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Determination of Phytochemical, Proximate, Mineral and Vitamin Values in Various Parts of Five Varieties of *Colocasia esculenta* (L.) Schott

C.A. Ezeabara[1*], C.U. Okeke[2]

[1,2]Department of Botany, Faculty of Biosciences, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Nigeria

[*]*Corresponding Author: ca.ezeabara@unizik.edu.ng, Tel.: +2348039264458*

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Abstract — *Colocasia esculenta* (L.) Schott is a herbaceous perennial plant of the family Araceae. Determinations of the phytochemical, proximate, mineral and vitamin contents of *C. esculenta* var. *antiquorum*, *C. esculenta* var. *esculenta*, 'kochuo', 'nwine' and 'ogeriobosi' parts were conducted using standard procedures. Significance of any differences was measured using Duncan's Multiple Range Test (DMRT). Highest concentrations of saponins were detected in the leaves, petioles and roots of the five *C. esculenta* varieties. Moreover, highest values of crude protein, vitamins A, B_1, B_2, C and E were present in the leaves of all the varieties. High levels of calcium were found in the leaves and petioles of all the varieties. Considering the phytochemical and nutrient values in the leaves and petioles of these *C. esculenta* varieties, their utilization as food and drug in ethno-medicine is highly encouraged. In addition, they could be regarded as good sources of these medicinal and nutritional agents.

Keywords— Phytochemicals, Alkaloids, Saponins, Calcium, Vitamin C

I. Introduction

Colocasia is one of five genera (*Alocasia*, *Amorphophallus*, *Cyrtosperma*, *Colocasia and Xanthosoma*) of economic importance in the family of Araceae [1, 2]. This genus is widely distributed in Africa, Australia, Europe, Northern America and Southern America [3]. *Colocasia* is one of the edible genera of this family and is used as important food crop in South-eastern Nigeria. *Colocasia esculenta* is widely distributed in Nigeria. The plant extends to north-western [4], south-southern [5] and south-eastern zones [6]. Moreover, it has several varieties that are staples in the diet of South-eastern zone. The most common ones are *C. esculenta* var. *antiquorum*, *C. esculenta* var. *esculenta*, 'kochuo', 'nwine' and 'ogeriobosi'.

Morphologically, *C. esculenta* resembles *Xanthosoma sagittifolium* (L.) Schott in their vegetative features; hence, some people mistake one for the other. Moreover, both are commonly known as cocoyam. In an earlier study, Ezeabara *et al.* [7] differentiated between the two genera of Araceae. They reported that *Colocasia* can be differentiated from *Xanthosoma* at the point of attachment of the petiole to the leaf. *Colocasia esculenta* and *X. sagittifolium* have been reported to have few cultivars each [8]. In addition, the cultivars vary in their vegetative characters and in the way they are processed or consumed due to acridity and taste. Acridity is a characteristic of all members of aroid family as a result of presence of calcium oxalate crystals distributed throughout their tissues [9].

II. Related Work

Colocasia esculenta grows well in moist and partial to full shady areas. Women in Igbo culture area of Nigeria primarily produce this crop; hence, it is regarded as woman's crop. The plant is mainly grown for their edible corms and cormels as sources of staple carbohydrate. Moreover, Ezeabara *et al*. [10] reported the rich nutritional importance of five varieties of *C. esculenta* cormels. They are used as major staple food in South-eastern Nigeria during lean periods, usually before the maturation of cultivated *Dioscorea* spp. that are the primary stable food in this region. 'Kochuo', a variety that does not undergo prolonged cooking before it is eaten, is mainly used in this period because it is normally cultivated alongside species of *Dioscorea*, but matures earlier. Other varieties are used during this period as dried chips that were processed and stored during the preceding harvest season. They are preserved by storing in cool and dry place or over the fireplace. Moreover, the usage of the leaves and petioles of this plant as vegetable is greatly minimal. In a certain town in Anambra State, South-eastern Nigeria, only the leaves of *C. esculenta* var. *antiquorum* and *C. esculenta* var. *esculenta* are seldom used as vegetables by the lesser percentage of the population. They are picked when the *C. esculenta* is matured and ready for harvest. Subsequently, they are dried, hung over fireplace and used as vegetables. On the other hand, the petioles are not used as vegetables. The objectives of this work, therefore, were to determine the phytochemical, proximate, mineral and vitamin contents of leaf, petiole and root of *C. esculenta* varieties.

