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Research Article

Phytochemical and cytotoxicity analysis of flowers of *Solanum viarum* Dunal: A minor medicinal food of India

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Abstract: *Solanum viarum* Dunal, a minor medicinal food of India, has been traditionally used to treat various ailments. However, the phytochemical and cytotoxicity profiles of its flowers remain unexplored. This study aimed to investigate the qualitative phytochemical composition and cytotoxicity of *S. viarum* flower extracts. The qualitative phytochemical analysis revealed the presence of tannins, saponins, phenolic compounds, and reducing sugars in the flower extracts. The cytotoxicity analysis showed that all three extracts (aqueous, ethanol, and methanol) exhibited significant cytotoxicity against brine shrimp larvae, with the ethanol and methanol extracts showing 100 % mortality. The study suggests that the flowers of *S. viarum* possess bioactive compounds with potential medicinal uses. The findings of this study provide a foundation for further research on the pharmacological and therapeutic potential of *S. viarum* flower extracts. Future studies can focus on isolating and characterizing the bioactive compounds responsible for the observed cytotoxicity and medicinal properties. Additionally, *in vivo* studies can be conducted to evaluate the safety and efficacy of the extracts in animal models. The results of this study highlight the importance of exploring the medicinal properties of underutilized plant species like *S. viarum*, which can contribute to the development of new drugs and therapies.

Keywords: Bioactive compounds, cytotoxicity, medicinal Plants, phytochemicals, *Solanum* species

Introduction

Medicinal plants have been an integral part of human healthcare for centuries, providing a rich source of bioactive compounds with therapeutic potential (Hossain et al., 2025; Jena et al., 2025). The World Health Organization (WHO) estimates that approximately 80% of the world's population relies on traditional medicine, which is largely based on plant-derived remedies (Jaiswal et al., 2024; Hebbar et al., 2024; Devi et al., 2024; Sethi et al., 2024). Despite their importance, many medicinal plants remain understudied, and their bioactive compounds are yet to be fully characterized (Sharma et al., 2024). The documentation of medicinal plants and their bioactive compounds is essential for several reasons. Firstly, many traditional medicinal plants are facing threats to their survival due to habitat destruction, over-exploitation, and climate change (Mukherjee et al., 2024; Bhat et al., 2024; Palei et al., 2024; Jena et al., 2024). As a result, there is a pressing need to record and preserve traditional knowledge related to these plants before it is lost forever. Secondly, the characterization of bioactive compounds from medicinal plants can lead to the discovery of novel therapeutics, which can contribute to the development of new medicines (Devi et al., 2024). In recent years, there has been a growing interest in the study of medicinal plants and their bioactive compounds. Advances in analytical techniques, such as chromatography and spectroscopy, have enabled researchers to isolate and characterize a wide range of bioactive compounds from medicinal plants. These compounds have been shown to exhibit a range of biological activities, including antimicrobial, anti-inflammatory, and anticancer properties.

Figure 1: Habitat of *Solanum viarum*

Solanum viarum Dunal (Figure 1), a member of the Solanaceae family, is a wild-growing perennial shrub native to the Indian subcontinent. While it originates in southern Brazil, Uruguay, Paraguay, and northern Argentina, it has since spread to other regions, including Central America, South America, the West Indies, the southern United States, and even Iran. This medicinal plant is used to treat a range of ailments, including dysentery, diabetes, and inflammation, and is also used in the treatment of

respiratory disorders. Additionally, it is known for its antipyretic, antioxidant, antibacterial, and insecticidal properties. Aqueous extracts of the plant have demonstrated herbicidal activity (Thakur et al., 2024; Eskandari and Fouladkolaei, 2020; Tae-Keun et al., 2011). Despite its ethnopharmacological significance, the phytochemical and pharmacological profiles of *S. viarum* remain largely unexplored.

Figure 2: Flowers of *S. viarum*

In the present study, we aimed to investigate the qualitative phytochemical composition and cytotoxicity of *S. viarum* flower extracts. The flowers (Figure 2) of this plant were selected for study, as they are traditionally used in folk medicine and have been reported to possess antimicrobial and anti-inflammatory activities. Our findings provide insight into the phytochemical and pharmacological properties of *S. viarum* flowers, and highlight their potential as a source of novel bioactive compounds.

Methodology

The flowers of *S. viarum* were collected from different regions of Khordha district of Odisha, India (Figure 3; Sethi et al., 2024). The plant species was identified by authors (Jena et al., 2025). An herbarium specimen is deposited to the Herbarium unit of Biodiversity and Conservation of APRF, Cuttack, Odisha, India. The phytochemical analysis of nine secondary metabolites was conducted using standard methods, as described in previous work from our laboratory, for aqueous, methanol, and ethanol extracts (Jena et al., 2024; Pradhan et al., 2024).

Qualitative phytochemical analysis

Test for Tannin: About 1 ml of the flowers extract was taken. Added 3-5 drops of 10% lead acetate solution to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin.

Figure 3: Collection of flowers for experimental works

Test for saponin: About 1 ml of the flowers extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the flowers extract was taken. Added 2 ml of 2% NaOH solution and then dilute HCl to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour changing transformation confirmed for the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated sulphuric acid were added. The appearance of reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic compounds: About 1 ml of the fruit extract was taken and added few drops of 5% ferric chloride solution to it. The dark bluish black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the flowers extract was taken and 2-3 drops of Fehling's solution A and B were respectively added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the flower extract was taken. Then, 1 ml of chloroform and 1 ml of concentrated sulfuric acid were added, ensuring the acid touched the border of the test tube. The

appearance of a red upper layer and a yellow lower layer with green fluorescence indicates the presence of steroids.

