DETERMINATION OF SOME HEAVY METALS IN SPINACH AND LETTUCE FROM SELECTED MARKETS IN KADUNA METROPOLIS

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ABSTRACT

Heavy metals such as copper, zinc, cadmium and lead were analyzed in vegetable samples (lettuce and spinach) obtained from ten major markets within Kaduna metropolis. The samples were digested by dry-ashing techniques and the trace metal were determined using atomic Absorption Spectrophotometry (AAS). The result were compared with the standard set by FAO/WHO (2001) which shows that for spinach sample cadmium and lead are within the permissible limit with the exception of Gumi market with (Cd 0.30 mg/kg). zinc was found to be within the acceptable limit for all spinach sample obtained. Copper was found to have exceeded the stipulated standard in all spinach samples except for sample from Angwan Rimi market with (0.06mg/kg). for lettuce sample, cadmium and zinc were found to be within the stipulated limit. Analysis for copper in the lettuce sample clearly show that samples from all other markets exceeded the acceptable limit, except samples from Gumi and Sabo markets with (0.32mg/kg and 0.32mg/kg) respectively. From the stipulated limits set by WHO/FAO, consumers of vegetables from this study areas were likely to be liable to copper toxicity and some few metals as stated above.

INTRODUCTION

Heavy metals are substances with a specific gravity of greater than 4.0 or 5.0g/cm^3 Heavy metals refer to any metallic element that has a relatively high density and is toxic or poisonous at high concentration. They include mercury, cadmium, Arsenic, Chromium, Thallium and lead . Heavy metals are natural components of the earth's crust, they cannot be destroyed or degraded. To a small extent they enter our bodies via food, drinking water and air[2]. Vegetables are part of daily diets in many households since it an important source of vitamins and minerals which is required for human health. They are made up of chiefly cellulose, hemicelluloses and pectin substances that give them their texture and firmness[5].

They constitute an important part of the human diet since they contain carbohydrates, proteins, vitamins, minerals and fibres required for human health. They also act as neutralizing agents for acidic substances formed during digestion[3].

Consumers demand for better quality vegetable is increasing, this perceptions of what is regarded as better quality are however subjective. Some consumers consider undamaged, dark green and big leaves as characteristics of good quality leafy vegetables. However, the external morphology of vegetables cannot guarantee safety from contamination. Heavy ranks high amongst the chief contaminants of leafy vegetables. Vegetables take up metals by absorbing them from contained soils, as well as from polluted environments[5]. Vegetable plants growing on heavy metal contamination medium can accumulate high concentrated of trace elements and cause health risk to

consumers.[3]. Excessive amount of Pb and Cd in food is associated with etiology of a number of diseases especially with cardiovascular, kidney, nervous as well as bone diseases WHO[7].

As human activities increases, especially with the application of modern technologies, pollution and contamination of the human food chain has become inevitable. Heavy metal uptake by plants grown on polluted soils has been studied by many researchers[9]. Heavy metal exposure is not an entirely modern phenomenon.

Zinc obtains its toxicity from essential macronutrients for plants, animals and humans. It is also found naturally in water, most frequently in areas where it is mined, it enters the environment from industrial waste metal plating and plumbing, and is a major component of sludge. Zinc causes no ill health effects excepts in very high dose, it imparts undesirable taste to water and is toxic to plants at high levels[8].

High accumulation of lead, chromium and cadmium in leafy vegetables are due to atmospheric decomposition of substances with such metals. Voutsa et al;[6] studied the concentration of Cd and Zn in the soil and vegetation along some roadside in Nigeria and concluded from the result that automobiles are a major source of these metals along the road side environment. The magnitude of heavy metal deposition on vegetable surfaces varied with physiological nature of the vegetable[4].

Demirezen and Aksoy[1] reported higher concentration of lead, cadmium and copper in Abelmoschus esculentus collected from urban areas of Kayseri, Turkey and compared to those from rural areas. Heavy Metal Levels in Vegetable in Turkey
are within Safe Limits for Cu, Zn, Ni and exceeded for Cd and Pb. Appropriate precautions should also be taken at the time of transportation and marketing of vegetables.

