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Proximate and Mineral Composition Analysis of the Leaves of *Amaranthus cruentus* and *Ocimum gratissimum* in Some Selected Areas of Lagos State, Nigeria

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Abstract Vegetables are commonly grown crops all over the world. Thus, this study tends to determine proximate and mineral composition analysis of two commonly consumed vegetable leaves; African spinach (*Amaranthus cruentus*) and scent leaf (*Ocimum gratissimum*) in relation to locations. The plants samples were collected from three different locations in Lagos State Nigeria, namely; Lasu campus in Ojo, Abule-Ado in Amuwo-Odofin and Agric Farm in Ikorodu area. The experiments were carried out using standard analytical procedures. Proximate analysis results revealed that the values of moisture content, crude fat, crude fibre, crude proteins, carbohydrate and ash content ranged between 15.67 - 77.43%, 1.40 - 3.67%, 2.76 - 11.00%, 2.80 - 10.53%, 5.80 - 30.87% and 6.90 - 31.37% respectively. Mineral element analysis showed that the leaf samples of *A. cruentus* and *O. gratissimum* contained appreciable amounts of Calcium (13.65 - 23.00 mg/100g), Sodium (21.10 - 34.80 mg/100g), Iron (13.03 - 28.13 mg/100g) and Zinc (31.03 - 36.53 mg/100g). Although minute quantities of Lead (0.01 – 0.02mg/100g) were recorded in the two leaf samples, Cadmium was however not detected in the leaf samples. This study has shown that the leaves of *A. cruentus* and *O. gratissimum* are rich sources of nutrients and minerals essential for optimal growth and development of human and farm animals and these nutrients and mineral compositions are relatively influenced by environmental factors and or human activities.

Keywords Proximate and Mineral compositon, *Amaranthus cruentus, Ocimum gratissimum,* Location

1. Introduction

Vegetables are the fresh and consumable portions of herbaceous plants, which can be eaten wholly or in parts, raw or cooked as part of main dishes [1]. Vegetables may be edible fruits, seeds, flowers, leaves, stems, roots, bulbs and tubers [2]. Vegetables are important sources of macro and micro elements which are highly important for the maintenance of good health and prevention of diseases [3].

Most of the commonly eaten vegetables are the succulent leaves of plants; they are eaten as supplementary foods, side dishes or in soup as condiments, or eaten with other main dishes [4]. Leafy vegetables are regular ingredients in the diet of the average home in most tropical countries of Africa. These vegetables are valuable and cheap sources of important food types especially in rural areas where they contribute substantial quantities of proteins, minerals, vitamins, fibres and oils which are usually in short supply in daily menus [5]. In Nigeria, different types of leafy vegetables are eaten singly or in combination by different ethnic groups and they have been reported to contain ingredients which are useful in building up and repairing body tissues [6]. In rural areas of most developing countries, where poverty and natural disaster wreak havoc, the majority of the populace still depends heavily on starchy food as main sources of energy and protein thereby leading to the prevalence of protein deficiency amongst the people [7].

Furthermore, minerals cannot be produced by human and farm animals and as such they must eat mineral rich plants including leafy vegetables and water [8]. Vegetables also serve as buffers for acidic compounds produced during food digestion [9].

Two of the most commonly eaten vegetables in Nigeria are *Occimum gratissimum* and *Amaranthus cruentus*. *O. gratissimum* (Scent leaf) belongs to the family Lamiaceae. Its vernacular names in Nigeria include Efirin (Yoruba), Ahuji (Igbo), Aramogbo (Edo), and Daidoya (Hausa) [10]. It is an erect small plant not more than 1m high distributed throughout the tropic and subtropics regions of the world. It is cultivated in homes and leaves are used widely as

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vegetables, condiments and in traditional medicine to treat upper respiratory tract problems, skin diseases, pneumonia, cough, headaches, fever, conjunctivitis and as mosquito repellants [11]. *A. cruentus* is a fast growing vigorous erect annual plant that belongs to the family Amaranthaceae. The plant can grow up to 2m and is often cultivated in home gardens as leafy vegetables in Nigeria. In traditional medicine the leaves are employed as laxatives, tapeworm expellant and anti- tumor.

However, whether the *A. Cruentus* and *Ocimum gratissimum* leaves nutritional compositions are affected by different planting locations as a result of varying soil factors or as a result of some other environmental factors like ecological, have not been much worked upon.

