

Chapter 1

Phytochemical composition and biological activity of *Actinoscirpus grossus* (L.f.) Goetgh. & D.A.Simpson (Cyperaceae)

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ABSTRACT

Sedges play an essential role in maintaining the balance of wetland and grassland ecosystems. Among them, *Actinoscirpus grossus* of family Cyperaceae stands out for its ecological resilience and ethnomedicinal relevance. Traditionally, this plant has been used in Indian folk medicine. In addition to its medicinal role, it has applications in fodder, basketry, and wastewater treatment. Despite its rich traditional background, *A. grossus* remains underexplored in modern pharmacological research. Present study aims to highlight the phytochemical, pharmacological, and ethnobotanical importance of *A. grossus*, emphasizing the need for further scientific validation to integrate this traditional knowledge into contemporary medicine and sustainable ecosystem management.

Keywords: Ethnomedicine, cytotoxicity, plant-based therapeutics

INTRODUCTION

Sedges are often mistaken for grasses, but they play a unique and important role in wetland, wastewater, and grassland ecosystems. While grasses are well known for their medicinal properties, members of the Cyperaceae family also have nutritional value, making them significant for wildlife management and grassland restoration (Al-Rowaily *et al.*, 2019). The first species studied in this series, *Actinoscirpus*

grossus, is a perennial or tuber forming plant that grows naturally across tropical and subtropical Asia and northern Australia (POWO, 2025). In India, it is commonly found in wetlands, swampy areas, and grasslands, especially those that have been disturbed. The plant flowers during the rainy season and can be easily recognized by its distinct features (Saxena and Brahmam, 1996): roots and stolons ending in small black tubers, erect, spongy, and sharply three-angled stems, keeled leaves that are as long as the stem. The spikelets are numerous, brown, and densely packed with many small flowers, while the nut is three sided, smooth, brown, and slightly pointed at the tip. This less studied member of the Cyperaceae family considering modern drug research holds great promise because of its long-standing use in traditional medicine. Its tuber extracts can help protect the liver, restoring enzyme balance, reducing lipid damage, and improving antioxidant activity in ethanol induced liver injury in rats (Ganapathi *et al.*, 2021). And this interconnects the traditional use of *A. grossus* rhizomes in treating jaundice and other bile related disorders. For generations, this plant has been a part of Indian folk medicine, used to manage a variety of ailments (Table 1). Its continued relevance today highlights the importance of bridging traditional knowledge with modern science to explore natural and more holistic approaches to health. Majorly, the rhizomes have been reviewed to be used in the treatment of disease related to eyes and skin (like Erysipelas and Cellulitis), problems associated with pregnancy (lactation, breast tissue development, miscarriage) and irregular menstrual cycles, common ailments like cough, cold, vomiting, diarrhea and even as a heart tonic for promoting immunity and strengthening cardiac muscles (Singh, 2017).

Table 1: Ethnomedicinal uses of *Actinoscirpus grossus* (Singh, 2017)

Ailment	Part used	Formulation	Mode of use	Therapeutic effects
Jaundice and Vomiting	Whole plant	Fresh juice (Swaras) extracted from the plant	Taken orally	Relieves jaundice, vomiting, and Pitta (bile) - related imbalances
Heart tonic, lactation and breast development	Whole plant	Fresh extract or tonic form	Taken orally	Strengthens heart muscles, promotes milk secretion & supports

