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Medicinal Plants Effective Against *Toxoplasma gondii*, a Major Cause of Miscarriage: A Review

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A B S T R A C T

Objective: *Toxoplasmosis* is an infectious disease caused by the protozoan parasite *Toxoplasma gondii*, which poses a serious threat during pregnancy. Maternal infection can lead to transplacental transmission, resulting in grave complications such as congenital abnormalities, premature birth, and miscarriage. Timely prevention and treatment are crucial for safeguarding the health of both mother and foetus. This review aims to identify and report medicinal plants with potential efficacy against toxoplasmosis.

Methodology: A comprehensive review was conducted using keywords such as "toxoplasmosis," "parasitic infection," "traditional medicine," "medicinal plants," and "treatment." Relevant literature was retrieved from databases including Google Scholar, SID, Magiran, and Scopus, as well as classical Iranian traditional medicine sources. Irrelevant studies were excluded, and the selected literature was analysed to extract pertinent findings.

Results: The review identified a number of medicinal plants traditionally recognised for their antiparasitic properties and their role in enhancing the immune system. Notable among these are *Heracleum persicum* (Persian hogweed), *Foeniculum vulgare* (fennel), *Lawsonia inermis* (henna), *Trachyspermum ammi* (ajwain), *Allium sativum* (garlic), *Juglans regia* (walnut), *Zingiber officinale* (ginger), *Carum carvi* (black cumin), *Eucalyptus spp.*, *Ferula gummosa*, *Artemisia spp.*, *Marrubium vulgare*, *Salvia officinalis* (sage), *Lippia citriodora* (lemon verbena), *Myrtus communis*, *Curcuma longa* (turmeric), *Syzygium aromaticum* (clove), *Mentha spp.* (mint), *Sideritis spp.* (ironwort), *Scrophularia striata*, *Allium cepa* (onion), *Alyssum spp.*, *Lepidium sativum*, *Raphanus sativus* (radish), *Tagetes spp.*, *Taraxacum officinale* (dandelion), *Balsamodendron spp.*, saffron-coloured turmeric, *Ginkgo biloba*, *Olea europaea* (olive), *Sophora flavescens*, *Melia azedarach*, *Zataria multiflora*, *Dracocephalum spp.*, and *Stachys lavandulifolia*. These plants have been documented as potentially effective agents in controlling *T. gondii* infections linked to miscarriage.

Conclusion: The findings of this review suggest that numerous medicinal plants within the corpus of Iranian traditional medicine exhibit promising antiparasitic and immunomodulatory properties against *Toxoplasma gondii*. These botanicals may serve as adjunctive therapies in the management of toxoplasmosis, particularly in pregnant women. However, their use should be approached with caution and administered under professional medical supervision alongside conventional treatments to mitigate potential side effects and ensure safety.

Keywords: Infection, Parasite, *Toxoplasma gondii*, Toxoplasmosis, Medicinal Plants, Traditional Medicine

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Introduction

Toxoplasmosis, a parasitic infection, poses a serious threat to women's health, particularly during pregnancy. The disease can lead to severe complications for the fetus and cause long-term health consequences for the mother. Given the pivotal role of women as the cornerstone of family wellbeing, enhancing their awareness of chronic diseases such as toxoplasmosis can play a significant role in preventing health issues and empowering them to manage such infections effectively [1-3]. Toxoplasmosis is caused by the protozoan parasite Toxoplasma gondii, which can infect individuals at any age. However, the infection is particularly dangerous in pregnant women and immunocompromised individuals [4]. In most cases, toxoplasmosis remains asymptomatic. Nonetheless, some individuals may experience flu-like symptoms including fever, myalgia, and lymphadenopathy [4]. In severe instances, especially among immunosuppressed patients, the infection may lead to complications such as encephalitis or ocular damage [4]. Toxoplasma gondii is widely distributed around the globe, with estimates suggesting that over 40 million people in the United States alone are infected [5]. The parasite is capable of persisting in the host for extended periods—sometimes for life—yet in immunocompetent individuals, the infection generally remains latent and symptomless [5].

