EFFECT OF HEAVY METALS ON CASSAVA TUBERS (*Manihot esculenta*) AND PUMPKIN LEAVES (*Telfairia occidentalis*) FROM PRISON FARM IN ELELE, IKWERRE LGA OF RIVERS STATE. NIGERIA.

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ABSTRACT:

The concentration of five heavy metals in pumpkin leaves (Telfairia occidentalis) and cassava tubers (Manihot esculenta) from Elele prison farm Rivers State was determined. The result showed high level of heavy metal concentration in the order of Cu (6.62 mg/kg) > Cr (4.82 mg/kg) > Pb (4.08 mg/kg) > Cd (1.46 mg/kg) > Hg (<0.001) in pumpkin leaves ((Telfairia occidentalis) when compared with heavy metal concentration detected in the cassava tuber (Manihot esculenta) sample from Elele prison farm Rivers State in the order of Cu   (2.77 Mg/kg) > Pb (0.99 Mg/kg) > Cr (0.77) > Cd (0.18 Mg/kg) > Hg (< 0.001Mg/kg). The concentration of heavy metals (Cadmium, Chromium and lead) in pumpkin leaves from Elele prison farm Rivers State were higher than the concentration of heavy metals of cassava tubers from Elele prison farm Rivers State. It was observed that the concentration of lead, chromium and cadmium in the pumpkin leaves and cassava tubers were above WHO/FAO and Codex General standard for contaminants and Toxins in food and feed (CODEX STAN 193-1995) safe limits .

Keywords: Cassava tubers, pumpkin leaves, Rivers State, Heavy metals, health risk, Elele

INTRODUCTION

Pollution is one of the most important problems around the world in which thousands of millions of world inhabitants suffer health problems related to industrial, (effluents, sewage, oil spillage etc), agricultural and atmospheric pollutants. Industrial wastes and effluents are being discharged randomly on the soil, into canals, rivers, along road sides or in the vicinity of industry without any treatment in Nigeria and other parts of the world. They pollute productive soils, natural water system as well as ground water. Heavy metals are extremely persistent in the environment. They are non-biodegradable and thermo degradable and therefore readily accumulate to toxic level (Akguc et al., 2008).

Heavy metals are defined as elements in the periodic table having atomic number more than 20 or having densities more than $5g/cm^3$. The environmental burden with heavy metal are that they are non degradable and most of them have toxic effect on living organisms when they exceeded a certain concentration level either in water, soil or food substances (Hong et al., 2014).

Heavy metals can accumulate in soil at toxic level due to long term application of waste-water. The contamination of vegetables with metals due to the soil and atmospheric contamination poses a threat to their quality and safety (El-Fadel et al., 1997). Heavy metal contamination levels in agricultural soil are of major significance because of the potential to accumulate in soil for a long period of time (Iwegbue et al. 2013). High concentration of metal ions in soil environment may pose a significant risk to the quality of soils, plants, natural waters and human health (Wu and Zhang, 2010). Excessive accumulation of heavy metals in agricultural soils may result not only in soil contamination but also consequences for food quality and public health safety issues. Evidence of heavy metal contamination/pollution of agricultural soils and uptake of the heavy metals in vegetables and fruits in Romania and Brazil were reported by Lacatusu, 2008; Guerra et al. 2012, they further added that the toxic effects of some heavy metals in

vegetables like Cu and Pb focus on several human body organs such as liver, kidneys, spleen and lungs causing a variety of biochemical defects. Therefore it is essential to monitor the heavy metal contamination/pollution levels of pumpkin leaves and cassava tubers in Elele in Ikwerre Local Government area.

Heavy metals are not easily biodegradable and consequently can be accumulated in human vital organs. This situation causes varying degrees of illness based on acute and chronic exposures (Demirezen & Ahmet, 2006).

