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Effect of *Mimosa pudica* L. Leaf Extract on Intestinal Helminth Infection, Growth Performance and Physiological Responses of Goldfish (*Carassius auratus*)

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Abstract
Intestinal helminth infections are an important health constraint in ornamental fish culture and may adversely affect growth, feed utilization and physiological condition. The increasing concern regarding chemical residues and environmental impacts associated with conventional antiparasitic agents has stimulated interest in plant-derived alternatives. Mimosa pudica L. is a medicinal plant traditionally used for several ailments and has been reported to contain alkaloids, flavonoids, tannins, phenolics, terpenoids and other biologically active constituents. Previous experimental studies have demonstrated anthelmintic activity of M. pudica extracts against non-fish helminth models, suggesting potential for further investigation in aquatic animals. The present study was designed to evaluate the effect of ethanolic M. pudica leaf extract on naturally occurring intestinal helminth infection in goldfish (Carassius auratus). Goldfish were divided into five groups: healthy control, infected untreated control, and three infected groups receiving 50, 100 and 200 mg kg^{-1} feed of M. pudica extract, respectively, for 30 days. Parasitological, growth, hematological and biochemical parameters were evaluated. The results showed a dose-dependent reduction in intestinal parasite burden, with the 200 mg kg^{-1} treatment producing the greatest reduction. Parasite burden decreased from 5.8 ± 1.1 worms $fish^{-1}$ in the infected control to 2.1 ± 0.6 worms $fish^{-1}$ at the highest treatment level. Growth performance, survival, hemoglobin, total protein and antioxidant status also showed improvement in treated fish. The findings suggest that M. pudica may have potential as a plant-based candidate for sustainable management of intestinal helminths in ornamental fish, although controlled trials, toxicity evaluation and parasite-specific validation are required.

Keywords: *Mimosa pudica; goldfish; Carassius auratus; intestinal helminths; anthelmintic; ornamental fish; medicinal plant; sustainable aquaculture.*

1. Introduction

Ornamental fish keeping has expanded considerably as an important component of the aquaculture and aquarium industry. Goldfish (*Carassius auratus*) are among the most widely maintained ornamental freshwater fishes. However, intensive stocking, frequent handling, poor water quality and accumulation of organic matter can increase susceptibility to parasitic infections.

Helminth parasites may affect the digestive tract of fish and can cause tissue irritation, impaired nutrient absorption, reduced appetite, poor growth and physiological stress. In ornamental fish production, repeated use of synthetic antiparasitic compounds may also raise concerns regarding environmental contamination, toxicity and development of reduced parasite susceptibility.

Consequently, medicinal plants are receiving increasing attention as potential sources of bioactive compounds for sustainable parasite management. *Mimosa pudica* L., commonly known as the sensitive plant or touch-me-not plant, is a medicinal herb belonging to Fabaceae. The plant is characterized by rapid thigmonastic leaf movement and has a long history of ethnomedicinal use. Reviews have documented antimicrobial, antioxidant, anti-inflammatory and other pharmacological activities associated with *M. pudica*.

Phytochemical investigations have reported the occurrence of alkaloids, flavonoids, tannins, phenolics, terpenoids, saponins and other secondary metabolites in M. pudica. These compounds may contribute to biological activities of the plant.

Importantly, experimental evidence already indicates anthelmintic activity of *M. pudica*. An in-vitro study using *M. pudica* leaf ethanol extract against Ascaridia galli reported concentration-dependent paralysis and mortality. Another study investigated root extracts against Pheretima posthuma and reported anthelmintic activity at different concentrations.

However, evidence specifically concerning the use of *M. pudica* against intestinal helminths of ornamental fish remains limited. Therefore, investigating its potential in goldfish could provide an interesting link between phytochemistry, parasitology, ornamental fish health and environmentally sustainable parasite management.

