



Ethnobotany of Medicinal Plants Used to Treat Leishmaniasis in Ethiopia: A Systematic Review

Yibeltal Aschale¹, Muluken Wubetu^{2*} and Haimanot Reta³

¹Department of Medical Laboratory sciences, College of Health Sciences, Debre Markos University, Debre Markos, Ethiopia

²Department of Pharmacy, College of Health Sciences, Debre Markos University, Ethiopia

³Department of Biology and Botanical Science, College of Natural and Computational Science, Debre Markos, Ethiopia

Abstract

Background: Leishmaniasis is an infectious tropical vector born disease imposing high burden in developing countries including Ethiopia. Its treatment is still using pentavalent antimonial which have been used for several years and prone to drug resistance. Other alternative drugs like amphotericin B also have horrible side effects. Therefore, new drugs are urgently needed and drug screening efforts should be encouraged. No review has been done that broadly indicates medicinal plants used to treat leishmaniasis. The aim of this review was to provide an overview of the Ethnobotany of medicinal plants used to treat leishmaniasis in Ethiopia.

Materials and methods: Databases (Pub Med, Google Scholar, Research Gate, and Hinari) were searched for published articles on the Ethnobotany of medicinal plants used to treat leishmaniasis in Ethiopia without restriction in the year of publication or methodology. Some studies were also identified with manual Google search. Primary search terms were "Leishmania review", "Leishmaniasis" "Ethiopia", "medicinal plants" and "Ethnobotany". Studies that did not contain full ethnobotanical data on to medicinal plants traditionally used to treat Leishmaniasis and plants which are out of flora list of Ethiopia were excluded from this review.

Results: The database search produced a total of 206 articles. After adjustment for duplicates and inclusion and exclusion criteria, 11 articles were found appropriate for the review. Majority of the studies were qualitative in nature and some were mixed type. None of the medicinal plants traditionally used to treat leishmaniasis in Ethiopia are confirmed scientifically. Of the 28 plants identified from the various studies, 53.6% were herbs and the common plant part used was leaf (44.8%) followed by latex (20.7%). Majority of the plant remedies were given topically (75.7%). Cutaneous leishmaniasis comprises high percentage of *leishmania* infection treated by traditional medicinal plants.

Conclusion: Variety of medicinal plants have been used by Ethiopian people of different cultures to treat leishmaniasis. Most of the plants were herbs and the commonly used plant part was leaf. Majority of prepared remedies were applied externally to the affected part. There is an urgent need to conduct clinical trials on such plants to support traditional claims and to analyze molecular and cellular mechanisms involved.

Keywords: Ethnobotany; Leishmaniasis; Medicinal plants; Review; Ethiopia

Background

Leishmaniasis is a tropical disease caused by protozoan parasites of the genus *leishmania* [1]. It is one of neglected disease and even not include in the list of tropical disease priorities in Ethiopia [2]. Leishmaniasis has a focal distribution and it is common to remote areas like other neglected tropical disease [3]. Visceral leishmaniasis specially is recognized as serious public health problem as it causes death if left untreated having high case fatality rate [4]. Lack of simple and easily applied tools for its management and complex eco-epidemiology contribute for the difficulty in prevention and control of the disease [3,5].

Plants remain to be the source for majority of people in developing countries to treat various health problems [6]. They are a rich source of many natural products most of which have been extensively used for human welfare, and treatment of various diseases [7,8]. In Ethiopia a variety of medicinal plants are used as natural medicines without scientific base. Plant extracts or plant derived compounds provide important source of new medicinal agents [9,10]. A high diversity of secondary metabolites with interesting biological activities can be produced from plant extracts [11].

About eighty (80%) percent of the Ethiopia people and ninety percent (90%) of livestock depend on traditional medicine for their health care and more than 95 percent of traditional medicine preparations are made from plant origin. Similarly, there has been a

continuous growth of demand for traditional medicines globally and in many developing countries health care system [12]. Urgent need for alternative drug formulation leads to screening of natural products for potential use in leishmaniasis treatment.