The aims of this research is to determine heavy metals such as Zinc, Cadmium, Copper and Lead in vegetables obtained from different markets in Kaduna metropolis.

MATERIALS AND METHODS

All samples were collected from different market in Kaduna metropolis and these market were Gumi market, Kawo market, Kakuri Market, Angwar Rimi market, Angwar Sunday market, Sabo Market, Station market, Kasuwar Barchi market, Monday market and television market so as to monitor the extent of pollution of these metals within the environment.

Ashing of the Vegetable Samples

About 5g of the powered sample was weighed and transferred to a weighed crucible and ashed in a muffle furnace for 4hrs at a temperature of 500°C after which it was placed in a desiccator to cool and take the weight of the ash was taken.

Digestion of the Vegetable Samples

The weighed ash (spinach & lettuce) were transfer into a beaker and 20cm^3 of HNO_3/H_2O_2 solution in a ratio of 2:1 was added and the mixture was placed on heating mantle and heated in a fume hood to near dryness. The contents were cooled

and 20cm^3 of distilled water was then added and filtered. The filtrate was then transferred to a clean propylene sample bottle with a leak-proof lid. The resultant solution was then analyzed for zinc, cadmium, copper and lead.

RESULTS AND DISCUSSION

The mean concentration of heavy metals i.e cadmium (cd), Zinc (Zn) lead (pb) and copper (Cu) determine from the vegetables, and lettuce from ten market in Kaduna metropolis were. Table 1 showed the mean concentration of cadmium in spinach obtained from various markets in Kaduna metropolis. The highest concentration was obtained from Gumi market with 0.3mg/kg. All other samples obtained from other markets were found to be within the limit set by FAO/WHO i.e. 0.2mg/kg consumers of spinach from the above mentioned markets do not face any danger of cadmium toxicity.

The results in Table 1 also revealed the mean concentration of zinc in spinach samples. Gumi market had the highest concentration of 0.16mg/kg while the lowest concentration was obtained from television market with 0.1mg/kg. this indicate that all samples obtained were found to be within the stipulated limit stated by FAO/WHO which is 99.40mg/kg, hence, consumers of spinach from the above mentioned market do not face any danger of zinc toxicity as at the time of study.

Table 1: Mean Concentration of Cadmium and Zinc in Spinach Samples

Sample Location	Cd (mg/kg)	Zn (mg/kg)
Market 1 (Gumi)	0.30	0.16
Market 2 (Kawo)	0.10	0.08
Market 3 (Kakuri)	0.05	0.10
Market 4 (Angwan Rimi)	0.07	0.02
Market 5 (Angwan Sunday)	0.11	0.07
Market 6 (Sabo)	0.04	0.10
Market 7 (Station)	0.07	0.07
Market 8 (Kasuwar Barchi)	0.03	0.09
Market 9 (Monday)	0.07	0.07
Market 10 (television)	0.01	0.01

Table 2 showed the mean concentration of lead in spinach samples obtained from various markets in Kaduna metropolis.

Lead was not detected from television market, while the highest concentration of

lead was found in samples from Gumi market with 0.36mg/kg and Kasuwar barchi with 0.34mg/kg while the lowest concentration of lead was found in samples from Kakuri and Monday market with 0.1mg/kg each respectively.

All other samples from the markets were found to be within the limit as stipulated by WHO/FAO which is 0.3mg/kg except for samples obtained from Gumi and Kasuwar Barchi which are 0.36mg/kg and 0.34kg respectively and hence consumers of spinach from these markets are prone to lead toxicity. This may be because of the location i.e its proximity to major roads and composition of these markets which is cosmopolitan. Table 2 also shows the copper concentration of spinach samples obtained from the various markets in Kaduna metropolis. The highest mean concentration of copper was found in sample from Gumi market with 0.15mg/kg and the lowest obtained from Angwan Rimi Market with 0.06mg/kg. All the other markets apart from Angwan Rimi, Station and Monday market exceeded the limit as stipulated by FAO/WHO i.e. 0.8mg/kg. Hence consumers of spinach from these markets are in danger of copper toxicity.

