



Analysis of proximate composition and mineral nutrients of three leafy vegetables commonly consumed in Lagos, Nigeria

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Abstract

Analysis of proximate composition and mineral nutrients of three commonly consumed vegetables *Amaranthus cruentus*, *Celusia argenta* and *Corchorus olitorius* leaves was carried out using standard methods of food analysis. The mean leaves moisture content is 23.57, 15.58 and 30.90% respectively for *A. cruentus*, *C. argenta* and *C. olitorius*. The vegetables have high ash content ranging from 21.30 to 32.36% which is within the range reported in some Nigerian leafy vegetables. The mean protein, carbohydrate and crude fibre content are: 12.66, 29.41, 7.83%; 9.35, 32.84, 11.70%; 11.24, 31.34, 6.6% respectively for *A. cruentus*, *C. argenta* and *C. olitorius*. All the studied vegetables have low fat content *A. cruentus* (0.45%), *C. argenta* (0.21%), *C. olitorius* (0.32%). The leaves have energy values of 177.55 cal/100 g for *C. olitorius* followed by *A. cruentus* with energy value of 176.67 cal/100 g and *C. argenta* having the least energy value of (174.93 cal/100g) of food. The vegetables are all good sources of calcium, iron and zinc.

Keywords: Leafy vegetables, *Amaranthus cruentus*, *Celusia argenta*, *Corchorus olitorius*, nutritive minerals.

INTRODUCTION

Vegetables are the fresh and edible portions of herbaceous plants, which can be eaten raw or cooked (Fayemi (1999), Dhellot et al (2006)). They contain valuable food ingredients which can be successfully utilized to build up and repair the body.

Vegetables are valuable in maintaining alkaline reserve of the body. They are valued mainly for their high carbohydrate, vitamin and mineral contents. Vegetables may be edible roots, stems, leaves, fruits or seed. Each group contributes to diet in its own way (Robinson (1990)). *Amaranthus hybridus*, *Celusia argenta* and *corchorus* are popular edible vegetables in Nigeria. *Corchorus octorius* is usually recommended for pregnant women and nursing mother because it is believed to be rich in iron (Oyedele et al (2006)).

Vegetables contain both essential and toxic elements over a wide range of concentrations, (Ajewole (1999)). The concentration of these elements is a function of the concentrations in the soil in which the vegetable is planted. Leafy vegetables are regular ingredient in the diet of the average Nigeria with their level of consumption; they can provide appreciable amounts of nutritive minerals (Ajewole (1999)).

Most developing countries depend on starch-based food as the main staple food for the supply of both energy and protein. This accounts in part for protein deficiency which prevails among the populace as recognized by Food and Agricultural Organization (Ladeji et al. (1995)). In Nigeria, *A. hybridus* leaves combined with condiments are used to prepare soup (Oke, (1983); Mepha et al. (2007)). In Central African, their leaves are eaten as spinach or green vegetables (Dhellot et al., (2006)). These leaves boiled and mixed with a groundnut sauce are eaten as salad in West and Southern Africa (Oliveria and DeCarvalho (1975); Martin and Telek (1979)). *Amaranthus hybridus* leaves have been shown to contain large amount of squalene, a compound that has both health and industrial benefits (Rao and New mark (1998); Smith (2000); He and Corke, (2003)).

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 acids (Okafor 1983; Thompson and Kelly,

