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NUTRIENTS, PHYTOCHEMICALS AND TERPENE COMPOSITION OF SPICE MADE FROM *Xylopia aethiopica*

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ABSTRACT
Background: *Xylopia aethiopica* is a plant of enormous importance in African cuisines and traditional medicine. It is nutritionally rich and spicy. Almost all its parts are medicinally useful.
Objective: The aim of this study was to evaluate the proximate, vitamins, minerals and phytochemicals content of *Xylopia aethiopica*.
Methods: *Xylopia aethiopica* was obtained from Green Healthcare Botanical Gardens Owerri, Imo State, Nigeria. The fruit of the plant was processed into powder. Proximate composition was determined using standard methods, minerals content was determined with atomic absorption spectrophotometry, vitamins composition was determined by Spectrophotometric method, phytochemicals content was determined using colorimetric method, and terpenes content was by headspace solid-phase microextraction combined with gas chromatography-mass spectrometry with flame-ionization detection (GC-FID).
Results: Carbohydrate was the highest at 62.18% and protein the least at 3.99%. Vitamins A, B_1 and C were present. The minerals detected were Mg, K, Na, Ca, Mn, Fe, Cu and Zn. The phytochemicals present were tannins, alkaloids, flavonoids, saponins, phytates, oxalates and phenols. The plant contained several terpene compounds which were at a high yield (3.953%).
Conclusion: This spice can contribute important nutrients to diets. Its diverse phytochemicals might be responsible for its therapeutic functions.

Keywords: *Proximate, vitamins, minerals, phytochemicals, terpenes*

INTRODUCTION

Spices are aromatic plants whose flowers, leaves, root, bark and seeds are used in seasoning food (1). They are the most diversified natural food sources to mankind as they transverse cultures, religions and geographical locations, offering different varieties to choose from. With this diversity, they are used in different dishes and delicacies to please the palate. They are usually mixed to create variation in the taste and flavour of different foods. In traditional delicacies they are added in small quantities to exert their aromatic potentials. These potentials are due to the presence of terpenes, phenols and other volatile aromatic oils (2).

Spices are essential part of traditional African cuisines with so many of them cultivated or growing wild in Nigeria (3). One of such spices is *Xylopia aethiopica*. *X. aesthiopica* is an evergreen tree of the family A*nnonaceae*, mostly found in rain forests in tropical Africa, especially near the coast. It is indigenous to West Africa, where it is used both as spice and medicine. In Africa in general *X. aesthiopica* is cultivated more for its use in ethno-medicine than as spice.

In Nigeria, it is known as Uda in Igbo, Eeru in Yoruba and Illa in Ibibio. Almost all the plant parts are medicinally useful. *X. aesthiopica* seeds and leaves are used in Nigeria to treat haemorrhoids (4); measles, chicken pox, and jaundice (5) and as a lactating aid (6). It is usually used in preparing yam pepper soup for lactating mothers in igbo speaking part of Nigeria. In Ghana, the stem and root bark are used to heal wounds and boils (7). In Gabon a decoction of the leaves is used to treat rheumatism and as an anthelmintic. In Cote d'ivoire, it is given as a tonic to women after child birth (8). It has been reported that the plant's main pharmacological properties are due to its diterpenoid constituent, present in its fruit (9, 10).

Spices contain macronutrients and micronutrients necessary for growth and normal body function and may help in alleviating nutrient deficiencies. The aim of this study was to determine the proximate, vitamins, minerals and phytochemical content of *X. aesthiopica* fruit.

MATERIALS AND METHODS

Sample Collection

Xylopia aethiopica friuts (Figure 1) were sourced from Green Healthcare Foundation Botanical Gardens in Owerri West local government area in Imo state, Nigeria. The samples were identified by plant taxonomists from Imo state Polytechnic Umuagwo.

Sample Preparation

The *X. aethiopica* fruits were washed briskly, dried in air and cabinet oven at the temperature of 60^0C for 30 mins. The fruits were ground to smooth powder with Marlexelectroline grinder and packaged. The processing of *X. aethiopica* spice is shown in Figure 2.

