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Systematic Review

A Systematic Review of Medicinal Plants with Anti-Entamoeba histolytica Activity: Phytochemistry, Efficacy, and Clinical Potential

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Abstract

Background and objectives: Amoebiasis, or amoebic dysentery, is a gastrointestinal disorder caused by the parasite *Entamoeba histolytica.* The disease is endemic in parts of Africa, Asia, North and South America, leading to several deaths annually. Reported adverse effects associated with the current first-line treatment for amoebiasis, coupled with the evolution of resistance to it, call for the need to search for plant-based alternatives. This study systematically reviews medicinal plants with activity against *Entamoeba histolytica*.

Methods: The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed to retrieve scholarly literature. The study reviewed 70 articles from 7 popular databases: Google Scholar, PubMed, ScienceDirect, Booksc.org, Emerald, Scopus, and MEDLINE, highlighting several plants with anti-amoebic properties.

Results: The primary parts of the plant used in the treatment of *Entamoeba histolytica* were the leaves (61%), followed by rhizomes (13%), roots (8%), seeds (8%), stems (4%), and fruits (4%). The families Asteraceae (18%) and Zingiberaceae (18%) contain most plants that are effective against *Entamoeba histolytica*. These medicinal plants families are rich in phytochemicals such as terpenoids and flavonoids that have anti-entamoeba histolytica activity. Maceration is the most commonly used extraction method.

Conclusions: The results suggest that plants are a promising source of new agents to combat amoebiasis caused by *Entamoeba histolytica.* The most frequently used plant parts were leaves (61%), and the maceration method was the most common extraction technique due to its simplicity and cost-effectiveness. The majority of studies were limited to *in vitro* models, with only one plant (*Adenophyllum aurantium*) tested *in vivo.* Further research is needed to establish their mechanisms of action, toxicities, and clinical potential.

Introduction

Amoebiasis, commonly known as amoebic dysentery, is a gastrointestinal illness caused by the protozoan parasite *Entamoeba histolytica (E. histolytica)*.[1] This pathogen invades the intestinal mucosa and, in severe cases, disseminates to extraintestinal sites such as the liver, causing life-threatening complications. According to a study by Nasrallah *et al*.,[2] intestinal amoebiasis is responsible for more than 55,000 deaths annually, making it the third leading cause of parasitic death globally, after malaria and schistosomiasis.

Though treatment with metronidazole and tinidazole is standard, emerging drug resistance and adverse effects have compromised treatment outcomes.[3]

In response to these limitations, there is renewed interest in plant-based therapies, especially in communities where traditional medicine remains the primary form of healthcare. Several medicinal plants have been historically used for gastrointestinal ailments, and recent pharmacological studies have begun to validate their anti-amoebic effects.[4]

Keywords: Medicinal plants; Maceration; Ethnobotany; Ethnomedicine; Amoebiasis; Dysentery, *Entamoeba histolytica*; Review.

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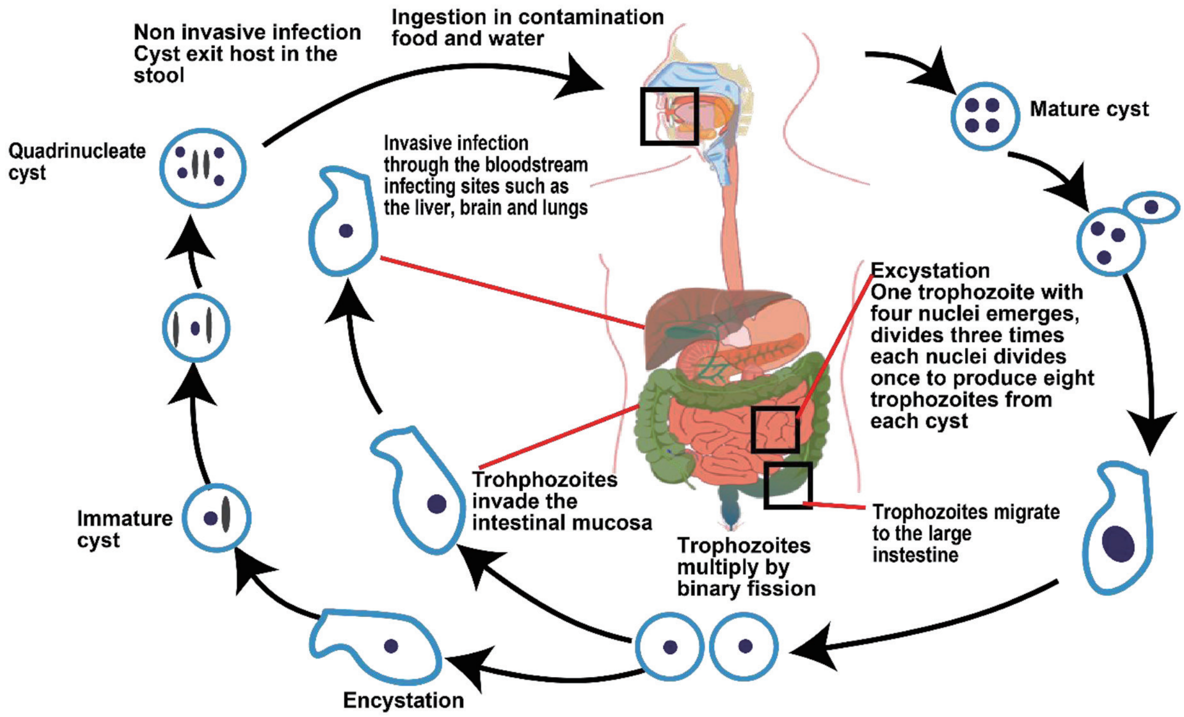

Fig. 1. The life cycle of *Entamoeba histolytica* (The figure was designed using Adobe Illustrator [Version 27.7.0.421] based on[13]).

