Chapter 12

Nutritional and medicinal values of *Fuirena umbellata* Rottb.

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Abstract: *Fuirena umbellata* belonging to the family Cyperaceae, is an underexplored sedge with potential pharmacological properties. In present study, qualitative phytochemical screening was carried out to detect primary and secondary metabolites in different solvent extracts of *F. umbellata*, followed by thin-layer chromatography (TLC)-based antioxidant assays using DPPH (2,2-diphenyl-1-picrylhydrazyl). Among the secondary metabolites, tannins, saponins, phenols, flavonoids, and reducing sugars were present in polar extracts, while non-polar fractions were largely inactive. Primary metabolites such as proteins and carbohydrates were detected mainly in ethanol and aqueous extracts. TLC analysis of aqueous fractions revealed distinct antioxidant-active bands with retention factor (Rf) values ranging from 0.371 to 0.985, indicating the presence of bioactive compounds with radical-scavenging potential. These findings highlight the importance of *F. umbellata* as a promising fodder grass of wildlife & livestock. It could be also the source of natural antioxidants and suggest its potential applications in nutraceutical and pharmaceutical industries.

Keywords: Cyperaceae, phytochemical screening, primary metabolites, secondary metabolites

Introduction

The search for natural antioxidants has intensified due to their potential role in preventing oxidative stress-related disorders such as cardiovascular diseases, diabetes, and cancer (Mallik et al., 2024). Plants of the family Cyperaceae have long been recognized for their ecological importance (Barrett, 2013) and ethnomedicinal uses (Taheri et al., 2021). However, many species remain unexplored for their chemical constituents and biological activities. Keeping the need of screening of therapeutic agents from nature and restoration of biodiversity particularly grasslands, an attempt has been made to document the nutritional and medicinal uses of *Fuirena umbellata* Rottb. It is commonly distributed in wetland habitats, is a perennial sedge traditionally used as fodder and for phytoremediation properties (Lekeufack et al., 2017). Despite its ecological significance,

there is less or no information on its phytochemical profile and antioxidant potential. Present study aims to provide a preliminary assessment of the primary and secondary metabolites present in different solvent extracts of *F. umbellata* and to evaluate their antioxidant properties using TLC-based DPPH assays.



Figure 1: Plant parts of *Fuirena umbellata*

Materials and methods

F. umbellata 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: Distilled 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

Phytochemical screening revealed a clear polarity-dependent distribution of metabolites (Table 1). Polar extracts (ethanol and aqueous) contained a rich array of secondary metabolites, including tannins, saponins, phenols, flavonoids, and reducing sugars. The aqueous extract was particularly rich, containing all tested metabolites except alkaloids, which were not detected. In contrast, the non-polar n-hexane extract showed only reducing sugars, suggesting that most antioxidant compounds are hydrophilic. The primary metabolite analysis (Table 2) demonstrated the presence of proteins and carbohydrates primarily in ethanol and aqueous extracts, while n-hexane contained only carbohydrates. These metabolites contribute to the nutritional value of the plant, supporting its traditional use as fodder. TLC-DPPH analysis of aqueous extracts revealed distinct antioxidant-active zones in all tested solvent systems (Table 3; Figure 2). The highest activity was recorded in the ethyl acetate: methanol: distilled water mobile phase, which produced two sharp antioxidant bands (Rf: 0.371 and 0.714) and a streak extending from 0.571 to 0.985. The chloroform: ethyl acetate: formic acid system showed a single strong spot at Rf: 0.984, while n-hexane: petroleum ether: ethanol developed a single band at Rf: 0.754. The multiple active spots indicate the presence of diverse radical-

scavenging compounds, likely polyphenols, and flavonoids, consistent with the qualitative phytochemical results.

Table 1: Qualitative phytochemical analysis for detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	Only Reducing sugars
	Ethanol	Tannin, Saponin, Phenol and Reducing sugars
	Aqueous	Tannin, Saponin, Flavonoid, Phenol and Reducing sugars

Table 2: Qualitative phytochemical analysis for detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	Only Carbohydrate
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *F. umbellata* using different mobile phases

	Mobile Phases	Rf value of Spots		
Aqueous		S1	S2	Streak
	Ethyl acetate: Methanol: Distilled water (40:5.4:4)	0.371	0.714	0.571-0.985

	Chloroform: Ethyl acetate: Formic acid (5: 4: 1)	0.984	-	0 – 0.666
	n-Hexane: Petroleum ether: Ethanol (90:10:1)	0.754	-	-

(Rf: Retention factor)

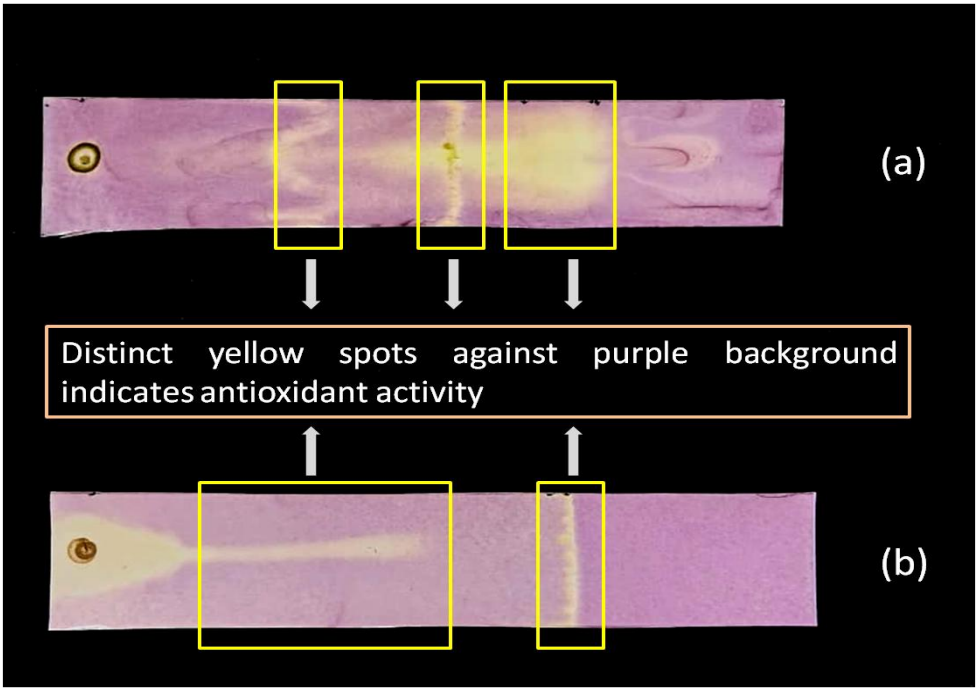


Figure 2: Antioxidant activity of *F. umbellata* in mobile phases a) Ethyl acetate: Methanol: Distilled water and b) n-Hexane: Petroleum ether: Ethanol

Conclusion

Present study demonstrates that *Fuirena umbellata* is a valuable fodder sedge with phytoremediation properties and a rich source of bioactive compounds, including polyphenols and flavonoids, which exhibit notable antioxidant activity. The prevalence of metabolites in polar extracts indicates that aqueous and ethanol fractions are optimal for further isolation and characterization of bioactive compounds. These findings provide a scientific foundation for the potential nutraceutical and pharmaceutical applications of *F. umbellata*, underscoring the need for further comprehensive chemical and biological

investigations. Additionally, the diversity of primary and secondary metabolites in *F. umbellata* suggests its potential for restoring grasslands, highlighting its multifaceted utility.

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