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Research Article

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Assessment of Heavy Metals on some Selected Fruit Sold in Port Harcourt Metropolis.

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Abstract

Heavy metals such as copper, lead and zinc were analyzed in somefruits and vegetable samples obtained from the fruit garden market in Port Harcourt. The fruit samples were orange and pineapple while the vegetable was carrot. The samples were digested by dry-ashing technique and the trace metals were determined using Atomic Absorption Spectrophotometer (AAS). The results were compared with the standard set by FAO/WHO (2001) which shows that for orange and pineapple samples, copper was within permissible limit with the exception of carrot (Cu 0.133±0.002 mg/kg) which slightly exceeded the stipulated standard. Zinc was found to be within the acceptable limit for all pineapple, orange and carrot samples obtained (2.569±0.001, 4.005±0.002 and 3.138±0.002 mg/kg) However, Lead was not detected in all the samples according to the WHO/FAO standard. The absence of Lead in the vegetable and fruits sampled at the time of this study cannot guarantee the safety of these fruit always for consumption; therefore, regular monitoring should be conducted as to detect increasing levels of lead in vegetables.

Keywords: Heavy metals, fruits, vegetable, Lead, Zinc, Copper

1. Introduction

Heavy metal contamination refers to the excessive deposition of toxic heavy metals in the soil caused by human activities (Ibrahim. *et al.*, 2006). Heavy metals in the soil include some significant metals of biological toxicity, such as Mercury (Hg), Cadmium (Cd), Lead (Pb), Chromium (Cr) and Arsenic (As), etc. They also include other heavy metals of certain biological toxicity, such as Zinc (Zn), Copper (Cu), Nickel (Ni), Stannum (Sn), Vanadium (V) (Hussain, *et al.*, 2013).

The heavy metals that are available for plant uptake are those that are present as soluble components in the soil solution or those that are easily solubilized by roots exudates (Baylock *et al.*, 2000). Although plants require certain heavy metals for their growth and development, excessive amounts of these metals can become toxic to plants. The ability of plants to accumulate essential metals equally enables them to acquire other non-essential metals (Djingova *et al.*, 2000);

as metals cannot be broken down when concentration within the plant exceed optimal level, they adversely affect the plant body directly and indirectly. Some of the direct toxic effects caused by high metal concentration include inhibition of cytoplasmic enzymes and damage to cell structure due to oxidative stress (Assche *et al.,* 2000).

Some of the heavy metals like As, Cd, Hg, Pb, and Se, are not essential for plant growth, since they do not perform any physiological function in plants. Others such as Co, Cu, Fe, Mn, Ni, and Zn, are essential element required for normal plant growth and metabolism of plants, but these elements can easily lead to poisoning when the concentration are greater than normal optimum values (Garrido *et al.*, 2002).

2. Study Area

The study area is located at the Rivers State University Main gate, Port Harcourt, with latitude of 4.7923 and longitude of 6.9825. The study site is characterized by tropical monsoon climate with mean annual temperature of 34℃, 65% humidity and 0.9948 atmospheric pressure. It is an urbanized area and a transit for both private and commercial vehicles.

2.1 Location of Sampling

3. Sampling and Methods of Analysis

3.1 Collection of Samples

One medium size basket of fresh orange, pineapple and carrot samples were purchased from the fruit market from different fruit sellers and transported to a greenhouse located at University of Port Harcourt (UNIPORT) where their dry mass was determined before they were analyzed.

3.2 Heavy Metals Analysis

3.2.1 Lead

Lead (Pb) was analyzed by an atomic absorption spectrophotometer at 283.3µ wave length. The wave length was selected with a narrow slit with air, and acetylene gas flow was adjusted. Other settings as recommended for the instrument employed was attended to and regulated. Hollow cathode lamp was given adequate time to stabilize before aspirating standard lead concentration, the aspiration tubing and system were flushed with distilled water severally before aspirating the test sample solution on the sample experimental conditions used for standard

The concentration of Lead ion in the sample was extrapolated from the standard graph of lead ion plotted. The concentration was expressed in *mg/L* or *ppm* from the equipment corrections which were made necessary in units of choice.

