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Level and effects of Cadmium and Lead from Vegetables Grown by Wastewater Irrigation at Federal Lowcost in Bauchi metropolis, Nigeria

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Abstract In this work, Cadmium (Cd), and Lead (Pb) were successfully analyzed from vegetable grown by wastewater irrigation at the Federal Lowcost of Bauchi metropolis. The vegetables analyzed were Spinach (*Amaranthus spinosus*), Jute leaves (*Hibiscus canabinus*), and Tomatoes (*Solanum lycopersicum*) respectively. A random sampling method was used for the collection of the samples. The concentration of Cadmium in spinach, Jute leaves, and Tomatoes ranges from 0.00 mg/kg – 0.01 mg/kg which were all within the minimum permissible limits (0.02 mg/kg) of WHO/FAO. While Lead ranges from 0.01 mg/kg – 0.02 mg/kg, this indicates that all sample obtained were found to be within the stipulated permissible limits stated by WHO/FAO which is 2.00 mg/kg.

Keywords Federal Lowcost**,** Cadmium, Lead, irrigation, spinach, jute leaves, tomatoes, Bauchi

Introduction

Metal accumulation in vegetables may pose a direct threat to human health. Commercial and residential vegetable growing areas are often located in urban areas and are subject to anthropogenic contamination. Studies of vegetables grown in locations close to industries and roadsides have reported elevated levels of heavy metals [10]. Vegetables take up metals by absorbing them from contaminated soils, as well as from deposits on different parts of the vegetables exposed to the air from polluted environments [9]. It has been reported that nearly half of the mean ingestion of lead, cadmium, and mercury through food is due to plant origin (fruit, vegetables, and cereals). Moreover, some population groups seem to be more exposed, especially vegetarians, since they absorb more frequently 'tolerable daily doses' [9]. The consumption of vegetables produced in contaminated areas, in addition to ingestion or inhalation of contaminated particles from vehicular emissions, are two principal factors contributing to human exposure to metals.

Heavy metals are bioaccumulated and bioaccumulated both by natural and anthropogenic sources [13]. The use of dumpsites as farmland is a common practice in urban and suburban centers in Nigeria because decayed and composted wastes enhance soil fertility. These wastes often contain heavy metals in various forms and at different

contamination levels. Some heavy metals like As, Cd, Hg, and Pb are particularly hazardous to plants, animals, and humans [4] Municipal waste contains such heavy metals as As, Cd, Cu, Fe, Hg, Mn, Pb, Ni, and Zn which end up in the sink when they are leached out from the dumpsites. Soil is a vital resource for sustaining two human needs of quality food supply and quality environment. Plants grown on land polluted with municipal, domestic, or a land polluted with municipal, domestic or industrial wastes can absorb heavy metals inform of mobile ions present in the soil through their roots or foliar absorption. These absorbed metals get bioaccumulated in the roots, stems, fruits, grains, and leaves of plants [7].

This work is aimed at determining the level and effects of Cadmium and Lead from vegetables grown by wastewater irrigation at federal lowcost in the Bauchi metropolis.

Materials and Methods

Sampling point

The sampling point is at Federal Lowcost in Bauchi metropolis, Nigeria.

Vegetable Sampling

Spinach leaves (*Amaranthus spinosus),* Jute leaves *(Hibiscus cannabinus),* and Tomatoes *(Solanum lycopersicum),* were randomly uprooted, packed into plastic bags, and washed with distilled water to remove debris, insects, and other dirt. The edible parts were separated from the other portions, rinsed with distilled water, shredded and minced. The samples were air-dried in paper bags and then ground, homogenized, and heated in an oven at 105 ^{0}C to a constant weight [2]. The contents were cooled and placed in clean paper bags and stored in desiccators until digestion.

