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Evaluating The Mineral Composition Of Four Varieties Of African Yam Bean At Afikpo Region Of Ebonyi State In Nigeria

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ABSTRACT: The mineral composition of white, brown, spotted and black coat coloured African yam bean varieties that are being cultivated in the Afikpo town of Ebonyi State in Nigeria was determined in this study. The iron, calcium, magnesium and zinc contents were determined using the Atomic Absorption Spectrophotometer. The results showed that there were no significant differences in the composition of zinc and magnesium in the four varieties of African yam bean examined. The black coat colour had the highest value of magnesium with 8.280 mg/l, while the white variety had the least value of 7.470 mg/l. There was no significant difference in the iron content of the mean value of the white variety, brown and spotted variety, but there was significant difference when compared to the black variety that has the least iron content of 0.140 mg/l among the four varieties. The white coat coloured variety has the highest calcium content among the four varieties studied. The findings suggest that the white yam bean variety is a better source of food for infants during the weaning period due to the high calcium content.

KEYWORDS – Minerals composition, African yam bean, Afikpo-indigenous yam bean, Yam bean analysis

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I. INTRODUCTION

African yam bean (*sphenostylis stenocarpa*) is one of the edible grains that is wdidely cultivated in Africa. It is used for human and animal nutrition [1-2]. African yam bean belongs to the family *fabaceae* and genus *sphenostylis* [3]. The bean is an underutilized food legume crop in the tropics that is not as popula as other major food legumes [4]. It is a tropical African plant grown in most parts of the hot and humid tropical regions at middle and low altitudes and more especially in southern Nigeria [5]. The Igbo people of Eastern Nigeria call it Okpodudu, Ijiriji, Azama, Uzaaka. The Hausa tribe calls it girigiri, Yoruba tribe calls it sese, and Ibibio tribe calls it nsama [6]. The nutritional benefits of African yam bean have attracted the attention of numerous researchers [7-12] in the past.

Ndidi et al. [13] examined the proximate, anti-nutrients and mineral compositions of raw and processed African yam bean seeds in KadunaState of Nigeria, as well as the effect of processing on the parameters. The results showed that the levels of moisture, crude lipid, nitrogen-free extract, gross energy, true protein, and crude fibre between the processed and unprocessed African yam bean differed significantly. There was significant reduction in the levels of hydrogen cyanide, trypsin inhibitor, phytate, oxalate, and tannins in the processed yam bean relative to the unprocessed one. Also, the levels of sodium, calcium and potassium in the processed and unprocessed yam bean were high. The findings suggest that the yam bean intake could reduce malnutrition effects on the people of Kaduna in Nigeria.

Nwokolo [14] conducted a study to assess the nutrition content of African yam bean and bambara groundnut using the broiler chick asseys. The results showed that metabolisable energy content was high in both African yam bean and bambara groundnut. The African yam bean has a low true protein digestability relative to the bambara groundnut. The findings indicated that African yam bean and bambara groundnut have mineral, amino acid and fatty acid content that are within the range found in most eaten pulses.

Akintayo [15] investigated changes in the quality and mineral composition of African Yam bean that is cooked in kaun solution. The results showed that cooking African yam bean in different concentrations of kaun at atmospheric pressure and longer cooking time increased water absorption. The optimal cooking conditions were found to be cooking in 0.1 % kaun concentration at 90 minutes, increased the concentrations of Zn, Ca, Fe, Na and K ,but decreased the concentration of Mg and Cu. The findings indicated that cooking African yam bean in kuan solution with concentration higher than 0.1 % caused an unappealing deep brown colour, less number of split beans or even no splits and decreased softening of the beans.

Nwosu et al. [16] subjected African yam bean seeds to different processing treatments such as soaking in water, blanching, cooking and roasting to study its effects on the proximate and functional properties. The results indicated that the protein content was the highest in the sample soaked in water for 24 hours, but decreased after 8 minutes blanching. The protein content of the cooked sample decreased by 17.97 % for 20 minutes cooking and 12.53 % for 60 minutes cooking, while the roasted sample decreased by 11.55 % and 11.33

% at the 100 ℃ for 35 minutes and 180 ℃ for 25 minutes. The findings showed that the heat treatment increased the oil absorption capacity from 2.51 % to 4.05 %, water absorption capacity from 3.76 % to 4.68 %, swelling index from 4.00 cm to 9.60 cm, bulk density from 0.58 kg/m3 to 0.89 kg/m3, but decreased the gelation from 30 ℃ to 20 ℃, wettability from 9 seconds to 1 second, foam capacity from 29.0 cm3 to 23.3 cm3 and viscosity from 12.30 to 23.3 cp. They suggested that African yam bean could be incorporated into foods to improve nutritional value.

