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Levels of some mineral element in the leaves of three Nigerian vegetables in Abeokuta, Ogun State of Nigeria

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ABSTRACT

Some mineral element levels in three Nigerian Vegetables were investigated. High levels might cause pollution of these vegetables thereby rendering them unsafe for consumption by the populace living in these environment. Moisture content, Iron, Manganese and Copper were determined in green Soko, Celocia argents L; Tete, Amaranthus hybridus L; and Ewe iroko (Ugu) Telfaira occidentalis collected from four markets (Gbangba, Kuto, Olumore and Iberekodo) in Abeokuta metropolis. Moisture content was determined by standard method while Iron was determined colourimetrically. Copper and Manganese were determined using Atomic Absorption Spectrophotometer, Perkin Elmer Corporation, Norwalk Model. % MCof the leaves ranged from 85.00% in Ugu of Gbangba to 92.48% in Soko of Kuto. The concentrations of Iron, manganese and Copper in the leaves ranged from 6.540 mgkg^{-1} in Tete of Kuto to 8.40 mgkg^{-1} in Soko of Olomore, 0.483 mgkg^{-1} in Ugu of Kuto and Gbangba to 8.420 mgkg^{-1} in Soko of Gbangba and Iberekodo, 0.041 mgkg^{-1} in Ugu of Kuto and Gbangba to 0.047 mgkg^{-1} in Soko of Iberekodo. Their observed mean values are 7.405 mgkg^{-1}, 0.484 mgkg^{-1} and 0.042 mgkg^{-1} respectively. The levels of some elements in these vegetables were found to be below the permissible level recommended by WHO but were also found to be lower than the recommended daily dietary intake except for Manganese. Leaves of these three vegetables are recommended for consumption for the populace in this environment.

Keywords: Mineral elements, levels, pollution, permissibe limit, daily dietary intake

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INTRODUCTION

The word vegetable has been in use for a very long time but there had been no satisfactory definition for it. Vegetable, according to Longman Dictionary of contemporary English, can be defined as the part of the plant that is grown for food to be eaten with the main part of a meal (Procter, 1978).

A vegetable is a part of plant that is eaten by humans but is not a fruit, nut, herbs, spice or grain. For example, carrots and cabbage are vegetables. They are also regarded as sources of roughage in diets (Dara, 1993).

Vegetables and fruits are sometimes called produce (Essian, 1992). The food value of vegetable, especially leafy and fruit vegetable is low because of large amount of water.

There is an increasing awareness of consumption of vegetable in maintaining health, particularly in areas where animal protein is scarce. Presences of vegetables in human diets are very valuable because of the vitamins, mineral elements like Calcium, Copper, Iron, Manganese, Molybdenum and fibre. They provide and contribute to pungency and flavour of soups. They are nutritionally most valuable when eaten fresh and raw.

Although, they are not the major source of energy, they provide maximum quality of food for the consumers and they also grow quickly. They have nutritive significance for minerals and vitamins which are essential in the maintenance of health, that cannot be overemphasized (Bolaji *et al.*, 2008).

Vegetables also contain some solid matters which are made up of carbohydrates along with small amount of proteins and fats. They also contain cell wall and long cytoplasm which stores starch. These substances, together with water are called the major constituents. However, those present in relatively small amounts along with other classes of organic compounds and a wide range of mineral elements drawn from the soil are referred to as 'minor' constituents and can have the most important influence on colour, flavor, nutritive value and texture.

Iron, Copper and Manganese are important to human body because they act as cofactors for a number of enzymes that catalyze important chemical transformations required for the health of the people and maintenance of structural integrity of cell membrane. They are essential parts of the biochemical reactions that affect the bones, the brain function, the energy supply to mention but a few.

The presence of these elements has always been of interest to nutritionist and food scientists due to the role they play in human health (Turnland, 1998). The importance of Iron, Copper and manganese has been well established with several reasons. Firstly, in rich industrialized and developed countries dietary deficiencies of Iron, Copper and Manganese has been the cause of severe damage (Turnland, 1998).

Iron deficiency in the blood leads to a condition known as anaemia. However, copper causes a great decline in the state of health while Manganese causes asthma, slipped tendon, nerve damage, growth retardation and miscarriage to mention but a few.

Iron deficiency manifests itself as a hyperchromicanaemia in which the conditional number of red blood cells may be normal but there is a subnormal level of circulating haemoglobin in the cells. The oxygen capacity of the blood is lowered, many body functions are affected and there is general weakness and fatigue.

