



A review of the most important medicinal herbs affecting giardiasis

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ABSTRACT

Infection due to the protozoa giardia is one of the most common parasitic infections in the world. Millions of people across the world acquire this infection each year. The most common clinical symptoms of giardiasis include abdominal pain, bloating and diarrhea, indigestion, epigastric pain, nausea, vomiting, and oily feces with bad smell. Drugs used for giardiasis lead to certain side effects, such as unpleasant taste in the mouth, gastrointestinal discomfort, nausea, headache and leukopenia. Considering the importance of giardiasis infection, it is essential to identify anti-parasitic herbal drugs to eliminate cystic and trophozoite types of this disease. Hence, this article is aimed to report the medicinal plants that are used in Iranian traditional medicine against giardiasis. The information in this review study was obtained from scientific articles indexed in databases such as ISI, PubMed, Scopus, SID, Magiran and Google Scholar that were retrieved using the search terms giardia, protozoa, herbs, extracts and essential oils. Medicinal plants such as *Lavandula stoechas*, *Ferula assa-foetida*, *Tanacetum parthenium*, *Allium paradoxum*, *Chenopodium botrys*, *Carum copticum*, *Allium sativum*, *Artemisia annua*, *Allium ascalonicum*, *Ziziphora clinopodioides*, *Zataria multiflorahad*, *Eucalyptus globulus*, *Lippia berlandieri*, *Punica granatum* are among the most important herbs used in Iranian herbal medicine as anti-giardiasis agents. These herbs are good candidates to produce natural and effective drugs for giardia.

Implication for health policy/practice/research/medical education:

This article presented useful information about anti-giardiasis plants which could help pharmacists and scientists in provision of new drugs.

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Introduction

Giardiasis is a parasitic disease caused by a flagellated protozoa called *Giardia lamblia*, *Giardia intestinalis* or *Giardia duodenalis* (1,2). Infection caused by this parasite has been reported from all over the world, including various regions of Iran. Infection due to the Protozoa giardia is one of the most common parasitic infections in the world. Millions of people worldwide acquire this parasite every year (3). Transmission of this disease occurs through fecal-oral route, especially through contaminated food and water intake. The most important route of transmission is contaminated drinking water

(4). The incidence of this infection has been observed in children more than other age groups (5). Prevalence of giardiasis, as with most intestinal diseases, varies depending on the health status and is more common in temperate and tropical climates than cold regions (6,7). The most common clinical symptoms of giardiasis include abdominal pain, bloating and diarrhea. Other symptoms include indigestion, epigastric pain, nausea, vomiting, and fatty stools with bad smell (8,9).

Common medications for the treatment of this disease include nitroimidazole derivatives including tinidazole, ornidazole, metronidazole and nimorazole, benzimidazole

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derivatives such as mebendazole and albendazole, and other drugs such as quinacrine, furazolidone and paromomycin, among which metronidazole is a selective drug for the treatment of giardiasis. These drugs have unpleasant side effects such as an unpleasant taste in the mouth, gastrointestinal discomfort, nausea, headache and leukopenia. In addition, some of these drugs can lead to neurotoxic effects, restlessness, seizures and dizziness, and disrupt the process of the treatment. In addition, the mutagenic, carcinogenic, and adverse effects of some of them on the embryo have been demonstrated by studies on laboratory animals (10-12). As the giardiasis infection is transmitted and spread by cyst, different ways have been recommended to remove cyst, one of which is the use of plants and natural nutrients to eliminate the cyst of the parasite (13,14). Medicinal plants and plant products have always been used to treat pain and illnesses from the old times (15-17), because when chemical drugs were not available, humans used these natural and accessible sources for treatment (18-21). Considering the importance of giardiasis, it is necessary to study the effect of anti-parasitic herbal drugs on the elimination of cystic and trophozoite forms of the disease. On the other hand, many herbal drugs have been discovered and used for the treatment of protozoan diseases. Therefore, it is particularly important to review such drugs, especially anti-giardia herbal drugs, because they can be used to produce effective natural drugs for this infectious agent. Hence, this article is aimed to report the medicinal plants that are used in Iranian traditional medicine against giardiasis

Methods

The information in this review study was obtained from scientific articles indexed in databases such as ISI, PubMed, Scopus, SID, Magiran and Google Scholar that were retrieved using the search terms *giardia*, *protozoa*, *herbs*, *extracts* and *essential oils*.

