

**Concentrations of Heavy Metal in
the soil and Cassava plant on
Sewage Sludge Dump.**

C.I. IGBOZURUIKE,

A.O. Opara-Nadi and I.K. Okore

**Imo State University Owerri, Imo
State, Nigeria**

Introduction

- Another environmental aspect of toxic metals in sludge is their accumulation in plants, especially food crops. This accumulation depends on the plant species and on the chemistry of the metals in the soil. It is also posited that the consequences of such contamination are that trace metal concentrations in locally grown vegetable and crop may greatly exceed accepted standards, as may the metal uptake by the consumer. So, recognizing plant different abilities for metal uptake and accumulation especially where the concentration is located in the consumable part is very crucial because they can cause health problem ranging from heart attack to cancer. Consequently, the concern over application of sewage sludge to the farm land is that, some sewage sludge contain high concentrations of heavy metals and questions about their potential health and environment effects have continued to be crucial. In spite of awareness on the dangers associated with the ingestion of high volume of these heavy metals, farmers are known to produce vegetables and other crops in old garbage dumps in small and large cities around the world where improper management of municipal waste exists. In an assessment of the new regulations for sludge disposal even for “low contaminant” sludges, Heavy metal content could be the limiting factor in sludge application to agricultural land. Base on numerous studies and findings, determination of concentrations of heavy metals in both soil and plant have been proposed to detect the toxic (man) and phyto-toxic (plant) levels.
- This work aimed at determining the soil heavy metal concentrations and accumulation in cassava plant cultivated on sewage sludge dump for urban agriculture.
- Also ascertain if these heavy metals are in high and toxic concentration.

Approach

- A sewage sludge dump site along Owerri onitsha road Imo state cultivated with cassava plant by a farmer was used for this study. The dump was under severe and intense deposit of sewage sludge for about 2 years, abandoned for about 3 years before subsequently cleared and cultivated with cassava plant. Also a non-dump site (control site) half a kilometer from the dump site was selected (The site is a fallowed agricultural land with secondary re-growth). Soil samples (for all site type) were randomly collected using soil auger. 15 soil samples were randomly collected and each 5 bulked, for 3 composite replicates, according to Plank (1988). Soil samples were spread on clean and dried paper sheet for air drying. After air drying, the samples were crushed in clean ceramic mortar using a small ceramic pestle. These samples were passed through 2-mm sieve to get a fine soil fraction. The fine soil fraction was used to extract heavy metals using the DTPA .A 10g of soil samples were mixed with 20ml DTPA (0.05 M – adjusted to pH 7.3 with TEA), then shaken on a reciprocation shaker for 30 – 45 minutes before filtering through whatman No 1 filter.
- The filtrate were analysed for heavy metals (Cu, Pb, Zn, Ni, Cd,) on Atomic Absorption Spectrophotometer (AAS), Perkin Elmer model 306. Soil pH was determined in distilled (deionised) water (1:2.5 soil-water ratio) using glass electrode pH meter (Dewer model).

For the Cassava plant, cassava tubers were randomly sampled at maturity. 15 samples were collected, each 5 bulked, for 3 composite replicates, according to Plank (1988). The tubers variously collected were washed and peeled to remove soil particles. Each sample was placed in a forced-draft oven at 550C for about 12 hours, then grounded and passed through a 2-mm sieve. A 0.50g sample was dry-ashed in a porcelain crucible for 4-6 hours at 500C. The residue (ash) was dissolved in 25ml of 1 M hydrochloric acid. Analysis for Ni, Cu, Zn, Pb, Cd were done on the ash solution using Atomic Adsorption Spectrophotometer. Accuracy was assessed by analyzing 3 replicates of the selected samples. Comparisons was done between the result from the non-dump site and the result from the dump site using t-test procedure.

Findings

Metals concentration in the SOIL.

	Mg kg ⁻¹				
Sources	Ni	Zn	Cu	Pb	Cd
Dump site	25.15 ^a	59.7 ^a	68.2 ^a	10.85 ^a	8.38 ^a
Non-dump site	10.35 ^b	17.7 ^b	15.5 ^b	2.50 ^b	1.10 ^b

Within each column, means with different letter (s) are significantly different ($p < 0.05$) according to Fishers Least Significant Different.

Metals concentration in the CASSAVA TUBER

	Mg kg ⁻¹				
Sources	Ni	Zn	Cu	Pb	Cd
Dump site	38.25 ^a	138.7 ^a	125.8 ^a	5.50 ^a	3.60 ^a
Non-dump site	7.0 ^b	28.80 ^b	30.3 ^b	0.80 ^b	0.14 ^b

Within each column, means with different letter (s) are significantly different ($p < 0.05$) according to Fishers Least Significant Different.

Soil concentration

Critical Range

- Pb > 16.85 mg kg⁻¹

>35-180 mg kg⁻¹

- Cd > 8.38 mg kg⁻¹.

>12-70 mg kg⁻¹

- Cu > 68.2 mg kg⁻¹

>50-250 mg kg⁻¹

- Ni >25.15 mg kg⁻¹

>20-70 mg kg⁻¹

- Zn >79.7 mg kg⁻¹

>10-100 mg kg⁻¹

Tuber concentration

- Pb > 16.85 mg kg⁻¹ Critical range
> 15-120 mg kg⁻¹
- Cd > 3.60 mg kg⁻¹
>10-30 mg kg⁻¹
- Cu > 125.8 mg kg⁻¹
>20-100 mg kg⁻¹
- Ni > 38.25 mg kg⁻¹
>40-60 mg kg⁻¹
- Zn > 138.7 mg kg⁻¹
> 40-150 mg kg⁻¹

- **Miller and Miller (2000) noted that Zn and Cu are toxic to plants before they accumulate in sufficient (maximum) tissue concentration to affect animal or humans. As a result, over application tend to kill or stunt plants, minimizing opportunities to affect animals or humans consuming them. Also, Miller and Miller (2000) showed that cassava plant are not hyperaccumulator.**
- **The increase in Ni, Zn, Cu, Pb and Cd content in both the soil and the Cassava plant in the dump site relative to the non-dump site must be attributed to dumping of sewage sludge on that soil (dump). Increased heavy metal content of the soil can lead to increased plant uptake of metals that may be injurious to human and animal health.**

Average consumption

- Africa 70% 65%
- Asia..... 10% 50%
- America..... 05% 40%
- Europe..... 10% 40%

➤ Direct consumption bases

➤ Processed consumption base

Direction

- **Toxic heavy metal(s) concentration (in excess) causes-**
 - **Cancer, Heart disease, Stroke, Obesity etc**
- **The result suggest that farming on this dump should be discouraged.**
- **This site can be used for farming if the dump is treated by any process of managing and remediation of metal (s) contaminated soils.**
- **Crops with least susceptibility to contamination be grown.**

Future Research Interest

- A research is going on to examine the concentrations and physico-chemical properties -OM, OC, EA, ECEC, %BS, Ca, Mg, Na, N, P,K etc in the site.

Thank you for your attendance

Acknowledgement

- HILARY A. OKORIE Ph.D
- ONUH MARTIN ONUH Ph.D

Imo state University Owerri, Nigeria