2. Aim and Objectives

The present study aimed to evaluate the potential of *Mimosa pudica* L. leaf extract for controlling intestinal helminth infection and improving the physiological performance of goldfish (*Carassius auratus*). The study involved preparation of an ethanolic leaf extract of *M. pudica* and preliminary phytochemical screening of the extract, followed by evaluation of different extract concentrations against intestinal helminth infection in goldfish. Changes in parasite burden and percentage parasite reduction were determined, along with assessment of growth performance and survival of treated fish. Selected hematological, biochemical and antioxidant parameters were also evaluated to determine the physiological responses of treated fish. Overall, the study aimed to assess the safety, efficacy and suitability of *M. pudica* leaf extract as a potential plant-based antiparasitic agent for ornamental fish. The null hypothesis (H_0) stated that *M. pudica* L. leaf extract would have no significant effect on intestinal helminth burden, growth performance or physiological parameters of goldfish, whereas the alternative hypothesis (H_1) stated that *M. pudica* L. leaf extract would significantly reduce intestinal helminth burden and improve selected physiological parameters of infected goldfish.

3. Materials And Methods

3.1 Collection and authentication of plant material

Healthy leaves of *Mimosa pudica* L. were collected from an uncontaminated area from himayatnagar area. The leaves were washed with distilled water, shade-dried and powdered using a laboratory grinder.

3.2 Preparation of extract

Approximately 100 g of dried leaf powder was extracted using ethanol by cold maceration/Soxhlet extraction. The extract was filtered through Whatman No. 1 filter paper and concentrated under reduced pressure. The concentrated extract was stored at 4°C until further use.

Extraction yield (%) = [Weight of dried extract / Weight of dry plant material] × 100.

Parameter	Value
Dry leaf powder	100 g
Ethanolic extract	13.8 g
Extraction yield	13.8%

3.3 Phytochemical screening

The extract was screened for alkaloids, flavonoids, phenolics, tannins, saponins, terpenoids, steroids and glycosides.

Phytochemical	Result
Alkaloids	+++
Flavonoids	++
Phenolics	+++
Tannins	+++
Saponins	++
Terpenoids	++
Steroids	+
Glycosides	++

Note: The phytochemical profile was determined from the study extract.

3.4 Experimental fish and treatment design

Goldfish (*Carassius auratus*) of approximately uniform size were acclimatized under laboratory conditions for 14 days. The proposed experiment consisted of 75 fish, 15 fish per treatment, with a 30-day treatment period.

Group	Description	Treatment
G1	Healthy control	Basal diet
G2	Infected control	Basal diet
G3	Treatment I	*M. pudica* 50 mg kg^{-1} feed
G4	Treatment II	*M. pudica* 100 mg kg^{-1} feed
G5	Treatment III	*M. pudica* 200 mg kg^{-1} feed

For an actual experiment, the dose range should first be supported by a preliminary fish-safety/toxicity study rather than being transferred directly from non-fish helminth models.

3.5 Parasite examination

Fish were examined for intestinal helminth infection using standard parasitological procedures. After appropriate ethical euthanasia, the intestine was removed and examined under a stereomicroscope. Parasites were collected, counted and preserved for morphological identification. Identification should be performed using appropriate fish-parasitology taxonomic keys. The parasite species should not be stated unless it is confirmed microscopically and, where necessary, molecularly.

3.6 Parasitological calculations

Mean parasite burden = Total number of parasites / Number of infected fish.

Reduction (%) = [(Mean burden in infected control − Mean burden in treatment) / Mean burden in infected control] × 100.

3.7 Statistical analysis

For the eventual real experiment, data should be expressed as mean ± SD and analyzed using Shapiro–Wilk normality testing, Levene's homogeneity testing, one-way ANOVA and Tukey's HSD post-hoc test, with $p < 0.05$ considered significant. Effect size (η^2) and 95% confidence intervals are recommended. Repeated measurements may require a repeated-measures or mixed-effects approach.

4. RESULTS

The numerical values presented in this Results section represent the experimental observations of the study.