3.2.2 Copper

Copper (Cu) was analysed at 324.8µ wave length. Air and gas pressure flow was adjusted. Silt width and other settings as recommended for the instrument were adjusted. Hollow cathode lamp was energized and adequately allowed to stabilize. The instrument was calibrated with standard copper ion concentrations and the same graph was plotted

The sample solution was aspirated into the equipment and the concentration in the same was extrapolated from the standard copper graph in *ppm* or *mg/L.*

3.2.3 Zinc

Preparation sample as above 213.8µ wave length was selected, air gas pressure flows was adjusted. Slit width and other setting as recommended were adjusted. Hollow cathode lamp was allowed to stabilize.

Standard zinc ion concentration was aspirated to calibrate the equipment and to obtain a standard graph of the ion tested. Aspiration system was flushed with de-ionized water occasionally before further use. The sample solution was aspirated and the concentration of zinc ion in the sample was extrapolated and recorded in *ȷ/L or ppm*

4. Statistical Analysis

5. Results

5.1 Heavy metal Concentration in Fruits

5.1.1 Copper (Cu) Level in Orange (mg/kg)

The result for the concentration of copper in orange fruits obtained from street vendors in Port Harcourt metropolis, is presented in figure 1. The results for orange fruits shows a copper concentration of 0.056 mg/kg which was within the permissible oral limit of copper (0.04-0.05) in oranges as set by WHO/FAO and US EPA standards, hence consumers of orange from the above mentioned market do not face any danger of copper toxicity as at the time of study. The FAO/WHO permissible limit of daily oral intake of heavy metals was used as a standard of comparison in this study, and these were compared with the heavy metal values obtained in the study.

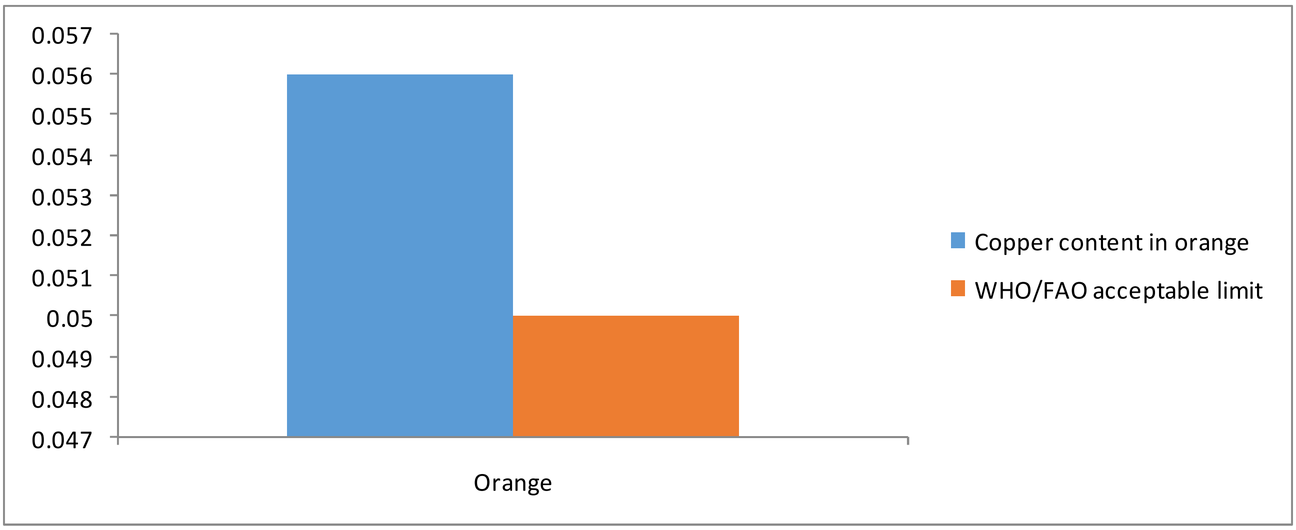

Fig1: Copper level in Orange

5.1.2 Copper (Cu) level in Pineapple (mg/kg)

The result for the total concentration of copper in pineapple fruits obtained from street vendors in Port Harcourt metropolis revealed copper concentration of 0.038 mg/kg which was below the acceptable limit for copper in fruits as stipulated by WHO/FAO (0.05 mg/kg) an indication that consumers of pineapple from the above mentioned markets do not face any danger of copper toxicity as shown in figure 2.