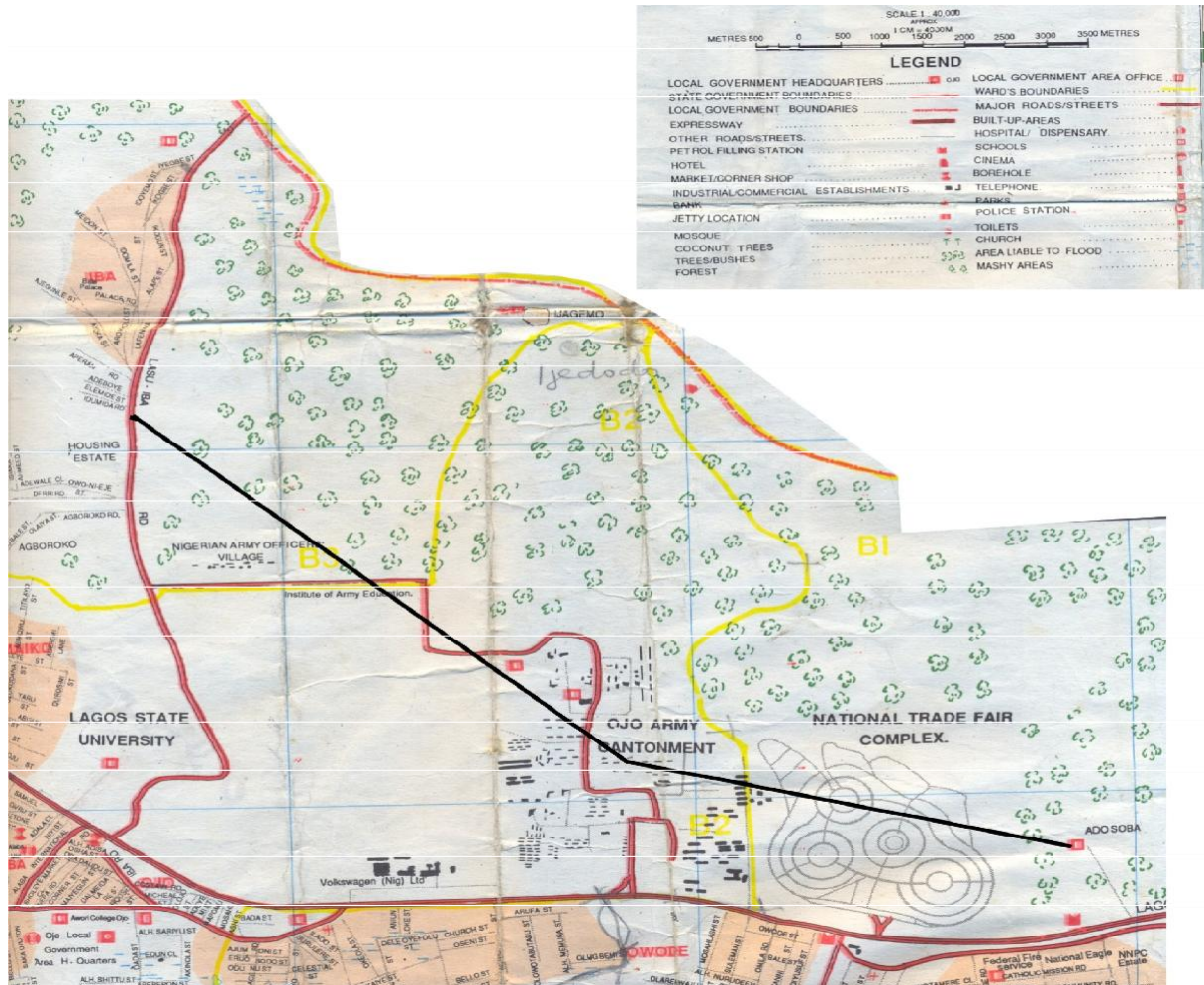


Figure 1. The sampling points are along the straight line.

1990). Vegetables also act as buffering agents for acidic substances produced during the digestion process. (Thompson and Kelly 1990). Several works reporting compositional evaluation and functional properties of various types of edible wild plants in use in developing countries abound in the scientific literature (Locke et al., 2000; Faruq et al., 2002; Akindahunsi and Salawu, 2005; Edeoga et al., 2006; Hassan and Umar, 2006; Ekop, 2007). But much still needs to be done on the proximate analysis and mineral composition of edible leafy vegetables grown in Nigeria.

