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RESEARCH ARTICLE

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Metal concentration of some microelements found in some fruits and vegetables, commonly consumed in Zaria metropolis

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ABSTRACT

The concentrations of calcium, iron, manganese, lead and zinc were determined in two different fruits (mango and cabbage) and three vegetables (uwgu/pumpkin, lettuce and spinach). The concentrations of these metals in the fruits and vegetables were also compared with the recommended/standard levels by the WHO. Atomic Absorption Spectrophotometer (A.A.S) was used for the analysis of the metals. From the results, it was found that the concentration of Calcium was highest in mango, (64.97 mg/g); iron concentration was highest in Uwgu, (5.0mg/g). The results of the percentage moisture content of the various samples analyzed showed that lettuce had the highest moisture content (93.2 %) while mango had the least moisture content (84.8 %) in samples gotten from Sabo; and it was found that lettuce has the highest moisture content (94.0 %) while uwgu had the least moisture content of (80.9 %) in samples gotten from Samaru.

Keywords: Calcium, Iron, Manganese, Zinc, Lead, Fruits, Vegetables.

INTRODUCTION

Fruit is a ripened seed bearing part of a plant usually fleshy, dry and edible. The matured ovary may form a juicy fruit such as apple, peach etc. or it may develop into dry fruit such as chest out[2]. Fruit is formed through the process of fertilization which involves the union of male and female reproductive structure of flowering plant. The major part of the edible portion of fresh fruit contain about 75-95% water, poor source of protein and oil but contain reasonable amount of carbohydrates[4]. In general protein content of different fruit is not greater than 3.5% usually fat content of different fruit is not greater than 1%, fruit are rich source of vitamin C[ascorbic acid].

Vegetables are an important ingredient of human diet that contains essential nutrients and trace elements[1]. Environmental pollution has caused the contamination of soil; on the other hand waste water irrigation resulted in the significant mixing of the heavy metal content of the agricultural land[11]. The chief cause is the waterways through which heavy metals are leached out of the soil and are taken by the vegetation. If plants decay, these toxic metals are redistributed and as a consequence their enrichment in the agricultural soil occurs. Bioaccumulation, geo-accumulation and bio magnifications may result because of entrance of these heavy metals to the ecosystem. Thus long term waste water irrigation leads to build up of heavy metals in soils and food crops[10]. Rapid industrialization and urbanization with insufficient environmental monitoring planning often results in discharge of the industrial and sewage waste into rivers and lakes which lead to gradual pollution of our water resources. Many times such wastewater is drained to the agricultural land where this polluted water is used for irrigating crops including vegetables. Thus polluted effluent water is found to be rich not only in organic water and nutrient but also

in heavy metals like lead, chromium, cadmium, nickel, cobalt etc, that finally reach to the soil of agricultural area and leads to food chain contamination as crops and vegetables absorb them from the soil. Heavy metals are not easily biodegradable and it leads to their accumulation in human vital organs causing varying degree of illness on acute and chronic exposure[17].

The recommended daily fiber intake is 28g/day for adult women and 36g/day for adult men[6]. Most health advising group provides guidance for obtaining the recommended levels of fiber consumption from especially fruits vegetables and whole grains[3, 6]. The nutritive value of vegetable is increased greatly because of the presence of mineral salts, and vitamins, they also serve as roughages that help in digestion[5].

The aim of this study is to determine the dry matter level of calcium, iron, manganese, phosphorus and zinc in some fruits and vegetables that are commonly consumed regularly by humans and the objectives are to determine the concentration of calcium, iron, manganese phosphorus, and zinc in some fruits and vegetables and to compare the level of calcium, iron manganese, phosphorus, and zinc in some fruits and vegetables with the recommended standard intake levels by the WHO[16].

MATERIALS AND METHODS

Two different types of fruits: Mango (*Mangifera indica*) and cabbage (*Brassica integrifolia*); and three different types of vegetables: spinach *(Amaranthus sp*), ugwu (*Telferia occidentalis)* and lettuce (*Lactuca sativa*) were purchased from Samaru and Sabon gari market.

