

Heavy metal concentration of some Root Crops from Eke Awka, Anambra State, Nigeria

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ABSTRACT

The heavy metal contents of Cassava, Yam, Cocoyam, Potato and Carrot collected from Eke Awka in Anambra State were studied. Cocoyam had the highest content of Arsenic (7.89 ± 0.09 ppm) while Potato had the highest level of Lead (4.42 ± 0.01 ppm) and Cadmium (7.81 ± 0.04 ppm). Nickel was highest in Yam with a value of 1.82 ± 0.02 ppm. The highest value for Chromium (9.71 ± 0.04 ppm) was recorded in Cassava. For mercury, Yam and Potato contained the highest value of 0.82 ± 0.07 ppm. The results obtained in this study showed that all the sampled crops had heavy metal contents above the FAO/WHO permissible limit. As such this call for a serious health concern as the crops analysed are staple food consumed on daily basis by Nigerians. The high levels of the heavy metals could be attributed to pollution and contamination of the soil where they were cultivated. Therefore, the studied root crops are not recommended for human consumption due to the high levels of the heavy metal present in them.

Keywords: *Root crops, Heavy metal, Biological system, Environmental pollution*

INTRODUCTION

Industrial wastes, modern agricultural techniques like irrigation, heavy use of chemical fertilizers and pesticides can also lead to an increase in heavy metals in soils. Heavy metals in soil pose potential threats to the environment. Crops planted in such soil can accumulate the heavy metals, thus posing a great health risk to humans who consume them (Komárek *et al.*, 2008., Jung, 2008., Sinha *et al.*, 2010). Cadmium, lead and nickel are the heavy metals of greatest concern to human health because plants can accumulate them through the soil and introduce them into the human food chain. Cd accumulates in the body and causes kidney dysfunction, skeletal damage and reproductive deficiency. Lead and Nickel are also toxic contaminants in crops. Lead causes liver, brain, and central nervous system dysfunction and is classified by the U.S. EPA as a probable human carcinogen. Nickel is also known to cause respiratory problems (Antonious *et al.*, 2011). While Cadmium, lead and nickel are regarded as exceptionally toxic, heavy metals like iron, copper, and zinc are essential metals for humans, since they play an important role in biological systems, but these essential heavy metals can produce toxic effects when their intake is excessively elevated (Apau *et al.*, 2014., Mendil *et al.*, 2005; Narin *et al.*, 2005., Sinha *et al.*, 2010 and Arogunjo, 2007). Heavy metals are among the range of contaminants that can be found in crops (Pasquini, 2006 and Matthew-Amune and Kakulu, 2012).

Heavy metals analysis is an important part of environmental pollution studies. The consequences of these heavy metals in food crops such as Cassava, Yam, Cocoyam, Potatoes and Carrot have been of considerable interest because of their toxic effect in human beings (Apau *et al.*, 2014). Hence, there is the need to study levels of heavy metals in food crops,

such as yam, cocoyam, potato, cassava and carrots, selected from some markets within Awka metropolis so as to ascertain the risk posed by these metals to consumers.

MATERIALS AND METHODS

Samples of Cassava, Yam, Cocoyam, Potatoes and Carrot were bought from Eke Awka market, Awka North LGA, Anambra State, Nigeria and were washed thoroughly with distil water to remove dirt. They were peeled to remove their coats and were manually chopped into small pieces with stainless kitchen knife. The samples were dried in laboratory oven at 65⁰C for about 8hrs to a constant weight. The dried samples were ground into powder using mortar and pestle. Metal contents of the samples were determined by atomic absorption spectrometry according to the methods of AOAC (2003). 1 g each of the grounded sample was weighed and placed in a 50 ml beaker. 10 mL of concentrated nitric acid was added and shaken vigorously. The solution was gently heated on a hot plate at a temperature of 120⁰C till a clear solution was obtained. The digested samples were left to cool and then filtered through Whatman No. 42 filter paper. The resulting solutions were rinsed with 20mL of deionised water and filtered into a standard 25mL volumetric flask and made up to mark with distilled water. Treated samples were then analysed using Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

The concentration of Ar, Pb, Cd, Ni, Cr and Hg in different root crops collected in Eke Awka, Anambra State, Nigeria and presented in Table 1.