It is a common tradition in Lagos, Nigeria to cultivate vegetables along roadside due to limited arable farmland, high population and easy accessibility to the consumers. This work is therefore aimed at evaluating the proximate composition (moisture content, ash, crude fibre, protein, fat and carbohydrate) and mineral nutrient (calcium, iron and zinc) of *Amaranthus cruentus*, *C. argenta* and *C. olerarius* planted along roadside with a view to compare the results obtained with those planted on arable farmland in other parts of the country.

MATERIALS AND METHODS

Sample collection and treatment

Three commonly consumed leafy vegetable (*A. cruentus* (*Tete*), *C. argenta* (*Soko*) and *C. olerarius* (*Ewedu*) were collected from three different planting locations along roadside farmlands in Ojo Local Government Area of Lagos State (Figure 1). The samples were collected between the months of July and August 2005.

The leaves were detached from the stalk. Part of the detached leaves was used for moisture content determination. The remaining leaves were rinsed with deionized water and sun dried for 5 days on a clean paper with constant turning over to avert fungal growth (Fasakin, 2004). The sun dried sample was ground into fine powder using dried pestle and mortar and sieved through 2.0 mm mesh prior to analysis (Fasakin, 2004). Proximate analysis (moisture content, ash, crude fibre, protein and fat) were determined using standard method of AOAC (1997). Carbohydrate was calculated by difference. Food energy calculation was derived by multiplying the percentage of crude protein and carbohydrate by 4.1 and crude fat by 9.3 (Khalil and Saleemullah, 2004). The nutritive elements (Ca, Fe and Zn) content of the leaves were determined by wet digestion and analysed using Buck 210VGS scientific model of Atomic Absorption spectrophotometer (Awofolu, 2005). Appropriate quality assurance procedures and precautions were carried out to ensure re-

Table 1. Statistical Measurement of proximate concentration (%) of different vegetables.

Vegetable		moisture	Protein	Crude fibre	CHO	Fat	Ash
Soko	Mean ± S.D	15.60 ± 1.00	9.40 ± 0.90	11.70 ± 0.80	32.80 ± 1.70	0.21 ± 0.01	32.40 ± 1.60
	Range	14.70 - 16.70	8.80 - 10.40	10.70 - 12.40	31.10 - 34.30	0.020 - 0.021	30.90 - 34.10
Tete	Mean ± S.D	23.60 ± 4.10	12.70 ± 1.40	7.80 ± 1.80	29.40 ± 1.40	0.45 ± 0.03	26.30 ± 4.20
	Range	19.00 - 27.00	11.40 - 14.10	6.40 - 10.00	28.50 - 31.00	0.041 - 0.046	22.40 - 30.80
Ewedu	Mean ± S.D	30.90 ± 1.30	11.20 ± 0.30	6.70 ± 1.40	31.30 ± 1.50	0.32 ± 0.01	21.20 ± 0.80
	Range	29.20 - 36.10	11.20 - 12.30	5.40 - 8.10	30.40 - 33.0	0.030 - 0.032	21.00 - 21.40

