

Phytochemical analysis and antioxidant potential of *Tacca leontopetaloides* (L.) Kuntze

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Abstract

Tacca leontopetaloides (L.) Kuntze was evaluated for its primary and secondary metabolites along with antioxidant potential using aqueous, ethanol and n-hexane extracts of the whole plant. Qualitative analysis revealed the presence of several primary and secondary metabolites, including proteins, carbohydrates, starch, tannins, saponins, terpenoids, reducing sugars, steroids and alkaloids. Quantitative analysis recorded tannin (71.10 mg/100 mL), saponin (12.66%), phenol (5.77 mg/100 mL) and flavonoids (0.02 mg/mL). Antioxidant activity was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical-scavenging assay. The aqueous extract showed the highest inhibition, increasing from 60.5% at 0.0625 mg/ml to 65.11% at 1.0 mg/ml, followed by the ethanol extract (60.11–63.94%) and n-hexane extract (58.88–61.38%). The findings indicate that *T. leontopetaloides* contains diverse bioactive constituents and exhibits concentration-dependent DPPH radical-scavenging activity, particularly in the aqueous extract.

Keywords: Antioxidant activity, bioactive compounds, DPPH assay, phytochemicals

Introduction

Tuberous plants are important components of many traditional food (Agarwal *et al.*, 2023) [2] and medicinal systems (Kumar *et al.*, 2013; Karle *et al.*, 2022) [8, 10] because their underground storage organs serve as reservoirs of carbohydrates, nutrients and biologically active constituents (Swain *et al.*, 2020) [25]. They are particularly valuable in rural and tribal communities, where tuberous plants may contribute to food security, healthcare services (Kumar *et al.*, 2013; Kumar *et al.*, 2017; Lal *et al.*, 2024) [10, 11, 16] and household livelihoods. Researchers have reported their bioactive compounds and pharmacological values (Kumar and Jena, 2014; Mohanty *et al.*, 2021) [9, 20] but

despite their importance, many tuberous plants remain comparatively underexplored for their phytochemical composition and biological properties. Systematic evaluation of these plants can therefore provide useful information on their nutritional (Kumar *et al.*, 2017b; Kumar, 2020) [11, 15] and pharmacological potential (Kumar *et al.*, 2017a) [11] and may also support their sustainable utilization and conservation. *Tacca leontopetaloides* (L.) Kuntze (Figure 1) is a tuberous plant of interest because its underground storage organ and other plant parts have potential nutritional and ethnobotanical significance (Chouhan *et al.*, 2026) [5].

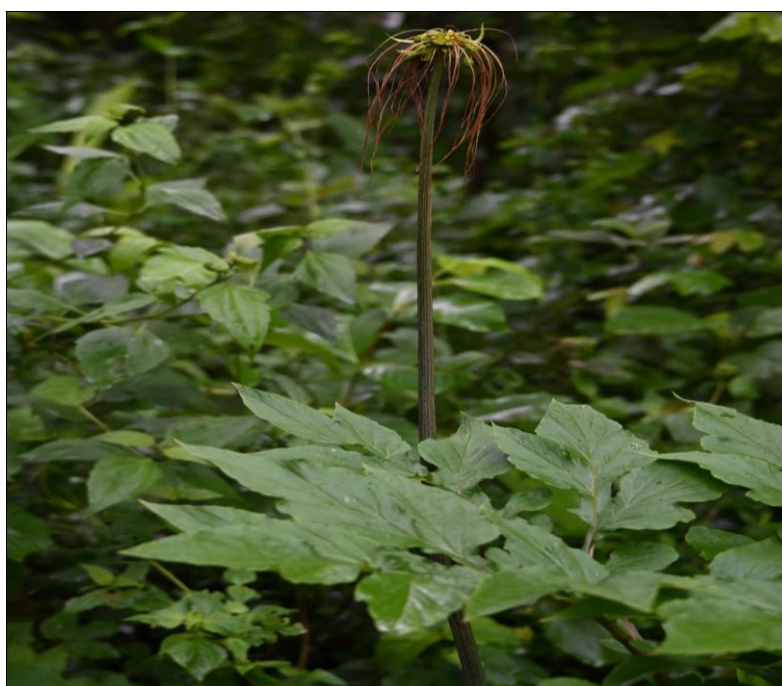


Fig 1: Plant parts of *T. leontopetaloides*

These constituents are associated with various biological activities, including antioxidant properties. The present study was undertaken to characterize the phytochemical constituents and evaluate the antioxidant potential of *T. leontopetaloides*. Qualitative screening of primary and secondary metabolites, quantitative estimation of selected phytochemicals and DPPH radical-scavenging assessment were carried out using aqueous, ethanol and n-hexane extracts. The study is significant because it provides baseline information on the bioactive constituents of this comparatively underexplored tuberous plant and establishes its potential as a source of antioxidant compounds. The findings may serve as a foundation for further pharmacological, nutritional and phytochemical investigations and contribute to the scientific documentation and sustainable utilization of *T. leontopetaloides*.