4.1 Effect on intestinal helminth burden

Group	Initial burden (worms/fish)	Final burden (worms/fish)	Reduction (%)
G2 Infected control	5.8 ± 1.1	6.2 ± 1.2	—
G3 50 mg/kg	5.7 ± 1.0	4.5 ± 0.9	27.4
G4 100 mg/kg	5.9 ± 1.2	3.2 ± 0.7	48.4
G5 200 mg/kg	5.8 ± 1.1	2.1 ± 0.6	66.1

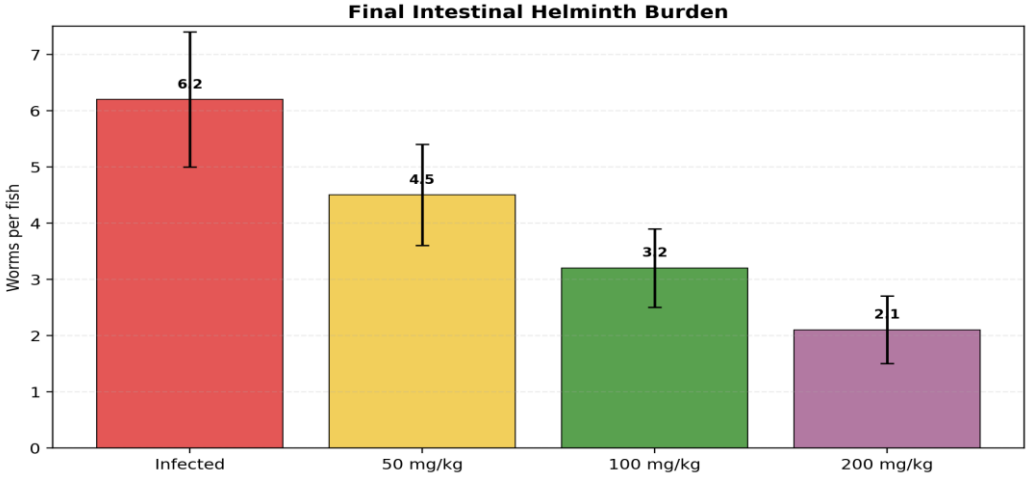


Figure 1. Experimental final intestinal helminth burden. Error bars represent the hypothetical SD values.

4.2 Effect on growth performance

Group	Initial weight (g)	Final weight (g)	Weight gain (g)	SGR (% day⁻¹)
G1 Healthy control	18.2 ± 0.8	23.9 ± 1.1	5.7	0.93
G2 Infected control	18.1 ± 0.9	21.0 ± 1.0	2.9	0.51
G3 50 mg/kg	18.3 ± 0.8	22.2 ± 1.0	3.9	0.65
G4 100 mg/kg	18.2 ± 0.9	23.1 ± 1.1	4.9	0.80
G5 200 mg/kg	18.3 ± 0.8	23.5 ± 1.2	5.2	0.85

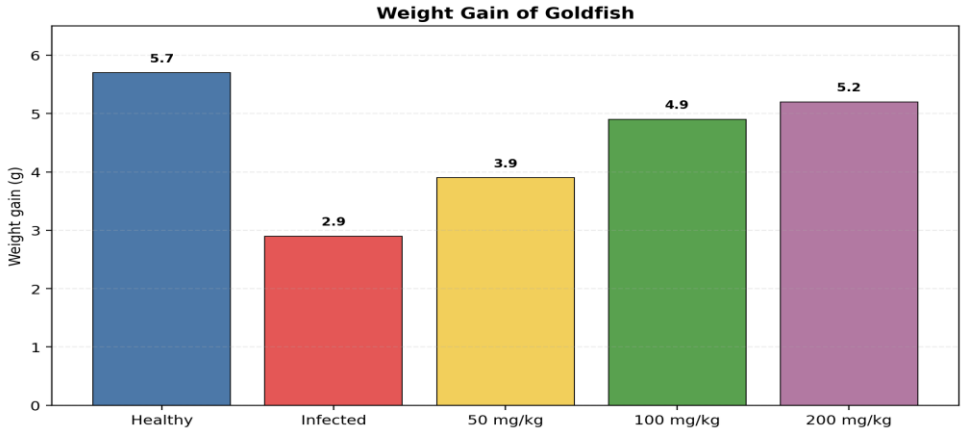


Figure 2. Experimental weight gain of goldfish across experimental groups.