This study systematically evaluates medicinal plants with anti-*E. histolytica* activity, analyzing their phytochemistry, efficacy, and clinical potential, with the aim of supporting future drug development and integration into public health strategies.

Most clinical cases of amoebiasis have been reported in developing countries such as Bangledesh, India, Mali, Algeria, Nepal, Congo, Kenya, South Africa, and Cameroon. A study by Morán *et al*.[5] indicated that intestinal amoebiasis causes more than 55,000 deaths yearly. South Africa alone has a prevalence rate of 12.4%. In 2012, Kenya and Uganda recorded clinical prevalence rates of 58.3% and 19.93%, respectively, for intestinal amoebiasis.[6,7] In Abidjan, the mortality rate is reported to be 15%. Most of the contributing factors to complications such as amoebic liver abscess and the lethality of the infection are attributed to late diagnosis, poor hygiene, poor water treatment, and poor sanitation.[2,8,9] The prevalence of *E. histolytica*-induced intestinal amoebiasis is reported to be 11.7% in India.[10] A similar prevalence rate (11%) has been reported in children from Bangladesh.[11] In North America, an annual incidence rate of one to five cases per 100,000 Mexicans was reported from 1995 to 2000, and 1,128.8 to 615.85 per 100,000 inhabitants from 2002 to 2006.[10] Amoebiasis is ranked among the 20 most lethal diseases in Mexico.[12] Amoebiasis is endemic in South America, including Brazil, Colombia, and Ecuador.

An individual contracts an *E. histolytica* infection by ingesting cysts from contaminated food or water. The mature cyst is resistant to low pH levels in the stomach, allowing it to withstand gastric acids. Once it reaches the intestine, intestinal trypsin degrades the cyst wall. Excystation occurs when the cyst arrives in the cecum or the lower part of the ileum.

When a cyst undergoes excystation, it releases eight active trophozoites, which are transported to the large intestine by peristalsis. There, they mature and reproduce by binary fission, feeding on the host's ingested materials.

Trophozoites attach to the mucus lining of the intestine using lectins and secrete proteolytic enzymes that lead to tissue destruction and necrosis. When these parasites enter the bloodstream, they can cause extraintestinal illnesses. As the number of trophozoites increases, some of them stop reproducing and revert to cyst form through a process called encystation. The cysts are then excreted in feces, contaminating food and water, which completes the life cycle (Fig. 1).[13]

Materials and methods

Search strategy

The study utilized various electronic databases, including Google Scholar, PubMed, ScienceDirect, Booksc.org, Emerald, Scopus, and MEDLINE, to search for scholarly publications on medicinal plants with anti-amoebic properties, revealing valuable insights into botanical remedies. A dataset of 70 publications was analyzed using keywords such as "amoebiasis", "medicinal plants with anti-amoebic properties", "medicinal plants with activity against *Entamoeba histolytica*", "geographical distribution", "overview of amoebiasis", and "plants with anti-amoebic properties", offering a thorough comprehension of the illness and possible natural remedies. The plants were identified through a review of existing literature that featured at least one study assessing their anti-amoebic properties.

Inclusion and exclusion criteria

The study analyzed articles published after 2009, excluding those in non-English languages. Articles were reviewed if they had validated botanical names, plant parts, extraction solvents, and medicinal uses. Active phytochemical constituents with anti-amoeba activity were also noted.