III. METHODOLOGY

2.1 Sources of Materials
Leaf, petiole, and root samples of *C. esculenta* were collected from Uga, Aguata LGA, (Anambra South), Anambra State, Nigeria. The voucher specimens were deposited in Department of Botany herbarium, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. The voucher specimen numbers are NAU-102, NAU-103, NAU-104, NAU-105 and NAU-106 for *C. esculenta* var. *antiquorum*, *C. esculenta* var. *esculenta*, 'kochuo', 'nwine' and 'ogeriobosi' respectively.

2.1 Preparation of Plant Materials
Fresh leaves, petioles and roots of five *C. esculenta* varieties were collected in the months of August – October. The leaves and roots were air-dried at room temperature for five days while the petioles were sun-dried for seven days. The dried samples were ground into fine powder using a manual grinder (Corona, USA), and then stored in a tightly closed jar prior to analyses.

2.3 Qualitative Phytochemical Analysis
The homogenous samples of the petioles of the five varieties were subjected to phytochemical analysis for qualitative determinations, using the methods described by Harborne [11], Trease and Evans [12] and Sofowora [13].

2.4 Quantitative Phytochemical Assay
Alkaloids and total saponins determinations were done using the method outlined by Obadoni and Ochuko [14]. Flavonoid content of the sample was determined by the method described by Kumaran and Karunakaran [15] and Gracelin *et al*. [16].Van-Burden and Robinson [17] method was used for total tannins determination. Alkaline Pikrate Colorimeter method of Trease and Evans [12] was used for determination of Hydrogen cyanide (HCN).

2.5 Proximate Analysis
Analysis of the proximate contents of the five varieties was determined using the methods of Onwuka [18].

2.6 Determination of Minerals
Determination of iron was done by simple spectrophotometric method [19,20]. Calcium and magnesium determinations were carried out using the Versanate EDTA titrimetric method of Udoh and Oguwale [21]. The molybdovanadate colourimetric method [22] was employed for phosphorus determination. Sodium and potassium determinations were done by Flame photometry.

2.7 Determination of Vitamin Contents
The vitamins A, C and E assay were performed with the methods of Pearson [23] and Ogugua *et al*. [24] while vitamins B_1, B_2 and B_3 contents were determined using the method outlined by Okwu and Josiah [25].

2.8 Determination of Anti nutrients
The colorimetric method of Onwuka [18] was used to determine the phytate level whereas the oxalate determination was done using the method of Oke *et al.* [26] and Onwuka [18].

2.9 Statistical Analysis
SPSS software version 20 was used for the statistical analysis. The data was analysed at 0.5 level of probability using One–Way–Anova. The significance of any differences was measured using Duncan's Multiple Range Test (DMRT). The data were expressed as mean ± standard deviation of triplicate determinations.