In contrast, toxoplasmosis in pregnant women or immunocompromised persons can result in life-threatening outcomes. Preventive measures are thus critically important for these high-risk groups [5]. The parasite can be transmitted via ingestion of undercooked meat or contaminated water, exposure to cat faeces, or contact with contaminated soil. While the infection often remains subclinical in healthy individuals, it can pose serious risks to the fetus during pregnancy and cause significant morbidity in immunocompromised individuals [6]. Symptoms, when present, tend to be mild and nonspecific, often resembling influenza. These may include low-grade fever, muscle pain, and swollen lymph nodes. In immunosuppressed individuals, however, toxoplasmosis may result in brain damage, ocular lesions, or involvement of other organs [7]. Ocular toxoplasmosis may manifest as blurred or reduced vision, ocular pain, redness, and photophobia. Although congenitally infected neonates are often asymptomatic at birth, they may develop neurological or ocular complications later in life [8].

Diagnosis of toxoplasmosis is typically made through serological testing of IgG and IgM antibodies. In certain cases, molecular testing or biopsy may be required. During pregnancy, analysis of amniotic fluid alongside ultrasonography is essential to assess potential fetal infection [9]. Maternal toxoplasmosis can lead to miscarriage, stillbirth, or preterm delivery [10]. Infections contracted during early gestation are associated with more severe fetal outcomes, such as neurodevelopmental disorders or internal organ damage, whereas later infections tend to result in less severe consequences [11].

Preventing toxoplasmosis is feasible through strict adherence to hygiene and awareness of transmission routes. Recommended practices include regular handwashing, thorough cooking of meat and shellfish, avoidance of unfiltered water, careful washing of fruits and vegetables, meticulous cleaning of kitchen utensils, and keeping cats indoors [12]. These measures collectively reduce the likelihood of infection.

Treatment strategies depend on the severity of the disease and the patient’s overall health status. In immunocompetent individuals, the infection often resolves spontaneously without pharmacological intervention [13]. However, in severe cases or among immunocompromised patients, treatment with medications such as pyrimethamine and sulfadiazine is necessary [13]. During pregnancy, therapy may involve spiramycin or a combination of pyrimethamine, sulfadiazine, and folinic acid, depending on the gestational age and fetal condition [14]. Infants diagnosed with congenital toxoplasmosis require long-term treatment with similar medications, alongside regular monitoring for potential side effects [14].

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In traditional medicine, various medicinal plants are suggested as complementary therapies to boost the immune system and alleviate symptoms associated with parasitic infections [15]. Due to their antimicrobial and anti-inflammatory properties, such herbal remedies may offer benefits in reducing parasitic load. However, they must be employed with medical supervision and should not replace evidence-based pharmacotherapy [16]. Accordingly, the present study aims to identify and report medicinal plants with potential efficacy in managing toxoplasmosis.

Methodology

This narrative review was conducted using a comprehensive search of key terms including toxoplasmosis, parasitic infection, traditional medicine, herbal remedies, and treatment. Databases consulted included Google Scholar, SID, Magiran, and Scopus, as well as authoritative texts in Iranian traditional medicine.
Initial screening involved exclusion of low-quality or irrelevant studies. Subsequently, articles that specifically addressed the traditional use of medicinal plants in the treatment of toxoplasmosis and met standard scientific criteria were selected for inclusion. Studies focusing on non-related treatments or those grounded in non-scientific sources were excluded from the final analysis.

Results

The findings of this review indicate that a wide range of medicinal plants including *Heracleum persicum* (Golpar), *Foeniculum vulgare* (Fennel), *Lawsonia inermis* (Henna), *Trachyspermum ammi* (Ajwain), *Allium sativum* (Garlic), *Juglans regia* (Walnut), *Zingiber officinale* (Ginger), *Nigella sativa* (Black cumin), *Eucalyptus* spp., *Cota tinctoria* (Zarrin-giah), *Artemisia* spp., *Marrubium vulgare* (Horehound), *Salvia officinalis* (Sage), *Lippia citriodora* (Lemon verbena), *Myrtus communis* (Myrtle), *Curcuma longa* (Turmeric), *Syzygium aromaticum* (Clove), *Mentha* spp. (Mint), *Sideritis* spp. (Mountain tea), *Echium amoenum* (Borage), *Allium cepa* (Onion), *Alyssum* spp., *Lepidium* spp., *Raphanus sativus* (Radish), *Tagetes* spp., *Taraxacum officinale* (Dandelion), *Balsamita major* (Balsamo), *Curcuma aromatica* (Wild turmeric), *Ginkgo biloba*, *Olea europaea* (Olive), *Sophora flavescens*, *Azadirachta indica* (Neem tree), *Zataria multiflora* (Shirazi thyme), *Dracocephalum* spp., and *Stachys* spp. have demonstrated promising anti-toxoplasmic activity in traditional medicinal sources.