Digestion of Vegetable Samples

The already partitioned Vegetable samples were grounded and powdered with a mortar. The dried powdered vegetable samples (1.00 g) were digested using a mixture of concentrated Nitric acid (HNO_3), Sulphuric acid ($H_2SO_{4)}$, and Perchloric acid ($HClO_4$) in 5:1:1 ratio. The digests were filtered and made up to mark in a 100 cm^3 volumetric flask with distilled water [2].

Determination of Heavy Metals

The digested samples were analyzed for Cd and Pb using Atomic Absorption Spectrophotometer (AAS 210 VGP) from the Public Health Engineering laboratory, Abubakar Tafawa Balewa University Bauchi.

Results

The results of Cadmium and Lead analyzed on Spinach, Jute leaves, and Tomatoes at Federal Lowcost (FLC) were presented in figures 1 - 3 as shown below.

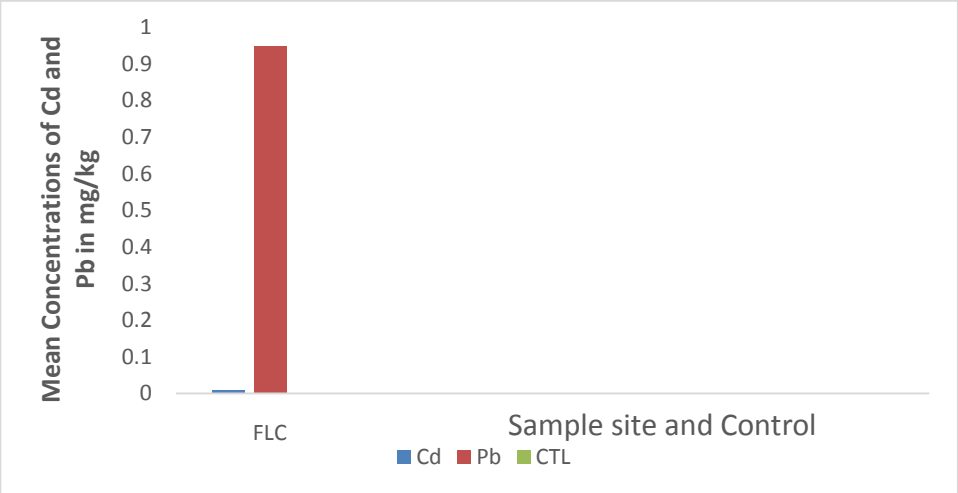

Figure 1: Mean Concentration of Cd and Pb in Spinach at FLC in Bauchi Metropolis

Figure 1 indicates that the mean concentration of Cd from Spinach in FLC is 0.01 mg/kg, and the concentration of Pb is 0.95 mg/kg which both are below the maximum permissible limits of WHO, [14] at 0.02 mg/kg and 2.00 mg/kg respectively. While the Control has 0.00 mg/kg.