IV. RESULTS AND DISCUSSION

A variety of phytochemical, proximate, vitamin and mineral compositions were present in the varieties of *C. esculenta* parts (Tables 1 – 4). The phytochemical result showed that considerable high levels of saponins were detected in the leaves, petioles and roots of all the varieties, with the highest values present in the leaves. Moreover, the highest saponin content was found in the leaves of 'ogeriobosi' (1.41±0.01 mg/g) (Table 1). Plant-based saponins possess antimicrobial actions. Relatively high values of alkaloids were found in the three parts of all the varieties. Alkaloids isolated from plants have analgesic and antimicrobial properties. Low levels of tannins were detected in the leaves, petioles and roots of all the varieties of *C. esculenta*. The highest value was found in the leaves of 'ogeriobosi' (0.65±0.03 mg/g). This suggests that *C. esculenta* synthesizes low concentration of tannins. The concentrations of oxalate present in the roots of these varieties of *C. esculenta* were highest when compared with other parts. The highest concentration was found in the root of *C. esculenta* var. *esculenta* (1.79±0.01 mg/g). Oxalate is an anti nutrient but could be reduced by processing the food. Hydrogen cyanide detected in all the *C. esculenta* varieties followed a pattern that leaf>root>petiole and it occurred in high concentrations. The lowest levels were present in the petioles of all the species, except *C. esculenta* var. *esculenta*. Nevertheless, the high concentration of hydrogen cyanide could be reduced through cooking and steaming. Moreover, in a former work, Ezeabara and Nwiyi [27] reported highest values of hydrogen cyanide in the leaves of *Boerhavia diffusa* L. (2.24±0.00 Mg/kg) and *B. erecta* L. (2.17±0.01 Mg/kg) when compared with the stems and roots. Presumably, the leaves of plants synthesize and accumulate highest concentrations of hydrogen cyanide. A number of factors such as temperature, pH and herbivory might have affected the synthesis, accumulation, level and location of these phytochemicals in this plant species. Plant species, age, season and climatic factors determine the formation and accumulation of phytochemicals [28]. Different classes of phytochemicals inhibit normal feeding behaviours, act as poisonous substances, or interfere with insect digestion; thereby warding off insects from plants [29]. The colour, flavour and aroma of plants and their parts are determined by the phytochemicals present.

Flavonoids are the primary agents for the attractive colours of plant parts including flowers, fruits and leaves [30]. Hence, they function as plant pigments. Purple is among the colours of special flavonoid-related anthocyanins [31]. In the petioles, the highest flavonoid contents were present in 'kochuo' (0.60±0.06 mg/g) and 'ogeriobosi' (0.57±0.02 mg/g). This could be responsible for the purple colouration at the point of attachment of the petiole of 'kochuo' to its abaxial leaf surface as well as on the 'ogeriobosi' petiole [7].

The proximate study revealed that the highest crude protein contents were present in the leaves of all the varieties, with the highest value in leaves of 'ogeriobosi' (22.82±0.02%). In addition, appreciable quantities of crude protein were found in the petioles of all the varieties, with the highest content present in the petiole of 'kochuo' (19.50±0.09%) (Table 2). Protein builds and repairs body cells and tissues. Generally, low percentages of fat were detected in the leaves, petioles and roots of all the varieties of *C. esculenta*, with the lowest values in the roots. This suggests that small quantity of fat is synthesized by this plant. Considerable quantities of carbohydrates were present in the leaves, petioles and roots of all the varieties, with the highest levels in the root. In the leaves, the highest value of carbohydrates was detected in 'nwine' (33.89±0.16%) while the lowest content was found in *C. esculenta* var. *esculenta* (24.09±0.1%). In the petiole, the highest value of carbohydrate was present in the 'ogeriobosi' (40.00±0.18%) whereas the lowest percentage was detected in 'kochuo' (31.31±0.65%). Moreover, highest percentages of crude fibre were found in the leaves of 'kochuo' (13.81±0.02) and 'nwine' (13.79±0.12) while the least was detected in the leaves of *C. esculenta* var. *antiquorum* (4.39±0.03). In the petioles, the highest quantity of crude fibre was present in 'kochuo' (12.77±0.03%) while the lowest value was found in 'nwine' (9.71±0.04%). Significant values of crude fibres were also detected in the root, with the highest level in 'ogeriobosi' (10.35±0.03%). These imply that both leaf and petiole of *C. esculenta* are endowed with nutrients and could be used as vegetables. The roots could be gathered after harvest and used for formulation of animal feeds. In an earlier research, Azubuike *et al*. [32] reported that with the exception of crude fibre and moisture contents, the ash, crude protein, fat and carbohydrate values of *C. esculenta* sun-dried leaves were higher than those of fresh and boiled samples. Therefore, preserving the leaves, petioles and roots of *C. esculenta* by drying is encouraged.

