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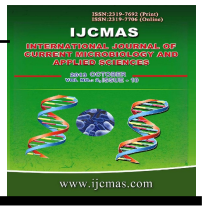

Original Research Article

Determination of the vitamin and mineral composition of common leafy vegetables in south eastern Nigeria

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Keywords

Leafy vegetables; vitamins; mineral composition.

A B S T R A C T

Vitamin and mineral composition of some Nigerian leafy vegetables: akpulu (*Ficus capensis*), big eggplant (*Solanum melongena*), agbara leaf (*Mucuna pruriens*), medium eggplant (*Solanum macrocarpon*), ewa (*Solanum nigrum*), *Moringa oleifera* lam, small egg plant (*Solanum aethiopicum*), and kale (*Cridoscolus acontifolius*) were investigated. The vitamin A content of the samples ranged from 25.22-108.48mg/100ml, vitamin C composition varied from 0.08-3.18mg/100ml and vitamin E content ranged from 3.39-7.71mg/100ml. Mineral element analysis showed that the leafy vegetables contained high levels of selenium at 570.00-1030mg/100ml, calcium was 91.33-873.33mg/100ml, zinc (3.33-491.66ml/100ml), manganese (11.53-120μg/ml), iron (13.85-80.42mg/100ml) and magnesium (14.69-44.45mg/100ml) and low level of potassium (1.65-4.90mg/100ml), and a toxic element lead (0.21-95.63mg/100ml) which may be due to soil contamination. These results reveal that Nigerian leafy vegetables contain an appreciable amount of vitamins and minerals despite the presence of toxic element and should be include in diets to supplement our daily allowance needed by the body.

Introduction

Vegetables are the edible parts of plant that are consumed wholly or in parts, raw or cooked as part of main dish or salad. A vegetable includes leaves, stems, roots, flowers, seed, fruits, bulb and tubers (Uzo, 1989; Uwaegbute, 1989). Green leafy vegetables occupy an important place among the food crops as they provide adequate amounts of many vitamins and minerals for humans. They are rich sources of oil, carbohydrates, carotene, ascorbic acid, retinol, riboflavin, folic acid and minerals like calcium, iron, zinc, magnesium, manganese and selenium depending on the vegetable consumed (Fasuyi, 2006; Ihekoronye and Ngoddy, 1985). Ononugbu (2002) reported that vegetable fats and oil lower blood lipids thereby reducing occurrence of disease associated with damage of coronary artery. Green leafy vegetables constitute an indispensable constituent of human diet in Africa generally and West African in particular. Apart from the variety which

they add to the menu (Mepha and Eboh, 2007; Subukola *et al*., 2007), they are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, minerals, vitamins, fibers and other nutrients which are usually in short supply in daily diets (Mohammed and Sharif, 2011). In addition, green leafy vegetables are used in the diet of postpartum women during which time it is claimed that they aid the contraction of the uterus. It is worthwhile to note that consumption of numerous types of edible plants as sources of food could be beneficial to nutritionally marginal population especially in developing countries where poverty and climate is causing havoc to rural populace. However, low consumption of green leafy vegetables in diet is one of the major factors which leads to deficiency of vitamins and iron. Minerals and vitamins cannot be synthesized by animals and must be provided from plants or vitamins and mineral-rich water.

The present study therefore aimed at evaluating the levels of vitamins and mineral composition of some common green leafy vegetables in south-eastern Nigeria.

Materials and Methods

Source of Materials

Eight different leafy vegetables were obtained from two different location: Afor Market in Awgu Local Government Area and Eke Market in Nkanu Local Government Area both in Enugu State, Nigeria. The leaves were identified by a taxonomist Prof. (Mrs) M. O. Nwosu of the Botany Department, University of Nigeria, Nsukka.

Preparation of Samples

The vegetable leaves used for the studies were harvested fresh; the leaves were destalked, washed with clean cold tap water and room dried for 4 weeks. After drying, the leaves were ground into a fine powder using a mortar and pestle, sieved and stored in air-tight containers under refrigerated temperature prior analysis.

Vitamin Analysis

The vitamins in the leafy vegetables were determined by the official methods of the Association of Official Analytical Chemists (AOAC, 1990).