The fruits and vegetables were washed, cut into small pieces with knife and was dried in an oven at 80^{o}C for about 48hrs. The samples were crushed into powder in a mortar with pestle; 5.0g powder of each sample was weighed in a porcelain crucible and ash in a muffle furnace at 500^{O}c for 16 hours.

The samples were digested using the method of Vogel (12). Removal of water from sample was done by dehydration in an oven (13).

Elemental analysis of calcium, iron, manganese, phosphorus and zinc level were carried out using Atomic Absorption Spectrophotometer (A.A.S) method of Analysis, in Multi User Research Laboratory in Chemistry Department, Ahmadu Bello University, Zaria.

RESULTS AND DISCUSSION

Table 1: Concentration of elements in the fruits and vegetables

CONCENTRATION OF MICROELEMENTS IN THE SAMPLES (mg/g)											
Variation	Ugwu		Cabbage		Mango		Amaranthus		Lettuce		
Sample	SM1	SB1	SM2	SB2	SM3	SB3	SM4	SB4	SM5	SB5	
Element											Anova: Two-Factor Without Replication
Zn	1.23	1.43	1.87	3.06	1.16	0.85	0.66	0.21	0.73	0.58	
Fe	4.26	5.46	1.43	1.86	1.72	1.48	2.69	0.99	4.85	3.55	*SUMMARY*
Ca	12.66	11.31	14.98	4.49	64.97	61.09	11.09	2.33	15.96	15.36	Row 1
Mn	0.75	0.14	0.76	1.31	1.94	2.02	0.28	0.19	0.88	0.84	Row 2
Pb	0.0061	1.25	0.01	0.04	0.05	0.05	0.047	0.021	0.01	0.077	Row 3
											Row 4

KEY: *SM = SAMARU; SB = SABON GARI*

Graphical illustration of moisture contents of fruits and vegetables are shown in fig i and ii respectively