Vegetables are an important part of human's diet. In addition to a potential source of important nutrients, vegetables constitute important functional food components by contributing protein, vitamins, iron and calcium which have marked health effects (Arai, 2002). Vegetables, especially those of leafy vegetables grown in heavy metals contaminated soils, accumulate higher amounts of metals than those grown in uncontaminated soils because of the fact that they absorb these metals through their leaves (Al Jassir et al., 2005).

The environmental problems associated with Heavy metal pollution have increased during the last decade. It has become increasing evident that this type of pollution is affecting plants, human, and animals resources. Thus, the aim of this study is to investigate the level of heavy metals including Pb, Mn, Cu, Ni, Cd and Zn in Elele Prison farm in Rivers State. Nigeria.

2   MATERIALS AND METHODS

2.1   Study Area

Elele prison farm is located in Ikwerre LGA of Rivers State, Nigeria. This prison farm is situated in Elele Ikwerre Local Government Area, Rivers State, Nigeria; its geographical coordinates are 5° 6' 6" North, 6° 48' 51" East.

2.2   Collection of Sample

Cassava tubers (*Manihot esculenta*) and pumpkin leaves (*Telfairia occidentalis)* were collected from Elele prison in Ikwerre Local Government Area, Rivers State Nigeria in November, 2015.

2.3. Sample Collection and Treatment

Fresh pumpkin leaves (*Telfairia occidentalis)*, cassava tubers were randomly collected from six spots (30 meters apart) on the farm in the month of November 2015. Each vegetable samples were pooled together to obtain good representation and then divided into three portions for composite replicate analyses (Alinnor, 2004; Iyaka, 2007). The vegetables was washed with tap water to remove soil particles and dust and then rinsed with distilled water. They were sliced using knife to aid drying at room temperature. The samples were air dried on white tiles for two days in the laboratory and then oven-dried at 60 °C for five days to

constant weight. The dried samples were crushed and finely ground using porcelain mortar and pestle to pass a 250 µm mesh sieve. Then, each of the processed powder was subjected to acid digestion (Alinnor, 2004; Iyaka, 2007) and the concentrations of the heavy metals Hg, Cd, Cr, Pb and Cu in the solutions were determined using atomic absorption spectrophotometer equipped with air-acetylene burner.

2.4 Acid Digestion of the Samples

A measured weight (2 g) each of the processed, cassava sample, pumpkin sample was digested in 12 mL of aqua regia HNO_3/ HCl (1:3) on a hot plate for 3 hours at 110 ^{o}C until the brown fumes disappeared. Heating was then continued until the brown fumes turned to white. 20 ml of distilled water was added and heated until a colourless solution was obtained. The solution was allowed to cool and filtered into a standard volumetric flask (100 ml) through Whatman No. 42 filter paper and the volume was made to the mark with distilled water (Alinnor, 2004; Iyaka, 2007). The concentrations of the heavy metals (Cd, Cr, Cu, Hg and Pb) in the cassava and pumpkin leaves (*Telfairia occidentalis*) samples were determined using atomic absorption spectrophotometer. The beaker was brought down to cool to room temperature. The mixture was rinsed with 20mls of deionized water and filtered into a standard 25mls volumetric flask using whatman filter paper. The concentration of lead, cadmium, chromium, copper and mercury were determined in the cassava and pumpkin samples using Atomic Absorption Spectrophotometer (AAS).

3.0 RESULT

The Mean Concentration of heavy metals (mg/kg) and their levels found in the samples of pumpkin leaves (*Telfairia occidental*), and Cassava

tubers from Elele prison farm Rivers State are presented in Table 1 and figure 1.

The concentration of heavy metal detected in the pumpkin leaves from Elele prison farm Rivers State showed high level of heavy metal concentrations in the order of Cu (6.62 mg/kg) > Cr (4.82 mg/kg) > Pb (4.08 mg/kg) > Cd (1.46 mg/kg) > Hg (<0.001). Concentrations of Cr (4.82 mg/kg), Pb (4.08) and Cd(1.46) were above permissible limits of FAO(2005), WHO (2005),European Standard (2006), Codex General standard for contaminants and Toxins in food and feed (CODEX STAN 193-1995) safe limits. Hg (< 0.001) and Cu (6.62) in pumpkin leaves (*Telfairia occidental*) were below permissible limits of FAO (2005), WHO (2005) safe limits.

