Mineral Composition of Some Selected Vegetables Sold in Mile 3 Market, Port Harcourt Rivers State Nigeria

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Abstract

Five green leafy vegetables (Water leaf, Pumpkn leaf, Scent Leaf and Bitter leaf) commonly consumed in Port Harcourt, Rivers State Nigeria, were purchased from Mile 3 market and analysed for mineral composition. The presence of Na, Zn, K, Fe, Mg and Ca were analysed using Atomic Absorption Spectrophotometry, Versenate EDTA complexometric method, and by Flame Photometery. The mean values obtained for Na ranged from 8.686±0.343 to 10.540±0.378 mg/Kg, Zn ranged from 0.438±0.069 to 0.863±0.064 mg/Kg, K ranged from 3.928±0.692 to 11.943±0.635 mg/Kg, Fe ranged from 1.250±0.231 to 5.546±0.307 mg/Kg, Mg ranged from 5.111±0.447 to 8.739±0.489 mg/Kg and Ca ranged from 6.019±0.367 to 10.910±0.344 mg/Kg. Each of the leafy vegetables investigated contained mineral constituents which were different when compared with other vegetables. Green leafy vegetables are a good source of macro/micro nutrients.

Keywords: *Dietary intake, leafy vegetables, mineral elements, nutrients, standard dietary allowance (RDA)*

INTRODUCTION

Plants offer a diversity of resources that add to the essential need of both human beings and animals like food, clothing and shelter. Amongst plants of economic importance are therapeutic plants. Plants have been exploited as medicinal agent right from time immemorial in both systematized and unorganized forms. The curative properties of several herbal medicines have been known in various ancient cultures and traditions. Medicinal plant has been the key sources of traditional herbal medicine among rural inhabitants worldwide (Augustine et al., 2015).

According to Arasaretnam et al. (2018) green leafy vegetables (GLV) is indispensable for healthy living. Reports from results obtained recommend that green leafy vegetables comprise considerable quantity of needed micronutrients in addition to the existence of high quantities of vitamin C. The results from the work also showed that the high intake of GLVs may well provide nutritional needs indispensable for the normal growth of human and animals thereby giving sufficient protection against diseases that may arise due to malnutrition. Results have indicated that vegetables might possibly serve as a better source of certain vital minerals that can

qualitatively contribute to the nutritional requirement of humans. Based on results obtained from the processing of vegetables, suggestion was given that the daily nutritional necessities could better be attained by consuming steamed processed vegetables instead of consuming the boiled processed vegetables, which would also undoubtedly reduce such diseases like high blood pressure Adeniyi et al. (2021).

Vegetables are the edible parts of plant that are consumed wholly or in parts, raw or cooked as part of main dish or salad. A vegetable includes leaves, stems, roots, flowers, seed, fruits, bulbs, tubers and fungi. Vegetables are decent sources of oil, carbohydrate, minerals and vitamins dependent on the vegetable consumed. Leafy vegetables are essential items of diet in many Nigerian families. Apart from the diversity which vegetables add to the menu (Subukola et al., 2007), they are treasured sources of nutrients particularly in the rural areas where they contribute considerably to protein, minerals, vitamins, fibers and other nutrients which are typically in short supply in daily diets (Mohammed & Sharif, 2011). It is useful to know that the consumption of several kinds of edible plants as sources of food might be very favourable to nutritionally negligible population specifically in developing countries where poverty and climate is initiating havoc to the countryside populace. In countless developing countries, the source of minerals is insufficient to meet the mineral necessities of the fast growing population. Minerals cannot be synthesized by animals and therefore should be provided from plants or mineral-rich water (Anjorin et al., 2010).

Mineral composition plays a critical part in the nutritional importance of vegetables, as minerals are indispensable and crucial micronutrients dynamic for numerous physiological functions in the human body (Adegbola et al., 2019). Minerals such as calcium, sodium, iron, zinc, potassium, magnesium, and manganese are involved in bone health, fluid balance, oxygen transport, immune function, and metabolism (Oboh et al., 2019; Eke-Ejiofor et al., 2021). Hence, a good understanding of the mineral composition or constituents of vegetables is imperative and vital for ensuring adequate, proper and acceptable nutrient intake which could aid and promote overall health and well-being of man.