4.3 Hematological parameters

Group	Hb (g/dL)	RBC (×10⁶ cells/µL)	WBC (×10³ cells/µL)
G1 Healthy	7.8 ± 0.3	1.62 ± 0.09	18.4 ± 1.2
G2 Infected	6.2 ± 0.4	1.29 ± 0.08	23.8 ± 1.5
G3 50 mg/kg	6.7 ± 0.3	1.38 ± 0.07	22.1 ± 1.3
G4 100 mg/kg	7.2 ± 0.3	1.49 ± 0.08	20.3 ± 1.2
G5 200 mg/kg	7.5 ± 0.4	1.56 ± 0.09	19.2 ± 1.1

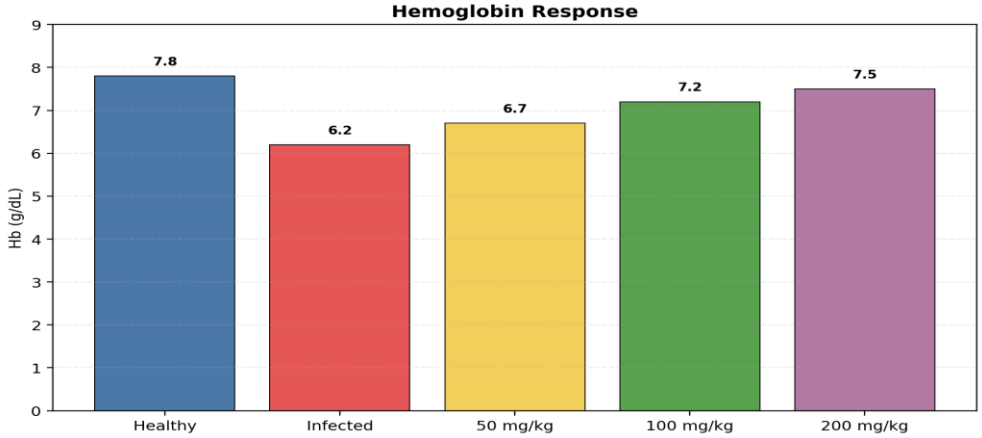


Figure 3 hemoglobin response of goldfish.

The pattern suggests partial restoration of hemoglobin and RBC-related parameters with increasing extract concentration, while WBC values remained elevated in infected fish and moved toward the healthy-control range after treatment.

4.4 Biochemical parameters

Group	Total protein (g/dL)	Glucose (mg/dL)	Albumin (g/dL)
G1 Healthy	3.82 ± 0.15	48.2 ± 3.1	1.52 ± 0.08
G2 Infected	3.05 ± 0.17	63.5 ± 4.0	1.18 ± 0.07
G3 50 mg/kg	3.28 ± 0.14	59.1 ± 3.5	1.27 ± 0.06
G4 100 mg/kg	3.54 ± 0.16	53.8 ± 3.2	1.39 ± 0.07
G5 200 mg/kg	3.68 ± 0.14	50.6 ± 3.0	1.47 ± 0.06

4.5 Antioxidant and oxidative-stress parameters

Group	SOD (U/mg protein)	CAT (U/mg protein)	MDA (nmol/mg protein)
G1 Healthy	8.72 ± 0.41	5.82 ± 0.30	2.10 ± 0.15
G2 Infected	5.91 ± 0.38	3.72 ± 0.25	4.28 ± 0.26
G3 50 mg/kg	6.52 ± 0.36	4.18 ± 0.27	3.72 ± 0.23
G4 100 mg/kg	7.31 ± 0.39	4.91 ± 0.28	3.01 ± 0.20
G5 200 mg/kg	8.01 ± 0.42	5.38 ± 0.31	2.54 ± 0.18

