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Research Article

PROXIMATE, MINERALS AND ANTI – NUTRIENTS COMPOSITION OF TWO LEAFY VEGETABLES COMMONLY CONSUMED IN IDU, URUAN, AKWA IBOM STATE, NIGERIA

***E. I. UWAH, E. A. MOSES, K. R. OKOKON**

Department of Chemistry, University of Uyo, P.M.B. 1017 Uyo, Akwa Ibom State, Nigeria
*Corresponding Author: uwahemmai@yahoo.com

Abstract

Two leafy vegetables danby (*Justica schinipen*) and green (*Amaranthus viridis*) locally called *mmeme* and *uman inyan afia*, respectively, and commonly consumed in Idu, Uruan, Akwa Ibom State were analysed for the proximate, minerals and anti – nutrients composition in order to ascertain their suitability for human consumption or otherwise. The analyses were performed using standard analytical methods for food analysis. The results revealed that in *Justica schinipen*, the proximate composition (%) was; moisture contents 78.75±0.10, ash contents 14.88±0.01, crude fibre 9.93±0.02, crude protein 21.04±0.04, crude lipid 3.32±0.02 and carbohydrate 50.87±0.01. The caloric value was 317.32 ±0.00 kcal. In *Amaranthus viridis*, the values were; moisture contents 77.62 ±0.02, ash contents 17.84 ±0.02, crude fibre 11.90 ±0.01, crude protein 18.54 ±0.02, crude lipid 2.27 ±0.02, carbohydrate 49.45 ±0.00. The caloric value was 292.43 ±0.02 kcal. Minerals composition (mg/100g) obtained in *Justica schinipen* were; sodium (Na) 9.11±0.03, phosphorus (P) 33.77±0.00, potassium (K) 83.21±0.02, calcium (Ca) 15.17±0.04 and magnesium (Mg) 24.65±0.02. In *Amaranthus viridis*, the values were; Na 17.48±0.01, P 24.09±0.02, K 13.63±0.02, Ca 17.89±0.02 and Mg 39.11±0.01. Vitamins content (%) in *Justica schinipen* were; vitamin A 0.32±0.01 and vitamin C 4.18±0.01. In *Amaranthus viridis*, the values were; vitamin A 0.56±0.01 and vitamin C 3.82±0.01. Anti – nutrients composition (mg/100g) in *Justica schinipen* were; cyanide 0.32±0.00, oxalate 404.80±0.01, phytate 6.67±0.02 and tannin 0.21±0.01. In *Amaranthus viridis*, the values were; cyanide 0.30±0.00, oxalate 369.60±0.01, phytate 7.17±0.02 and tannin 0.16±0.01. The results indicated that proximate, minerals and vitamins composition of the vegetables were in appreciable quantities, while their anti – nutrients composition were rather low, hence the suitability of the vegetables for human consumption.

Keywords: Proximate, minerals, ant – nutrients, composition, leafy vegetables, Idu, Uruan.

