Review paper

NUTRITIONAL COMPOSITIONS OF SELECTED GREEN LEAFY VEGETABLES IN OYO STATE, NIGERIA

ABSTRACT

The nutritional compositions of eleven green leafy vegetables obtained from major towns in Oyo State, Nigeria, were investigated using standard analytical methods for proximate analysis. The following nutrients in percentage were determined; moisture contents, ash, fat, crude fibre, crude protein and carbohydrate. The green leafy vegetable used are *Talium triangulare, Amaranthus hybridus*, *Launaena taraxacifolia Ocimum gratissimum*, *Celosia argentea, Cucuribita maxima, Abelimoschus esculentus, Solanum macrocarpon, Vernonia amygdalina* and *Sesamum indicum*. All nutrients were present in appreciable quantities. Moisture contents ranged from 5.33 ± 0.06% - 8.33 ± 0.06%, ash (23.07 ± 0.06% - 61.27 ± 0.06%), fat (1.13 ± 0.06% - 3.37 ± 0.06%), crude fibre (2.43 ± 0.12% - 22.03 ± 0.06%), crude protein (18.50 ± 0.10% - 55.23 ± 0.06%) and carbohydrate (0.23 ± 0.06% - 8.83 ± 0.06%). The functional properties of vegetables were close in term of high protein level indicating that they are more nutritious. Also, the level of their ash content showed that the vegetables are very rich in essential minerals for healthy life when compared with one another and recommended dietary allowance (RDA). Thus, there is a need for farmers in the area to engage in dry season vegetable production so as to ensure availability of leafy vegetables throughout the year.

Keywords: Oyo state, proximate, nutritional composition, green leafy vegetables.

INTRODUCTION

Vegetables are the fresh and edible portions of herbaceous plants, which can be eaten raw or cooked (Dhellot *et al*., 2006; Onwardi *et al*., 2009). 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. Vegetables can be grouped into edible roots, stems, leaves, fruits or seed. Each group contributes to diet in its own way (Onwardi *et al*., 2009). Leafy vegetables are regular ingredient in the diet of average Nigerian with their level of consumption; they can provide appreciable amounts of nutritive minerals (Ajewole, 1999). *Amarathus hybridus*, *Celusia argentea, Abelmoschus esculentus, Talinum triangulare, Vernonia amygdalina* and *corchorus olitorious* are popular edible vegetables in Nigeria. *Corchorus olitorius* is usually recommended for pregnant women and nursing mother because it is believed to be rich in iron (Oyedele *et al*., 2006).

Most developing countries depend on starch-based food as the main staple food for the supply of both energy and protein. This account in part for protein deficiency which prevails among the populace as recognized by Food and Agricultural Organization; F.A.O (Ladeji *et al*., 1995).

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). 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 the rural populace (Martin and Meitner, 1998). African indigenous leafy vegetables (ALVs) are the cheapest and most readily available sources of important proteins, vitamins, especially the pro-vitamin A (Martin and Meitner, 1998) and essential amino acids. Vegetables rank higher in production than all other crops; they are known to provide 80% of the vitamin A in diet (Bosland and Votava, 2000). Indigenous vegetables are reported to play a very important role in income generation and subsistency

(Schippers, 2000). They are important commodities for poor households because their prices are relatively affordable when compared to other food items. Vegetables provide very important sources of employment for those outside the formal sector in urban areas because of their generally short, labour intensive production systems, low levels of investment and high yield (Schippers, 2000). A large number of African indigenous leafy vegetables have long been known and reported to have health protecting properties and uses (Okeno *et al*., 2003). It is reported that the roots, leaves and twigs, as well as the bark of the tree of Moringa plants (*Moringa oleifera*) are used in traditional medicine (Smith and Eyzaguirre 2007).