Different studies have been conducted on Ethnobotany of medicinal plants used to treat various human diseases in different parts of Ethiopia. However, there has not been any review conducted on Ethnobotany of plants used to treat Leishmaniasis. Therefore, there is an urgent need to assess the overall traditional preparation techniques and types of plants used in the management of leishmaniasis. This review is complementary of various medicinal plants that have been directed towards plants having leishmanicidal activity. It gives a comprehensive information on the scientific name of plants, method of preparation, route of administration, plant part used and the habit of the plant used. This review will also give new force for obtaining synthetic compounds.

*Corresponding author: Muluken Wubetu, Department of Pharmacy, College of Health Sciences, Debre Markos University, Ethiopia, E-mail: mulukenwubetu1986@gmail.com

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Materials and methods

Search strategy

Databases (Pub Med, Google Scholar, Research Gate, and Hinari) were searched for published studies done on Ethnobotany of medicinal plants in Ethiopia. Some studies were also identified with a manual Google search. No restriction was applied to the year of publication, methodology, or study subjects. Primary search terms were “Leishmania review”, “Leishmaniasis,” “Ethiopia”, “medicinal plants”, and “Ethnobotany”.

Inclusion/exclusion criterion

Studies which do not contain full information about Ethnobotany

(method of preparation, growth form, plant part used, route of administration), surveys which did not address intestinal parasitosis as a disease treated traditionally by practitioners and studies which incorporated only medicinal plants of livestock usage were excluded. Plants which are out of flora list of Ethiopia were also excluded from this review [13].

Data abstraction

The authors screened the articles based on the inclusion/exclusion criteria. The details of medicinal plants were extracted from each study using an abstraction forms: scientific, family and local name, growth form of plant, plant part used, methods of preparation, specific use and route of administration (Table 1).