The concentration of heavy metals detected in the cassava tuber sample from Elele prison farm Rivers State showed increase in the order of Cu (2.77 Mg/kg) > Pb (0.99) > Cr (0.77) > Cd (0.18 Mg/kg) > Hg (< 0.001Mg/kg).

It was observed that lead, chromium and cadmium were above WHO/FAO and Codex General standard for contaminants and Toxins in food and feed (CODEX STAN 193-1995) safe limits.

Table 1: Mean Concentration of heavy metals (mg/kg) in pumpkin leaves (*Telfairia occidental*) and Cassava tubers (*Manihot esculenta*) samples from Elele prison farm Rivers State.

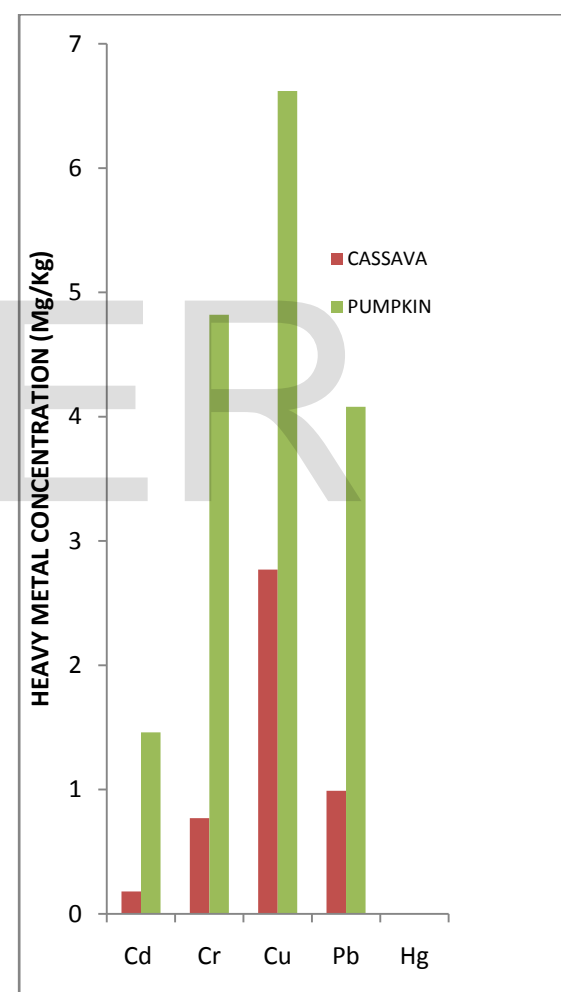| SAMPLES	HEAVY METALS (Mg/ Kg)				
	Cd	Cr	Cu	Pb	Hg
CASSAVA	0.18	0.77	2.77	0.99	< 0.001
PUMPKIN	1.46	4.82	6.62	4.08	< 0.001

FIGURE 1: Mean Concentration of heavy metals (mg/kg) in pumpkin leaves (*Telfairia occidental*) and Cassava tubers from Elele prison farm Rivers State.

DISCUSSION

Heavy metals are the most dangerous contaminants since they are persistent and accumulate in water, sediments and in tissues of the living organisms, through two mechanisms, namely "bioconcentration" (uptake from the ambient environment) and "biomagnification" (uptake through the food chain) (Chaphekar, 1991). Hyperaccumulators are plants that can absorb high levels of contaminants concentrated either in their roots,shoots and/or leaves (Penkala, 2005).