Determination of Vitamin A (Retinol)

A quantity, one gram, of the sample was weighed and macerated with 20mls of n-hexane in a test tube for 10 minutes. Then 3mls of the upper hexane extract was transferred into a dry test tube in duplicates and evaporated to dryness. Following this, 0.2ml of acetic anhydride chloroform reagent was added and 2ml of 50% trichloroacetic acid (TCA) in chloroform was also added. The absorbance was taken at 15 seconds and 30 seconds intervals at 620nm.

Determination of Vitamin C (Ascorbic acid)

About 0.5g of the sample was weighed, macerated with 10mls of 0.4% oxalic acid in a test tube for 10 minutes, centrifuged for 5 minutes and the solution filtered. 1ml of the filtrate was transferred into a dry test tube in duplicates, 9mls of 2,6-dichlorophenol indophenol was added and absorbance was taken at 15 seconds and 30 seconds interval at 520nm.

Determination of Vitamin E (Tocopherol)

One gram (1g) of the original sample was weighed, macerated with 20mls of n-hexane in a test tube for 10 minutes and centrifuged for 10 minutes. The solution was filtered, 3mls of the filtrate was transferred into a dry test tube in duplicates and evaporated to dryness in a boiling water bath. Following this, 2mls of 0.5N alcoholic potassium hydroxide was added and boiled for 30 minutes in a water bath. Then 3mls of n-hexane was added and was shaken vigorously. The n-hexane was transferred into another set of test tubes and evaporated to dryness. A volume, 2mls, of ethanol was added to the residue. Another volume, 1ml of 0.2% ferric chloride in ethanol was added. Then 1ml of 0.5% α^1 α^1-dipyridyl in ethanol was added followed by the addition of 1ml of ethanol to make it up to 5mls. The solution was mixed and absorbance taken at 520nm against the blank

Mineral Analysis

The minerals in the leafy vegetables were analyzed from solution obtained when 5g of the samples were digested with 10mls of 5N concentrated hydrochloride. The mixtures were placed on a water bath and evaporated almost to dryness. The solution was cooled and filtered into 100ml standard flask and diluted to volume with distilled water. Atomic absorption spectrophotometer was used to analyze the minerals separately after acid digestion of the sample, as described in the official method of the Association of Official Analytical Chemists.

Determination of Calcium (Ca)

About 1ml of the sample was pipette into a test tube in duplicate. Then 3mls of calcium working reagent was added and absorbance at 512nm was read against the blank.

Determination of Potassium (K)

About 5mls of the sample was pipette into a test tube in duplicate. Then 2mls of colbalnitrite was added, shaken vigorously and allowed to stand for 45 minutes and centrifuged for 15 minutes. The supernatant was drained-off and 2mls of ethanol was added to the residue. The solution was shaken vigorously and centrifuged for another 15 minutes. The supernatant was drained off and 2mls of distilled water was added to the residue. The solution was boiled for 10 minutes with frequent shaking to dissolve the precipitate. About 1ml of 1% choline hydrochloride and 1ml of 2% sodium ferric cyanide was added. Then 2mls of distilled water was also added and the solution was shaken to mix well. The absorbance was taken at 620nm against the blank.

Determination of Magnesium (Mg)

About 5mls of the sample was pipette into a test tube in duplicate. Then 1ml of 0.67N sulphuric acid (H_2SO_4) was added and 1ml of 0.05% titan yellow was added also. Then 1ml of 0.01% gum acacia was added and 2mls of 10% sodium hydroxide (NaOH) was also added. The solution was mixed and the absorbance was taken at 520nm against the blank.

Determination of Manganese (Mn)

About 5mls of the sample was pipette into a test tube induplicate and 0.25ml of concentrated sulphuric acid (H_2SO_4) was added and boiled for 1 hour in a boiling

water bath. A spatula tip full sodium periodate was added and was heated for another 10 minutes, colled and the absorbance was taken at 520nm against the blanks.