The WHO recommended a minimum daily intake of 400g of fruits and vegetables (WHO, 2003). However, it is not clear from the report what proportion of this total daily intake should go to vegetables. Nevertheless, according to the Kobe framework document and an FAO report, the recommended total daily intake is equivalent to five (5) servings of 80g each of fruits and vegetables (FAO/WHO 2004 and FAO, 2003). Vegetables are full of water, especially when eaten raw, and when eaten, the body does not need to use some of its own water to digest them. This means less pressure is put on the digestive systems (Lussier, 2010). Green leafy vegetables like cabbage, lettuce, dandelion, and Moringa may be eaten raw, boiled or dried. Perhaps the most common use in all parts of the world is boiled vegetable leaves. This process eliminates potential pathogens, sometimes poisonous or irritating substances are neutralized and spoilage is brought to a halt (Martin *et al*., 1998).

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 (Onwardi *et al*., 2009). Vegetables also act as buffering agents for acidic substances produced during the digestion process (Onwardi *et al*., 2009).

Traditional African leafy vegetables are better adapted to the environment than the introduced exotic vegetables and also provide low-cost quality nutrition for large parts of the population in both rural and urban areas (Clement, 2011). Inadequate information on these vegetable species is causing gradual neglect of some of the useful ones that have been used for food over the years. Vegetables are a vital constituent of West African diet, and traditional vegetable species are highly important yet, many species are poorly known, being used only locally (Shei, 2008). The objective of this study is to evaluate the nutritional value of some leafy vegetables consumed in Oyo State South West of Nigeria to give more information that are lacking on the importance of these vegetables on the nutrient they supply and the best way of consuming them.

MATERIALS AND METHODS

Eleven leafy vegetables were collected from different locations within the study area (Ibadan, Ogbomoso, Oyo, Igboora, Iseyin, and Saki all in Oyo State) between months of March and April 2016. Vegetable collected includes *Talium triangulare, Amaranthus hybridus*, *Launaena taraxacifolia Ocimum gratissimum*, *Celosia argentea, Cucuribita maxima, Abelimoschus esculentus, Solanum macrocarpon, Vernonia amygdalina* and *Sesamum indicum*. They were identified and authenticated at department of Botany, University of Ibadan, Nigeria. The vegetables were air-dried at room temperature and ground to fine powder, using a laboratory mill and stored in air-tight containers for laboratory analysis. The nutritional compositions in terms of proximate analysis were carried out to determine Moisture contents, crude protein, crude fibre, fat, ash, and carbohydrate. All analysis were carried out in triplicates.

NUTRITIONAL ANALYSIS

The moisture content of the vegetable samples was determined after drying at 105 ºC in an electric oven (model: UNISCOPE5M9053) until a constant weight was attained (AOAC, 2000). The micro-Kjeldahl method was employed to determine the total nitrogen and the crude protein (N×5.95) (AOAC, 2000). A dry ashing method was used to determine the ash content (AOAC, 2000). The samples were ashed in a furnace (model: SXL) at 550 °C. The remaining inorganic material was cooled, weighed and further used for the determination of mineral contents. An ash solution was prepared by dissolving the ash in 100 ml of 1 M HCl. Crude fat was determined by Soxhlet extraction and crude fiber by incineration method after acid and base digestion. Total carbohydrate was calculated by the difference method (summing the values of moisture contents, crude protein, ash and crude fat (ether extract) and subtracting the sum from 100) (AOAC, 2000).