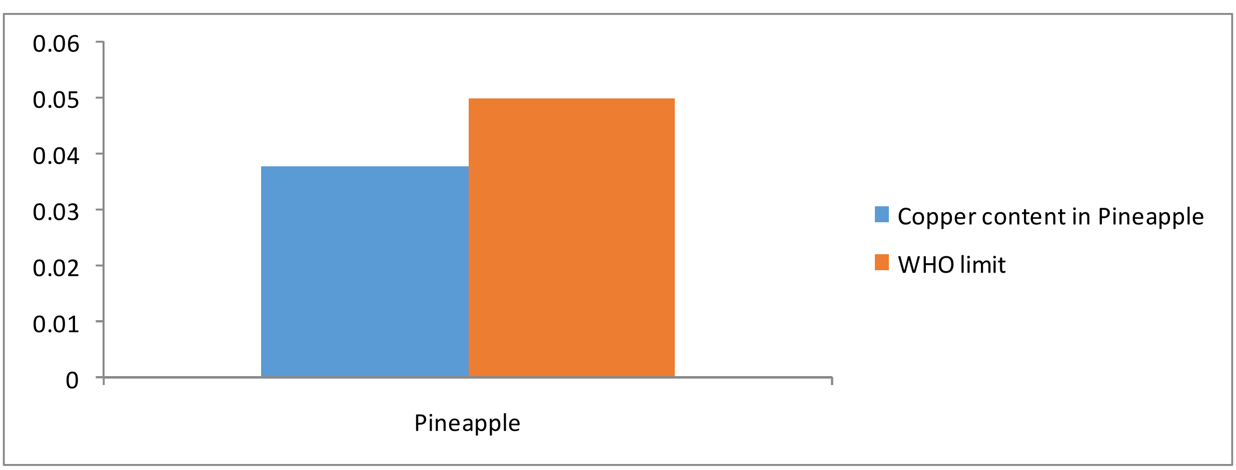

Fig 2: Copper level in Pineapple fruit

5.1.3 Concentration of Copper (Cu) in Carrot (mg/kg)

The result in figure 3 shows the concentration of copper in carrot fruits obtained from street vendors in Port Harcourt metropolis. The concentration of copper obtained in the carrot sample is 0.133 mg/kg. This value exceeded the WHO/FAO daily acceptable limits for tuberous or root vegetables (0.04mg\kg). The high value for copper obtained in this research portends danger for carrot purchased from this market as consumers are prone to copper toxicity as shown in figure 3 .