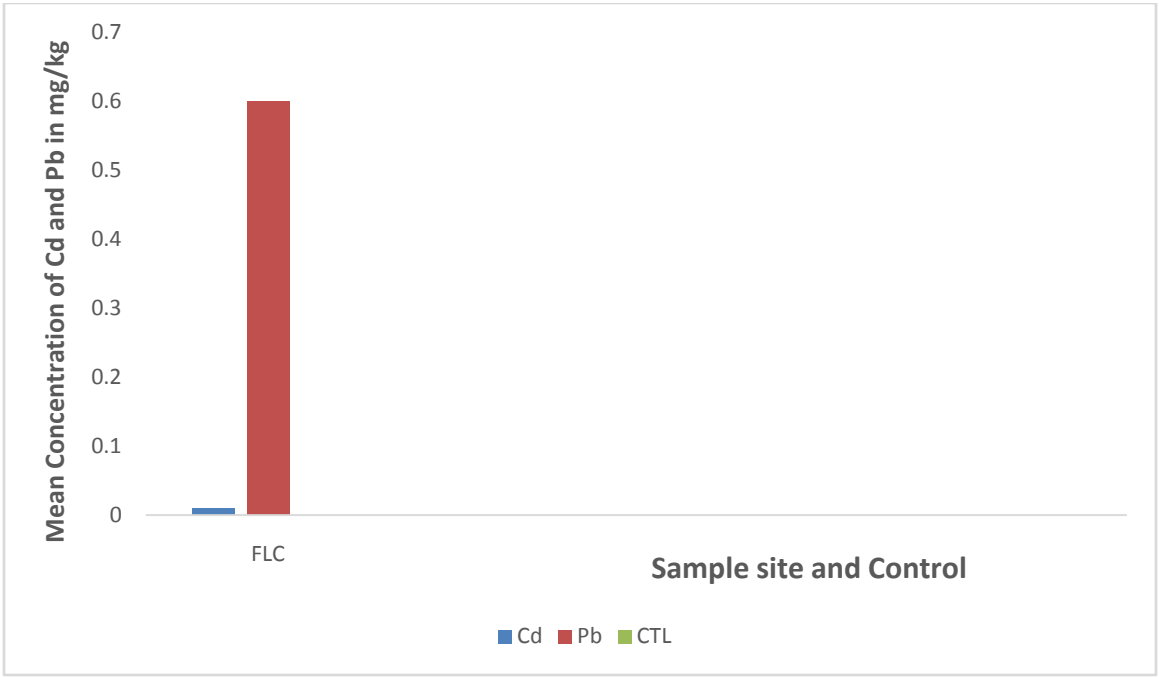

Figure 2: Mean Concentration of Cd and Pb in Jute Leaves at FLC in Bauchi Metropolis

Figure 2 indicates that the mean concentration of Cd from Jute Leaves in FLC is 0.01 mg/kg, and the concentration of Pb is 0.60 mg/kg which both are below the maximum permissible limits of WHO, [14] at 0.02 mg/kg and 2.00 mg/kg respectively. While the Control has 0.00 mg/kg.