Thus, locations determine the properties of soil in different places and this may leads to different compositions of the soil nutrients [12,13] and then could lead to varying chemical constituents of the same plants grown on it.

Environmental conditions in different areas could contribute to varying soil properties and varying compositions of the plants.

The essence of this study was to evaluate the proximate composition and mineral constituents of two important and commonly consumed leafy vegetables viz: *A. cruentus* and *O. gratissimum* in relation to locations.

2. Materials and Methods

Collection of Plant Materials

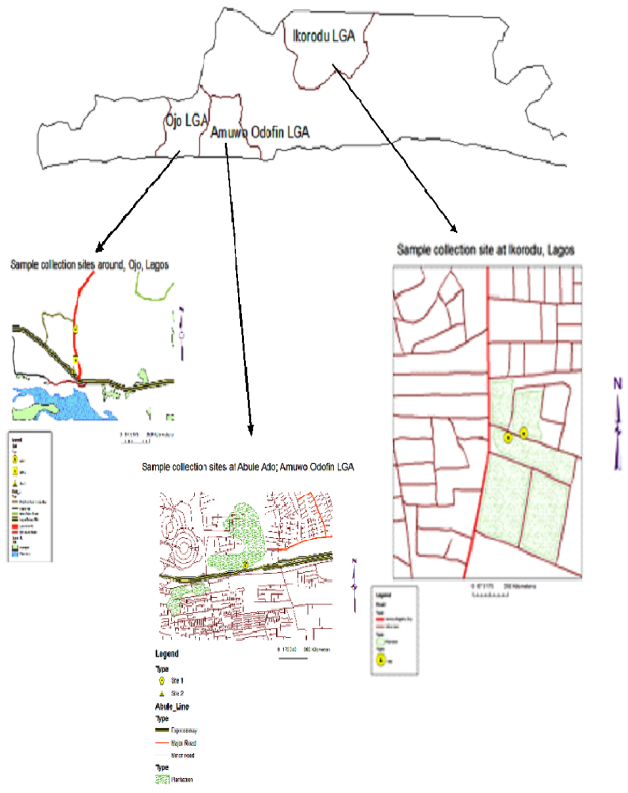

Figure 1. Map of Lagos State Showing Sample Locations

The two leafy vegetables (*A. cruentus* and *O. gratissimum*) (Figures 2 and 3) were freshly harvested from local farms in three different locations in Lagos (Lagos State University (LASU) Campus in Ojo Local Government area, Abule Ado in Amuwo-Odofin Local Government area and Agric Farm in Ikorodu Local Government area) (Figure 1).

Figure 2. Image showing *O. gratissimum* plants

Figure 3. Image showing *A. cruentus* plants

Processing of Plant Materials

The fresh leaves of the vegetables were thoroughly and separately washed with deionized distilled water. Afterwards, they were dried in the oven by exposing the leaves to a constant temperature at 45°C for 3-4 days. The leaves were then grounded into fine powder using dried pestle and mortar.

Proximate Analysis

The proximate analysis for the leafy vegetable samples for moisture, ash, crude fibre and fat were carried out following the standard methods of AOAC [14]. Nitrogen was determined by micro-kjeldahi method as described by Pearson [15] and the percentage nitrogen was converted to crude protein by multiplying by 6.25. Carbohydrate was determined by difference. All findings were performed in triplicates.

Mineral Analysis

The mineral constituents of the leafy vegetable samples were analysed using the solution obtained by dry ashing the samples at 550°C and dissolving the ash in distilled deionized water in flask. All the minerals (Ca, Fe, Na, Zn, Cd and Pb) were analysed using atomic absorption spectrophotometer (Buck Scientific Model 200A).

3. Results and Discussion

3.1. Proximate Composition

The percentage moisture contents of the analysed leafy vegetables revealed that *A. cruentus* and *O. gratissimum* contained 16.11 and 75.73% respectively (Table 1 and Figure 4, 5). These values were higher than those reported earlier for some Nigerian leafy vegetables by Onwordi *et al.* [6]. *A. cruentus* contained higher ash content (30.88%) when compared to O. *gratissimum* (7.12%) (Table 1). The ash contents obtained are similar to those of O. gratissimum reported by Fagboun et al. [16] and *A. hybridus* [17]. Ash content is of significant importance in foods as they account for the mineral constituents [18]. The crude protein contents of *A.cruentus* and *O. gratissimum* reported in this study (Table 1 and Figure 4, 5) were low when compared to the protein contents of some leafy vegetables in other studies by Onwordi *et al.* [6], Asaolu *et al.* [19] and Fagboun *et al.* [16].