				breast tissue development
Skin and eye disorders	Rhizome, leaves	Paste or extract	Applied externally	Improves skin and eye conditions
Diarrhea and heat stroke	Rhizome	Rhizome mixed with rose water to make a homogenized mixture, then filtered	Filtrate given 2–3 times daily	Calms the body and helps regulate heartbeat
Eye redness, high blood pressure and heat stroke	Rhizome	Paste of rhizome mixed with <i>Glycyrrhiza glabra</i>	Applied externally on eyes	Reduces redness and irritation in eyes
Erysipelas and Cellulitis (types of skin inflammation)	Rhizome, leaves	Lepa (herbal paste) prepared with cow ghee	Applied externally twice daily	Reduces swelling, infection and inflammation
Antiabortifacient, menstrual irregularities and uterine pain	Rhizome (with other herbs)	Decoction made from <i>Scirpus grossus</i> , <i>Asparagus racemosus</i> , <i>Trapa natans</i> , <i>Centella asiatica</i> , <i>Nymphaea alba</i>	Taken orally on empty stomach (morning & evening)	Prevents miscarriage, regulates menstrual cycle, relieves uterine pain
Cough, cold, weakness, fever, jaundice and heart disorders	Rhizome	<i>Kaserva</i> <i>Avaleha</i> : decoction of 2.5 kg roots boiled in 25L water (reduced to 1/4th), mixed with jaggery, cow ghee, <i>Trikatu</i> , <i>Trijat</i> , and <i>Kaseru</i> (<i>A. grossus</i>) powder	10-15 g taken daily	Acts as general tonic, relieves respiratory issues, boosts energy and immunity

Apart from its medicinal uses, the plant has been long used as fodder and a raw material for waving mats, bags, strings, ropes, and baskets while its ecological significance brings it in as a suitable species to be used in phytoremediation for improving water quality in constructed wetlands (Jinadasa *et al.*, 2006) by acting as a purifying agent for non-metal (like ammonia, phosphate) and metal contaminants. Taken together, the ecological resilience and rich ethnomedicinal history of *Actinoscirpus grossus* make it an ideal candidate for scientific exploration, which has been assessed in this study by diving into its toxicity screening and phytochemical profiling.



Figure 1: *Actinoscirpus grossus* in its natural habitat

METHODOLOGY

Whole plants of *Actinoscirpus grossus* (Figure 1) were collected from natural wetland habitats of Nayagarh district of Odisha, India and identified based on morphological characteristics using standard flora (Saxena and Brahmam, 1996). The collected samples were thoroughly washed under running tap water to remove adhering soil and debris. The cleaned plant materials were shade dried at room temperature (25 ± 2 °C) for a week to avoid thermal degradation of sensitive compounds. The dried material (Figure 2) was coarsely powdered using a

mechanical grinder and stored in sterile, airtight container until further use. Then, powdered samples were subjected to solvent extraction using three different solvents of varying polarity: n-hexane (non-polar), ethanol (polar), and aqueous (highly polar). For each solvent, 10 g of plant powder was macerated in 100 mL of solvent for 48 hours with occasional shaking (Devi *et al.*, 2023).



Figure 2: Dried plant parts of *A. grossus*

The extracts were filtered through Whatman No. 1 filter paper and filtrates were concentrated by air drying at room temperature. Dried crude extracts were stored in airtight glass vials at 4 °C until further analysis. Preliminary phytochemical analysis of *A. grossus* extracts was carried out to detect the presence of primary (proteins, carbohydrates, starch, sucrose, lipids, and amino acids) and secondary (tannins, saponins, flavonoids, terpenoids, phenolics, reducing sugars, steroids, alkaloids) metabolites. Standard phytochemical procedures (Jena *et al.*, 2025) were followed

to qualitatively screen the occurrence of each compound. The intensity of color change in each test was used as an indicator of metabolite presence (+) or absence (–). The cytotoxic potential of the hydroethanolic extract of *A. grossus* was evaluated using the brine shrimp lethality bioassay (Jena *et al.*, 2025). Brine shrimp (*Artemia salina*) eggs were hatched in artificial seawater (3.5% saline) under continuous aeration for 48 hours at room temperature to obtain active nauplii (Figure 3).

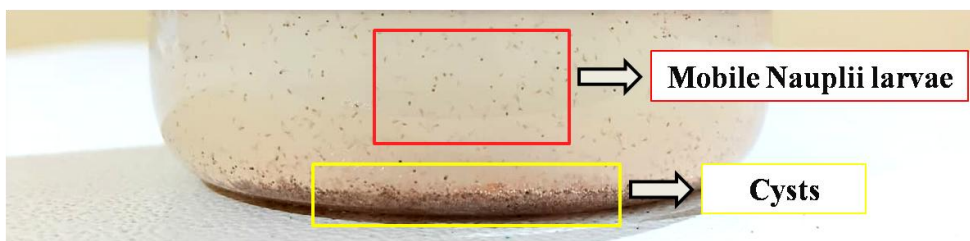


Figure 3: Hatching of nauplii in saline water

Different concentrations of the plant extract (32, 63, 94, 125, and 156 mg/mL) were prepared using 3.5% saline as solvent. Ten nauplii were introduced into each test vial containing different concentration of extract solution. A control group (3.5% saline only) and a positive control group treated with vincristine sulphate were also maintained. The number of dead nauplii was counted at 1, 2, 3, and 4 hours, and the mortality percentage was calculated to analyze cytotoxic activity.

