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## PROXIMATE AND MINERAL COMPOSITION OF THE SEEDS AND PODS OF *XYLOPIA AETHIOPICA*

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### ABSTRACT

*The seeds and pods of Xylopia aethiopica were analysed for its proximate and mineral composition using standard analytical methods. The proximate composition showed that the lipid content of the seeds (22.1± 0.05%) was higher than that of the pods (21.0± 0.01%). The carbohydrates content of 47.7± 0.03% in the pods was higher than 43.6 ± 0.02% found in the seeds, which further gave rise to higher calorific (energy) value of 382.0± 0.11 kca/100g for the pods than 376.5 ±0.04 kca/100g recorded for the seeds. The mineral analysis indicated higher potassium content in the seeds and pods than the other minerals analysed. When compared to their respective recommended dietary allowance (RDA), the seeds and pods of this plant are good sources of copper and iron. Nutrient density (ND) which is used to evaluate the nutritional significance further confirmed that the seeds are a good sources of the mineral elements copper and iron, while the pods are a moderate source of potassium.*

**Keywords:** *Xylopia aethiopica*, Nutrient density, recommended dietary allowance, Energy value, Carbohydrates.

### INTRODUCTION

The term *Xylopia aethiopica* refers to the seed shrubby tree reaching a height of 20m found in Africa. *Xylopia* belongs to the family *Annonaceae* while *aethiopica* refers to the origin of the tree (though most grow in West African countries like Nigeria, Senegal and Ghana). It is a slim, tall, evergreen, aromatic tree, 15-30m high and 60-70cm in diameter with a straight stem and a slightly stripped or smooth bark, many branched crown and sometimes buttressed. The fruits are small, the carpel form dense cluster twisted bean-like pods and seeds have a musky flavor and are used as a pepper substitute. The pods are dark brown cylindrical 2.5 to 5cm long and 4 to 6mm thick (*Xylopia aethiopica*, 2010).

The common names of this plant are African pepper, Guinea pepper and Ethiopia pepper while the vernacular names include kimba (Hausa), Uda (Igbo), Tsunfyania (Nupe) and Erunje (Yoruba) (Abudullahi *et al.*, 2003). Crushed powdered fruit and seed are dried and used as pepper substitutes. The seeds have an aromatic pungent taste and were formerly sold under the name nergro pepper, Ethiopia pepper. The dried fruit are important in the preparation of two special local soups named as obe ata and isi-ewu taken widely in the southern parts of Nigeria. Medicinally the fruit is used against cough, stomachache, dizziness and used with other plants for the treatment of the skin infections. The seeds of *Xylopia aethiopica* with other species, rubbed on the body as cosmetic. The crushed powdered fruit mixed with shea butter and cocorus oil is used as cosmetic and perfumes products (*Xylopia aethiopica*, 2010). The aim of this work is to analyze the seed and pods of this plant for its

proximate and mineral composition and the objective is to used standard analytical methods.

### MATERIALS AND METHODS

**Sample collection and sample treatment:** The seed pods were bought at mobile market in Minna, Niger state. Prior to analysis, the samples were split open to remove the seed from the pod. They were open dried in the laboratory and pounded into powder using pestle and mortar. Thereafter the powdered seeds were sieved and stored in a polyethylene bag which was then used for proximate and mineral analysis. Samples of seeds and pods before pounding were used for moisture content determination.

**Proximate analysis:** The moisture content of the seeds and pods were determined by drying 5g of the seeds and pods (in triplicate) in a Gallenkamp oven at 105<sup>o</sup> C until constant weight was attained (AOAC, 1990). Ash content was determined according to the method described by Ceirwyn (1995) which involved dry ashing in lenton muffle furnace at 600<sup>o</sup> C until grayish white ash was obtained. Crude protein was determined by multiplying the value obtained from kjeldahl's nitrogen by a protein factor of 6.25 (AOAC, 1990). Crude lipid was quantified by the method described by AOAC (1990) using the soxhlet apparatus and petroleum ether (B.P. 60<sup>o</sup> C - 80<sup>o</sup>C) as a solvent. Crude fiber was determined by acid-base digestion with 1.25% H<sub>2</sub>S<sub>0</sub>4 (W/V) and 1.25% NaOH (W/V) solutions. Available carbohydrates were calculated by difference i.e. Available Carbohydrates (%) = 100 - (crude protein+ crude lipid+ crude fibre +ash) (AOAC, 1990).