(a) (b)

Figure 1: *Xylopia aesthiopica* (a) fruits (b) powder

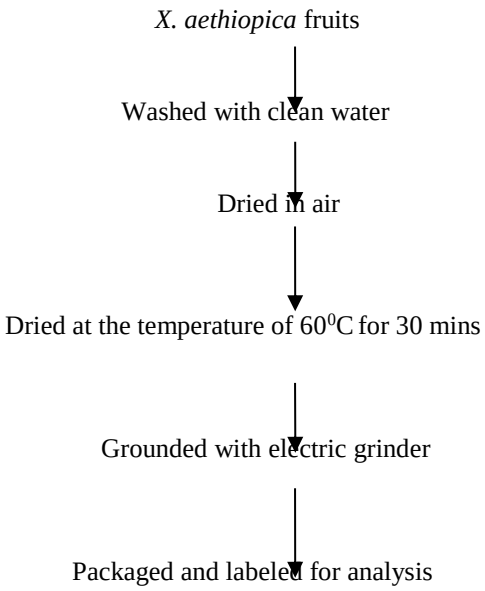

Figure 2: Flow chart for processing of *X. aethiopica* spice

Chemical analysis

The moisture, ash, fat, protein, crude fibre and carbohydrate content of the spices were determined using standard AOAC methods (11). Vitamins A, B_1 and C were determined by Pearson (12) method. The atomic absorption spectrophotometer (AAS) method of AOAC (11) was used to determine mineral (iron, calcium, zinc, copper, manganese, sodium, magnesium and potassium) and heavy metal content of the spices. Terpene content was determined using FET headspace GC-FID according to method of Hilliard *et al*. (13) by ANRESCO Laboratories Inc., San Francisco, CA, USA.

Statistical Analysis

The data obtained from different analyses were subjected to statistical analysis using SPSS v20 to obtain mean and standard deviation.

Results

The findings for proximate composition of *X. aethiopica* fruit are presented in Table 1. The carbohydrate content was the highest at 62.18±1.50% and protein the least at 3.99±0.20%.

Table 1: Proximate composition of *X. aethiopica* spice

Property	Amount g/100g
Protein	3.99±0.20
Moisture	11.70±0.91
Fat	9.74±0.02
Ash	4.65±0.04
Crude fiber	7.74±0.82
Carbohydrate	62.18±1.50

Table 2 shows the vitamin composition result. Vitamins A, B_1 and C were present, with concentrations 1.77%, 0.65% and 0.26% respectively.

Table 2: Vitamin composition of *Xylopia aethiopica* spice

Property	Percentage (%)
Vitamin-A	1.77±0.05
Vitamin-B_2	0.65±0.02
Vitamin-C	0.26±0.01

Table 3 revealed the minerals contained in *X. aethiopica* as potassium, sodium, magnesium and calcium, iron, manganese, copper and zinc. Potassium (K) had the highest concentration (1.331±0.03) while copper (Cu) had the lowest (0.001±0.001%).

Table 3: Mineral composition of *X. aethiopica*

Property	Percentage (%)
Mg	0.194±0.01
K	1.331±0.03
Na	0.142±0.01
Ca	0.287±0.02
Mn	0.008±0.004
Fe	0.012±0.02
Cu	0.001±0.001
Zn	0.002±0.001

The phytochemicals present were tannins, alkaloids, flavonoids, saponins, phytates, oxalates and phenols (Table 4). Alkaloid was the principal phytochemical (11.74±0.08%) and tannin the least abundant (0.68±0.01%).

Table 4: Phytochemical composition of *X. aethiopica*

Property	Result (mg/Kg)
Tannin	0.68±0.01
Alkaloid	11.74±0.08
Flavonoid	3.86±0.12
Saponin	5.07±0.03
Phytate	9.46±0.06
Oxalate	1.42±0.04
Phenol	3.13±0.02

Table 5 shows the terpene profiling result of the *Xylopia aethiopica* spice powder. Ocimene 2 was the major terpene detected constituting 2.936%. α-pinene, camphene, β-myrcene, β –pinene, d 3-carene, limonene, α–terpinene, y-terpinene , eucalyptol, linalool, menthol, (-)-borneol, terpineol, terpinolene, β–caryophyllene, and α–humelene were all present in minute amounts.

Table 5: Terpene profile of *X. aethiopica* spice

Analyte	**%**
α-Pinene	0.081
Camphene	0.015
β-Myrcene	0.055
β –Pinene	0.112
d 3-Carene	0.020
Limonene	0.082
α –Terpinene	0.009
Ocimene 1	0.010
Ocimene 2	2.936
p-Cymene	BDL
Eucalyptol	0.104
y-Terpinene	0.307
Terpinolene	0.051
Linalool	0.068
Isopulegol	BDL
Menthol	0.036
(-)-Borneol	0.006
Terpineol	0.032
Citronellol	ND
Geraniol	ND
β -Caryophyllene	0.023
α –Humelene	0.006
Nerolidol 1	BDL
Nerolidol 2	ND
Guaiol	BDL
Caryophyllene Ox	ND
α –Bisabolol	BDL
Eudesmol	ND
Total	**3.953±0.68**