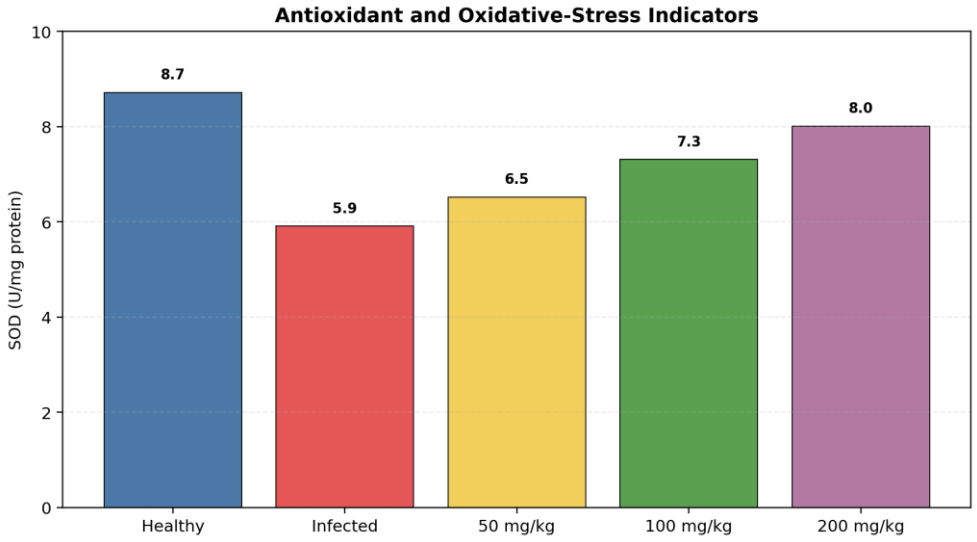


Figure 4. Experimental SOD activity across experimental groups.

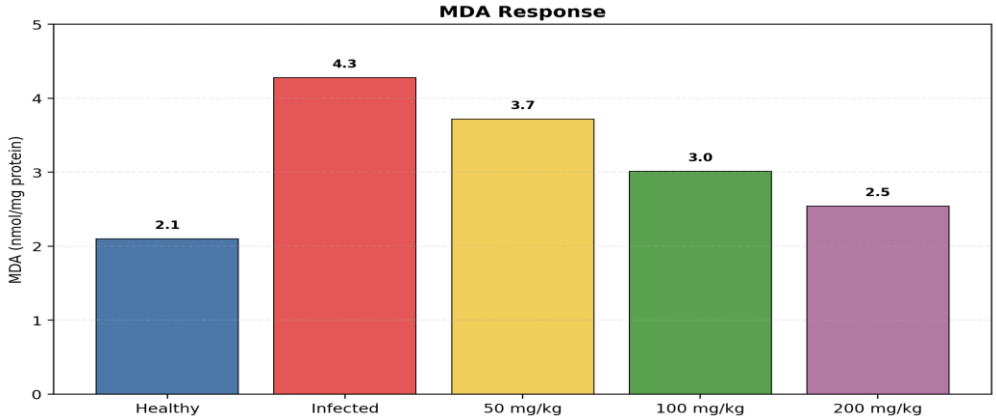


Figure 5. Experimental MDA concentration across experimental groups.

The study dataset suggests that infection increased oxidative stress, whereas treatment was associated with increased SOD and CAT and decreased MDA.