Determination of Iron (Fe)

About 2.5mls of the sample was pipette into a test tube in duplicate and 0.4ml of 5N sodium hydroxide (NaOH) was added to bring the pH between 4.0-4.5. Soon 0.75ml of acetate buffer of pH 4.5 was added and 0.5ml of 25% hydroquinone was added and 0.5ml of 0.1% α^I α^I dipridyl was also added and 0.35ml of distilled water added to make it up to 5mls. The absorbance was taken at 520nm against the blank.

Determination of Selenium (Se)

About 1ml of the sample was pipette into a test tube in duplicate then 1ml of concentrated HCl and 0.4ml of 2,4-dinitrophenyl hydrazine/N-1, Naphylethlene diamine hydrochloride (2,4-DrPH-NEDA) were added. Then 2.6mls of distilled water was added and mixed. The absorbance was measured at 520nm against the blank.

Determination of Lead (Pb)

A volume, 5mls, of the sample was pipette into a test tube in duplicate and 5mls of 10% sodium citrate and 1ml of 25% ammonia were also added. From this mixture, metals were extracted by adding consecutively 5ml portions of ditizone extraction solution 1 until ditizone became green after extraction. Time per extraction was 1 minute and after each addition of the 5ml of ditizone extraction solution I, the upper will be transferred to another dry test tube. After the extraction, the supernatant was separated from the residue, 12.5ml of 1% nitric acid was added, shaken and allowed to settle. The supernatant was transferred again to a dry test tube, 2.5ml of hydroxylemyl hydrochloride, 2ml of ammonia and 2.5ml of ditizone were added to the supernatant. The mixture was shaken for 1minute and the residue was separated from the supernatant. The supernatant was discarded while the residue was allowed to settle and centrifuged for 15minutes. The absorbance was taken at 520nm against the blank.

Results and Discussion

The results of the vitamin composition of some leafy vegetables grown in Southeastern Nigeria are shown in Table 1. The vitamin A content of the eight leafy vegetable ranged from 25.22mg/100ml in *Ficus capensis* to 108.48mg/100ml in *Moringa oleifera*. Vitamin A is important for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell functions (Lukaski, 2004). *Solanum nigrum* had (3.18mg/100ml) of vitamin C content when compared with Mucuna pruriens with (0.08mg/100ml) which is the least of the leafy vegetables investigated. Vitamin C is a potent antioxidant that facilitates the transport and uptake of non-heme iron at the mucosa, the reduction of folic acid intermediates and the synthesis of cortisol. Its deficiency includes fragility to blood capillaries gum decay, scurvy (Bender, 2009). Vitamin E content varied from 3.39 to 7.71mg/100ml. Vitamin E is a powerful antioxidant which helps to protect cells from damage by free radicals and it is vital to the formation and normal function of red blood cell and muscles (Lukaski, 2004).

Table.1 Vitamin composition of some green leafy vegetables grown in Southeastern Nigeria

S.No.	Nutrient (mg/100ml)	*Ficus capensis*	*Solanum melongena*	*Mucuna prurien*	*Solanum macrocarpon*	*Solanum nigrum*	*Moringa oleifera lam*	*Solanum aethiopicum*	*Cridoscolus acontifolius*
1	Vitamin A	25.22±2.36	94.54±1.11	64.82±2.02	92.45±4.21	54.99±2.23	108.48±6.64	94.66±3.22	63.31±6.82
2	Vitamin E	3.39±1.22	6.12±1.44	4.14±0.89	4.97±1.62	4.70±0.36	4.95±0.59	7.34±1.49	7.71±1.57
3	Vitamin C	2.76±1.85	0.92±0.03	0.08±0.08	1.62±0.63	3.18±0.76	0.56±0.07	1.21±0.05	2.3±0.12

Values are mean ± SEM of duplicate determination

Table.2 Mineral composition of some green leafy vegetables grown in Southeastern Nigeria