Toxoplasmosis has been recognised as one of the leading causes of miscarriage in humans, and the consumption of these herbal remedies may serve as a natural adjunctive approach to managing the infection [17-31]. Additional details regarding these plants and their traditional anti-toxoplasmic uses are presented in Table 1.

Table 1. Medicinal Plants with Antimicrobial and Anti-inflammatory Properties Based on Traditional Use and Proposed Mechanisms of Actio

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Herbal name	Scientific Name	Botanical Family	Used Plant Part	Traditional Mode of Use	Proposed Mechanism of Action
Zanjabīl (Ajwain)	*Trachyspermum ammi*	Apiaceae	Seed	Brewed as herbal tea or used as extract	Exhibits antimicrobial and anti-inflammatory properties
Rāziyāneh (Fennel)	*Foeniculum vulgare*	Fabaceae (Note: should be Apiaceae)	Seed	Administered as tea or extract	Immune-boosting with anti-inflammatory effects
Avishan-e Shirāzi	*Origanum vulgare*	Lamiaceae	Leaf	Leaves brewed into tea or used in extract form	Antimicrobial activity and inflammation reduction
Murd (Myrtle)	*Myrtus communis*	Myrtaceae	Leaf	Consumed as leaf extract or herbal infusion	Enhances immune response and possesses antimicrobial properties
Eucalyptus	*Eucalyptus globulus*	Lauraceae (Note: should be Myrtaceae)	Leaf	Consumed as decoction or in extract form	Demonstrates antimicrobial and anti-inflammatory actions
Zanjebīl (Ginger)	*Zingiber officinale*	Zingiberaceae	Rhizome	Taken as decoction or powdered supplement	Known for antimicrobial and anti-inflammatory effects
Maryam-goli (Sage)	*Salvia officinalis*	Lamiaceae	Leaf	Brewed or extracted for medicinal use	Strengthens immunity and counters microbial agents
Dārchīnī (Cinnamon)	*Cinnamomum verum*	Lauraceae	Bark	Used as decoction or powder	Exerts antimicrobial and anti-inflammatory effects
Be-limoo	*Aloysia citrodora*	Verbenaceae	Leaf	Consumed as infusion or extract	Offers antimicrobial and anti-inflammatory properties

[DOI: 10.61186/pbp.7.3.14]

Zarrin-giyāh	*Lippia citriodora*	Verbenaceae	Leaf	Brewed or extracted for medicinal benefit	Enhances immunity; antimicrobial efficacy noted
Kadoo-ye Halvā'ī	*Cucurbita pepo*	Cucurbitaceae	Fruit	Eaten raw or in dried form	Reduces inflammation and supports immune health
Darmaneh	*Artemisia absinthium*	Asteraceae	Leaf and Root	Prepared as decoction or extract	Provides antimicrobial and anti-inflammatory actions
Farāsion	*Artemisia herba-alba*	Asteraceae	Leaf	Administered as decoction or powder	Immuno-modulatory with anti-inflammatory potential
Gerdoo (Walnut)	*Juglans regia*	Juglandaceae	Seed	Seeds taken as powder or infusion	Possesses antimicrobial and anti-inflammatory activities
Zīreh Sīyāh (Cumin)	*Cuminum cyminum*	Apiaceae	Seed	Taken as powdered form or infusion	Boosts immunity and combats microbial growth
Loobiya (Fava Bean)	*Vicia faba*	Fabaceae	Seed	Consumed as powder or herbal tea	Immuno-stimulatory with antimicrobial potential
Zeytūn (Olive)	*Olea europaea*	Oleaceae	Fruit	Eaten raw or dried	Antimicrobial and anti-inflammatory effects observed
Avishan (Thyme)	*Thymus vulgaris*	Lamiaceae	Leaf	Brewed as tea or used as extract	Immune-enhancing; rich in antimicrobial constituents
Na’nā’ (Peppermint)	*Mentha piperita*	Lamiaceae	Leaf	Consumed as decoction or in extract form	Demonstrates antimicrobial and anti-inflammatory actions

