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PHYTOCHEMICAL PROFILING AND ANTIOXIDANT POTENTIAL OF *COLOCASIA ESCULENTA* L. COLLECTED FROM HIMACHAL PRADESH (INDIA).

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ABSTRACT

Colocasia esculenta (Taro), an important medicinal tropical root crop consumed in traditional diets and healthcare systems. The present investigation aimed to study the phytochemicals and antioxidant capacity of leaf and corm extracts of *C. esculenta* collected from different agro-ecological locations of Himachal Pradesh, India. Preliminary screening revealed the presence of alkaloids, flavonoids, phenolics, tannins, glycosides, saponins, proteins, and reducing sugars in most extracts, with methanolic and aqueous extracts showing higher extractability of phytoconstituents. Quantitative analysis showed significant variation ($p < 0.05$) in TPC and TFC among cultivars, plant parts, and solvents. Methanolic extracts exhibited the highest phenolic content, with maximum TPC recorded in wild corm samples (68.08 mg GAE/g DW), while the maximum flavonoid content (TFC) was observed in local cultivars from Bilaspur (BL) (181.20±0.48 mg QE/g DW) in chloroform extract. Antioxidant evaluation demonstrated significant DPPH radical scavenging activity, with the lowest IC_{50} value (41.41 µg/mL) observed in aqueous wild leaf extract. The antioxidant potential showed a positive association with phenolic and flavonoid contents. Overall, the findings confirm that *C. esculenta* leaves and corms are rich sources of bioactive compounds with significant antioxidant activity. The observed variability among cultivars highlights the potential for selecting superior genotypes for functional food and pharmaceutical applications.

KEYWORDS: *Colocasia esculenta*, phytochemical screening, phenolics, flavonoids, antioxidant activity, DPPH assay.

INTRODUCTION

To meet global healthcare needs, traditional systems of medicine have played a crucial role. The Indian System of Medicine is one of the largest and most extensive traditional healthcare system and comprises medicinal practices that originated in India. Plants have contributed significantly to the maintenance and improvement of human health and have long been used as a key component of medicines, seasonings, beverages, cosmetics and dyes. Consequently, scientific interest in plant-based research has increased worldwide. Numerous medicinal herbs are traditionally used in the treatment of cardiovascular, digestive, metabolic, and central nervous system (CNS) disorders. Medicinal plants and herbal formulations, along with their isolated bioactive compounds, have demonstrated a broad spectrum of biological activities (Pawar *et al*., 2018). Among such plants with broad-ranging applications, *Colocasia esculenta* has gained considerable scientific attention.

Colocasia esculenta (L.), vegetatively propagated tropical root and tuber crop. It is primitive crop, native to the Indo-Malayan region probably Bangladesh and Eastern India. It is mostly found in grasslands, wetlands and marsh habitats. Taro is ranked 9th among major world food crop, with its cultivation widely distributed across Africa and other tropical regions (Macharia *et al*., 2014). In India, taro is cultivated in 0.052-million-hectare area with 0.0654 million tons production and 12.57 tons per hectare productivity. It is mostly grown in states like Uttar Predesh, Bihar, Punjab, West Bengal, Assam, Andhra Pradesh, Tamil Nadu, Uttrakhand and Himachal Pradesh (Reddy, 2015). Botanical cultivars of taro are grouped into two categories: *Colocasia esculenta var. esculenta* (eddo type) and *Colocasia esculenta var. antiquorum* (dasheen type) (Kumar *et al*., 2022). Taro is characterized by having an underground stem, corm, leaves and flowers. Not only corms but petioles, leaves and flowers are also used as vegetable. The diverse bioactive compounds present in taro have been used since ancient time to treat various aliments like asthma, pneumonia, internal haemorrhage and neurological disorders (Prajapati *et al*., 2011). These compounds have been associated with significant therapeutic properties, including antioxidant, anti-inflammatory, anticancer and anti-diabetic activities. Studied have reported the presence of phenols, flavonoids, alkaloids, glycosides, saponins, tannins, proteins and amino acids in taro, responsible for its protective effects against oxidative stress, metabolic disorders and microbial infection. Phenolics such as chlorogenic acid, catechin and quercetin contribute to higher radical scavenging capacity, thereby preventing cellular damage and enhancing human health (Pertiwi *et al*., 2025).

Classification of plant

Kingdom: Plantae
Division: Tracheophyta
Class: Liliopsida
Order: Arales
Family: Araceae
Genus: *Colocasia*
Species: *Colocasia esculenta* (L.) Schott**.**
Vernacular names: Taro, Kachalu, Arvi, Alluu, Sempu, Kachu.

