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Phytochemical profiling and antioxidant activity of *Curculigo orchioides* Gaertn. (Hypoxidaceae)

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Abstract
Curculigo orchioides is a medicinal plant of forest floor. The present study evaluated the selected secondary metabolites and antioxidant activity of whole plant parts of *C. orchioides*. Qualitative screening was conducted for primary and secondary metabolites, while quantitative analysis was performed for tannins, saponins, phenols, and flavonoids. Antioxidant activity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. The qualitative analysis revealed that aqueous and ethanol extracts contained proteins, carbohydrates, and starch, whereas sucrose was detected only in the aqueous extract. Among the secondary metabolites, tannins, terpenoids, phenolic groups, and reducing sugars were detected in both aqueous and ethanol extracts while saponins and alkaloids were detected only in the aqueous extract. The quantitative analysis reported tannin content of 76.89 mg/100 mL, saponin content of 6.31%, phenol content of 6.90 mg/100 mL, and flavonoid content of 0.03 mg/mL. DPPH radical inhibition increased with concentration in all three extracts. These findings indicate measurable in vitro radical-scavenging activity and differences in the phytochemical profiles of the extracts. Further investigation using validated quantitative methods and appropriate experimental controls is necessary to establish the biological significance and potential applications of the plant.

Keywords: Radical scavenging, secondary metabolites, medicinal flora

Introduction
Medicinal plants represent an important source of naturally occurring secondary metabolites with potential applications in traditional healthcare, pharmaceutical research and the development of plant-based products (Mukherjee *et al.,* 2024; Rout *et al.,* 2026) [8, 9]. Secondary metabolites are an important preliminary step in evaluating medicinal plants (Kumari *et al.,* 2026) [5]. Qualitative screening provides information about the profiling of secondary metabolites while quantitative analysis helps estimate the amounts of specific bioactive compounds (Stochmal *et al.,* 2022) [11]. The solvents of a plant extract may vary according to the polarity and chemical characteristics (Wakeel *et al.,* 2019) [12]. Consequently, examining extracts prepared with solvents of different polarities can provide an initial understanding of the distribution of detectable phytochemicals within a plant. *Curculigo orchioides* (Figure 1-2) is a medicinal plant investigated in the present study for its phytochemical characteristics and antioxidant potential (Cao *et al.,* 2008) [2]. The present study aimed to characterise the qualitative phytochemical profiles of three solvent extracts of *C. orchioides*. The findings provide preliminary experimental information for further investigation of the plant's secondary metabolites and potential biological properties.

Materials and methods
The present study investigated the whole plant parts of *C. orchioides* collected from Mayurbhanj, Odisha, India. The plant material was identified by the authors. Soxhlet extraction was performed using three solvents: aqueous, ethanol, and *n*-hexane. The resulting extracts were used for subsequent experimental analyses (Jena *et al.,* 2025) [4]. The aqueous, ethanol, and *n*-hexane leaf extracts were subjected to qualitative screening to determine the presence or absence of selected primary metabolites, namely proteins, carbohydrates, starch, sucrose, lipids, and amino acids (Das *et al.,* 2026) [3]. The observations were recorded as positive (+) or negative (−), depending on the detection of each constituent. Qualitative phytochemical screening was conducted on the prepared extracts to assess the occurrence of selected secondary metabolites and other bioactive constituents.



Fig 1: Leaves and root of *Curculigo orchioides*

The compounds examined included tannins, saponins, flavonoids, terpenoids, phenolic groups, reducing sugars, steroids, and alkaloids (Marndi *et al.*, 2024) [7]. The results were documented according to the presence or absence of the respective constituents in each extract. Quantitative estimation was undertaken to determine the levels of selected phytochemicals in the leaf material. The constituents analysed included tannins, saponins, total phenols, and total flavonoids. Their quantities were reported using the respective measurement units provided in the original dataset (Soni *et al.*, 2026) [10]. The antioxidant activity of the aqueous and ethanol leaf extracts was assessed at concentrations ranging from 0.0625 to 1.0 mg/mL. The experimental results were expressed as percentage inhibition to indicate the observed antioxidant response. As the supplied dataset does not specify the assay procedure or the reagent employed, the method is described generically as an antioxidant assay without attributing it to a particular analytical technique (Kumari *et al.*, 2026; Acharya *et al.*, 2026) [1, 5].