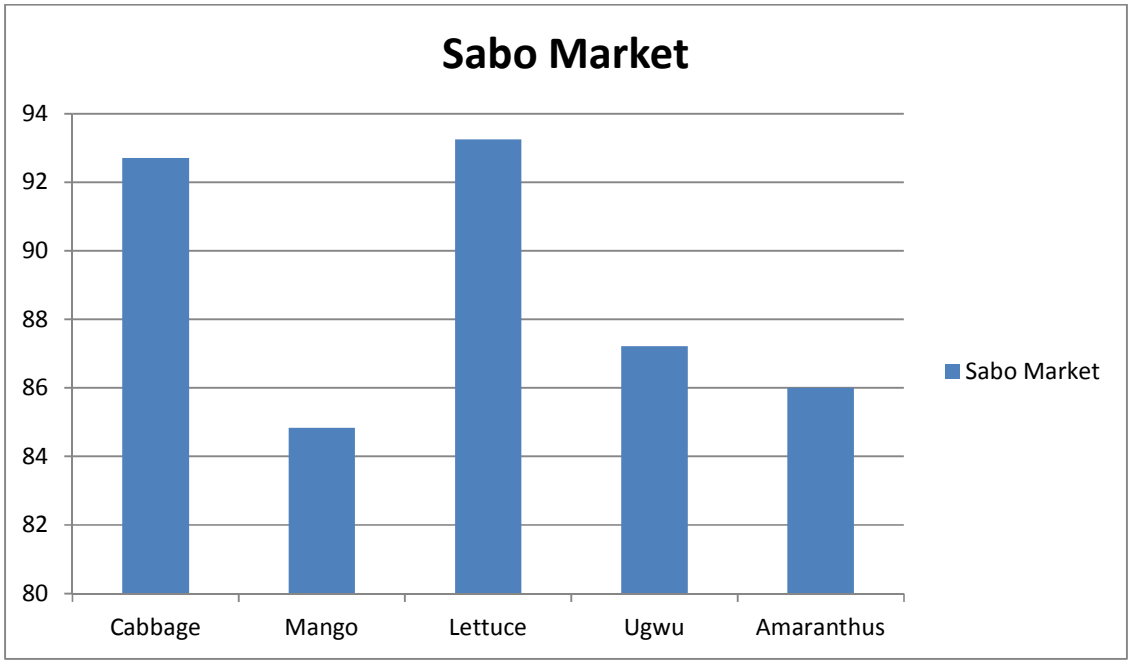

Fig i: Bar Chart showing the Moisture content of Fruit and Vegetables from Sabo Market

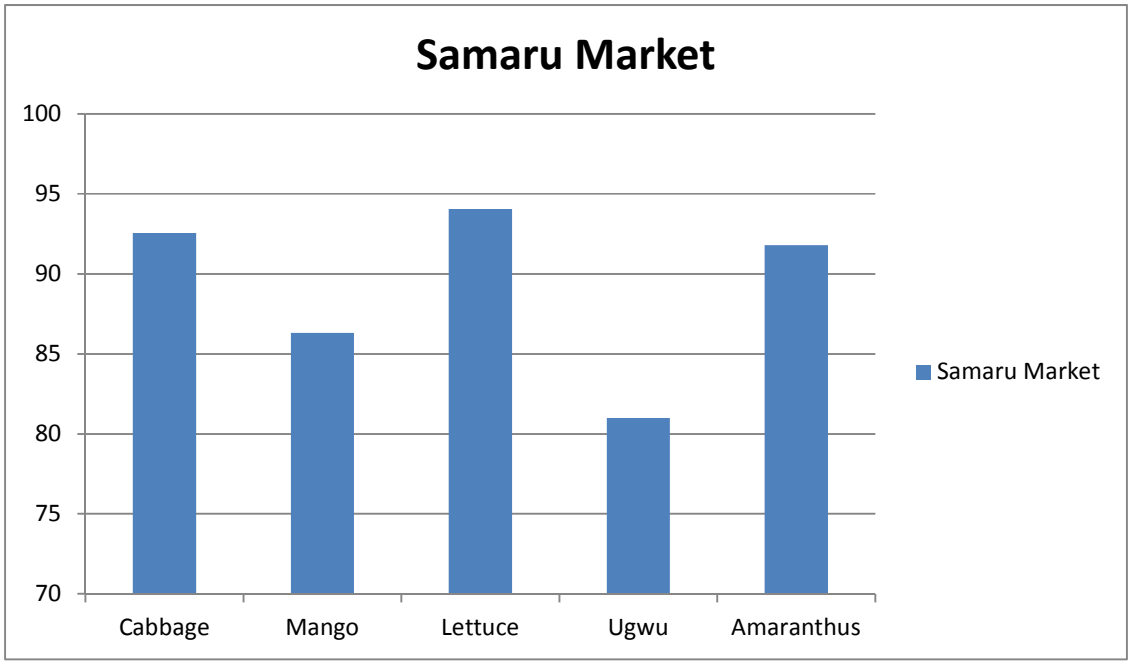

Fig ii: Bar Chart showing the Moisture content of Fruit and Vegetables from Samaru Market

From the result it was found that the fruits and vegetables under study are very rich in calcium. Calcium is not known to be toxic because it is an essential element for bone development and maintenance and also for reduction of cholesterol level in humans (8). Ugwu and Lettuce have high Iron (Fe) content. For all the fruits and vegetables, they have low lead (Pb) contents probably because of the absence of many industries in the area. Ugwu and Cabbage from Sabo have higher Zinc (Zn) and Iron (Fe) values than in Samaru while Mango, Amaranthus and Lettuce from Samaru have higher Zn and Fe contents, however the mean concentration was above the maximum permissible 0.30mgdm-^{3} (14), this may be due to a number of factors that influence the concentration of mineral elements on

and within plants, these factors include climate, atmospheric, deposition, nature of soil on which the plant is grown, irrigation with waste water, these observations were made by (9). Zinc and iron were higher in concentration in samples collected from Sabo than in Samaru, because Sabo is richer in these metals for mango, lettuce and amaranthus. For Ca, all the fruits and vegetables purchase from Samaru have high Ca content than from Sabo. For Mn, mango and cabbage purchase in Samaru have higher content than in Sabo. For Pb, all the fruit and vegetables from Sabo and Samaru have low content, except for amaranthus purchased from Samaru that have high Pb content.

