

Pharmacological Evaluation Of Antioxidant And Anthelmintic Activities Of *Solanum Trilobatum* Linn. Using *In Vitro* & *In Silico* Approaches

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ABSTRACT

Helminthiasis continues to be a major global health issue affecting both humans and animals. The present investigation was designed to assess the in-vitro antioxidant and anthelmintic potential of different extracts of *Solanum trilobatum* Linn., along with *in-silico* molecular docking analysis of its bioactive constituents. Various extracts, including ethanol, methanol, and aqueous, were prepared and subjected to preliminary phytochemical evaluation. Antioxidant activity was determined using DPPH and nitric oxide radical scavenging assays, whereas anthelmintic efficacy was tested using the *Tubifex tubifex* model organism. Molecular docking analysis was carried out targeting tubulin protein (PDB ID: 1SA0). Phytochemical screening confirmed the presence of important secondary metabolites such as flavonoids, alkaloids, phenolic compounds, saponins, and glycosides. Among the extracts, the ethanolic fraction exhibited superior antioxidant activity, with IC₅₀ values of 144.8 µg/mL in the DPPH assay and 229.3 µg/mL in the nitric oxide assay. In anthelmintic evaluation, the ethanolic extract produced notable paralysis and death times comparable to the standard drug albendazole. Docking results further revealed strong binding interactions of compounds like beta-sitosterol and diosgenin with the target protein. Overall, the findings suggest that *Solanum trilobatum* has significant therapeutic potential and could be explored further for the development of plant-based anthelmintic agents. [1,2,3,4,5,6,7,8].

Keywords: *Solanum trilobatum*, Antioxidant, Anthelmintic, Molecular docking, Phytochemicals.

INTRODUCTION

Helminthiasis refers to parasitic infections caused by helminths and represents a major cause of morbidity in both human and animal populations. These infections are highly prevalent across the globe, particularly in regions with inadequate sanitation and poor environmental hygiene. Among them, soil-transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms are commonly reported, especially in children and other high-risk groups.

The emergence of resistance to commonly used anthelmintic drugs, including albendazole, has necessitated the search for alternative treatment strategies. Medicinal plants constitute an important reservoir of bioactive compounds and have long been utilized in traditional systems of medicine for the

management of parasitic infections. *Solanum trilobatum* Linn., a member of the Solanaceae family, is known for its diverse pharmacological properties, including antimicrobial, anti-inflammatory, and antioxidant activities.

In this context, the present study was undertaken to investigate the antioxidant and anthelmintic efficacy of *Solanum trilobatum* extracts and to explore the interaction of its phytoconstituents with target proteins using *in-silico* molecular docking approaches. [3, 8,9,10,11,12]

MATERIALS AND METHODS

Plant Material and Extraction

The plant material of *Solanum trilobatum* was collected and authenticated. It was shade-dried, coarsely powdered, and extracted by cold maceration

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using 90% ethanol, 90% methanol, and water as solvents. The resulting extracts were filtered, concentrated under reduced pressure, and stored at 4°C until further use [3,13,14].

Preliminary Phytochemical Screening

The extracts were subjected to preliminary phytochemical analysis to identify the presence of major secondary metabolites, including alkaloids, flavonoids, tannins, saponins, glycosides, phenolic compounds, and terpenoids, using established qualitative procedures.

In-vitro Antioxidant Activity

- **DPPH Assay**

A 2 mL aliquot of DPPH solution (200 µM) was mixed with 0.1 mL of the extract at concentrations of 10, 50, 100, 200, 400, 800, and 1000 µg/mL. The reaction mixture was incubated in the dark at room temperature for 20 minutes. Ascorbic acid was used as the reference standard. The absorbance was measured at 517 nm, and the percentage of radical scavenging activity was calculated [2,15,16].

$$\% \text{inhibition} = \frac{\text{Absorbance (Control)} - \text{Absorbance (sample)}}{\text{Absorbance (Control)}} \times 100$$