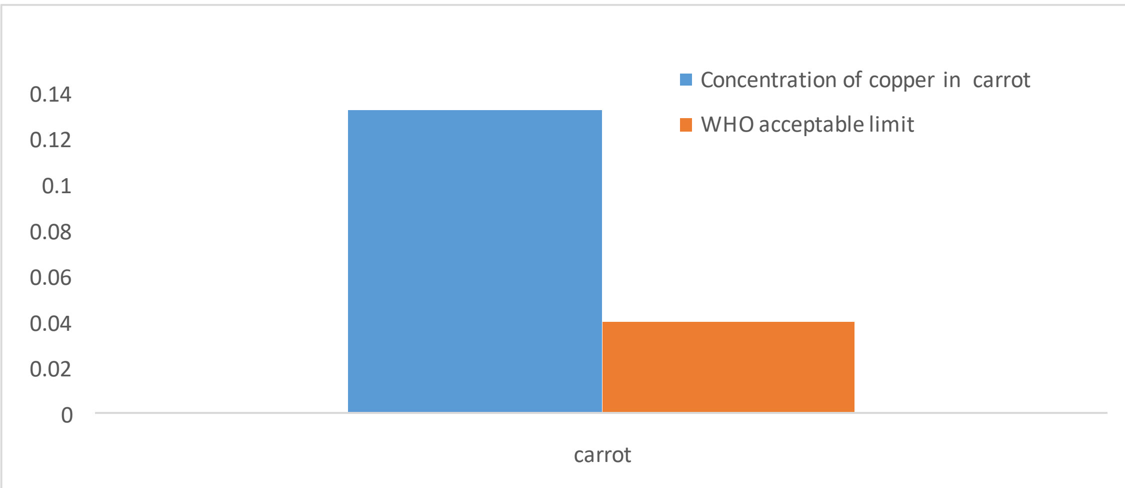

Fig 3: Concentration of Copper in Carrot

5.1.4 Concentration of Zinc (Zn) in Orange (mg/kg)

The result for the concentration of Zn in orange fruits obtained from street vendors in Port Harcourt metropolis is as shown in fig 4. The result showed that the orange fruits sampled had zinc concentration of 2.569 mg/kg as compared to the acceptable limit of zinc set by WHO/FAO standards(99.4 mg/kg). The concentration of zinc obtained in the sampled orange fruits is below the acceptable limit fruits (fig.4).

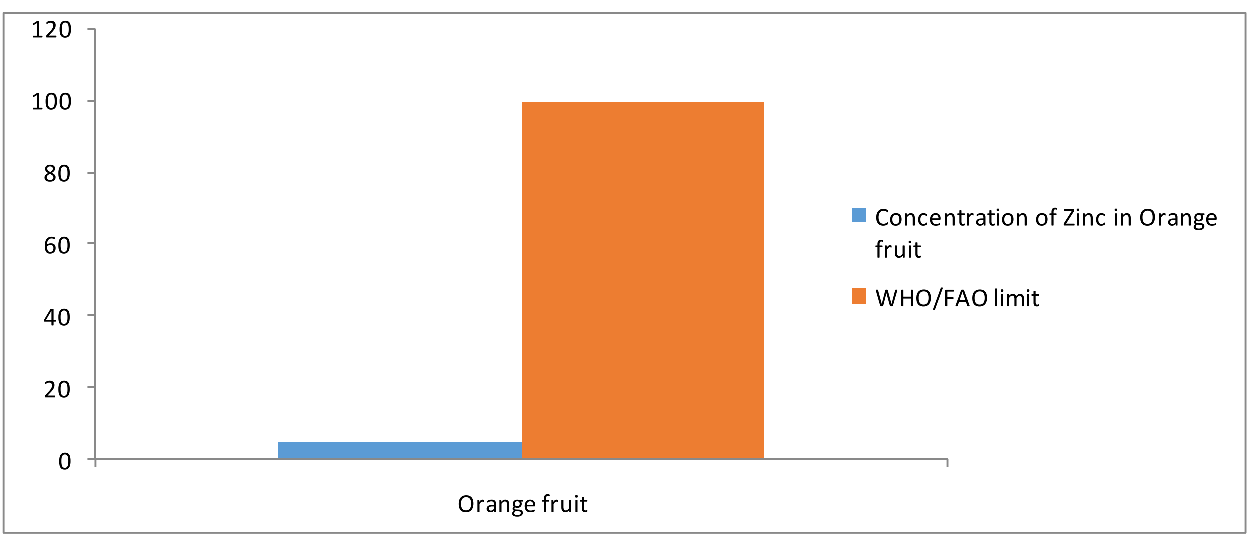

Fig.4: Concentration of Zinc in Orange

5.1.5 Concentration of Zinc (Zn) in Pineapple

The result showed the concentration of Zinc in pineapple fruits obtained from street vendors in Port Harcourt metropolis. The result obtained shows that the concentration of zinc in the sampled pineapple fruits is 4.005 mg/kg which is below the WHO acceptable limit for oral daily intake of zinc for fruits (99.1 mg/kg).