The crude fibre of the two investigated vegetables ranged from 3.14 -10.68% (Table 1 and Figure 4, 5). The crude fibre content of *A. cruentus* particularly fell within the reported values (8.50 – 20.90%) for some Nigerian vegetables [20]. Dietary fibre helps to lower serum cholesterol level, risk of coronary heart diseases, constipation and diabetes [21].

The carbohydrate content of *A. cruentus* (30.10%) was higher than that of *O. gratissimum* (6.63%) (Table 1). The carbohydrate content of *A. cruentus* (30.10%) could be comparable to 29.4%, 31.34% and 32.84% of *A. cruentus*, *Cochorus olitorius* and *A. argenta* respectively as reported by Onwordi *et. al.* [6] but the value was higher than the values reported for some leafy vegetables consumed in Nigeria which includes *Vernonia amygdalina* (8.65%), *O. gratissimum* (1.22%) and *Hibiscus sabdarifa* (15.79%) [19]. Carbohydrate constitutes a major class of naturally occurring organic compounds which are essential for the maintenance of life and also provide raw materials for many industries [22]. The percentage fat values of the *A. cruentus* and *O. gratissimum* are 1.62% and 3.59% respectively (Table 1 and Figure 4, 5). These values are slightly higher than the fat content of some leafy vegetables commonly consumed in Nigeria, 0.45% in *A. cruentus*, 0.21% in *A. argenta* and 0.32% in C. olitorius as reported by Onwordi *et al.* [6] and lower compared to some other vegetables consumed in West Africa [23]. The crude fat analysis shows that leafy vegetables are poor in lipids and this confirms their relevance as good diets for healthy living.

However, in comparison, the results reveals that the moisture contents, crude fibres, fats and ashes of *O. gratissimum* obtained from different locations were similar; crude proteins and carbohydrates obtained from LASU Ojo Campus was higher than those obtained from other locations (Figure 4). The moisture contents obtained from *A. cruentus* was similar to those of Abule Ado and LASU Ojo Campus locations with Ikorodu showing greater affinity (Figure 5). These findings was supported by Oluwole *et al.* [24], attributed these variation to abiotic factors such as water, soil mineralization, and so on within and around the locations.

3.2. Mineral Composition

The mean concentration value of calcium of *A. cruentus* (20.83mg/g) was higher than that of O. *gratissimum* (14.40 mg/g) (Table 2 and Figure 6). The calcium levels in the leaves studied were lower than the values reported in some green leafy vegetables eaten locally in Nigeria [19]. Calcium has been reported to aid the growth and maintenance of bone, teeth and muscles [25]. Zinc contents varied from 31.60 mg/g (*O. gratissimum*) to 34.33mg/g (*A. cruentus*) (Table 2). These values were higher when compared to the values obtained from the mineral analysis of some vegetables as confirmed by Fagboun *et al.* [16]. Zinc is known to play a significant role in the normal functioning of the immune system and it is also associated with protein metabolism [26]. The investigated leafy vegetables are good sources of zinc because they are well above 6.23mg/g recommended Borgert *et al.* [27].

The Iron (Fe) and Sodium concentrations of *A. cruentus* (26.2mg/g and 34.18mg/g) were higher than that of *O. gratissimum* (14.76mg/g and 22.18mg/g). These values compare favourably with the findings of Ibrahim et al. [26].

Fe is an essential trace element for haemoglobin formation, oxidation of fat, carbohydrate and proteins [28]. Cadmium was not detected in the two vegetables while Lead was detected in extremely low amounts (0.01mg/g). Lead, Cadmium and other heavy metals are known to be highly toxic even in low concentration to living organisms.