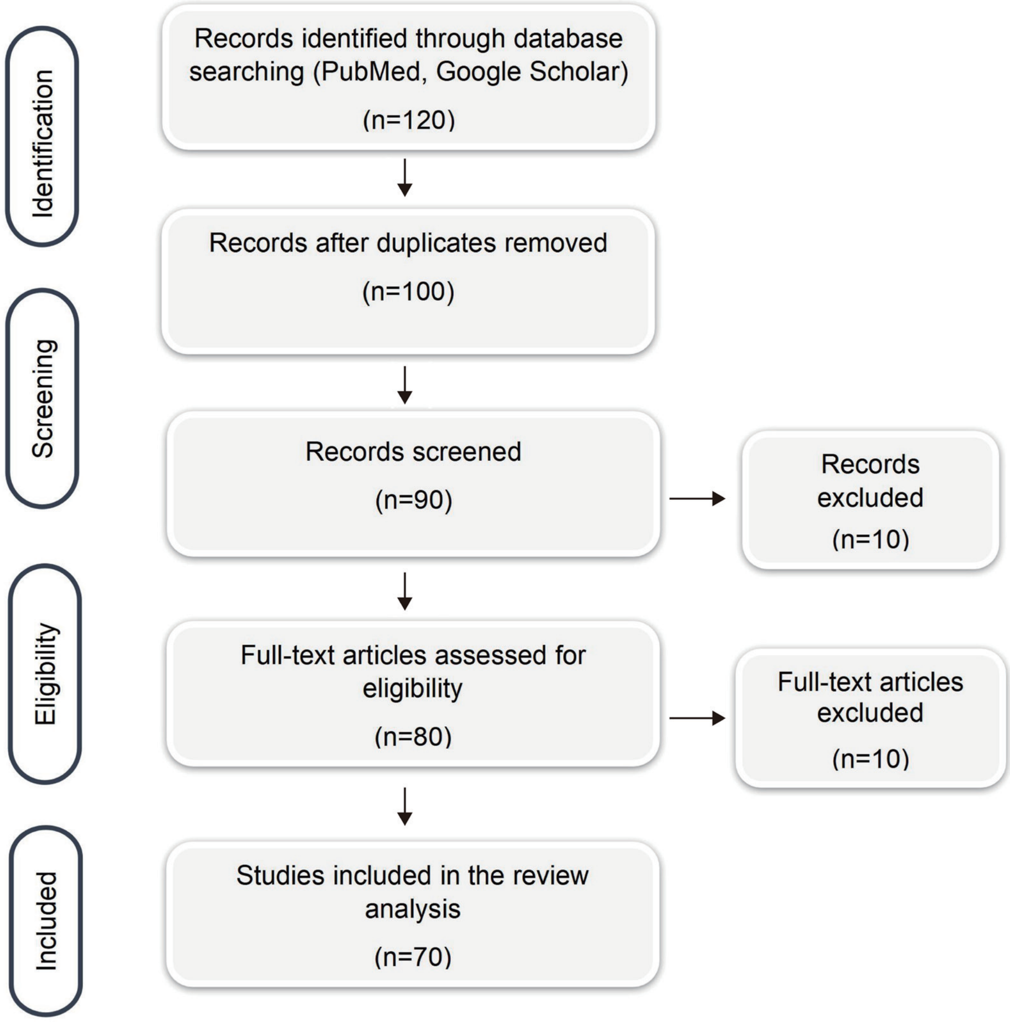

Fig. 2. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)-adapted flow diagram of the search strategy for the selection of articles for this review.

Studies that were excluded comprised those lacking primary experimental data, as well as studies not specifically focused on *E. histolytica*.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were used to conduct a thorough review, as described by Moher *et al*.[14]

This strategy was divided into four main stages, as illustrated in Figure 2. These stages included identifying relevant literature, screening the reports, reading the full text to determine eligibility, and applying exclusion and inclusion criteria.

Data analysis

The initial search strategy identified approximately 120 articles. Out of these, 90 studies met all the inclusion criteria for further screening. These studies were in English, had full text available, were related to the anti-amoebic properties of plants, and were dated mainly from 2009 to 2025. Each article was examined in various aspects, including the title, abstract, introduction, methods, results, discussion, and conclusion. Additionally, the inclusion and exclusion criteria, the sampling method, and whether valid instruments were used were checked. Ultimately, 80 studies were deemed relevant; however, 10 articles were excluded from the review, leaving 70 articles for further analysis.

Results

Table 1 outlines the scientific name, family name, chemical constituents, extraction method, parts used, and other traditional uses.[15–51] Approximately 21 plants were found to possess anti-amoeba properties.

Figure 3 presents a detailed graph illustrating the distribution of various plant parts, emphasizing key components such as leaves, roots, aerial parts, rhizomes, seeds, stems, and fruit. Conversely, Figure 4 offers a captivating depiction of plant family distribution, providing insights into the diversity and interrelationships among different plant groups.

Brief literature on plants reported to have anti-amoebic activity

Many plant-based medicines have been reported to possess anti-amoebic properties, including the following:

Table 1. A summary of the various plants reported to have anti-amoebic activities

