Chapter 5

From weed to resource: antioxidant potential of *Cyperus haspan* L. (Cyperaceae) in wetland ecosystems

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ABSTRACT

Weeds are commonly considered undesirable plants, yet many of them possess significant medicinal value due to their rich phytochemical composition. *Cyperus haspan*, a widely distributed wetland weed, has been used in traditional practices for treating various ailments, but its scientific evaluation remains limited. Present study was conducted to assess the phytochemical constituents and antioxidant potential of the whole plant of *C. haspan*. Three solvent extracts (n-hexane, ethanol and aqueous) were subjected to qualitative phytochemical screening for both primary and secondary metabolites. The ethanolic and aqueous extracts showed the presence of key primary metabolites such as proteins and carbohydrates, along with secondary metabolites including flavonoids, tannins and reducing sugars, whereas no compounds were detected in the non-polar extract. Qualitative antioxidant screening showed prominent spots of the aqueous extract with high Rf (Retention factor) values under different solvent systems, confirming the presence of multiple antioxidant active compounds. These findings suggest that *C. haspan* contains bioactive constituents capable of scavenging free radicals, supporting its traditional use and highlighting its potential as a natural source of antioxidants and emphasizing the importance of exploring neglected weeds for their possible applications in herbal medicine and nutraceutical development.

Keywords: Green medicine, radical scavenging, weeds

INTRODUCTION

Today weeds have shifted from being a nuisance in agricultural lands to become a topic of research in the scientific community (Chauhan *et al.,* 2017). Weeds are generally considered unwanted in the prospering agricultural, horticultural and floricultural lands because of their fast growth and competition with crops (Naeem *et al.,* 2022; Haq *et al.,* 2023). However, many of these plants possess rich phytochemical diversity and strong biological activity, making them valuable from a medicinal and ecological perspective (Sreelakshmi and Jeeshna, 2024). Currently, oxidative stress caused by free radicals is one of the major contributors to aging and various chronic diseases, including cancer, cardiovascular disorders and neurodegenerative conditions (Leyane *et al.,* 2022). Natural antioxidants derived from plants play a crucial role in neutralizing these free radicals and protecting the body from cellular damage (Chandimali *et al.,* 2025). While medicinal plants are widely studied for this purpose, weeds growing in challenging environments such as wetlands, roadsides and agricultural margins may develop strong antioxidant defense mechanisms to survive harsh conditions (Llauradó Maury *et al.,* 2020). These survival strategies often result in the accumulation of potent secondary metabolites such as flavonoids, phenolics, and tannins in them which can be used in development of sustainable green medicine (Movahedi *et al.,* 2021). Also in traditional systems of medicine, several weed species have been used for centuries to treat common ailments, reduce inflammation, and improve general health (Leinen *et al.,* 2023; Roy and Devi, 2025). *Cyperus haspan* (Figure 1) is one of those many neglected members of Cyperaceae that thrives in dry tropical habitats and is native to tropical and subtropical regions (POWO, 2025) across the world. It is an annual or perennial sedge which is economically used as a source of food and fodder by people of Tropical and East Africa (Rameshkumar *et al.,* 2022). People get livelihood by making baskets, mats from the culm of this species. Its rhizomes, reported to be used in treating fever and cough (Arya *et al.,* 2022). Alongside other febrifuge plants (Rameshkumar *et al.,* 2022) it has also been reviewed for medicinal uses by the indigenous people of French Guiana (Wayapi). This points towards how socially infamous weeds from being a threat to farm and forest productivity is slowly returning back to their rich cultural heritage associated with their traditional medicinal uses. And because of their abundance, less knowledge associated with grasses and sedges and easy availability, they remain scientifically ignored and underexplored, especially with regard to their bioactive compounds. In that regard, given study dives into the qualitative phytochemical screening of *C. haspan* for accessing its current position as a fodder for wildlife and to access its antioxidant potential for documenting a baseline data for future research works.



Figure 1: Collection of *C. haspan* from wetland

METHODOLOGY

Plants of *Cyperus haspan* (Figure 1-2) were collected from the wetlands of the Puri district, Odisha, India. Species identification was confirmed using standard regional flora book (Saxena and Brahmam, 1996).



