. *Med Vet Entomol*. 2003; 17: 228-31.
6. Chitura T, Muvhali PT, Shai K, Mushonga B, Kandiwa E. Use of medicinal plants by livestock farmers in a local municipality in Vhembe District, South Africa. *Appl Ecol Environ Res*. 2018; 16: 6589-605.
7. Damtew Bekele ZA, Beyene Petros HT. Ethnobotanical study of plants used for protection against insect bite and for the treatment of livestock health problems in rural areas of Akaki District, Eastern Shewa, Ethiopia. *Topclass J Herb Med*. 2012; 1: 12-24.
8. Doughari JH, Human IS, Bennade S, Ndakidemi PA. Phytochemicals as chemotherapeutic agents and antioxidants: possible solution to the control of antibiotic resistant verocytotoxin producing bacteria. *J Med Plants Res*. 2009; 3: 839-848.
9. Nyahangare ET, Mvumi BM, Mutibvu T. Ethnoveterinary plants and practices used for ecto-parasite control in semi-arid small-holder farming areas of Zimbabwe. *J Ethnobiol Ethnomed*. 2015; 11: 30.
10. Lulekal E, Asfaw Z, Kelbessa E, Van Damme P. Ethnoveterinary plants of Ankober District, North Shewa Zone, Amhara Region, Ethiopia. *J Ethnobiol Ethnomed*. 2014; 10: 21.
11. Gebrezgabiher G, Shewit Kalayou SS. An ethno-veterinary survey of medicinal plants in woredas of Tigray region, Northern Ethiopia. *Int J Biodivers Conserv*. 2013; 5: 89-97.
12. Gameda N, Mekonnen W, Lemma H, Tadele A, Urga K, Addis G. Insecticidal activity of some traditionally used Ethiopian medicinal plants against sheep ked *melophagus ovinus*. *J Parasitol Res*. 2014; 2014: 978537.
13. Gemedo-Dalle T, Maass BL, Isselstein J. Plant biodiversity and Ethnobotany of Borana pastoralists in southern Oromia, Ethiopia. *Econ Bot*. 2005; 59: 43-65.
14. Ghorbani A. Studies on pharmaceutical ethno botany in the region of Turkmen Sahra North of Iran (Part 1). *J Ethnopharmacol*. 2005; 102: 58-68.
15. Giday M, Teklehaymanot T, Animut A, Mekonnen Y. Medicinal plants of Shinasha, Agew-awi and Amhara peoples in North West Ethiopia. *J Ethnopharmacol*. 2007; 110: 516-25.
16. Hassan H, Waheed M, Akash T, Ashaq A. Ethnoveterinary study of medicinal plants in malakand valley, Pakistan district. 2014; 67: 6.
17. Kategile JA, Mubi S, editors. Future of livestock industries in East and Southern Africa. International Livestock Centre for Africa, Addis Ababa: ILRI. 1992.
18. Adama K, Amadou T, Souleymane P, Celestin SB, Gustave K, Hamidou TH. Ethno medicinal study of plants used in ectoparasites infections of ruminant livestock in Sahelian region of Burkina Faso, West Africa. *Nat J, producer. Plant resource*. 2012; 2: 611-6.
19. Kalayou S, Haileselassie M, Gebre-Egziabher G, Tiku'e T, Sahle S, Taddele H, et al. In vivo antimicrobial activity screening of some ethnoveterinary medicinal plants traditionally used against mastitis, wound and gastrointestinal tract complications in Tigray Region, Ethiopia. *Asian Pac J Trop Biomed*. 2012; 2: 516-22.
20. Kebede B. A study on ethnoveterinary medicine knowledge and practices in Moyale wereda of Liben zone, Somali region [DVM thesis]; 2004 - Faculty of Veterinary Medicine of Addis Ababa University. 2004.
21. Tolossa K, Debela E, Spiridoula Athanasiadou AT, Ganga G, Houdijk JGM. Ethno-medicinal study of plants used for treatment of human and livestock ailments by traditional healers in South Omo, Southern Ethiopia. *J Ethnobiol Ethnomed*. 2013; 9: 1-15.
22. Liang GM, Chen W, Liu TX. Effects of three neem-based insecticides on diamondback moth (Lepidoptera: Plutellidae). *Crop Prot*. 2003; 22: 333-40.
23. Luseba D, Tshisikhawe MP. Medicinal plants used in the treatment of livestock diseases in vhembe region, Limpopo province, South Africa. *J Med Plants Res*. 2012; 594.
24. McCorkle CM. An introduction to ethnoveterinary research and development. *J Ethnobiol*. 1986; 6: 129-49.
25. Megersa M, Asfaw Z, Kelbessa E, Abebe Beyene BW. An ethnobotanical study of medicinal plants in Wayu Tuka District, East Welega Zone of Oromia Regional State, West Ethiopia. *J Ethnobiol Ethnomed*. 2013; 9: 1-18.
26. Mekuria S, Gezahegn E. Prevalence of external parasite of poultry in intensive and backyard chicken farm at Wolayta Soddo town, Southern Ethiopia. *Vet World*. 2010; 3: 33-538.
27. Menegsha A. A review on ethno-veterinary medicine practices and indigenous knowledge. *J Vetmed Anim Sci*. 2020; 3: 1029.
