Chapter 10

Bioactivity of *Abildgaardia ovata* (Burm.f.) Kral (Cyperaceae): an ecological and nutraceutical perspective

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ABSTRACT

Abildgaardia ovata is widely distributed across tropical and subtropical wetlands of the world. Yet, it is scientifically overlooked considering its ecological, ethnomedicinal and potential nutraceutical value. Present study aimed to investigate the qualitative phytochemical profile of *A. ovata* using different extracts to assess the distribution of primary and secondary metabolites across solvents of varying polarity. The n-hexane extract detected none of the tested metabolites while the ethanolic extract revealed the presence of proteins, carbohydrates, starch and reducing sugars, suggesting moderate extraction of polar primary metabolites. The aqueous extract was the richest, containing proteins, carbohydrates, tannins, saponins, flavonoids, terpenoids and reducing sugars highlighting suitability of water for extracting bioactive compounds. The findings showcase *A. ovata* to possess a diversified profile of polar phytochemicals that may contribute to its ecological resilience, fodder value and traditional therapeutic applications.

Keywords: *Abildgaardia*, Cyperaceae, natural therapeutics

INTRODUCTION

The Cyperaceae family, comprise of sedges that plays a vital multifunctional role across diverse ecosystems, particularly wetlands (Roy and Devi, 2025). Many species within this family serve as a valuable nutritional animal fodder, providing palatable and fibre-rich biomass for livestock, especially in regions where grasses are seasonally scarce (Wu *et al.,* 2025). Their tough, persistent root systems and

rapid regrowth make them dependable forage resources under low-input conditions. They are also known for their exceptional environmental stress tolerance as they continue to thrive in waterlogged soils, saline marshes, periodically flooded zones and nutrient-poor habitats (Wu *et al.,* 2025). This resilience is linked to their specialized anatomical features such as aerenchyma, rhizomatous growth and efficient water-use strategies, enabling them to maintain productivity under harsh conditions (Wu *et al.,* 2025).

