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Heavy Metals Level Evaluation in *Lycopersicon Esculentum (Tomato)* and *Daucus Carota (Carrot)* Cultivated In Two Farming Communities in Kazaure Local Government Area

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ABSTRACT

The exposure to heavy metals such as Ni, Cd, Cr, Co, Pb, As, Hg, Zn, Fe and Cu, has been reported as a risk to human health through the consumption of vegetable when exposed to air pollution and other environmental and agricultural pesticides. This paper is aimed to evaluate the level of heavy metal in carrot and tomatoes cultivated in two farming communities in Kazaure Local Government Area, Jigawa State, Nigeria. The heavy metals were analysed using Atomic Absorption Spectroscopy. The result showed that the mean levels concentration of heavy metals from carrot and tomatoes fruit cultivated from the two farming communities in Kazaure namely Gada and Firji farming areas. The heavy Ni, Cd, Fe, Pb, Mn, Zn and Cr concentration for carrots cultivated at Gada farming area were ranged from 0.06-0.09 mg/kg, 0.08-0.09 mg/kg, 8.24-8.91 mg/kg,0.13-0.23 mg/kg,1.23-,1.56-1.67 mg/kg and 0.02-0.04 mg/kg respectively. The heavy metals As Cu and Co were not detected in the fruits of carrot for cultivated in both two farming areas. While the mean concentration obtained from tomatoes fruits from the Gada and Firji farming areas ranged from 0.14-0.16 mg/kg, 0.06-0.07 mg/kg, 6.11-6.12 mg/kg, 0.97-0,99 mg/kg, 1.11-1.23 mg/kg, 0.35-0.39 mg/kg for Ni, Cd, Fe, Mn, Zn and Cr respectively. While As, Cu, Pb and Co were not found in tomatoes harvested from the two farming communities. The study concludes that the level of some heavy metals analysed in carrot and tomatoes fruits were found within the permissible level except lead and cadmium.

KEYWORDS: *Carrot, tomatoes, heavy metal and Vegetable*

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INTRODUCTION

Heavy metals are non-biodegradable hazardous contaminants in food and have long biological half-lives (Heidarieh.,2013). Due to their increasing trends in human foods and environment. Metals most often found as contaminants in vegetable and can pose as a significant health risk to humans, particularly in elevated concentrations above the very low body requirements (Alloway, 1995); e.g. chromium, arsenic, cadmium, lead, mercury, manganese, etc. Heavy metals are natural constituents of the Earth's crust. Because they cannot be degraded or destroyed, heavy metals are persistent in all parts of the environment. In small amounts, they enter the human body via food, drinking water and air. Heavy metals such as iron, copper, manganese, and zinc are nutritionally essential for a healthy life when present in food in small quantities. These elements, or some form of them, are commonly found naturally in foodstuffs, in fruits and vegetables, and in commercially available multivitamin products (International Occupational Safety and Health Information Centre, 1999). Some heavy metals play essential roles in the body like helping in the functioning of critical enzymes in the body. Physiological roles are known for iron (haemmoeties of heamoglobin and cytochromes), copper (amine oxidases, dopamime hydrolase and collagen synthesis) and zinc (protein synthesis, stabilisation of DNA and RNA) (Suruchi and Khana, 2011).

Air pollution of the natural environment by heavy metals is a universal problem because these metals are indestructible and most of them have toxic effect on living organisms, when permissible concentration levels are exceeded (Akoto *et al.*, 2008). Toxic metals comprise a group of harmful minerals that have no known function in the body. Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues. Toxic heavy metals include; lead cadmium, arsenic, mercury, aluminium, antimony, bismuth, barium and uranium. Heavy metals needed in lesser quantities are usually toxic in greater amount (Alam, 2003).

Food is essential for the upkeep and growth of living things especially humans. Due to the nutritional values of vegetables, people are encouraged to add vegetables to their meals. *Daucus carota* and *Lycopersicon esculentum* (carrot and tomato) are fruit vegetables that are consumed in almost every house in Kazaure and communities around and are usually consumed in their raw state. When these vegetables are contaminated with heavy metals, these metals accumulate and lead to the malfunctioning of some human organs. Bearing in mind the probable toxicity and persistent nature of heavy metals and the frequent consumption of vegetables, it is necessary to know these vegetables are safe for human consumption. The aim of this study is to determine the levels of heavy metal in commonly consumed vegetables *Lycopersicon esculentum* (Tomato) and *Daucus carota* (Carrot) from two farming communities in Kazaure Local Government Area.