S. no	Scientific name	Family name	Local name	Growth form	PU	Specific use	Method of preparation	RoA	Ref
1	<i>Euphorbia abyssinica</i> Gmel	Euphorbiaceae	Kulkual (Am)	Tree	leaf	Cutaneous leishmaniasis	Crushing the leaf and mixing it with butter	Topical	[15]
					Latex	Visceral leishmaniasis	The wound is touched with a hot thread and the latex of 1 and 2 is applied on the wound	Topical	[16]
2	<i>Englerinawoodfordioides</i> (Schweinf.) M. Gilbert	Loranthaceae	Teketsila (Am)	Shrub	Leaf	Cutaneous leishmaniasis	Crushing the leaf and apply it topically	Topical	[15]
3	<i>Bruceaantidysenterica</i> J. F. Mill.	Simaroubaceae	Abalo (Am)	Shrub	Seed	Cutaneous leishmaniasis	Crushing the seed and apply on the infected area	Topical	
4	<i>Daturastramonium</i> L.	Solanaceae	Mestenager (Tig)	Herb	Leaf	Unspecified Leishmaniasis	Leaves are crushed and pasted on affected area	Topical	[17]
5	<i>Euphorbia cactus</i> Boiss	Euphorbiaceae	Kolqualhamat (Tig)	Shrub	Latex	Unspecified Leishmaniasis	Latex is smeared on affected area	Topical	
6	<i>Euphorbia petitiiana</i> A. Rich.	Euphorbiaceae	Hindukduk (Tig)	Herb	Latex	Unspecified Leishmaniasis	Rub leaf on affected part until cure	Topical	
7	<i>Argemonemexicana</i> L.	Papaveraceae	Eshoktilian, medafe(Tig)	Herb	Latex	Unspecified Leishmaniasis	Apply it on affected part until cure	Topical	[18]
8	<i>Asparagus africanus</i> Lam.	Asparagaceae	Kastanito(Tig)	Climber	Root	Unspecified Leishmaniasis	Crush, mix it with honey and apply on affected part	Topical	
9	<i>Commicarpuspeduncululosus</i> (A. Rich.) Cufod.	Nyctaginaceae	Eznianchiwa (Tig)	Herb	Leaf	Unspecified Leishmaniasis	Crush, boil with butter and apply it on affected part	Topical	
10	<i>Phytolacca dodecandra</i> L. Herit.	Phytolaccaceae	Endode (Or)	Shrub	Root	Cutaneous leishmaniasis	The root is powdered and pasted with butter.	Topical	[19]
11	<i>Gossypium spp.</i>	Malvaceae	Jirbi (Or) Tit(A)	Shrub	Seed	Cutaneous leishmaniasis	The seed is powdered and pasted with butter	Topical	
12	<i>Nicandraphysalodes</i> (L.) Gaertn.	Solanaceae	Machara(Or)	Herb	Leaf	Unspecified Leishmaniasis	Powdered leaf is mixed with water and drunk	Oral	[20]
13	<i>Plectranthus</i> spp.	Lamiaceae	Dachet(Am)	Herb	Leaf	Unspecified Leishmaniasis	Crush paste	Topical	
14	<i>Clematis hirsute</i> Perr & Guill	Ranunculaceae	AzoHareg (Am)	Climber	Leaf	Unspecified Leishmaniasis	Mildly heated Powder paste	Topical	[21]
15	<i>Guizotiaabyssinica</i> (L. F.) Cass.	Astraceae	Noug (Am)	Herb	Seed	Unspecified Leishmaniasis	Mildly heated Powder paste	Topical	
16	<i>Hordeumvulgare</i> L.	Poaceae	Gebis (Am)	Herb	Seed	Visceral leishmaniasis	Barely dough (Ligus) is prepared; bread is baked from this Ligus and applied on the wound as bandage with the hot inner soft part.	Bandaging/ Dressing	
17	<i>Ficusvasta</i> forssk.	Moraceae	Shola (Am)	Tree	Latex	Visceral leishmaniasis	The latex is applied on the wound till it is cured.	Topical	
18	<i>Clematis hirsute</i> Perr and Guill	Ranunculaceae	Yeazo Areg (Am)	Climber	Latex	Visceral leishmaniasis	The wound is touched with a hot thread and the latex of 1 and 2 is applied on the wound	Topical	[16]
19	<i>Rehamnusprnoides</i> L. Herit,	Rhamnaceae	Gesho (Am)	Shrub	Leaf	Visceral leishmaniasis	The leaves are crushed into powder and applied as bandage on the wound.	Bandaging/ Dressing	
20	<i>Rumex abyssinicus</i> Jacq	Polygonaceae	Mekmeko (Am)	Herb	Root	Visceral leishmaniasis	The roots are crushed and applied bandage on the wound.	Bandaging/ Dressing	
21	<i>Ranunculus multifidus</i> Forssk.	Ranunculaceae	Etsesyol (Am)	Herb	Leaf	Visceral leishmaniasis	The leaves are pounded to powder and mixed with honey (to attach) and applied on the wound	Topical	

22	<i>Scadoxus multiflorus</i> (Martyn) Raf	Amaryllidaceae	Dem Astefi (Am)	Herb	Root	Unspecified Leishmaniasis	Root paste is applied topically	Topical	[22]
23	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Tult (Am)	Herb	Root	Unspecified Leishmaniasis	Rubbing the spot with fresh root and leaf until cure; topical	Topical	
24	<i>Dissotis senegambiensis</i> (Guill. & Perr.) Triana	Melastomataceae	NM	Herb	Leaf	Cutaneous leishmaniasis	NM	Nasal	[23]
25	<i>Ocimum lamiiifolium</i> Hochst. Ex Benth.	Lamiaceae	NM	Herb	Leaf	Cutaneous leishmaniasis	NM	Nasal	
26	<i>Sphearanthus Steetzii</i> Oliv. & Hiern	Asteraceae	Qoricha –Cheffe (Or)	Shrub	Bark & Leaf	Cutaneous leishmaniasis	Leaves and bark are pounded while fresh and the concoction applied on the skin surface where wounds occur	Bandaging/ Dressing	[24]
27	<i>Clematis simensis</i> Fresen.	Ranunculaceae	Hazo (T)	Herb	Leaf	Cutaneous leishmaniasis	Mixed with <i>Sidaschimpri</i> , crushed and placed on the infected site	Topical	[18]
28	<i>Osyris quadripartite</i> Decn	Santalaceae	Qerets (Am)	Shrub	Leaf	Unspecified Leishmaniasis	NM	Topical	[25]

Table 1: Ethnobotany of medicinal plants used to treat Leishmaniasis (Am= Amharic, Or=Oromifa, A=Ari, Tig=Tigre, PU=Parts used, RoA=Route of administration, NM=not mentioned).