Seventeen trace element, have been identified as important for biological functioning in animals but increasing consumption of highly refined or fabricated foods substantially reduces the intake of important micro minerals. These micronutrients may eventually prove essentially for man but present knowledge indicates that the following trace minerals are critical to life. These are Chromium, Cobalt, Copper, Iron, Manganese, Iodine, Molybdenum, Selenium and Zinc. The list is not considered to be exclusive but rather a reflection of the present state of information about the human needs for the trace elements.

The most abundant mineral elements of vegetables are macro nutrients which include Potassium, Calcium, Iron, magnesium, Nitrogen, Phosphorus, together with other elements such as Sodium, Aluminium and Silicon which though not essential to the plant but are often well present in the soils.

The essential micronutrients are Chlorine, Copper, Manganese, Zinc, Molybdenum, which are present in minute quantities. It is interesting to note that the distribution of the various elements within the plant is not uniform and the amount varies from vegetables to vegetables. The mineral elements can have an important influence on the quality of vegetable products. The deficiencies of these elements during growth result in the poor quality of crops. However, a variety of nutrient density in fruits, vegetables and whole grain foods may protect the body against the free radicals, that is, unstable compounds (Bhata, 2002)**.**

The nutritional requirements for Iron are exceedingly small and vary somewhat with age and sex. Fortunately, nature has provided the new born infant with an adequate reserve of this vital element which is normally sufficient to tide him over a dietary period which is restricted to milk that is low in Iron. In growing children, the demand for Iron is to increase blood formation but absorption does not exceed 10-15mg per day.

Manganese is present in a very small amount in the body but the highest concentration of this element is found in the bones, liver, kidney, pancreas and pituitary gland. Manganese is required for bone metabolism and many enzymes reactions. It is often found in combination with lecithin. It gives strong nerves coordination of thoughts and production of elasticity with quick recuperative ability. According to Dr Curl C. Pferifer, Manganese is needed in the formation of thyroxin which is produced by the thyroid gland.

Manganese makes up part of the polysaccharides which are used to form collagen, the strong, fibrous, connective material that builds tissues throughout the body. Manganese also influences the intestinal tract, laryngical passages, excretory duct of the liver, the ovaries and the lining of the generative organ.

Women who have menstrual pains need both Calcium and Manganese. Manganese deficiency provides varied and peculiar symptoms and complaints.

The prominent among these symptoms or perhaps diseases associated to lack of manganese in the body include asthma, carpal tunnel syndrome, chondroitin sulphate metabolism, convulsion, growth rate retardation, infertility, miscarriage, nerve damage, reconstructive knee surgery, slipped tendon, still births, spontaneous abortion to mention but a few.

Although, Copper is not actually a constituent of haemoglobin, it is present in certain other plasma proteins such as ceruloplasma. It is also a component of erythrocuprotein which occurs in the erythrocyte where it plays a role in oxygen metabolism. Deficiency symptoms of Copper in the body include anaemia, poor growth, bone disorders, scouring infertility, depigments, lesions in the brain stem and spinal cord problem.

However, since vegetables are cheap and are always available throughout the year and based on the fact that they are nutritional sources of trace minerals, this research is therefore aimed at determining the levels of these mineral elements in the leaves of three Nigerian vegetables from four markets in Abeokuta, so as to ascertain their suitability for human consumption with much reference to food safety.

MATERIALS AND METHODS

Sample Collection

The vegetables, green soko, *Celecia argent L*; tete *Amaranthus hybridus L* and ewe iroko (Ugu) *Telfaira occidentalis* were collected freshly from four markets namely Gbangba, Kuto, Olomore and Iberekodo in Abeokuta South and North Local Government Areas, Ogun State of Nigeria. These markets were however chosen based on patronage than other market within the township, because of closeness and ease of accessibility to many populace from adjoining villages.

The edible part (leaves) of the vegetables were thoroughly washed with distilled water and allowed to drain at room temperature. Care was taken to prevent the leaching of nutrients from the leaves of the vegetables. The samples were packed in air tight envelopes and dried inside an oven at 60^0C.

MOISTURE CONTENT DETERMINATION

The moisture content of the vegetables were determined by weighing the samples before and after drying using an analytical balance. The two weights were noted and recorded. The percentage moisture content was calculated using the formula below:

Weight before drying – weight after drying = weight of moisture

$$\text{\% of moisture content} = \frac{\text{weight of moisture}}{\text{weight before drying}} \times 100$$

DIGESTION AND MINERAL ELEMENT DETERMINATION

'Wet oxidation' method was used to treat the samples prior to analysis. About 1.0 g of ground fine sample which had been oven-dried at 60^0C was weighed into a 125 ml Erlenmeyer flask which had been previously washed with perchloric acid and distilled water. This was followed by the addition of 4 ml of perchloric acid, 25 ml of concentrated HNO_3 and 2 ml of concentrated H_2SO_4 in a fume cupboard.

