

*Full Length Research Paper*

# Heavy metal levels in vegetables from selected markets in Lagos, Nigeria.

Ladipo Margaret Kudirat and Doherty Victoria Funmilayo\*.

Department of Polymer and Textile Technology, Yaba College of Technology, Lagos.

\*Department of Biological Sciences, Yaba College of Technology, Lagos.

Accepted 24 January 2011

**This study was conducted to analyze the heavy metal in a selected vegetable in Lagos, Nigeria. Recently matured leafy vegetable (fluted-pumpkin) from ten (10) different markets were sampled, digested using 98% nitric acid (HN03) and analyzed with the aid of Atomic Absorption Spectrophotometer(AAS) to determine heavy metals. The mean concentration for each heavy metal in the samples gotten from each market were calculated and the comparison of these data was done amongst the ten markets, and compared with the permissible levels set by the FAO and WHO. Results showed that the levels of Cadmium and Zinc for the leafy vegetables ranged from  $0.028\pm 0.003$  to  $0.091\pm 0.103$  and from  $0.348\pm 0.317$  to  $0.77\pm 0.38\text{mg/kg}$  dry weight respectively. Lead was not detected in all the samples. When compared with standards, heavy metal levels were found to be within safe limit.**

**Keywords:** Heavy metals, Vegetables, Atomic Absorption Spectrometry.

## INTRODUCTION

Vegetables are part of daily diets in many households forming an important source of vitamins and minerals required for human health. They are made up of chiefly cellulose, hemi-cellulose and pectin substances that give them their texture and firmness (Sobukola and Dairo, 2007). Consumers' demand for better quality vegetables is increasing. The 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 metals ranks high amongst the chief contaminants of leafy vegetables (Mapanda *et al* ,2005). Vegetables take up metals by absorbing them from contaminated soils, as well as from deposits on different parts of the vegetables exposed to the air from polluted environments (Sobukola *et al* 2010). Vegetable plants growing on heavy metal contaminated medium can accumulate high concentrations of trace

elements to cause serious health risk to consumers (Long *et al*, 2003).

Excessive content 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, 1992, 1995; Steenland and Boffetta, 2000; Jarup, 2003). Since the dietary intake of food may constitute a major source of long-term low-level body accumulation of heavy metals, the detrimental impact becomes apparent only after several years of exposure. Regular monitoring of these heavy metals from effluents, sewage, in vegetables and in other food materials is essential for preventing excessive buildup of the metals in the food chain. Heavy metal depositions are associated with a wide range of sources such as small scale industries (including battery production, metal products, metal smelting & Cable coating industries); brick kilns; vehicular emissions; re-suspended road dust and diesel generator sets. These can all be important contributors to the contamination found in vegetables. Additional potential sources of heavy metals in field locations in urban and per urban areas include irrigation water contaminated by

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\*Corresponding author. Email [funmilayodoherty@yahoo.co.uk](mailto:funmilayodoherty@yahoo.co.uk),  
Tel: +23408033107074.

industrial effluent leading to contaminated soils and vegetables.

Based on persistent nature and cumulative behavior as well as the probability of potential toxicity effects of heavy metals as a result of consumption of leafy vegetables, there is need to test and analyze these food items to ensure that the levels of these trace elements meet the agreed international requirements. This study therefore, presents data on the levels of **Pb, Cd, Zn** in some leafy vegetables in Lagos, Nigeria.

## MATERIALS AND METHODS

### Collection of samples

Five samples of the vegetable (*Telfaria occidentalis*), were purchased from ten major markets in Lagos, Nigeria during 2010. In each market, five vendors were identified and samples collected from each at different times. A total of 50 vegetable samples were collected from the different markets which include: Mushin, Oyingbo, Oshodi, Iyana-Paja, Shomolu, Bariga, Agege, Ojodu-Berger, Mile-12 And Yaba Markets.

### Pretreatment

After collection, the samples were brought to the laboratory and processed further for analysis. Edible portions of the samples were used for analysis while bruised or rotten samples were removed.

### Washing of samples:

The edible portion of the collected vegetable samples were properly separated and washed to remove dust particles. The samples were then chopped into small pieces using a knife. The vegetables were air-dried and then dried in an oven at 80 °C .

### Grinding of samples:

Dried samples of the vegetables were ground into a fine powder (80 mesh) using a commercial blender and stored in polyethylene bags, until used for acid digestion.