The observed concentration of Pb, Zn, Ca, Fe, Mn in fruit and vegetables were compared with the recommended limit as established by the (7) and (16) to assess the levels of food contamination. The daily intake amount of calcium needed for adults (1000mg/day), and children need (800 to 1300 mg/day). For iron the daily amount needed for adult (10 to 15 mg/day), children (10 to 12 mg/day), for manganese (2 to 5 mg/day) for children and adult, zinc (12 to 15 mg/day) for adult and (10 to 15 mg/day), lead (1 to 60 mg/day) for adult and children.

The present study reports on the heavy metal content of Zn, Ca, Fe, Pb and Mn determined in selected fruit and vegetables collected from market site in Samaru and Sabon gari. The Anova result shows that the concentrations of micro-elements in the sample show that there is highly significant difference in the concentration of the elements, because the P-value is greater than the F-value. In the second table the concentration based on the two locations. The t-test result showed that there is no significant difference in Zn, Fe, Ca and Pb, but there is significant difference in Mn in terms of their locations because the T-value and Critical Value is higher.

The Zn value in mango was analyzed to exceed the recommended value needed in trace amounts, the Ca value in mango also exceeds the recommended value of 14, this is said to be more toxic and can cause disease. Fe value in mango falls within the recommended range of 0 to 2. Mn exceeds the recommended value of trace amounts. The Zn value in cabbage was analyzed to follow the recommended value needed of 0-5, and this metal is important in a number of key activities, ranging from protein and carbohydrate metabolism to the immune system, wound healing, growth and vision. The Ca value in cabbage also falls short of the recommended value of 75, and if you do not have enough calcium from the food you eat, your body automatically takes the calcium needed from your bones. If the body continues to tear down more bones than it replaces over a period of years in order to get sufficient calcium, the bones will become weak and break down. Fe value in cabbage slightly exceeds the recommended value of 1, because to aid the absorption of ion, one needs to take food rich in vitamin C, at the same time eat the food containing ion. Mn falls within the recommended values of 2-5, because the function of this mineral is not specific since other minerals can perform in its place. And deficiency of calcium is rear in humans. The Zn value in Amaranthus was analyzed to slightly exceed the recommended value needed of trace amounts, the Ca value in Amaranthus falls short of the recommended value of 125 and Ca deficiency may result in muscles spasms and cramps in short term osteoporosis. Fe value in mango falls within the recommended range of 1 to 2. Mn slightly exceeds the recommended value of trace amounts.

The results of Ca, Mn, Zn, Pb and Fe concentrations in the samples analysed is presented in table 2, from the results of the analysis , it was found that the mean concentration of calcium was found to be 23.93 ± 27.01 mg/g which is below the maximum permissible limit of 7.5 mgdm-3 as reported by (15). The mean Zinc concentration was found to be 1.13 ± 1.12 mg/g in the samples analyzed. The mean ion concentration was found to be 2.99 ± 2.66 mg/g in the sample analyzed. The mean manganese concentration was found to be 4.61 ± 0.09 mg/g in the sample analyzed.

This implies that the soil (land) used for planting Ugwu and Cabbage in Sabo are richer in Zn and Fe than those from Samaru, while Samaru lands are richer in these metals in Zn and Fe for mango, lettuce and Amaranthus, for all the vegetables and fruits purchased from Samaru

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The results of the percentage moisture content of the various samples analyzed are presented in Fig i. From the result, it was found that lettuce had the highest moisture content in Sabo is (93.2 %) while mango had the least moisture content (84.8 %). It was found in Fig ii that lettuce has the highest moisture content in samara of (94.0 %) while Uwgu had the least moisture content of (80.9 %).