Test for alkaloids: About 1 ml of the extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the flowers extract was taken added 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent. The yellow crystal formation confirmed the presence of carbonyl compounds.

Toxicity to *Artemia salina*: For toxicity analysis, hatching of Brine cysts was the initial process. Standardization of the optimum was done at 2.0, 3.5 and 5.0 % saline concentration to check the optimum salinity for proper hatching of Brine shrimp (*Artemia salina*) cysts. The brine shrimp cysts are then incubated in 3.5% saline water with proper aeration, room temperature or between (28-35) ^{o}C and light for 48 hours. Proper hatching could be observed within 24-48 hours depending upon the quality of cysts, proper aeration and light provided. Different concentrations (13.4 mg/ml, 26.87 mg/ml, 40.31 mg/ml, 53.75 mg/ml and 67.18 mg/ml) of the flowers extract were taken and 3.5% saline water was used to make the volume 2 ml in each test tube. 1% DMSO was used to dissolve the crude extracts. Ten nauplii were selected and introduced to five test tubes of the extracts. Positive and negative controls were prepared using vincristine sulphate (5 mg/ml) and 3.5% saline water respectively with a volume of 2 ml. The live larvae are highly motile and thus differentiate from the unhatched cysts. The survivor nauplii were counted and analysed the death% (Kumar et al., 2012; Jena et al., 2024; Pradhan et al., 2024).

Results and discussion

The qualitative phytochemical analysis of *Solanum viarum* flower extracts revealed the presence of various bioactive compounds (Table 1). The aqueous, ethanol, and methanol extracts were found to contain tannins, while saponins were detected in the aqueous and methanol extracts. Phenolic compounds were present in all three extracts, and reducing sugars were detected in the ethanol and methanol extracts. These findings suggest that *S. viarum* flowers possess a diverse range of phytochemicals with potential therapeutic applications.

Table 1: Qualitative phytochemical analysis of *Solanum viarum* flower using different extracts

Phytochemicals	**Solvents**		
	Aqueous	**Ethanol**	**Methanol**
Tannin	Detected	Detected	Detected
Saponin	Detected	Not detected	Detected
Flavonoids	Not detected	Not detected	Not detected
Terpenoids	Not detected	Not detected	Not detected
Phenolic compounds	Detected	Detected	Detected
Reducing sugars	Not detected	Detected	Detected

Steroids	Not detected	Not detected	Not detected
Alkaloids	Not detected	Not detected	Not detected
Carbonyl compounds	Not detected	Not detected	Not detected

The cytotoxicity analysis of *S. viarum* flower extracts were performed using the brine shrimp lethality assay. The results showed that all three extracts exhibited significant cytotoxicity against brine shrimp larvae (Table 2). The ethanol and methanol extracts were found to be more cytotoxic than the aqueous extract. These findings suggest that *S. viarum* flower extracts possess bioactive compounds with potential anticancer properties. The presence of tannins, saponins, and phenolic compounds in *S. viarum* flower extracts may contribute to their cytotoxic and therapeutic effects. The findings of the present study provide evidence for the potential therapeutic applications of *S. viarum* flower extracts. Further studies are needed to isolate and characterize the bioactive compounds present in these extracts, and to evaluate their safety and efficacy in animal models. The results of the present study suggest that *S. viarum* flowers may be a valuable source of novel bioactive compounds with potential applications in medicine and agriculture.

Table 2: Cytotoxicity analysis of *Solanum viarum* flower using different extracts

Extracts	**Concentration (in mg/ml)**	**Initial number of Nauplii**	**Number of deaths of Nauplii (in hours)**			**Death rates (%)**
			1	**2**	**3**	
Aqueous	25	10	0	0	1	10
	50	10	3	3	6	60
	100	10	7	7	7	70
	200	10	10	10	10	100
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	10	10	10	100
Ethanol	25	10	10	10	10	100
	50	10	10	10	10	100
	100	10	10	10	10	100
	200	10	10	10	10	100
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	10	10	10	100
Methanol	25	10	10	10	10	100
	50	10	10	10	10	100
	100	10	10	10	10	100
	200	10	10	10	10	100
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	10	10	10	100

Conclusion

In conclusion, the present study highlights the phytochemical and cytotoxic potential of *Solanum viarum* flower extracts. The qualitative phytochemical analysis identified the presence of tannins, saponins, phenolic compounds, and reducing sugars in the extracts. Cytotoxicity tests demonstrated that the extracts exhibited significant activity against brine shrimp larvae, suggesting their potential as a source of novel bioactive compounds. These findings support the traditional use of *S. viarum* flowers in folk medicine and underscore their potential as a valuable source of therapeutic agents. Future research should focus on isolating and characterizing the bioactive compounds in *S. viarum* flower extracts, as well as assessing their safety and efficacy in animal models. Further studies are also needed to explore the possible applications of *S. viarum* flowers in both medicine and agriculture. The development of standardized extracts and formulations could offer a valuable complement to conventional therapies for various diseases. Additionally, research into the cultivation and conservation of *S. viarum* plants is essential to ensure a sustainable supply of this promising medicinal resource.

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