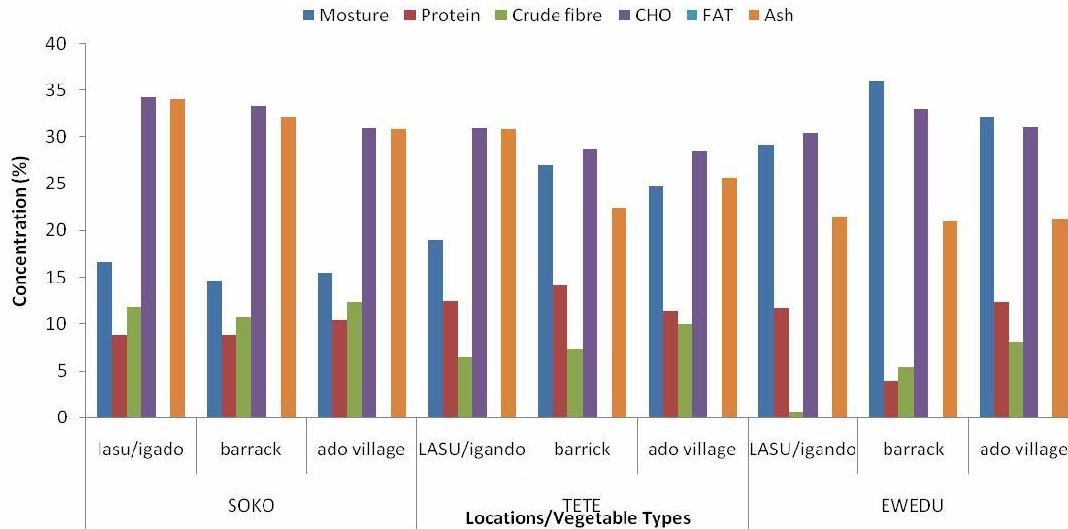


Figure 2. Mean proximate concentration of different vegetables (Soko, Tete and Ewedu) from different locations.

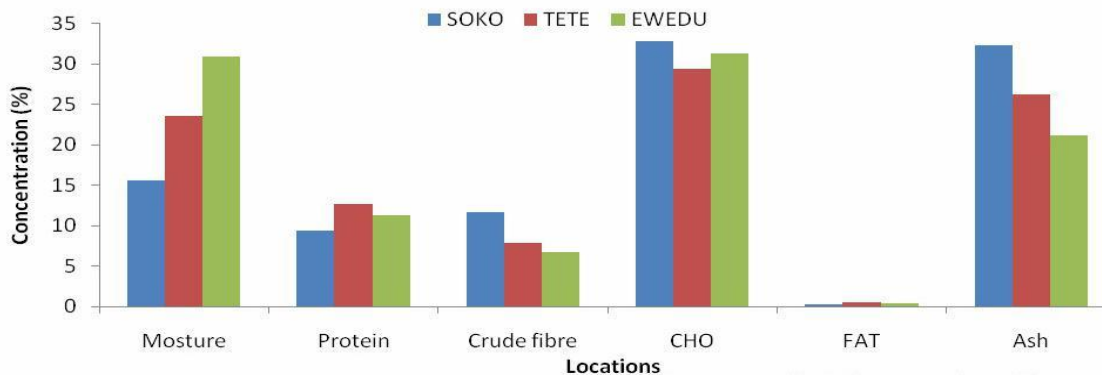


Figure 3. Mean proximate concentration of different vegetables (Soko, Tete and Ewedu).

reliability of the data.

RESULTS AND DISCUSSION

The results of the proximate analysis are represented in Tables 1, Figures 2 and 3 while that of the nutritive me-

tals represented in Table 2 and Figure 4.

The mean moisture content of the analyzed vegetables as presented in Figure 2: showed *A. cruentus*, *C. argenta* and *C. olitorius* to contain 23.57, 15.58 and 30.90% respectively. These values are lower than those reported earlier for some Nigeria green vegetables (Akindahunsi

Table 2. Statistical Measurement of Mineral elements concentration(mg/g) of different vegetables.

Vegetable		Ca	Fe	Zn
Soko	Mean ± S.D	27.80 ± 1.30	0.39 ± 0.04	0.09 ± 0.00
	Range	26.30 - 28.70	0.36 - 0.43	0.09 - 0.10
Tete	Mean ± S.D	27.90 ± 5.00	0.60 ± 0.00	0.08 ± 0.01
	Range	24.94 - 33.70	0.59 - 0.60	0.08 - 0.09
Ewedu	Mean ± S.D	23.40 ± 6.70	0.47 ± 0.09	0.05 ± 0.00
	Range	19.30 - 31.00	0.36 - 0.54	0.05 - 0.06