Scientific name	Family name	Chemical constituents present in the plant	Preparation	Parts used	Type of study	Other traditional uses	Reference
Argemone Mexicana	Papaveraceae	Berberine, Protopine, Sanguinarine	Methanolic extraction by maceration	Leaves	*In vitro*	Respiratory infections, chronic diarrhea, dysentery, and peptic ulcers	27,28
Allium sativum	Amaryllidaceae	Allicin	Aqueous and ethanolic extraction by maceration	Leaves	*In vitro*	Alzheimer's disease, atherosclerosis, and diabetes	29,30
Artemisia ludoviciana	Asteraceae	Phenylpropanoids, Camphene, Germacrene D	Methanolic extraction by infusion	Leaves	*In vitro*	Coughs, sore throats, and colds	31,32
Adenophyllum aurantium	Asteraceae	Trans-pinocamphone, Limonene	Ethyl acetate extraction by infusion	Root	*In vivo*	Candidiasis and abdominal discomfort	21,33
Alpinia galanga	Zingiberaceae	1'acetoxychavicol acetate	Chloroform extraction by maceration	Rhizome	*In vitro*	Eczema, coryza, bronchitis, otitis interna, and gastritis	34,35
Boesenbergia rotunda	Zingiberaceae	Pinostrobin, Panduratin A	Methanolic and chloroform extraction by maceration	Rhizome	*In vitro*	Aphrodisiac and vasorelaxant properties	36,37
Curcuma longa	Zingiberaceae	Curcumin	Ethanolic extraction by maceration	Rhizomes	*In vitro*	Hepatoprotective, blood-purifying, antioxidant, liver tissue detoxifier, and regenerator	38,39
Carica papaya	Caricaceae	Benzyl isothiocyanate (BITC)	Aqueous extraction by maceration	Seed, Leaves	*In vitro*	Malaria, dengue fever, antiviral properties, and asthma	40,41
Cucurbita pepo	Cucurbitaceae	Cucurbitacins Phytosterols	Ethanolic extraction by maceration	Seed	*In vitro*	Anticarcinogenic, antidiabetic, and antihypertensive properties	42,43
Codiaeum variegatum	Euphorbiaceae	Ceramide	Aqueous extraction by maceration	Leaves	*In vitro*	Cancer, constipation, diabetes, and digestive problems	16,17
Dysphania ambrosioides	Amaranthaceae	Ascaridole	Methanolic extraction by infusion	Leaves	*In vitro*	Hypertension, bronchitis, respiratory conditions, and pharyngitis	18,44
Decachaeta incompta	Asteraceae	Incomptines A and B	Chloroform extraction by maceration	Leaves	*In vitro*	Bacterial infections like urinary tract infections	19,20
Euphorbia hirta	Euphorbiaceae	Tannins	Methanolic extraction by maceration	Leaves	*In vitro*	Diarrhoea, intestinal parasitosis, and peptic ulcers	45,46
Geranium mexicanum	Geraniaceae	Quercetin, Kaempferol, Epicatechin	Methylene chloride extraction by maceration	Leaves	*In vitro*	Antioxidant, anti-inflammatory, and antihypertensive	15,21
Lepidium virginicum	Brassicaceae	Glucosinolates	Methanolic extraction by maceration	Root	*In vitro*	Expectorant, diuretic, and anti-inflammatory	21,22
Lippia graveolens	Verbenaceae	Thymol, Carvacrol	Methanolic extraction by the Soxhlet system	Leaves	*In vitro*	Bacterial infections, digestive disorders, and inflammatory diseases	47,48
Ruta chalepensin	Rutaceae	Chalepensin	Methanolic extraction by the Soxhlet system	Leaves	*In vitro*	Lung conditions	23,24
Rubus coriifolius	Rosaceae	Anthocyanins Ellagitannins	Methanolic extraction by maceration	Leaves, Stem	*In vitro*	Diarrhea	49,50
Salvia polystachya	Lamiaceae	Linearolactone	Acetone extraction by chromatography	Leaves	*In vitro*	Antimalarial, antipyretic, antihemorrhagic, and heartburn	20,25
Xylopia aethiopica	Annonaceae	Xylopic acid Geraniin	Methanolic extraction by maceration	Fruit	*In vitro*	Boils, sores, wounds, and cuts	26
Zanthoxylum liebmannianum	Rutaceae	Skimmianine	Ethanolic extraction by maceration	Leaves	*In vitro*	Rheumatism, digestive disorders, and gastrointestinal disorders	21,51

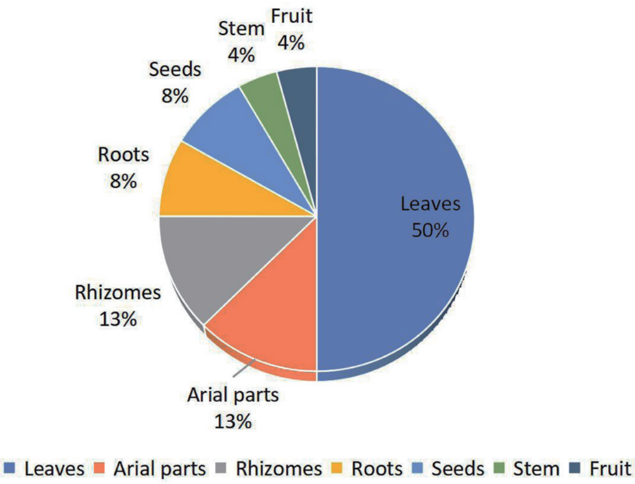

Fig. 3. Frequency of plant parts used in anti-amoebic preparations. Distribution of parts of the plants used in preparation shows that the leaves are the most (61%) used in the treatment. Other parts used are rhizomes (13%), roots (9%), seeds (9%), stems (4%), and fruits (4%).

Argemone Mexicana Papa, a weed that is native to Mexico and tends to grow in hard places and around farms.[52,53] In an *in vitro* study under axenic conditions, the methanolic extract of the leaves of *A. mexicana* exhibited growth inhibition against the trophozoites of the *E. histolytica* strain. The liquid chromatography-mass spectrometry examination of the extract's fractions revealed higher anti-amoebic activity, which pointed to the presence of jatrorrhizine and berberine alkaloids.[54]