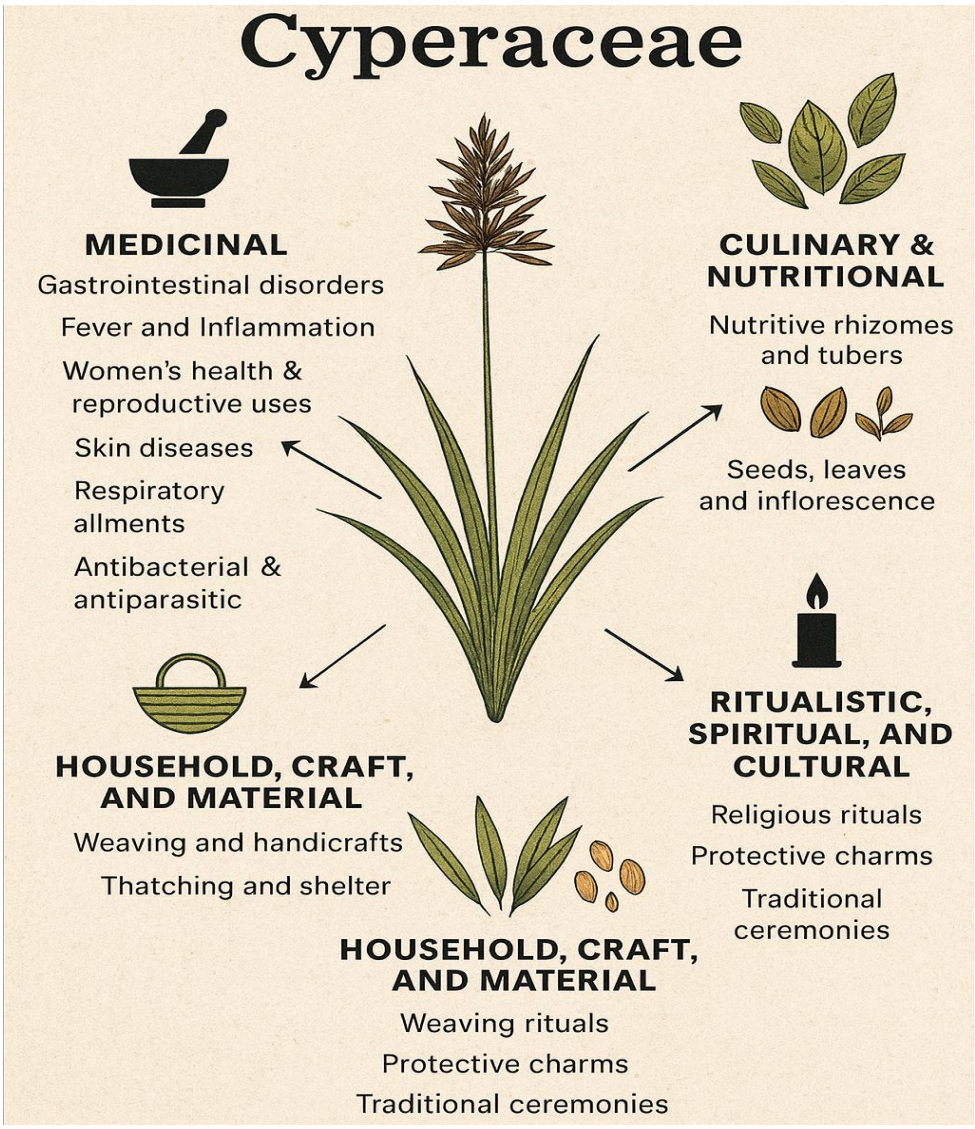


Figure 1: Medicinal, nutritional and cultural roles of Cyperaceae family

Ecologically, sedges play essential roles in maintaining ecosystem balance. Their dense root-mats stabilize soil, prevent erosion, enhance sediment accumulation and improve water filtration by trapping suspended particles and pollutants (Taheri *et al.,* 2021). By regulating hydrology and improving substrate quality, they create microhabitats supporting a wide variety of invertebrates, amphibians, birds and microorganisms (Wei *et al.,* 2022). In many wetland systems, Cyperaceae often act as keystone species, driving primary productivity and shaping the structure and function of the habitat. Their presence helps in mediating nutrient cycling, supporting trophic interactions and sustaining biodiversity (Więcław *et al.,* 2022). Beyond their ecological and nutritional importance, members of the Cyperaceae family hold deep cultural, ceremonial and ethnomedicinal significance in many traditional societies (Mishra *et al.,* 2016; Kujawska *et al.,* 2020; Rameshkumar *et al.,* 2022). Sedges are often woven into the fabric of local heritage through their use in crafts, rituals and daily utility items such as mats, baskets, roofing materials and ceremonial accessories (Rameshkumar *et al.,* 2022). These practices help preserve indigenous craftsmanship and intergenerational knowledge (Figure 1). Ethno-medicinally, they are valued for their rhizomes, tubers and aerial parts, which are used as remedies for digestive ailments, inflammation, fever, skin infections, reproductive health and respiratory disorders (Rameshkumar *et al.,* 2022; Bezerra and de Oliveira, 2023; Roy and Devi, 2025). These uses form a vital part of traditional healing systems like Ayurveda, Siddha and Unani, especially in rural and tribal communities where the cultural pharmacology is passed down orally through generations (Rameshkumar *et al.,* 2022; Bezerra and de Oliveira, 2023).



Figure 2: Infloroscence of *Abildgaardia ovata*

The continued presence and use of sedges thus support the retention of traditional ecological knowledge, reinforce community identity and maintain the cultural-biological link that actually preserve local healthcare practices and establishes a healthy biodiversity (Al-Rowaily *et al.,* 2019; Singh and Kumar, 2025). Despite their abundance in wetlands and marginal landscapes, many sedges remain scientifically overlooked, leading to significant knowledge gaps in their taxonomy, phytochemistry, adaptive strategies and ecosystem services. On that note, *Abildgaardia ovata* (Figure 3), a perennial sedge common to moist habitats of tropics and subtropics across the world was explored. It has been studied in this chapter for its phytochemical diversity in two aspects, first as a potential source of nutritional fodder for wildlife and secondly, as a reservoir of bioactive compounds with pharmacological importance because of its reported use of leaves by the Lodha tribal community of West Bengal (Chaudhury *et al.,* 2018) in treatment of Diarrhea (oral intake of juice) and insect bite (topical application).



