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# Evaluation of Some Heavy Metals Around Major Dumpsites in Bolari West Ward, Gombe State, Nigeria

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## ABSTRACT

The levels of heavy metals (Cu, Pb, Zn and Fe in mg/kg) in dumpsite soils from Bolari west ward, Gombe State, Nigeria were assessed with respect to distance from the dumpsites. The heavy metal concentrations were determined by atomic absorption spectrophotometry. The results show that iron had the highest concentration in all the soils, and copper had the lowest concentration. The concentration of the heavy metals can be represented in the following order: sample A: Fe > Zn > Cu, and sample B and D: Fe > Zn. However, Pb was not found in all the sampling sites and their control samples. The heavy metal concentrations were found to be higher in the dumpsite soils as compared with the control samples. Thus, the metal concentrations decrease with increased distance from the dumpsites. The heavy metals found are higher than the WHO permissible limits for heavy metals in soil.

**Keyword:** Atomic Absorption Spectrophotometer (AAS), Dumpsite soil, Heavy metals

## INTRODUCTION

Waste is defined as any material that is not useful and does not represent any economic value to its owner (Annepu, 2012). The disposal of materials that contains heavy metals in open dumpsites are of concern and pose dangers to people in contact with the soil and plants of the sites in which they are disposed. In Nigeria, leachates from refuse dumpsites constitute a source of heavy metal pollution to both soil and aquatic environments (Odukoya *et al.,* 2001). In some cases, wastes are dumped recklessly with no regards to the environmental implications, while in some dumpsites, wastes are burnt in an open site and ashes abandoned at the site.

The concentrations of heavy metals in soil around waste dumpsites are influenced by types of wastes, topography, runoff and level of scavenging (Abidemi, 2011, Ideriah *et al.,* 2005).Once heavy metals are deposited in the soil, they are not degraded and persist in the environment for a long time causing serious environmental pollution (Oyelola *et al.,* 2009). Heavy metals are natural elements in the environment. However, anthropogenic releases, including industrial and domestic effluents, urban storm, water runoff, landfill leachate, atmospheric sources, and dumping of sewage sludge can give rise to higher concentrations of the metals relative to the normal background values. The term "heavy metal" refers to a metal or metalloid with a density exceeding 5g /cm$^3$ and is usually associated with pollution and toxicity, although some of these elements (essential metals) are actually required by organisms at low concentrations (Adriano, 2001).

Heavy metals occur naturally in the ecosystem with large variations in concentrations. In modern times, anthropogenic sources of heavy metals, i.e. pollution from the activities of humans, have introduced some of these heavy metals into the ecosystem (Oluyemi, *et al.,* 2008). The presence of heavy metals in the environment is of great ecological significance due to their toxicity at certain concentrations,

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translocation through food chains and non-biodegradability which is responsible for their accumulation in the biosphere (Awolulu, 2005).

Sources of heavy metals in soils in urban environment mainly include; its natural occurrence in the soil derived from parent materials and human activities which are associated with activities such as atmospheric deposition, industrial discharges, waste disposal, waste incineration, urban effluent, long-term application of sewage sludge, fertilizer application in soil, and vehicle exhausts (Bilos *et al.,* 2001, Turer and Maynard 2003).

According to Magaji *et al*., 2019 soil becomes toxic when heavy metal content in the soil exceeds natural background level. This may cause ecological destruction and deterioration of environmental quality, influence yield and quality of crops as well as atmosphere, and health of animal through food chains. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. One specific threat resulting from inadequate wastes disposal is the contamination by heavy metals that have significant toxic potential for the environment (soil, water and air), human's beings and the exposed biodiversity (Tankari *et al.,* 2013).

Toxic heavy metals can also be taken directly by man and other animals through inhalation of dusty soil. Heavy metal pollutants such as copper, lead and zinc Magaji *et al*., 2019 from additives used in gasoline and lubricating oils are also deposited on highway soils and vegetation. Therefore, this study aimed to determine the concentrations of heavy metals such as Fe, Zn, Pb, and Cu from dumpsites in Bolari West ward, Gombe State, Nigeria.

## MATERIALS AND METHOD

### Study Area

The study area covered three major dumpsites, namely: - Karofi Bolari dumpsite (sample A), Gombe NYSC Zonal office dumpsite (sample B) and Konan Jamila dumpsite (sample C), all located in Bolari west ward of Gombe Local Government Area, Gombe State. A soil control sample at each dumpsite was collected from a site about 50 m away from the dumpsite, bearing in mind that the distance from the dumpsites will make them to be less exposed to the pollutants. These samples were labelled as Sample A, Sample B and Sample D, with the control sample as Sample Ac, Bc, and Dc in the above order.