Thus, in comparison, the quantities of Ca, Fe in *O. gratissimun* in both Abule-Ado and LASU Ojo Campus were similar compare those in Ikorodu, while Abule-Ado showed greater affinities for Na in *O. gratissimum* than those in Ikorodu and LASU Ojo Campus and Zn compositions of *O. gratissimum* in both Abule-Ado and Ikorodu showed greater affinities than those of LASU Ojo Campus (Figure 6). However, Ca proportions in *A. cruentus* in both Ikorodu and LASU Ojo Campus were higher than those in Abule-Ado; A. cruentus in Ikorodu showed greater affinities for Fe than others, LASU Ojo Campus showed higher Na compositions than others while Zn compositions in both Abule-Odo and Ikorodu showed similar proportions than LASU Ojo Campus (Figure 6). These differences in mineral compositions at different locations were attributed to both direct and indirect impacts of human activities and natural soil profiles [29].

Table 1. Proximate composition (%) of the two leafy vegetables

Vegetable	Moisture	Protein	Crude Fibre	` CHO	Fat	Ash
A. cruentus						
Mean ± S.D	16.11 ± 1.35	10.09 ± 0.72	10.68 ± 1.13	30.10 ± 1.13	1.62 ± 1.39	30.88 ± 1.27
Range	14.00 -18.0	9.40 – 12.00	1.10 – 12.00	28.00 -34.00	0.60 – 2.30	28.60 – 34.00
O. gratissimum						
Mean ± S.D	75.73 ± 1.36	3.71 ± 0.67	3.14 ± 0.62	6.63 ± 0.94	3.59 ± 0.24	7.12 ± 0.46
Range	70.00 -78.20	2.00 – 6.00	2.40 – 3.60	5.60 -10.00	3.40 – 4.00	6.00 – 8.00

SD = Standard deviation

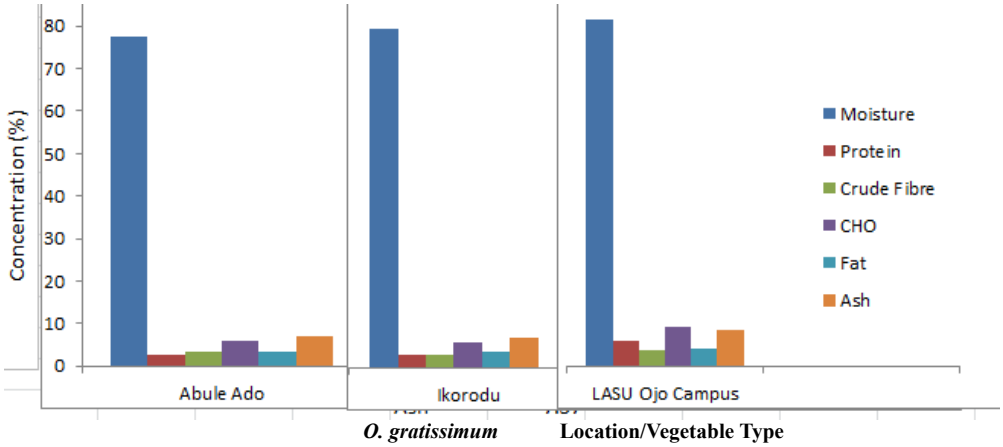

Figure 4. Comparison of Mean proximate concentration of *O. gratissimum* from different locations

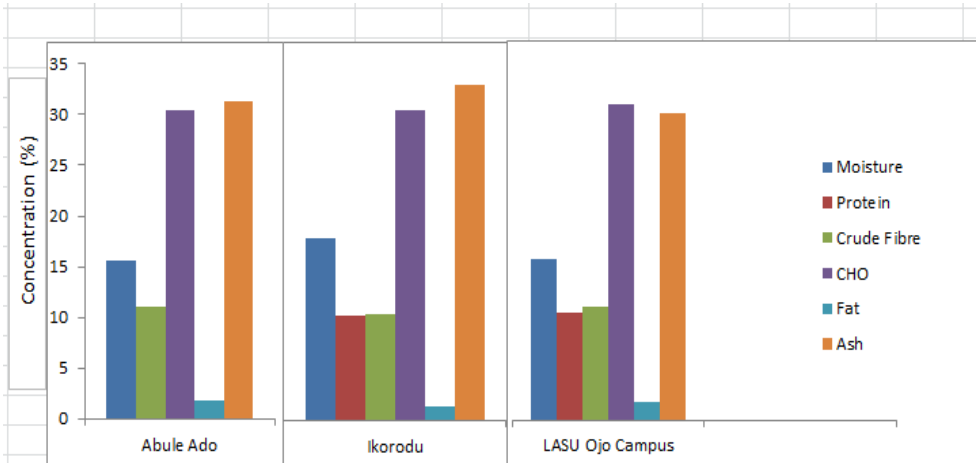

Figure 5. Comparison of Mean proximate concentration of *A. cruentus* from different locations