Results

Literature search results

The search of the Pub Med, Google Scholar, Research Gate, and Hinari databases and Google provided a total of 206 studies. After adjustment for duplicates, 98 remained. Of these, 84 studies were discarded, since after review of their titles and abstracts, they did not meet the criteria. The full texts of the 14 studies were reviewed in detail. Three studies were discarded after the full text had been reviewed, since they did not address much of the required information. Finally, 11 studies were included in the review (Figure 1).

Study characteristics

Methodological validity of all the 11 studies was checked prior to inclusion in the review by undertaking critical appraisal using a standardized instrument adapted to Guyatt et al. [14]. The 11 studies differed significantly in the number of plants identified. From these 11 articles, the majority (9) were conducted to assess the Ethnobotany of medicinal plants used to treat human diseases, while the rest studies focused on Ethnobotany of medicinal plants used in the treatment of both human and livestock disorders. All the studies were conducted in different parts of Ethiopia and are qualitative and mixed type. The studies used purposive sampling to select study subjects. The detailed description of each plant collected from different studies is given below (Table 1).

Medicinal plants growth form and plant parts used

Twenty eight medicinal plants distributed in 19 families were identified from the reviewed studies. Unfortunately, none of the medicinal plants traditionally used to treat leishmaniasis in Ethiopia are proofed scientifically. Majority of the plants were herbs (53.6%) followed by shrubs (28.6%) (Figure 2). The commonly used plant parts were leaves (44.8 %) followed by latex (20.7%). Root account 17.2% of the total plant parts used (Figure 3).

Method of preparation and route of administration

Traditional medicinal practitioners in Ethiopia apply different techniques of preparation like drying, crushing, concoction, and decoction (Table 1). They use simple methods and equipments during their remedy preparation. Of the routes commonly used to administer remedies in the treatment of leishmaniasis, topical route was the common route which consists 75.7% (n=22) followed by bandaging 13.8% (n=4) and nasal 6.9% (n=2) way of administration. Only one preparation was intended to be administered orally (Figure 4).