RESULTS AND DISCUSSION

Phytochemical screening: The qualitative phytochemical analysis of *Actinoscirpus grossus* extracts revealed noticeable variation in the presence of bioactive compounds depending on the solvent used. The analysis of primary metabolites (Table 1) indicated that proteins and carbohydrates were present in both ethanol and aqueous extracts, whereas starch was detected only in the ethanol extract. Sucrose, lipids, and amino acids were absent in all three solvent extracts, showing that *A. grossus* primarily contains water and ethanol soluble nutrients. Among the secondary metabolites (Table 2), tannins were detected both in aqueous and ethanolic extract whereas reducing sugars were detected only in the ethanol extract. The n-hexane extract, being non-polar, did not show any detectable secondary metabolites, suggesting limited solubility of polar compounds in this solvent system. Overall, the ethanol extract demonstrated the richest phytochemical profile, indicating its efficiency in extracting both primary and secondary metabolites.

Table 1: Qualitative phytochemical analysis (Primary metabolites) of *A. grossus*

Primary metabolites	n-hexane	Ethanol	Aqueous
Proteins	-	+	+
Carbohydrates	-	+	+
Starch	-	+	-
Sucrose	-	-	-
Lipid	-	-	-
Amino acid	-	-	-

Present = (+); Absent = (-)

Table 2: Qualitative phytochemical analysis (Secondary metabolites) of *A. grossus*

Secondary metabolites	n-hexane	Ethanol	Aqueous
Tannin	-	+	+
Saponin	-	-	-
Flavonoids	-	-	-
Terpenoids	-	-	-
Phenolic compounds	-	-	-
Reducing sugars	-	+	-
Steroids	-	-	-
Alkaloids	-	-	-

Present = (+); Absent = (-)

Table 3: Cytotoxicity analysis of *Actinoscirpus grossus* using Brine shrimp nauplii

Extract	Concentration (in mg/mL)	Initial number of Nauplii	Number of deaths (after hours)				Death rate (%)
			1	2	3	4	
Hydro- ethanolic	32	10	0	4	10	10	100
	63	10	0	4	10	10	100
	94	10	0	10	10	10	100
	125	10	9	10	10	10	100
	156	10	9	10	10	10	100
	3.5% Saline	10	0	0	0	0	0
	Vincristine sulphate	10	10	10	10	10	100

Cytotoxicity analysis: The cytotoxic potential of the hydroethanolic extract of *A. grossus* was evaluated using the brine shrimp lethality bioassay (Table 3). The mortality rate of nauplii increased with extract concentration, showing 100% death across all tested concentrations (32–156 mg/mL) after 4 hours of exposure. The standard drug, vincristine sulphate, also caused 100% mortality, while the control group (3.5% saline) showed no mortality. These results indicated that the hydroethanolic extract of *A. grossus* exhibits significant cytotoxic activity, suggesting the presence of potent bioactive compounds with possible anticancer or pesticidal properties (Niksic *et al.*, 2021).

CONCLUSION

Actinoscirpus grossus is more than just wetland sedge and it represents a vital link between traditional healing practices and modern pharmacological potential. Long valued in ethnomedicine for treating liver, skin, and reproductive disorders, showed promising bioactive properties that merit deeper biochemical and pharmacological investigation. Furthermore, its ecological role in phytoremediation and sustainable land use strengthens its importance beyond medicine. By bridging indigenous wisdom with scientific research, *A. grossus* may contribute not only to natural drug discovery but also to biodiversity conservation and holistic healthcare. Continued exploration of such underrepresented species could open new pathways for sustainable and culturally rooted innovations in modern medicine.

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