Despite the widespread consumption of Fluted Pumpkins, Bitter leaf, Scent leaf, and Water leaf in the region, there is a lack of comprehensive data on their mineral composition. . Furthermore, the lack of empirical data on the mineral composition of these vegetables in the specific context of Port Harcourt, Rivers State, Nigeria, underscores the need for localized research to guide nutrition policies and interventions tailored to the region's population. By addressing this research gap, the study seeks to provide valuable insights into the nutritional adequacy of locally available vegetables, thereby facilitating evidence-based decision-making by policymakers, nutritionists, and consumers alike. Ultimately, the findings of this research will contribute to promoting better health outcomes and reducing the burden of malnutrition in the community.

MATERIALS AND METHODS

Sample collection

The different vegetable types; pumpkin leaf (*Telfaria occidentalis*), bitter leaf (*Vernonia amygdalina*), scent leaf (*Ocimum gratissimum*) and water leaf (*Talinum triangulare*) were obtained from Mile 3 Market in Port Harcourt, Rivers State, Nigeria. They were be properly

identified by crop scientist. The reagents that was used for different analysis were all of high analytical grade

Sample preparation:

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^{o}C 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 elements contents using Buck Scientific model 210VGP Atomic Absorption Spectrophotometer.

Mineral element analysis

The mineral elements (Na, Zn, K, Fe, Mg and Ca) were determined by Atomic Absorption Spectrophotometry (AAS) according to the method of Muhammad et al. (2022). Briefly, about 2 g of the sample of each vegetable type were dried using hot oven at 100°C for 30 minutes. The dried samples were then placed on hot plate until smoke-free. Afterwards, furnace set at 550°C for 3 hours was employed to attain white ash of the samples. The ash was then dissolved in 5 ml of 6 M HCl by warming on hot plate for 2-3 minutes. The solution got was put into 50 ml flask followed by the addition of 1 M HNO_3. The standard solutions of the mineral elements were prepared by dissolving the stock standard in 0.3 M HCl to the anticipated concentrations. The AAS was calibrated using the standard solution. The solutions were sprayed into the Atomic Absorption Spectrophotometer (AAS) and minerals were measured by taking the absorbance at a specific wavelength of the elements. Minerals in the samples was analyzed from solution obtained when 5g of the ash sample was digested with 10ml of 5N hydrochloric acid. Iron (Fe), calcium (Ca), and magnesium (Mg) content of samples were determined by atomic absorption spectrometry and potassium (K) and sodium were determined by flame photometry according to the methods of AOAC (2004).

Instrumentation

The metal concentrations were determined and analyzed on a Buck Scientific Model 210VGP Atomic Absorption Spectrometer (AAS) that was equipped with a background correction. The result obtained for each sample represents a mean value of three replicate readings. A calibration curve of absorbance against concentrations of each element under investigation was constructed and lastly the concentration of each element was estimated or determined from the calibration curve of its standards by interpolation.

RESULTS AND DISCUSSION

The results recorded for the concentrations of some essential minerals in the vegetables investigated and sold in Mile 3 Market during the period of study are shown in Tables 1 to 3 while the mean concentrations during the period of study is shown in Table 4.

