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RESEARCH PAPER

NUTRITIONAL CONTENT OF COMMON *Amaranthus hybridus* VEGETABLE (EFO TETE) IN NIGERIA

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ABSTRACT

Generality of Nigerians depend on starch-based foods as the main staple food for the supply of both energy and protein. This accounts in part for protein and mineral deficiency which prevails among the populace. Many of the local vegetable materials are under-exploited because of inadequate scientific knowledge of their nutritional potentials. The focus of this study was to determine the nutritional value of *Amaranthus hybridus* vegetable commonly consumed by the generality of the people. The vegetable seeds were planted in five different locations in the Botanical Garden of Yaba College of Technology and harvested after eight weeks. The freshly harvested leaves from each of the locations were subjected to proximate and micronutrient analyses using standard analytical methods. The Proximate analysis showed the percentage moisture content 84.0%, ash 12.70%, fat 3.25%, protein 16.38%, crude fibre 7.9% and carbohydrate 50.77%, while its calorific value was 289.92 Kcal/100g. The dietary mineral content values in mg/100g are calcium 153+1.3 phosphorus 63.20$\pm$ 1.04, potassium 370.12$\pm$ 2.84, magnesium 215$\pm$ 1.06, iron 12.5$\pm$ 0.47, sodium 3.72$\pm$ 0.15, copper 0.67$\pm$ 0.05, zinc 1.32$\pm$ 0.10, cobalt 0.52$\pm$ 0.08, selenium 0.067$\pm$ 0.03, and chromium 1.36$\pm$ 0.13. These results showed that the vegetable contained an appreciable amount of nutrients and mineral elements that could be included in diets to supplement the daily requirement by the body. Consumption of the vegetable will help average Nigerians to obtain the minerals required for healthy living.

KEYWORDS: Leafy vegetables, heavy metals, plant minerals, nutrients, atomic absorption spectrometry.

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INTRODUCTION

In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acid. Vegetables act as neutralizing agents for acidic substances formed during digestion (Yusuf and Oluwole, 2009)

Amaranthus hybridus, popularly called “Amaranth or pigweed”, is an annual short –lived herbaceous plant of 1- 6 feet high. The leaves are dull green, and rough, hairy, ovate or rhombic with wavy margins. The flowers are small, with greenish or red terminal panicles. Taproot is long, fleshy red or pink. The seeds are small and lenticellular in shape; with each seed averaging 1 – 1.5 mm in diameter and 1000 seeds weighing 0.6 – 1.2 g. It is rather a common species in waste places, cultivated fields and barnyards (Mepha *et al*., 2007). In Nigeria, *A. hybridus* leaves combined with condiments are used to prepare soup (Mepha *et al*., 2007).

Vegetables have been reported to be good sources of oil, carbohydrates, minerals as well as vitamins. The fats and oils lower blood lipids thereby reducing the occurrences of diseases associated with the damage of the coronary artery (Adenipekun and Oyetunji, 2010). The proteins in vegetables are superior to those in fruits but inferior to those in grains, and the potassium content of leafy vegetable is good in the control of diuretic and hypertensive complications (George, 2003). This study is aimed at documenting the nutrient and chemical compositions of *A. hybridus* leaf in a bid to determining its usefulness and suitability as an edible vegetable.

MATERIALS AND METHODS

Sample Preparation

The vegetable seeds were planted in five different locations in the Botanical Garden of Yaba College of Technology and harvested after eight weeks. The freshly harvested leaves from each of the locations were thoroughly rinsed with de-ionized water. The residual moisture was evaporated at room temperature before sun-drying for 2 - 3 days on a clean paper with constant turning over to avert fungal growth. The sun-dried sample was ground into fine powder using pestle and mortar, and sieved through a 2.0 mm mesh sieve to obtain a dried powdered sample that was used for all the analyses.

Proximate Analysis

The recommended methods of the Association of Official Analytical chemists (AOAC, 1999) were used for the determination of moisture, ash, crude lipid, crude fibre and nitrogen content.

Moisture Content Determination

Five grams(5g) of the sample was weighed into petri-dishes. The dishes and the samples were placed in the oven at 105°C for 3 hours, after which a pair of tongs was used to transfer the dish into a desiccator, allowed to cool and weighed. The samples was transferred back to the oven for 30 minutes, cooled again in the desiccator and re-weighed. The moisture content was estimated on dry basis as percentage moisture content using the equation:

$$\frac{Wc - Wa}{Wb - Wa} \times 100$$

Where; Wa = Initial Weight of dish
Wb = Initial Weight of dish + sample
Wc = Final weight of dish + sample

Protein Content Determination
1g of the sample was weighed into the digester with catalyst; 20ml of concentrated H_2SO_4 was added and allowed to react until a clean solution is obtained. The digest was cooled and transferred into 10ml volumetric flask and made up to mark with distilled water. 20ml of boric acid was pipetted into a conical flask the indicator and 75ml of distilled water were added. 10ml of the digest was pipetted into Kjeldahl distillation flask. 20ml of 20% NaOH was added through the funnel into the digest and steam heated until the turned green. This was titrated with HC1 (0.05N) in a 50ml burette.