### Sampling

The method proposed by Yusuf *et al.,* (2015) for sample collection was adopted with little modification. The sampling was carried out in the specified location of interest in the month of February, 2021. The soil samples were collected from the top layer at a depth of 0 – 15 cm using clean stainless steel material and transferred into a clean and labelled polythene bag for onward analysis in the laboratory.

### Sample Preparation aand Digestion

The size of the collected samples was reduced and spread on a tray in a layer not thicker than 15 mm. Thereafter, the various samples were placed in an oven at a temperature of 160°C. They were left in the oven for 6 hours to remove the moisture in the sample. Each oven-dried sample was crushed into particles and passed through a 2 mm sieve. However, before crushing commenced, stones, fragments of glass and other noticeable impurities were removed by hand. A 3 g of each soil sample was accurately weighed and treated with 30 ml of high purity concentrated $HNO_3$. The mixture was placed on a hot plate until it became dry. It was then cooled

(Magaji *et al.,* 2019). This procedure was repeated with another 30 ml aliquot of concentrated $HNO_3$ followed by 30 ml of 2 M HCl. Each digested soil sample was then warmed in 60 ml of 2 M HCl to redissolved the metal salts (Magaji *et al.,* 2019). The extract was filtered with filter papers, and the volume was then adjusted to 75 ml with distilled water. The digested samples were then stored in a sampling bottle for analysis using AAS.

## RESULTS AND DISCUSSION

The heavy metals concentrations in the dumpsite soils and control samples are presented in Table 1.

**Table 1:** Heavy metals concentration obtained in Bolari west ward dumpsite soil.

| | Elements mg/kg | | | |
|---|---|---|---|---|
| **Samples** | **Fe** | **Cu** | **Zn** | **Pb** |
| Sample A | 1556.35 | 46.70 | 53.08 | ND |
| Sample B | 1673.99 | ND | 86.07 | ND |
| Sample D | 1451.82 | ND | 55.17 | ND |
| Control Sample Ac | 1329.65 | ND | ND | ND |
| Control Sample Bc | 1320.94 | ND | ND | ND |
| Control Sample Dc | 1353.29 | ND | ND | ND |
| WHO permissible limits for heavy metals in soil | - | 36 | 50 | 85 |

*ND: Not detected*

The value of Fe in samples A, B and C are 1556.35 (1329.65 as control), 1673.99 (1320.94 as control) and 1451.82 (1353.29 as control) mg/kg, respectively. The Fe concentration of the samples is higher in the soil samples than in the control samples. The high concentration of Fe in the waste dump could have been due to the type of waste dumped. If the waste dump contains more metals scraps from mechanic shops and welder's workshops than from household waste which will have more of spoilt food, woods from broken furniture, ashes, broken glasses and plastics etc definitely, the soil around such waste dumpsite will contain more of Fe than control soil. The levels of Fe in soils were relatively high. The concentration of Fe obtained in this research is slightly higher than the results reported by Sulaiman *et al.,* 2018.

The Cu value in sample A is 46.70 mg/kg and was not detected in samples B and D, as well as their control samples. The concentration of Cu found was above the WHO (1996) permissible limits for heavy metals in soil.

The Zn value in sample A, B and D are 53.08, 86.07 and 55.08 mg/kg respectively. However, Zn was not detected in the control samples. The result obtained were lower than the study reported by sulaiman *et al.,* (2019). All of the samples analyzed from the dumpsites were above the WHO (1996) permissible limits for heavy metals in soil.

The Pb was not detected in the analyzed samples probably, because waste containing Pb has not been dumped into the dumpsites.

## CONCLUSION

The present study focused on the need to continue to monitor concentrations of toxic metals such as Fe, Cu, Zn and Pb in dumpsites located within residential areas in Bolari west ward of Gombe LGA, in order to create periodic awareness among the public. Three major dumpsites were identified and samples were collected from each for analysis. The results show that iron had the highest concentration in all the samples analyzed while Cu had the lowest concentration, and the Pb concentration was not detected in all

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the samples. The heavy metals concentrations in all the samples were higher than their control samples. The concentration of all heavy metals in the dumpsites locations was higher than WHO permissible limits for heavy metals in soil. Thus, the high concentration of those metals in the soil may pose risks and hazards to humans and the ecosystem through direct ingestion or contact with contaminated soil and drinking of contaminated ground water, reduction in food quality.

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