RESULTS AND DISCUSSION

Table of Proximate Composition of Vegetable Samples

Leafy Vegetables	Moisture (%)	Ash (%)	Fat (%)	Crude Fiber (%)	Crude Protein (%)	Carbohydrate (%)
Amaranthus hybridus	5.50 ± 0.10	27.53 ± 0.06	3.37 ± 0.06	10.07 ± 0.06	55.23 ± 0.06	0.23 ± 0.06
Talinum triangulare	7.70 ± 0.10	40.10 ± 0.1	3.23 ± 0.06	20.07 ± 0.12	25.30 ± 0.10	3.63 ± 0.06
Launaena taraxacifolia	5.33 ± 0.06	23.07 ± 0.06	1.30 ± 0.00	20.10 ± 0.10	50.10 ± 0.10	0.43 ± 0.06
Ocimum gratissimum	7.73 ± 0.06	46.2 ± 8.7×10^{-29}	1.37 ± 0.06	10.10 ± 0.10	32.63 ± 0.06	2.13 ± 0.15
Cucuribita maxima	6.17 ± 0.06	50.27 ± 0.06	1.13 ± 0.06	10.07 ± 0.12	30.47 ± 0.06	1.90 ± 2.72×10^{-16}
Ocimum canum	6.77 ± 0.06	23.13 ± 0.06	1.20 ± 0.00	20.13 ± 0.12	47.13 ± 0.12	2.03 ± 0.06
Celosia argentea	6.33 ± 0.06	40.13 ± 0.06	2.67 ± 0.06	22.03 ± 0.06	20.20 ± 0.17	8.83 ± 0.06

Solanum macrocarpon	6.27 ± 0.06	54.03 ± 0.06	2.20 ± 0.10	2.43 ± 0.12	23.10 ± 0.10	12.23 ± 0.06
Abelmoschus esculenthus	6.23 ± 0.06	61.27 ± 0.06	3.40 ± 0.10	7.60 ± 0.10	20.10 ± 0.00	1.43 ± 0.06
Vernonia amygdalina	7.27 ± 0.06	58.33 ± 0.15	2.47 ± 0.06	10.17 ± 0.06	19.20 ± 0.17	2.67 ± 0.06
Sesanum indicum	8.33 ± 0.06	58.17 ± 0.06	2.33 ± 0.06	10.13 ± 0.06	18.50 ± 0.10	2.40 ± 0.00

Mean values ± Standard deviation values n=3.

The eleven leafy vegetables show the moisture content ranges from 5.33% to 8.33%. The results obtained were close to that reported for *Basella alba (*11.57%) and *Amaranthus hybridus* (10.00%) by Asaolu *et al*., (2012), *Cleome gynandra* (15.90%) reported by Clement (2011) and 15.6% for *Celusia argentia* by Onwardi *et al.,* (2009). In this study, it was observed that a closer relationship occurred between the moisture content of the leafy vegetables under study, but a great difference was observed when compared with the one reported by Idris *et al., (*2009) for *Abelimoschus esculentus* (82.53%) and 79.98% reported for *Corchorus olitorious* by Adeniyi *et al.,* (2013). Also, as it has been reported in the work of Kivenin *et al.,* (2011) that leafy vegetables have high moisture content ranging from 72.93% to 91.83%, the significant difference observed now may be due to the cultivation conditions that influence the water level of vegetables (Florkowski *et al*., 2009). George, (2003) stated that moisture content makes an important contribution on the texture of the leaves and helps in maintaining the protoplasmic content of the cells; it also makes them perishable and susceptible to spoilage by microorganisms.

The highest result was recorded for *A. esculenthus* (61.27%) while *Launaena taraxacifolia* had the least value of 23.07%. Ash, according to Mc Clement (2003) is the inorganic residue which provides a measure of the total amount of minerals present in food. There were significant interactions among the samples used in this study and a great difference was obtained when compared with the ash content range of 10.0% - 12.5% recorded for *Cleome*

136 *gynandra* by Clement (2011). The range obtained in this research was less than that reported
137 by Tamegnon *et al*., (2012) for *Solanum macrocarpon* (92.58%).