Table 1
Heavy metal concentration of root crops

| Root Crops | Arsenic (ppm) | Lead (ppm) | Cadium (ppm) | Nikel (ppm) | Chromium (ppm) | Mercury (ppm) |
|------------|---------------|-------------|--------------|-------------|----------------|---------------|
| Cassava | 6.58 ± 0.08 | 3.34 ± 0.03 | 0.39 ± 0.08 | 1.24 ± 0.01 | 9.71 ± 0.04 | 0.48 ± 0.10 |
| Yam | 9.06 ± 0.03 | 3.41 ± 0.10 | 0.48 ± 0.08 | 1.83 ± 0.02 | 3.65 ± 0.07 | 0.82 ± 0.07 |
| Cocoyam | 7.89 ± 0.09 | 3.41 ± 0.04 | 0.36 ± 0.01 | 0.94 ± 0.10 | 6.73 ± 0.09 | 0.60 ± 0.07 |
| Potatoes | 4.04 ± 0.10 | 4.42 ± 0.01 | 7.81 ± 0.04 | 0.49 ± 0.02 | 0.41 ± 0.07 | 0.82 ± 0.07 |
| Carrot | 3.56 ± 0.05 | 2.02 ± 0.06 | 0.51 ± 0.09 | 1.42 ± 0.01 | 6.69 ± 0.10 | 0.32 ± 0.06 |
| FAO/WHO | 1.00 | 0.10 | 0.10 | - | - | 0.10 |

The results obtained from this study showed that Arsenic varied from 3.56±0.05 to 9.06±0.03 ppm. The arsenic levels in the crops were higher than WHO-recommended permissible limit (1.0 ppm). The levels of arsenic in the root crops may not be safe because of arsenic toxicity on human health as a result of continuous intake of the contaminated crop (Rahaman *et al.*, 2012). Arsenic is a toxic metal that can cause health problems such as conjunctivitis, heart diseases, cancer, skin lesions (Guha-Mazumder *et al.*, 2000). The Lead contents were recorded to be within the range of 2.02 ± 0.06 ppm to 4.42 ± 0.01 ppm. FAO/WHO permissible limit for Lead in roots and tubers is 0.10 ppm. The Lead content in the sampled crops were higher than the FAO/WHO permissible limit (FAO/WHO, 2011). This poses a serious health concern as Lead affects almost every organ system in the human body. The CNS is particularly vulnerable in infants and children under the age of six. Large amounts of Lead exposure may Lead to blood anemia, severe stomach ache, muscle weakness, and brain damage. Lower levels of exposure may affect a child's mental and

physical growth leading to learning disabilities and seizures (Thiulogachandar *et al.*, 2014). Cadmium contents were observed to be 0.39 ± 0.08 ppm, 0.48 ± 0.08 ppm, 0.36 ± 0.01 ppm, 7.81 ± 0.04 ppm, and 0.51 ± 0.09 ppm for Cassava, Yam, Cocoyam, Potatoes, and Carrot respectively. The cadmium contents in the samples were above the FAO/WHO permissible limit of 0.10 ppm (Codex Stan 193-1995). Cadmium is a toxic heavy metal even at low concentration. It causes learning disabilities and hyperactivity in children (Hunt, 2003). Nickel content from this study ranged from 0.49 ± 0.02 ppm in Potatoes to 1.83 ± 0.02 ppm in Yam. Nickel is not an essential element but in a few trace amounts it may be beneficial to activate some enzyme systems. The absorption of Nickel is very low and its chronic intake is associated with an increased risk of lung cancer (Duda-Chodak and Blaszczyk, 2008).

Mercury was detected in all the samples. The values ranged from 0.032 ± 0.06 for Carrot to 0.82 ± 0.07 for Yam and Potato. The values were above the FAO/WHO permissible limit of 0.10 ppm. There are wide spectrums of health problems associated with high exposure of mercury. The health effects include damage to the central nervous system and the kidney (Food Safety Authority of Ireland, 2009). The values for Chromium ranged from 0.41 ± 0.07 ppm in Potato to 9.71 ± 0.04 ppm in cassava. Chromium can have positive and negative effect on human health according dose, exposure time, and its oxidation state. While Cr(III) is an essential nutrient for human, its excess presence in the body has dangerous health effects. Cr(VI) is considered to be 10 to 100 times more toxic than Cr(III). Cr(VI) can cause allergic reactions and skin eruptions, gastric disturbance, ulcers, weakness of immune system, kidney damage and lung cancer (Kotas and Stasicka, 2000).

CONCLUSION

The results obtained in this study showed that all the sampled crops had heavy metal contents above the FAO/WHO permissible limit. As such this call for a serious health concern as the crops analysed are stable food consumed on daily basis by Nigerians. The high levels of the heavy metals could be attributed to pollution and contamination of the soil where they were cultivated. Therefore, the studied root crops are not recommended for human consumption due to the high levels of the heavy metal present in them.

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