In the mineral tests of the leaves, petioles and roots of the five of *C. esculenta* varieties, phosphorus, magnesium, calcium, iron, sodium and potassium contents were present in all the varieties, and followed a pattern that leaf>petiole. Highest calcium content was relatively present in the leaves of all the varieties, with the highest value in *C. esculenta* var. *esculenta* (465.82±0.02 mg/100g). In addition, considerable high percentages of calcium were detected in the petioles of all the varieties, with the highest levels also found in *C. esculenta* var. *esculenta* (376.68±0.24 mg/100g). Calcium is essential for strong bone and teeth. Furthermore, appreciable quantities of magnesium were found in the three parts of all the varieties. In the leaves, the highest concentration was present in *C. esculenta* var. *esculenta* (103.49±0.0 mg/100g) while the least was detected in 'kochuo' (89.39±0.30 mg/100g). Moreover, the highest magnesium content in the root was detected in *C. esculenta* var. *esculenta* (103.69±0.21 mg/100g) whereas the lowest level was found in 'kochuo' (75.72±0.17 mg/100g). Magnesium increases calcium absorption from the blood into the bone. High levels of calcium, potassium and sodium present in the leaves of all the varieties of *C. esculenta*, agree with the work of Azubike *et al*. [32] whereas the high values of potassium and magnesium disagree; where they reported that there were low potassium and magnesium contents in *C. esculenta* sun-dried leaves. Moreover, with the exception of sodium and potassium values that followed a pattern that root>leaf, other mineral values were higher in the leaves than in the root (Table 3). Generally, all the parts of the varieties contained relatively low level of iron. In a previous study, relatively low values of iron were also detected in leaves (3.79+0.01 mg/100g), stems (2.62+0.11 mg/100g) and roots (4.87+0.10 mg/100g) of aqueous extract of *Portulaca oleracea* L. [33]. This indicates that plants synthesize low iron contents. Iron helps to create the haem portion of the haemoglobin that transports oxygen inside the blood.

In the vitamin investigations of the leaves, petioles and roots of the five *C. esculenta* varieties, the highest levels of vitamins A, B_1, B_2, C and E were present in the leaves of all the varieties, whilst vitamin B_3 was highest in the petiole of *C. esculenta* var. *antiquorum* (1.88±0.02 mg/100g). The vitamin C contents were also high in all the varieties petioles, with the highest value in *C. esculenta* var. *antiquorum* (160.36±0.07 mg/100g). The root of all the varieties contained lowest quantities of all the vitamins (Table 4). The deficiencies of vitamins A, B_1, B_2, B_3, C and E cause night blindness (in severe condition, xeropthalmia), beri beri, ariboflavinosis, pellagra, scurvy and low immune system respectively.

V. CONCLUSION AND FUTURE SCOPE

This study revealed that the leaves and petioles of *C. esculenta* var. *antiquorum*, *C. esculenta* var. *esculenta*, 'kochuo', 'nwine' and 'ogeriobosi' are typically low in tannins, fat, iron, magnesium, vitamins B_1 and B_2 and high in saponins, alkaloids, flavonoids, crude protein, crude fibre, calcium, phosphorus, potassium, and vitamins A, B_3, C and E. Therefore, the presence of this wide range of health promoting phytochemicals and nutrients in these parts of *C. esculenta* varieties suggests their uses in ethno-medicine as food and drug. The leaves and petioles could also be regarded as good sources of saponins, alkaloids, flavonoids, crude protein, crude fibre, calcium, phosphorus, potassium, and vitamins A, B_3, C and E. In addition, the leaves could also be used as wrappings for other food materials before cooking. The roots also contained considerable phytochemical and nutritional composition; hence, incorporating them in the ingredients for manufacture of animal feeds would be beneficial. Moreover, using drying method as the means of preserving the leaves and petioles of *C. esculenta* for year round availability is highly encouraged.

Further studies are needed in order to investigate the pharmacological property of the active compounds present in these varieties of *C. esculenta* as well as ascertain the clinical applicability of the leaves and petioles in human beings.