Calculation:

$$\textbf{\% total nitrogen} = \frac{1.401 \times (\text{Sample titre - blank titre}) \times M}{\text{Sample weight}}$$

M = Molarity of the acid
% protein (crude) = % total nitrogen x conversion factor

Ash Content Determination
The dried material obtained from moisture determination was ignited on a blue flame of a Bunsen burner till the smoke is given off. This was kept in the muffle furnace at 550°c and heated to constant weight. It was then transferred to the dessicator to cool and weighed.
Calculation:

$$\% \text{ Ash} = \frac{\text{Weight of ash} \times 100}{\text{Weight of sample}}$$

Crude Fibre Content Determination
2g of the dried vegetable was weighed into the fibre flask and 100ml of 0.255 NH_2SO_4 was added. The hot mixture was filtered through a fibre sieve cloth. The filtrate obtained was thrown off. 100ml of 0.313M NaOH solution was added to the residue and heated under reflux to dissolve any organic .constituents. The residue was washed with about 50ml hot water twice on the sieve cloth before it was finally transferred into the crucible. The residue was oven dried at 105°c overnight to remove the moisture. The oven dried residue was cooled in a dessicator and later weighed (Wl). The residue was transferred to the muffle furnace and ashed at 550°C for 4hours. The grey ash (free of carbonaceous material) was

cooled in the dessicator and weighed (W2). The difference between W1-W2, gives the weight of fibre (AOAC, 1999)

$$\textbf{\% fibre} = \frac{\textbf{Wl-W2x 100}}{\textbf{Weight of sample}}$$

Carbohydrate Content Determination
The carbohydrate content is determined by difference as highlighted by AOAC (1999).

The carbohydrate content of the sample was determined as; % carbohydrate = 100% - % (Ash + fibre + moisture + protein + fat).

Fat Content Determination
Fat content was determined using ether extraction in Mojonnier fat extraction apparatus AOAC (1999).

Estimation of Energy Value
The sample calorific value was estimated (in Kcal) by multiplying the percentage crude protein, crude lipid and carbohydrate by the recommended factor (2.44, 8.37 and 3.57 respectively) used in vegetable analysis (Asibey-Berko and Tayie, 1999).

Mineral analysis
The mineral elements comprising sodium, calcium, potassium, magnesium, iron, zinc and phosphorus were determined according to the method of Shahidi *et al*. (1999) with some modifications. 2.0 g of each of the processed samples was weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550^0C in a muffle furnace. The resultant ash was dissolved in 5.0 ml of HNO_3/HCL/H_2O (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5.0 ml of de-ionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100.0 ml volumetric flask by filtration through Whatman No.42 filter paper and the volume was made to the mark with de-ionized water. The mineral elements were determined using Perkin-Elmer Analyst 300 Atomic Absorption Spectroscopy (AAS). A 10 cm long cell was used and concentration of each element in the sample was calculated on percentage (%) of dry matter i.e. mg/100 g sample. Phosphorus content of the digest was determined colorimetrically.

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RESULTS AND DISCUSSION

Table 1: Proximate Composition of *Amaranthus hybridus* Leaves

Parameters	DW Concentration %
Moisture Content	84.00
Ash	12.70
Fat	3.25
Protein	16.38
Crude Fibre	7.90
Carbohydrate	50.77
Calorific value Kcal/100g	289.92

Table 2: Mineral Composition of *Amaranthus hybridus* Leaves.

Parameters	Conc. (mg/100g)
Calcium	153.00±1.30
Phosphorus	63.20± 1.04
Potassium	370.12± 2.84
Magnesium	215.00± 1.06
Iron	12.50± 0.40
Sodium	3.72± 0.15
Copper	0.67± 0.05
Zinc	1.32± 0.10
Cobalt	0.52± 0.08
Selenium	0.067± 0.03
Chromium	1.36± 0.13

Each data is a mean of five replicates.

