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# Assessment and effects of Lead (Pb) and Chromium (Cr) from vegetables grown by waste water irrigation at doctor's quarters in Bauchi metropolis, Nigeria

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**Abstract**
Vegetables that are widely consumed in Bauchi metropolis include Spinach (*Amaranthus spinosus*) called Alaiyaho in Hausa, Jute leaves popularly known as Rama in Hausa (*Hibiscus cannabinus*) and Tomatoes (*Solanum lycopersicum*) also known as Tumatir, are cultivated through irrigation with wastewater. Lead (Pb) and Chromium (Cr) were analyzed from vegetables grown by wastewater irrigation at Doctors Quarters of Bauchi metropolis. The samples of the vegetables were collected from the sample locations through random sampling for reliable representation. Atomic Absorption Spectrophotometer model 210 VGS was used for the analysis using a standard procedure. The concentration of Pb in Spinach, Jute Leaves and Tomatoes ranged from 2.10 mg/kg – 3.00 mg/kg which are all above the Minimum permissible limits (2.00 mg/kg) of World Health Organization (WHO, 1996). While Cr ranged from 1.20 mg/kg – 1.28 mg/kg which are all within the minimum permissible limit (1.30mg/kg) of WHO.

**Keywords** Bauchi, irrigation, vegetables, atomic absorption spectrophotometer, desiccator, jute leaves, tomatoes, spinach and homogenized

## Introduction
Vegetables are important ingredients in human diet and contain essential nutrients and trace elements that have potential health benefits (Abdullah and Chmielnicka, 2005) [1]. Environmental pollution has caused the contamination of soil; on the other hand, wastewater irrigation resulted in significant infusion of non-essential elements in agricultural lands (Mapanda *et al.*, 2005) [12]. The main cause of the infusion is the waterways through which non-essential elements are leached out of the soil and taken by the vegetation. If plants decay, these potential toxic elements are redistributed, and accumulate in agricultural soils. Long-term irrigation with wastewater leads to a build-up of heavy metals in soils and foods (Khan *et al.*, 2007) [10].

Exposure of vegetables or plant products to various metal containing components has varying health implications (Soomro *et al.*, 2003) [16]. Furthermore, consumption of food and vegetation contaminated with heavy metals can seriously deplete some essential nutrients in the body causing a decrease in immunological defenses, in trauterine growth retardation, impaired psycho-social behaviour, disabilities associated with malnutrition, and a high prevalence of upper gastrointestinal cancer (Jarup, 2003) [9].

It has been reported that sewage effluents contain significant amounts of major plant nutrients and thus fertility levels of soil are increased under sewage irrigation of crops like cabbage, radish, cauliflower, spinach (Jolocam *et al.*, 2010). However, studies of crops (cabbage, radish, chandaliya) irrigated with untreated sewage water revealed the presence of toxic metals like Pb, Cr, Cd, Ni, Fe, Co, Zn, thereby reducing soil fertility and agricultural outputs (Anjula and Sangeeta, 2011) [5].

This work is aimed at determining the level of Pb and Cr in vegetables grown at Doctor's Quarters in Bauchi metropolis through waste water irrigation.

## Materials and Methods
### Sampling Point
The sampling point is Doctor's Quarters in Bauchi metropolis, Nigeria.

### Vegetable Sampling
Spinach leaves (*Amaranthus spinosus),* Jute leaves *(Hibiscus cannabinus),* Tomatoes

*(Solanum lycopersicum)*, were randomly uprooted, packed into plastic bags, and washed with distilled water to remove debris, insects and other dirts. 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 constant a weight (Francek *et al.*, 1994) [8]. The contents were cooled and placed in clean paper bags and stored in desiccators until digestion.

**Vegetable Samples Digestion**

The already partitioned Vegetable samples were ground 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 digested samples were filtered and made up to mark in 100 $cm^3$ volumetric flask with distilled water (Ademorati, 1996) [3].

