Evaluation of Micronutrients Composition of some Leafy Vegetables Sold in Lapai, Niger State, Nigeria

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Abstract

Evaluation of micronutrient constituents of commonly consumed leafy vegetables in a particular area gives an insight of the derivable nutritional benefits of such vegetables available for the populace of the area. This is very critical in nutritional assessment and thus justifies why nine (9) fresh leafy vegetables, namely, Telfairia occidentalis (fluted pumpkin), Pterocarpus mildbraedii (African rosewood), Amaranthus cruentus (amaranthus), Abelmoschus esculentus (okra), Corchorus olitorius (jetu mallow), Solanum melongena (eggplant), Talinum triangulare (waterleaf), Lactuca sativa (lettuce) and Vernonia amygdalina (bitter leaf) were obtained from three different market in Lapai, Niger State, Nigeria and analysed for their vitamins (β-carotene, vitamin C, E and B6) and minerals (Na and K) compositions using standard analytical procedures. Results of vitamins composition of the leafy vegetables showed the ranges of β-carotene, vitamin C, vitamin B_6 and vitamin E in the vegetables were 392.17 ± 0.42 - 29478.22 ± 3.71 µg/100 g, 82.226 ± 0.10 - 232.88 ± 0.10 mg/100 g, 1.41 ± 0.15 - 325.82 ± 0.12 mg/100 g and 0.04 ± 0.00 - 0.23 ± 0.01 µg/100 g, respectively. The mineral concentrations of the vegetables showed that the sodium content range from 11.04 ± 4.65 - 27.50 ± 0.15 mg/Kg while potassium concentration range from 129.20 ± 8.03 - 231.80 ± 4.65 mg/Kg. It is concluded that the leafy vegetables contain appreciable amount of some vitamins and mineral elements require for the maintenance of good health.

Keywords: Leafy vegetables, Micronutrients, Vitamins, Minerals.

Introduction

Vegetables are edible parts of plants that are consumed whole or in parts, raw or cooked as part of main dish (Ejoh *et al.*, 2005; Oboh, 2005; Antial *et al*., 2006). The tropical and sub-tropical countries of the world are blessed with varieties of vegetables some of which are domesticated, while others grow wild and their prices are relatively affordable when compared with other food items in the areas (Ejoh *et al.*, 2005). Vegetables may be edible roots, stems, leaves, fruits or seed. Each group contributes to diet in its own way (Aliyu and Morufu, 2006). They contain valuable food ingredients which can be successfully utilized to build up and repair the body. They are valued mainly for their high vitamin, mineral elements, antioxidants and phytochemicals contents (Aliyu and Morufu, 2006; Musa and Ogbadoyi, 2012; Musa *et al*., 2014). The nutrients content and composition in leafy vegetables depend on species/cultivar, soil type, nutrient content of the soil and other environmental conditions. It is for this reason that this study was conducted to evaluate some micronutrients composition in the leaves of the commonly consumed leafy vegetables in Lapai, viz; *A. cruentus*, *C. olitorius, T. triangulare*, *T. occidentalis, S. melongena, P. mildbraedii*, *A. esculentus, L. sativa* and *V. amygdalina*. This is with the aim of assessing the nutritional contributions of each of this leafy vegetable to the people of the study area.

Materials and Methods

Sources of Samples: The samples of *A. cruentus*, *C. olitorius, T. triangulare*, *T. occidentalis, S. melongena, P. mildbraedii*, *A. esculentus, L. sativa* and *V. amygdalina* were bought from three different markets, Lapai. The vegetables were identified in the Department of Biology, Ibrahim Badamasi Babangida University, Lapai Niger State, Nigeria.

Preparation of samples: The fresh vegetables were sorted to remove those with bruises and other defects. The leaves of the sorted fresh vegetables were destalked, washed with distilled water to remove dirt. The washed leaves were drained using plastic sieve and then used for chemical analysis

Analytical Procedure: The mineral elements (Na and K) in samples were determined according to the method of Ezeonu *et al*. (2002) involving the use of flame photometer (Jenway PFP7). The ascorbic acid concentration was determined by 2, 6-dichlorophenol indophenols method (Jone and Hughes, 1983) while the estimation of β-carotene was done by ethanol and petroleum ether extraction method as described (Musa *et al*., 2010). Vitamin E content in the samples was analysed by the method of Rosenberg (1992). The concentration of vitamin B6 in the fresh leaves of vegetable samples was determined according to the method of AOAC (1990).

Statistical Analysis: The data obtained were subjected to Analysis of Variance (ANOVA) using SAS statistical package. Means were separated using Duncan's Multiple Range Test (DMRT). Significance was accepted at $P < 0.05$. The data is given as mean ± SEM.