Table 1. Mean phytochemical composition (mg/g) of Colocasia esculenta var. antiquorum, Colocasia esculenta var. esculenta, 'Kochuo', 'Nwine' and 'Ogeriobosi' leaf, petiole and root

Plant Parts	Composition	*Colocasia esculenta* var. *antiquorum*	*Colocasia esculenta* var. *esculenta*	'Kochuo'	'Nwine'	'Ogeriobosi'
Leaf	Tannins	0.41 ± 0.01^a	0.52 ± 0.01^b	0.61 ± 0.03^c	0.57 ± 0.01^d	0.65 ± 0.03^e
	Flavonoids	0.55 ± 0.02^a	0.71 ± 0.02^b	0.71 ± 0.04^b	0.73 ± 0.01^b	0.78 ± 0.01^c
	Alkaloids	0.70 ± 0.05^a	0.91 ± 0.02^b	0.90 ± 0.03^b	0.86 ± 0.01^c	0.94 ± 0.02^b
	Saponins	1.25 ± 0.02^a	1.35 ± 0.02^b	1.35 ± 0.03^b	1.31 ± 0.01^c	1.41 ± 0.01^d
	HCN (mg/kg)	4.51 ± 0.01^a	5.81 ± 0.01^b	5.51 ± 0.09^c	5.33 ± 0.06^d	5.28 ± 0.03^d
	Oxalate	0.47 ± 0.01^a	0.54 ± 0.02^b	0.66 ± 0.02^c	0.57 ± 0.04^b	0.77 ± 0.03^d
	Phytate	0.38 ± 0.02^a	0.59 ± 0.04^b	0.48 ± 0.01^c	0.51 ± 0.01^c	0.50 ± 0.02^c
Petiole	Tannins	0.29 ± 0.01^a	0.36 ± 0.01^b	0.38 ± 0.03^b	0.33 ± 0.02^c	0.38 ± 0.01^b
	Flavonoids	0.47 ± 0.02^a	0.53 ± 0.01^b	0.60 ± 0.06^c	0.53 ± 0.04^b	0.57 ± 0.02^c
	Alkaloids	0.66 ± 0.05^a	0.76 ± 0.02^b	0.77 ± 0.02^b	0.73 ± 0.01^b	0.84 ± 0.02^c
	Saponins	1.06 ± 0.01^a	1.17 ± 0.01^a	1.18 ± 0.02^a	1.10 ± 0.02^a	0.86 ± 0.57^a
	HCN (mg/kg)	1.74 ± 0.01^a	2.34 ± 0.01^b	1.93 ± 0.02^a	1.92 ± 0.03^a	1.71 ± 0.28^a
	Oxalate	0.55 ± 0.05^a	0.53 ± 0.01^b	0.65 ± 0.02^c	0.62 ± 0.01^c	0.62 ± 0.02^c
	Phytate	0.32 ± 0.05^a	0.48 ± 0.02^b	0.35 ± 0.01^a	0.40 ± 0.03^c	0.40 ± 0.02^c
Root	Tannins	0.34 ± 0.01^a	0.44 ± 0.01^b	0.44 ± 0.02^b	0.38 ± 0.02^c	0.46 ± 0.02^b
	Flavonoids	0.58 ± 0.02^a	0.61 ± 0.01^a	0.59 ± 0.02^a	0.56 ± 0.04^b	0.61 ± 0.01^a
	Alkaloids	0.80 ± 0.16^a	0.84 ± 0.02^a	0.92 ± 0.02^a	0.85 ± 0.02^a	0.93 ± 0.02^a
	Saponins	1.19 ± 0.01^a	1.31 ± 0.02^b	1.31 ± 0.01^b	1.24 ± 0.02^c	1.33 ± 0.02^b
	HCN (mg/kg)	3.46 ± 0.02^a	4.78 ± 0.02^b	4.79 ± 0.05^b	4.93 ± 0.04^c	4.80 ± 0.02^b
	Oxalate	1.53 ± 0.02^a	1.79 ± 0.01^b	1.59 ± 0.01^c	1.66 ± 0.02^d	1.62 ± 0.03^e
	Phytate	0.37 ± 0.02^a	0.49 ± 0.00^b	0.38 ± 0.02^a	0.47 ± 0.04^b	0.40 ± 0.01^a

