



Research Article

A Review: Therapeutic Potential of Indian Traditional Medicinal Herbs in Fascioliasis Control

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Abstract

Fascioliasis is a zoonotic disease caused by liver flukes of the genus *Fasciola* that continues to impart significant economic burdens on livestock production and poses emerging threats to human health in endemic regions, including the Indian subcontinent. The conventional control strategy for fascioliasis is based on synthetic chemical anthelmintics and molluscicides, which develop drug resistance, are toxic to non-targeted organisms and are toxic to the environment. This review work analyses the potential of Indian traditional herbs as an alternative to fascioliasis control with a dual strategy, like targeting the intermediate host freshwater snails (molluscicidal activity) and directly affecting the parasitic trematodes (anthelmintic activity). Depending upon noble research from Indian laboratories over the past decades, we collect evidence for Indian medicinal plants like *Alstonia scholaris*, *Asparagus racemosus*, *Azadirachta indica*, *Curcuma longa*, *Dregea volubilis*, *Glycyrrhiza glabra*, *Nigella sativa*, *Tamarindus indica*, and *Thevetia peruviana*. The active phytoconstituents like alkaloids, curcuminoids, tannins, terpenoids, and saponins show various mechanisms of action including enzyme inhibition (acetylcholinesterase, phosphatases, and cytochrome oxidase), tegumental disruption, and oxidative stress modulation. The review highlights the potential of phytochemicals and the advantages of biodegradable plant-based composition. Challenges, including standardisation, field efficacy validation, and commercialisation pathways are addressed, with recommendations for integrating traditional knowledge with modern parasitological approaches for sustainable fascioliasis management.

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INTRODUCTION

Fascioliasis is commonly called as liver fluke disease and represents one of the most significant worldwide parasitic disease mainly affecting livestock, with about US \$3 billion annual economic losses throughout the world. It is caused by two species of trematodes, like *Fasciola hepatica* and *F. gigantica*; the former is predominant in temperate regions.

while other in tropical and subtropical regions, including the Indian subcontinent. Fascioliasis in India causes potent morbidity and mortality in ruminants especially in cattle, goats, sheep and buffaloes leading to decrease in meat, milk, and wool production (Mas-coma, *et al.*, 2018) [2] and also weight loss, liver infections and increased infestation of other diseases

(Kumar and Singh, 2006; Vishwakarma and Kumar, 2023, Vishwakarma and Kumar, 2025) [1, 13, 12].

The life cycle of *Fasciola* has an obligate intermediate host, freshwater snails *Lymnaea acuminata* that belong to the family Lymnaeidae. The primary host is infected by contaminated water with miracidium larvae to complete their life cycle, so the cycle easily breaks at the level of snails. The conventional control strategies have mainly been based on synthetic molluscicides such as copper sulfate, niclosamide, and organotin compounds, along with anthelmintics including triclabendazole for treating infected host snails.

The World Health Organisation has uses thousands of synthetic compounds to snail control, but due to non-target toxicity, high costs, emergence of persistence, environmental persistence and most important things, snails are a crucial part of ecosystem. The same things associated with anthelmintics, triclabendazole resistance in *Fasciola* populations.

While plant products are eco-friendly, bio-degradable, low costs and easily availability and shows rich anthelmintic potential exposed various field of research. The plant and its products like *Nigella sativa* (black cumin), *Curcuma longa* (turmeric), and *glycyrrhiza glabra* (mulethi) prominently used in Ayurveda for parasitic infections, while *Alstonia scholaris*, *Thevetia peruviana*, and *Euphorbia* species have been traditionally used for pest control.

This review focus to measure the scientific evidence for Indian traditional herbs in fascioliasis control and analyse both their molluscicidal activity against vector snails and their direct anthelmintic effects on the parasite and we also explore the active phyto-constituents, synergistic potential, mechanisms of action, and challenges that must be acknowledge translate into practical and sustainable control strategies.

Epidemiology and Control Challenges

Infestations

In Indian continents the *F. gigantica* is the predominant species that affects livestock with prevalence rates about 10% - 60% across various agricultural climatic zones. The eastern region of Uttar Pradesh have high infection rates, due water logged areas, high irrigation systems, traditional animal husbandry etc. makes the contact of ruminants with contaminated water bodies.

The economic impact occurs through multiple ways like in chronic infection leads to reduced reproduction rates, liver damage, , reduced feed ingestions, and production of milk, meat, wool etc., while acute infections causes mortality specially in young animals.

The limitations of molluscicides, anthelmintic drugs, and management practices to limit snail habitat, explore the alternative approaches that are effective, eco-friendly, low costs investments, accessible to rural communities and bio-degradable ability, the plant derived molluscicides and anthelmintics are most sustainable and effective method to control fascioliasis.