MATERIAL AND METHOD

Collection of plant sample: leaf and corms samples of local cultivars/landraces and wild taro plants were collected from four locations of Kangra, Hamirpur and Bilaspur district of Himachal Pradesh (India) during 2022-2023 (Fig. 1).

Collected samples were identified and authenticated at Botanical Survey of India, Northern Regional Centre, Dehradun with accession number 1298, 1299, 1300, 1301. The sample were coded as KL, KC represent leaf and corm samples of local cultivars respectively collected from farm field of Kangra district, WL, WC represent wild leaf and corm samples respectively collected from wild habitat of Kangra district, HL, HC represent leaf and corm samples of local cultivars respectively collected from farm field of Hamirpur district and BL, BC represent leaf and corms samples of local cultivars respectively collected from farm field of Bilaspur district.

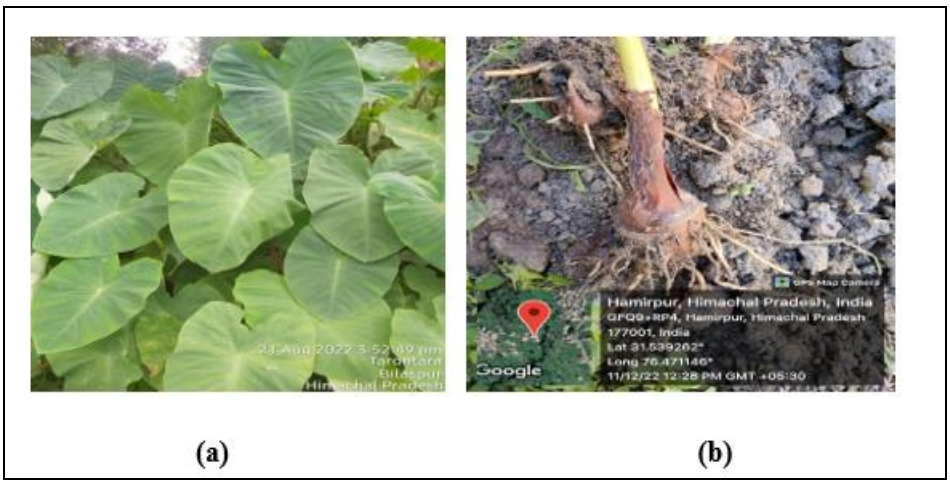

Fig. 1: *Colocasia esculenta* (a) leaves (b) corms.

Samples preparation

The collected leaf and corms samples were thoroughly washed to remove adhering dirt followed by drying. Leaves were shade dried, whereas corms were dried at 60ºC in oven for twenty-four hours. After that, the materials were then grounded to make solid powder and extracted using soxhlet extraction in methanol, aqueous and chloroform solvent. The resulting extract was filtered at room temperature and subsequently evaporated with the help of rotary evaporator to obtain crude extracts which was then transferred airtight glass vials and stored in a refrigerator at temperature below 4ºC until further use.

Preliminary phytochemical screening of *Colocasia esculenta*

The preliminary phytochemical screening of leaf and corm extracts of *C. esculenta* obtained using different solvents was done for the detection of various phytoconstituents, using standard procedures with minor modifications (Sadasivan & Manickam, 1992 and Raman, 2006) (Table 1 & Fig. 2).

Table 1: Preliminary test for phytochemical screening of leaves and corm samples of *Colocasia esculenta*.

Name of test		Procedure	Observations
Test for alkaloids			
1)	Mayer	2 mL of extract + 2-4 drops of Mayer's reagent	Creamy precipitate
2)	Wagner	2 mL of extract + 2-4 drops of Wagner's reagent	Brownish precipitate
3)	Picric acid	2 mL of extract + few drops of 2% picric acid	
Test for flavonoids			
1)	Alkaline reagent	Few mL of extract + 2ml of 2% NaOH solution and few drops of diluted hydrochloric acid	Yellow colour becomes colourless
2)	Lead acetate	Few mL of extract + few drops of 10% lead acetate solution	Yellow precipitate
3)	Ferric chloride	Extract aqueous solution + 4-5 drops of 10% ferric chloride solution	Greenish precipitate