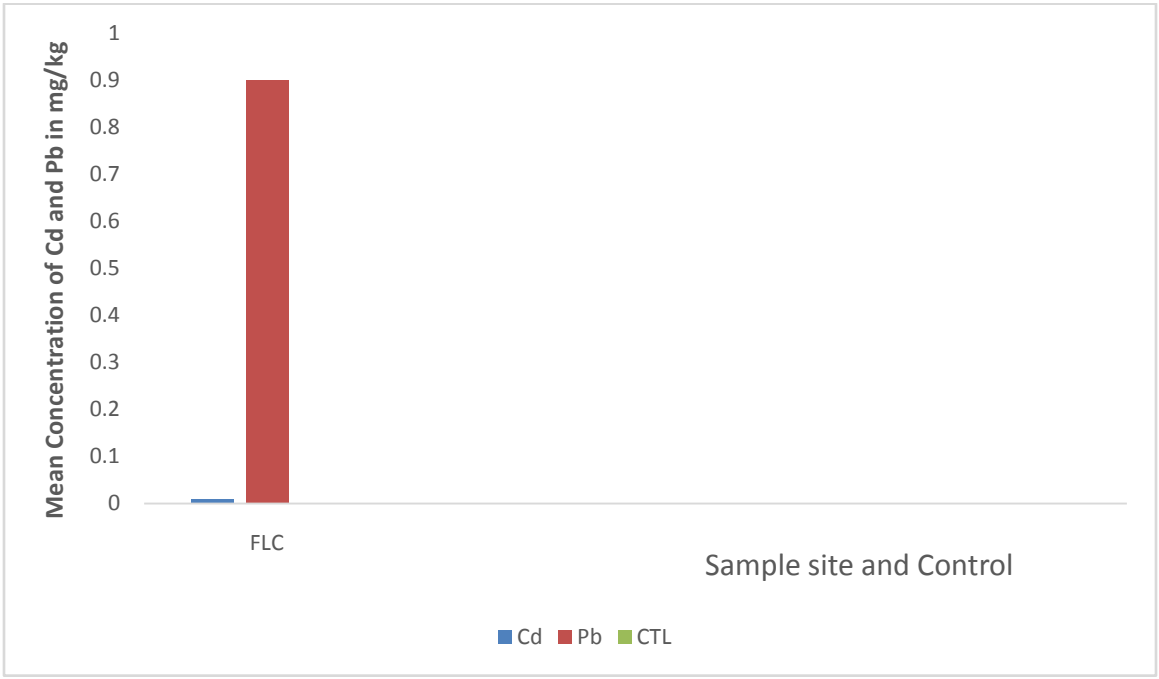

Figure 3: Mean Concentration of Cd and Pb in Tomatoes at FLC in Bauchi Metropolis

Figure 3 indicates that the mean concentration of Cd from Spinach in FLC is 0.01 mg/kg, and the concentration of Pb is 0.90 mg/kg which both are below the maximum permissible limits of WHO, [14] at 0.02 mg/kg and 2.00 mg/kg respectively. While the Control has 0.00 mg/kg.

Discussion

The mean concentrations of Cd and Pb in mg/kg as analyzed at Federal Lowcost were represented in figures 1 – 3 for Spinach, Jute leaves, and Tomatoes respectively. Cadmium had 0.01 mg/kg for Spinach leaves, 0.01 mg/kg for Jute leaves and 0.01 mg/kg for Tomatoes respectively. While Pb had 0.95 mg/kg for Spinach leaves, 0.60 mg/kg for Jute leaves, and 0.90 mg/kg for Tomatoes respectively. All the Controls (CTL) recorded 0.0 mg/kg for the three vegetables.

Heavy metals (Cd and Pb) concentration in Spinach, Jute leaves, and Tomatoes were analyzed and compared with WHO/FAO., [14] standards. All the vegetables analyzed were found to be within the permissible limits stipulated by WHO/FAO of 0.02 mg/kg and 2.00 mg/kg for Cd and Pb respectively. This shows that Spinach, Jute leaves, and Tomatoes grown at Federal Lowcost are safe for human consumption and the consumers are not likely to face any thread due to metal contamination.

Figures 1-3 shows the mean concentrations of Cd and Pb from Spinach, Jute leaves, and Tomatoes. The concentration of Pb which ranges from 0.60 mg/kg – 0.90 mg/kg were higher than that reported by Ali *et al.,* [3] which ranges from 0.1 mg/kg – 0.36 mg/kg, but lower than that reported by Gurukiran *et al.,* [8], which ranges from 24 mg/kg – 185 mg/kg respectively. The concentration of Pb obtained were all below the permissible limit of the World Health Organisation [14] as 2.00 mg/kg, also lower than the concentration ranges reported by Abdulmojeed *et al.,* [1] which ranged from 0.71 ± 0.04 – 1.10 ± 0.06 mg/kg. These concentrations were lower than that reported by Anita *et al,* [5] which ranged from 0.01 – 4.47 mg/kg also lower than that reported by Oladunni *et al.,* [11] as 10.20 ± 0.65 – 19.85 ± 0.15 mg/kg but higher than that reported by Opaluwa *et al.,* [12] as 0.02 – 0.43 mg/kg but lower than that reported by Batagarawa, [6] which ranged from 10.38 – 154.64 mg/kg.

On the other hand, the concentrations of Cd in all the vegetables were found to be 0.01 mg/kg all through. The concentration of Cd was found to be lower than that reported by Ali *et al.,* [3] which ranges from 0.01 mg/kg – 0.30 mg/kg.

Conclusion

Cadmium and Arsenic concentrations in Spinach, Jute leaves, and Tomatoes were analyzed and found to be within the permissible limits of WHO/FAO as 0.02 mg/kg and 2.00 mg/kg respectively. Therefore, from the findings of this research work, it shows that all the three vegetables grown are safe for consumption without any health risk attributed to Cadmium and Lead related diseases.

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