**Determination of Pb and Cr**

The digested samples were analyzed for Pb and Cr with Atomic Absorption Spectrophotometer (AAS 210 VGP) from public health engineering laboratory, Abubakar Tafawa Balewa University Bauchi (Francek *et al.*, 1994) [8].

**Results**

The results of Lead (Pb) and Chromium (Cr) analysed on the vegetables (Spinach, Jute leaves and Tomatoes) at Doctor's Quarters were presented in figures 1 - 3 as shown below.

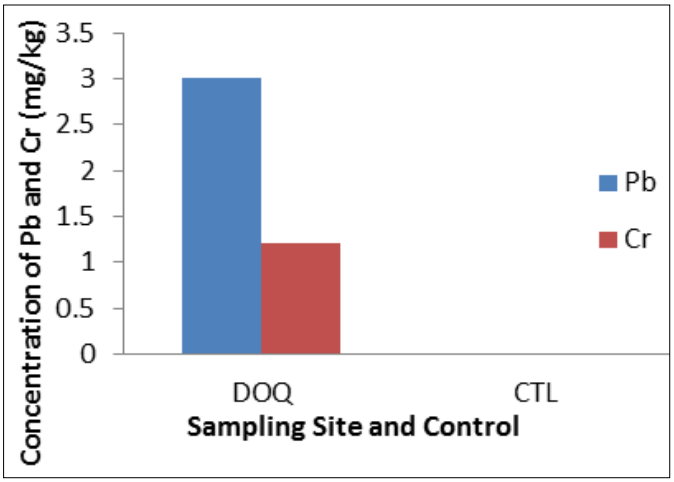


**Fig 1:** Concentration of Pb and Cr in Spinach at DOQ

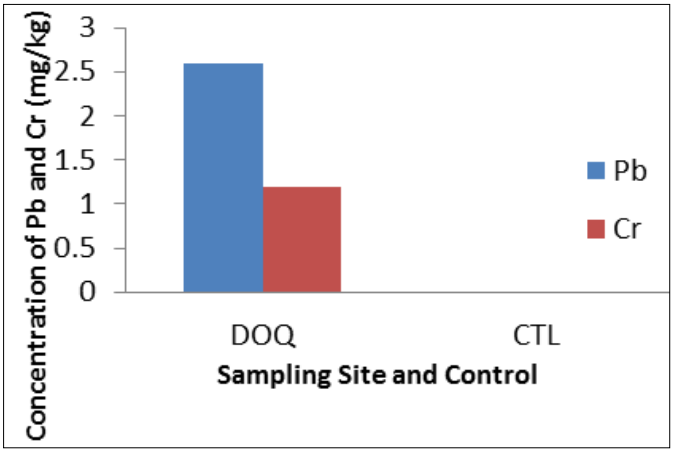


**Fig 2:** Concentration of Pb and Cr in Jute Leaves at DOQ

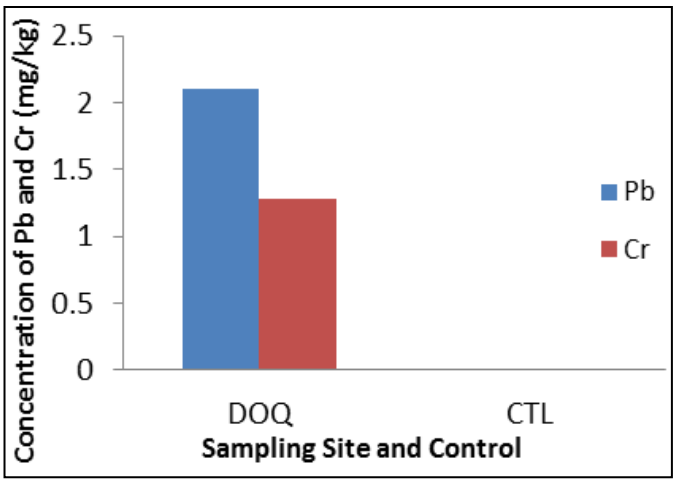


**Fig 3:** Concentration of Pb and Cr in Tomatoes at DOQ

**Discussion**

The concentrations of Pb and Cr in mg/kg as analysed at Doctor's Quarters were presented in figures 1 – 3 for Spinach, Jute leaves and Tomatoes. Lead (Pb) had 3.00 ± 0.03 mg/kg for Spinach leaves, 2.60 ± 0.04 mg/kg for Jute leaves and 2.10 ± 0.06 mg/kg for Tomatoes. While Chromium (Cr) had 1.20 ± 0.03 mg/kg for Spinach leaves, 1.20 ± 0.05 mg/kg for Jute leaves and 1.25 ± 0.01 mg/kg for Tomatoes respectively.

The concentration of Pb obtained for Spinach in this research was slightly higher than the permissible limit of World Health Organisation (WHO, 1996) [17] as 2.00 mg/kg. These concentrations were lower than that reported by Anita *et al*, (2010) which ranged from 0.01 – 4.47 mg/kg also lower than that reported by Oladunni *et al.*, (2013) [14] as 10.20 ± 0.65 – 19.85 ± 0.15 mg/kg but higher than that reported by Opaluwa *et al.*, (2012) as 0.02 – 0.43 mg/kg.

The concentration of Cr obtained for Spinach leaves in this research was slightly lower than the permissible limits of World Health Organisation (WHO, 1996) [17] as 1.30 mg/kg, also lower than the concentration ranges reported by Oladunni *et al.*, (2013) [14] as 1.82 ± 0.91 – 2.04 ± 1.67 mg/kg.

The concentration of Pb obtained for Jute leaves in this research was slightly higher than the permissible limit of World Health Organisation (WHO, 1996) [17] as 2.00 mg/kg, also higher than the concentration ranges reported by Abdulmojeed *et al.*, (2011) [2] which ranged from 0.71 ± 0.04 – 1.10 ± 0.06 mg/kg.