Table 1: Concentrations (mg/Kg) of essential mineral sold in Mile 3 Market in January

Vegetables (mg/Kg)	Essential minerals					
	Na	Zn	K	Fe	Mg	Ca
Water leaf	9.044	0.344	11.082	1.812	6.208	10.493
Pumpkin leaf	9.612	0.785	10.079	5.146	7.203	5.650
Scent leaf	8.210	0.737	3.003	0.993	8.114	9.056
Bitter leaf	10.019	0.749	7.105	1.583	4.564	9.567

Table 2: Concentrations (mg/Kg) of essential mineral sold in Mile 3 Market in March

Vegetables (mg/Kg)	Essential minerals					
	Na	Zn	K	Fe	Mg	Ca
Water leaf	9.761	0.463	12.149	2.309	6.800	10.902
Pumpkin leaf	10.128	0.862	10.689	5.602	7.551	5.887
Scent leaf	8.846	0.807	4.112	1.203	8.795	9.514
Bitter leaf	10.697	0.911	7.564	1.994	5.110	10.003

Table 3: Concentrations (mg/Kg) of essential mineral sold in Mile 3 Market in May

Vegetables (mg/Kg)	Essential minerals					
	Na	Zn	K	Fe	Mg	Ca
Water leaf	9.942	0.507	12.597	2.727	7.143	11.335
Pumpkin leaf	10.334	0.941	10.940	5.891	7.49	6.519

Scent leaf	9.003	0.862	4.668	1.554	9.308	9.860
Bitter leaf	10.905	0.995	7.906	2.203	5.660	10.414

Table 4: Mean concentrations (mg/Kg) of essential mineral sold in Mile 3 Market during the period under investigation

Vegetables (mg/Kg)	Essential minerals					
	Na	Zn	K	Fe	Mg	Ca
Water leaf	9.582±0.388	0.438±0.069	11.943±0.635	2.283±0.374	6.717±0.386	10.910±0.344
Pumpkin leaf	10.025±0.304	0.863±0.064	10.569±0.361	5.546±0.307	7.415±0.152	6.019±0.367
Scent leaf	8.686±0.343	0.802±0.051	3.928±0.692	1.250±0.231	8.739±0.489	9.477±0.329
Bitter leaf	10.540±0.378	0.885±0.102	7.525±0.328	1.927±0.258	5.111±0.447	9.995±0.346

Sodium (Na)

The mean results recorded for sodium (Na) within the months for the different vegetables sold in Mile 3, Port Harcourt were, water leaf; 9.582±0.388 mg/Kg, pumpkin leaf; 10.025±0.304 mg/Kg, scent leaf; 8.686±0.343 mg/Kg and bitter leaf; 10.450±0.378 mg/Kg. The occurrence of Na in the different vegetables were in the order: bitter leaf > pumpkin leaf > water leaf > scent leaf. Asaolu et al. (2012) reported 15.01 to 88.00 mg/100g for sodium in different vegetable leaves in an investigation carried out on proximate and mineral composition of Nigerian leafy vegetables. Also Ogbuji et al. (2016) recorded concentration ranges of 0.11±0.01 to 0.45±0.06 mg/100g while evaluating the mineral compositions of green leafy vegetables consumed in South Eastern Nigeria

Sodium and potassium are important intracellular and extracellular cations respectively. Sodium is involved in the regulation of plasma volume, acid-base balance, nerve and muscle contraction (Akpanyung, 2005). Sodium (Na) has been reported and observed to be a needed element for fluid balance and nerve function in the human body (WHO, 2012).

Zinc (Zn)

The mean results recorded for zinc (Zn) within the months for the different vegetables sold in Mile 3, Port Harcourt were, Water leaf; 0.438±0.069 mg/Kg, pumpkin leaf; 0.863±0.064 mg/Kg, scent leaf; 0.802±0.051 mg/Kg and bitter leaf; 0.885±0.102 mg/Kg. The occurrence of Zn in the different vegetables were in the order: pumpkin leaf > bitter leaf > scent leaf > water leaf. Ogbuji et al. (2016) observed in a research conducted that Zn concentrations ranges from 0.49 ± 0.01 mg/100

g to 2.08±0.02 mg/100 g with *Pterocarpus mildbreadii* (Uha) having the highest content (2.08 ± 0.02 mg/100 g), while *Talinum traiangulare* (Water Leaf) had the lowest content (0.49 ± 0.01 mg/100 g). Noah and Alaba (2020) also recorded concentration range of 3.66±0.01 to 6.43±0.00 mg/100g for different leafy vegetables investigated.