Introduction

Proximate analysis is done to estimate the relative amounts of protein, lipid, moisture, ash, fiber and carbohydrate in materials such as vegetables and other plants based on the chemical properties of the materials. Indeed, proximate analysis is done to determine the approximate amounts of substances within a material (Heck et al., 2000; Tan-Wilson et al., 1987). Vegetables are the leafy outgrowth of plants used as food. They include those plants or parts of plants used in making soup or served as integral parts of the main sources of our meal. Consumption of vegetables as food offers the most rapid and lowest cost means of providing adequate supplies of vitamins, minerals and fibers to the people (Uwah et al., 2009; Ihekoronye and Ngoddy, 1985). Vegetables contain nutrients which can be absorbed by the body to be used as energy sources, body building, regulatory and protective material (Saidu and Jideobi, 2009). These nutrients are carbohydrates, lipids, proteins, ash, fibers, vitamins and moisture. Indeed vegetables constitute an important part of the human diet (Uwah and Ogugbuaja, 2012). Generally, leafy vegetables are comparatively rich in fibers, while cereals, root vegetables and other foodstuff are relatively poor sources of fibers (Saidu and Jideobi, 2009; Brain and Allan, 1986). These fibers lower the cholesterol levels of the body and consequently decrease the risk of cardiovascular diseases (Chionyedua et al., 2009). Leafy vegetables are regular ingredient in the diet of an average Nigerian. These vegetables can provide appreciable amounts of nutritive minerals needed by the body if they are consumed in appropriate combinations (Ajewole, 1999). On the other hand, leafy vegetables also contain anti - nutritional factors that can affect the availability of the nutrients. Anti - nutrients are natural or synthetic compounds that interfere with the absorption of nutrients. For example, Protease inhibitors are substances that inhibit the actions of trypsin, pepsin and other proteases in the gut, thereby preventing the digestion and subsequent absorption of protein (Tan-Wilson et al., 1987). Similarly, lipase inhibitors interfere with enzymes, such as human pancreatic lipase, that catalyzes the hydrolysis of some lipids, including fats (Heck et al., 2000). Ladeji et al. (2004) noted that oxalate can bind to calcium present in food thereby rendering calcium unavailable for normal physiological and biochemical role such as the maintenance of strong bone, teeth, cofactor in enzymatic reaction, nerve impulse transmission and as clotting factor in the blood. Oke (1969) had earlier reported that calcium oxalate, which is insoluble, may also precipitate around soft tissues such as the kidney, causing kidney stones. Similarly, Erdman (1979) noted that Phytic acid can bind to mineral elements such as calcium, zinc, manganese, iron and magnesium to form complexes that are indigestible, thereby decreasing the bioavailability of these elements for absorption. In another study, Makkar and Beckar (1998) pointed out that Phytic acid has a negative effect on amino acid digestibility thereby posing problems to non-ruminant animals due to insufficient amount of intrinsic factor phytase necessary to hydrolyze the phytic acid complexes. Phytate is also associated with nutritional diseases such as rickets and osteomalacia in children and adult respectively.

This study is aimed at analysing the proximate, minerals and anti – nutrients composition of two leafy vegetables: danby (*Justica schinipen*) and green (*Amaranthus viridis*) commonly consumed in Idu, Uruan, Akwa Ibom State with a view to establishing the chemical, nutritional and toxicological properties of the vegetables, thereby ascertaining their suitability for human consumption both for nutritional and medicinal purposes or otherwise, which will be useful for the nutritional education of the public with a view to improving the nutritional status of the population.

Materials and Methods

Samples collection and Preparation

Two leafy vegetables danby (*Justica schinipen*) and green (*Amaranthus viridis*) locally called *mmeme* and *uman inyan* afia, respectively, commonly consumed in Idu, Uruan, Akwa Ibom State were collected from three different farms in Idu. The two different vegetable samples collected were separately pooled together to obtained composite samples. The vegetable samples were identified and authenticated by a taxonomist in the Department of Botany and Ecological studies, University of Uyo, Uyo. The leaves were carefully removed from the stems, washed differently with distilled water and oven-dried. The dried leaves were ground into powder using pestle and mortar and kept in properly labeled plastic bottles in a freezer prior analysis.

Analytical procedures

Proximate Analysis

Moisture, ash, crude lipid and crude fiber composition of the vegetable samples were determined in accordance with the standard methods of AOAC (1997). Moisture contents determination was done by oven drying the samples to constant weight at about 105^{o}C for 24 hours. Nitrogen was determined by the micro-Kjeldahl method (Pearson, 1976) and the percentage nitrogen content was converted to crude protein by multiplying by 6.25. Ash determination was done by incineration of about 2g of each sample in a furnace at 550^{O}C for 24 hours. The % ash contents were obtained as in equation (1) below:

$$\% \text{ Ash} = \frac{\text{Weight of Ash}}{\text{Weight of sample}} \times 100 \qquad \ldots\ldots\ldots\ldots\ldots (1)$$

Crude lipid determination involved using exhaustive soxhlet extraction of a known weight of samples with petroleum ether (boiling point 40-60^{o}C) and methanol mixed properly in the ratio 1:1. Crude fiber was obtained from the loss in weight on ignition of dried residue remaining after digestion of fat-free samples with 1.25% each of sulphuric acid and sodium hydroxide solutions under specified condition. The % fiber contents were obtained as in equation (2) below:

$$\% \text{ Fiber} = \frac{\text{Loss of weight on ignition}}{\text{Weight of sample used}} \times 100 \qquad \ldots\ldots\ldots\ldots\ldots (2)$$

Carbohydrate (CHO) contents in the samples were determined as the differences obtained after subtracting the total nitrogen (protein), lipid, ash and fiber from the total dry matter. The caloric value for each vegetable sample was obtained from the sum total of the protein, lipid and carbohydrate contents after multiplying by their respective Atwater factors of 4, 9 and 4.