138 Therefore the small difference observed when these vegetables are compared with one
139 another, and the immense difference observed when compared with the vegetables studied by
140 another scientist above may be of the fact that, there is different concentration of minerals in
141 the soil onto which they were planted. Crude fibre ranged from 2.43% (*S. macrocarpon*) to
142 22.03% (*Celosia argentea*), this fell within the range (8.50% - 20.90%) reported by Isong and
143 Idiong, 1997 for some Nigerian vegetables. Dietary fibre helps to prevent constipation, bowel
144 problems and piles. High crude fibre in the vegetable according to CFW, (2003) could also
145 help in blood cholesterol attenuation, as well as blood glucose attenuation when consumed.
146 The fibre content recorded in this study were in line with 6.0g/ 100g to 6.33g/100g reported
147 by Hassan *et al*. (2007) and also in line with the result obtained for crude fibre content of
148 Asaolu *et al*., (2012) which ranges from 8.05% to 12.08%. Therefore, *Celosia argentea,*
149 *Launaena taraxacifolia*, *Talinum triangulare* and *Ocimum canum* are good source of crude
150 fibre as suggested by this study which could be of immense health benefit to their consumer
151 which follows Clement (2011) reports, that an increased intake of dietary fibre appears to be
152 useful in treatment of both obesity and diabeties.

153 The crude fat content in this study ranges from 1.20% to 3.40%, where high values were
154 observed for *Abelmoschus esculenthus, Amaranthus hybridus and Talinum triangulare.*
155 Asaolu *et al*. (2012) study, reported 3.51% to 14.02% range for crude fat in *Amaranthus*
156 *hybridus, Indian spinach and Telfaira occidentalis.* Vegetables with high Dietary fats
157 represent the most compact chemical energy available to man (Kummerow, 2007).

158 The protein content of the vegetables ranged from 18.50% to 55.23% with *Amaranthus*
159 *hybridus* showing the highest value followed by *Launaena taraxacifolia and Ocimum canum*

among others. It is also in accordance to the result reported by Asaolu *et al*. (2012) which ranges from 46.56% to 66.60%. Plant foods that provide more than 12% of their calorific value from protein have been shown to be good source of protein (Ali, 2009). This shows that all the leafy vegetables investigated are all good sources of protein. Protein help in building and maintaining all tissue in the body forms an important part of enzymes, fluid and hormones of the body and also helps form antibodies to fight against inaction and supplies energy (Jonhson, 1996). Proteins help in building and maintaining all tissues, forms an important part of enzymes, fluids, hormones of the body and form antibodies (immunoglobulin) that fight against infections and supplies energy (Clement, 2011). The protein content of vegetables in this study was high, showing that they are more nutritious.

The level of protein in the vegetables generally indicates that they are very important for human health and are good supplements for people living below the poverty level, especially in the rural areas.

It has been stated by Osei (2003) that carbohydrate may form 50 – 80% of the dry matter in the form of non- starch polysaccharides including cellulose, hemicelluloses and lignin. But looking through the result for *Ocimum gratissmum* (2.13%), *Cucuribita maxima* (1.90%), *Ocimum canum* (2.03%), *Talinum triangulare* (3.63%), *Vernonia amygdalina* (2.67%), *Sesanum indicum* (2.40%) and *Celosia argentea* (8.83%) their carbohydrate contents were low except for *Solanum macrocarpon* (12.23%) which had the highest among the vegetables in this study. There was a significant difference when compared with the result obtained for *Corchorus olitorius* (30.40% - 33.0%) by Onward *et al.,*(2009). Carbohydrate was low in the sample due to high level of protein content.

CONCLUSION

The result of this research work showed that all the vegetables used in this study are more nutritious because they are very good source of protein. Also, their fibre contents were a bit low but when consumed, could correct body abnormalities such as obesity and diabetes. Also, their low fat content level indicated that, they are good for human health because they will not easily provide additional calories to the body when ingested. High ash contents indicate that, they are vital source of minerals (Na, K, Fe, Zn, Cu, Ca and P), particularly Ca could be helpful in building up strong teeth and bones, and also prevent haemophilia in blood.

Farmers should continue engaging in vegetable production and marketing. The farmers should be motivated by the government, especially the local government with provision of effective measures that could guide against any factor which may hinder the productivity of the vegetables. In addition, for sustenance of poor people in some rural areas, leafy green vegetables are very important and should therefore be an effective and efficient means of transportation to other parts of the country where productivity is low.