Zinc is an important element for nerve function and male fertility. It is vital for normal sexual improvement especially for the development of testes and ovaries, it is also indispensable for reproduction (Ayoola et al., 2008). It is also needed for proper and healthy functioning of heart and also normal growth. The amount of Zn reported in this work is significantly different with the estimated average daily dietary zinc intake range from 5.6 to 13 mg/day in infants and children and from 8.8 to 14.4 mg/day in adults aged 20 to 50 years (FAO, 2001). Regular consumption of leafy vegetables might help in preventing the adverse consequence of zinc deficiency which possibly could results in stunted growth and delayed sexual maturation, as a result of its role in nucleic acid metabolism and protein synthesis. Most of these effects are treatable with adequate amounts of zinc (Ogbuji et al. (2016).

Potassium (K)

The mean results recorded for potassium (K) within the months for the different vegetables sold in Mile 3, Port Harcourt were, water leaf; 11.943±0.635 mg/Kg, pumpkin leaf; 10.569±0.361 mg/Kg, scent leaf; 3.928±0.692 mg/Kg and bitter leaf; 7.525±0.328 mg/Kg. The occurrence of K in the different vegetables were in the order: water leaf > pumpkin leaf > bitter leaf > scent leaf. In the work of Achikanu et al. (2013) on some leafy vegetables, potassium content ranged from 1.64 to 4.90mg/100ml and that *Solanum macrocarpon* had the highest potassium content. The values were lower than this work and also when compared with standard dietary allowance (RDA). Also in the work of Asaolu et al. (2012) on different vegetable leaves potassium ranged from 16.85 to 168.96 (mg/100g) which is higher than that recorded in this work.

Potassium is the main or principal cation in intracellular fluid and functions in acid base balance, regulation of osmotic pressure, muscle contraction and Na+ /K+ ATPase (Murray et al., 2000; Achikanu et al., 2013). Increasing dietary potassium has lowered blood pressure in humans, which by itself should reduce the risk of stroke; nevertheless, some of the protective effects of K seem to extend beyond its capability to lower blood pressure (Ogbuji et al., 2012).

Iron (Fe)

The mean results recorded for iron (Fe) within the months for the different vegetables sold in Mile 3, Port Harcourt were, water leaf; 2.283±0.374 mg/Kg, pumpkin leaf; 5.546±0.307 mg/Kg, scent leaf; 1.250±0.231 mg/Kg and bitter leaf; 1.927±0.258 mg/Kg. The occurrence of Fe in the different vegetables were in the order: pumpkin leaf > water leaf > bitter leaf > scent leaf. Ogbuji et al. (2016) reported that the Fe had a range of 184.2±1.76 to 583.7 ± 0.12 mg/100g with *Ocimum gratissimum* (Nchuanwu) having the highest composition of 583.7+ 0.12mg/100g while *Telfaria occidentalis* (Ugu) had the lowest composition of 184.2±1.7 mg/100g, which are higher than the values recorded in this work..

Fe is significant in the food particularly for pregnant and nursing mothers as well as infants. It is also required by the elderly to decrease cases of diseases associated with lack of iron such as anemia (D'Mello, 2003). Fe is necessary and important in haemoglobin formation (Fasuyi, 2006). Iron (Fe) is an essential trace element in the human body, it plays central roles in haemopoiesic, control of infection and cell mediated immunity (Bhaskaran, 2001). The deficiency of iron has been described and reported as the most predominant nutritional deficiency and iron deficiency anemia is projected to affect more than one billion people globally (Trowbridge & Martorell, 2002). The significances of iron deficiency include reduced work capacity, impairments in behaviour and intellectual performance and decrease resistance to infection (Dioxin et al., 2004).

