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COMPARATIVE ANATOMY, NUTRACEUTICAL POTENTIALS AND HEAVY METAL COMPOSITION OF TWO VARIETIES OF *Lasianthera africana* (P. Beauv)

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ABSTRACT

This study investigated the anatomical features, nutraceutical potentials and heavy metal compositions in two varieties of *Lasianthera africana* (P. Beauv) which is a member of the family *Icacinaceae* predominantly found mostly in southern Nigeria. The anatomical studies were carried out with free hand sectioning using a systematic arrangement of 5 razor blades. The slides were viewed using the light microscope and microphotographs were taken after careful examination from good preparations. The heavy metals, nutrients and antinutrients were analysed by standard methods. The anatomy of mid-ribs showed bicollateral vascular systems. There are three vascular traces and node is unilacunar. The vascular bundles and pith in mid-rib of dark variety is more extended than in white variety. The petiole anatomy of the two varieties has partially separated rib bundle wings. The stems have rings of open vascular systems and the pith of stem anatomy of dark variety is larger than that of white variety. The dark variety has more protein (28.00 $\pm$ 0.04%) than white variety (24.94 $\pm$ 0.02%), more oxalate (130.24 $\pm$ 0.10 mg/100 g) as against (92.56 $\pm$ 0.09 mg/100 g) in the white variety; and lead was also higher (0.692 mg/100 g) in the dark variety than in the white variety (0.038 mg/100 g). This study has shown that *Lasianthera africana* possesses anatomical features which are of taxonomic importance in the taxonomic delimitation of the varieties; has high nutritional contents and low levels of antinutrients except oxalate which is high and may be reduced to non-toxic level by processing, thus rendering it safe for human consumption.

Keywords: Icacinaceace, bicollateral, unilacunar, microphotographs

INTRODUCTION

Lasianthera africana (P.Beauv.) (Family-*Icacinaceae*) is widely distributed in the tropical rain forest (Hutchinson and Dalziel, 1973). There are four ethno varieties distinguished by their taste, leaf colour and ecological distribution. The leaves are consumed as vegetable in southern Nigeria. *L. africana* is commonly used as antacid, analgesic, antispasmodic, laxative, antipyretic, antiulcerogenic, antidiabetic and antimalarial (Okokon, *et al.,* 2007). Biological activities reported on *Lasianthera africana* include bacteriostatic (Itah, 1997), fungicidal (Itah, 1996) antidiabetic (Ekanem, 2006), antiplasmodial (Okokon, *et al.,* 2007), antimicrobial (Andy, *et al.,* 2008) and antiulcer (Okokon, *et al.,* 2009). The leaf extract has been reported to contain alkaloids, terpenes, saponins, tannins, flavonoids, anthraquinones and cardiac glycosides with LD_{50} value of 5000 mg/kg (Okokon, *et al.,* 2009).

Lasianthera africana is one of the top six commonly consumed green leafy vegetables by Efik and Ibibio ethnic groups of Nigeria (Bassey *et al.*, 2006). It is called "editan" in Efik and Ibibio local dialects of Nigeria. It is a perennial, glabrous, shrub that reaches a height of 61-136 cm (Hutchinson and Dalziel, 1973). Among the Ibibios, four local varieties distinguished by their taste, leaf colour and ecological distribution are known (Bassey *et al.*, 2006). The varieties are "afia" (white variety), "obubit" (black variety), "idim" (riverine variety) and "akai" (forest variety). The leaf has been used since pre-historic time for preparing soup and in many traditional concoctions for the treatment of various ailments (Sofowora, 1989). Ebana *et al.* (1996) reported that the leaves of *Lasianthera africana* are rich in chemical compounds of nutritional and medicinal importance. Preliminary screening of the leaves for phytochemicals indicated the presence of alkaloids, flavonoids, saponins, anthraquinones, glycosides and tannins in all the four ethnovarieties (Bassey *et al.,* 2006).

