

Phytochemical screening and antioxidant activity of *Flemingia chappar* Buch. Ham. ex Benth. (Fabaceae)

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DOI: <https://doi.org/10.66856/ijaps.2026.8.3.8271>

Abstract

Medicinal plants contain diverse bioactive compounds with potential therapeutic properties. The evaluation of bioactivity of therapeutic plants is an important work in ethnopharmacology. Present study evaluated the availability of phytochemicals and antioxidant activity of *Flemingia chappar* leaves. Aqueous, ethanol and *n*-hexane leaf extracts were screened for primary and secondary metabolites. Selected phytochemicals were quantified and antioxidant activity was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay. Results revealed that protein and carbohydrates were detected in aqueous and ethanol extracts. Aqueous extract contained tannins, saponins, flavonoids, phenols, reducing sugars and alkaloids, while ethanol extract contained tannins, flavonoids, phenols and reducing sugars. Tannin (112.68 mg/100 mL), saponin (7.97 %), total phenol (9.82 mg/100 mL) and flavonoid (0.28 mg/mL) were quantified. DPPH inhibition increased with concentration, reaching 75.39 % in aqueous and 73.90 % in ethanol extract at 1.0 mg/mL. *F. chappar* leaves showed diverse phytochemicals and appreciable concentration-dependent antioxidant activity, indicating potential for further biological investigation.

Keywords: Bioactivity, medicinal plants, therapeutic potentials

Introduction

Plants constitute an important natural reservoir of chemically diverse compounds (Devi *et al.*, 2026) [4] with nutritional (Das *et al.*, 2026) [5], ecological (Sharma *et al.*, 2026; Dimri *et al.*, 2026) [8, 22] and therapeutic potential (Chouhan *et al.*, 2026) [4]. Primary metabolites such as proteins (Hertzler *et al.*, 2020) [10] and carbohydrates (Trouvelot *et al.*, 2014) [24] are essential for plant growth and metabolism, whereas secondary metabolites including phenolics, flavonoids, tannins, saponins and alkaloids contribute to plant defence (Palazon and Alcalde, 2025) [19] and may possess important biological activities (Sahoo *et*

al., 2024) [21]. Consequently, phytochemical investigation of traditionally useful plant species provides a basis for identifying bioactive compounds and understanding their possible therapeutic relevance (Kumar *et al.*, 2023) [13]. Oxidative stress, resulting from an imbalance between reactive oxygen species and antioxidant defence mechanisms has been associated with cellular damage and several chronic disorders (Birben *et al.*, 2012) [3]. Plant-derived antioxidants have attracted considerable attention because phenolic compounds (Platzer *et al.*, 2022) [20] and flavonoids (Zahra *et al.*, 2024) [26] can act as free-radical scavengers (Tüğen and Buruleanu, 2025) [25].



Fig 1: Leaves, flowers and fruits of *F. chappar*

Among the plants, the genus *Flemingia* (Fabaceae) is of considerable ethnobotanical importance (Kumbhare *et al.*, 2023) [15]. From this genus, *F. chappar* is a shrub (Figure 1). It has ethnomedicinal uses (Ghalot *et al.*, 2011) [9] and less reports are available on its pharmacological potentials (Dhar *et al.*, 1971 [7]; Padmavathamma and Shanmugapandian, 2024) [18]. Therefore, the present study was undertaken to evaluate the availability of bioactive compounds of *F.*

chappar leaves using aqueous, ethanol and *n*-hexane extracts and to assess their antioxidant activity using the DPPH free-radical scavenging assay. The study aimed to evaluate the primary and secondary metabolites present in the leaves of *Flemingia* and to assess the concentration-dependent antioxidant activities of its aqueous and ethanolic leaf extracts, thereby generating baseline data for future ethnopharmacological investigations.