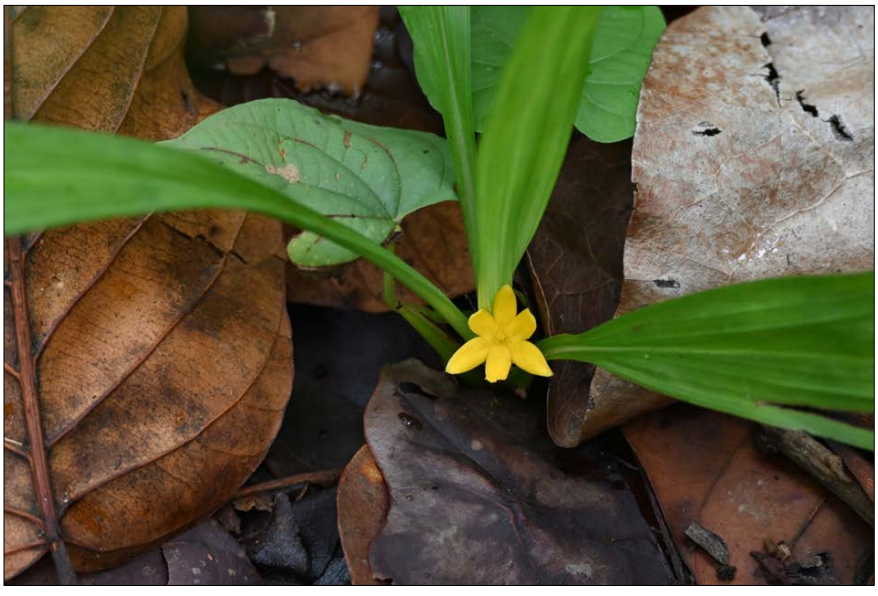


Fig 2: Habit and flowers of *C. orchioides*

Results and discussion

The qualitative screening of primary metabolites revealed differences among the aqueous, ethanol and *n*-hexane extracts of *C. orchioides* (Table 1).

Table 1: Qualitative Phytochemical Analysis for Primary Metabolites *Curculigo orchioides*

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

(+: Detected; -: Not detected)

Proteins, carbohydrates and starch were detected in both aqueous and ethanol extracts, whereas sucrose was detected only in the aqueous extract (Table 1). These observations demonstrate that the qualitative detection of primary metabolites differed according to the extraction solvent. The detection of carbohydrates and starch in the aqueous and ethanol extracts is consistent with the ability of these solvents to extract certain polar constituents. The detection of sucrose only in the aqueous extract further illustrates the differences observed between the two extraction systems. The secondary-metabolite screening identified several chemical groups in the aqueous and ethanol extracts, whereas none of the tested groups was detected in the *n*-hexane extract (Table 2).

Table 2: Qualitative Phytochemical Analysis for Secondary Metabolites *Curculigo orchioides*

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

(+: Detected; -: Not detected)

Tannins, terpenoids, phenolic groups, and reducing sugars were detected in both aqueous and ethanol extracts. Saponins and alkaloids were detected only in the aqueous extract. The aqueous extract exhibited the broadest qualitative profile among the tested extracts, with six of the eight screened secondary-metabolite groups detected. The ethanol extract showed four positive results, while the *n*-hexane extract showed none. These findings suggest that the aqueous and ethanol extraction systems recovered a greater diversity of the tested constituents than the *n*-hexane extraction system under the conditions employed. The detection of tannins and phenolic groups is relevant to the investigation of antioxidant properties because certain compounds within these broad chemical classes can participate in radical-scavenging reactions. Terpenoids and alkaloids are also chemically diverse groups that warrant further characterisation. However, qualitative detection alone cannot establish which compounds are responsible for the observed antioxidant activity. The failure to detect flavonoids in the qualitative screening should be interpreted cautiously because the quantitative analysis reported a flavonoid value of 0.03 mg/mL.