Mineral Analysis

Mineral elements composition in the leafly vegetables were determined using the AAS after acid digestion of the samples (AOAC, 1997). Two (2.0) g of the samples were digested with concentrated nitric acid and concentrated perchloric acid in ratios 5:3; the mixtures were placed on a water bath for three hours at 80^oC. The resultant solution was cooled and filtered into 100 cm^3 standard flask and made up to the mark with distilled water. Vitamin A in the samples was determined by the standard method of AOAC (1997). Vitamin C contents in the analyzed samples were estimated by macerating the samples with stabilizing agents such as 20% metaphosphoric acid, by titration using the method described by Pongracz et al. (1971). About 10 g of ground samples were soaked for 10 min in 40 cm^3 metaphosphoric acid (20% w/v). The mixture was centrifuged at 3000 rpm for 20 min and the supernatant obtained was diluted and adjusted with 50 cm^3 of distilled water. Ten (10) cm^3 of this mixture was titrated to the end point with dichlorophenol-indophenol (DCPIP) 0.5 g/L.

Anti-nutrients evaluation

Oxalate determination

This was done by the titration method described by Day and Underwood (1986). One (1)g of sample was taken in a 100 cm^3 conical flask. 75cm^3 of 3M H_2SO_4 were added and stirred for 1 hour with a magnetic stirrer and then filtered. 25cm^3 of the filtrate were then titrated while hot against 0.05 M $KMnO_4$ solution to give a faint pink colour which persisted for at least 30 seconds. The oxalate contents were then calculated by taking 1cm^3 of 0.05M $KMnO_4$ as equivalent to 2.2 mg oxalate (Chinma and Igyor, 2007; Ihekoronye and Ngoddy, 1985).

Phytate content determination

This was done using the method of Wheeler and Ferrel (1971). 100cm^3 of the sample were extracted with 3% trichloroacetic acid (TCA). The extracts were treated with $FeCl_3$ solution and the iron contents of the precipitate formed were determined using AAS. The phytic acid contents were then calculated using a 4:6 Fe/P atomic ratio (Okon and Akpanyung, 2005).

Hydrogen cyanide determination

This was done using the alkaline titration method as described by AOAC (1997). 100cm^3 of each sample were steam-distilled into a solution of NaOH. The distillate was treated with dilute KI solution. This was then titrated against 0.02 M $AgNO_3$ solution until it changes from clear to a faint but permanent turbid solution indicating the endpoint. The hydrogen cyanide contents in the samples were determined by taking 1cm^3 of 0.02 M $AgNO_3$ as equivalent to 1.08 mg Hydrogen Cyanide (HCN).

Tannins determination

Tannins in the samples were determined by the method of Kadhakrishna and Sivaprasad (1980) and the Follin-Dennis Spectrophotometric method as described by Pearson (1976). 1.0g of each sample was dispersed in 10 cm^3 distilled water, agitated and allowed to stand for about 30 minutes at room temperature (with shaking every 5 minutes), after which it was centrifuged to obtain the extract (supernatant). 2.5 cm3 of the extract was then dispersed into a 50 cm^3 volumetric flask. In a similar way, 2.5 cm^3 of tannic acid solution was dispersed into a separate 50 cm^3 flask and a series of standard solutions having the concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 mg/cm^3 were prepared. One (1) cm^3 of Follin's reagent was added into each flask and followed by the addition of 2.5 cm^3 saturated Na_2CO_3 solution [Follin's reagent was prepared by dissolving 500g of ammonium sulphate, 5g of uracil ethanoate and 6 cm^3 glacial ethanoic acid in water and the volume make up to 1litre (Uric acid test)].

Statistical analysis

The analyses were performed in triplicate and data were analysed using Excel and GraphPad InStat-[DATASET1.ISD]. Differences between means were evaluated by Student's t-test. Statistical significant difference was stated at $p<0.05$.