Test for phenolic compounds			
1)	Iodine	2 mL of extract + few drops of diluted iodine solution	Transient red colour
2)	Lead acetate	Dissolve plant extract in 5mL distilled water + 3mL of 10% lead acetate solution	Whitish precipitate
3)	Ferric chloride	aqueous extract + 4-5 drops of 5% ferric chloride solution	Appearance of Dark green colour
Test for proteins and amino acids			
1)	Millon	1 mL extract + 4-5 drops of Millon's reagent	White precipitate
Test for tannins			
1)	10% Sodium hydroxide	Few mL of extract + 3 mL of 10% sodium hydroxide	Emulsion formation
2)	Braymer	1 mL extract + 3 mL distilled water + 3 drops of 10% ferric chloride solution	Appearance of Blue green colour
Test for reducing sugars			
1)	Benedict	Few mL of extract + 2 mL of Benedict's reagent boiled for 5-10 minutes	Appearance of green, yellow colour
2)	Fehling	1 mL extract + 1 mL of Fehling A & Fehling B solution + boiled for 5-10 minutes	Red precipitate
Test for glycosides			
1)	Keller-Killani	Few mL extract + 1 mL glacial acetic acid + few drops of 5% ferric chloride + conc. H_2SO_4	Blue-coloured solution
2)	Concentrate H_2SO_4	2 mL of plant extract + 1 mL glacial acetic acid + 3-4 drops of 5% ferric chloride solution + conc. sulphuric acid	Brown ring appears
Test for phytosterols and triterpenoids			
1)	Hesse's response	Few mL extract + 1 mL chloroform + 1 mL conc. sulphuric acid	Pink ring in the lower chloroform layer
2)	Salkowski	1 mL plant extract + 4-5 drops of conc. sulphuric acid	A golden yellow layer appears
Test for saponins			
1)	Foam test	Few mL extract + 5 mL of distilled water	Stable foam formation

Fig. 2: Preliminary screening of leaves and corms of *Colocasia esculenta.*

Determination of total phenolic content

Total phenolic content (TPC) in the leaf and corm samples from wild and local cultivar of taro was estimated by Folin Ciocalteu method with minor modifications, as described by Singleton *et al*. (1999). In this assay, Folin – Ciocalteu reagent (FCR) reacts with phenolic compounds present in plant extract, resulting in the formation of a dark blue colour complex which is quantify by spectrophotometrically. For the analysis, 100 µL of plant extract was mixed with 10% Folin-Ciocalteu reagent and 2% sodium carbonate solution. The reaction mixture was thoroughly shaken and incubated in the dak at room temperature for one hour. After incubation, absorbance was measured at 765 nm against a blank. A

calibration curve was prepared using gallic acid as the standard, and total phenolic content was expressed as milligrams of gallic acid equivalents per gram of dry weight (mg GAE/g DW).

Determination of total flavonoid content

Total flavonoid content in the extracts was estimated by using aluminium chloride method with minor modifications, as described by Singleton *et al*. (1999). 100 µL of plant extract was mixed with 2% aluminum chloride solution and 1 mM potassium acetate solution. The reaction mixture was shaken thoroughly and incubated at room temperature for 20 minutes. Absorbance was measured at 415nm against blank using spectrophotometer. Readings were taken in triplicates, and the average value of absorbance was used to calculate flavonoid content. A calibration curve was prepared using quercetin as standard, and flavonoid content was expressed as milligrams of quercetin equivalents per gram of dry weight (mg QE/g DW).

Determination of radical scavenging activity

The DPPH radical scavenging activity of leaf and corm extracts was determined following the method of Blois, (1958) with slight modifications. Various conc. of methanol, aqueous and chloroform extract (5, 10, 15, 20, 25 and 30 µg/mL) were combined with 0.2 mM DPPH. The mixture was incubated in the dark for 30 min at room temperature. Control preparation was done containing all reagents except the sample. Absorbance was taken at 517 nm using spectrophotometer and ascorbic acid served as the positive control. The radical scavenging activity using DPPH was calculated using the following formula:

$\%Inhibition = (A_0 – A_1)/A_0 \times 100$

A_0 = absorbance of control

A_1 = absorbance of the sample

Statistical analysis

All the experiments were done in triplicate. Data was subjected to ANOVA (one way analysis of variance) using IBM-SPSS software and difference among sample mean were assessed using DMRT (Duncan's Multiple Range Test) at a $p<0.05$ significance level.