Although previous researchers have conducted studies on African yam bean, there exist little literature on the composition of the African yam bean that is grown in Afikpo town in Ebonyi state of Nigeria. Therefore, the present study seeks to determine the mineral composition of four varieties of African yam bean that are cultivated in the Afikpo region of Ebonyi state, Nigeria.

II. MATERIALS AND METHODS

The four varieties of African yam bean (white, brown, spotted and black varieties) that were used in this study were purchased from a farmer in Afikpo north local government area of Ebonyi State in Nigeria. The yam bean samples were prepared according to the method described by Eneche [17]. 2 g of African yam bean seed that was free from foreign particles such as stones, leaves and sticks as damaged and contaminated seeds was weighed and milled with a locally fabricated attrition mill to obtain fine flour. The African yam bean flour produced was packaged in sealed polyethylene bags for analysis. The dried samples of the sample, ground to pass through a 1 mm mesh sieve were transferred into a crucible and ashed in a muffle furnace at 500 ℃ for 3 hours. The crucibles were removed after the ashing was completed. After cooling, 10 ml of 2M hydrochloric acid was added and heated directly until boiling. The contents in each crucible were thereafter transferred into 50 ml volumetric flask and then diluted to 50 ml.

The optical density of elements except phosphorus was determined using the Atomic Absorption Spectrophotometer. The concentration of each element contained in the sample was calculated thus:

$$\text{Concentration of each element} = \frac{\text{Microgram/ml of sample x Dilution x Original volume}}{\text{Weight of sample x } 10^6}$$

(concentration × 10000 = concentration in part per million (ppm); ppm ×100 = mg/100g; mg/100g × 1000 = microgram/100g.

III. RESULTS AND DISCUSSION

The results of the mineral composition of the African yam bean are presented in Table 1. The white, brown, spotted and black varieties of African yam bean were observed to be rich in mineral such as iron, calcium, zinc and magnesium.

Table 1: Mineral composition of four varieties of African yam bean

Sample	Iron (mg/l)	Calcium (mg/l)	Zinc (mg/l)	Magnesium (mg/l)
White variety	0.570 ± 0.000^a	14.390 ± 0.000^a	2.880 ± 1.000^a	6.700 ± 1.000^a
Brown variety	0.487 ±0.100^a	10.100 ±1.000^b	4.050 ± 0.000^a	7.550 ± 1.000^a
Spotted variety	0.570 ± 0.000^a	10.540 ± 1.000^b	2.750 ± 1.000^a	7.470 ±0.000^a
Black variety	0.140 ± 0.000^b	13.830 ± 0.000^a	3.660 ±1.000^a	8.280 ± 1.414^a

Values with the same superscript in the same column are not significantly different ($p<0.05$)

From the result, it was observed that the four varieties of African yam bean were not significantly different ($p>0.05$) in zinc and magnesium composition. The percentage value of zinc in the brown variety was high but was not significantly different ($p>0.05$) from other varieties. Zinc functions in cell and energy metabolism for growth and development, cell signalling system, the immune system, neurological development, and in reproduction [18]. The findings connote that the African yam bean flour is necessary for adequate functioning of human body cells.

It was observed that magnesium composition does not depend on the variety. The black coat colour had the highest value of magnesium with 8.280 mg/l, while the white variety had the least value of 7.470 mg/l. Most magnesium found in the human body is found in the skeleton, the next highest accounting is in the muscle tissues and the rest is found in other tissues and fluids. Magnesium is essential for energy production, protein formation and cellular replication [19].

There was no significant difference ($p>0.05$) in the iron content of the mean value of the white variety, brown and spotted variety, but there was significant difference when compared to the black variety that has the least iron content of 0.140 mg/l among the four varieties. Iron is essential for metabolism, DNA synthesis, growth, healing, immune function, reproduction, as a cofactor in many enzyme reactions, prevention of anaemia, and is found in haemoglobin and myoglobin, a protein which transport oxygen through the blood and muscles [18]. This makes the African yam bean flour a rich source of nutrient.

The calcium composition ranged from 10.100 mg/l in brown variety to 14.390 mg/l in the white variety. The result showed that white and black variety differed significantly compared with brown and spotted. Calcium is the most common and most abundant mineral in the body and is found primarily in the bones and

teeth. A small but absolutely essential amount of calcium is found in the blood and soft tissue [18]. A comparison of the four varieties of the African yam bean flour indicated that calcium, magnesium and zinc were more in the seed when compared to iron.

IV. CONCLUSION

The evaluation of the mineral composition of four varieties of the African yam bean that are being farmed in the Afikpo town of Ebonyi State in Nigeria was conducted. The results showed that the white coat coloured variety has the highest calcium content among the four varieties studied, and there were no significant differences in the composition of zinc and magnesium in the four varieties of African yam bean examined. The findings suggest that the white yam bean variety is a better source of food for infants during the weaning period due to the high calcium content.

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