Results and Discussion

The results obtained in this study are presented in Tables 1 to 3 and in Figure 1. Table 1 shows the results of the proximate (moisture, ash, fibre, protein, lipid, carbohydrate) composition in % and caloric value (Kcal/100g) of the two leafy vegetable samples, danby (*Justica schinipen*) and green (*Amaranthus viridis*). The moisture, ash, fibre, protein, lipid and carbohydrate (CHO) contents (%) in danby (*Justica schinipen*) were: 78.75±0.10, 14.88±0.01, 9.93±0.02, 21.04±0.04, 3.32±0.02 and 50.87±0.01, respectively. The moisture, ash, fibre, protein, lipid and carbohydrate (CHO) contents (%) in green (*Amaranthus viridis*) were: 77.62 ±0.02, 17.84 ±0.02, 11.90 ±0.01, 18.54 ±0.02, 2.27±0.02 and 49.45±0.00 %, respectively. The caloric values of the two vegetables were: danby (*Justica schinipen*) 317.32 ±0.00 and green (*Amaranthus viridis*) 292.43 ±0.02 Kcal/100g. The values of each of the proximate composition of the two vegetables were significantly different at $p < 0.05$. The caloric values of the two vegetables were equally significantly different at $p < 0.05$. The high levels of moisture contents in the two vegetables investigated in this study, were in close range with those of *O. gratissimum* (84.0%), *V. amygdalina* (80.12%), *Telfairia occidentalis* (79.92%) obtained by Sobowale et al. (2011), which are in agreement with the report that fruits and vegetables contain as high as 85% water (Jenson,1978). The crude fat or lipids levels obtained in the two vegetables investigated in this study were lower than those of *Talinum triangure* (5.90%) and *Amaranthus hybridus* (4.80%) reported by Akindahunsi and Salawu (2005).The low levels of crude fats or lipids obtained in the two leafy vegetable samples in this study are in agreement with other studies that leafy vegetables are poor sources of lipids. Onyeike et al. (2003) noted that consumption of such leafy vegetables in large amount is a good dietary habit and may be recommendable to people suffering from obesity. Accordingly, Antia et al. (2006) pointed out that a diet providing 1 – 2% of its caloric of energy as fats is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular disorders such as atherosclerosis, cancer and aging. The high levels of protein and total carbohydrate in these leafy vegetables indicated that the vegetables are good sources of calorific foods; hence their high caloric values which are attributed to the relatively high levels of moisture, protein, lipids and total carbohydrate contents. The ash contents obtained in the two leafy vegetables in this study were below those reported in *Talinum triangulare* (20.05%) by Akindahunsi and Salawu, 2005 and higher than those of *Occimum graticimum* (8.00%) and *Hibiscus esculentus* (8.00%) also reported by Akindahunsi and Salawu, 2005. The values were however in close range with those obtained in the leaves of *Vernonia colorate* (15.86%) and *Moringa oleifera* (15.09%) reported by Lockeett et al. (2000). The results suggested high deposit of mineral elements in the leaves of the two leafy vegetables studied. High ash content is a reflection of the mineral contents preserved in the food material.

Table 1: Proximate composition (%) and Caloric value (Kcal/100g) of Danby (*Justica schinipen*) and Green (*Amaranthus viridis*) commonly consumed in Idu, Uruan

Samples	Proximate composition						
	Moisture (%)	Ash (%)	Fibre (%)	Protein (%)	Lipid (%)	CHO (%)	Caloric value (Kcal/100g)
Danby	78.75^{a} ±0.10	14.88^{a} ±0.01	9.93^{a} ±0.02	21.04^{a} ±0.04	3.32^{a} ±0.02	50.87^{a} ±0.01	317.32^{a} ±0.00
Green	77.62^{b}±0.02	17.84^{b}±0.02	11.90^{b} ±0.01	18.54^{b} ±0.02	2.27^{b} ±0.02	49.45^{b} ±0.00	292.43^{b} ±0.02

Above values are means ±SD of triplicate analyses. Within column, means with different letters are significantly different, $p < 0.05$.