Figure 3: *A. ovata* thriving in its natural habitat

METHODOLOGY

Collection and authentication of plant material: whole plants of *Abildgaardia ovata* (Figure 2) were collected from the moist areas of Mahanadi River, Cuttack,

Odisha, India and taxonomically identified based on their morphological characters using standard regional flora (Saxena and Brahmam, 1996).

Material preparation: the freshly collected plant samples were washed well for cleansing dirt particles. After that, the samples were shade dried at room temperature (25 ± 2 °C) for about ten days. Dehydrated samples were crushed into a coarse powder and stored for later experimental use (Devi *et al.,* 2023).

Solvent extraction: the dried powdered plant material was subjected to sequential maceration extraction using different solvents: n-hexane (non-polar), ethanol (polar) and distilled water (highly polar) following established protocol (Devi *et al.,* 2023).

Phytochemical profiling: qualitative phytochemical tests were carried out on the prepared extracts to screen for major classes of plant metabolites. Established phytochemical protocol (Jena *et al.,* 2025) was employed on targeted extracts:

1. **Primary metabolites**

a) **Test for carbohydrates:** About 1 ml of extract is mixed with 2-5 drops of Fehling's solution A and B and kept in the water bath for 30 minutes. Reducing sugar reacts with Fehling's reagent in an alkaline medium to form orange-to-red precipitate. The appearance of this orange or red precipitate indicates the presence of carbohydrates.

b) **Test for protein:** About 1 ml of extract is mixed with 2-5 drops of Millon's reagent and kept in the water bath for 30 minutes. The pink coloration indicates the presence of protein.

c) **Test for starch:** To 1 ml of extracts, 2-3 drops of concentrated Hydrochloric acid (HCl) are added and heated for 1-2 minutes. NaOH following Benedict's reagent is added to this solution and kept in the water bath. The change in coloration from bluish-green to red-orange indicates the presence of starch.

d) **Test for sucrose:** 1 ml of extract is mixed with 2-3 drops of Iodine solution. The appearance of a blue black colour indicates the presence of sucrose.

e) **Test for lipid:** 1 ml of extract is mixed with 2-5 drops of Sudan-III. The appearance of pink droplets indicates the presence of lipids.

f) **Test for amino acids:** 1 ml of extract is mixed with 5 drops of Ninhydrin reagent and kept in the water bath for 30 minutes. Ninhydrin is a powerful oxidizing agent to give a purple-coloured product (diketohydrin) termed as Rhuemann's purple. The appearance of purple or bluish colour indicates the presence of amino acids.

2. Secondary metabolites

a) **Test for tannin:** 1 ml of plant extract is mixed with 4-5 drops of 10% lead acetate solution. The formation of a light-yellow precipitate confirms the presence of tannins.

b) **Test for saponin:** 1 ml of plant extract is mixed with 1 ml of distilled water and after vigorous shaking; the formation of a stable, persistent froth confirms the presence of saponins.

c) **Test for flavonoids:** To 2 ml of plant extract, a few drops of dilute sodium hydroxide (NaOH) are added. The appearance of an intense yellow colour indicates the presence of flavonoids. Subsequent addition of 4-5 drops of dilute sulphuric acid causes the colour to fade, further confirming the presence of flavonoids.

d) **Test for terpenoids:** A mixture of 1 ml of plant extract and 2 ml of Chloroform ($CHCl_3$) is prepared and an equal volume of concentrated sulphuric acid (H_2SO_4) is added. The appearance of a reddish-brown coloration at the interface confirms the presence of terpenoids.

