Available online at http://www.ajol.info/index.php/njbas/index
Nigerian Journal of Basic and Applied Science (2011), 19(2):208-212 ISSN 0794-5698

Mineral Composition of Some Leafy Vegetables Consumed in Kano, Nigeria

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ABSTRACT: Five different vegetable samples were obtained from Yan-Kaba Market, Kano city, Nigeria, and were analyzed for the presence of Mg, Mn, Cu, Zn, Mo, and Fe using Atomic Absorption Spectrophotometery. The results of the analysis showed that, on the average, highest concentration of Mg was recorded in the range of 0.964 to 1.393mg/g in all the samples analyzed, while Mo was found to be the least with concentration range of 0.014 to 0.031mg/g. Comparing the mineral contents obtained in this work with the Recommended Dietary Allowances (RDAs) values, the results indicate that the vegetables could be good supplement for some of the elements analyzed.
Keywords: Leafy Vegetables, Mineral, Trace Metals

INTRODUCTION

Leafy vegetable are widely used for culinary purposes. They are used to improve the quality of soup and also for their dietary purposes (Sobukola *et al*., 2007). They are made up of chiefly cellulose, hemi-cellulose and pectin substances that give them their texture and firmness (Sobukola and Dairo, 2007). Fresh vegetables are of great importance in the diet because of the presence of vitamins and mineral elements. They are very important protective food and useful for the maintenance of health and the prevention and treatment of various disease (D' Mellow. 2003). However, these plants contain both essential and toxic metals over a wide range of concentrations (Radwan and Salama, 2006).

Metals are circulated by biogeochemical processes. Some metals are essential and their deficiency results in impairment of biological functions. When present in excess, essential metals may become toxic. Other metals not known to have essential function may give rise to toxic manifestations when intakes are in excess (Friberg and Norberg, 1986). Unlike organic chemicals that can be eliminated from tissue by metabolic degradation, the metals are not biodegradable and therefore have potential for bioaccumulation (Gbaruko and Friday, 2007).

Accumulation in tissues do not necessarily imply the occurrence of toxic effects because inactive complexes or storage are formed in case of certain metals (Clarkson, 1986).

Heavy metals imputes need not to be as small as possible because some metals are indispensable for life. There are three criteria for determining whether or not an element is essential;

- It must have direct influence on the organism and is involved in its metabolism.
- The organism can never grow complete in its life cycle without adequate supply of the element, and
- The element cannot be wholly replaced by any other (Alloway, 1990).

Copper and Zinc are essential elements whose lack give rise to deficiency problems in plants and animals (Alloway, 1990). Food plants that tolerate high concentration of potentially hazardous metals (phyto-accumulators) create greater health hazard to consumers than those that are more sensitive. In general, food plants are more sensitive to Cu and Zn than to Pb and Cd (Alloway, 1990). Excessive uptake of both essential (Cu and Zn) and non essential (Pb and Cd) metals may results in adverse effect on soil biota (Alloway, 1990).

The aim of this work is to determine the levels of Cu, Zn, Mg, Mn, Mo, and Fe in leaves of some selected leafy vegetables consumed by the inhabitants of Kano, Nigeria.

MATERIALS AND METHOD

Sampling Collection and Preparation

Five commonly and widely consumed leafy vegetables in Kano, Nigeria were selected for analysis. The varieties are; *Hibiscus cannabinus, Cassia tora, Vernonia amygdalina, Corchorus olitorius, and Corchorus tridens.* The vegetable were purchased from "Yan-Kaba market in Kano city, Nigeria. Identified in the Department of Biological Sciences, Bayero University Kano-Nigeria.

The leaves were separated in each case, cut into pieces, washed, and air dried on the laboratory benches and later dried in an oven at 80^0C for six hours. The dried materials were grounded into powder using mortar and pestle. Each powdered sample was digested as reported by Anjorin *et al.* (2010). Briefly, 2g of each powdered samples was weighed into separate beaker and treated with $20cm^3$ of HNO_3 and digested on an electric hot plate at 70-90^{o}C for 60 min. Blank was prepared similarly by digesting $20cm^3$ of HNO_3 in an empty beaker. The content of the beaker was allowed to cool, filtered through Whatman No. 42 filter paper into volumetric flask and made up to volume of $100cm^3$ with de-ionized water. The digests were analyzed for the mineral and trace metals contents using Buck Scientific model 210VGP Atomic Absorption Spectrophotometer.

Instrumentation

Metal concentrations were determined on a Buck scientific model 210VGP Atomic Absorption Spectrometer (AAS) equipped with a background correction. The result of each sample represents an average of three replicate readings. A calibration curve of absorbance against concentrations of each element under investigation was constructed and finally the concentration of each element was determined from the calibration curve of its standards by interpolation.

RESULTS AND DISCUSSION

The results of some essential minerals in the vegetables investigated was presented in Figure 1.