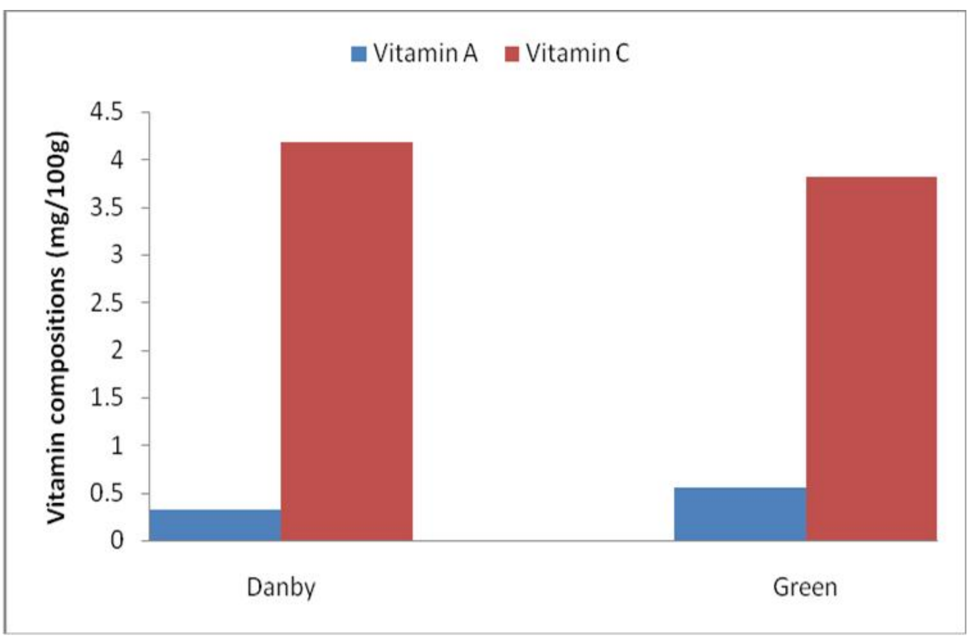

Figure 1: Vitamins composition (mg/100g) of Danby (*Justica schinipen*) and Green (*Amaranthus viridis*) commonly consumed in Idu, Uruan

The substantial amounts of fibre obtained in the two leafy vegetable samples in this study indicated that *Justica schinipen* and *Amaranthus viridis* can help in keeping the digestive system healthy and functioning properly. Fibre aids and speeds up the excretion of wastes and toxins from the body thereby preventing them from sitting in the intestine or bowel for too long, which could cause a build-up and lead to several diseases. Fibre cleanses the digestive tract by removing potential carcinogens from the body and prevents the absorption of excess cholesterol (Hunt et al., 1980; Usunobun et al., 2014). Adequate intake of dietary fibre can lower the cholesterol level, the risk of coronary heart disease and hypertension (Chionyedua et al., 2009). In addition, adequate intake of dietary fibre can lower the risk of constipation, diabetes, colon and breast cancer (Rao and Newmark, 1998; Ishida et al., 2000; Usunobun et al., 2014).

The anti-nutrients (cyanide, oxalate, phytate, tannin) composition in mg/100g of the two leafy vegetable samples are presented in Table 2. In *Justica schinipen*, cyanide were 0.32±0.00, oxalate 404.81±0.01, phytate 6.67±0.02 and tannin 0.21±0.01 mg/100g. In *Amaranthus viridis*, cyanide were 0.30±0.00, oxalate 369.60±0.01, phytate 7.17±0.02 and tannin 0.16±0.01 mg/100g. The values of each of the anti-nutrients in the two vegetables were significantly different at $p < 0.05$. With the exception of oxalate (404.81±0.01 mg/100g) in *Justica schinipen* and 369.60±0.01 mg/100g in *Amaranthus viridis* and considering the negative effects of anti-nutrients on organisms, the low levels of anti-nutrients obtained in the two leafy vegetable samples are indications that the vegetables are safe for human consumption. The high levels of oxalate in the vegetables may constitute potent human poisons.