REFERENCES

Adeniyi, B. 2013. Nutritional Evaluation of Some Staple Leafy Vegetables in Southern Nig. *Int'*
Journal of Agric and Food Science, 3(1): pp. 18-23.

Ajewole, K. 1999. Analysis of the Nutritive Elements in Some Nigerian Leafy Vegetables
Proceedings 23rd Annual NIFST Conference, pp. 25-27 0ctober, Abuja

Ali, A. 2009. Proximate and Mineral Composition of the Marchubeh (*Asparagus officinalis*).
World Dairy and Food Science, 4(2): pp. 142-149.

AOAC. 1990. "*Official Method* of *Analysis*", 15th Edition, Association of Official
Analytical Chemists. Washington D. C. Leafy Vegetables. *Food Chemistry,* 5: pp.
243-247.

AOAC. 1990. "*Official Methods of Analysis"*, 14th Edition, Association of Official
Analytical Chemists, Washington D.C., Arlington, Virginia, U. S. A., pp. 1137–1139.

AOAC. 2000. "*Official Methods of Analysis".* 17th Edition. *Association of Official Analytical Chemists.* Washington, D. C., U. S. A., p. 2000

Bosland, P. W. and Votava, E. J. 2000. Peppers: Vegetable and Spices *Capsicums*. Crop Production Science in Horticulture Series No. 2, CABI Publishing, United Kingdom.

Asaolu, S. S, Adefemi, O. S, Oyakilome, I. G., Ajibulu, K. E. and Asaolu, M. F. 2012. Proximate and Mineral Compositions of Nigerian Leafy Vegetables. *Journal of Food Research,* 1(3) ISSN 1927-0887

C. F. W. 2003. All Dietary Fiber is Fundamentally Functional. C. F. W. Report. Publication no. W-2003-0407-01O. 128 / May-June, 2003. 48(3).

Clement, A. 2011. Assessment of some Traditional Leafy Vegetables of Upper East Region and Influence of Stage of Harvest and Drying Method on Nutrients Content of Spider Flower (*Cleome gynandra* l.). B. Sc. (Hon). Thesis submitted to the Department of Horticulture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.x+136.

Dhello, J. R., Matouba, E., Maloumbi, M. G., Nzikou, J. M., Safou-Ngoma, D. G., Linder, M.,
Desobry S., Parmentie, 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): pp. 1095-1101.

Florkowski, J. W., Robert, L. S., Bernhard, B. and Stanley, E. P. 2009. *Postharvest Handling: A Systems Approach*, Second Edition. Elsevier Inc. Academic Press.

George, P. M. 2003. Encyclopedia of Foods. Volume 1. Humane Press; Washington. p. 526.

Hassan, S. W., Umar, R. A., Maishanu, H. M., Matazu, I. K., Faruk, U. Z. and Sani A. A. 2007. The Effects of Drying Method on the Nutrients and Non-nutrients Composition of Leaves of *Gynandropsis gynandra* (Capparaceae). *Asian Journal of Biochemistry 2* (5): pp. 349-353, ISSN 1815-9923.

Idris, Yisah, J. and Itodo, A. U.2009. Proximate and Mineral Composition of the Leaves of *Abelmoschus esculentus*: *International Journal of Tropical Agriculture and food system* 3(2): pp. 134-143

Isong, E. and Idiong. 1997. Nutrient Content of the Edible Leaves of Seven Wild Plants from Nigerian. *Plant foods for human nutrition,* 51: pp. 79-84
.
Johnson, R. S. 1996. Key Nutrients. Cooperative extension service, Iowa State University of Science and Technology, Ames, Iowa. Keding, G., Weinberger, K., Swai, I. and Mndiga, H. 2007. Diversity, Traits and Use of Traditional Vegetables In Tanzania. Technical Bulletin No. 40. Shanhua, Taiwan: AVRDC- The World vegetable Centre. p. 53.

Kummerow, F. A. 2007. *Fats in Human Nutrition.* Department of Food Technology, University of Illinois, Urbana, Illinois.

