Evaluation of Copper, Iron and Lead level in Some Selected Vegetables in Three Abuja main Market

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ABSTRACT--- ***The level of Copper, Iron and Lead contents in six selected Vegetables in Abuja Markets were determined using Atomic Absorption Spectrometry. The vegetables include; Ductus carrotus, Citrullus lanatus, Ipomea batatas, Alium sepa, Gingiber officinalis. and Detariium microcapum. The results revealed that average concentrations of Cu, Fe, Pb detected were ranged from 24- 28µg/g, 320 - 2140µg/g, 20 - 100µg/g for Utako market, 18 - 34µg/g, 260- 720µg/g, 20µg/g for Wuse Market, 26 - 34µg/g, 260 - 1940µg/g, 20 - 100µg/g for Garki market respectively. The concentrations levels of the metals were compared with those reported for similar vegetables from some other parts of the world. The intakes of Cu, Fe and Pb through vegetables was also estimated and were found to be below the recommended tolerance levels proposed by Joint FAO/WHO Expert committee on Food Additives, 1999. The Cu, Fe and Pb contents obtained showed that vegetables from these markets could serve as good dietry supplement since the levels are within safety baseline contents for human consumption.***

Keywords---- Estimation, Copper, Iron, Lead, Vegetables, Abuja

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1. INTRODUCTION

Vegetables as reported by [1] are essential sources of a wide range of vital micronutrients. Several researchers observed that vegetables consumption could prevent a number of chronic non-communicable diseases such as cardiovascular diseases, kidney, nervous as well as bone diseases even sometime contribute substantially to protein, mineral, vitamins, fiber and other nutrients which are usually in short supply in daily diets [2, 3, 1, 4, 5]. [6] reported that most vegetables consumed in Nigeria are being planted in rural areas and are transported to the urban area for human consumption. The recent trend indicated that there is an increasing awareness on the nutritive value of vegetables to the extent that most people now prefer eating vegetables to meat [7]. Vegetables have been recognized to have some medical properties due to antioxidant and antimicrobial action. Many of them were even documented to possess anti diabetic, anti inflammatory, and anti hypertensive potential [8, 7, 9].

Despite these essential benefits derived from consuming vegetables, most available literature established that whatever is taken as food might cause metabolic disturbance if it does contain more than the permissible limits of heavy metals. Recently heavy metal pollution in the environment has increasingly gathered a global interest. In this respect, contamination of vegetables with heavy metals has always been considered a critical challenge in scientific community [10]. Heavy metal contamination may occur due to irrigation with contaminated water, the addition of fertilizers and metal-based pesticides, industrial emissions, transportation, harvesting process, storage and/or sale. Because of their cumulative behaviour and toxicity, they have a potential hazardous effect not only on crop plants but also on human health [11, 12, 13, 14]

During the last decades, the increasing demand of the safety level of most vegetables have stimulated research regarding the risk associated with their consumption as result of contamination by pesticides, heavy metals and/or toxins [15]. The determination of heavy metals concentration in vegetables is very important because the healthy and natural uptake of microelements, vitamins, minerals, sugars, pectins, fibres achieved by their consumption contributes to the equilibrium needed by the human body. Therefore monitoring programmes for residues and contaminants contribute to improving food safety. The objectives of this study are to estimate the level of Iron, Copper and Lead that may be present in the selected vegetables, to provide a baseline data on Pb, Cu and Fe levels in dried vegetables and to establish the daily intake level of these metals through consumption of the vegetables.

2. MATERIALS AND METHODS

Sample area and collection

Dried Vegetables samples of *Ductus carrotus, Citrullus lanatus, Ipomea batatas, Alium sepa, Gingiber officinalis and Detariium microcapum* were purchased from three markets namely: Utako, Wuse and Garki market within Abuja metropolis, packaged into labelled paper bags and transported to the laboratory awaiting analysis. Sampling was done at random from different retailers and was quite representative since the area from where vegetables examined were scattered.