Table 2. Mineral composition (mg/g) of the two leafy vegetables

Vegetable	Ca	Fe	Na	Zn	Cd	Pb
A. cruentus						
Mean ± S.D	20.83 ± 2.99	26.2 ± 1.42	34.18 ± 1.72	34.33 ± 1.86	0.0 ± 0.00	0.01 ± 0.05
Range	17.00 -27.00	22.00 – 28.35	30.00 – 36.30	30.06 -38.70	0.00 – 0.00	0.00 – 0.02
O. gratissimum						
Mean ± S.D	14.44 ± 1.24	14.76 ± 1.83	22.18 ± 2.79	31.60 ± 0.72	0.0 ± 0.00	0.01±0.06
Range	13.00 -17.0	11.00 – 18.50	15.00 – 26.00	30.60 - 38.70	0.00 – 0.00	0.01` – 0.02

SD = Standard deviation

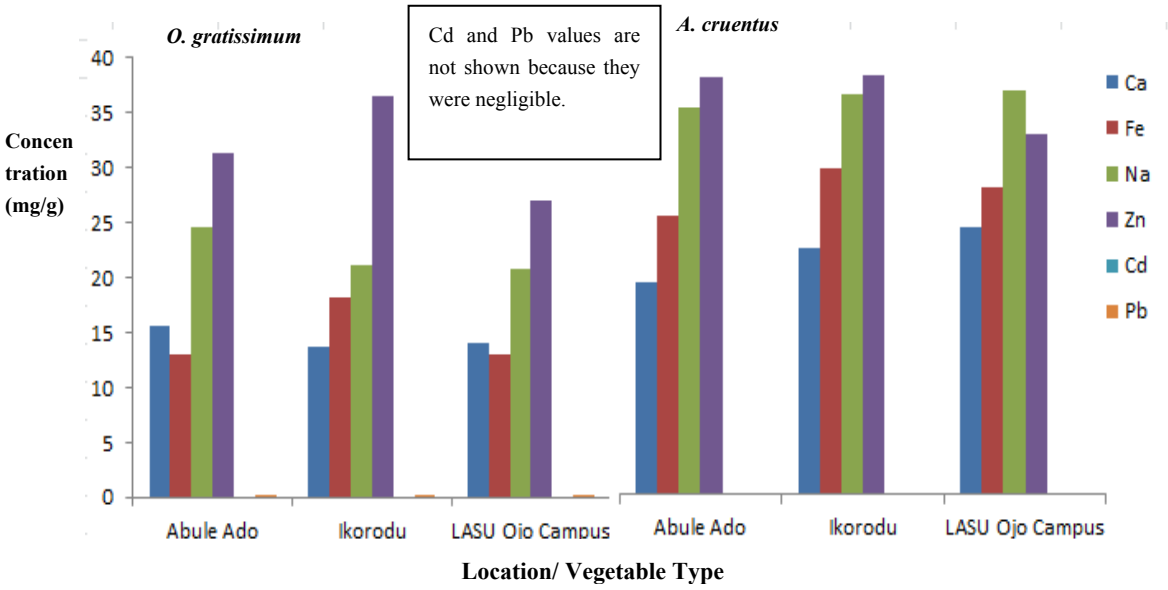

Figure 6. Comparison of Mean mineral concentration (mg/g) of the two leafy vegetables from different locations

4. Conclusions

Findings from this study have shown that the investigated leafy vegetables are highly nutritious source of food. Both vegetables contains varying amount of nutrients and minerals in relation to locations. These vegetables also contains very low amount of heavy metals and fat which suggest that if consumed in sufficient amount, they would help to maintain normal growth and development.

It therefore, recommends the consumption of these two vegetables from the different locations studied as they are safe and highly rich in nutrients. Thus, vegetables contribute a number of minerals and enable their continuous availability from time to time. Minerals are important vital body functions such as acid base and water balance.

However, further researches should be conducted on the effects of weather or season on the nutritional composition of the leaves of *A. cruentus* and *O. gratissimum* and or whether the nutritional compositions will be affected when cooked or eaten raw.

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