Results

Concentration of Vitamins and Mineral Elements: The results of the vitamin and mineral concentrations in the leaves of the studied vegetables are presented in Table 1. The concentration of β-Carotene in the fresh leaves of the vegetables range from 392.17 ± 0.42 - 29478.22 ± 3.71 µg/100 g with the highest and lowest values found in *V. amygdalina and P. mildbraedii*, respectively (Table 1). The mean values of ascorbic acid content in the fresh samples of the vegetables are 111.72 ± 0.11, 82.226 ± 0.10, 154.97 ± 0.21, 95.43 ± 6.54, 194.82 ± 0.12, 231.42 ± 0.11, 232.88 ± 0.10, 144.45 ± 0.15 and 120.486 ± 4.65 mg/100 g for *A. cruentus, C. olitorius, T. triangulare, T. occidentalis, S. melongena, P. mildbraedii, A. esculentus, L. sativa* and *V. amygdalina*, respectively. The results showed that the concentration of ascorbic acid is highest in the leaves of *A. esculentus* while *C. olitorius* has the least content of the vitamin (Table 1).

The mean concentrations of vitamin B6 in the vegetables are as follows; *A. cruentus* (12.22 ± 0.42 mg/100 g), *C. olitorius* (8.02 ± 0.11 mg/100 g), *T. triangulare* (1.41 ± 0.15 mg/100 g), *T. occidentalis* (6.46 ± 3.71 mg/100 g), *S. melongena* (325.82 ± 0.12 mg/100 g), *P. mildbraedii* (12.30 ± 0.11 mg/100 g), *A. esculentus* (4.24 ± 0.10 mg/100 g), *L. sativa* (11.08 ± 0.21 mg/100 g) and *V. amygdalina* (13.75 ± 6.54 mg/100 g), with *S. melongena* and *T. triangulare* having the highest and lowest content of vitamin B6, respectively (Table 1).

Table 1: Vitamin and mineral compositions in the leaves of some leaf vegetables

Leafy vegetables	β-carotene (µg/100g)	Vitamin C (mg/100 g)	Vitamin B6 (mg/100 g)	Vitamin E (µg/100 g)	Na (mg/Kg)	K (mg/Kg)
A .cruentus	8361.66±0.11^{d}	111.72±0.11^{ab}	12.22±0.42^{c}	0.04±0.00^{a}	15.83±0.11^{b}	129.20±8.03^{a}
C. olitorius	7411.05±0.10^{cd}	82.226±0.10^{a}	8.02±0.11^{b}	0.23±0.08^{c}	14.79±0.10^{b}	201.40±0.10^{cd}
T. triangulare	11515.17±0.15^{e}	154.97±0.21^{ab}	1.41±0.15^{a}	0.16±0.01^{b}	27.50±0.15^{c}	137.18±8.03^{b}
T. occidentalis	27023.55±4.65^{f}	95.43 ±6.54^{a}	6.46±3.71^{b}	0.18±0.00^{b}	11.04±4.65^{a}	143.76±6.54^{b}
S. melongena	10133.28±0.12^{e}	194.82±0.12^{b}	325.82±0.12^{d}	0.08±0.02^{a}	15.00±0.12^{b}	193.68±0.12^{c}
P. mildbraedii	392.17±0.42^{a}	231.42±0.11^{c}	12.30±0.11^{c}	0.11±0.00^{b}	11.25±0.42^{a}	174.80±0.11^{c}
A. esculentus	704.516±0.11^{b}	232.88±0.10^{c}	4.24±0.10^{a}	0.15±0.01^{b}	11.87±0.11^{a}	196.33±0.10^{c}
L. sativa	6440.07±0.15^{c}	144.45±0.15^{ab}	11.08±0.21^{c}	0.14±0.01^{b}	25.00±0.15^{c}	191.90±0.15^{c}
V. amygdalina	29478.22±3.71^{g}	120.486±4.65^{ab}	13.75±6.54^{c}	0.15±0.01^{b}	13.25±3.71^{ab}	231.80±4.65^{d}

Similarly, the mean values of vitamin E in *A. cruentus, C. olitorius, T. triangulare, T. occidentalis, S. melongena, P. mildbraedii, A. esculentus, L. sativa* and *V. amygdalina* are 0.04 ± 0.00, 0.23 ± 0.08, 0.16 ± 0.00, 0.18 ± 0.00, 0.08 ± 0.02, 0.11 ± 0.00, 0.15 ± 0.01, 0.14 ± 0.01 and 0.15 ± 0.01 µg/100 g, respectively (Table 1). The concentrations of Na in the vegetables range from 11.04 ± 4.65 - 27.50 ± 0.15 mg/100 g, with *T. occidentalis* and *L. Sativa,* having the lowest and highest content of the mineral element, respectively (Table 1). Among the studied vegetables, *A. cruentus* (129.20 ± 8.03 mg/Kg) has the lowest while *V. amygdalina* (231.80 ± 4.65 mg/Kg) has the highest concentration of potassium (Table 1).