Results

Medicinal plants such as *Lavandula stoechas*, *Ferula assa-foetida*, *Tanacetum parthenium*, *Allium paradoxum*, *Chenopodium botrys*, *Carum copticum*, *Allium sativum*, *Artemisia annua*, *Allium ascalonicum*, *Ziziphora clinopodioides*, *Zataria multiflorahad*, *Eucalyptus globulus*, *Lippia berlandieri*, *Punica granatum* are among the most important herbs used in Iranian herbal medicine as anti-giardiasis agents. The herbs with anti-Giardia properties are described below and summarized in Table 1.

Lavandula stoechas L

This herbal plant belongs to Lamiaceae family. The results of the studies have shown that lavender plants are very effective in intravenous conditions and have a therapeutic potential for Giardia infection. So that the dose of 400

mg/mL of hydroalcoholic extract of lavender is effective against *Giardia lamblia* (22).

Ferula assa-foetida

This herbal plant belongs to Apiaceae family. Alcoholic and aqueous extracts of *Ferula assa-foetida* had positive effects on *Giardia lamblia* cysts. The effect of fecundity of the alcoholic extract was greater than that of the aqueous extract. The percentage of fecundity of the alcoholic extract of *Ferula assa-foetida* was 37% at a concentration of 20 mg/mL and at the fourth hour it was 100%. While the highest percentage of fecundity of the aqueous extract of Angus, at the same temperature and concentration in the fourth hour was 57.23 mg/mL (23). After 4 hours, the effect of the plant was 100%.

Tanacetum parthenium

This herbal plant belongs to Asteraceae family. Based on the results of a study, chloroform extract of *Tanacetum parthenium*, at a concentration of 100 mg/mL, was effective in the treatment of *Giardia lamblia* infection of Balb/C mice (24).

Allium paradoxum

This herbal plant belongs to Asteraceae family. Alcoholic hydroalcoholic extract of *Allium paradoxum* with 100 mg/mL could eliminate *Giardia lamblia* cysts in Balb/C mice. Therefore, hydroalcoholic extracts of *Allium paradoxum* can be introduced as a natural anti-giardia compound (25).

Chenopodium botrys L

This herbal plant belongs to Amaranthaceae family. The results of a study showed that the alcoholic and aqueous extracts of Turkish *Chenopodium botrys* seeds in vitro had a deleterious effect on *Giardia lamblia* cysts. The harmful effect of the alcoholic extract of this plant was greater than its aqueous extract. The effect of Turkish *Artemisia* alcoholic extract at a temperature of 37°C, concentration of 20 mg/mL, at fourth hour was 100%. While the highest germination percentage of aqueous extract of *Artemisia turkey* with the same concentrations was 66.1 (26).

Carum copticum

This herbal plant belongs to Apiaceae family. The results of a study showed that its alcoholic extract as well as its essential oil had good effects on *Giardia lamblia* cysts under laboratory conditions. The results of this study showed that after 60 minutes contact of hydroalcoholic extract and essential oil on *Giardia lamblia* cysts, the MICs of *Carum copticum* were 100 and 8 mg/mL, respectively (27).

Allium sativum

This herbal plant belongs to Amaryllidaceae family. It

Table 1. Bioactive compounds of herbal plants

Scientific name	Active ingredients	Plant figure
<i>Lavandula stoechas</i> L	Flavonoids, phenolic acids, diprenes, triplepenes, tannins, materials as bitter, resins, saponin (22)	
<i>Ferula assa-foetida</i>	α -Pinene, β -pinene, sabinene, eremophilene, β -caryophyllene and himachalen-7-ol (23)	
<i>Tanacetum parthenium</i>	Parthenolide (24)	
<i>Allium paradoxum</i>	Limonen, Spathulenol, alpha-Bisabolol, Z-Nerolidol, n-Tricosane, n-Docosane (25)	
<i>Chenopodium botrys</i> L	Linoleic acid, ferrozine (3-(2-pyridyl)-5,6-bis (4-phenyl-sulfonic acid)-1,2,4-triazine) (26)	
<i>Carum copticum</i>	Thymol, Trinin, Pinen and Myrcens (27)	
<i>Allium sativum</i>	Allicin (28)	
<i>Artemisia annua</i>	Artemisinin (29)	

Table 1. Continued

Scientific name	Active ingredients	Plant figure
<i>Allium ascalonicum</i>	Thymol and carvacrol (30)	
<i>Ziziphora clinopodioides</i>	Thymol and phenolic compounds (31)	
<i>Zataria multiflorahad</i>	Thymol and carvacrol (32)	
<i>Eucalyptus globulus</i>	Cineol (33)	
<i>Lippia berlandieri</i>	Tannin and verinalin (34)	
<i>Punica granatum</i>	Resin compounds (34)	

has been reported that Garlic extract is quite effective on *Giardia* cysts. Although the treatment of infected mice during 3 days at 20 and 40 mg/kg body weight of garlic extract did not completely improve all of the mice, the dose of 80 mg/kg of body weight during three days resulted in their complete recovery (28).