Methodology

Plant material of *T. leontopetaloides* was collected from Mahanadi River areas, Odisha. Plant was identified by the authors (Jena *et al.*, 2025)^[7]. For qualitative phytochemical screening, whole plant extracts were prepared by Soxhlet extraction using solvents of different polarities following standard procedures (Kumar *et al.*, 2013; Marndi *et al.*, 2024)^[10, 18]. Primary metabolites including proteins, carbohydrates, starch, sucrose, lipids and amino acids were screened using standard qualitative tests, while secondary metabolites such as tannins, saponins, flavonoids, terpenoids, phenolic compounds, reducing sugars, steroids and alkaloids were detected using established phytochemical methods (Jena *et al.*, 2024; Marndi *et al.*, 2024)^[6, 18]. Quantitative estimation of selected secondary metabolites was carried out using standard colorimetric methods. Total phenols, tannins, saponins and flavonoids were estimated using appropriate reagents and spectrophotometric measurements at 515, 720 and 510 nm, respectively, with corresponding standard curves used for quantification (Swain and Hillis, 1959; Sadasivam and Manickam, 1996; Obadoni and Ochuko, 2001; Chang *et al.*, 2002; Shirazi *et al.*, 2014; Raina and Misra, 2023)^[4, 21, 22, 23, 24, 26].

For antioxidant evaluation, dried whole plant parts were extracted by maceration with selected solvents for 48 h, followed by filtration, concentration and preparation of working extracts in 1% dimethyl sulfoxide. A 0.1 mM DPPH solution was prepared in methanol and different concentrations of the extracts were mixed with DPPH in a 1:1 ratio. After incubation in darkness at room temperature for 10 min, absorbance was measured at 517 nm using a UV-Visible spectrophotometer. DPPH radical-scavenging activity was expressed as percentage inhibition and plotted against extracts concentration with quercetin used as the standard (Abubakar and Haque, 2020; Baliyan *et al.*, 2022; Majhi *et al.*, 2026)^[1, 3, 17].

Results and Discussion

The qualitative screening of primary metabolites in *T. leontopetaloides* revealed differences among the aqueous, ethanol and n-hexane extracts. Proteins and carbohydrates were detected in the aqueous and ethanol extracts, whereas they were not detected in the n-hexane extract. Starch was also present in the aqueous and ethanol extracts but absent

in the n-hexane extract. Sucrose, lipids and amino acids were not detected in any of the tested extracts (Table 1).

Table 1: Qualitative phytochemical analysis of primary metabolites *T. leontopetaloides*

Primary metabolites	Aqueous extract	Ethanol extract	n-Hexane extract
Protein	++	++	-
Carbohydrates	+	+	-
Starch	+	+	-
Sucrose	-	-	-
Lipid	-	-	-
Amino acid	-	-	-

The detection of proteins, carbohydrates and starch indicates the presence of important primary metabolites in *T. leontopetaloides*. The absence of these constituents in the n-hexane extract may be related to differences in the extraction characteristics of the solvents, as non-polar n-hexane is less suitable for extracting many polar primary metabolites. The occurrence of carbohydrates and starch is also relevant to the characterization of tuberous plants because these compounds are commonly associated with storage functions. However, the present qualitative results should be interpreted as screening evidence rather than quantitative estimates. The secondary metabolite screening demonstrated the presence of tannins and saponins in the aqueous and ethanol extracts, while both were absent in the n-hexane extract. Terpenoids were detected in the aqueous and ethanol extracts, whereas phenolic groups and flavonoids were not detected in any of the extracts. Reducing sugars were present in the aqueous and ethanol extracts. Steroids were detected in the aqueous and ethanol extracts, while alkaloids were detected only in the aqueous extract (Table 2).

Table 2: Qualitative phytochemical analysis of secondary metabolites *T. leontopetaloides*

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

(+: Positive; -: Not detected; ++: Strongly positive)

The results indicate that the aqueous and ethanol extracts recovered a broader range of the tested secondary metabolites than the n-hexane extract. In particular, the detection of tannins, saponins, terpenoids and steroids suggests the presence of chemically diverse constituents in the plant. The detection of alkaloids only in the aqueous extract further demonstrates that extraction solvent can influence the phytochemical profile obtained. Conversely, the absence of flavonoids and phenolic groups in the qualitative screening does not necessarily indicate their complete absence from the plant, but rather that they were not detected under the test conditions used. Quantitative analysis showed that tannin was the major reported constituent at 71.10 mg/100 mL, followed by saponin at