- **Nitric Oxide Scavenging Assay**

At physiological pH, sodium nitroprusside in aqueous solution generates nitric oxide, which subsequently reacts with oxygen to form nitrite ions that can be detected using Griess reagent. The reaction mixture containing 3 mL of sodium nitroprusside in phosphate-buffered saline (10 mM) and various concentrations of the extract (10, 50, 100, 200, 400, 800, and 1000 µg/mL) was incubated at 37°C for 4 hours. A control without the test sample was maintained under identical conditions. After incubation, 0.5 mL of Griess reagent was added, and the absorbance was measured at 546 nm. Ascorbic acid was used as the standard reference. The percentage inhibition of nitric oxide radical formation was then calculated. [5,17,18]

$$\% \text{inhibition} = \frac{\text{Absorbance (Control)} - \text{Absorbance (sample)}}{\text{Absorbance (Control)}} \times 100$$

In-vitro Anthelmintic Activity

The anthelmintic activity was evaluated using the method described by Ajaiyeoba *et al.*, with slight modifications. *Tubifex tubifex* worms were selected as the experimental model due to their sensitivity to anthelmintic agents and ease of handling under laboratory conditions. All test and standard solutions were freshly prepared prior to the experiment. Albendazole (1 mg/mL) was used as the reference standard, while normal saline served as the control.

In this study, ten worms were placed in each Petri dish and divided into five groups. Each group was treated with 3 mL of extract at different concentrations (5, 8, and 10 mg/mL). The time required for paralysis was recorded when no movement was observed except upon vigorous shaking. The time of death was noted when the worms showed no movement even after exposure to warm water (50°C).

[1,19,20]

Molecular Docking Studies

Molecular docking analysis was carried out using Molegro Virtual Docker against the tubulin protein (PDB ID: 1SA0). Selected phytoconstituents, including solasodine, diosgenin, β-sitosterol, and tomatidine, were evaluated for their binding affinity and interaction with the target protein. [21,22]

Statistical Analysis

Data were expressed as mean ± SEM and analyzed using GraphPad Prism software. Statistical significance was determined using ANOVA.

RESULTS

Phytochemical Screening

Phytochemical screening revealed the presence of major secondary metabolites, including flavonoids, alkaloids, phenolic compounds, glycosides, and saponins in all extracts, with the ethanolic extract exhibiting the highest abundance of these constituents.



Antioxidant Activity

The ethanolic extract exhibited the highest antioxidant activity, with IC_{50} values of 144.8 $\mu\text{g/mL}$ in the DPPH assay and 229.3 $\mu\text{g/mL}$ in the nitric oxide scavenging assay, followed by the methanolic and aqueous extracts.

Anthelmintic Activity

The ethanolic extract demonstrated notable anthelmintic activity, exhibiting a paralysis time of 5.14 ± 0.62 minutes and a death time of 20.71 ± 0.16 minutes at a concentration of 10 mg/mL, which was comparable to the standard drug Albendazole.

Molecular Docking

Molecular docking analysis indicated that β -sitosterol and diosgenin exhibited strong binding affinity toward the tubulin protein, suggesting their potential role as anthelmintic agents.

DISCUSSION

The findings of the present study indicate that *Solanum trilobatum* exhibits notable antioxidant and anthelmintic activities. The superior efficacy of the ethanolic extract may be attributed to its higher content of bioactive constituents, particularly flavonoids and phenolic compounds, which are well known for their free radical scavenging properties and potential to disrupt parasitic physiological processes.

Furthermore, molecular docking analysis supported the experimental results by demonstrating favorable binding interactions of selected phytoconstituents with the tubulin protein. These observations suggest that the bioactive compounds present in the plant may exert their anthelmintic effects through mechanisms comparable to those of conventional drugs [3,23,24,25,26].

CONCLUSION

The findings of the present study demonstrate that *Solanum trilobatum* possesses significant antioxidant and anthelmintic potential, with the ethanolic extract exhibiting the highest activity among the tested extracts. Molecular docking analysis further supported these results by revealing favourable

interactions of key phytoconstituents with the target protein, suggesting their possible role as therapeutic agents. However, further investigations, including the isolation and characterization of active compounds as well as detailed *in vivo* and clinical studies, are necessary to validate these findings. [1, 2, 24, 27, 28, 29, 30]

FUTURE PERSPECTIVES

Future research should focus on isolation and characterization of active phytoconstituents, followed by *in-vivo* and clinical studies to establish safety and efficacy.

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