RESULTS AND DISCUSSION

Organoleptic properties of *Colocasia esculenta*

Table 2: Organoleptic properties of leaves and corms of *Colocasia esculenta.*

S.No.	Parameters	Leaves of *Colocasia*	corms of *Colocasia*
1	Odour	Sweet smell	Sweet smell
2	Colour	Greenish colour	Whitish colour
3	Taste	Mildly sweet taste	Mildly sweet taste
4	Consistency	Fine powder	Fine powder

Preliminary phytochemical screening

Preliminary phytochemical screening of methanol, aqueous and chloroform extracts of leaves and corms of different *Colocasia esculenta* cultivars revealed the presence of diverse bioactive compounds. Alkaloids, flavonoids, phenolics, tannins, proteins, amino acids, reducing sugars, glycosides and saponins were detected in most samples, with methanol and aqueous solvents showing higher extractability. Phytosterols and triterpenoids were mainly confined to methanolic and chloroform extract, while saponins showed uniform distribution across all plant extract and solvents (Table 2). These findings are in consistent with those reported by and Dwivedi *et al*. (2016) and Rajput *et al*. (2023).

Total phenol content

In the present study, total phenol content in *Colocasia esculenta* leaves and corm showed significant variation across cultivars. In methanolic extract, WC recorded maximum phenol content (68.08±0.26 mg GAE/g DW), which was significantly superior to all other leaf and corms samples whereas minimum phenol content was observed in BC (43.53±0.69 mg GAE/ g DW). In aqueous extract, HL exhibited maximum phenol content (9.96±0.10 mg GAE/g DW) which was significantly higher than other while HC showed the lowest (1.46±0.05 mg GAE/ g DW) phenol content. In chloroform extract, maximum phenol content (2.42±0.05 mg GAE/g DW) was observed in KL which was significantly higher than others and lowest (0.14±0.02 mg GAE/g DW) in HL. Overall, leaf samples in all the solvents exhibited highest phenol content compared to corms. Rajput *et al*. 2023, also reported that phenolic content was found to be higher in methanol extract (325±0.003 mg GAE/g DW in leaves and 115±0.005 mg GAE/g DW in tubers) when compared to aqueous extract (19.25±0.004 mg GAE/g DW in leaves and 3.85±0.001 mg GAE/g DW in tubers).

Table 3: Phytochemical constituents of leaves and corm samples of *Colocasia esculenta.*

Phytochemicals	Name of test	BL			HL			KL			WL			BC			HC			KC			WC		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	
Test for alkaloids	Mayer	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Wagner	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-
	Picric acid	-	+	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Test for flavonoids	Alkaline reagent	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Lead acetate	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Shinoda	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
Test for phenols	Iodine	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+
	Lead acetate	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Ferric chloride	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Test for tannins	Braymer	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-
	Sodium hydroxide	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Test for protein and amino acid	Million	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Test for reducing sugars	Benedict	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	+	-	+	+	-
	Fehling	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Test for glycosides	Keller-Killani	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Conc. H_2SO_4	-	+	-	-	+	-	-	+	-	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+
Test for phytosterols and tri-terpenoids	Hesse's response	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+	+	-	+
	Salkowski	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
Test for saponins	Foam	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

*'+' indicates present and '-' indicates absent, **1** – Methanol, **2** – Aqueous, **3** – chloroform*

Total flavonoid content

In the present study, total flavonoid content in *Colocasia esculenta* leaves and corms exhibited statistically significant variation across cultivars. In the methanolic extract, HL recorded the highest flavonoid content (86.84±2.13 mg QE/g DW), which was statistically higher than other leaf and corm samples while lowest content (2.05±0.19 mg QE/g DW) in HC. In aqueous extract, WL recorded highest flavonoid content (1.61±0.14 mg QE/g DW) and was significantly higher than most samples, while the lowest value was recorded in WC (0.25±0.11 mg QE/g DW), which was statistically at par with HC. In contrast, the chloroform extract, BL recorded highest flavonoid content (181.20±0.48 mg QE/g DW), significantly higher than other whereas lowest flavonoid content (23.07± mg QE/g DW) was observed in WC, which was statistically comparable with KC, HC and BC. These findings are in consistent with Rustiani *et al*. (2021) and Rajput *et al*. (2023).

Radical scavenging activity

Fig. 3 shows the antioxidant activity of the methanol, aqueous and chloroform extract of leaves and corms of *Colocasia esculenta*, along with antioxidant activity of ascorbic acid (standard). Table 4 represent the IC_{50} values of leaves and corms samples of *Colocasia*. In methanolic extract, the highest DPPH radical scavenging activity (27.39 %) at 30 µg/mL was recorded in HL with lowest IC_{50} value (54.03µg/mL), while the lowest activity (21.45%) was recorded in KL. In the aqueous extract, BL exhibited the maximum DPPH radical scavenging activity (37.04%), while minimum activity (11.71%) was recorded in HC. However, based on IC_{50} values, WL showed the lowest IC_{50} (41.41 µg/mL), which was statistically comparable to BL. In chloroform extract, the maximum DPPH radical scavenging activity (32.06%) was observed in HC, with lowest IC_{50} value (48.53 µg/mL) which was statistically comparable with KC and BL while, minimum in BC (21.07%). These findings are consistent with those reported Keshav *et al.* (2019).