Energy (calorific) value (kcal/100g) = (Crude lipid x 9) + (Crude protein x 2) + (Carbohydrate x 4) (Asibey-Berko and Taiye, 1999).

**Sample preparation for mineral analysis:** Six (6) gram each of the powdered seed and pod sample was weighed into a crucible and gently heated over a bunsen burner until it charred. The charred samples with the crucible was transferred into a lento muffle furnace at about 600<sup>o</sup> C and content ashed until grayish white ash was obtained. It was cooled first at room temperature and then in a desiccators. Concentrated HCl (5cm<sup>3</sup>) was added and heated for 5 minutes on a hot plate in a fume cupboard. The mixture was then transferred into a beaker and the crucible washed several times with distilled water. The mixture was made up to 40 cm<sup>3</sup> and boiled for 10

**Nutrient density (ND):** This was estimated using the equation below

$$ND (\%) = \frac{[Np/Ep]}{[Nr/Er]} \times 100$$

Where Np = Nutrient concentration (Mineral element in the food).

Ep = Energy supplied by food

Nr = Recommended daily intakes of nutrient

Er = Recommended energy intakes (3000 Kcal/day for an adult male given by WHO/FAO) (Cole, 1980).

**Contribution to RDA (%)** =  $\frac{\text{Concentration of the element}}{RDA} \times 100$

RDA = recommended dietary allowance (NRC, 1989).

**Data analysis:** Data were generated in triplicates and the mean standard deviation determined according to Steel and Torrie (1980).

## RESULTS AND DISCUSSION

**Proximate composition:** Table 1 presents the proximate composition of the seeds and pods of *Xylopia aethiopica*. The moisture content (6.0 ± 0.13 %) of the seed was higher than (5.0 ± 0.11%) of the pod which indicate that the seeds covered by the pod

minutes on a bunsen burner. The mixture was then cooled, filtered and rinsed into 100cm<sup>3</sup> volumetric flask made upto the 100cm<sup>3</sup> mark with distilled water (Ceirwyn, 1995). The solution was prepared in triplicate.

### Determination of minerals concentration

Sodium and Potassium were analyzed with flame atomic emission spectrophotometer. Phosphorus was determined with Jenway 6100 spectrophotometer at 420nm using Vanadium Phosphomolybdate (Vanadate) colorimetric method with KH<sub>2</sub>PO<sub>4</sub> as the standard (Ceirwyn, 1995). The concentration of Ca, Mg, Cu, Fe, Mn, and Zn in the solution were determined using Atomic Absorption Spectrophotometer AAS 969 (Bulk Scientific, MODEL VGB 210/211) AOAC, 1990).

retain higher water content. The pod ash content of 5.0 ± 0.11 % was higher than 4.4±0.01 % for the seed. The ash content of the pods indicate that the pods are better sources of mineral elements since the ash content of a plant material is an index of total mineral content.

**Table 1: Proximate composition of the seeds and pods of *Xylopia aethiopica*.**

Parameter	Concentration (% dry weight)	
	Seeds	Pods
Moisture content <sup>a</sup>	6.0 ± 0.13	5.0 ± 0.11
Ash	4.4 ± 0.01	5.1 ± 0.02
Crude protein	1.6 ± 0.12	1.1 ± 0.03
Crude lipid	22.1 ± 0.05	21.0 ± 0.01
Crude fiber	22.3 ± 0.03	20.1 ± 0.01
Available Carbohydrate	43.6 ± 0.02	47.7 ± 0.03
Calorific (Energy) value Kcal/100g	376.5 ± 0.04	382.0 ± 0.11

The data are mean values ± standard deviation (SD) of triplicate determination.

<sup>a</sup>Values expressed as % wet weight.