Fig 2: Dried leaves of *F. chappar*

Methodology

Leaves of *Flemingia chappar* were collected from Rourkela, Odisha, India, shade-dried and powdered. The powdered material (Figure 2) was extracted separately with aqueous, ethanol and *n*-hexane solvents using Soxhlet method (Abubakar and Haque, 2020; Marndi *et al.*, 2024; Jena *et al.*, 2025) [1, 12, 17]. The extracts were qualitatively screened for primary and secondary metabolites (Kumar *et al.*, 2013; Jena *et al.*, 2024) [11, 14]. Tannin, saponin, total phenol and flavonoid contents were quantitatively estimated (Jena *et al.*, 2025) [12]. Antioxidant activity of aqueous and ethanol extracts was evaluated by the DPPH radical-scavenging assay (Shirazi *et al.*, 2014; Baliyan *et al.*, 2022; Majhi *et al.*, 2026) [2, 5, 23]

Results and discussion

Qualitative phytochemical screening revealed clear differences among the three solvent extracts. Protein and carbohydrates were present in both aqueous and ethanol extracts (Figure 3), whereas neither was detected in the *n*-hexane extract (Table 1). Starch, sucrose, lipid and amino acids were not detected in the tested extracts. The aqueous extract showed a comparatively broader phytochemical profile (Figure 4). Tannin, saponin, flavonoid, phenolic group, reducing sugar and alkaloid were detected (Table 2). The ethanol extract contained tannin, flavonoid, phenolic group and reducing sugar, while saponin and alkaloid were not detected. Quantitative analysis showed tannin as the major reported phytochemical at 112.68 mg/100 mL, followed by total phenol at 9.82 mg/100 mL. Saponin was recorded at 7.97%, while flavonoids were quantified at 0.28 mg/mL (Table 3).

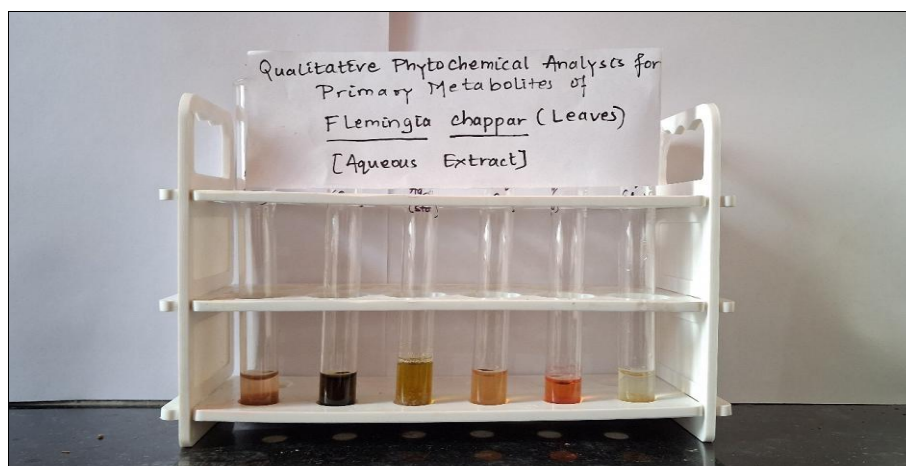


Fig 3: Phytochemical screening of primary metabolites

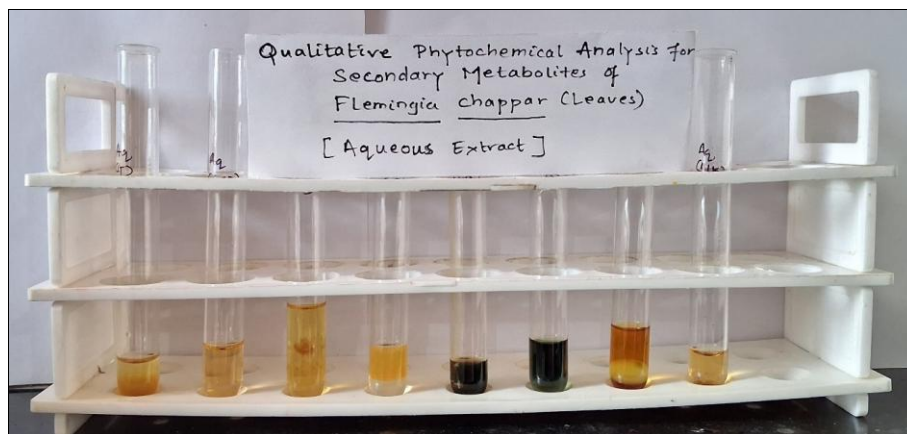


Fig 4: Phytochemical screening of secondary metabolites

Table 1: Qualitative phytochemical analysis of primary metabolites of *F. chappar*

Bioactive compounds	Aqueous extract	Ethanol extract	n-Hexane extract
Protein	+	+	-
Carbohydrates	+	+	-
Starch	-	-	-
Sucrose	-	-	-
Lipid	-	-	-
Amino acid	-	-	-