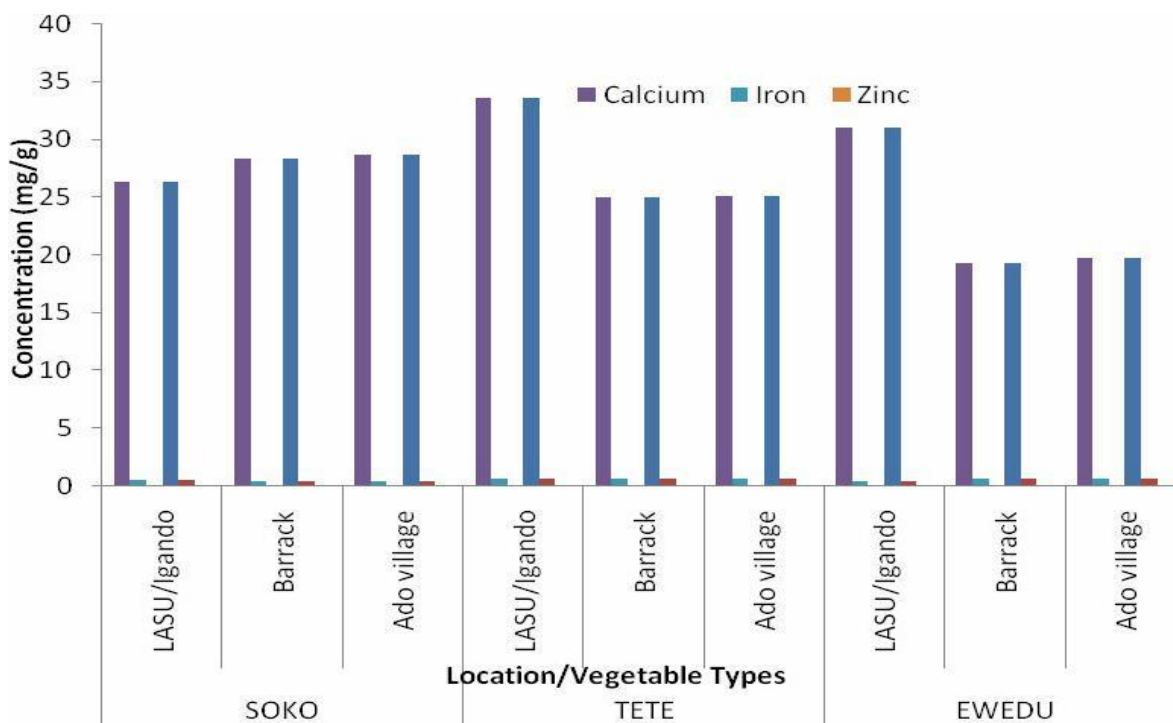


Figure 4. Mean concentration (mg/g) of nutritive metals of different vegetables from different locations.

and Salawu, 2005), and a significant difference in the moisture contents was observed in vegetables collected from the various locations. For Ash content of *C. olerius* (21.20%) is comparable to the leaves of *Talinum triangulare* (20.05%), Ifon and Bassir (1980); Ladan et al.(1996), but higher than the values reported for *Ipomeabatatas* (11.10%), *Vernonia colorate* (15.86%) and *Morin-ga oleifera* (15.09%), Lockett et al. (2000); Antia et al.(2006) *Ocimum gratissium* (18.00%) and *Hibiscus escu-lentus* (8.00%), (Akindahunsi and Salawu, 2005) (Ta-ble1). The ash content of *A. cruentus*, (26.29%) and *C.argenta* (32.36%) is much higher than all the above re-ported vegetables.

Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer

(Ishida et al., 2000; Rao and Newmark, 1998). The crude fibre of *C. olerius* (6.66%) is similar to the report given by Akindahunsi and Salawu, (2005), that of *A. cruentus*, (7.83%) is greater than *C. olerius* and *C. argenta* (11.70%) is higher than *Amaranthus hybridus* (8.61%) reported by Akubugwo et al. (2007).

The crude protein content of *A. cruentus*, *C. argenta* and *C. olerius* (12.66%, 9.35%, and 11.24%) (Table 1) respectively is higher than protein content of *Momordicafoecide* (4.6%) leaves consumed in Nigeria and Swazi-land, Ogle and Grivetti, (1985); Isong et al (1999); Has-san and Umar (2006), but lower than those of *I. batatas* (24.85% DW), *Amaranthus candatus* (20.5% DW), *Piperguineeses* (29.78%) and *T. triangulare* (31.0%), Etuk et al. (1998); Akindahunsi and Salawa (2005); Antia et al. (2006).