The concentration of Cr obtained for Jute leaves in this research was slightly lower than the permissible limits of World Health Organisation (WHO, 1996) [17] as 1.30 mg/kg.

The concentration of Pb obtained for Tomatoes in this research was slightly higher than the permissible limits of World Health Organisation (WHO, 1996) [17] as 2.00 mg/kg, also higher than concentration ranges reported by Abdulmojeed *et al.*, (2011) [2] which ranged from 1.44 ± 0.11 – 1.79 ± 0.12 mg/kg but lower than that reported by Batagarawa, (2000) which ranged from 10.38 – 154.64 mg/kg.

The concentration of Cr obtained for Jute leaves in this research was slightly lower than the permissible limits of World Health Organisation (WHO, 1996) [17] as 1.30 mg/kg but higher than the concentration ranges reported by Abdulmojeed *et al.*, (2011) [2] which ranged from 0.16 ± 0.05 – 0.58 ± 0.03 mg/kg.

This shows that vegetables grown at Doctor's Quarters in Bauchi metropolis are free from Cr contamination. Any health

problem emanating from this area as a result of the consumption of vegetables could be attributed Pb contamination.

## Conclusion

The results of Pb and Cr as analysed at Doctor's quarters have high content of Pb concentration above permissible limits of World Health Organization (WHO, 1996) [17]. The study was able to find out that the high Pb content could be attributed to anthropogenic activities such as oil pillage from mechanical workshops, refuse dumps containing electronic parts, paint deposits and Clinical waste from Abubakar Tafawa Balewa University Bauchi. This implies that the Bioaccumulation of Pb in all the vegetables were higher and consumption of these vegetables could lead to Pb related diseases such as hypertension, arthritis, diabetes, anemia, cancer, cardiovascular diseases, cirrhosis, reduced fertility in men and women, hypoglycemia, headache, kidney diseases and stroke are some of its long term result (Lokesshappa *et al.,* 2007). Furthermore, it was observed that agronomic practices such as application of fertilizers use of waste as manure can affect bio-availabilty and crops accumulation of Pb and Cr (Okunola *et al.,* 2004).

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