One unique characteristic of *Lasianthera africana* leaf is that it has bitter taste that requires debittering prior to culinary use. Debittering helps to enhance palatability and acceptability of the soup prepared with the leaf. Traditionally, the leaf

is usually debittered by squeeze washing with water or treatment with aqueous extract from unripe plantain peel ash. The use of higher concentration of unripe plantain peel ash usually gives objectionable flavour to the soup prepared with the debittered leaf and may have negative effect on other beneficial constituents in the leaf.

The relevance of this study is to enhance information on the existing literature and taxonomic characteristics of dark and white varieties of *Lasianthera africana* due to the economic importance of this plant. Thus, the objectives of this study is aimed at providing information on the comparative anatomy, nutrients, antinutrients and heavy metals composition of dark and white varieties of *Lasianthera africana*.

MATERIALS AND METHODS

Collection of plant samples

The fresh leaves of *Lasianthera africana* used for this study were collected from Uyo Village in Akwa Ibom State and were identified by a taxonomist in the Department of Biological Sciences, Akwa Ibom State University.

Anatomical studies

Leaves of the plant were fixed in formaldehyde, acetic and 70% alcohol (FAA) in the ratio of 1:1:18 of 40% formaldehyde, acetic acid and 70% alcohol for at least 48 hours following the method of Johanson, (1978). The free hand sectioning using a systematic arrangement of 5 razor blades as described by Wahua *et al*. (2013) was also adopted. Microphotographs were taken from good preparations.

Determination of nutrient substances

Analyses of the nutrient content of the two varieties of *Lasianthera africana* were carried out using the method of AOAC (1990).

Anti-nutritive Tests

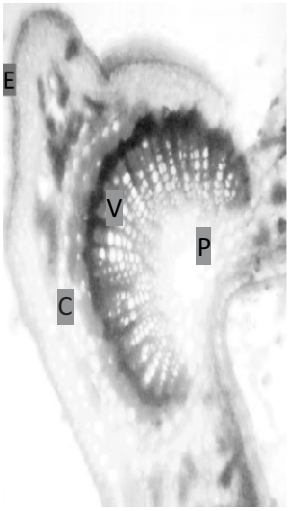
The method of AOAC (1990) was employed to determine the level of hydrocyanide, oxalate, phytate and tannins.

Determination of heavy metals

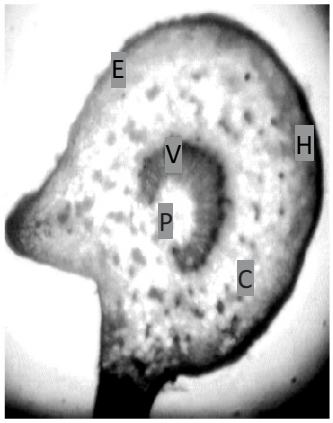
The method of AOAC (1990) was used to determine the level of Cd, Cr, Pb, Ni and V using Atomic Absorption Spectrophotometer (AAS) (Unicam Solar 969).

RESULTS

The anatomy of mid-ribs indicates bicollateral vascular systems. There are three vascular traces and node is unilacunar. The vascular bundles and pith in mid-rib of dark variety is more extended than in white variety. The petiole anatomy of the two varieties has a partially separated rib bundle wings revealed with arrow. The stems have rings of open vascular systems and the pith of stem anatomy of dark variety is larger than that of white variety (Plates 1-6)



1



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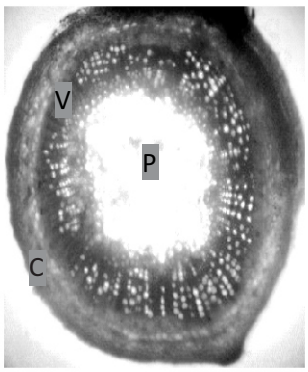