According to Pearson (1976), plant food that provides more than 12% of its calorific value from protein is considered good source of protein. Therefore, *A. cruentus* leaves meet this requirement. Furthermore, adults, children, pregnant and lactating mothers require 34 - 56, 13 - 19 and 17 - 71 g of protein daily respectively (FND, 2002).

The carbohydrate content of *A. cruentus*, (29.41%), *C. argenta* (32.84%) and *C. olerius* (31.34%) is comparable to 20 and 23.7% reported for *Senna obtusifolia*, *Amaranthus incurvatus* leaves respectively (Faruq et al., 2002; Hassan and Umar, 2006). However, lower than reported values for *Corchorus tridens* (75.0%) and sweet potatoes leaves (82.8%) (Asibey-Berko and Tayie, 1999). The recommended carbohydrate dietary allowance values for children, adults, pregnant and lactating mothers are 130, 130, 175 and 210 g respectively (FND, 2002).

A. cruentus, *C. argenta* and *C. olerius* leaves are poor source of lipid. The crude oil contents of 0.45, 0.21 and 0.32% respectively are low compared to reported values (8.3 - 27.0%) in some vegetables consumed in West Africa (Ifon and Bassir, 1980; Sena et al., 1998).

C. olerius leaves has energy values of 177.55 cal followed by *A. cruentus* with energy value of 176.67 cal and *C. argenta* having the least energy value of 174.93 calories per 100 g food. The crude fat analysis showed that vegetables are deficient in fats and this makes them good for health. ANOVA was used to analyse the results obtained from different locations. At 95% confidence level, there is a static difference in the moisture content, crude fibre, fat and ash contents of the investigated vegetables collected from the various locations.

Vegetables are good sources of fiber, which lowers the body cholesterol level, consequently decreases the risk of cardiovascular diseases. It is required that vegetables should be used frequently as they are good for health and provide most of the essential nutrients for normal body functions when consumed in appropriate combination.

The nutritive metals basically calcium, iron and zinc were determined in the vegetables. The concentration of calcium is in the order of *A. cruentus* (27.9mg/g), *C. argenta* (27.7mg/g) and *C. olerius* (23.3mg/g) (Table 2). Calcium is good for growth and maintenance of bones, teeth and muscles (Dosunmu, 1997; Turan et al., 2003), therefore these vegetables could provide veritable sources of calcium. The *A. cruentus*, *C. argenta* and *C. olerius* leaves have iron and zinc with mean concentration of 0.6 and 0.08 mg/g, 0.39 and 0.09 mg/g and 0.47 and 0.05 mg/g respectively. Minerals are important for vital body functions such as acid base and water balance. Calcium and phosphorus are the minerals present in the largest quantity in the structure of the body and in the bones. Iron is an important constituent of hemoglobin. Vegetables contribute these minerals and enhance their availability in daily life. These vegetables can supplement the daily requirements of Ca, Fe and Zn which have been put by (FAO/WHO 2001) at (260 mg/day), (0.425 mg/g) and zinc (0.099 mg/g) respectively (Weigert, 1991).

Conclusion

From this research it is shown that vegetables are nutritious foods that provide sufficient amount of nutrients needed for normal body function, maintenance and reproduction. It was found that nutrient compositions in all the selected vegetables were different.

Vegetables are poor sources of fat that make them good food for obese people. They are good source of fiber and can decrease the concentration of high cholesterol level in body. Comparing the mineral content with recommended dietary allowance, it was showed that the vegetables leaves are good sources of calcium, iron and zinc.

ACKNOWLEDGEMENT

We are grateful to Mr. Adekoya, M.A. of Evans Medical Plc. for assisting in the analysis.