Figure 2: Plant parts of *C. haspan*

After collection, the plant material was washed under running tap water to clean dirt. The samples were then shade dried at room temperature for a week and once completely dried (Figure 3), the material was coarsely ground and stored in sterile,

airtight containers until extraction. For solvent extraction, three solvents with differing polarities were used *i.e.* n-hexane (non-polar), ethanol (polar) and distilled water (highly polar). About 7 g of the powdered plant material was soaked in 70 mL of each solvent separately and periodically agitated for 48 hours for extraction (Devi *et al.,* 2023). Whatman No. 1 filter paper was used for filtration and the filtrates were left room temperature for evaporation.



Figure 3: Dried plant parts of *C. haspan*

Obtained crude extracts were stored in refrigerator conditions at 37-40°F (3 - 4°C) for further use. Crude extracts of *C. haspan* were dissolved in 1% DMSO and were used for preliminary qualitative phytochemical screening for detection of primary and secondary metabolites, following standard protocols with slight modifications (Jena *et al.,* 2025). The aqueous extract was then analyzed by Thin-Layer Chromatography (TLC) using three different mobile phase systems following standard procedure with slight modifications (Pattnaik and Bhatnagar, 2023; Balasaheb *et al.,* 2025). The solvent systems used were:

a) Ethyl acetate: Methanol: Water (40: 5.4: 4) [EMW] — polar (neutral system)

b) Chloroform: Ethyl acetate: Formic acid (5: 4: 1) [CEF] — intermediate polarity (acidic system)

c) n-Hexane: Petroleum ether: Ethanol (10: 10: 80) [NPE] — non-polar to weakly (basic system)

The developed TLC plates were air dried and sprayed with 0.2% DPPH (2,2-Diphenyl-1-picrylhydrazyl) solution in methanol as a detecting reagent. Appearance of yellow bands against a purple background was taken as indication of the presence of antioxidant compounds, and the retention factor (Rf) values were calculated for each system.

RESULTS AND DISCUSSION

Phytochemical screening: Three different solvent extracts (n-Hexane, Ethanol and Aqueous) were qualitatively screened for detection of primary and secondary metabolites (Table 1). None of the tested compounds were detected in the non polar (n-Hexane) extract for both primary and secondary metabolites. Proteins and carbohydrates were tested positive in both ethanolic and aqueous extract showing that the polar solvents were effective for dissolving primary metabolites. While tannin was commonly detected in both the polar solvent, reducing sugars and flavonoids were tested positive for ethanolic and aqueous extract respectively reflecting their moderate phytochemical richness.

Antioxidant activity: The TLC (Thin Layer Chromatography) – based DPPH (2,2-diphenyl-1-picrylhydrazyl) analysis revealed the presence of antioxidant active compounds in the aqueous extract of *C. haspan* (Table 2). Different mobile phase systems produced distinct band patterns, indicating variation in compound polarity and separation efficiency. Using the ethyl acetate: methanol: water (40:5.4:4) solvent system, a prominent spot (S1) was observed at a high Rf value of 0.983, along with streaking between 0.25 and 0.583, suggesting the presence of multiple compounds with different polarities (Figure 4). In the chloroform: ethyl acetate: formic acid (5:4:1) system, only one distinct spot (S1) was detected at an Rf value of 0.514, indicating moderate separation of compounds. The n-hexane: petroleum ether: ethanol (10:10:80) system showed three clear spots with Rf values of 0.5, 0.75, and 0.983, demonstrating better separation of antioxidant active components in this solvent system. Overall, the presence of multiple spots with high Rf values confirms that the whole plant extract of *C. haspan* contains different antioxidant compounds.

