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

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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 terrible 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 ethnobotony 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 Ethnobotony 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:** Ethnobotony; 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 leishmaniacal 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.
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).

<table>
<thead>
<tr>
<th>S. no</th>
<th>Scientific name</th>
<th>Family name</th>
<th>Local name</th>
<th>Growth form</th>
<th>PU</th>
<th>Specific use</th>
<th>Method of preparation</th>
<th>RoA</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Euphorbia abyssinica Gmel.</td>
<td>Euphorbiaceae</td>
<td>Kukual (Am)</td>
<td>Tree</td>
<td>Leaf</td>
<td>Cutaneous leishmaniasis</td>
<td>Crushing the leaf and mixing it with butter</td>
<td>Topical</td>
<td>[15]</td>
</tr>
<tr>
<td>2</td>
<td>Engelineranoodfordiiodes (Schweinf.) M. Gilbert</td>
<td>Loranthaceae</td>
<td>Teketsa (Am)</td>
<td>Shrub</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>The wound is touched with a hot thread and the latex of 1 and 2 is applied on the wound</td>
<td>Topical</td>
<td>[16]</td>
</tr>
<tr>
<td>3</td>
<td>Bruceantydisynterica.J. F. Mill.</td>
<td>Simaroubaceae</td>
<td>Abalo (Am)</td>
<td>Shrub</td>
<td>Seed</td>
<td>Cutaneous leishmaniasis</td>
<td>Crushing the leaf and apply it topically</td>
<td>Topical</td>
<td>[15]</td>
</tr>
<tr>
<td>4</td>
<td>Daturastramonium L.</td>
<td>Solanaceae</td>
<td>Mestenager (Tig)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Leaves are crushed and pasted on affected area</td>
<td>Topical</td>
<td>[17]</td>
</tr>
<tr>
<td>5</td>
<td>Euphorbia cactus Bois</td>
<td>Euphorbiaceae</td>
<td>Kolquathamart (Tig)</td>
<td>Shrub</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Latex is smeared on affected area</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Euphorbia pettilianaA. Rich.</td>
<td>Euphorbiaceae</td>
<td>Hindukduk (Tig)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Rub leaf on affected part until cure</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Argeomonexicana L.</td>
<td>Papaveraceae</td>
<td>Eshoktilian, medafe(Tig)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Apply it on affected part until cure</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Asparagus africanus Lam.</td>
<td>Asparagaceae</td>
<td>Kastanito(Tig)</td>
<td>Climber</td>
<td>Root</td>
<td>Unspecified leishmaniasis</td>
<td>Crush, mix it with honey and apply on affected part</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Commicarpuspedunculosus (A. Rich.) Cufo.</td>
<td>Nyctaginaceae</td>
<td>Ezniarchiwa (Tig)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Unspecified leishmaniasis</td>
<td>Crush, boil with butter and apply it on affected part</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Phytolacce dodecandra L. Herit.</td>
<td>Phytoplacceae</td>
<td>Endode (Or)</td>
<td>Shrub</td>
<td>Root</td>
<td>Unspecified leishmaniasis</td>
<td>The root is powdered and pasted with butter.</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Gossypium spp.</td>
<td>Malvaceae</td>
<td>Jirbi (Or) Tir(A)</td>
<td>Shrub</td>
<td>Seed</td>
<td>Unspecified leishmaniasis</td>
<td>The seed is powdered and pasted with butter</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nicandraphysalisodites (L.) Gaertn.</td>
<td>Solanaceae</td>
<td>Machara(Or)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Unspecified leishmaniasis</td>
<td>Powdered leaf is mixed with water and drunk</td>
<td>Oral</td>
<td>[20]</td>
</tr>
<tr>
<td>13</td>
<td>Plectranthusspp.</td>
<td>Lamiaceae</td>
<td>Dachet(Or)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Unspecified leishmaniasis</td>
<td>Crush paste</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Clematis hirsute Perr &amp; Guill</td>
<td>Ranunculaceae</td>
<td>Azohareg(Or)</td>
<td>Climber</td>
<td>Leaf</td>
<td>Unspecified leishmaniasis</td>
<td>Mildly heated Powder paste</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Hordeum vulgare L.</td>
<td>Poaceae</td>
<td>Gebis (Am)</td>
<td>Herb</td>
<td>Seed</td>
<td>Visceral leishmaniasis</td>
<td>Bandaging/ Dressing</td>
<td>Barelly dough (Ligus) is prepared; bread is baked from this Ligus and applied on the wound as bandage with the hot inner soft part</td>
<td>Topical</td>
</tr>
<tr>
<td>17</td>
<td>Ficusvasta forssk.</td>
<td>Moraceae</td>
<td>Shola (Am)</td>
<td>Tree</td>
<td>Latex</td>
<td>Visceral leishmaniasis</td>
<td>Topical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Clematis hirsute Perr and Guill</td>
<td>Ranunculaceae</td>
<td>Yeazo Areg (Am)</td>
<td>Climber</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Bandaging/ Dressing</td>
<td>The leaves are crushed into powder and applied as bandage on the wound.</td>
<td>Topical</td>
</tr>
<tr>
<td>19</td>
<td>Rehmannusprinoides L. Herit.</td>
<td>Rhamnaceae</td>
<td>Gesho (Am)</td>
<td>Shrub</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Bandaging/ Dressing</td>
<td>The roots are crushed and applied bandage on the wound.</td>
<td>Topical</td>
</tr>
<tr>
<td>20</td>
<td>Rumex abyssinicus Jacq</td>
<td>Polygonaceae</td>
<td>Mekmeko (Am)</td>
<td>Herb</td>
<td>Root</td>
<td>Visceral leishmaniasis</td>
<td>Bandaging/ Dressing</td>
<td>The roots are crushed and applied bandage on the wound.</td>
<td>Topical</td>
</tr>
<tr>
<td>21</td>
<td>Ranunculus multifidus Forssk.</td>
<td>Ranunculaceae</td>
<td>Ellesyol (Am)</td>
<td>Herb</td>
<td>Leaf</td>
<td>Visceral leishmaniasis</td>
<td>Bandaging/ Dressing</td>
<td>The leaves are pounded to powder and mixed with honey (to attach) and applied on the wound</td>
<td>Topical</td>
</tr>
</tbody>
</table>
Results

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 have 13.8% (n=4) and nasal 6.9% (n=2) way of administration. Only one preparation was intended to be administered orally (Figure 4).

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).
Articles obtained from database search n= (206)

Duplicates excluded n= (108)

Titles and abstracts screened (n=90)

Excluded studies (n=84)
• Totally irrelevant (n=76)
• Only live stock treatment (n=8)

Full text article retrieved (n= 14)

Excluded full text article (n=3)
Reported insufficient information (n=3)

Included full text articles (n=11)

Figure 1: Flow diagram of study selection.

Figure 2: Proportion of growth form of medicinal plants used for treatment of Leishmaniasis.

Figure 3: Proportion of plant parts used for treatment of Leishmaniasis.
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.

Acknowledgment

Not applicable

References