REFERENCES

- Ajewole K (1999). Analysis of the nutritive elements in some Nigerian leafy vegetables. Proceedings 23rd Annual NIFST Conference. 25-27 October, Abuja.
- Akindahunsi AA, Salawu SO (2005). Photochemical screening and nutrient-anti-nutrient composition of selected tropical green vegetables. Afr. J. Biotech. 4: 497-501.
- Akubugwo IE, Obasi NA, Chinyere GC, Ugbo AE (2007). Nutritional and chemical value of *Amaranthus hybridus* L. leaves from Afikpo, Nigeria. Afr. J. Biotechnol. 6(24): 2833-2839.
- Antia BS, Akpan EJ, Okon PA, Umoren IU (2006). Nutritive and Anti-Nutritive Evaluation of sweet potatoes (*Ipomoea batatas*) leaves. Pak. J. Nutr. 5(2): 166-168.
- AOAC (1997). Methods of Analysis of Association of Official Analytical chemists (16th ed). Washington, D.C.1: 600-792.
- Asibey-Berko E, Tayie FAK (1999). Proximate analysis of some under-utilized Ghanaian vegetables. Ghana J. Sci. 39: 91-92.
- Awofolu OR (2005). A survey of Trace metals in vegetation, soil and lower animals along some selected major Roads in metropolitan city of Lagos. Environmental Monitoring and Assessment 10: 431-447.
- Dhellit JR, Matouba E, Maloumbi MG, Nzikou JM, Safou-Ngoma DG, Linder M, Desobry S, Parmentier M (2006). Extraction, chemical composition and nutritional characterization of vegetable oils: Case of *Amaranthus hybridus* (Var 1 and 2) of Congo Brazzaville. Afr. J. Biotechnol. 5(11): 1095-1101.
- Dosunmu MI (1997). Chemical composition of the fruit of *Tetrapleura tetrepra* and the physico-chemical Properties of its oil. Global J. Pure Appl. Sci. 3: 61-67.
- Edeoga HO, Omosun G, Uche LC (2006). Chemical composition of *Hyptis suaveolens* and *Ocimum gratissium* hybrids from Nigeria. Afr. J. biotechnol. 5(10): 892-895.
- Eko AS (2007). Determination of chemical composition of *Gnetum africanum* (AFANG) seeds. Pak. J. Nutr. 6(1): 40-43.
- Etuk EU, Basse MN, Umoh UO, Inyang EG (1998). Comparative nutritional studies on three local varieties of *Heinsia crinita*, Plant Varieties Seeds 11: 151-158.
- FAO/WHO (2001). Codex Alimentarius Commission Food additives and contaminants. Joint FAO/WHO Food Standards Programme; ALI NORM 01/12A:1-289.
- Faruq UZ, Sani A, Hassan LG (2002). Proximate composition of sickle pod. (*Senna obtusifolia*) leaves. Nig. J. Basic Appl. Sci. 11: 157-164.
- Fasakin K (2004). Proximate composition of Bungu (*Cerototheca sesamoides* Endl) leaves and seeds Biokemistri. 16: 88-92.
- Fayemi PO (1999). Nigerian Vegetables, Heinemann Educational Books Nigeria, 1st Edition pp 1-8.