Artemisia annua

This herbal plant belongs to Asteraceae family. According

to the results of a study, hydroalcoholic extract of *Artemisia annua* plant at a concentration of 100 mg/mL for 24 hours used as an effective compound for the elimination of *giardia* cysts (29).

Allium ascalonicum

The results of one study showed that *Allium ascalonicum* (0.2 mg/mL) inhibited *Giardia*. It is known that the main compounds of this plant are disulfides (30).

Ziziphora clinopodioides

The inhibitory dose of *Ziziphora clinopodioides* (zirica) has been reported to be 0.015 mg/mL. It is known that the main compounds of this plant are thymol and phenols (31).

Zataria multiflorahad

a dose of 0.01 mg/mL of *Zataria multiflorahad* has had anti-*Giardia* effects. The main components of this plant are thymol and carvacrol (32).

Eucalyptus globulus

Eucalyptus (*Eucalyptus globulus*) at a dose of 0.022 mg/mL has had anti-*Giardia* effect due to the presence of active substances such as cineol (33).

Lippia berlandieri

The *Lippia berlandieri* plant at a dose of 0.85 mg/mL has shown to possess anti-*Giardia* effect due to the presence of substances such as tannins and verinalin (34).

Punica granatum

The pomegranate at a dose of 17 mg/mL has anti-*Giardia* effect due to its peppery content (31). The marked mango is composed of resin compounds. Based on the results of a study, it has been determined that mangoes with a dose of 212 mg/mL has anti-*Giardia* effect (34).

Discussion

Based on the results, medicinal plants such as *Lavandula stoechas*, *Ferula assa-foetida*, *Tanacetum parthenium*, *Allium paradoxum*, *Chenopodium botrys*, *Carum copticum*, *Allium sativum*, *Artemisia annua*, *Allium ascalonicum*, *Ziziphora clinopodioides*, *Zataria multiflorahad*, *Eucalyptus globulus*, *Lippia berlandieri* and *Punica granatum* are important herbs used in Iranian herbal medicine as anti-giardiasis agents. In traditional medicine, *Lavandula stoechas* is used to treat the common cold, reduce blood pressure, treat headache, reduce stress, induce relaxation (35,36). The plant contains active ingredients including flavonoids, phenolic acids, diterpenes, triterpene, tannins, bitter substances, resin, and saponin (37). *Allium paradoxum* has antiparasitic, antibacterial, anti-cancer and antioxidant effects (38-43). In traditional medicine, *Chenopodium botrys* has been used as an anti-parasitic plant (43). In traditional medicine, *Carum copticum* is used as carminative, anti-nausea, tonic, anthelmintic, diuretic and hypocholesterolemic plant, as well as an expectorant and spasm reliever. This plant serves as an appetite stimulant, and the fruit of the plant is traditionally used as a food flavoring (44). The plant contains compounds such as thymol, terpinene, phellandrene, pinene group, cymene group and myrcene, which are mainly oxygenated monoterpenes (45). Garlic is one of the medicinal plants that produce anti-parasitic and antimicrobial effects (46).

One of the important compounds of *Allium sativum* is allicin (47). In traditional medicine, *Artemisia annua* was used as an anti-parasite and anti-malarial agents (48-50). The most important compound that has been isolated from the *Artemisia annua* is artemisinin (51-60). *Giardia* is one of the most common gastrointestinal parasites that causes various personal and social problems. Drugs such as metronidazole, furazolidone and paramomycin are prescribed for giardia and its species. The exact mechanism actions of the medicinal plants are not clear. Metronidazole causes the death of microorganisms by preventing subsequent replication. Probably the herbal drugs and bioactive compounds of this study, through a mechanism similar to the metronidazole mechanism, caused the death of *Giardia's* parasite. It should be noted that polyphenols which are abundant in most of these plants have been shown to possess anti-giardiasis effects (31).

Conclusion

The medicinal plants can produce anti-parasitic effects due to their active ingredients and antioxidant compounds, and can be used as effective natural anti-giardiasis drugs.

Authors' contributions

All authors all contributed equally in planning and carrying out this study. All authors read the manuscript and confirmed the publication for final version.

Conflict of interest

None.

Ethical considerations

Not applicable.

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