The seeds crude lipid content of 22.1 ± 0.05 % was higher than 21.0 ± 0.01 % of the pods. The crude protein and crude fiber contents of the seeds were higher than that of the pods. The result revealed that the seed of *Xylopia aethiopica* are better sources of protein and fiber than pods.

Carbohydrates are the human body's key sources of energy. When carbohydrates are broken down by the

body, glucose is produced; glucose is critical to help maintain tissues protein, metabolize fat, and fuel the central nervous system. The higher carbohydrate content (47.7 ± 0.03 %) of the pods gives rise to higher energy value for the pods of *Xylopia aethiopica* (382.0 ± 0.11 kcal/100g). The findings revealed that the pods of this plant are better energy sources than the seeds.



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**Mineral content:** The mineral composition of the seeds and pods of *Xylopi aethiopic a* was shown in table 2. Potassium is an essential mineral which must be consumed in the diet. It performs many essential function in the human body. The potassium content of the pods ( $1144.58 \pm 0.03$  mg/100g) was higher than  $78.16 \pm 0.01$  mg/100g of the seeds. This result indicated that the pods of *Xylopi aethiopic a* could be a good diet for hypertensive patients since diets high in potassium

can reduce the risk of hypertension and possibly strokes (Potassium, 2010).

The role of sodium in the body is to actively pump out or let in fluids and nutrients in and out of the cells and through cell membranes - thus sodium is involved in cellular transportation occurring across membranes. The sodium concentration of  $4.67 \pm 0.17$  mg/100g in the seeds was lower compared to  $75.00 \pm 0.13$  mg/100g recorded for the pods.

**Table 2: Mineral composition of the seeds and pods of *Xylopi aethiopic a***

Mineral Elements	Concentration (mg/100g dry matter)	
	Seeds	Pods
K	$78.16 \pm 0.01$	$1144.58 \pm 0.03$
Na	$4.67 \pm 0.17$	$75.00 \pm 0.13$
Ca	$5.31 \pm 0.01$	$5.03 \pm 0.10$
P	$2.25 \pm 0.02$	$1.80 \pm 0.01$
Mg	$3.16 \pm 0.11$	$7.16 \pm 0.04$
Cu	$1.44 \pm 0.02$	$1.33 \pm 0.01$
Fe	$7.18 \pm 0.01$	$29.10 \pm 0.03$
Mn	$0.73 \pm 0.01$	$0.68 \pm 0.01$
Zn	$3.46 \pm 0.03$	$3.81 \pm 0.01$

The data are mean value  $\pm$  standard deviation (SD) of triplicate.

The human body utilizes the mineral calcium as one of the main structural building compounds. Calcium also imparts hardness and strength to the skeletal system and the teeth (Calcium, 2010). The seeds of this plant showed higher calcium content of  $5.31 \pm 0.01$  mg/100g than  $5.03 \pm$  mg/100g recorded for the pods. Human bones are rigid and strong due the presence of phosphorus and calcium, these two minerals form much of the strong structural framework of skeletal system in the human body (Phosphorus, 2010). Phosphorus content of the seeds ( $2.25 \pm 0.02$  mg/100g) was found to be higher than  $1.80 \pm 0.01$  mg/100g of the pods. According to Guil-Guerrero *et al.* (1998), for good calcium and phosphorus intestinal utilization, Ca/P ratio must be close to one. The seeds and pods of *Xylopi aethiopic a* have a high ratio of 2.36 and 2.79 indicating that it is in favour of Ca and the diet based on this need to be supplemented in favour of phosphorus.

Many important enzymes systems and reactions require the mineral magnesium as an essential component. The seeds magnesium content of  $3.16 \pm 0.11$  mg/100g was lower compared to  $50.00 \pm 1.53$  mg/100g recorded for the seeds of sugar Apple (Hassan *et al.*, 2008).

Copper helps to keep blood vessels, nerves, immune system and bones health. It is important for infant growth, brain development and for strong bones. The result revealed that the copper content in the seeds of *Xylopi aethiopic a* was  $1.44 \pm 0.02$  mg/100g while that of the pods way  $1.33 \pm 0.01$  mg/100g. When compared to the recommended dietary allowance (RDA) of copper which are 1.5-3 mg/day for adult male and female, pregnant and lactating mother and 1-3 mg/day for children (7-10 years) (NRC, 1989), the result indicated that the seeds and pods of this plant are good sources of copper.

