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Research Article

Phytochemical analysis and antioxidant activity of *Cyperus tenuispica* Steud. (Cyperaceae): A fodder of wildlife and livestock

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Abstract: Present study investigated the phytochemical analysis and antioxidant activity of *Cyperus tenuispica* Steud. (Cyperaceae), a plant used as fodder for wildlife and livestock. Qualitative phytochemical analysis revealed the presence of secondary metabolites such as tannins, saponins, flavonoids, and reducing sugars in aqueous extracts, while primary metabolites like proteins and carbohydrates were detected in ethanol and aqueous extracts. The plant's antioxidant potential was evaluated using TLC-based DPPH analysis, which showed promising activity in various mobile phases. These findings suggest that *C. tenuispica* possesses valuable phytochemicals and antioxidant properties, warranting further research into its medicinal applications and restoration of grasslands.

Keywords: *Cyperus tenuispica*, antioxidant activity, phytochemical screening, DPPH assay, fodder species, secondary metabolites, primary metabolites

Introduction

The genus *Cyperus* belonging to family Cyperaceae comprises a large group of sedges widely distributed across tropical and subtropical regions of the world (Ribeiro et al., 2021). Several species of this genus are known for their ecological importance (Barrett, 2013) as well as ethnobotanical (Peerzada et al., 2015; Kamala et al., 2018; Bezerra and Oliveira, 2023) and pharmacological uses

(Taheri et al., 2021; Rameshkumar et al., 2022). They are also food of many wildlife and livestock (Wu et al., 2025; Klagkou et al., 2025). Among them, *Cyperus tenuispica* Steud., is an underexplored species that commonly grows in grasslands, wetlands, and agricultural fields (Figure 1). Despite its ecological and economic significance, scientific investigations on its biochemical and pharmacological attributes remain scarce. Secondary metabolites are responsible for diverse biological activities (Chandrashekar et al., 2025). These compounds play a vital role in scavenging free radicals, thereby protecting living organisms from oxidative stress related health problems.

Figure 1: Collected plant parts of *C. tenuispica* for experimental works

Plants are rich in these metabolites which are not only nutritionally valuable as fodder but also possess potential medicinal properties. Identifying and characterizing such compounds in less-studied fodder plants like *C. tenuispica* can provide insights into their dual role in sustaining animal health and offering natural therapeutic agents. Antioxidant activity is a critical parameter for evaluating the health-promoting

potential of plant-derived products. Methods such as thin-layer chromatography (TLC) combined with DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assays enable rapid screening of antioxidant compounds. In this context, the present study investigated the qualitative phytochemical profile and antioxidant capacity of *C. tenuispica* using different solvent extracts.

Materials and methods

Cyperus tenuispica was collected from Cuttack, Odisha, India (Figure 1). Plant specimen is identified by authors followed by published literature (Saxena and Brahmam, 1996). Successive extractions were performed using n-hexane, ethanol, and distilled water. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025). For the detection of antioxidant potential, DPPH assay was carried out (Bhatnagar et al., 2013). n-Hexane, acetone, ethanol, and aqueous extracts were run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air dried and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

a) Ethyl acetate: Methanol: Water (40: 5.4:4) [EMW] (Polar neutral)

b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)

c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [BEA] (Non-polar/Basic)

Results and discussion

The experimental works revealed that non-polar n-hexane extract of *C. tenuispica* showed no detectable secondary metabolites (Table 1). Among polar solvents, ethanol extract revealed the presence of reducing sugars only, whereas the aqueous extract exhibited a richer profile containing tannins, saponins, flavonoids, and reducing sugars (Table 1). This highlights the aqueous fraction as a potential source of antioxidant phytochemicals. Analysis of primary metabolites indicated that proteins and carbohydrates were absent in the n-hexane extract but were clearly present in both ethanol and aqueous extracts (Table 2).