Table 3: Quantitative Phytochemical Analysis of *Curculigo orchioides*

Secondary metabolites	Quantity
Tannin	76.89 mg/ 100 ml
Saponin	6.31 %
Phenol	6.90 mg/ 100 ml
Flavonoids	0.03 mg/ml

The reported tannin value was 76.89 mg/100 mL, while the phenol value was 6.90 mg/100 mL. Saponin content was reported as 6.31%, and the flavonoid measurement was 0.03 mg/mL (Table 3). These values provide an initial quantitative description of selected chemical constituents in the investigated plant material. Among the reported measurements, tannins had the highest numerical value when expressed in their respective reported units. In particular, the percentage reported for saponins cannot be directly compared with values expressed in mg/100 mL or mg/mL without additional information about sample preparation, the measurement basis, and the analytical methods. Tannins and phenolic compounds are of interest in antioxidant research because many compounds in these groups can donate electrons or hydrogen atoms under suitable conditions.

Table 4: Antioxidant assay (DPPH) of *Curculigo orchioides*

Extract	Concentration (mg/mL)	Inhibition Percentage (%)
n-Hexane	0.0625	60.20
	0.125	61.23
	0.25	61.82
	0.5	63.36
	1.0	64.90
Ethanol	0.0625	60.05
	0.125	61.08
	0.25	61.60
	0.5	62.84
	1.0	64.31
Aqueous	0.0625	59.83
	0.125	61.45
	0.25	61.96
	0.5	63.21
	1.0	64.17

The DPPH assay results showed increasing inhibition percentages with increasing extract concentration for all three extracts. The *n*-hexane extract increased from 60.20% inhibition at 0.0625 mg/mL to 64.90% at 1.0 mg/mL (Table 4). The ethanol extract increased from 60.05% to 64.31%, while the aqueous extract increased from 59.83% to 64.17% across the same concentration range. At the lowest concentration, the *n*-hexane extract exhibited the highest reported inhibition (60.20%), followed by the ethanol extract (60.05%) and the aqueous extract (59.83%). At 0.125 mg/mL, the aqueous extract showed the highest inhibition at 61.45%, followed by the *n*-hexane extract at 61.23% and the ethanol extract at 61.08%. At 0.25 mg/mL, the aqueous extract showed 61.96% inhibition, compared with 61.82% for the *n*-hexane extract and 61.60% for the

ethanol extract. At 0.5 mg/mL, the *n*-hexane extract recorded 63.36% inhibition, followed closely by the aqueous extract at 63.21% and the ethanol extract at 62.84%. At the highest tested concentration of 1.0 mg/mL, the *n*-hexane extract showed the highest reported inhibition of 64.90%. The ethanol and aqueous extracts showed 64.31% and 64.17% inhibition, respectively. The difference between the highest and lowest values at this concentration was 0.73 percentage points.

Conclusion

The present investigation provides preliminary information on the phytochemical composition and *in vitro* antioxidant activity of *Curculigo orchioides*. Qualitative screening revealed differences among aqueous, ethanol, and *n*-hexane extracts. The aqueous extract showed the broadest profile of detected secondary metabolites, including tannins, saponins, terpenoids, phenolic groups, reducing sugars, and alkaloids. The ethanol extract contained detectable tannins, terpenoids, phenolic groups, and reducing sugars, whereas none of the screened primary or secondary metabolites was detected in the *n*-hexane extract. Quantitative analysis reported tannin, saponin, phenol, and flavonoid measurements of 76.89 mg/100 mL, 6.31%, 6.90 mg/100 mL, and 0.03 mg/mL, respectively. In the DPPH assay, inhibition increased with concentration in all three extracts. The highest reported inhibition was 64.90% for the *n*-hexane extract at 1.0 mg/mL, followed by 64.31% for the ethanol extract and 64.17% for the aqueous extract. These results support further investigation of the plant's chemical constituents and radical-scavenging properties. Nevertheless, the findings are preliminary and do not establish therapeutic efficacy, safety, or antioxidant benefits in humans. Future work should include validated quantitative phytochemical methods, chromatographic identification of individual compounds, replicated antioxidant assays, appropriate positive and negative controls, and statistical analysis. Such studies would help establish the reproducibility of the observations and clarify the potential applications of *C. orchioides* in pharmaceutical and plant-based product research.

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