S.No.	Minerals (mg/100ml)	*Ficus capensis*	*Solanum melongena*	*Mucuna prurien*	*Solanum macrocarpon*	*Solanum nigrum*	*Moringa oleifera lam*	*Solanum aethiopicum*	*Cridoscolus acontifolius*
1	Selenium	570±30	745±135	900±110	1030±10	730±30	840±Nil	655±55	725±55
2	Calcium	383.16±1.50	738.66±11.17	91.13±65.33	712.33±5.67	873.33±16.67	303.00±16.00	387.33±356.00	401.33±19.33
3	Zinc	53.33±43.33	491.66±85.00	64.99±48.33	146.66±3.33	248.33±8.33	3.33±Nil	123.33±3.33	36.33±13.33
4	Manganese	11.53±1.79	75.63±5.89	58.20±2.31	120.5±9.74	72.56±2.31	32.82±7.18	102.04±0.51	49.48±11.54
5	Iron	26.14±2.05	65.84±0.78	80.42±22.71	59.03±4.10	64.81±0.96	13.85±12.41	36.86±2.17	37.92±1.20
6	Lead	0.21±13.99	45.47±43.58	81.05±64.84	62.52±8.42	49.35±60.73	95.21±97.42	68.68±85.42	95.63±118.89
7	Magnesium	19.99±0.56	39.35±0.65	14.69±0.69	32.38±2.10	44.45±0.89	25.34±9.32	29.46±0.40	29.51±0.53
8	Potassium	2.39±0.06	2.75±1.59	1.77±3.90	4.90±1.71	4.10±1.53	1.65±0.49	2.26±0.55	2.75±0.73

Values are mean ± SEM of duplicate determination

Table 2 shows the mineral composition of some green leafy vegetables grown in southeastern Nigeria. Selenium content showed significant values from 570.00 to 1030mg/100ml. Selenium as an antioxidant helps prevent oxidative stress, inflammation and DNA repair. It is also a constituent of glutathione peroxidase which is a major scavenger of H_2O_2 (Arinola *et al*., 2008; Murray *et al*., 2000). Calcium content ranged from 91.13 to 873.33mg/100ml in *Mucuna pruriens* and *Solanum nigrum*, respectively. These values are higher than the values reported for some selected vegetable leaves in Nigeria, such as *Amaranthus hybridus*, *Hibiscus sabdariffa*, and *Telfaria occidentali* (Asolu *et al*., 2012). Calsium functions as a constituent of bones and teeth, regulation of nerve and muscle function (Brody, 2004).

Potassium content ranged from 1.64 to 4.90mg/100ml. *Solanum macrocarpon* had the highest potassium content. The values were lowe when compared with standard dietary allowance (RDA). Potassium is the principal cation in intracellular fluid and functions in acid base balance, regulation of osmotic pressure, muscle contraction and Na^+/K^+ ATPase (Mathothra, 1998; Murray *et al*., 2000). The magnesium content ranged from 14.69 tot 44.45mg/100ml. The values obtained in these studies are low to meet the recommended daily allowance (RDA) of 400mg/day for men, women of 19 to 39 years old (Food and Nutrition Board, 1997).

The iron content varies from 13.85 to 80.42μg/ml in *Moringa oleifera* Lam and *Mucuna prurience* respectively. The values were significantly higher than the values reported for some selected leafy vegetables in Nigeria (Chinma and Igyor, 2007). Iron is a part of the heme of haemoglobin (Hb), myoglobin, and cytochromes (Chandra, 1990). The content of Zinc ranged from 3.33 to 419.66mg/100ml and manganese ranged from 11.53 to 120mg/100ml and these were significantly higher when compared with the standard recommended dietary allowance (RDA). Zinc is very useful in protein synthesis, cellular differentiation and replication, immunity and sexual functioins (Pathak and Kapil, 2004). Manganese is part of enzyme involved in urea formation, pyruvate metabolism and the galactotransferase of connective tissue biosynthesis (Chandra, 1999). Lead values range from 0.21 to 95.63mg/100ml. Lead causes adverse effect in several organ and organ systems including nervous, renal, cardiovascular, reproduction, haematological, and immune system (Patil *et al*., 2006).

The present study has shown that the Nigerian leafy vegetables examined have an appreciable content of vitamin A, vitamin E and low content of vitamin C. The vegetables also contained good minerals with abundance of them in selenium, calcium, zinc, iron, manganese, and magnesium while they were least in potassium. The results suggest that the vegetables if consumed in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition.

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