The human body needs iron for the formation of the oxygen-carrying protein haemoglobin and myoglobin.

Haemoglobin carries oxygen bound in the lungs to the cells while myoglobin acts as the receptor and storage point for some of the oxygen found in muscle tissues. The seeds of *Xylopi aethiopic a* contain  $7.18 \pm 0.01$  mg/100g of iron while  $29.10 \pm 0.03$  mg/100g was found in the pods. The seeds of this plant are moderate source of iron compared to the RDA of iron which are 10 mg/day for adult male and children (7-10years), 13 mg/day for pregnant and lactating mothers and 15 mg/day for adult female (NRC, 1989).

Manganese is important in the breakdown of amino acids and the production of energy. It activates various enzymes which are important for proper digestion and utilization of foods. The manganese content of the seeds ( $0.73 \pm 0.01$  mg/100g) and of the pods ( $0.68 \pm 0.01$  mg/100g) indicate that the seeds and pods of *Xylopi aethiopic a* are poor sources of this mineral element compared to the RDA which are 2-5 mg/day for adult male and female, pregnant and lactating mothers and 2-3 mg/day for children (7-10years) (NRC, 1989).

Zinc helps to speed up the healing process after an injury. The seeds and pods of *Xylopi aethiopic a* contain  $3.46 \pm 0.03$  mg/100g and  $3.81 \pm 0.01$  mg/100g amount of zinc respectively. The findings revealed that the seeds and pods of this plant are poor sources of zinc compared to the element RDA of 10 mg/day for children (7-10 years), 12 mg/day for adult female, 15 mg/day for adult male and 19 mg/day for pregnant and lactating mothers (NRC, 1989).

The contribution of mineral elements by the seeds and pods of *Xylopi aethiopic a* to the dietary intake was evaluated and presented in table 3. The seeds and pods of this plant are good sources of Cu and Fe while the pods are moderate sources of K and the seeds and pods are poor sources of other mineral elements analyse.





**Table 3: Contribution of mineral elements by the seeds and pods of *Xylopi* *aethi* *opica* to the dietary intake.**

Mineral	RDA	Contribution to RDA (%)	
		Seeds	Pods
K	2000	4	57
Na	500	1	15
Ca	1200	0.4	0.4
P	1200	0.2	0.2
Mg	350	1	2
Cu	1.5-3	48-96	44-89
Fe	10-15	48-72	194-291
Mn	2-5	15-37	14-34
Zn	12-19	18-29	20-32

The nutrient density (ND) is the index of nutrition quality used to evaluate the nutritional significance of mineral elements and presented in table 4. Food materials with ND of 100% supply the nutrient needed in the same proportion as the calorie needed. Copper, iron,

manganese and zinc have nutrient density greater than 100% which revealed that the seeds and pods of this plant can serve as source of supplement for these mineral elements.

**Table 4: Nutrient density of mineral element in the seeds of *Xylopi* *aethi* *opica***

Minerals	RDA(mg)	Nutrient density (%)	
		Seeds	Pods
K	2000	31	449
Na	500	7	118
Ca	1200	4	3
P	1200	1	1
Mg	350	7	16
Cu	1.5-3	382-765	348-696
Fe	10-15	381-572	1524-2285
Mn	2-5	116-291	107-267
Zn	12-19	145-230	157-249

**CONCLUSION**

Proximate and mineral composition of the seeds and pods of *Xylopi* *aethi* *opica* was analysed using standard analytical techniques. The result revealed higher carbohydrate content in the pods than the seeds which result into corresponding increase in the energy (calorific) value of the pods since carbohydrate supply energy. As expected of any seed, the lipid content of the seeds was

higher than that of the pods since seeds contain oils. The findings further indicated higher potassium content in the pods which make the pods of this plant a better diet especially for the hypertensive patient since potassium reduces blood pressure and possible stroke attack. The seeds and pods are good sources of copper and iron compared to their RDA.

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