Chapter 18

Nutritional and medicinal potential of *Fimbristylis ferruginea* (Cyperaceae)

Sumitra Jethy and Sanjeet Kumar*

Biodiversity and Conservation Lab., Ambika Prasad Research Foundation, Odisha, India

*Email-Id: sanjeetaprf@gmail.com

Abstract: *Fimbristylis ferruginea* is an underexplored sedge species commonly occurring in wetlands, marshes, and coastal ecosystems belonging to the family Cyperaceae. Despite its ecological significance, limited information exists on its nutritional and medicinal potential. The present chapter highlights the available primary-secondary metabolites, and antioxidant activity of *F. ferruginea*. Qualitative analysis revealed the presence of proteins, carbohydrates, starch, tannins, flavonoids, saponins, and reducing sugars. Antioxidant potential was demonstrated through thin-layer chromatography (TLC)-based DPPH (2,2-diphenyl-1-picrylhydrazyl) analysis, with distinct retention factors in different solvent systems. The findings highlight the importance of *F. ferruginea* as a potential source of bioactive compounds with nutraceutical and therapeutic relevance. Present study advocates further exploration and conservation of sedges as valuable non-conventional plant resources.

Keywords: Cyperaceae, primary metabolites, secondary metabolites, nutraceuticals, medicinal plants, sedges, wetland biodiversity

Introduction

Cyperaceae, the sedge family, comprises about 5,600 species distributed worldwide, with many adapted to wetland and coastal habitats (Taheri et al., 2021). Members of this family play crucial ecological roles, including soil stabilization, water retention, and as fodder for herbivores (Barrett, 2013). However, their nutritional and pharmacological values remain largely neglected compared to other angiosperm families. *Fimbristylis ferruginea* (L.) Vahl, commonly referred to as rust-colored fimbristylis, is a perennial sedge that thrives in saline soils, estuaries, and littoral zones across tropical and subtropical regions (Saxena and Brahmam, 1996; Figure 1). Traditionally, species of *Fimbristylis* have been used in ethnomedicine treatments (Chauhan et al., 2024). Nevertheless, *F. ferruginea* itself has not been systematically studied for its phytochemical richness and bioactivity. This chapter

provides insights into the nutritional and medicinal potential of *F. ferruginea* by presenting results of qualitative phytochemical screenings and antioxidant activity analyses. It also places the species in the broader context of sedge utilization and its future research prospects.



Figure 1: Aerial parts of *Fimbristylis ferruginea*

Materials and methods

Fimbristylis ferruginea was collected from Nayagarh, Odisha, India (Figure 2). Plant specimen was identified by authors followed by published literature (Saxena and Brahmam, 1996). Soxhlet apparatus was used (n-hexane, ethanol, and distilled water) for extraction. 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). Aqueous extract was 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) [HPE] (Non-polar/Basic)



Figure 2: Whole plant of *Fimbristylis ferruginea*

Results and discussion

The phytochemical profile (Table 1) revealed tannins, flavonoids, saponins, and reducing sugars in ethanol and aqueous extracts, while no secondary metabolites were detected in n-hexane extracts.

Table 1: Qualitative phytochemical analysis for detection of secondary metabolites

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

Table 2: Qualitative phytochemical analysis for detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Protein, Starch and Carbohydrate
	Aqueous	Protein and Carbohydrate

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

	Mobile Phases	Rf value of Spots	
		S1	Streak
Aqueous	Ethyl acetate: Methanol: Water (40:5.4:4)	-	0-0.5
	Chloroform: Ethyl acetate: Formic acid (5: 4: 1)	0.983	-

	n-Hexane: Petroleum ether: Ethanol (10: 10: 80)	0.666	0.783 – 0.916

(Rf: Retention factor)

Primary metabolites including proteins, carbohydrates, and starch were identified in ethanol and aqueous extracts (Table 2). Distinct antioxidant activity was recorded in TLC-based DPPH assays (Table 3; Figure 3). The aqueous extract displayed spots with retention factors ranging from 0.666 to 0.983 in different mobile phases, confirming antioxidant potential.

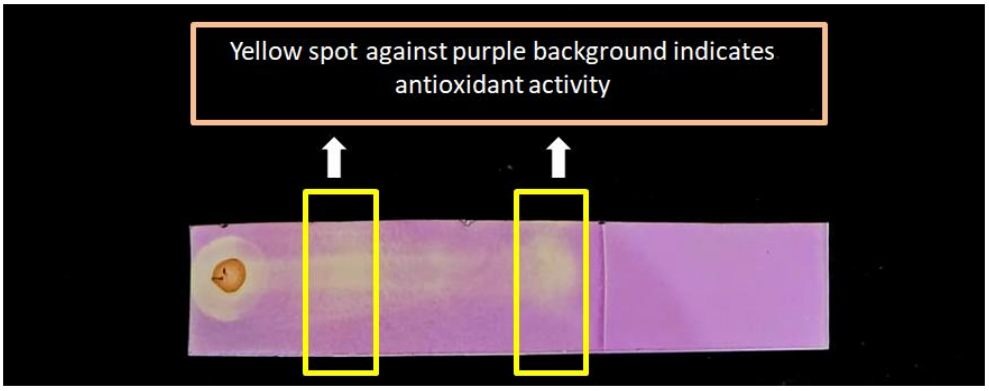


Figure 3: Antioxidant activity of *Fimbristylis ferruginea*

The results establish *F. ferruginea* as a promising sedge with both nutritional and medicinal relevance. The detection of proteins and carbohydrates suggests potential dietary benefits, particularly for communities relying on wetland resources. Secondary metabolites such as tannins and flavonoids are widely recognized for their antioxidant, anti-inflammatory, and antimicrobial activities (Platzer et al., 2022). The antioxidant profiling through DPPH-TLC highlights radical scavenging potential, aligning with earlier reports on antioxidant-rich sedges. These findings open avenues for isolation of individual bioactive compounds and exploring pharmacological activities such as antimicrobial, anti-diabetic, and hepatoprotective effects.

Conclusion

The phytochemical and antioxidant analyses of *Fimbristylis ferruginea* confirm the presence of nutritionally valuable primary metabolites and bioactive secondary metabolites. Its antioxidant activity further supports medicinal potential, making it a candidate for future nutraceutical applications. Given its abundance in wetland ecosystems, *F. ferruginea* may serve as a sustainable resource for non-conventional plant-

based health supplements. However, detailed pharmacological, toxicological, and clinical studies are essential to validate its efficacy.

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