Sample preparation and digestion for heavy metals determination

The vegetables samples were washed with deionised water to remove debris and sand and later air-dried for 24hours. They were oven dried to a consistent weight at a temperature of 80^{o}C. The dried samples were crushed in a mortar and the resulting powders were sieved using 400µm sieve. 0.5 g of oven-dried, ground and sieved sample was weighed into an acid-washed porcelain crucible and ashed in a muffle furnace for four hours at 500°C. The crucibles were removed from the furnace and cooled. 10 mL of 6 M HCl was added covered and heated on a steam bath for 15 min. Another 1 mL of HNO_3 was added and evaporated to dryness by continuous heating for one hour to dehydrate silica and completely digest organic compounds. Finally, 5 mL of 6 M HCl and 10ml of water were added and the mixture was heated on a steam bath to complete digestion. The mixture was cooled, filtered and diluted to 100cm^3 with de-ionized distilled water. The filtrate was then transferred into a sample bottle and kept for the analysis of heavy metals.

Elemental analysis of samples

Fe, Cu and Pb level were determined on each final solution using Atomic Absorption spectrophotometer; model Pye Unicam SP-9 Cambridge, UK.

3. RESULTS

Iron, Copper and Lead analysis of each vegetable obtained from Utako, Wuse and Garki market in microgram per gram are shown in Table 1, 2 and 3 below.

Table 1: Results of Iron, Copper and Lead content of each vegetable obtained from Utako market in microgram per gram (µg/g)

Tissue	Fe µ g/g	Cu µg/g	Pb µg/g
A	320	24	100
B	440	26	Nd
C	380	26	20
D	2140	28	20
E	460	28	Nd
F	1140	24	Nd

Key:
A. *Ductus carrotus*
B. *Citrullus lanatus*
C. *Ipomea batatas*
D. *Alium sepa*
E. *Gingiber officinalis*
F. *Detariium microcapum*
Nd; not detected

Table 2: Iron, Copper, and Lead, content of each vegetable obtained from Wuse market in microgram per gram (μg/g)

Tissue	Fe μg/g	Cu μg/g	Pb μg/g
A	720	30	nd
B	340	34	nd
C	260	18	nd
D	580	24	nd
E	380	28	nd
F	580	34	20

Table 3, Iron, Copper, and Lead level of each vegetable obtained from Garki market in microgram per gram (μg/g)

Tissue	Fe μg/g	Cu μg/g	Pb μg/g
A	280	26	nd
B	260	26	20
C	500	30	20
D	1940	26	100
E	820	34	20
F	560	26	60

Table 4: Daily intake of heavy metals by urban population of Utako Market through consumption of vegetables

Tissue	Fe (μg/g)			Cu (μg/g)			Pb(μg/g)		
	Adults	children	Comment	Adults	children	Comment	Adults	Children	Comment
A	0.01	0.48	No effect	0.00	0.04	No effect	0.00	0.00	No effect
B	0.02	0.66	No effect	0.00	0.04	No effect	Nd	Nd	No effect
C	0.02	0.57	No effect	0.00	0.04	No effect	0.00	0.03	No effect
D	0.09	3.21	No effect	0.00	0.04	No effect	0.00	0.03	No effect
E	0.02	0.69	No effect	0.00	0.04	No effect	Nd	Nd	No effect
F	0.05	1.71	No effect	0.00	0.04	No effect	nd	Nd	No effect
Safe limit	425μg/g			0.2 μg/g			0.3μg/g		

Table 5: Daily intake of heavy metals by urban population of Wuse Market through consumption of vegetables

Tissue	Fe (µg/g)			Cu(µg/g)			Pb(µg/g)		
	Adults	children	Comment	Adults	Children	Comment	Adults	children	Comment
A	0.03	1.08	No effect	0.00	0.05	No effect	Nd	Nd	No effect
B	0.01	0.51	No effect	0.00	0.05	No effect	Nd	Nd	No effect
C	0.01	0.39	No effect	0.00	0.03	No effect	Nd	Nd	No effect
D	0.02	0.87	No effect	0.00	0.04	No effect	Nd	Nd	No effect
E	0.02	0.57	No effect	0.00	0.04	No effect	Nd	Nd	No effect
F	0.02	0.87	No effect	0.00	0.05	No effect	0.00	0.03	No effect
Safe limit	425µg/g			0.2 µg/g			0.3µg/g		

Table 6: Daily intake of heavy metals by urban population of Garki Market through consumption of vegetables