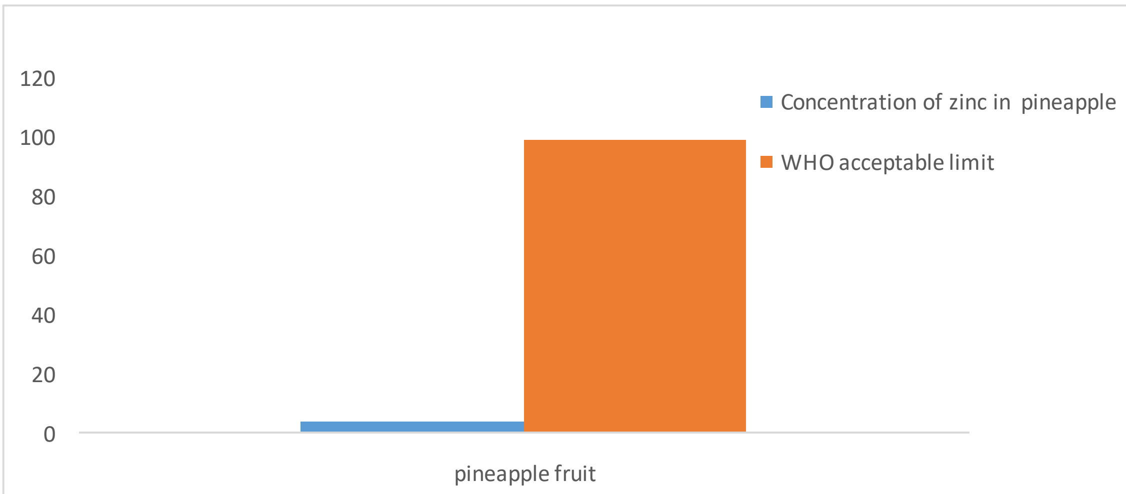

Fig.5: Concentration of Zinc in Pineapple

5.1.6 Concentration of Zinc (Zn) in Carrot

The result showed the concentration of zinc in carrot fruits obtained from street vendors in Port Harcourt metropolis. The concentration of copper obtained in this study was 3.138 mg/kg and the maximum permissible limits by WHO and FAO. The result obtained showed that the concentration of zinc was below the acceptable limit of zinc in root vegetables which ranges from 88.1-99.4 mg/kg as set by the US EPA and WHO standards for oral daily intake of this metal. (Fig.6).