ND = Not Detected; **BDL** = Below Detection Limit (0.0015%)

DISCUSSION

The findings for proximate composition of *X. aethiopica* fruit showed that the spice contained protein, fibre, ash, fat and carbohydrate in varying proportions. Carbohydrate was the most abundant nutrient whereas protein was the least. Osabor (14) reported less carbohydrate, more protein and crude fat in the fruits while Uhegbu (15) reported less carbohydrate, more fat, protein, fibre and ash in the seeds, than reported in this study. Hwang (16) reported differences in nutrient compositions of *X. aethiopica* whole fruit, seed and capsules and concluded that the nutrient content of plant might be affected by factors such as genetics, environment and methods of processing.

The spice is chiefly carbohydrate with appreciable amount of fat. This implies that the spice can increase the energy content of a diet. The protein content was low and can only slightly augment protein deficient diet. The protein content of 3.99% was higher than reported by Hwang (16) for fruit obtained in Ghana which was 0.82% and Liberia which was 2.88%. The moisture content after drying was high and close in value to amounts reported by Hwang (16**).** The difference in values obtained in the two studies suggests impact of geographical location. Fruits have high moisture content which account for their perishability or short shelf life. High water activity promotes microbial growth and enzymes activities in food (17).

The crude fibre content of the spice was reasonably high and comparable to that of mushroom (18). Dietary fibre has hypocholestrolaemic properties which may prove useful in preventing stroke and heart diseases (18). *X. aethiopica* contained low level of ash, indicative that the mineral content relative to other nutrients was low.

The analysis of mineral elements of this spice revealed appreciable concentrations of potassium, sodium, magnesium and calcium while iron, manganese, copper and zinc were considerably lower. Minerals are needed in small amounts in the

body where they serve for electrolyte balance, as components of tissues and in metabolism (19). Potassium was found to be the most abundant mineral. High potassium and low sodium diet are good for the management of hypertension (20). Calcium was next in amount to potassium. This spice can supply dietary calcium for healthy teeth and muscular functions. Calcium is a major component of supportive tissue in animals. Calcium also acts in cellular signalling to exert allosteric regulatory effects on proteins and enzymes (21). Iron is required for the formation of blood component needed for oxygen transport. Zinc is an essential trace element needed for proper central nervous system function and for hormonal balance in the body (22). Zinc The metal is a co-factor in the function of enzymes and influence gene expression for protein synthesis (23). It also plays a critical role in ensuring stronger immunity (24). According Maxwell and Volpe (25) zinc is a versatile mineral for thyroid function. Prasad (26) reported that zinc supplementation decreased oxidative stress and inflammation. Magnesium is an essential cofactor in many enzymatic reactions in intermediary metabolism (27).

The spice is rich in vitamins A, B_1 and C. Vitamin A is involved in good vision and bone formation. Vitamin B_1 functions in macronutrient metabolism. Vitamin C is also involved in bone formation, functions as an anti-infective, has anti-oxidant property and promotes wound healing (28). All three vitamins are sufficient to meet the RDA values.

Phytochemical analysis revealed the presence of tannins, alkaloids, flavonoids, saponins phytates, oxalates and phenol. Saponins have anti-inflammatory, antibiotic, and anti-oxidant, hypocholesterolaemic effects (29,30). Tannins possess astringent properties to quicken the healing of wounds (31). Alkaloids have antimalaria, antipuretic, anagelsic and antimicrobial properties (29,32,33). Flavonoids are phenolic compounds with antioxidants and anti-cancer activity (31). Phytochemicals have anti-nutrient activities, interfering with mineral and vitamins availability (34). High phytate and oxalate was reported in this study, which can make important minerals especially calcium, derivable from the spice unavailable (35). This effect of phytates and oxalates are minimized with cooking (35).

Ocimene 2 was the major terpene detected in the dried spice powder, amounting to 2.936%. The other terpenes present were α-pinene, camphene, β-myrcene, β–pinene, d 3-carene, limonene, α–terpinene, y-terpinene , eucalyptol, linalool, menthol, (-)-borneol, terpineol, terpinolene, β–caryophyllene, and α–humelene. The terpenes levels in the spice were generally low compared to those reported by Hwang (16), Karioti (36) and Elhassan (37). Plants vary in their terpene content depending on the method of sampling, the plant species, time of harvest, post harvest processing and environment (38).

CONCLUSION

The importance of *X. aethiopica* as a good source of nutritional and phytochemical compounds was brought to light in the present study. The plant can be used to assuage vitamin and mineral deficiencies.

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