Table 2: Anti-nutrients composition (mg/100g) of Danby (*Justica schinipen*) and Green (*Amaranthus viridis*) commonly consumed in Idu, Uruan

Samples	Anti-nutrients composition (mg/100g)			
	Cyanide	Oxalate	Phytate	Tannin
Danby	0.32^{a}±0.00	404.81^{a}±0.01	6.67^{a}±0.02	0.21^{a}±0.01
Green	0.30^{b}±0.00	369.60^{b}±0.01	7.17^{b}±0.02	0.16^{b}±0.01

Above values are means ±SD of triplicate analyses. Within column, means with different letters are significantly different, $p < 0.05$.

However, Akwaowo et al. (2000) noted that cooking properly before consumption significantly reduces the total oxalate contents of leaves or vegetables.The Minerals (Na, P, K, Ca, Mg) composition (mg/100g) of the two leafy vegetable samples are presented in Table 3. In *Justica schinipen*, Na was 9.11±0.03, P 33.77±0.00, K 83.24±0.02, Ca 15.17±0.04 and Mg 24.65±0.02 mg/100g. In *Amaranthus viridis*, the minerals composition were, Na 17.48±0.01, P 24.09±0.02, K 13.63±0.02, Ca 17.89±0.03 and Mg 39.11±0.01 mg/100g. The values of each of the minerals composition in the two vegetables were significantly different at $p < 0.05$. Most of these values were in close range with those reported in *V. amygdalina* and *Telfairia occidentalis* by Sobowale et al. (2011). The high levels of these minerals in the two leafy vegetable samples added to the nutritional value of the two leafy vegetables. Minerals content are essential components of the nutritive value of leafy vegetables. Ca salts provide rigidity to the skeleton and Ca^{2+} play a role in many metabolic processes (FAO, 2004). Ca and P are associated for growth and maintenance of bones, teeth and muscles (Turan et al., 2003). Mg, is known to prevent muscle degeneration, growth retardation, congenital malformations and bleeding disorders (Chaturvedi et al., 2004). Vitamins composition (mg/100g) of danby (*Justica schinipen*) and green (*Amaranthus viridis)* vegetable samples are presented in Figure 1. Vitamin A was as low as 0.32±0.01 mg/100g in *Justica schinipen* and 0.56±0.01 mg/100g in *Amaranthus viridis*. The value obtained for vitamin C in *Justica schinipen* was 4.18±0.01 mg/100g and 3.82±0.01 mg/100g in *Amaranthus viridis.* These vitamins A and C values in the two leafy vegetables which are means of triplicate determinations were significantly different at $p < 0.05$. These values were low when compared with the Vitamin C levels of 178.5 mg/100g in *V. amygdalina* and 162.5 mg/100g in *Telfairia occidentalis* reported by Sobowale et al. (2011). According to Arabshahi et al. (2007), many plants have been identified as good sources of natural antioxidants such as tocopherols, vitamin C, carotenoids and polyphenols which are responsible for maintaining good health and protection against coronary heart diseases and cancer.

Table 3: Minerals composition (mg/100g) of Danby (*Justica schinipen*) and Green (*Amaranthus viridis*) commonly consumed in Idu, Uruan

Samples	Minerals composition (mg/100g)				
	Na	P	K	Ca	Mg
Danby	9.11^{a}±0.03	33.77^{a}±0.00	83.24^{a}±0.02	15.17^{a}±0.04	24.65^{a}±0.02
Green	17.48^{b}±0.01	24.09^{b}±0.02	13.63^{b}±0.02	17.89^{b}±0.03	39.11^{a}±0.01

Above values are means ±SD of triplicate analyses. Within column, means with different letters are significantly different, $p < 0.05$.

Conclusion

Based on the analyses and the results, this study revealed that the two leafy vegetables, danby (*Justica schinipen*) and green (*Amaranthus viridis*) commonly consumed in Idu, Uruan, Akwa Ibom State, contain appreciable levels of moisture, ash, fibre, protein, lipid, carbohydrate, minerals and caloric value. The study equally revealed low levels of anti-nutrients with the exception of oxalate whose levels were high in the two vegetable samples. Vitamins A and C contents of the vegetables were equally low. Although low, the presence of the vitamins in the leafy vegetable samples makes the vegetables very relevance to health. Accordingly, cooking properly before consumption, significantly reduces the total oxalate contents of the vegetables. It can therefore be concluded that the vegetables are suitable for human consumption both for nutritional and medicinal purposes. This study will be useful for the nutritional education of the public with a view to improving the nutritional status of the population.

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