- *Allium sativum L*., known as garlic, is a potent herb and spice that is derived from a tuber.[55] Allicin concentrations as low as 30 µg/mL from garlic extracts can inhibit amoeba growth.[56] Also, essential oil from the plant demonstrated a minimum inhibitory concentration (MIC) of 0.3 µg/mL against *E. histolytica* after 48 h of anti-amoebic action.[57]
- *Artemisia ludoviciana* Nutt. (Asteraceae) is a rhizomatous, white-woolly perennial herb that can grow up to 1 m tall and has a pungent sagebrush scent. *Artemisia ludoviciana*'*s* methanolic extract has been shown to have anti-*E. histolytica* activity with a half-maximal inhibitory concentration (IC_{50}) of 82.2 µg/mL.[15]
- *Adenophyllum aurantium (L.)* is an endemic herb in Mexico of the Asteraceae family that is traditionally known in Mexico as "arnica silvestre".[58] The ethyl acetate root extract is efficient against *E. histolytica* trophozoites as well as in preventing encystment, the growth of liver abscesses, fibronectin adhesion, and erythrophagocytosis, among other harmful stages of the parasite.[58] Thiophenes, which are the primary constituents of the extract and include 5-(4″-hydroxy-1″-butynyl)-2-2′-bithiophene and -terthienyl, may be responsible for this effect.
- *Boesenbergia rotunda* (L.) Mansf., often known as fingerroot, is a plant whose rhizomes are utilized in Asian nations as a spice and herbal remedy.[59] Both the methanol and chloroform extracts from this plant were rated as "active", with a half-maximal IC_{50} of less than 100 µg/mL against *E. histolytica* in a study.[60]
- *Carica papaya* L. is considered one of the most nutritious and medicinally important fruit crops of tropical and subtropical regions of the world. According to a study, immature seeds required an MIC of 62.5 µg/mL for the destruction of amoeba parasites, whereas mature seeds needed a MIC of 7.81 µg/mL.[61] One of the bioactive compounds found in *C. papaya* seeds and leaves is benzyl isothiocyanate, which has been shown to have anti-amoebic activities. The dysfunctional mitochondria of amoebas are thought to be primarily caused by benzyl isothiocyanate.[61] Again, the extract of papaya seeds that have been macerated in water possesses anti-amoebic properties against

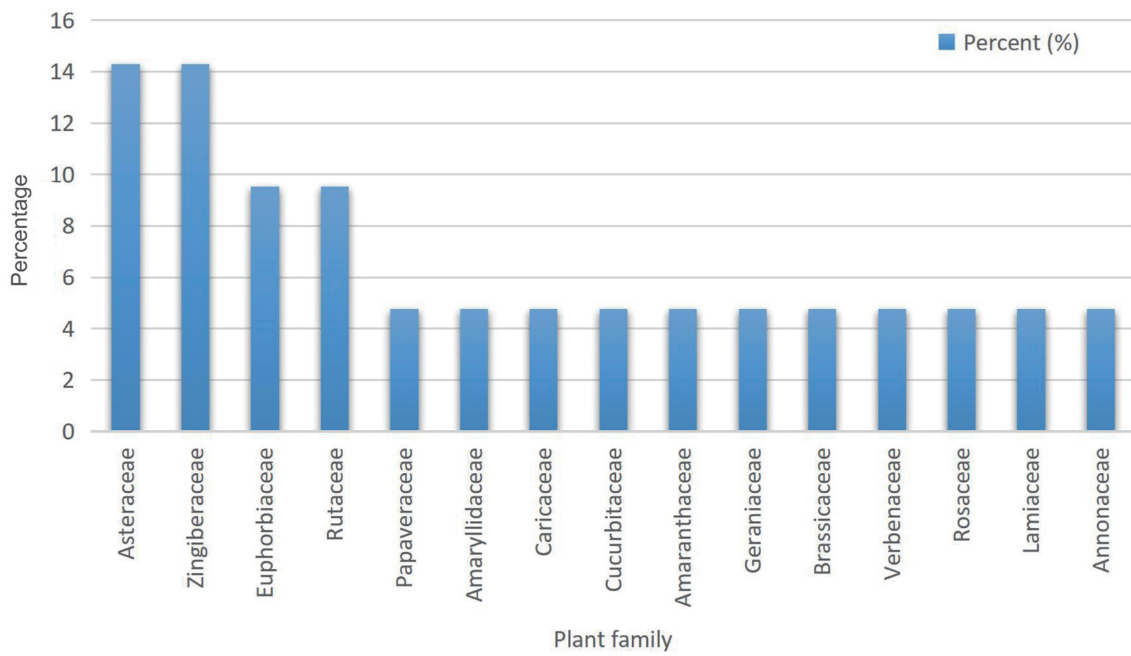

Fig. 4. A graph of the distribution of anti-amoebic plant families. Analysis of the reported plant families reveals Asteraceae (14%) and Zingiberaceae (14%) have species mostly reported to be effective in amoebiasis. Other significant families are Euphorbiaceae (10%) and Rutaceae (10%). The remaining families show 5% distribution.