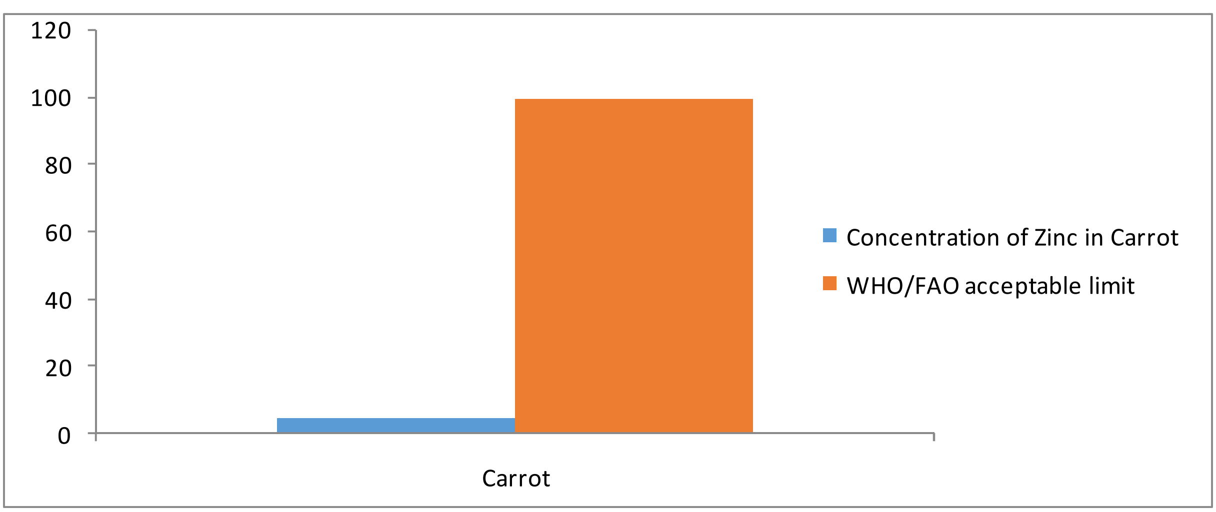

Fig 6: Concentration of Zinc in Carrot

5.1.7 Concentration of Lead (Pb) in Orange, Pineapple and Carrot

The results for the heavy metal content (Pb) of orange, pineapple and carrot obtained at the Rivers State University main gate Port Harcourt showed that Lead was non-detected in the various samples collected. That is, no Lead was found in all the sampled fruits collected at the sampled location.

6. Discussion

Copper (Cu) is an essential trace element required for proper health in an appropriate limit. Its high uptake in fruits can be harmful for human health and in the same way; lower uptake in human consumption can cause a number of symptoms like growth retardation, skin ailments, gastrointestinal disorders, etc. From this study, its concentration ranged between 0.054 mg/kg for orange to 0.133 mg/kg for carrot. Sobukola *et al.*, (2010) have reported 0.015 mg/kg, 0.002 mg/kg, 0.003 mg/kg and 0.009 mg/kg for pineapple, orange, pawpaw and banana respectively. The concentration of copper was found to be higher in the tuberous vegetables as compared to fruit vegetables. This trend was found to be in accordance with previous studies estimating heavy metals in vegetables (Arora *et al*., 2008). The results shows that consumers of orange and pineapple sold in the Rivers State University main gate do no face any danger of copper toxicity.

Among all heavy metals, Zinc is the least toxic and an essential element in human diet as it requires maintaining 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. Zinc (Zn) is an important component of many vital enzymes. Symptoms of Zinc deficiency may include vomiting, tachycardia, nausea, vascular shock and pancreatic disorder. The concentrations of Zn from this study were found to be about 10 times lower in all the tested samples compared to the maximum permissible limit of 99.40 mg/kg by WHO and FAO. These values were observed to be very high compared to results from similar analysis by Sobukola *et al.*, 2010. Since all the samples analyzed for zinc where below the safe limit set by FAO/WHO that is 99.1mg/kg, consumers of orange, pineapple and carrot sold in Rivers State University main gate do not face danger of zinc toxicity.

Lead (Pb) 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 (Damirezen and Aksoy, 2006). It accumulates in the brain leading to plumbism. In children it leads to lower IQ, short attention span, hyperactivity and mental deterioration. Loss of memory and weakness of joints have been reported in adults. No trace of Lead (Pb) was observed in all the sampled fruits and vegetables. 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. The non-detection of Lead in all the sampled fruits and vegetables also shows that consumers of these fruits in the sampled location do not face any danger of Lead poisoning (Damirezen and Aksoy, 2006).

However, the concentrations of Copper (Cu) and Zinc (Zn) 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. 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.

The concentration of heavy metals in orange, pineapple and carrots obtained from the Rivers State University Main Gate were analyzed and compared with standard as set by the FAO/WHO (2007). Orange and pineapple samples are within the permissible limits stipulated by FAO/WHO, hence consumers of these products do not face any danger of heavy metal poisoning, while carrot samples fell above the limits stipulated by FAO/WHO and as such consumers of such vegetables might likely face threat to metal contamination. Generally, the levels of heavy metals were observed to be lower than those of previous published works and regulatory standards. This may be due partly to the absence of pollution in the area under investigation.

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