Traditional medicinal plants with molluscicides

To check (interrupt) the life cycle of *Fasciola* at intermediate host snail stage provide several advantages. Singh, *et al.*, 2010

[4]; evaluated various traditional plants for molluscicidal activity against *L. acuminata* to establishing dose-response relationships, analyse mechanism of action and identifying active principles. Some important traditional medicinal plants and their activities are as follows-

i) *Thevetia peruviana* (Yellow oleander)

It belongs to family Apocynaceae, represents the potent molluscicidal activity against *Lymnaea* and their toxic activity occurs due to a flavonoid- apigenin-5-methyl ether and triterpenoid glycosides present in the plant.

ii) *Alstonia scholaris* (Devil's tree)

It belongs to the family Apocynaceae, which is a medicinal plant widely used in Ayurveda for its anti-diarrhoeal and anti-malarial properties that contain multiple bioactive compounds like β -sitosterol, betulin, pseudo-akuammigine (an alkaloid) and ursolic acid. These compounds show neurotoxic effects on snails to control their populations.

iii) *Euphorbia* species

The species of *Euphorbia*, like *Euphorbia hirta* and *Euphorbia pulcherrima* active components like ellagic acid, diterpenoids, pulcherrol, and β -amyrin, that help to their molluscicidal and insecticidal properties.

iv) *Tamarindus indica*

The ethanol extract of *T. indica* bark shows potent molluscicidal activity against *L. acuminata* with the active component saponin (Soni *et al.*, 2020) [5].

v) *Glycyrrhiza glabra*

The ethanol extract of dried root powder of *G. glabra* shows potent larvicidal activity against redia larva of *F. gigantica* to measures of fascioliasis control (Vishwakarma and Kumar, 2021a) [10].

vi) *Sapindus mukorossi* and *Terminalia chebula*

These plants show additional resources for molluscicidal activity with active component saponin in the fruit powder of *S. mukorossi* and tannic acid in the fruit powder of *T. chebula* that can effectively control the populations of *L. acuminata* (Upadhyay and Singh, 2011) [9].

vii) *Asparagus racemosus*

The dried root powder of *A. racemosus* shows anthelmintic activity against *Fasciola* larva (sporocyst, redia, and cercaria) (Vishwakarma and Kumar, 2021b) [11].

Active components in combinations

The combination of active components in phytotherapy of snails is more potent than individual activities, which permits combining multiple herbs and scientific validation.

Sunita *et al.*, 2013 [7-8] evaluated binary combinations (1:1 ratio) of plant-derived active components against *Fasciola* larvae *in vivo*. The combination of azadirachtin and allicin proved highly toxic against redia (8hr LC₅₀ 0.007 mg/L) and cercaria (8hr LC₅₀ 0.006 mg/L), substantially more effective than the compound alone. Combinations of citral with umbelliferone or ferulic acid showed intermediate toxicity, while still exceeding the efficacy of individual components (Sunita and Singh, 2011) [6].

The combination effects may occur due to

- Inhibition of detoxification, compounds that inhibit parasite detoxification enzymes compensate for the toxicity of others.
- They show multi-target effects with different compounds that attack distinct parasite systems simultaneously.
- Sequential action, one compound damages protective barriers, and the other allows greater penetration.
- Enhanced bioavailability, in which one compound may facilitate the uptake of another.

Integration with Conventional Approaches

The IPM (integrated parasite management) strategies are a replacement of conventional control of plant-based molluscicides and anthelmintic activity, but may show following importance-

- **Combination therapy:** Supplementing anthelmintic treatment with phyto-therapeutics to enhance efficacy against resistant strains.
- **Targeted application:** By using plant-based products in environmentally sensitive areas where synthetic chemicals are restricted.
- **Community-based programs:** Exploiting the local knowledge and resources for sustainable control.
- **Rotational use:** The alternating plant-based and synthetic molluscicides to slow resistance development.

Advantages of Phyotherapy

The plant-based molluscicides and anthelmintic activity show advantages over synthetic compounds. Plant-based products are-

- Eco-friendly
- Biodegradable,
- Not affect non-target aquatic organisms like fish, amphibians, and insects
- Microbial communities are involved in nutrient cycling

Hence, the overall structure and functions of the ecosystem are not affected by plant-based products during fascioliasis control strategies.

Economic importance

The plant-based products are perhaps their greatest advantage in the Indian context, because many medicinal plants are used for molluscicide preparation, like turmeric, neem, tamarind, etc., are already cultivated or available as byproducts of existing agricultural systems. Hence local availability of medicinal plants shows low costs and intellectual property.

CONCLUSIONS

The reviewed documents showed that Indian traditional herbs show effective potential for fascioliasis control through multiple, complementary mechanisms. Plants including *Thevetia peruviana*, *Asparagus racemosus*, *Alstonia scholaris*, *Tamarindus indica*, *Azadirachta indica*, *Glycyrrhiza glabra*,

Curcuma longa, *Nigella sativa*, and *Dregea volubilis* have been scientifically validated for molluscicidal activity against the vector snail *L. acuminata* and direct anthelmintic effects against *F. gigantica*.

The active phyto-constituents, alkaloids, tannins, saponins, curcuminoids and terpenoids act through defined molecular mechanisms to suppress the infestations of *Fasciola*. The selectivity representation by some compounds affects *Fasciola* larvae more than snail hosts.

The combination effects enhancement offers strategies for improving efficacy rather than single compounds. The biodegradability and local availability of plant resources address environmental and economic concerns associated with synthetic molluscicides, making these approaches particularly suitable for resource-limited farming communities in endemic areas.

However, significant challenges remain before plant-based products can be recommended for worldwide use. Standardisation, field efficacy validation, formulation development, regulatory approval, and integration with existing control programs require sustained research investment and multi-stakeholder collaboration. The extensive research foundation established by Indian malacology and parasitology groups provides a strong platform for addressing these challenges.

We can say that from the above analysis, the traditional medicine plant-based control of fascioliasis is more efficient, has low costs, is easily available, eco-friendly, biodegradable and convenient for low economic countries, rather than synthetic molluscicides and anthelmintic drugs.

CONFLICT OF INTEREST

The authors have no conflicts of interest.

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