Results are in Mean ± Std of triplicate determinations. Different letters in a row are significantly different ($p > 0.05$). *HCN =Hydrogen cyanide*

Table 2. Mean proximate composition (%) of Colocasia esculenta var. antiquorum, Colocasia esculenta var. esculenta, 'Kochuo', 'Nwine' and 'Ogeriobosi' leaf, petiole and root

Plant Parts	Composition	*Colocasia esculenta* var. *antiquorum*	*Colocasia esculenta* var. *esculenta*	'Kochuo'	'Nwine'	'Ogeriobosi'
Leaf	Moisture content	9.62±0.02^{a}	10.24±0.01^{b}	10.74±0.02^{c}	8.78±0.02^{d}	9.63±0.02^{a}
	Dry matter	90.38±0.03^{a}	89.76±0.01^{b}	89.28±0.02^{c}	91.23±0.03^{d}	90.38±0.03^{a}
	Ash	213.46±0.02^{a}	22.64±0.05^{b}	22.60±0.13^{c}	18.65±0.08^{d}	22.75±0.01^{b}
	Crude fibre	4.39±0.03^{a}	12.80±0.04^{b}	13.81±0.02^{c}	13.79±0.12^{c}	12.79±0.01^{b}
	Fat	3.44±0.02^{a}	8.49±0.06^{b}	2.30±0.02^{c}	3.18±0.02^{d}	3.13±0.01^{d}
	Crude protein	22.54±0.08^{a}	21.74±0.12^{b}	21.66±0.04^{b}	21.78±0.04^{b}	22.82±0.02^{c}
	CHO	26.55±0.13^{a}	24.09±0.10^{b}	28.89±0.21^{c}	33.89±0.16^{d}	28.89±0.05^{c}
Petiole	Moisture content	10.62±0.07^{a}	10.81±0.03^{b}	10.28±0.04^{c}	9.85±0.01^{d}	8.90±0.06^{e}
	Dry matter	89.13±0.72^{a}	89.19±0.03^{b}	89.68±0.05^{c}	90.16±0.02^{b}	91.10±0.06^{d}
	Ash	21.53±0.06^{a}	23.69±0.21^{b}	23.41±0.68^{b}	16.24±0.01^{c}	17.48±0.10^{d}
	Crude fibre	10.46±0.04^{a}	10.63±0.02^{b}	12.77±0.03^{c}	9.71±0.04^{d}	11.89±0.01^{e}
	Fat	2.79±0.01^{a}	3.32±0.07^{b}	2.73±0.02^{a}	3.05±0.01^{b}	2.82±0.10^{a}
	Crude protein	16.35±0.02^{a}	17.51±0.09^{b}	19.50±0.09^{c}	16.91±0.03^{d}	18.91±0.01^{e}
	CHO	38.25±0.18^{a}	34.04±0.37^{b}	31.31±0.65^{c}	44.23±0.04^{d}	40.00±0.18^{e}
Root	Moisture content	7.71±0.08^{a}	10.33±0.08^{b}	9.88±0.05^{c}	7.33±0.06^{a}	6.77±0.02^{d}
	Dry matter	92.30±0.08^{a}	89.73±0.08^{b}	90.30±0.23^{c}	92.64±0.07^{d}	93.22±0.01^{e}
	Ash	23.7±0.03^{a}	23.7±0.03^{a}	23.8±0.02^{a}	20.6±0.04^{b}	23.8±0.02^{a}
	Crude fibre	9.62±0.03^{a}	8.49±0.01^{b}	9.85±0.01^{c}	9.80±0.03^{c}	10.35±0.03^{d}
	Fat	0.83±0.01^{a}	0.75±0.01^{b}	0.48±0.03^{c}	0.49±0.01^{c}	0.49±0.01^{c}
	Crude protein	6.77±0.04^{a}	5.67±0.03^{b}	6.89±0.04^{c}	6.65±0.10^{d}	5.86±0.05^{e}
	CHO	51.30±0.18^{a}	50.99±0.12^{b}	49.07±0.04^{c}	55.07±0.21^{d}	52.71±0.08^{e}