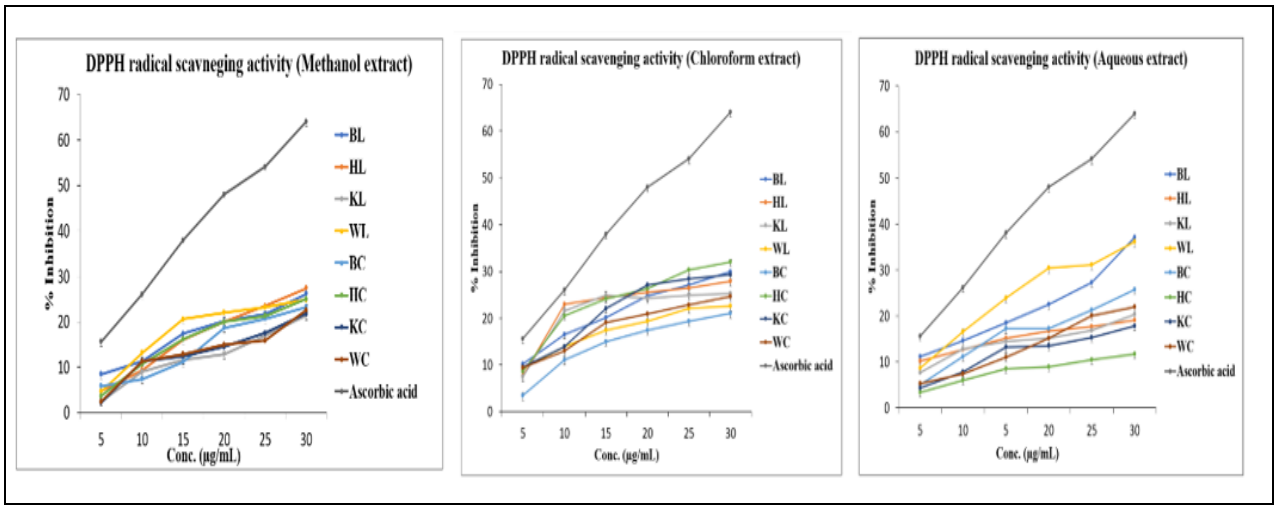

Fig. 3: DPPH radical scavenging activity of leaves and corm samples of *Colocasia esculenta*.

Table 4: IC_{50} values of leaves and corm samples of *Colocasia esculenta*.

Sample	IC_{50} (µg/mL)		
	Methanolic extract	Aqueous extract	Chloroform extract
BL	63.94 ± 1.52^{b}	46.29 ± 0.48^{a}	54.42 ± 0.34^{ab}
HL	54.03 ± 1.42^{a}	117.75 ± 2.70^{f}	60.56 ± 2.57^{bc}
KL	72.59 ± 1.07^{c}	99.49 ± 2.67^{e}	64.81 ± 1.40^{bc}
WL	59.39 ± 1.28^{b}	41.41 ± 0.49^{a}	79.49 ± 3.46^{e}
BC	64.02 ± 2.37^{b}	61.56 ± 1.01^{b}	71.93 ± 3.57^{d}
HC	59.27 ± 1.32^{b}	150.25 ± 4.20^{g}	48.53 ± 1.18^{a}
KC	71.62 ± 0.54^{c}	91.06 ± 0.46^{d}	51.06 ± 0.96^{a}
WC	72.95 ± 2.24^{c}	68.18 ± 0.81^{c}	69.02 ± 0.73^{cd}

Results are expressed as Mean±SE (n=3). Means with different letters within the same column show significant difference ($p<0.05$).

CONCLUSION

The present investigation highlights the phytochemical richness and antioxidant potential of *C. esculenta* leaves and corms. Both plant parts exhibited acceptable organoleptic properties, supporting their suitability for dietary and medicinal use. Both plant parts are rich source of bioactive compounds with substantial antioxidant activity. The significant variability among cultivars suggests the potential for selecting superior genotypes for nutritional, functional food, and pharmaceutical applications. These results scientifically validate the traditional use of *C. esculenta* and

indicate its promising potential as a natural antioxidant source. Further studies focusing on compound isolation, *in vivo* validation, and mechanism-based bioactivity assessments are recommended to fully explore its therapeutic applications.

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