Table 1: Qualitative phytochemical analysis of *C. haspan*

Category of Metabolites	Extract	Detected Bioactive Compounds	Phytochemical richness
Primary Metabolites	n-hexane	No tested compound detected	◆
	Ethanol	Proteins and carbohydrates only	◆
	Aqueous	Protein and carbohydrates	◆
Secondary Metabolites	n-hexane	No tested compound detected	◆
	Ethanol	Tannin and Reducing sugars	◆
	Aqueous	Tannin and Flavonoids	◆

(◆= low, ◆= moderate, ◆= high)

Table 2: TLC-based DPPH analysis of whole plant extract of *C. haspan*

	Mobile Phases	Rf value of spots			
		S1	S2	S3	Streak
Aqueous	Ethyl acetate: Methanol: Water (40:5.4:4)	0.983	-	-	0.25 – 0.583
	Chloroform: Ethyl acetate: Formic acid (5: 4: 1)	0.514	-	-	-
	n-Hexane: Petroleum ether: Ethanol (10: 10: 80)	0.5	0.75	0.983	-

(Rf: Retention factor)

Ecological link: The dominance of polar primary and secondary metabolites (Table 1) in *C. haspan*, along with the clear presence of antioxidant streaks (Table 2), reflects an adaptive strategy for survival in wetland environments that are often exposed to high moisture, variable oxygen levels, microbial pressure and oxidative stress (Bodelier and Dedysh, 2013). These phytochemicals likely function as protective agents, helping the plant tolerate environmental fluctuations, resist pathogens and maintain physiological balance in dynamic aquatic and semi-aquatic habitats (Kumar *et al.,* 2023). This biochemical resilience also explains its persistence and ecological significance as a common wetland weed.

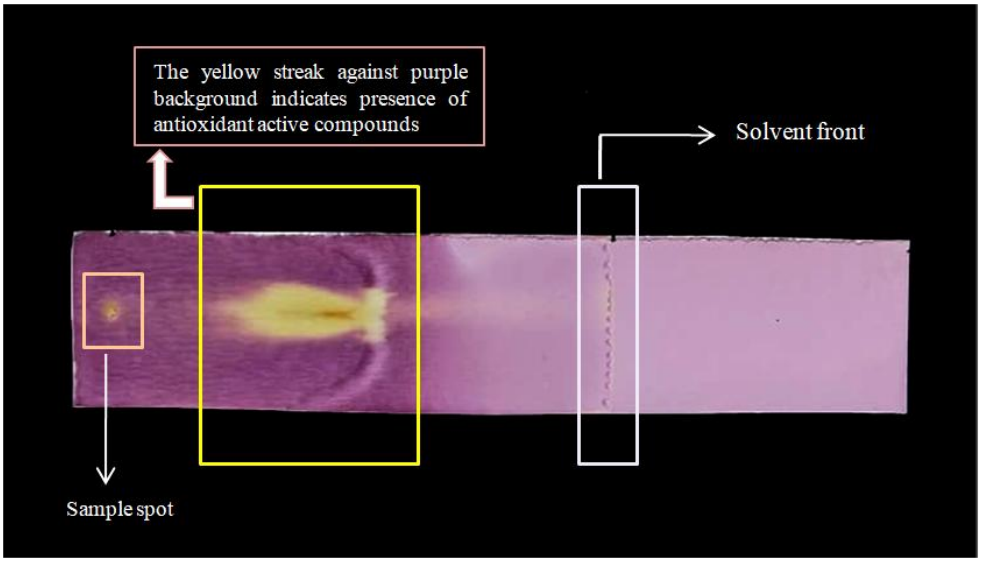


Figure 4: Antioxidant screening of aqueous extract of *C. haspan* in (Ethyl acetate: Methanol: Water) system

CONCLUSION

Present investigation highlighted the hidden medicinal potential of the commonly neglected sedge *Cyperus haspan*. The qualitative phytochemical screening demonstrated that the plant contains several bioactive compounds, particularly in polar solvent extracts. The presence of flavonoids, tannins, proteins, and carbohydrates suggested its significant biochemical importance. The preliminary antioxidant screening further supported the presence of multiple antioxidant active constituents in the aqueous extract of the plant. These compounds may play a vital role in protecting living systems against oxidative stress and related disorders. Ecologically, the ability of this wetland sedge to produce antioxidant metabolites may be an adaptive response to survive in fluctuating and stressful environmental conditions. Overall, this study provides scientific validation for the traditional use of *C. haspan* and emphasizes that weeds should not be viewed merely as undesirable plants but as valuable biological resources. Further studies focused towards its compound characterization, isolation following other pharmacological parameters can help assess its potential applications in pharmaceutical and nutraceutical fields.

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