The contents were mixed and heated gently at a low temperature on a hot plate. Intense heating continued until an intense white fumes appeared and thereafter finally heated for half a minute and allowed to cool down before 50 ml of distilled water was added. Thereafter, the mixture was boiled for half a minute gently on the hot plate and allowed to cool for some minutes before the solution was filtered into a 100 ml pyrex volumetric flask and stored prior to analysis for the mineral elements under investigation (AOAC, 2000).

Iron was determined colourimetrically while copper and manganese were determined using Atomic Absorption Spectrophotometer, Perkin Elmer Corp. Norwalk Model (Encyclopedia, 2002).

RESULTS AND DISCUSSION

The results of the percentage of moisture contents and mineral elements investigated in the three (3) vegetables collected from four (4) markets within Abeokuta South and North Local Government Areas of Ogun State are presented in the Tables 1 and 2 below:

Table 1: Percentage Moisture Contents of the three different vegetables

Samples	Locations	Wt before drying (g)	Wt after drying (g)	MC (g)	%MC
Soko	Gbangba	63.73	5.80	57.84	90.76
	Kuto	62.50	4.70	57.80	92.48
	Olomore	64.50	6.50	58.00	89.92
	Iberekodo	65.60	5.60	60.00	91.46
Tete	Gbangba	57.35	7.92	49.43	86.20
	Kuto	58.40	8.00	50.40	86.30
	Olomore	56.50	6.85	49.65	87.88
	Iberekodo	59.70	7.50	52.20	87.44
Ugu	Gbangba	76.15	11.42	64.73	85.00
	Kuto	75.50	10.50	65.00	86.09
	Olomore	75.60	10.60	65.00	85.98
	Iberekodo	76.50	9.50	67.00	87.58

Table 2: Levels of Iron, Manganese and Copper in the three different vegetables in $mgkg^{-1}$

Samples	Locations	Iron ($mgkg^{-1}$)	Manganese ($mgkg^{-1}$)	Copper ($mgkg^{-1}$)
Soko	Gbangba	8.374	8.420	0.046
	Kuto	8.375	8.388	0.045
	Olomore	8.400	8.410	0.044
	Iberekodo	8.376	8.420	0.047
Mean		8.381	8.410	0.046
Tete	Gbangba	6.542	1.267	0.044
	Kuto	6.540	1.265	0.043
	Olomore	6.600	1.269	0.046
	Iberekodo	6.550	1.268	0.045
Mean		6.558	1.267	0.045
Ugu	Gbangba	7.404	0.483	0.041
	Kuto	7.403	0.483	0.041
	Olomore	7.405	0.484	0.042
	Iberekodo	7.406	0.484	0.042
Std WHO Limit		-	500	100
Daily dietary intakes		13.161	8.31	2.098
Mean		7.405	0.484	0.042

DISCUSSION

The percentage of MC of Soko in the four markets investigated has the highest percentage (92.48) observed for Soko collected at Kuto market whereas the lowest percentage (89.92) observed for Soko collected from Olomore market. The % MC in Tete among the four markets investigated ranged between 86.20 to 87.88% with the lowest percentage (86.20) observed for Tete collected from Gbangba market and the highest (87.88) observed for Tete at Olomore market. Also, the % MC observed in Ugu from the four markets showed that Ugu collected from Gbangba had the lowest percentage (85.00) while the highest percentage was observed for Ugu collected at Kuto (86.09). On the whole, Soko vegetable had the highest % MC (92.48) observed at Kuto market while the lowest % MC (85.00) observed in Ugu vegetable collected at Gbangba market