- FND (2002). Food and nutrition board, Institute of medicine. National Academy of Sciences. Dietary reference Intake for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, protein and Amino acid (micro-nutrients). www.nap.edu (Retrieved on 14/05/2007).
- Hassan LG, Umar KJ (2006). Nutritional value of Balsam Apple (*Morinda balsamifera* L.) leaves. Pak. J. Nutr. 5(6): 522-529.
- He HP, Corke H (2003). Oil and squalene in Amaranthus Grain and leaf. J. Agric. Food Chem. 51(27): 7913-7920.
- Ifon ET, Bassir O (1980). The nutritive value of some Nigerian leafy vegetables- part 2: The distribution of proteins, Carbohydrates (including ethanol-soluble simple sugars), Crude fat, Fibre and Ash. Food Chem. 5: 231-235.
- Ishida H, Suzuno H, Sugiyama N, Innami S, Todokoro T, Maekawa A (2000). Nutritional evaluation of chemical component of leaves, stalks and stems of sweet potatoes (*Ipomea batatas* Poir). Food Chem. 68: 359-367.
- Isong EU, Adewusi SAR, Nkanga EU, Umoh EE, Offiong EE (1999). Nutritional and phytochemical studies of three varieties of *Gnetum africanum* (Afang). Food Chem. 64: 489-493.
- Khalil IA, Saleemullah IA (2004). Chemistry One. Bio-analytical Chemistry. T. S. Printers Pakistan p.41.
- Ladan MJ, Bilbils LS, Lawal M (1996). Nutrient composition of some leafy vegetable consumed in Sokoto. Nig. J. Basic Appl. Sci. 5: 39-44.
- Ladeji O, Okoye ZS, Ojobe T (1995). Chemical evaluation of the nutritive value of leaf of fluted pumpkin (*Telferia occidentalis*). Food Chem. 53: 353-355.
- Lockeett CT, Calvert CC, Grivetti LE (2000). Energy and micronutrient Composition of dietary and Medicinal wild plants Consumed during drought: Study of Rural Fulani, Northeastern Nigeria. Int. J. Food Sci. Nutr. 51: 195-208.
- Martin FW, Telek L (1979). Vegetables for the hot humid. Part 6: Amaranth and Celosia. U.S. Dept of Agric., New Orleans, LA. pp. 156-163.
- Mepha HD, Eboh L, Banigbo DEB (2007). Effects of processing treatments on the Nutritive Composition and consumer acceptance of some Nigerian edible leafy vegetables. Afr. J. Food Agric. Nutr. Dev. 7(1): 1-18.
- Ogle BM, Grivetti LE (1985). Legacy of the chameleon: Edible wild plants in the Kingdom of Swaziland, Southern Africa. A cultural, ecological nutritional study. Part IV: Nutritional analysis and conclusion. Ecol. Food Nutr. 17: 41-64.
- Okafor JC (1983). Horticultural Promising indigenous wild plant species of the Nigerian Forest zone. Acta Hort. 123: 165 – 176.
- Oke OL (1983). Amaranth. In: Handbook of Tropical Foods. Chan HT (ed). Marcel-Dekker, Inc., New York pp. 1-14.
- Oliveria JS, DeCarvalho MF (1975). Nutritional Value of some edible leaves in Mozambique. Econ. Bot. 29: 255-259.
- Oyedele DJ, Asonugbo C, Awotoye OO (2006). Heavy metals in Soil and accumulated by Edible Vegetable after phosphate fertilizer application. Electron. J. Environ. Agric. Food Chem. 5(4):1446-1453.
- Pearson D (1976). Chemical analysis of foods. (7th ed) churchhill, Livingstone, London pp. 218-336.
- Rao CV Newmark HL (1998). Chemo-preventive effect of Squalene on colon cancer. Carcinogenesis 19: 287-290.
- Robinson DS (1990). Food biochemistry and nutritional value. Longman scientific and technical publisher, New York. USA.
- SenaLP, VanderJagt DJ, Rivera C, Tsin ATC, Muhammadu I, Mahammadu O, Milson M, Pastosyn A, Glew RH (1998). Analysis of Nutritional Components of eight famine foods of the Republic of Niger. Plant Foods Hum. Nutr. 52: 17-30.
- Smith TJ (2000). Squalene: Potential Chemo preventive agent. Expert Opin. Invest. Drugs 9: 1841-1848.
- Thompson HC, Kelly WC, (1990).Vegetable Crops.5th Ed. New Delhi: Mac Graw Hill Publishing Company Ltd.
- Turan M, Kordali S, Zengin H, Dursun A, Sezen Y (2003). Macro and Micro- Mineral content of some wild edible leaves consumed in Eastern Anatolia. Acta Agric. Scand. Sect. B, Plant Soil Sci. 53: 129- 137.
- Weigert P (1991). Metal loads of food of vegetable origin including mushrooms. In: Merian E, ed. Metals and Their Compounds in the Environment: Occurrence, Analysis and Biological Relevance. Weinheim: VCH, 458-68.