MATERIAL AND METHOD

Sampling of Vegetables

The vegetables (*Daucus carota* and *Lycopersicon esculentum*) were sampled from the two farming communities. The samples were collected from the farmlands during the second harvesting season 3 months after sowing. Three sampling plots of 9 m2 was demarcated within each farmland area. Each plot served as replicate. Within each plot samples of six plants of each vegetable (*Daucus carota* and *Lycopersicon esculentum*) were randomly harvested. The samples of vegetables were then separated into fruits, shoots and roots. The fruits were placed into separate polythene bags and labelled according to their farmland and was taken to Laboratory for preparation and analysis.

Preparation and Laboratory Analysis of Samples

Vegetables Preparation and Digestion

The collected vegetables were separated and clean first with tap water and then with distilled water to eliminate suspended particles. The calyx and pedicel were removed from all fruit samples and added to their respective shoots. Samples were cut into smaller pieces with a plastic knife. The samples were put in different crucibles and ash in a furnace at 650°C for two hours. A quantity of the ash (0.4 g) from each plant sample was weighed separately into a beaker. To each, 3 ml of concentrated HCl and 1 ml of concentrated HNO_3 was added, and heated on a hot plate at 100°C for 10 minutes to destroy any oxidiazable materials and carbonates. The solutions were topped with deionised water to the 30 ml mark and filtered using a Whatman NO 1 filter paper. The filtrate was used for the determination of heavy metals.

Determination of Heavy Metals by Atomic Absorption Spectrometer (AAS)

Atomic Absorption Spectrometer (AAS) was used for the analytical determination of the heavy metals. The instrument uses light to measure the concentration of gas phase atoms. The atoms absorb light and make transitions to higher energy levels. Since each element has a unique electronic structure, the wavelength of light at which the absorption would take place is a unique property of each individual element. The source of light is a hallow cathode lamp made of the same element as the metal of interest. The metal concentration is determined from the amount of light absorbed. The heavy metals of was aspirated into the excitation region of the AAS where they desolvated, vaporised and atomized by a flame discharge. The monochromator was used to isolate the specific wavelength of light emitted by the hallow cathode lamp from the non-analytical ones. The hallow cathode lamp used depended on the metal being analyzed. A light sensitive detector measured the absorbed light and a computer measured the response of the detector and translated into concentration.

Data Analysis

Data obtained were subjected to Analysis of Variance (ANOVA) using SPSS version 16 with values for $p < 0.05$ considered significantly different. Concentrations of heavy metals was expressed as mean ± SDM (Standard Deviation of the Mean).

RESULT AND DISCUSSION

Heavy Metal Mean Concentration in *Daucus Carota* (Carrot) *Lycopersicon Esculentum* (Tomatoes) Cultivated in Two Farming Area of Kazaure (Gada and Furji)

The mean levels concentration of heavy metals from carrot and tomatoes fruit cultivated from the two farming communities in Kazaure namely Gada and Firji farming areas. The heavy Ni, Cd, Fe, Pb, Mn, Zn and Cr concentration for carrots cultivated at Gada farming area were range from 0.06-0.09 mg/kg, 0.08-0.09 mg/kg, 8.24-8.91 mg/kg,0.13-0.23 mg/kg,1.23-,1.56-1.67 mg/kg and 0.02-0.04 mg/kg respectively. The heavy metals As, Cu and Co were not detected in the fruits of carrot cultivated in both two farming areas (Table 1). While the mean concentration obtained from tomatoes fruits from the Gada and Firji farming areas ranged from 0.14-0.16 mg/kg, 0.06-0.07 mg/kg, 6.11-6.12 mg/kg, 0.97-0,99 mg/kg, 1.11-1.23 mg/kg, 0.35-0.39 mg/kg for Ni, Cd, Fe, Mn, Zn and Cr respectively. While As, Cu, Pb and Co were not found in tomatoes harvested from the two farming communities (Table 1).