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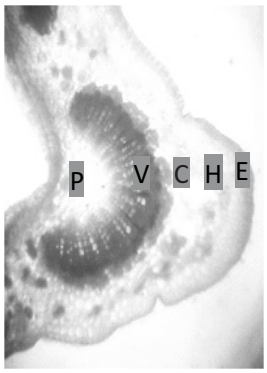
Lasianthera africana (dark green) Plate 1: Mid -rib Anatomy , Plate 2:Petiole Anatomy, Plate 3: Stem Anatomy



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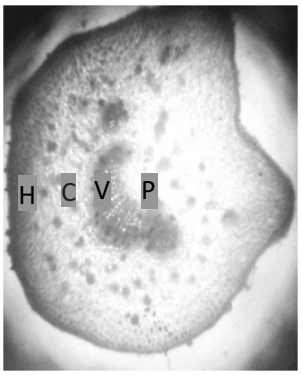

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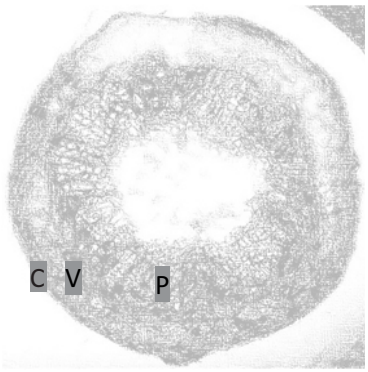

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Lasianthera africana (light green) Plate 4: Mid-rib Anatomy , Plate 5:Petiole Anatomy, Plate 6: Stem Anatomy

KEY: **E** represents Epidermis, **H** represents Hypodermis, **C** represents General cortex, **V** – vascular bundles, **P** – Pith.

In the antinutrient analysis, a value of 12.78 ± 0.06 mg hydrocyanide /100 g of leaves was obtained in dark variety and 12.59 ± 0.08 mg/100 g for white variety. Dark variety has tannin content of 9.52 ± 0.05 mg/100 g while white variety had 14.63 ± 0.03 mg/100 g. Dark variety has phytate content of 3.99 ± 0.02 mg/100 g while white variety has 7.48 ± 0.04 mg/100 g. Dark variety has oxalate content of 130.24 ± 0.10 mg/100 g while white variety has 130.24 ± 0.10 mg/100 g (Table 1)

Table1: Results of Antinutrient Composition of *Lasianthera africana* (values in mg/100 g)

SAMPLE	HCN	TANNIN	PHYTATE	OXALATE
Dark Variety	12.78 ± 0.06	9.52 ± 0.05	3.99 ± 0.02	130.24 ± 0.10
White Variety	12.59 ± 0.08	14.63 ± 0.03	7.48 ± 0.04	92.56 ± 0.09

Dark variety has moisture content of 5.50 ± 0.12% while white variety has 19.50 ± 0.11%. Dark and white varieties had ash content of 7.39 ± 0.03 and 6.75 ± 0.04% respectively. Dark variety has fibre content of 5.82 ± 0.01% while white was 4.50 ± 0.01%. Dark variety has protein content of 28.00 ± 0.04% while white variety had a value of 24.94 ± 0.02%. The lipid content of dark and white variety was 2.96 ± 0.02 and 5.50 ± 0.04% respectively. Dark variety had carbohydrate content of 55.83 ± 0.49% while that of white variety was 53.31 ± 0.45% and the caloric value of dark and white varieties was 361.96 ± 0.63 and 407.50 ± 0.51 kcal respectively (Table 2).

Dark variety has lead content of 0.692 mg/100 g of leaves analysed, while white variety was 0.0380.692 mg/100 g. Both varieties had equal vanadium content of 0.004%. Dark variety has copper content of 0.0016% while white variety has a value of 0.004%. Dark variety has cadmium content of 0.008% while white variety had 0.002%, and the nickel content in dark variety and white varieties was 0.0036 and 0.004% respectively (Table3).