The heavy metal levels determined were based on plants dry weight. Levels of cadmium and copper were observed to be the lowest for the samples while the levels of nickel and lead were the highest. Heavy metals affect the nutritive values of agricultural materials and also have deleterious effect on human beings. National and international regulations on food quality set the maximum permissible levels of toxic metals in human food; hence an increasingly important aspect of food quality should be to control the concentrations of heavy metals in food (Sobukola *et al*., 2008).

A. hybridus leaves show high moisture content (84% Dry Weight) is within reported range (81.4-90.3%) in some Nigerian green leafy vegetables. The percentage of ash, protein, fibre, energy and carbohydrate are lower than that of Afikpo, Ebonyi State, Nigeria (Akubugwo, *et al*., 2007), while moisture content, protein and carbohydrate are higher than that of Owerri, Imo State, Nigeria (Iheanacho and Udebuani, 2009).

Ash content, which is an index of mineral contents in biota, is low (12.70%) in this report compare with some other Nigerian leafy vegetable such as *Moringa oleifera* (15.09% DW) (Antia *et al*.,2006), but higher than that *Ocimum gratissium* (18.00%) *and Hibiscus esculentus* (8.00%) (Akindahunsi and Salawu, 2005). *Teiferia occidentalis* (1.80%)*, Talinum triangulare* (1.40%)*, Amaranthus spinosus* (2.60%) (Agbaire, 2011).

The crude lipid content (3.25% DW) is low compared to other vegetable leaves such as *Calchorus africanum* (4.20%) (Agbo, 2004). *Teiferia occidentalis* (4.20%)*, Talinum triangulare* (4.80%)*, Amaranthus spinosus* (4.20%) (Agbaire, 2011). The crude protein content of A. *hydridus* L (16.38%) is higher than protein content of *Momor-dica foecide* (4.6%), *Vernomia anydalira* (5.80%)*, and Amaranthus spinosus* leaves(4.60%) (Hassan and Umar, 2006; Agbaire, 2011), but lower than those of *Piper guineeses* (29.78%) and *T. triangulare* (31.00%) (Akindahunsi and Salawa, 2005; Antia *et al*., 2006).

Minerals are very important in human nutrition. It is well known that enzymatic activities as well as electrolyte balance of the blood fluid are related to adequacy of Na, K, Mg and Zn. Potassium is important in maintaining the body fluid volume and osmotic equilibrium. Metal deficiency syndrome like rickets and calcification of bones is caused by calcium deficiency.

The mineral contents like potassium, Calcium (153.00mg/g) and Phosphrous (63.20mg/g) of *A. hybridus* leaves in this report are higher than that of Afikpo (Akubugwo *et al*., 2007) and Owerri (Iheanacho and Udebuani, 2009), while Mg (215.00mg/g) is lower than that of Afikpo (Akubugwo *et al*., 2007) but higher than Owerri (Iheanacho and Udebuani, 2009).. Iron (12.50mg/g), Zinc (1.32mg/g) and Copper (0.67mg/g) are lower than that of Afikpo (Akubugwo *et al*., 2007). All the minerals are lower than that fromZimbabwe (Makobo *et al.,* 2010).

Copper is an essential micronutrient which functions as a biocatalysts, required for body pigmentation in addition to iron, maintain a healthy central nervous system, prevents anaemia and interrelated with the function of Zn and Fe in the body. However, most plants contain inadequate quantity of copper for normal growth which is usually ensured through artificial or organic fertilizers (Itanna, 2002). Zn and Fe of *A. hybridus* in this study and other related studies (Akubugwo *et al*., 2007; (Iheanacho and Udebuani, 2009) are higher other vegetable leaves like *Vernomia anydalira, Teltairia occidentalis, Talium trianglulare and Amararathus spinosus*. (Agbaire, 2011).

Cobalt has little direct activity on its own in the body as it is an integral component of vitamin B12 and as such its effects, sources and uses are very similar to that of vitamin B12. It is involved in preventing and treating pernicious anaemia and also helps in red blood cell production. Co also supports normal nervous system functions (Sobukola *et al*., 2008). Very little information has been reported on its concentrations in food materials. However, for this study, its level is 0.52 mg/g

CONCLUSION

The leaves of *A. hybridus* contain appreciable amount of proteins, fat, fibre, carbohydrate, calorific value and mineral elements, Thus, it can therefore be concluded that *A. hybridus* leaves can contribute significantly to the nutrient requirements of man and should be used as a source of nutrients to supplement other major sources. However, Chemical analysis should not be the sole criterion for judging the nutritional value of this plant. It is necessary to consider other aspects such as the biological evaluation of the nutrient content of the plant in order to determine the bioavailability of the nutrients and also the effects of processing on the chemical and nutritive value of the plant.

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