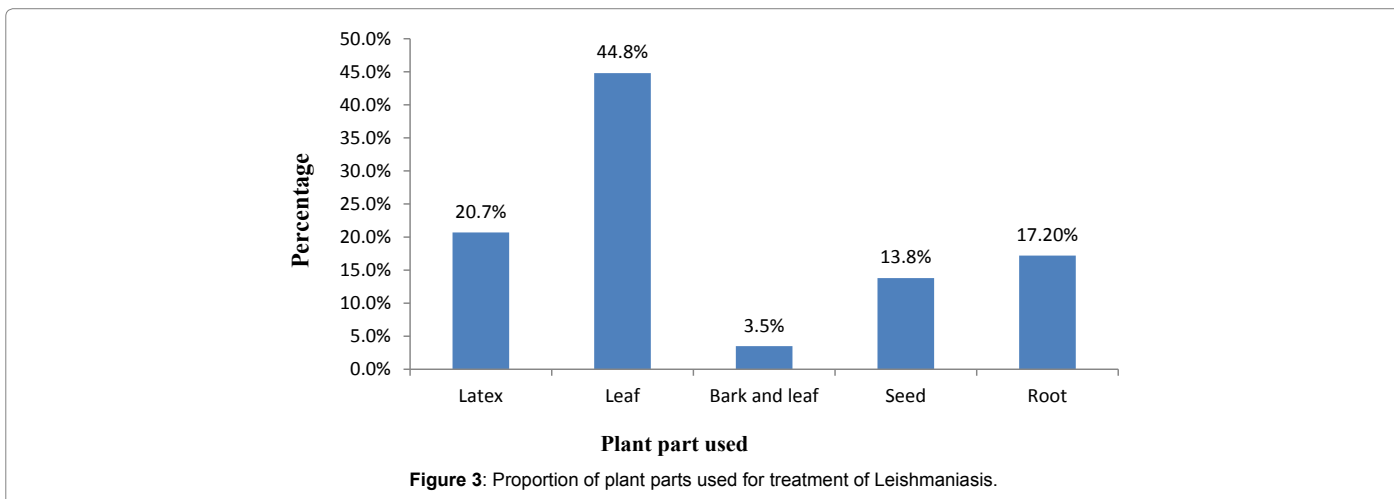
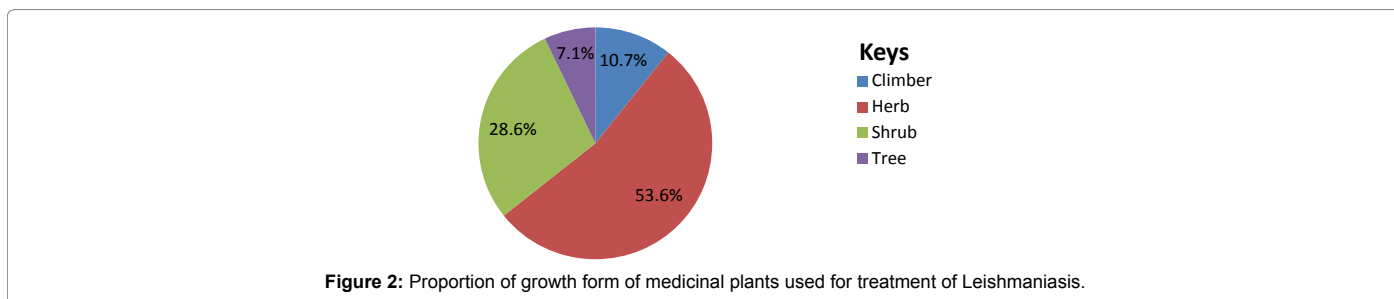
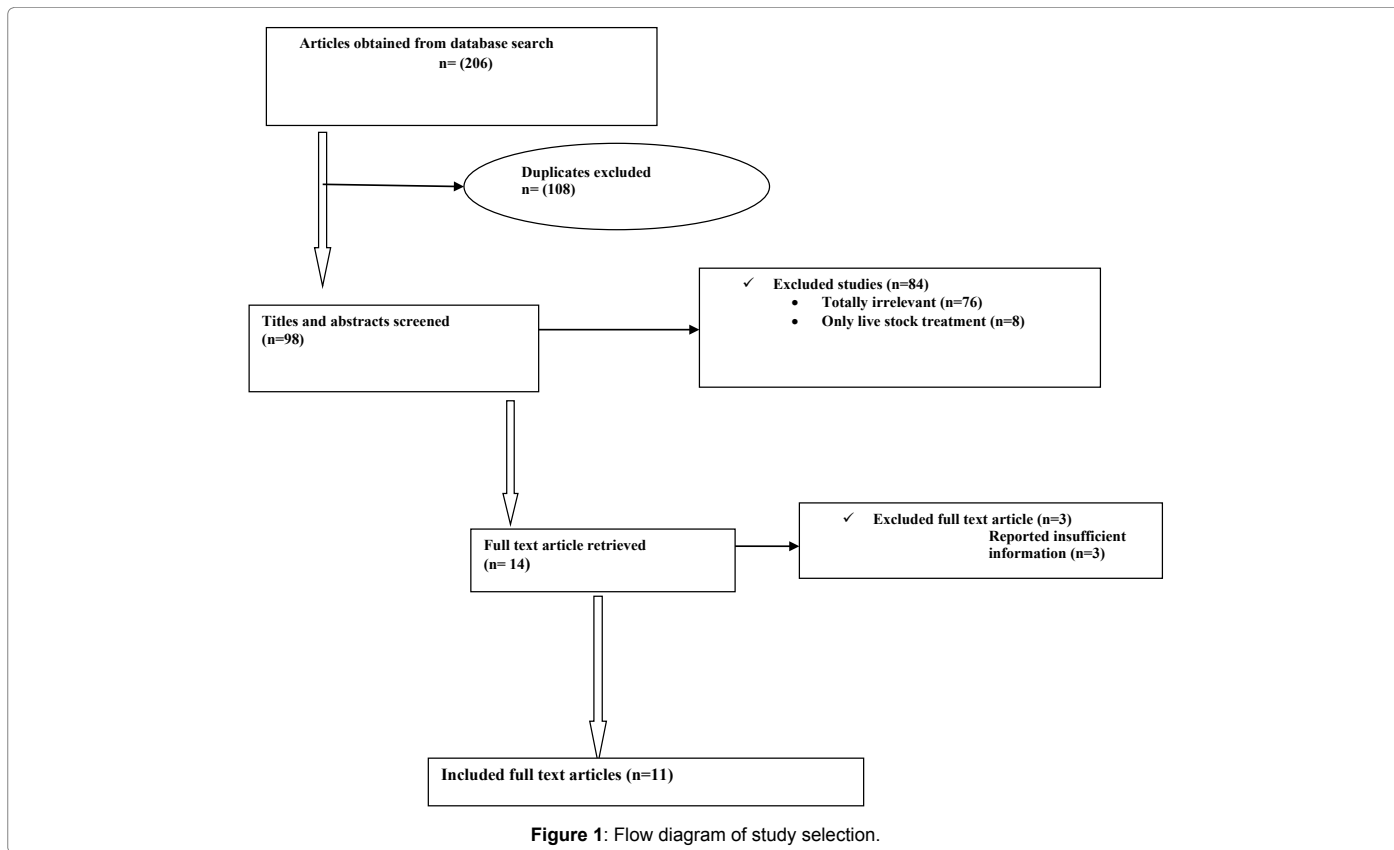
Type of leishmaniasis treated with medicinal plants