Table 1: Qualitative phytochemical analysis of *C. tenuispica* for detection of secondary metabolites

Polarity	Extracts	Detected secondary metabolites
Non-Polar ⇓ Polar	n-Hexane	All tested bioactive compounds were not detected.
	Ethanol	Only Reducing sugars
	Aqueous	Tannin, Saponin, Flavonoids and Reducing sugars

Table 2: Qualitative phytochemical analysis of *C. tenuispica* for detection of primary metabolites

Polarity	Extracts	Detected primary metabolites
Non-Polar ↓ Polar	n-Hexane	All tested bioactive compounds were not detected.
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

This suggests that polar solvents are more effective in extracting nutritionally important compounds. The TLC-based DPPH radical scavenging test confirmed the antioxidant potential of *C. tenuispica*. Prominent purple spots were observed against a yellow background, signifying free-radical inhibition. Three solvent systems produced distinct Rf values ranging from 0.546 to 0.985 (Table 3). Among them, the chloroform: ethyl acetate: formic acid (5:4:1) system yielded the highest Rf (0.985), indicating the presence of potent antioxidant compounds (Figure 2).

Table 3: TLC-based DPPH analysis of *C. tenuispica* using different mobile phases

	Mobile Phases	Rf value of Spots	
		S1	S2
Aqueous	Ethyl acetate: Methanol: Water (40:5.4:4)	0.818	0.927
	Chloroform: Ethyl acetate: Formic acid (5: 4: 1)	0.985	
	n-Hexane: Petroleum ether: Ethanol (90: 10: 01)	0.546	0.859

(Rf: Retention factor)

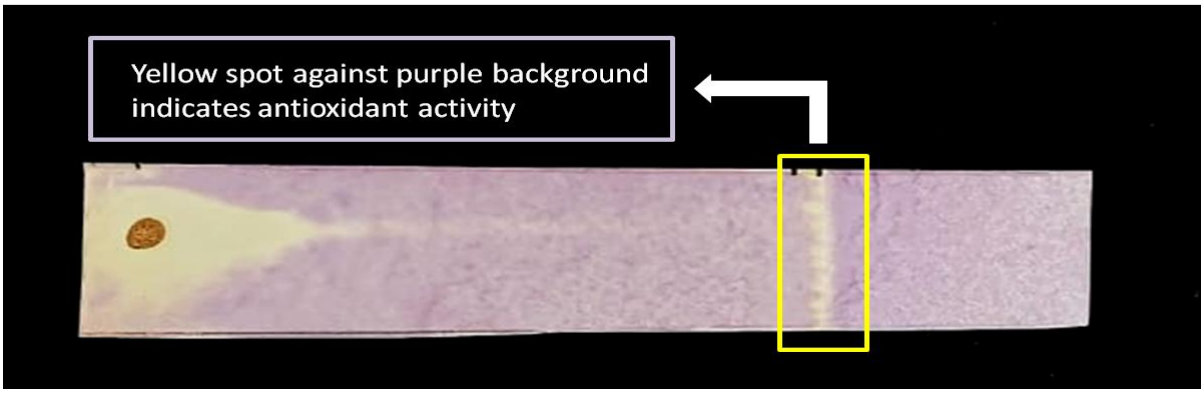

Figure 2: Antioxidant activity in Chloroform: Ethyl acetate: Formic acid (5:4:1) mobile phase

Conclusion

The present investigation demonstrates that *Cyperus tenuispica* is a phytochemically rich sedge with significant antioxidant potential. Qualitative analyses revealed the presence of key secondary metabolites such as tannins, saponins, flavonoids, and reducing sugars, particularly in the aqueous extract, along with primary metabolites like proteins and carbohydrates which reflects its nutraceutical potentials. The TLC-based DPPH assay further confirmed its ability to scavenge free radicals, indicating the presence of bioactive antioxidant compounds. These findings not only validate the traditional use of *C. tenuispica* as a nutritious fodder for wildlife and livestock but also suggest its potential as a natural source of therapeutic phytochemicals. Further studies focusing on quantitative phytochemical profiling, isolation of active compounds, and in vivo bioassays are recommended to fully explore its pharmacological applications and conservation value.

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