Kwenin, W. K., Wolli M. and Dzomeku, B. M. 2011. Assessing the Nutritional value of some African Indigenous Green Leafy Vegetables in Ghana. *Journal of Animal and Plant Sciences,* 10,(2): pp. 1300- 1305.

Ladeji, O., Okoye, Z. S. and Ojobe, T. 1995. Chemical Evaluation of the Nutritive Value of Leaf of Fluted Pumpkin *(Telferia occidentalis). Food Chem.,* 53: pp. 353-355.

Lussier, N. 2010. Nutritional Value of Leafy Green Vegetable.

Martin, E. A. and Farrell, D. J. 1998. Strategies to Improve the Nutritive Value of Rice Brawn in Poultry Diets. II Changes in Oil Digestibility, Metabolisable Energy and Attempts to Increase the Digestability of the Oil Fraction in the Diets of Chickens and Ducklings. *Br. Poult. Sci.,* 39(4): pp. 555-559

Mcclements, D. J. 2003. *Analysis of Food Products*. Chenoweth Lab, Room 238.

Mepba, H. D., Eboh, L. and Banigo, D. E. B. 2007. Effects of Processing Treatments on the Nutritive Compositions and Consumer Acceptance of Some Nigerian Edible Leafy Vegetables. *African Journal of Food, Agriculture, Nutrition and Development* 7(1).

Mohammed, M. I., and Sharif, N. 2011. Mineral Compositions of Some Leafy Vegetables Consumed in Kano, Nigeria. *Nigerian Journal of Basic and Applied Science, 19*(2), pp. 208-211.

Okeno, J. A, Chebet, D. K., Mathenge, P. W. 2003. Statues of indigenous vegetables. *Acta Hort. Culturae,* 621:pp. 95-100.

Onwordi, C. T, Anuoluwa, M. O and Adedoja, D. W. 2009. The Proximate and Mineral Compositions of three Leafy Vegetables Commonly Consumed in Lagos, Nigeria. *African Journal of Pure and Applied Chemistry*. 3 (6): pp. 102-107.

Osei S. 2003. *Animal Nutrition-Lecture Notes.* University of Education, Winneba. Faculty of Agriculture, Mampong-Ashanti.

Oyedele, D. J., Asonugho, C., Awotoye, O. O. 2006. Heavy Metals in Soil and Accumulated Edible Vegetable after Phosphate Fertilizer Application. *Electron. J. Environ. Agric. Food Chem*. 5(4): pp. 1446-1453.

Schippers, R. R. 2000. Economic and Social Importance of Indigenous African Vegetables: African Indigenous Vegetables, An Overview of the Cultivated species. Natural Resource Institute/ACP-EU Technical Centre for Agriculture and Rural Cooperation. Chatham, U.K.

Shei, L. 2008. An Evaluation of Native West African Vegetables. *Agriculture and Rural Development.*

316 Sobukola, O. P., Dairo, O. U., Odunewu, A. V., and Fafiolu, B. O. 2007. Thin-layer
317 Drying Process of Some Leafy Vegetables under Open Sun. *Food Science and*
318 *Technology,* 13(1), pp. 35-40.
319
320 Smith, F. I. and Eyzaguirre, P. 2007. *African Leafy Vegetables*: their Role in the World
321 Health
322 Organization's Global Fruit and Vegetables Initiative AJFAND on line, 7(3) ISSN
323 1684-5374.
324
325 WHO and FAO. 2004. *Vitamin and Mineral Requirements in Human Nutrition*. 2nd
326 Edition. World Health Organization and Food and Agriculture Organization of the
327 United Nations.
328
329 Wikipedia, 2010. *Meaning of Protein*. www.wikipedia.com.
330
331 World Health Organisation, 2003. Diet, Nutrition and the Prevention of Chronic Diseases.
332 *Report of a Joint FAO/WHO. Expert Consultation, WHO Technical Report series,*
333 Geneva.