Table 1: Heavy Metal Mean Concentration in *Daucus Carota* (Carrot) *Lycopersicon Esculentum* (Tomatoes) Cultivated in Two Farming Area of Kazaure (Gada and Furji)

Heavy Metals(mg/kg)	Recommended Value	*Daucus carota* (Carrot)		*Lycopersicon esculentum* (tomatoes)	
	CODEX (WHO/FAO,2007)	Gada Farm Land	Firji Farm Land	Gada Farm Land	Firji Farm Land
Nickel (Ni)	1.5	0.06±0.001^{a}	0.09±0.001^{a}	0.14±0.022^{b}	0.16±0.031^{b}
Arsenic (As)	0.20	ND	ND	ND	ND
Cadmium(Cd)	0.20	0.08±0.012^{c}	0.09±0.021^{c}	0.06±0.012^{d}	0.07±0.001^{d}
Copper (Cu)	40	ND	ND	ND	ND
Iron (Fe)	425	8.24±1.22^{e}	8.91±1.11^{f}	6.12±0.34^{g}	6.11±1.33^{g}

Lead (Pb)	0.01	0.002 ± 0.00^{h}	0.003 ± 0.00^{h}	ND	ND
Manganese (Mn)	500	1.23 ± 0.43^{i}	1.34 ± 0.33^{j}	0.97 ± 0.02^{p}	0.99 ± 0.034^{p}
Zinc (Zn)	60	1.56 ± 0.14^{k}	1.67 ± 0.26^{l}	1.11 ± 0.20^{q}	1.23 ± 0.44^{r}
Cobalt (Co)	0.05-0.1	ND	ND	ND	ND
Chromium (Cr)	2.3	0.02 ± 0.001^{m}	0.04 ± 0.001^{n}	0.35 ± 0.02^{s}	0.39 ± 0.03^{t}

Result are presented in triplicate as mean ± standard deviation, value in same row with different superscript are statistically significant ($p>0.005$)

The study showed that the mean concentrations of metals in the carrot and tomatoes fruits harvested from the two farming areas were generally below permissible level. This might be attributed to the root which seems to act as a barrier to the translocation of metals to the fruits. However, the levels of heavy metals were observed to be lower than those of previous reported. This may be in due partly to the low level of pollution in the cultivated areas and the season in which the sample was harvested. Cadmium is a heavy metal with high poisonous ability and it is a non-essential element in foods and natural waters and it accumulates principally in the kidneys and liver. Various sources of environmental contamination have been implicated for its presence in foods. 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 Umar, 2008). This is in line with what was obtained in this study of cadmium ranged from 0.6-0.9 mg/kg in both vegetables and farmland area. According to FAO/WHO, the safe limit for Cd consumption in vegetables is 0.2mg/kg. The contents of both Cadmium and Zinc reported in this study are within the permissible levels set by FAO/WHO in vegetables. Zinc is the least toxic and essential elements 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 1994) but high concentration of Zinc in vegetables may cause vomiting, renal damage, cramps, therefore, carrots and tomatoes which demonstrated some certain amount of Zinc can serve as supplement or utilized in many dishes. Copper was not detected in both vegetables cultivated in all the farming areas in this study, Copper is a component of other proteins associated with the processing of oxygen (Kachenko and Singh,2006). In cytochrome oxidase, which is required for aerobic respiration, copper and iron cooperate in the reduction of oxygen. Copper is also found in many superoxide dismutase and proteins that detoxify superoxides, to oxygen and hydrogen peroxide (Jones, 2009). Lead concentration was detected in carrot cultivated in both two farming area this may be as a result of human activities such as wastewater irrigation, solid waste disposal and sludge applications, solid waste combustion, agrochemicals and motors exhausted (Voutsa *et al*., 1996). The lead in fuels can contribute to the air pollution. It is highly unlikely that in that region as the major road that linked to Katsina and Niger republic. Air pollution could serve as main media that convert to soil pollution. Lead is a toxic element that can be harmful to plants, although plants usually show ability to accumulate large amounts of lead without visible change in their appearance or yield. In many plants lead accumulation can exceed several hundred times the threshold of maximum level permissible for human (McBride,2003) as indicated in this study were lead was found to be above the permissible limit set by FAO/WHO. Lead pollution shown to be commensurate with population/vehicular density (Afolami *et al.,* 2010), 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). 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 (Bahemuka and Mubofu, 1991).

CONCLUSION

In conclusion, the study revealed that the level of some heavy metals in carrot and tomatoes fruits were found within the permissible level except lead and cadmium, therefore regular monitoring of these toxic heavy metals in vegetables and other food materials is essential to prevent excessive build-up in the food chain. Further works should be carried out in the soil samples were the vegetables are grown.

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CONFLICT OF INTEREST

The authors have no any conflict of interest

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