CONCLUSION

In conclusion the result reported here confirm that the fruit and vegetable collected from chosen market site contained measured heavy metal contents within the safe limits presented by (16). This is an important result as human health is directly affected by the ingestion of fruit and vegetable as these plants are affected by contaminated soils and waste waters used for irrigating them, as well as the deposits on different parts of the fruit and vegetables. The bio-monitoring of trace elements in fleshy fruit needs to be continued because these are the main sources of food for humans in many parts of the world.

Mineral elements are of vital importance to both plants and animals including humans, some of these elements are required in large quantities and are recognized as macro elements or bio essential because they are essential in all living system while others are required in small amount (micronutrients) and are essential for plant growth and metabolism in animals examples are iron, zinc etc. Fruits and vegetables are good sources of calcium and iron, therefore regular consumption of these fruits and vegetables is essential for bone development and efficient oxygen carrier in blood system respectively.

REFERENCES

[1] M. Abdullah and J. Chmielnicka, *Biol. Trace Elements Res*. **1990**, 23, 25- 53.
[2] RS Kingsley; In Introduction to plant Biology 1st Ed. California State University Press, Chico-U.S.A, **2008**, pp. 60-64.
[3] A.H. Lichtenstein; L. J. Appel; M. Brands, Diet and Lifestyle recommendations revision: a scientific statement from the American Heart Association Nutrition Committee, PubMed, **2006**, 114, 1, 82-96.
[4] CJ Pearson; MJT Norman; PGE Searle; In The ecology of tropical foods crops. 2ndEd, Cambridge University Press, Cambridge U.K, **1984**, pp 28-30.
[5] OP Sharma; In Hills Economy, A. text book of Botany, 2nded Arish Press Dhaka, Bangladesh. **2004**, pp 18-21.
[6] US Department of Agriculture (USDA), *US Department of Health and Human Service.* Dietary Guidelines for Americans Washington, *Trace Element Res*., **2005**, 23: 25-53.
[7] FAO, Water quality for irrigation for agriculture. Irrigation Drainage Paper, **1985**, 2, 1-130.
[8] A.M. Ibrahim, MSc. Thesis, Bayero University, Kano. **2008**.
[9] J. Khairiah, M.K. Zalifah, Y.H. Yin, A. Aminah, *Pak.J.Biol.Sci*., **2004**, 7,1438-1442.
[10] S. Khan, Q. Cao, Y.M. Zheng, Y.Z. Huang and Y.G. Zhu, *Environ. Pollut*., **2008**, 52, 686-692.
[11] F.E.N. Mapanda, Mangwayana, J. Nyamangara, K.E.Giller, *Agric. Ecosyst.Environ*., **2005**, 107, 151-165.
[12] A.I. Vogel, Quantitative Inorganic Analysis, Fourth Edition. Longman London, **1983**, Pp 122 – 125
[13] B.F. Wilcox, Fundamental of Food Chemistry, 2nd edition. Paraclete Publishers; Yola, Adamawa State Nigeria, **2006**, Pp. 60 – 65.
[14] W.H.O., Guidelines for drinking water quality, Health Criteria and Other Supporting Information, 2nd Edition, Vol. 2: World Health Organization, Geneva, **1999**, Pp. 99 – 101.
[15] W.H.O., Guidelines for drinking water quality, World Health Organization, Geneva, **2003**, pp. 90 – 94.
[16] W.H.O., Guidelines for drinking water quality, 3rd edition, Vol. 1, World Health Organization, Geneva, **2004**, 55-58.
[17] NI Ward; FW Field; PJ Haines; In Environmental Analytical Chemistry in Trace Elements. Nackie Academic and Professional, UK.**1995**, pp. 320-328.