Discussion

The current study revealed that the studied leafy vegetables are good sources of some water and fat soluble vitamins that are essentially required by the body for various biochemical and physiological processes (Oboh, 2005). This is not surprising as most vitamins are synthesized by plant tissues (Eleazu and Eleazu, 2013). The concentrations of the vitamins in the vegetables varied with species (Aliyu and Morufu, 2006). The vegetables also bioaccumulate appreciable amount of sodium and potassium that are require for fluid and acid-base balances. β-carotene, the precursor of vitamin A, which is a powerful antioxidant protecting the cells from damage caused by free radicals; it enhances the function of immune system and has the ability to stimulate cell to cell communication (George, 1999; Musa and Ogbadoyi, 2012; Musa *et al*., 2013). *V. amygdalina* (29478.22 ± 3.71 µg/100 g) had the highest content of β-carotene while *P. mildbraedii* (392.17 ± 0.42 µg/100 g) had the lowest content of the provitamin. The concentration of β-carotene in these vegetables is over and above the recommended adult daily allowance of 900 µg of vitamin A (George, 1999; Akanya, 2004) except that the concentration of the provitamin A in *P. mildbraedii* and *A. esculentus* is lower than the recommended daily allowance of vitamin A. The result thus suggests that complete dependency on *P. mildbraedii* and *A. esculentus* for the provitamin

may led to disease conditions associated with β-carotene (vitamin A) deficiency such as night blindness and increase incidence of cancer formation in various organs (George, 1999).

Vitamin C is one of the essential cofactors of some enzymes and a potent antioxidant (Musa and Ogbadoyi, 2012). The range of this water soluble vitamin in the vegetables is 82.226 ± 0.10 - 232.88 ± 0.10 mg/100 g with *C. olitorius* and *A. esculentus* having the lowest and highest content of the vitamin, respectively. This study clearly showed that each of these vegetables contained enough vitamin C to meet the recommended dietary allowance of 60 mg (Olaofe, 1992, George, 1999, Musa *et al*., 2014) if 100 g of the fresh leaves of each of the vegetables are consumed. Therefore, adequate intake of any of the vegetables will prevent the disease conditions associated with deficiency of this important water soluble vitamin. The fresh leaves of the studied vegetables are very rich sources of vitamin B6. Each of the vegetables contains enough of the vitamin to meet the range of adult recommended allowance of 1.6 – 2.0 mg (George, 1999). It therefore, follows that inclusion of adequate amount of the leaves of any of the vegetables can help in the regulation of the metabolism of protein especially in the nerve tissues, the liver, and the skin, and formation of red blood cell (George, 1999). The vitamin E content ranged from 0.04 ± 0.00 - 0.16 ± 0.01 µg/100 g, with the highest and lowest contents found in *A T. triangulare* and *A. cruentus*, respectively. The amount of vitamin E in each of the vegetables is lower than recommended daily allowance 8-10 mg of the vitamin (George, 1999). Therefore, these vegetables are not good sources of this vitamin that act as antioxidant which protects cells against aging and cancers, formation of reproductive cells, and facilities good operation of the central nervous system and of pituitary gland (George, 1999; Wagner *et al,* 2004; Vasundev, 2006).

The range of 11.04 ± 4.65 -27.50 ± 0.15 mg/kg obtained for Na in the study leafy vegetables fall far below the recommended daily intake of 2400 mg based on a 200 calorie intake (netrition.com, downloaded 11/05/2015). Thus complete dependency on the vegetables as a major source of the mineral require for the maintenance of acid-base and fluid balances, normal osmotic pressure, heart beat and cell permeability in the body (Titz *et al*., 1994; Satyanarayana and Chakrapani, 2009) may lead to the deficiency of the mineral element and it attendant health problems. However, this mineral element is added in our meal preparations in the form of sodium chloride or table salt as condiment. This practice will augment the low concentration of Na in the leafy vegetables. The potassium concentration in the fresh leaves of the vegetables range from 129.20 ± 8.03 - 231.80 ± 4.65 mg/kg, thus the vegetables could be regarded as an excellent sources of the mineral element responsible for the maintenance of the intracellular osmotic pressure, acid-base balance, water balance and transmission of nerve impulse of the body (Satyanarayana and Chakrapani, 2009).

Conclusion

The results of the study revealed that the different leafy vegetables contain appreciable amount of vitamins and minerals and are therefore can be regarded a potential sources of micronutrients require for the maintenance of good health.