Magnesium (Mg)

Magnesium is widely distributed in plants and animal foods. Geochemical and other environmental variables rarely have a major influence on its contents in foods. Most green vegetables, legume, seeds, peas, beans and nuts are rich in magnesium, as are some shell fish, spices and Soya flour, all of which usually contain more than 500mg/kg fresh weight. Soft tissue magnesium functions as a co-factor of many enzymes involved in energy metabolism, protein synthesis, RNA and DNA synthesis and maintenance of the electrical potential of nervous tissues and cell membranes. Of particular importance with respect to the pathologic effects of magnesium deficiency is the role of this element in regulating potassium fluxes and its involvement in the metabolism of calcium FAO/WHO, (2002). As shown in the Figure 1, *Cochorus olitorius* contained the largest amount of magnesium (1.39mg/g) among the plants studied. The magnesium content of the other plants ranged from 0.893 to 1.191mg/g. Various values have been previously reported for vegetables which include 3.80mg/g in *C. tridens* and 3.968mg/g in *C. tora* (Barminas *et al.*, 1998). Similarly, Freiberger *et al.* (1998), reported *C. tridens*, *H. subdarifa* and *Moringa oleifera* to contain 3.85mg/g, 3.52mg/g and 4.34mg/g, respectively. These values are significantly different from those reported in this work. The differences in the mineral content of the vegetable plant might be due to soil compositions and the rate of uptake of minerals by individual plant (Anjorin *et al.*, 2010; Asaolu and Asaolu, 2010).

Manganese (Mn)

Manganese among the various plants was found to be concentrated in *C. olitorius* (0.613mg/g) than all other plants samples, followed by *C. tora* (0.425mg/g). *H. cannabinus* was having the least manganese content of 0.275mg/g, compared to *V. amyglidina* and *C. tridens* with 0.318 and 0.400mg/g respectively (Figure 1). Various values have been previously reported for leafy vegetables, which include 0.027mg/g of *V. amyglidina* by Ayoola *et al.* (2010). Barminas *et al.* (1998) reported the levels of manganese in *C. tora* and *C. tridens* to be 0.048mg/g and 0.074mg/g, respectively. Freiberger *et al.* (1998) had reported levels of Mn in *C. tridens* obtained from two different locations to be 0.0497mg/g and 0.0498mg/g. however, the values reported by these workers were less than to those obtained in this study. High concentration of Mn in these plants is not up to the extent that, are likely to cause harm to the individuals consuming them. But rather help them in preventing adverse effects of dietary deficiencies of manganese on the central nervous systems and skeletal anomalies among children (Barminas *et al.*, 1998). According to Itanna (2002), when people do not live up to the recommended daily allowance their health decrease, but when the uptake is too high health problems also occur. The recommended daily allowance for Mn is 2.5 to 5.0mg (FAO/WHO, 2002).

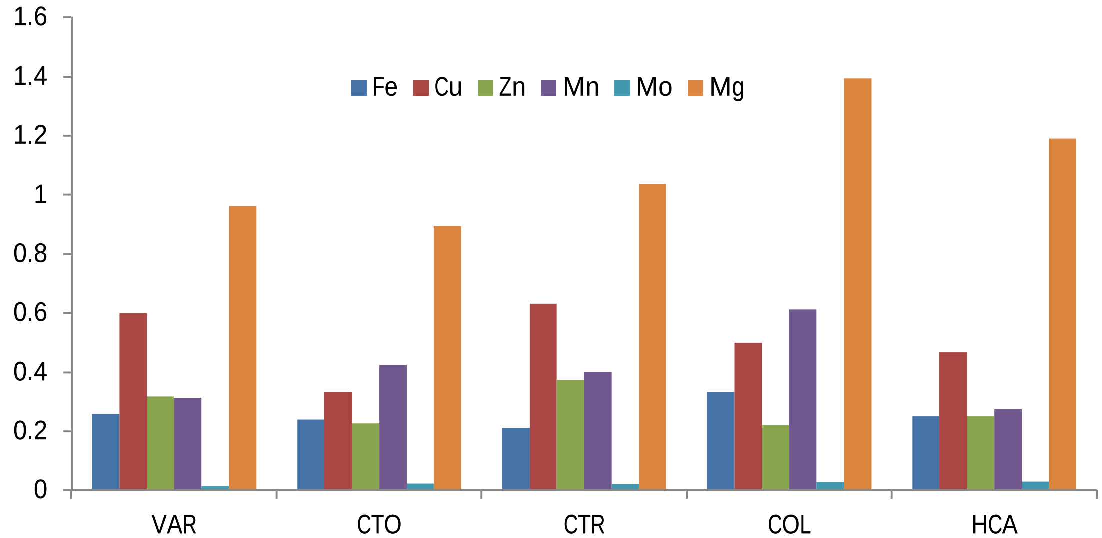

Figure 1: Mean concentrations of Fe, Cu, Zn, Mn, Mo, and Mg in leaves of samples analyzed

Key: VAR= *Vernonia amygdalina*, CTO= *Cassia tora*, COL =*Corchorus olitorius*, ,
HCA= *Hibiscus cannabinus.* CTR= *Chorchorus tridens*