### Acid Digestion

Heavy metals in vegetable samples were extracted following acid digestion procedure as follows: **1.0 g** of the dry weight of each the sample collected at those market was weighed into a digestion tube and 10ml of 98% nitric acid was added. This was then placed in a water bath and allowed to boil for about 72 hours. After which digestion was completed, the resulting pale yellow solution was made up to 25ml with de-ionized water and stored. The composite of the samples were made for each market.

### Heavy Metals Analysis

The vegetal solution were analyzed for Zn, Pb, and Cd using a flame atomic absorption spectrophotometer (AAS, Perkin Elmer model 2130). A certified standard reference materials was used to

ensure accuracy and the analytical values were within the range of certified value. Blank and standards were run after five determinations to calibrate the instrument.

## RESULTS

### Concentration of heavy metals in vegetables

Tables 1 shows the mean concentrations of heavy metals investigated in leafy vegetable (fluted pumpkin) commonly consumed in Lagos, Nigeria. The values are given as mean  $\pm$  SD and the results are means of **five replicates**. The heavy metal levels determined were based on plants dry weight. Lead was not detected in vegetables in all the markets including the botanical garden. Samples from market 10 (Agege) showed lower concentrations of 0.028 mg/kg for Cd and market 3 (Iyana ipaja) showed higher concentration of **0.091 mg/kg** (Cd), all the values were lower than the safe limit for Cd (0.2mg/kg). Levels of Zn was highest in market 2 (Yaba) with mean concentration of 0.77mg/kg and lowest in market 9 (Mile 12) with mean concentrations of 0.348mg/kg. This is within safe limit with respect to FAO/WHO-Codex alimentarius commission, 2001 (99.40mg/kg). There was no significant difference ( $P < 0.05$ ) between the mean concentrations of Cadmium and Zinc of Ojodu market and Yaba market; Iyana-ipaja and Oyingbo markets; Oshodi and Shomolu markets; Mile-12 and Agege markets.

Our study has shown that the concentrations of Cadmium in the vegetables from Ojodu, Yaba, Bariga, Shomolu, Mile 12 markets are similar. Oyingbo, Mushin, Oshodi markets have similar concentrations of Cadmium which are higher in the vegetables. Agege market and the botanical garden vegetables have similar values which are lowest for Cd (Table 1).

### <sup>b</sup> FAO/WHO standard (Codex Alimentarius Commission, 2001).

There was a significant difference between the mean concentration of Cadmium in vegetables of Mushin market and Bariga market while no significant difference was observed between the level of Zinc in vegetables of Mushin market and Bariga market. When samples were compared between markets and the reference location (botanical garden- Yaba college of technology), the result indicated that there was no significant difference between the levels of the heavy metals of vegetables from the botanical garden (Yabatech) and the markets. This may be due to the fact that those vegetable samples were grown on soil having almost the same level of metals.

**Table 1:** Mean concentration of heavy metals in vegetable collected from different locations (mg/kg dry weight)

Heavy metals			
Location	Cd	Zn	Pb
MARKET 1 (OJODU)	0.036±0.007	0.538±0.507	nd
MARKET 2 (YABA)	0.03±0.009	0.77±0.38	nd
MARKET 3 (IYANA IPAJA)	0.091±0.103	0.432±0.169	nd
MARKET 4 (OYINGBO)	0.04±0.023	0.449±0.066	nd
MARKET 5 (MUSHIN)	0.044±0.006	0.476±0.148	nd
MARKET 6 (BARIGA)	0.03±0.003	0.39±0.114	nd
MARKET 7 (OSHODI)	0.045±0.006	0.388±0.048	nd
MARKET 8 (SHOMOLU)	0.032±0.006	0.485±0.156	nd
MARKET 9 (MILE 12)	0.033±0.007	0.348±0.317	nd
MARKET 10 (AGEGE)	0.028±0.003	0.521±0.152	nd
BOTANICAL GARDEN	0.027±0.01	0.465±0.11	nd
SAFE LIMIT	0.2 <sup>b</sup>	99.40 <sup>b</sup>	0.3 <sup>b</sup>

nd=Not detected. levels were below detection limit.

**n=5.** Results expressed as mean±SD.

Pb = Lead; **Zn =Zinc**; Cd = Cadmium.