E. histolytica.[62]

- *Cucurbita pepo* L. is a cultigen from Mexico, used for food, medicine, fuel, and other purposes. Research in Iraq indicates that the ethanolic extracts of plant seeds exhibited significant anti-amoebic activity against *E. histolytica*. The study results showed an MIC of 500 μg/mL.[63]
- *Curcuma longa* L. is a perennial herb characterized by its pointed leaves and funnel-shaped yellow flowers. It typically grows to a height of three to five feet and is widely cultivated in Asia, particularly in India, China, and other tropical countries.[64] Curcumin is thought to make up 2–5% of this plant. The ethanol extract of the rhizomes has been shown to have anti-amoebic action against *E. histolytica*.[64,65] Curcumin exhibits amoebic activity between 100 and 300 μg/mL, with a dose-dependent effect on the trophozoites, proliferation, and morphology of *E. histolytica*.[66]
- *Codiaeum variegatum*, often known as the miracle shrub, is a plant that is frequently used as a decorative interior plant.[16] The aqueous leaf extract of *Codiaeum variegatum* was also found to exhibit significant anti-amoebic activity (EC_{50} of 10.74 μg/mL, 48 h of incubation) in comparison to the reference drug metronidazole.[17] Ceramide is a bioactive lipid that was extracted and discovered by Mfotie Njoya *et al*.[17] from the leaves of *Codiaeum variegatum (L.)*. It exhibited anti-amoebic activity against *E. histolytica* by disrupting the cell cycle, including cell differentiation, proliferation, and growth suppression.
- *Dysphania ambrosioides L*. is a Moroccan medicinal plant used in the treatment of various illnesses. The methanolic extract of the leaf includes sitosterol, stigmasterol, octadecanoic acid, scopoletin, and piperoylpiperidine, which have been shown to have activity against *E. histolytica*.[18] Additionally, ascaridole, which was shown to be the primary component of the essential oil *from D. ambrosioides* leaves, demonstrated *in vitro* efficacy against *E. histolytica* parasites.[67] The oil showed a half-maximal IC_{50} of 0.7 μg/mL, with partial efficacy to provide consistent protection against the *in vivo E. histolytica* model. This could be attributed to the rich content of ascaridole epoxide (45.5%) and cis-Ascaridole (34.2%) present in its leaves.[68]
- *Decachaeta incompta (DC.)* is a Mesoamerican flowering plant that has historically been used in Oaxaca.[19] The extract's half-maximal IC_{50} value for *E. histolytica* is 132.4 μg/mL, indicating its antiprotozoal activity.[20] The bioactive compounds known as incomptines A (72) and B (73) had an antiprotozoal impact on *E. histolytica* at 7.9 μM and 24.6 μM, respectively.[69] Enolase, ferredoxin oxidoreductase, and fructose 1,6-bisphosphate aldolase are three glycolytic enzymes that incomptine A has been shown to downregulate, which can disrupt energy metabolism and impair the proliferation of *E. histolytica*.[70]
- *Geranium mexicanum Kunth.,* belongs to the Geraniaceae family.[15] Its aerial portions, when extracted with methylene chloride, contained flavonoids which are effective against *E. histolytica*.[21] The flavonoids include kaempferol, tiliroside, and epicatechin. The most effective flavonoid is epicatechin, shows high efficacy against *E. histolytica* trophozoites.[71]
- *Lepidium virginicum L.,* commonly known as Virginia pepperweed or least pepperwort, is an herbaceous plant belonging to the mustard family (Brassicaceae). This plant is native to much of North America, including most of the United States, Mexico, and southern regions of Canada.[72] *Lepidium virginicum L*. was shown to be highly efficient against *E. histolytica* in a study by Ranasinghe *et al*.,[73] with a collective mean half-maximal IC_{50} of 198.63 μg/mL. Also, the methanolic extract of the roots of *Lepidium virginicum L*. was studied using a bioassay-guided approach, and the results revealed the compound benzyl glucosinolate as having amoebicidal action (IC_{50} = 50.0 μg/mL).[21,22]
- *Lippia graveolens* Kunth, a species of flowering plant in the Verbenaceae family, is native to the southwestern United States (Texas and southern New Mexico), Mexico, and Central America as far south as Nicaragua. The antiprotozoal action of *Lippia graveolens* extracts against *E. histolytica* is directly correlated with the content of the flavonoids identified in this plant. Significant growth inhibition of *E. histolytica* was exhibited by the isolated and purified flavonoids from *L. graveolens* (52% to 97% at a concentration of 150 μg/mL).[74]
- *Ruta chalepensis Pers*. typically grows in the mountains to an elevation of 1,000 meters above sea level. With a self-supporting growth habit, this tall subshrub (0.4–1 m tall) has light green leaves and a slender, wooden stem.[23] The parasite *E. histolytica*, the main cause of amoebiasis in humans, was found to be susceptible to the antiprotozoal effects of chalepensin (3-prenylated furanocoumarin).[24] This was isolated from the methanolic extract of the aerial parts of *R. chalepensis*. At a concentration of 150 μg/mL, 84.66% growth inhibition was seen against *E. histolytica*.
- *Rubus coriifolius* Liebm. is a Mesoamerican species of brambles in the rose family. It grows in central and southern Mexico (from Chiapas as far north as Tamaulipas) and Central America (Guatemala, Honduras, Nicaragua). The dichloromethane-methanolic extract has demonstrated the highest efficacy among the crude fractions against *E. histolytica*, exhibiting a half-maximal IC_{50} value of 55.6 μg/mL.[15] Epicatechin, catechin, nigaichigoside, β-sitosterol-3-O-D-glucopyranoside, hyperin, gallic acid, and ellagic acid, among other isolated compounds, had half-maximal IC_{50} values of 1.9, 65.5, 111.9, 82.16, 143.6, 220, and 56.5 μg/mL against *E. histolytica*, respectively.[15]
- In Mexican traditional medicine, *Salvia polystachya* Ort., often known as chia, is used as a purgative, antigastralgic, antimalarial, antipyretic, antihemorrhagic, and for heartburn and dysentery.[20,25] Diterpenoids were extracted from *Salvia polystachya Cav*. leaves and their antiprotozoal activity was assessed.[20,21] Linearolactone was found to be the most effective derivative against *E. histolytica*, with half-maximal IC_{50} values of 22.9 μg/mL.
- *Xylopia aethiopica* A. is also known as negro pepper, African pepper, Guinea pepper, and many more. Lowland rainforests, wet fringe forests, savanna regions, and coastal regions of Africa are its native habitats.[26] According to a study, xylopic acid and geraniin are effective against *E. histolytica*, with half-maximal IC_{50} values of 4.80 μg/mL (13.30 mM) and 34.71 μg/mL (36.44 mM), respectively.[75]
- *Zanthoxylum liebmannianum P*. Wilson, a member of the Rutaceae family, is also referred to as pickleweed.[21] *Zanthoxylum liebmannianum* was one of the 80 species studied that showed positive activity against *E. histolytica*.[76] Flavonoids, lignans, and sterols were present in the ethanolic leaf extracts that showed effectiveness against *E. histolytica*.[76]