Cutaneous and visceral leishmaniasis were identified to be *leishmania* infections that can be treated traditionally when encountered in human by using medicinal plants listed in the table. They account 31.0% and 24.2% respectively. The remaining 44.8% of *leishmania* infections were not specified and can be also treated by traditional healers using different medicinal plants (Figure 5).

Discussion

This review revealed that about 28 plant species find applications by the traditional healers of the country to treat leishmaniasis. These plants were distributed in 19 families and none of them was confirmed scientifically in animal model. This indicates less attention is given to the traditional medicine practices in drug formulation in general. This review revealed the presence of high species diversity of medicinal plants used for treatment of leishmaniasis. This is due to the climatic variation that exists in different provinces of Ethiopia. Family Ranunculaceae accounts the highest percentage (21.0%) followed by family Euphorbiaceae (15.8%). Family Astraceae and Solanaceae account 10.5% each. Another study undertaken in Spain [26] and Korea [27] revealed that Asteraceae has the highest number of medicinal plants. According to a study in Nigeria [28] family Caesalpiniaceae has higher number of plants.

According to this review, herbs constitute the highest percentage of the plants identified to have medicinal value in the treatment of leishmaniasis followed by shrubs. Similarly, other studies conducted elsewhere in Ethiopia indicated the dominance of herbs [29,30-34]. Herbs are seasonal which indicates that they are not accessible throughout the year which needs storage but can be easily cultivated in a limited area. However, Shrubs are known to be non-seasonal in nature which implies that they are accessible throughout a year and no need to store. In this review, leaf was the most commonly used plant part in the preparation of remedies as compared to other parts. Studies conducted in Nigeria [28] and Israel [35] also showed the dominance of leaves in the preparation of remedies. However, the use of plants leaf for medicinal purposes has its own limitations unless the plant is evergreen. Because leaves are seasonal this implies that they are not available throughout a year which needs storage if non-fresh leaves are required. There is no threat to the mother plant when leaves are harvested for medicinal purpose instead the highest threat to the mother plant comes with root, bark and stem harvest.