Iron (Fe)

Iron is important in the diet especially for pregnant and nursing mothers as well as infants. It is also needed by the convalescent and the elderly to reduce cases of diseases associated with deficiency of iron such as anemia (D'Mello, 2003). The highest iron content of 0.334mg/g was found in the leaves of *C. olitorius*. According to Figure 1, the leaves of *C. tridens* contain the least iron content of 0.213mg/g, while *V. amyglidina* and *H. cannabinus* have significantly higher iron content of 0.260 and 0.250mg/g, respectively. *V. amyglidina*, *C. tora* and *C. olitorius* leaves were reported to contain 0.277mg/g and 0.204mg/g and 0.84mg/g of iron respectively by Ayoola *et al.* (2010), Barminas *et al.* (1998) and Asaolu and Asaolu, (2010). Freiberger *et al*. (1998) reported the iron content of *C. tridens* obtained from two regions in Niger republic to be 0.385mg/g and 0.405mg/g. The values are in agreement with those obtained in this work. According to research carried out by Barminas *et al.* (1998), an average culinary preparation contains about 300g of the fresh leaves of vegetables and this would result in an intake of 30g dry weight leaves per serving portion. Therefore 0.33mg/g, 0.260mg/g and 0.250mg/g in *C. olitorius*, *V. amygdalina* and *H. cannabinus*, will contribute up to 9.9mg, 7.8mg and 7.5mg/serving portion of Fe respectively, to the recommended dietary allowance of Fe (10-15mg/day) (FAO/WHO, 2002).

Copper (Cu)

Copper is an essential micronutrient which functions as a biocatalysts, required for body pigmentation in addition to iron, maintain a healthy central nervous system, prevent anemia and interrelated with functions of Zn and Fe in the body (Akinyele and Osibenjo, 1982). However, most plants contain the amount of copper which is inadequate for normal growth which is usually ensured through artificial and organic fertilizers (Itanna, 2002). In this study the concentrations of Cu in the analyzed samples varied between 0.633 and 0.333mg/g with *C. tridens* leaves having the highest and *C. tora* the least copper concentrations as shown in Figure 1. The values obtained in this work were observed to be higher compared to other published results such as reported by Barminas *et al.* (1998), as *C. tora* and *C. tridens* which have 0.018mg/g and 0.015mg/g of copper, respectively. The difference in copper level could be due to the fact that many soils are geographically deficient in certain minerals and therefore foods plants grown in them lack those nutrients. A similar problem can be caused by over farming or poor soil management (Nielson, 1996).

Zinc (Zn)

Figure 1 shows the trace and mineral composition of five leafy vegetables widely consumed by people of Kano Nigeria. From the figure it can be seen that *C. tridens* contained the highest amount of zinc (0.375mg/g) followed by *V. amyglidina* (0.318mg/g), while 0.250mg/g, 0.228mg/g and 0.221mg/g were found in *H. Canabinus*, *C. tora* and *C. olitorius* respectively. The zinc content of *C. tora* (0.228mg/g) was not significantly different from that obtained in a published work of *Barminas et al.,* 1998), which reported *C. tora* to contain an average of 0.209mg/g Zn. They also reported *C. tridens*, *Amarantus spinosus*, *Adansonia digitata* to contain 0.123, 0.068 and 0.224mg/g of Zinc, respectively. Zinc is important for nerve function and male fertility. It is important for normal sexual development especially for the development of testes and ovaries, it is also essential for reproduction (Ayoola *et al.,* 2010), healthy functioning of the heart and normal growth (Elizabeth, 1994). Regular consumption of these three vegetables may assist in preventing the adverse effect of zinc deficiency which results in retarded growth and delayed sexual maturation because of its role in nucleic acid metabolism and protein synthesis (Barminas *et al.,* 1998).

Molybdenum (Mo)

The content of molybdenum in the plant samples analyzed ranges from 0.014mg/g to 0.031mg/g (Figure 1) in the *V. amyglidina* and *H. cannabinus* respectively while *C. tora* (0.024mg/g), *C. olitorius* (0.027mg/g) and *C. tridens* (0.022mg/g) have the intermediate levels. No much work was found for the composition of Mo in various plants. However, Freiberger *et al.* (1998) reported low Mo concentration (<0.005mg/g) on *C. tridens*, *Ammarantus viridus* (0.0075mg/g), *Ximenia americana* (0.063mg/g), *M. oleifera* (0.00745mg/g) and *Maerua crassifolia* (0.022mg/g). The recommended daily allowance for Mo ranges from 0.075 to 0.250mg/g (Nielson, 1996).

CONCLUSION

This study reported the concentrations of some trace elements and mineral composition of five different vegetable plants consumed by the Kano inhabitants; the results show that the plants are rich sources of minerals and beneficial trace elements. The findings have indicated that the vegetables studied could make significant contribution to the recommended dietary allowances for the nutrients. There is need to investigate the proximate composition of these vegetable in order to have a complete picture of their nutritional value.

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