Magnesium (Mg)

The mean results recorded for magnesium (Mg) within the months for the different vegetables sold in Mile 3, Port Harcourt were, water leaf; 6.717±0.386 mg/Kg, pumpkin leaf; 7.415±0.152 mg/Kg, scent leaf; 8.739±0.489 mg/Kg and bitter leaf; 5.111±0.447 mg/Kg. The occurrence of Mg in the different vegetables were in the order: scent leaf > pumpkin leaf > water leaf > bitter leaf. In the work carried out by Asaolu et al. (2013) magnesium ranged from 27.51 mg/100g in Indian spinach to 288.65 mg/100g in *Telfaria occidentalis*. The magnesium content obtained in the research of Achikanu et al. (2013) ranged from 14.69 to 44.45mg/100ml.

The values of magnesium obtained in the works cited are significantly different from those reported in this work; the difference might due to soil compositions and the rate of uptake of minerals by individual vegetables (Anjorin et al., 2010). Mg is important in treating of diarrhea and other gastrointestinal defects when taken in about 470 mg/day. It also has the capacity to treat duodenal cancers when 1200 mg/day is ingested, secondary coronary heart diseases and congested heart failure when about 384 mg/day is taken. The Mg RDAs ranges between 26 and 260 mg/day for the various human categories (FAO, 2001). Magnesium is very good for human health as it has been identified to reduce blood pressure (Fasuyi, 2006).

Calcium (Ca)

The mean results recorded for calcium (Ca) within the months for the different vegetables sold in Mile 3, Port Harcourt were, water leaf; 10.910±0.344 mg/Kg, pumpkin leaf; 6.019±0.367 mg/Kg, scent leaf; 9.477±0.329 mg/Kg and bitter leaf; 9.995±0.346 mg/Kg. The occurrence of Ca in the different vegetables studied were in the order: water leaf > bitter leaf > scent leaf > pumpkin leaf. In the work of Noah and Alaba (2020) African spinach had the value of calcium as 44.39±0.02 and in Bitter-leaf it was 31.84±0.01.

There was generally high Ca levels in all the leaves. The high Ca concentrations observed in the leafy vegetables studied showed that all the leaves are very nutritious. The result of this present study can be attested to that observed by different authors (Iheanacho & Udebuani, 2009; Angela et al., 2010; Asaolu et al., 2012, Mohammed & Sharif, 2012) who reported similar findings. Ogbuji et al. (2016) observed that *Ocimum gratissimum* (Nchuanwu) contained the highest level of Ca (2.87 ± 0.04 g/100 g) which is well above the 800 to 1200 mg/day recommended Ca standard for

adults. Asaolu et al. (2012) also reported high content of Ca in some leafy vegetables including *Ocimum gratissimum* (Nchuanwu). Small amount of the plants should be taken so as to ingest the optimum level of calcium intake of about 1000 mg/day (FAO, 2001). The difference in calcium level obtained from the different leafy vegetables in this study could be from the soil. Calcium is a major factor for sustaining strong bones and plays a part in muscle contraction and relaxation, blood clotting, coordination of inorganic elements present in the body (Ogbuji et al., 2016).

Conclusion

From the results obtained and the observations recorded in this work, the following conclusions are made;

This research work reported the mineral composition of some selected vegetables sold in Mile 3 Market, Port Harcourt Rivers State Nigeria. The result showed that the vegetables are rich source of mineral (macro and micro elements). Minerals are needed in the body because they form structure of the body and help the body systems work effectively. Green leafy vegetables are a good source of macro/micro nutrients.

The research work has also shown that the vegetable leaves of the studied plants are good sources of sodium, potassium, calcium, magnesium, iron and zinc and that the mineral compositions vary from plant to plant.

This study has also shown that the leafy vegetables examined have an appreciable content of mineral elements such as sodium, potassium, iron, magnesium, zinc and calcium.. The findings of this research work indicated that the vegetables studied could make significant contributions to the recommended dietary allowances for the nutrients and also provide essential health requirements to the consumers.

The results suggest that the vegetables should be widely consumed in sufficient amount and that they could contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition.

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