The higher the level of Iron therein as could be seen from concentration of Iron in Soko particularly with respect to Soko collected from Olomore market which was given as 8.400 $mgkg^{-1}$ as against the concentration of Iron observed in this vegetable in other three markets investigated viz: Gbangba (8.374 g); Kuto (8.375 g); and Iberekodo (8.376 g) respectively. The results of the concentrations of Iron (Fe), Manganese (Mn) and Copper (Cu) observed in the three vegetable investigated at the four market sampled are presented in Table 2 above. Here, it could be seen that the concentrations of Iron, Manganese and Copper in Soko vegetable ranged between 8.374 $mgkg^{-1}$ and 8.400 $mgkg^{-1}$; 8.388 $mgkg^{-1}$ and 8.420 $mgkg^{-1}$; for 0.044 $mgkg^{-1}$ and 0.047 $mgkg^{-1}$ with the observed mean value of 8.381 $mgkg^{-1}$, 8.140 $mgkg^{-1}$,and 0.046 $mgkg^{-1}$ respectively. Also, the values of these elements obtained in Tete vegetable ranged between 6.540 $mgkg^{-1}$ and 6.600 $mgkg^{-1}$; 1.265 $mgkg^{-1}$ and 1.269 $mgkg^{-1}$; 0.046 $mgkg^{-1}$ and 0.043 $mgkg^{-1}$ with the observed mean values of 6.558 $mgkg^{-1}$; 1.267 $mgkg^{-1}$; and 0.045 $mgkg^{-1}$ respectively. However, the concentrations or levels of Iron, Manganese and Copper in Ugu vegetable ranged between 7.406 mg/kg^{-1} and 7.403 mg/kg^{-1}; 0.483 mg/kg^{-1} and 0.484 mg/kg^{-1}; 0.041mg/kg^{-1} and 0.042 mg/kg^{-1} with the observed mean values of 7.4405 mg/kg^{-1}; 0.484 mg/kg^{-1}; and 0.042 mg/kg^{-1} respectively.

Iron concentration was found to be higher in Soko vegetable (8.400 $mgkg^{-1}$) at Olomore market while the lowest value (6.5400 $mgkg^{-1}$) was found in Tete vegetable at kuto market. Manganese concentration on the other hands was found to be in higher concentration (8.420 $mgkg^{-1}$) in Soko at Gbangba and Iberekobo markets while the lowest concentration (0.483 $mgkg^{-1}$) was observed in Ugu vegetable at Gbangba and Kuto markets.

Copper element was found to be extremely low in these vegetables investigated with the concentration ranged between 0.04 $mgkg^{-1}$ and 0.047 $mgkg^{-1}$.

In all, the concentrations of these elements particularly Manganese and Copper in the three vegetables investigated were found to be well below the permissible level recommended by World Health Organization (Manganese, 500 $mgkg^{-1}$ while for Copper, 100 $mgkg^{-1}$).

It must be stated here that the mean values of both the Iron and Copper levels observed in the three vegetables investigated at the four markets fell below the recommended daily dietary intakes of 13.161 $mgkg^{-1}$ and 2.098 $mgkg^{-1}$ respectively. The mean values of concentrations were found to be 8.381$mgkg^{-1}$; 6.558 $mgkg^{-1}$; and 7.405$mgkg^{-1}$ respectively as against the recommended values of 13.161$mgkg^{-1}$.

The concentration of Manganese (8.410 $mgkg^{-1}$), on the order hands were found to be higher than the recommended daily dietary intake only in soko vegetable in all the four markets investigated whereas the concentrations of these mineral elements in the other two vegetables (Tete and Ugu) were found to be lower than the recommended value. The mean value of Manganese concentration in Soko was given as 8.31$mgkg^{-1}$ whereas the concentration of these elements were found to be 1.267 $mgkg^{-1}$ and 0.484 $mgkg^{-1}$ in Tete and Ugu respectively as against the recommended value of 2.372 $mgkg^{-1}$ (Rubio *et al.,* 2009).

For the Copper levels however, the observed mean values were found to be 0.042 $mgkg^{-1}$; 0.045 $mgkg^{-1}$; and 0.042 $mgkg^{-1}$ respectively as against the recommended value of 2.098 $mgkg^{-1}$.

CONCLUSION

The levels of Iron, Manganese and Copper in the three common vegetables at the four markets within Abeokuta Metropolis investigated, compared with W.H.O. recommended permissible level and the daily dietary intakes. The results obtained showed that the concentrations of the three mineral elements investigated were found to be well below the permissible level as recommended by W.H.O.

The daily dietary intakes of Manganese concentration was found to be higher than the recommended value in Soko vegetable whereas the concentration of this element in the other two vegetables were found to be lower than the recommended daily dietary intakes.

The concentrations of the other two elements, namely Iron and Copper were found to be lower than the recommended daily dietary intakes.

Recommendation

In as much as the concentrations of these three elements investigated fell below the permissible levels, they could be recommended for human consumption by the populace living in these environment since there might be no serious contamination or pollution associated to these elements and no health safety risk attached.

Food substances that are very rich in Iron and Copper could however be recommended as supplements for those people that prefer to eat the three vegetables.

Food substances that are rich in manganese could only be recommended for those people that prefer to eat Tete and Ugu vegetables since the observed results showed higher concentration of this element in Soko which was higher than the recommended daily dietary intakes.

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