28. Mesfin F, Seta T, Assefa A. An ethnobotanical study of medicinal plants in Amaro Woreda, Ethiopia. *Ethnobot Res Appl*. 2014; 12: 341-54.
29. Mulugeta Y, Yacob HT, Ashenafi H. Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region. Ethiopia. *Trop Anim Health Prod*. 2010; 42: 1219-24.
30. Tsegaye N, Kumsa B, Hailu Y, Addis G, Debella A. In vivo acaricidal efficacy of *Eucalyptus globulus* and *Cymbopogon citratus* against *Sarcoptes scabiei* caprae of goats [MSc thesis]. Addis Ababa University; 2011.

31. Nibret M, Basaznew B. Assessment of Major Animal Production and Health Problems of Livestock Development in Lay-Armache-ho District, North Western Ethiopia. *AESR*. 2012; 7: 136-41.
32. Pangui LJ. Mange in domestic animals and methods of control. *Rev Sci Tech*. 1994; 13: 1227-47.
33. Peter G. Parasites and skin diseases. J.A. London: Allen Press and Company Limited. 1995; 212-56.
34. Purnell RE. Ectoparasite animal and controls methods. Books reviews. *Vet Parasitol*. 1996; 62: 175177.
35. Rahmeto A, Makelesh T, Megersa B, Desie S. Prevalence of small ruminant ectoparasites and associated risk factors in selected districts of Tigray region, Ethiopia. *Glob Vet*. 2011; 7: 433-7.
36. Regassa A. The use of herbal preparations for tick control in western Ethiopia. *J S Afr Vet Assoc*. 2000; 71: 240-3.
37. Ribeiro A, Romeiras MM, Tavares J, Faria MT. Ethnobotanical survey in canhane village district of massingar Mozambique medicinal plants and traditional knowledge. *J Ethnobiol Ethnomed*. 2010; 8: 6.
38. Eshetu GR, Dejene TA, Telila LB, Bekele DF. Ethnoveterinary medicinal plants: preparation and application methods by traditional healers in selected districts of southern Ethiopia. *Vet World*. 2015; 8: 674-84.
39. Nimbalkar SD, Patil DS, Deo AD. Ethnoveterinary practices (EVP) for control of ectoparasite in livestock. *Indian J Trad Knowl*. 2020; 19: 401-5.
40. SeyoumGetaneh ZG. An ethnobotanical study of medicinal plants in Debra libanosworeda Central Ethiopia. *Afr J Plant Sci*. 2014; 8: 366-79.
41. Di Stasi LC, Oliveira GP, Carvalhaes MA, Queiroz M, Tien OS, Kak-inami SH, et al. Medicinal plants popularly used in the Brazilian Tropical Atlantic Forest. *Fitoterapia*. 2002; 73: 69-91.
42. Suleman S, Alemu T. A survey on utilization of ethnomedicinal plants Nekemte town, East Wellega (Oromia) Ethiopia. *J Herbs Spices Med Plants*. 2012; 18: 34-57.
43. Tashale S, Merga B. Ethnoveterinary Practices of Borana Pastoralists and their possible contribution to livestock production and management. *Bull. Anim. Hlth. Prod Afr*. 2004; 52: 21-9.
44. Taylor MA. Taylor MA. Recent developments in ectoparasiticide review. *Vet J*. 2001; 161: 253-68.
45. Teklay Abera AB, Giday M. An ethnobotanical study of medicinal plants used in KilteAwulaelo District, Tigray Region of Ethiopia. *J Ethnobiol Ethnomed*. 2013; 9: 1-2.
46. Tekle Y. An ethno-veterinary botanical survey of medicinal plants in Kochore district of Gedeo Zone, Southern Nations Nationalities and Peoples Regional State (SNNPRs), Ethiopia. *J Sci Innov Res*. 2014; 3: 433-45.
47. Tesfaye H, Hishe M, Badasa S. Phytochemical and ethnobotanical study of medicinal plants used to treat Ectoparasite in ruminant animals in Eastern Tigray, Northern Ethiopia. *Int J Pharmacogn*. 2015; 2: 446-72.
48. Teshale S, Merga B, Girma A, Ensermu K. Medicinal Plants in the Ethnoveterinary Practice of BoranaPatoralists, Southern Ethiopia. *Int J Appl Res Vet Med*. 2004; 2: 220-5.
49. Worku T. Review on importance of ethnoveterinary practices in pastoral areas of Ethiopia. *Int J Res Stud Biosci (IJRSB)*. 2018; 6: 16-27.
50. Wall R, Shearer D. Veterinary entomology. 1st ed. UK: Chapman & Hall. 1997; 1-438.
51. Wondimu T, Kelbessa E, Asfaw Z. Ethnobotanical study of medicinal plants around Dheera town, Arsi zone, Ethiopia. *Int J Pharmacogn*. 2007; 112: 152-61.
52. Yakob HT, Yalew TA, Dinka AA. Part I. Ectoparasites prevalence in sheep and in goats in and around Wolaita Soddo, *Revue Méd Vét*. 2008; 159: 450-4.
53. Zewdu S, Tadesse T, Addisu A. Ectoparasites prevalence in small ruminants in and around Sekela, Amhara regional State. North-west, Ethiopia. *J Vet Med*. 2015; 2015: 216085.