Discussion

The use of medicinal plants is on the rise in both developed and developing countries. The underlying principle of their use is that these plants contain specific biologically active substances that affect the metabolic processes in humans.[77]

After researching the relevant databases, it was found that approximately 21 medicinal plants exhibit anti-amoebic activity against *E. histolytica*. These plants contain specific phytochemicals that can inhibit the growth of this organism. Notable among these phytochemicals are curcumin, allicin, and papain.[21]

The study reviewed the distribution of parts of the plants used in preparations for treatment against *E. histolytica* and included leaves (61%), rhizomes (13%), roots (9%), seeds (9%), stems (4%), and fruits (4%). The most commonly used plant part was leaves because of their rich concentration of bioactive compounds and their ease of accessibility.

The Asteraceae (14%) and Zingiberaceae (14%) families contained the most plants that are effective against *E. histolytica*, followed by the Euphorbiaceae (10%) and Rutaceae (10%) families, as reported in Figure 4. Both the Asteraceae and Zingiberaceae families are rich in terpenoids and flavonoids, which are known to exhibit activity against *E. histolytica*.[78]

Maceration was the most commonly used extraction method.[79] It involves soaking plant materials in a liquid for an extended period to effectively extract desired compounds.[80] Its popularity stems from its simplicity and lack of specialized equipment. The prolonged interaction enhances the extraction process, yielding a rich array of beneficial substances.[81] This method is not only effective but also cost-efficient, as it requires minimal equipment and can be scaled using community-level resources. Recent studies by Sankeshwari *et al*.[82] showed that cold maceration can extract compounds with improved antimicrobial properties, offering the potential for more effective natural remedies. These reports dovetail with our analysis, as seen in Table 1, where maceration was the most reported method of preparation.

The predominant study design employed was *in vitro*, with nearly all 21 plants evaluated through laboratory-based assays that measured trophozoite growth inhibition, typically using IC_{50} values. However, this approach introduces a limitation when attempting to extrapolate findings to clinical or *in vivo* settings, where factors such as pharmacokinetics, host immune response, and toxicity can significantly influence outcomes. Additionally, there was considerable variation in dosage ranges and concentrations across studies, and many did not report toxicity thresholds for host cells, leaving the therapeutic index uncertain. Furthermore, without cytotoxicity testing or established safety margins, even plants known for their high anti-amoebic activity (such as *Xylopia aethiopica* and *Curcuma longa*) cannot be assumed to be safe for prolonged or high-dose usage.

The plants identified above provide a valuable foundation for integrating medicinal plants into current healthcare strategies for managing amoebic dysentery, especially in regions where access to conventional drugs is limited. Water and alcohol-based extracts (especially those obtained via maceration) retain significant bioactivity, suggesting a feasible starting point for phytopharmaceutical product development.

Most of the plants identified are locally available, culturally accepted, and already in informal use, which provides a practical pathway for integrating these treatments into primary healthcare settings, especially in developing countries.

There are economic and infrastructural limitations that could hinder mass production and formal integration of these remedies. Standardizing doses, ensuring consistent phytochemical content, conducting toxicity testing, and obtaining regulatory approval can be costly and time-consuming, often requiring advanced laboratory infrastructure that is not readily accessible in many developing countries.

These plants demonstrate distinct strategic values: one focuses on safety and accessibility, while the other prioritizes high efficacy. Future research should emphasize *in vivo* studies, toxicological assessments, and controlled clinical trials to determine dosage parameters, therapeutic index, and formulation strategies.