The concentration of heavy metal detected in the pumpkin leaves from Elele prison farm Rivers State showed high level of heavy metal concentrations in the order of Cu (6.62 mg/kg) > Cr (4.82 mg/kg) > Pb (4.08 mg/kg) > Cd (1.46 mg/kg) > Hg (<0.001) when compared with heavy metal concentration of heavy metal detected in the cassava tuber sample from Elele prison farm Rivers State in the order of Cu (2.77 Mg/kg) > Pb (0.99 Mg/kg) > Cr (0.77) > Cd (0.18 Mg/kg) > Hg (< 0.001Mg/kg).

Concentration levels for Cu was the highest for samples from Elele prison farm Rivers State (6.62 mg/kg and 2.77 mg/kg) for pumpkin leaves and cassava tubers. Being an essential trace element, it is necessary for many enzymes. It is needed for the normal growth and development. High concentration of Cu causes metal fumes fever, hair and skin decolorations, dermatitis, respiratory

tract diseases, anemia, liver disease and kidney damage and some other fatal diseases in human beings (Khan et al., 2008). The high concentration of Cu present in the underground parts of the plants may be due to the absorption ability of the plants to get the trace heavy metals from the polluted soils.

Chromium plays a vital role in the metabolism of cholesterol, fat, and glucose. Its deficiency causes hyperglycemia, elevated body fat, and decreased sperm count, while at high concentration it is toxic and carcinogenic (Chishti et al., 2011). The highest concentration of Chromium (4.82 mg/kg) occurred in the leaves of the pumpkin leaves. It may be due to the absorption of Cr contents from the polluted air. WHO's permissible limit of chromium in plant is 1.5 mg/kg, while its daily dietary intake is 0.2 mg/kg (WHO, 1998)

Lead is a non essential heavy metal. Pb causes oxidative stress and contributes to the pathogenesis of lead poisoning by disrupting the delicate antioxidant balance of the mammalian cells. High level accumulation of Pb in body causes anemia, colic, headache, brain damage, and central nervous system disorder (Rehman et al., 2013). The pumpkin leaf samples contained the Pb concentration (4.08 mg/kg) while the cassava tuber value had the least level 0.99 Mg/kg.

Cadmium is also a non essential heavy metal. It is extremely toxic even at low

concentration. It causes learning disabilities and hyperactivity in children (Hunt, 2003). The experimental results showed that Cd concentration in pumpkin leaf samples was 1.46 mg/kg while the Cassava tubers had the least contents of Cd 0.18 Mg/kg.

The concentration of mercury detected in the pumpkin leaves and cassava tuber from Elele prison farm Rivers State was insignificant <0.001.

4. Conclusion

Pumpkin leaf is a common vegetable for the inhabitants of the study area from Elele prison farm in Ikwerre Local Government Area, Rivers State, and this study has revealed high accumulation of heavy metals (Cr , Pb, Cd) from Elele prison farm Rivers State which is also experiencing pollution activities and emissions of heavy metals from vehicles (fuel combustion, road abrasion, lubricating oil, tire and break wear). Through the atmospheric deposit or road runoff, heavy metals can be absorbed into the plant tissues of the pumpkin leaves which are marketed along roadsides. The concentration of heavy metals (Cadmium, Chromium and lead) in pumpkin leaves from Elele prison farm Rivers State were higher than the concentration of heavy metals of cassava tubers from Elele prison farm Rivers State. Vegetables, especially those of leafy vegetables grown in heavy metals contaminated soils, accumulate higher amounts of metals than those grown in uncontaminated soils because of the fact that they absorb these metals through their leaves (Al Jassir et al., 2005).

It was observed that lead, chromium and cadmium in pumpkin leaves and cassava tubers were above WHO /FAO, European standard and Codex General standard for contaminants and Toxins in food and feed (CODEX STAN 193-1995) safe limits. However the concentration of most of these metals have exceeded the permissible level. This therefore implies that regular consumption of the pumpkin leaves and cassava tubers will expose the consumers to heavy metal toxicity as the years go by and this calls for serious health concern as heavy metals are bioaccumulative in human organs and tissues and thus causing various diseases and disorders, if they are not properly controlled. Hence urgent steps should be taken by government and other environmental protection agencies to curtail this problem.

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