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Zanjabīl (Caraway)**	*Cuminum cyminum*	Apiaceae	Seed	Used as infusion or extract	Known for immune-boosting and antimicrobial properties
Zabān-dar-qafā	*Rosmarinus officinalis*	Lamiaceae	Leaf	Brewed as decoction or extracted	Reduces inflammation; exhibits antimicrobial activity
Bādemjān (Eggplant)	*Solanum melongena*	Solanaceae	Fruit	Consumed raw or dried	Offers antimicrobial and anti-inflammatory potential

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Discussion

Traditional Iranian medicine, as a time-honoured and reputable medical system, has long employed medicinal herbs to combat gastrointestinal parasites and infections. A considerable number of these plants are recognised for their antiparasitic properties. Among them, Trachyspermum ammi (ajwain) is particularly effective against intestinal and gastric parasites. Its rich terpenoid content supports intestinal cleansing and enhances digestive function [32, 33].

Foeniculum vulgare (fennel) exhibits notable antiparasitic and antioxidant properties, contributing to improved gastrointestinal health and immune function [34]. *Origanum vulgare* (Shirazi thyme), owing to its high thymol and carvacrol content, demonstrates significant antimicrobial and antiparasitic activity, proving beneficial in both intestinal parasitic infections and respiratory ailments [35].

Myrtus communis (myrtle) possesses antifungal and antiparasitic properties, primarily through its flavonoid compounds, which play a vital role in countering both infections and parasites within the digestive tract [36]. *Eucalyptus globulus* (eucalyptus) is well-known for its natural antiparasitic effects, particularly in treating respiratory and intestinal infestations. It also aids in soothing respiratory infections [37].

Zingiber officinale (ginger) contributes to parasite elimination through its anti-inflammatory and antiparasitic effects, notably by stimulating digestion and promoting bile secretion [38]. *Salvia officinalis* (sage) strengthens the immune system and alleviates gastrointestinal issues through its antimicrobial and antiparasitic compounds [39].

Cinnamomum verum (cinnamon) serves as a natural remedy against intestinal parasites, improving gut function thanks to its antibacterial and antiviral components [40]. *Aloysia citrodora* (lemon verbena) supports the treatment of intestinal parasitic infections via its antimicrobial and immune-boosting effects [41]. *Lippia citriodora* (also known as lemon verbena or "Zarrin Giah") is similarly recognised for its antiparasitic and antioxidant capacities, aiding in the relief of gastrointestinal infections [42].

Additional medicinal plants, including *Artemisia absinthium* (wormwood), *Juglans regia* (walnut), *Olea europaea* (olive), *Mentha piperita* (peppermint), *Rosmarinus officinalis* (rosemary), and *Solanum melongena* (aubergine), have all demonstrated varying degrees of antiparasitic efficacy [43–48].

Women's diseases require special care and timely prevention [49-51], and the use of reliable and safe resources such as medicinal plants can play a significant role in maintaining health and improving women's quality of life [52]. In many diseases and disorders [53-58], turning to nature and embracing traditional or natural therapeutic approaches can serve as a beneficial and complementary strategy helping to alleviate symptoms, support overall well-being, and enhance patients' quality of life [59].

Conclusion

Medicinal plants with antiparasitic activity play a prominent role in traditional Iranian medicine, particularly in the treatment of gastrointestinal and intestinal parasitic infections. These plants, by virtue of their antioxidant, antimicrobial, and immune-enhancing properties, contribute effectively to parasite eradication and the promotion of overall gastrointestinal health

Statements and Declarations

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Competing interests

The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

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