Tissue	Fe (µg/g)			Cu(µg/g)			Pb(µg/g)		
	Adults	children	Comment	Adults	children	Comment	Adults	Children	Comment
A	0.01	0.42	No effect	0.00	0.04	No effect	Nd	Nd	No effect
B	0.01	0.39	No effect	0.00	0.04	No effect	0.00	0.03	No effect
C	0.02	0.75	No effect	0.00	0.05	No effect	0.00	0.03	No effect
D	0.08	2.91	No effect	0.00	0.04	No effect	0.00	0.15	No effect
E	0.03	1.23	No effect	0.00	0.05	No effect	0.00	0.03	No effect
F	0.02	0.84	No effect	0.00	0.04	No effect	0.00	0.09	No effect
Safe limit	425µg/g			0.2 µg/g			0.3µg/g		

4. DISCUSSION

Heavy metal concentrations varied among different vegetables as indicated in Table 1, 2 and 3 above. Among the investigated vegetables, Samples collected from Utako market had the highest level of Fe in the range of 320 to 2140 µg/g, followed by vegetables purchased from Garki market with concentration range between 260-1940 µg/g while Wuse market recorded the least amount of Fe in the studied samples. The observed range of Fe concentration recorded was higher than the range 1.3 - 3.7 µg/g reported by [16] for lady's finger grown in waste water irrigated areas of Hyderabad, Andhra Pradesh. The obtained result is in agreement with [17] who reported that leafy vegetables are likely to accumulate Iron at higher levels compared to other metals. The concentration of Cu was low (34 µg/g; maximum) in all the vegetables from all the Markets (Table 1, 2 and 3) as compared to Cu concentration of 201.75 µg/g recorded by Liu *et al*., (2004) in tomato collected from waste water irrigated area of Zhengzhou city, China due to atmospheric deposition. The results showed that the levels of Pb in all vegetables from all the markets were between 20 to 100µg/g, respectively. Within the selected vegetables, the highest concentrations of Pb were noticed in Kuka, followed by Okro and Achi, Ofor from Garki, respectively. The concentration of Pb in Kuka (Table1 and 3) are high due to the influence of climate, atmospheric deposition, the nature of the soil on which the vegetables are grown, the degree of maturity of the vegetable at the time of harvest and the application of fertilizers [2, 18, 19,]. These concentrations of Pb in Kuka are lower than those detected in Pakistan [20]. [21, 22] affirmed that the heavy metals contents in vegetables varied depending on the country of origin, environmental pollution levels, plant part and technological processes. It is also believed that a combination of factors including the use of polluted water, bad practice in post harvesting handling of the vegetables products with disregard to the food safety guidelines, and the physical market environments in these locations surrounded by a heavy urban pollution deposition may have exacerbated contamination levels of these vegetable samples.

Daily intake estimate of Pb, Cu and Fe

The daily intake (µg/g/day) was calculated based on these purposes;

1. The adult weight is 50kg and the vegetable intake per day is 20g.
2. The children weight is 10kg and the vegetable intake is 15g.

$$\text{The daily intake } (\mu g/g/day) = \text{metal conc. in vegetable} \times \frac{\text{weight of vegetable}}{\text{Weight of body}}$$

Exposure of consumers and related health risks are usually expressed as provisional tolerable daily intake (PTDI), a reference value established by [23]. Table 4, 5 and 6 represents the estimation of each heavy metal intake through consumption of the studied foodstuffs. The average diet per person per day of all the vegetables is 20g for adult and 15g for children, respectively. Table 4, 5 and 6 showed that the maximum concentration of Fe^{2+} (0.09µg/g; adults and 3.21µg/g; children), Cu^{2+} (0.00µg/g; adults and 0.05µg/g; children) and Pb^{2+} (0.00µg/g; adults and 0.15µg/g; children), respectively from all the studied Markets in Abuja. These results are below PTDI limit for Pb, Fe and Cu which are 0.3µg/g, 425µg/g and 0.2µg/g respectively [23]. This level of Pb (0.15µg/g) in the sample may affect children's I.Q, although this value is still below the recommended safe limit.

5. CONCLUSION

The estimated daily intakes for the studied heavy metals are below those reported by the FAO/WHO who has set a limit for heavy metal intake based on body weight. Therefore, these vegetables are safe for consumption by the population of the studied area (Utako, Wuse and Garki of Abuja, metropolis).

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