e) **Test for phenolic compounds:** 1 ml of plant extract is treated with 5 drops of 1% ferric chloride ($FeCl_3$) solution, resulting in the formation of a bluish-black coloration, which indicates the presence of phenolic compounds.

f) **Test for reducing sugars:** 1 ml of plant extract is added with 3 drops of Fehling's solution A and B and kept in water bath for a few minutes. The formation of an orange-red precipitate confirms the presence of reducing sugars.

g) **Test for steroids:** 1 ml of plant extract is mixed with 2 ml of $CHCl_3$, followed by the addition of 2 ml of concentrated H_2SO_4. The resulting formation of two distinct phases, characterized by an upper red layer and a lower yellow layer with green fluorescence, confirms the presence of steroids.

h) **Test for alkaloids:** 1 ml of plant extract is mixed with 3-4 drops of Dragendorff's reagent and kept in water bath for a few minutes. The formation of an orange-red precipitate confirms the presence of alkaloids.

RESULTS AND DISCUSSION

The qualitative phytochemical profiling of *Abildgaardia ovata* showed clear solvent-dependent results in metabolite detection (Table 1).

Primary metabolite screening: Among primary metabolites, the n-hexane extract showed no detectable compounds whereas the ethanol extract contained proteins, starch (very low) and carbohydrates, indicating moderate extraction of polar nutrients. The aqueous extract revealed proteins and carbohydrates, both in low abundance.

Secondary metabolite screening: For secondary metabolites, the n-hexane extract again showed no detectable constituents. The ethanol extract was limited to reducing sugars, while the aqueous extract exhibited the highest phytochemical diversity containing tannins, saponins, flavonoids, terpenoids (low) and reducing sugars. The aqueous extraction showed comparatively greater phytochemical richness.

Table 1: Qualitative phytochemical analysis of *Abildgaardia ovata* for detection of primary and secondary metabolites

Category of metabolites	Extract	Detected bioactive compounds	Phytochemical richness
Primary Metabolites	n-Hexane	No tested compound detected	◆
	Ethanol	Protein, Starch (very low) and Carbohydrates	◆
	Aqueous	Protein and Carbohydrates (low)	◆
Secondary Metabolites	n-Hexane	No tested compound detected	◆
	Ethanol	Reducing sugars only	◆
	Aqueous	Tannin, Saponin, Flavonoids, Terpenoids (low) and Reducing sugars	◆

(◆ = low, ◆ = moderate, ◆ = high)

Ecological link: This phytochemical profile of *A. ovata* offers insight into its ecological performance within wetland and seasonally moist habitats. The modest presence of primary metabolites reflected a resource-efficient growth strategy typical of sedges inhabiting fluctuating hydrological environments (Mejdová *et al.,* 2021). Secondary bioactive compounds may contribute to the ability of the species to persist in nutrient-poor, waterlogged soils where competition and microbial pressure are comparatively higher than grasslands (Ehlers *et al.,* 2020). And here, the dominance of polar secondary metabolites such as tannins, saponins, flavonoids

and terpenoids especially in aqueous extract indicated toward its adaptive roles in stress tolerance, herbivore deterrence and antimicrobial defense (Kumar *et al.,* 2023).

CONCLUSION

Cyperaceae make up a vital part of the wetland ecosystems. Despite the presence of their healthy populations across the world, they remain underexplored as potential natural agents in today's modern research. The qualitative phytochemical assessment of *Abildgaardia ovata,* one of the resilient sedges of thriving wetlands highlighted its richness in polar bioactive compounds. Particularly within the aqueous extract, it contained tannins, saponins, flavonoids, terpenoids and reducing sugars. The absence of detectable compounds in the non-polar extract showed the dominance of hydrophilic constituents in the species. Presence of essential primary metabolites indicated towards its potential as a fibre-rich fodder for the fauna of wetlands. These findings not only validated the plant's traditional therapeutic relevance but also suggested ecological advantages such as stress tolerance and antimicrobial defense, which support its persistence in wetland and seasonally moist habitats which asks for further in-depth research regarding its pharmacological and nutraceutical aspect.

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