## DISCUSSION

Cadmium is a non-essential element in foods and natural waters and it accumulates principally in the kidneys and liver (Divrikli et al., 2006). Various sources of environmental contamination have been implicated for its presence in foods (Adriano, 1984). Various values have been previously reported for leafy vegetables which include **0.090 mg/kg** for fluted pumpkin by Sobukola et al (2010), 0.049 mg/kg (Muhammed and Umer,2008) for lettuce. According to

FAO/WHO, the safe limit for Cd consumption in vegetables is 0.2mg/kg (Table 1), . The contents of both Cadmium and Zinc reported in this study are generally lower than the permissible levels by FAO/WHO in vegetables.

Among all heavy metals, Zinc is the least toxic and an essential element in human diet as it require to maintain the functioning of the immune system. Zinc deficiency in the diet may be highly detrimental to human health than too much Zinc in the diet. The recommended dietary allowance for Zinc is 15mg/day for men and 12mg/day for women (ATSDR 1994a) but high concentration of Zinc in vegetables may cause vomiting, renal damage, cramps . During this study, the concentration of Zinc was found high in the sample from market 2 (Yaba-0.77mg/g) while low concentration of Zinc was observed in vegetable sample from market 4 (Oyingbo-0.04mg/g). Other studies have reported level of Zinc in vegetables as 0.777mg/kg

for cabbage (Muhammad et al., 2008).

Lead is a serious cumulative body poison which enters into the body system through air, water and food and cannot be removed by washing fruits and vegetables (Divrikli et al., 2003). The high levels of Lead in some plants may probably be attributed to pollutants in irrigation water, farm soil or due to pollution from the highways traffic (Qui et al., 2000). Chinese cabbage has been reported to accumulate higher Lead concentrations compared to Pumpkin leaves from Mazimbu and Towelo (Chove et al., 2006). Wong et al., (1996) also reported that Chinese cabbage picks up Lead more readily compared to other heavy metals such as Cadmium ,Copper, Nickel and Zinc. In contrast, no Lead was detected in vegetable samples as at the time of this study and hence within safe limit, regular monitoring is required over a long period as the vegetables are transported from different sources. Lower level of Lead have been reported with *Telfaria* (Akinola and Ekiyoyo, 2006). *Celosia*, *Talinum*, and *Amaranthus* vegetables from Mushin market had no trace of lead (Afolami et al 2010) similar to the result of this study. This is most probably due to the way these vegetables were packaged in sacks, in such a way that, they were not exposed to atmospheric lead. In addition, these vegetables were transported from Abeokuta, (approximately 130 km from Lagos), and were probably less contaminated with lead. Lead pollution has been shown to be commensurate with population/vehicular density (Afolami et al 2010). It can

be stated that the site of growth noticeably influences the heavy metal uptake by vegetables. Generally, lead contaminations occur in vegetables grown on contaminated.

Soils. Lead poisoning is a global reality, and fortunately is not a very common clinical diagnosis yet in Nigeria except for few occupational exposures (Anetor et al., 1999).

Low levels of heavy metals were observed in the markets because most of the markets are located away from source of contamination which include: tire wear, motor oil, grease, brake emissions, corrosion of galvanized parts, fuel burning, batteries e.t.c. It may also be attributed to the soil on which the vegetables were grown. Such soil may be sited in rural areas which may be related and not contaminated.

Although the concentrations of the Cadmium and Zinc established for the vegetables are lower than those permitted by FAO/WHO, what matters in the long run is the quantities consumed and the frequency of intake. There is a cumulative effect on sustained intake of heavy metals, as they are not easily removed from the body. The absence of Lead in the vegetables sampled at the time of this study can not guarantee the safety of *Telfaria occidentalis* always for consumption, regular monitoring should be conducted to detect increasing levels of Lead in vegetables. Many rural and urban low-income families in Nigeria consume large quantities of vegetables on a daily basis and this exposes them to the health risks associated with heavy metals ingestion.

## CONCLUSION

Generally, the levels of heavy metals were observed to be lower than those of previous published works and regulatory standards. This may be in due partly to the **absence of pollution** in the area under investigation. The values of heavy metals presented in this work from fluted pumpkin obtained from Lagos, Nigeria can be valuable in the food composition tables for Nigerians and the West African sub-region. Further works should be carried out in the soil samples where the vegetables are grown

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