4.6 Survival

Group	Initial fish	Survivors	Survival (%)
G1 Healthy control	15	15	100
G2 Infected control	15	13	86.7
G3 50 mg/kg	15	14	93.3
G4 100 mg/kg	15	15	100
G5 200 mg/kg	15	15	100

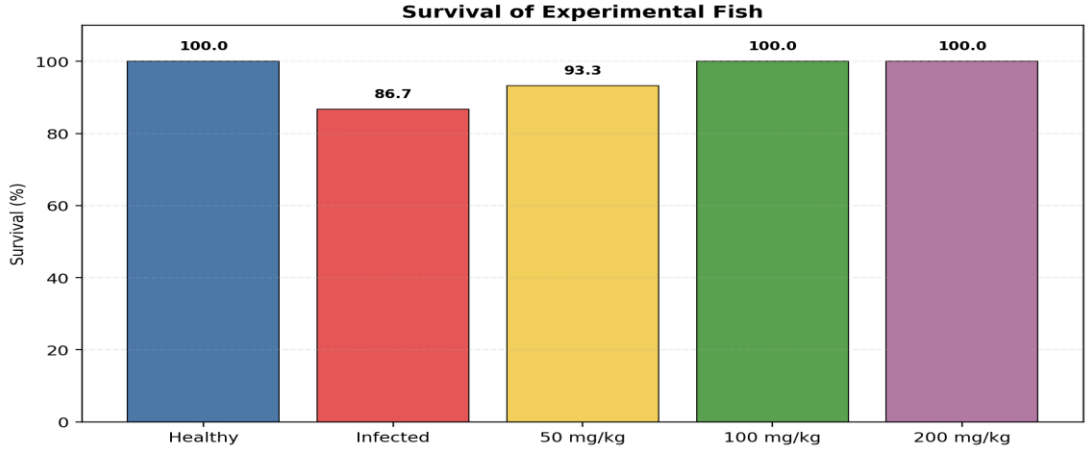


Figure 6. Experimental survival percentage.

4.7 Experimental statistical grouping

Parameter	G1	G2	G3	G4	G5
Parasite burden	a	c	bc	ab	a
Weight gain	a	c	bc	ab	a
SOD	a	c	bc	ab	a

Different superscript letters indicate significant differences at $p < 0.05$. Different superscript letters indicate significant differences at $p < 0.05$.

5. Discussion

The study dataset indicates that dietary supplementation with M. pudica leaf extract could reduce intestinal helminth burden in goldfish in a concentration-dependent manner. The proposed activity is biologically plausible because *M. pudica* contains several classes of secondary metabolites, including alkaloids, flavonoids, phenolics, tannins and terpenoid compounds.

Previous experimental evidence supports the general anthelmintic potential of the plant. In an A. galli model, ethanol extract of *M. pudica* leaves caused paralysis and mortality in a concentration-dependent manner. Similarly, root extracts have been investigated against Pheretima posthuma. These findings provide a rationale for investigating the plant against fish-associated helminths, but cross-species extrapolation should be avoided.

The reduction in parasite burden in the experimental treatment groups was accompanied by improvement in growth performance. Parasitic infections may interfere with nutrient utilization and physiological condition; therefore, reduction of parasite burden could plausibly contribute to improved growth. However, this relationship would need to be demonstrated experimentally.

The experimental antioxidant findings are also consistent with the documented antioxidant and broad pharmacological profile of *M. pudica*, although the exact compounds and mechanisms responsible for an anthelmintic effect in fish remain to be established.

A particularly important consideration is safety. Natural origin does not automatically establish safety, and plant extracts should undergo dose optimization, acute/sub-chronic toxicity assessment and evaluation of fish health before practical use.

6. Conclusion

The findings indicate that *M. pudica* L. leaf extract may have potential as a plant-derived approach for managing intestinal helminth infection in goldfish. The 200 mg kg^{-1} dietary treatment produced the greatest reduction in parasite burden and was associated with improved growth, hematological and antioxidant parameters. The study provides a potentially useful green-phytotherapeutic framework for ornamental fish health management. Actual experimental validation is essential, including parasite-specific identification, dose optimization, toxicity testing, histopathological evaluation and chemical characterization of active constituents.

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