(-: Not detected; +: Presence)

Table 2: Qualitative phytochemical analysis of secondary metabolites of *F. chappar*

Bioactive compounds	Aqueous extract	Ethanol extract	n-Hexane extract
Tannin	+	+	-
Saponin	+	-	-
Flavonoid	+	+	-
Terpenoid	-	-	-
Phenolic Group	+	+	-
Reducing sugar	+	+	-
Steroids	-	-	-
Alkaloids	+	-	-

(-: Not detected; +: Presence)

Table 3: Quantitative phytochemical analysis of *F. chappar*

Secondary metabolites	Quantity
Tannin	112.68 mg/100 mL
Saponin	7.97 %
Total phenol	9.82 mg/100 mL
Flavonoids	0.28 mg/mL

The DPPH assay demonstrated a concentration-dependent increase in radical-scavenging activity in both aqueous and ethanol extracts. For the ethanol extract, inhibition increased from 58.81% at 0.0625 mg/mL to 73.90% at 1.0 mg/mL. Similarly,

the aqueous extract showed an increase from 57.90% to 75.39% over the same concentration range. The corresponding absorbance values declined with increasing extract concentration, indicating increasing DPPH radical-scavenging activity (Table 4; Figure 5).

Table 4: Antioxidant assay (DPPH) of *F. chappar*

Extract	Concentration (mg/mL)	Inhibition Percentage (%)
Ethanol	0.0625	58.81%
	0.125	63.08%
	0.25	66.49%
	0.5	69.54%
	1.0	73.90%
Aqueous	0.0625	57.90%
	0.125	62.29%
	0.25	68.84%
	0.5	71.46%
	1.0	75.39%

The phytochemical profile of *F. chappar* leaves indicates the presence of several biologically important classes of compounds (Table 1-3). The detection of proteins and carbohydrates in aqueous and ethanol extracts, together with the absence of these constituents in *n*-hexane, demonstrates the influence of solvent characteristics on extraction. The broader profile observed in the aqueous extract, particularly the simultaneous detection of tannins, saponins, flavonoids, phenolic compounds, reducing sugars and alkaloids, suggests that polar constituents are prominent in the leaves. Tannins and phenolic compounds are of particular interest because phenolic hydroxyl groups can participate in free-radical neutralization. Flavonoids likewise represent an important group of plant-derived antioxidant compounds. In the present study, tannin showed the highest reported quantitative value among the measured metabolites, while total phenol and flavonoid were also detected quantitatively. These findings provide a plausible phytochemical basis for the antioxidant response observed in the leaf extracts. However, the present results establish association rather than a direct causal relationship between individual compounds and DPPH activity. The DPPH results showed a consistent increase in inhibition with increasing concentration of both extracts. The results indicate that the antioxidant activity of *F. chappar* leaves may be related to their phenolic, flavonoid and tannin content.

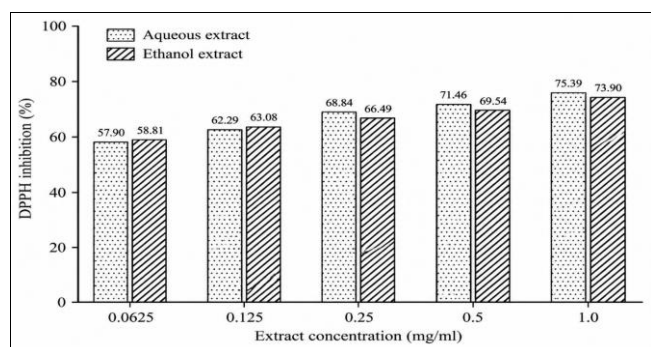


Fig 5: DPPH radical-scavenging activity of aqueous and ethanol extracts of *F. chappar* leaves

Conclusion

The present investigation demonstrates that *Flemingia chappar* leaves contain a diverse range of primary and secondary metabolites, particularly tannins, flavonoids, phenolic compounds, saponins and alkaloids. The aqueous extract exhibited the broadest qualitative phytochemical profile, while both aqueous and ethanol extracts demonstrated concentration-dependent DPPH radical-scavenging activity. At 1.0 mg/mL, the aqueous extract showed 75.39% inhibition compared with 73.90% for the ethanol extract. These findings highlight the phytochemical richness and antioxidant potential of *F. chappar* leaves and provide a basis for further phytochemical characterization and biological evaluation of this species.

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