References

Akanya, H.O. (2004). Retinol: The Vitamin of Life. Federal University of Technology, Minna. Inaugural lecture series No. 5. Scan Prints Nig. Ltd. pp 12.

Aliyu, H.M. and Morufu, A.I. (2006). Proximate analysis of some leafy vegetables (roselle, jute and bitter leaf). *International Journal of Foods and Agricultural Research*, **3**(1): 194-198.

Antia, B.S., Akpan, E.J., Okon, P.A. and Umoren, I.U. (2006). Nutritive and antinutritive evaluation of sweet potatoes (*Ipomoea batatas*) leaves. *Pakistan Journal of Nutrition*, **5**(2): 166 – 168.

AOAC (Association of Official Analytical Chemist). (1990). Standard Official Methods of Analysis, Association of Analytical Chemist. 15th Edn. Gaithersburg, USA: AOAC Press.

Ejoh, A.R., Tanya, A.N., Djuikwo, N.A. and Mbofung, C.M. (2005). Effect of processing and preservation methods on vitamin C and total carotenoid levels of some *Vernonia* (bitter leaf) species. *African Journal of Food Agriculture Nutrition and Development.* **5** (2): 105 – 117.

Eleazu, C.O. and Eleazu, K.C. (2013). Bioactive Constituents and *In vitro* Antioxidant Capacity of Water Leaf (*Talinum triangulare*) as Affected by Domestic Cooking. *European Journal of Medicinal Plants* **3**(4): 540-551**.**

Ezeonu, F.C., Musa, A., Stanly, C.D. and Oswald, C.E. (2002). Iron and zinc status in soils, water and stable food cultivars in Itakpe, Kogi State of Nigeria. *The Environmentalist*, **22**: 237-240.

Fasuyi, A.O. (2006). Nutritional potentials of some tropical vegetables leaf meals; chemical characterization and functional properties. *African Journal of Biotechnology*, **5**(1): 49-53.

George, D.P.R (1999). Newlife Style: Enjoy It. Editorial Safeliz, Spain. pp 39, 65 – 100.

Jone, E. and Hughes, R.E. (1983). Foliar ascorbic acid in some Angiosperms. *Phytochem*. **22**: 2493-2499.

Musa, A., Ezenwa, M.I.S., Oladiran, J. A., Akanya, H.O. and Ogbadoyi, E.O (2010). Effect of soil nitrogen levels on some micronutrients, anti-nutrients and toxic substances in *Corchorus olitorius* grown in Minna, Nigeria*. Afr. J. Agric Res.*, **5** (22): 3075–3081.

Musa, A. and Ogbadoyi E.O. (2012). Effect of plant leaf positions on some micronutrients, anti-nutrients and toxic substances in *Telfairia occidentalis* at vegetative phase. *American Journal of Experimental Agriculture.* **2**(2): 219-232.

Musa, A., Ogbadoyi, E.O. and Kumar, N. (2013). Effect of post-harvest handlings on the concentrations of some phytotoxins and micronutrients in *Vernonia amygdalina* (Bitter leaf). *Lapai Journal of Science and Technology*, **1**(1): 66-88.

Musa, A., Ogbadoyi, E.O., Musa, D.A., Kumar, N. and Makun, H.A. (2014). Micronutrients Constituents in the leaves of selected fresh leafy vegetables obtained from Minna town, Nigeria. *International Journal of Applied Biological Research*, **6**(1): 81 – 89.

Netrition.com. (2015). Reference values for nutrition labeling. http://www.netrition.com/rdi_page.html accessed on 11/05/2015.

Oboh, G. (2005). Effect of some post harvest treatment on the nutritional properties of *Cnidoscolus acountifolus* leaf. *Pakistan Journal of Nutrition*, 4 (4): 226 – 230.

Olaofe, O. (1992). Vitamin C content of Nigerian food – stuffs. *Nigerian Journal of Nutritional Science.* **13**(1 and 2): 1–7.

Rosenberg, H.R. (1992). Chemistry and Physiology of the vitamins. Interscience publishers Inc, New York. PP 452 – 453.

Satyanarayana, U. and Chakrapani, U. (2009). Essentials of Biochemistry. 2nd Edition. Books and Allied (P) Ltd. Beliaghata Main Road, Kolkata, India. pp 210- 224.

Tietz, W.W., Carl, A.B. and Edward, R.A. (1994). Tietz test book of Clinical Chemistry. 2nd Edition. W.B. Saunders Company London. pp 1184 – 1235.

Vasundev V. (2006). Fundamentals of Biochemistry, Textbook of Biochemistry. 2nd Edition. pp 281-289

Wagner, KH, Kamal-Eldin, A. and Elmadfa I. (2004). Gamma-tocopherol- an underestimated vitamin? *Ann. Nutr. Metab*., **48**:169-188.