Table 2: Proximate Composition of Dark and White Varieties of *Lasianthera africana*

PARAMETERS	DARK VARIETY	WHITE VARIETY
Moisture %	5.50 ± 0.12	19.50 ± 0.11
Ash %	7.39 ± 0.03	6.75 ± 0.04
Fibre %	5.82 ± 0.01	4.50 ± 0.01
Protein %	28.00 ± 0.04	24.94 ± 0.02
Lipid %	2.96 ± 0.02	5.50 ± 0.04
CHO %	55.83 ± 0.49	53.31 ± 0.45
Caloric value (Kcal)	361.96 ± 0.63	407.50 ± 0.51

Table 3: Concentration of Heavy Metals in Dark and White Varieties of *Lasianthera africana*

Sample	Pb (mg/100g)	V (mg/100 g)	Cu (mg/100g)	Cd (mg/100g)	Ni (mg/100 g)
Dark Variety	0.692	0.004	0.002	0.008	0.004
White Variety	0.038	0.004	0.004	0.002	0.004

DISCUSSION

The anatomy of mid-ribs reveals bicollateral vascular systems. There are three vascular traces and node is unilacunar. The vascular bundles and pith in mid-rib of dark variety is more extended than in white variety. The petiole anatomy of the two varieties has a partially separated rib bundle wings. The stems have rings of open vascular systems and the pith of stem anatomy of dark variety is larger than that of white variety. These anatomical features are of great taxonomic importance, since they are less affected by the environment (Stace, 1980). The vascular system of leaf and stem are also of taxonomic interest and value. These results are in accordance with the observations of Wahua and Sam (2013, 2016) who reported the comparative chemotaxonomic investigations on *Physalis angulata* Linn. and *Physalis micrantha* Linn. and also the taxonomic studies on *Solanum macrocarpon* Linn. and *Solanum incanum* Linn respectively.

The concentrations of the antinutrients in both dark and white varieties of *Lasianthera africana* was not on the high side as to constitute a health hazard, as they are within the safe level (Brown, 2007). The low concentration of antinutrients makes the plant safe for use. Antinutrients are

required in low concentrations to effect biochemical changes; hence the plant may be effective as ethnomedicine (Okaka and Okaka, 2001).

The presence of phytate (Phytic acid) in these varieties which is a hexaphosphate derivative of inositol is an important, storage form of phosphorus in plant. It causes calcium and zinc deficiency in man when in excess, the deficiency of these minerals results in Oteo-malacia, anaemia and rickets. However, it plays an important role in determining starch digestibility in food (Osagie, 1998). In plants it serves the purpose of preservation. Probably, because of its presence, the leaves provide anti-inflammatory action on wounds, burns and ulcers.

High content of tannin decreases protein quality by decreasing digestibility and causes damage to the intestinal tract (Butter, 1989). Dutta (1993) said that tannins are responsible for the flavor in tea and its use in the treatment of skin eruption and for other medicinal purposes due to their astringent properties.

The dark and white varieties of *Lasianthera africana* consumed mostly by the people of the southern Nigeria contain high nutritional value. Regular use of plant foods rich in protein makes a valuable addition to a diet (Wardlaw and Kessel, 2002). Fats insulate and protect body organs and also transport fat-soluble vitamins. The minimal intake of carbohydrate is 50 to 100 g per day, 60% of total energy intake is a typical recommendation (Wardlaw and Kessel, (2002). High carbohydrate and low fat diet aids control of hypertension and prevent obesity. Fat and protein stimulate the release of the hormone –gastric inhibitory peptide (GIP) from the walls of the small intestine. GIP slows the release of stomach contents into the small intestine (Wardlaw and Kessel, 2002).The high nutrient content of this plant tend to lend support to the benefits that consumers may derive since food rich in macronutrients are beneficial to the body (Okaka and Okaka, 2001).

CONCLUSION

The dark and white varieties of *Lasianthera africana* consumed mostly by the people of southern Nigeria have high nutritional values. The two possess anatomical features which are of great taxonomic importance in the taxonomic delimitation of the varieties. There is need for further studies on the characterization and toxicity level of the bioactive compounds.

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