Argenone Mexicana, Allium Sativum, and *Artemisia Ludoviciana* are plants noteworthy for their effectiveness against *E. histolytica*. Crude extracts can be obtained using solvents such as methanol, ethanol, and water. *Allium Sativum* contains allicin, which has been found to reduce the virulence of *E. histolytica* trophozoites by 90%.[15]

Also, an *in vivo* study has shown that *Adenophyllum aurantium* can help prevent liver abscesses associated with infection.[58] The chloroform extracts of *Alpinia galanga* had strong anti-amoebic activity, with an IC_{50} value of 55.2 μg/mL, making it more effective than other solvents like methanol and water. Both the methanol and chloroform extracts from *Boesenbergia pandurata* were considered "active", with an IC_{50} of less than 100 μg/mL against *E. histolytica*.[21] *Curcuma longa, Carica papaya, Cucurbita pepo*, and *Codiaeum variegatum* have been identified as possessing anti-amoeba activity. Curcumin, a key phytochemical in Curcuma longa, is recognized for its pharmacological effects. The seeds and leaves of *Carica papaya*, when macerated in water, release the compound Benzyl isothiocyanate, which contributes to mitochondrial dysfunction in *E. histolytica*. Although primarily regarded as a decorative plant, *Codiaeum variegatum* has also demonstrated the ability to disrupt the cell membrane of *E. histolytica.*[16,17]

Dysphania ambrosioides, Decachaeta incompta, Euphorbia hirta, and *Geranium mexicanum* are all medicinal plants noteworthy for their effectiveness against *E. histolytica*. *Dysphania ambrosioides* contains essential oil rich in ascaridole, while *Decachaeta incompta* contains incomptine A, which disrupts the energy metabolism and impairs the proliferation of *E. histolytica*. *Euphorbia hirta* negatively affects the function of enzymes, such as alkaline phosphatase, which are essential for the survival and metabolism of *E. histolytica*. A study also compared the efficacy of *Geranium mexicanum* with that of metronidazole; the results showed that *Geranium mexicanum* exhibited higher efficacy than metronidazole in an *in vitro* study.[50]

Lepidium virginicum, Lippia graveolens, Ruta chalepensin, and *Rubus coriifolius* have demonstrated activity against *E. histolytica*. *Lepidium virginicum* contains the phytochemical benzyl glucosinolate, which has been shown to possess amoebicidal properties. Additionally, *Ruta chalepensin*, which contains the active compound chalepensin, is effective in inhibiting the growth of *E. histolytica*.[23,24]

Salvia polystachya, Xylopia aethiopica, and *Zanthoxylum liebmannianum* are well-known medicinal plants. Aside from their uses for various conditions, such as their anti-inflammatory and anti-hypertensive properties, these plants have demonstrated activity against *E. histolytica*. Among the phytochemicals found in *Salvia polystachya*, linearolactone is noted to be the most effective against *E. histolytica*. Xylopic acid, extracted from *Xylopia aethiopica*, has an IC_{50} value of 4.80 μg/mL, indicating its activity against this parasite. Additionally, the ethanolic leaf extract of *Zanthoxylum liebmannianum* has also shown efficacy against *E. histolytica*.[21]

These plants demonstrate distinct strategic values: one focuses on safety and accessibility, while the other prioritizes high efficacy. Future research should emphasize *in vivo* studies, toxicological assessments, and controlled clinical trials to determine dosage parameters, therapeutic index, and formulation strategies.

Implications for sustainability

The anti-amoeba properties found in specific plant families have significant implications across various fields. The predominance of Asteraceae and Zingiberaceae, each making up about 14%, along with Euphorbiaceae (10%) and Rutaceae (10%), suggests clear targets for pharmaceutical research, thereby guiding drug discovery initiatives. This focused distribution indicates that these families are likely to share common biochemical pathways or molecular structures that confer their anti-amoeba properties, potentially speeding up the discovery of new therapeutic compounds. These results call for focused conservation efforts, especially for these four families, which together represent 48% of identified anti-amoeba plants. This data also provides empirical support for certain traditional medicinal practices, especially those utilizing species from these dominant families.

From an economic perspective, this distribution pattern reveals specific opportunities for sustainable cultivation and the advancement of biotechnology, especially in regions where these families occur naturally. The clear identification of high-value plant families enables a more efficient use of research resources and supports evidence-based conservation strategies. It also facilitates the cultivation and development of biotechnology, especially in regions where these families naturally occur.

Limitations

The significant dependence on readily accessible online databases, notably Google Scholar, PubMed, ScienceDirect, Booksc.org, Emerald, Scopus, and MEDLINE, underscores the potential for the omission of pertinent studies not indexed in these databases, particularly those emanating from regions with a rich tradition of medicinal plant research. This reliance may inadvertently exclude valuable contributions that are less prominently featured in mainstream academic discourse. Also, the preponderance of the studies examined were confined to *in vitro* models, except for *Adenophyllum aurantium*. This limitation poses challenges in extrapolating the findings to clinical applications. Moreover, numerous studies retrieved and reported in this work failed to sufficiently delineate the toxicity thresholds of the reported plants, resulting in an ambiguous therapeutic index that hinders the clinical application of most plants reported to be effective against *E. histolytica.*

Conclusions

The results suggest plants as a promising source of compounds to combat amoebiasis caused by *E. histolytica*. Asteraceae and Zingiberaceae families contain most plants that are effective against *E. histolytica.* Further research is needed to establish their mechanisms of action, toxicities, and clinical potentials. Overall, the study offers a thorough repository for the scientific community engaged in ethnobotany and drug discovery and development from medicinal plants.

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Conflict of interest

The authors declare that there are no conflicts of interest in this study.

Author contributions

Study design, statistical analysis, and manuscript drafting (SK, JAA); study analysis (MT, NNDN, AKQ); literature search (PBA, DK). All authors have approved the final version and publication of the manuscript.

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