Values are in Mean ± Std of triplicate determinations. Different letters in a row are significantly different (p>0.05). *CHO = Carbohydrate.*

Table 3. Mean mineral composition (mg/100g) of Colocasia esculenta var. antiquorum, Colocasia esculenta var. esculenta, 'Kochuo', 'Nwine' and 'Ogeriobosi' leaf, petiole and root

Plant Parts	Composition	*Colocasia esculenta* var. *antiquorum*	*Colocasia esculenta* var. *esculenta*	'Kochuo'	'Nwine'	'Ogeriobosi'
Leaf	P	180.41±0.07^{a}	167.43±0.03^{b}	174.55±0.65^{c}	172.58±0.19^{d}	174.62±0.02^{c}
	Mg	103.49±0.09^{a}	96.34±0.10^{b}	89.39±0.30^{c}	92.62±0.19^{d}	91.45±0.05^{e}
	Ca	465.82±0.02^{a}	452.79±0.03^{b}	458.10±1.13^{c}	445.56±0.24^{d}	459.31±0.04^{e}
	Fe	0.95±0.01^{a}	1.07±0.02^{b}	1.24±0.33^{b}	0.93±0.02^{a}	1.09±0.03^{b}
	Na	189.56±0.07^{a}	185.78±0.04^{b}	189.34±0.09^{c}	192.68±0.20^{d}	190.53±0.09^{e}
	K	196.78±0.07^{a}	206.80±0.01^{b}	198.42±0.12^{c}	207.62±0.02^{d}	194.74±0.11^{e}
Petiole	P	120.47±0.02^{a}	158.66±0.19^{b}	154.72±0.03^{c}	154.79±0.01^{c}	118.73±0.03^{d}
	Mg	69.28±0.04^{a}	75.44±0.31^{b}	70.84±0.02^{c}	71.84±0.05^{d}	74.82±0.19^{e}
	Ca	376.68±0.24^{a}	349.25±0.31^{b}	348.79±0.01^{c}	348.42±0.10^{d}	328.49±0.08^{e}
	Fe	0.88±0.02^{a}	0.79±0.05^{b}	0.84±0.03^{a}	0.87±0.00^{a}	0.87±0.01^{a}
	Na	160.74±0.02^{a}	153.61±0.02^{b}	153.62±0.12^{b}	149.62±0.03^{c}	154.82±0.10^{d}
	K	191.11±0.03^{a}	192.56±0.04^{b}	192.71±0.11^{b}	190.60±0.01^{c}	190.59±0.19^{c}
Root	P	161.75±0.08^{a}	162.32±0.02^{a}	163.51±1.15^{b}	160.62±0.16^{c}	159.30±0.02^{d}
	Mg	103.69±0.21^{a}	78.46±0.04^{b}	75.72±0.17^{c}	81.66±0.04^{d}	82.77±0.03^{e}
	Ca	128.69±0.08^{a}	128.20±0.04^{b}	129.33±0.06^{c}	131.75±0.04^{d}	132.65±0.05^{e}
	Fe	0.84±0.02^{a}	0.84±0.05^{a}	0.79±0.05^{b}	0.69±0.01^{c}	0.77±0.02^{b}
	Na	194.61±0.27^{a}	135.82±0.02^{b}	145.90±0.05^{c}	0.70±0.01^{c}	147.62±0.02^{e}
	K	208.62±0.15^{a}	149.57±0.06^{b}	148.94±0.31^{c}	153.69±0.21^{d}	152.83±0.02^{e}

Values are in Mean ± Std of triplicate determinations. Different letters in a row are significantly different (p>0.05).