Table 2: Mean Concentration of Lead and Copper in Spinach Samples

Sample Location	Pb (mg/kg)	Cu (mg/kg)
Market 1 (Gumi)	0.36	0.15
Market 2 (Kawo)	0.14	0.09
Market 3 (Kakuri)	0.01	0.09
Market 4 (Angwan Rimi)	0.04	0.06
Market 5 (Angwan Sunday)	0.06	0.10
Market 6 (Sabo)	0.13	0.13
Market 7 (Station)	0.02	0.08
Market 8 (Kwasuwar Barchi)	0.34	0.12
Market 9 (Monday)	0.01	0.08
Market 10 (television)	ND	0.12

ND: Not detected

Table 3 showed that mean concentration of cadmium in lettuce obtained from the various markets in Kaduna metropolis. Cadmium was not detected in samples from station and television markets respectively. The highest concentration was obtained in samples from Augwan Sunday market with 0.15mg/kg and the lowest from 0.01mg/kg from Kasuwar barchi market. All the samples obtained were found to be below the safe limit set by FAO/WHO i.e 0.2mg/kg. Hence, consumers of lettuce from these markets do not face danger of cadmium toxicity.

Table 3 also shows the mean concentration of Zinc in lettuce samples obtained from various markets in Kaduna metropolis. Zinc was not detected in lettuce samples obtained from Gumi market and the highest mean concentration of Zinc was analyzed from Monday market with 6.04mg/kg and the lowest was found in Sabo market with concentration of 0.78mg/kg. All the samples analyzed for Zinc in lettuce were found to be within the limit given by FAO/WHO of 99.40mg/kg.

Table 3: Mean Concentration of Cadmium and Zinc in Lettuce Samples

Sample Location	Cd (mg/kg)	Zn (mg/kg)
Market 1 (Gumi)	0.05	ND
Market 2 (Kawo)	0.11	4.17
Market 3 (Kakuri)	0.05	2.02
Market 4 (Angwan Rimi)	0.11	3.03
Market 5 (Angwan Sunday)	0.15	1.29
Market 6 (Sabo)	0.11	0.78
Market 7 (Station)	ND	5.93
Market 8 (Kwasuwar Barchi)	0.01	1.19
Market 9 (Monday)	0.07	6.04
Market 10 (television)	ND	4.01

ND: Not detected

Table 4 showed that mean concentration of lead in lettuce obtained from various markets in Kaduna metropolis lead was not detected in sample from Kasuwar barchi market. The highest concentration of lead was found in sampls from Anguwan Sunday market with 0. 01mg/kg and the lowest was from Gumi and Kakuri market respectively with 0.1mg/l leach. Angwan Rimi market had the value 0.02mg/kg which is within the limit as set by FAO/WHO of 0.3mg/kg while all other

market were found to have lead concentration that is higher than the permissible limit set by FAO/WHO.

Table 4 also shows the mean concentration of copper in lettuce sample from various markets in Kaduna metropolis. Copper was not detected in samples from Kasuwar barchi market. Samples obtained from station market had the highest concentration of copper with 9.7mg/kg while Gumi market had the least concentration of copper with 0.3mg/kg. All sample analyzed for copper are above the limit 0.08mg/kg with no exception. Thus consumers are likely to face danger of copper toxicity.

Table 4: Mean Concentration of Lead and Copper in Lettuce Samples

Sample Location	Pb(mg/kg)	Cu(mg/kg)
Market 1 (Gumi)	0.01	0.30
Market 2 (Kawo)	0.08	5.29
Market 3 (Kakuri)	0.01	1.03
Market 4 (Angwan Rimi)	0.02	4.00
Market 5 (Angwan Sunday)	0.10	1.16
Market 6 (Sabo)	0.03	0.32
Market 7 (Station)	0.05	9.70
Market 8 (Kwasuwar Barchi)	ND	ND
Market 9 (Monday)	0.08	4.37
Market 10 (television)	0.05	3.92

ND: Not detected

CONCLUSION

The concentration of heavy metals in spinach and lettuce obtained from various markets within Kaduna metropolis (North and South) were analyzed and compared with standard as set by the FAO/WHO (2007). Some sample are within the permissible limits while some samples fell were above the limits stipulated by FAO/WHO and as such consumers of such vegetables might likely face threat to metal contamination.

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