12.66%, phenol at 5.77 mg/100 mL, and flavonoids at 0.02 mg/mL (Table 3). The comparatively high reported tannin value indicates that tannins constitute an important component of the phytochemical profile obtained in this analysis. Saponins were also detected at a substantial reported level. Phenol and flavonoid values were comparatively lower, although their presence provides additional evidence of chemical diversity. It should be noted that the units differ among the reported constituents; therefore, direct numerical comparison of their quantities should be made cautiously. Importantly, the quantitative detection of phenols and flavonoids contrasts with their negative qualitative screening results in Table 2, indicating that the two analytical approaches may have different detection sensitivities or methodological conditions. This discrepancy should be clarified in the final manuscript if the original experimental protocols permit.

Table 3: Quantitative Phytochemical Analysis of *Tacca leontopetaloides*

Secondary metabolites	Quantity
Tannin	71.10 mg/100mL
Saponin	12.66 %
Total phenol	5.77 mg/100mL
Flavonoids	0.02 mg/mL

The DPPH assay demonstrated antioxidant activity in all three extracts, with inhibition generally increasing as extract concentration increased. The aqueous extract showed inhibition values from 60.50% at 0.0625 mg/mL to 65.11% at 1.0 mg/mL. The ethanol extract increased from 60.11% to 63.94%, whereas the n-hexane extract increased from 58.88% to 61.38% over the same concentration range (Table 4). Among the tested extracts, the aqueous extract showed the highest DPPH inhibition at all reported concentrations, while the n-hexane extract showed the lowest activity. The progressive increase in inhibition with increasing concentration indicates a concentration-dependent response within the tested range.

The comparatively higher activity of the aqueous extract is consistent with its broader qualitative detection of several metabolites, although a direct causal relationship cannot be established from the present data alone.

Table 4: Antioxidant assay (DPPH) of *T. leontopetaloides*

Extract	Concentration (mg/mL)	Absorbance (517 nm)	Inhibition Percentage (%)
Aqueous	0.0625	0.711	60.5%
	0.125	0.660	63.3%
	0.25	0.643	64.27%
	0.5	0.636	64.66%
	1.0	0.628	65.11%
Ethanol	0.0625	0.718	60.11%
	0.125	0.709	60.61%
	0.25	0.696	61.33%
	0.5	0.668	62.88%
	1.0	0.649	63.94%
n-Hexane	0.0625	0.740	58.88%
	0.125	0.727	59.61%
	0.25	0.714	60.3%
	0.5	0.711	60.5%
	1.0	0.695	61.38%

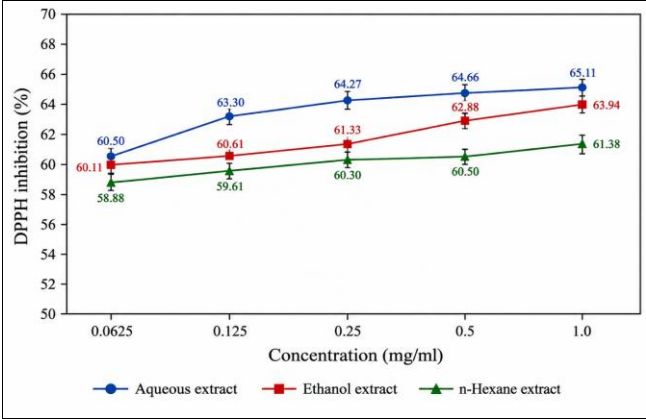


Fig 2: DPPH radical-scavenging activity (%) of aqueous, ethanol and n-hexane extract of the whole plant of *T. leontopetaloides* at different concentrations

The DPPH results therefore demonstrate measurable radical-scavenging activity of *T. leontopetaloides* extracts, with the aqueous extract showing the strongest activity under the conditions of the present assay. The reported control absorbance was 1.800. The results demonstrate that *T. leontopetaloides* contains diverse primary and secondary metabolites and exhibits measurable antioxidant activity (Figure 2). The aqueous and ethanol extracts generally showed broader phytochemical detection and stronger DPPH activity than the n-hexane extract, highlighting the importance of extraction solvent in phytochemical and antioxidant investigations.

Conclusion

The present study demonstrates that *Tacca leontopetaloides* possesses a diverse phytochemical profile, with several primary and secondary metabolites detected in its aqueous and ethanol extracts. Quantitative analysis further confirmed the presence of tannin, saponin, phenol and flavonoids. The plant extracts also exhibited DPPH radical-scavenging activity, with the aqueous extract showing the highest inhibition across the tested concentrations. Overall, these findings indicate that *T. leontopetaloides* is a promising source of bioactive constituents and antioxidant potential. The study provides useful baseline information for further phytochemical, pharmacological and nutritional investigations of this underexplored tuberous plant

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