Table 4. Mean vitamin composition of *Colocasia esculenta* var. *antiquorum*, *Colocasia esculenta* var. *esculenta*, 'Kochuo', 'Nwine' and 'Ogeriobosi' leaf, petiole and root (mg/100g of dry mass)

Plant Parts	Composition	*Colocasia esculenta* var. *antiquorum*	*Colocasia esculenta* var. *esculenta*	'Kochuo'	'Nwine'	'Ogeriobosi'
Leaf	B_1	0.61±0.01[a]	0.56 ±0.02[b]	0.47±0.03[c]	0.59±0.01[a]	0.54±0.03[d]
	B_2	0.08±0.00[a]	0.07±0.00[b]	0.06±0.01[b]	0.07±0.00[b]	0.06±0.00[b]
	B_3	0.98±0.00[a]	1.86±0.03[b]	1.63±0.01[c]	1.85±0.02[b]	1.71±0.01[d]
	C	165.78±0.03[a]	169.34±0.09[b]	165.79±0.01[a]	167.46±0.30[c]	163.83±0.03[d]
	A	17.36±0.07[a]	16.76±0.03[b]	15.45±0.03[c]	18.29±0.09[d]	14.80±0.02[e]
	E	11.81±0.03[a]	11.31±0.13[b]	11.66±0.04[c]	10.33±0.05[d]	11.58±0.05[c]
Petiole	B_1	0.52±0.01[a]	0.48 ±0.01[b]	0.43±0.01[c]	0.54±0.04[d]	0.49±0.01[e]
	B_2	0.07±0.00[a]	0.05±0.00[b]	0.05±0.00[b]	0.06±0.00[c]	0.05±0.00[b]
	B_3	1.88±0.02[a]	1.64±0.06[b]	1.60±0.02[c]	1.75±0.01[d]	1.63±0.02[b]
	C	160.36±0.07[a]	143.58±0.19[b]	149.27±0.03[c]	145.45±0.34[d]	146.80±0.02[e]
	A	14.34±0.10[a]	14.30±0.04[a]	14.75±0.04[b]	15.30±0.07[c]	15.14±0.04[d]
	E	6.78±0.00[a]	6.80±0.01[a]	1.84±0.57[b]	6.79±0.15[c]	5.84±0.09[c]
Root	B_1	0.08±0.00[a]	0.09 ±0.00[a]	0.07±0.00[a]	0.07±0.00[a]	0.08±0.00[a]
	B_2	0.03±0.00[a]	0.03±0.00[a]	0.03±0.00[a]	0.03±0.00[a]	0.03±0.00[a]
	B_3	0.08±0.00[a]	0.10±0.00[a]	0.08±0.00[a]	0.08±0.00[a]	0.08±0.00[a]
	C	0.79±0.01[a]	0.86±0.03[b]	0.83±0.01[a]	0.87±0.08[b]	0.93±0.02[c]
	A	0.64±0.01[a]	0.69±0.01[b]	0.70±0.01[c]	0.65±0.01[a]	0.79±0.01[d]
	E	0.68±0.03[a]	0.65±0.02[b]	0.88±0.02[c]	0.90±0.02[c]	0.64±0.01[b]

Results are in Mean ± Std of triplicate determinations. Different letters in a row are significantly different ($p>0.05$).

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AUTHORS' PROFILE

Chinelo A. Ezeabara is a Senior lecturer in Department of Botany, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Nigeria. She got her BSc, MSc and PhD (Nnamdi Azikiwe University, Awka, Nigeria). She is a plant taxonomist. She is a life member of Botanical Society of Nigeria (BOSON). Her research interest lies in phytomedicine, plant anatomy, morphology and taxonomy. She has published over forty articles in reputable local and international journals. She has 15 and 13 years of teaching and research experiences respectively. She has also reviewed manuscripts for international journals that help to maintain their high peer review standards.

Clement U. Okeke is currently working as a Professor in Department of Botany, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Nigeria. He bagged BSc Botany (University of Nigeria, Nsukka), MSc, PhD in Biosytematics/Taxonomy (University of Port Harcourt, Nigeria), LL.B (University of Nigeria, Nsukka). He is a member of Botanical Society of Nigeria (BOSON) and Nigerian Bar Association (NBA). He has up to 28 years of teaching experience and supervision of both undergraduate and postgraduate students. He also has up to 30 years of research experience. His research interest lies in phytochemistry, plant anatomy, morphology and taxonomy. He has done external examinations of both undergraduate and postgraduate students in many universities across Nigeria. He has published 40 and 120 articles in both local and international journals respectively.