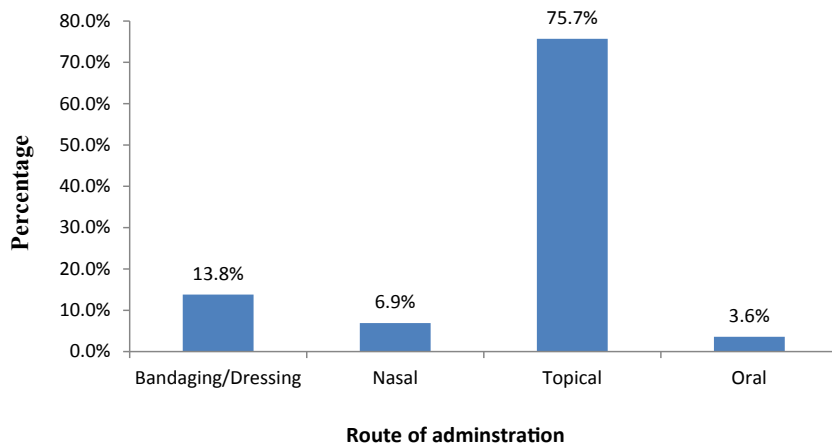


Figure 4: Proportion of route of administration of medicinal plants used for treatment of Leishmaniasis.

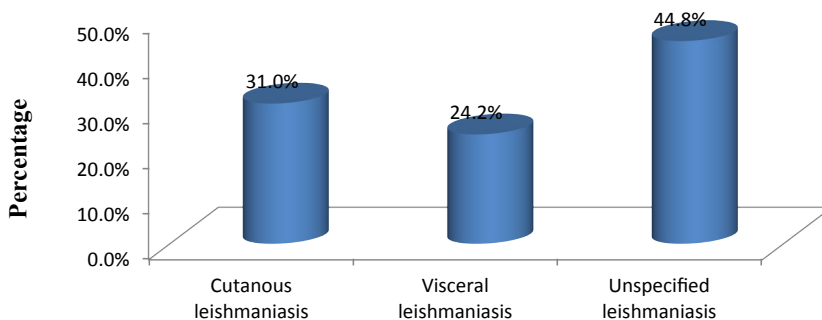


Figure 5: Proportion of type of leishmaniasis treated by medicinal plants.

Medicinal plants were formulated in various forms using different solvents and additives. Traditional medicinal Practitioners prepare remedies in such a simple manner without need of advanced techniques and further processing. This may be due to lack of formal education and processing instruments. Practitioners used butter, porridge, sugar, and honey as additives to increase the medicinal value/potency of the remedies. This is agreed with a study conducted in Israel [35] and Hawassa [36].

This review also revealed that high proportions of remedies were given topically. The reason for this is, traditional medicinal practitioners prefer simple routes like topical and oral that do not require special skill due to lack of ability to administer remedies in other complex routes like intravenous and intramuscular. As *leishmania* parasite is found in the affected area and medicines are applied to the affected area, topical routes allow rapid interaction between the prepared medicines and the parasite increasing its potency. Another study conducted in Sheko ethnic group of Southwest Ethiopia revealed that the most medicinal plant preparations were administered cutaneously [37].

Even though unspecified *Leishmania* infections were reported, in this review cutaneous and visceral leishmaniasis were the common *Leishmania* infections that can be treated traditionally when encountered in human using medicinal plants. The mechanism of action of Plant extracts and isolated secondary metabolites like flavonoids is often by interfering with central targets of *Leishmania* parasites (intercalation with DNA, alkylation of DNA), membrane integrity, microtubules and neuronal signal transduction [11].

Conclusion

In the present review, a total of twenty eight medicinal plants have been identified and recorded for their use for the treatment of leishmaniasis in Ethiopia. Most of the plants were herbs and the commonly used plant part was leaf. Even though most of these medicinal plants are widely utilized in different provinces of Ethiopia, information on their safety and efficacy are not scientifically proofed by using animal models. Therefore, it is advisable for researchers to conduct the safety and efficacy studies of the traditionally claimed medicinal plants in more detail in animal models and if possible in clinical trials.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for Publication

Not applicable

Availability of Data and Material

No additional data are required; all information is clearly stated in the main manuscript.

Competing Interests

The authors have declared that there is no competing interest.

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Authors' Contribution

MW, YA conceive the review, YA involved in data extraction, data analysis, interpretation and drafting of the manuscript. HR involved in data analysis and quality assessment. MW Critically reviewed the manuscript. All authors reviewed and approved the manuscript.

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Not applicable

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