EVALUATION OF WATER QUALITY OF SELECTED BOREHOLES IN OSO EDDA THROUGH THE ANALYSIS OF SOME HEAVY METALS (Pb, Cd, Cr, Zn and Cu)

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ABSTRACT

The research examined the concentrations of heavy metals in some selected boreholes in five locations within Oso Edda. The samples were analysed using Atomic Absorption Spectrophotometer. The results were compared with the World Health Organization (1993) drinking water standard. The concentrations of Pb in location A was 0.067, B 0.025, C 0.001, D 0.052 and E 0.004 mg/l; Cd concentrations in A was 0.017, B 0.012, C 0.007, D 0.005 and E 0.004 mg/l; Cr concentrations were A 0.01, B 0.001, C 0.012, D 0 and E 0.004 mg/l; Zn concentrations were A 0, B 0.028, C 0.006, D 0.003 and E 0.006 mg/l and Cu with concentrations of A 0.004, B 0.007, C 0.001, D 0.003 and E 0.003 mg/l. Lead in Locations A, B, D and E showed concentrations higher than WHO 0.00 mg/l and pose danger to the end users. Cadmium concentrations in all the five locations were higher than that of the WHO drinking water standard and pose no risk. The concentrations of Cr, Zn and Cu were below WHO drinking water standard. It is recommended that a systematic treatment of heavy metal concentrations in water sources in the study area be carried out regularly either through ion exchange or reverse osmosis techniques.

Keywords: heavy metals, boreholes, spectrophotometer, danger and Oso Edda

INTRODUCTION

Water is an essential resource for living systems, industrial processes, agricultural production and domestic uses. Ninety seven percent of the world's water is found in ocean. About 2.5 percent of the world's water is non-saline fresh water. Hodo *et al* (2010) reported that the use of water increases with growing population, putting increasing strain on these water resources. An adequate supply of safe drinking water is one of the major prerequisites for a healthy life. The importance of clean water and the link between contaminated water and illness was recognized in the distant past, even though the actual cause of disease was not properly understood until the latter half of the 19th century. Finding adequate supplies of fresh water to meet the ever increasing needs and maintaining its quality, is becoming a problem. Although water availability is not a problem on a global scale.

As a result of the increasing demand for water and shortage of supply, it is necessary to increase the rate of water development in the world and to ensure that the water is used more efficiently for drinking and other domestics purposes (WHO, 2006). The importance of water in daily living makes it imperatives and thorough examinations need to be conducted on it before consumption and other applications (Ademoroti, 1996).

The problem of water supply is a common feature in all rural areas in Nigeria. Safe, adequate and accessible supplies of water combined with proper sanitation are surely basic needs and have recently become essential components of primary healthcare for rural development in Nigeria, and many other developing countries. Spring, streams and boreholes have been some major sources of water to many areas in Nigeria for domestic and agro-allied uses, and hence the quality of water is very vital. These sources of water are polluted by domestic and industrial wastes, fertilizers and pesticides, refuse dump, landfill and acid rain (Wagh *et al*, 2009).

Polluted water is potentially dangerous to health because of possible outbreaks of typical dysentery or cholera, epidermis and other water-borne diseases. However, the chemistry of rocks and soils and rock geological condition on any area has a great influence on the water quality, which determines the concentration of introduced cations and anions in the water, making it unsuitable for the consumption (Ako *et al*, 1990).

The aim of this study is to evaluate some heavy metals such as Pb, Cd, Cr, Zn and Cu in some selected boreholes.

Materials and methods

Sample Collection

A minimum sample size of 100 ml was collected in a polyethylene bottle. Water samples were collected from five different locations within Oso Edda in Afikpo North Local Government Area of Ebonyi State in one litre jerry can. The jerry can was first rinsed with distilled water and then with the borehole water before filling it with the water for analysis. The sample locations were Ezeogo House (Sample A), Ndi-Obasi Village (Sample B), Ndi-Okpo Village (Sample C), Ndi-Ikpo Village (Sample D) and Ndi-Uche Village (Sample E), respectively. The samples were transported to Home Water Laboratory, Abakaliki, Ebonyi State for heavy metals analysis.

AAS Techniques

Atomic absorption spectrophotometer (AAS) was used for the determination of the concentration of heavy metals in the boreholes water samples. AAS makes use of absorption spectrometry to assess the concentration of an analyte in a sample. It requires standard solutions to establish the relationship between measured absorption and the analyte concentration, and relies on Beer-Lambert Law. It is commonly used for determining the concentration of a particular metal element in a sample. In their elemental form, metals will absorb ultra violet light and get excited. Each metals has a characteristics wavelength that will be absorbed. The AAS instruments used for a particular metal is by focusing a beam of UV light and at a specific wavelength through a flame and into a detector. The samples of interest is aspirated into the flame. If that metal is present in the sample, it will absorb some of the light thus reducing its intensity. A computer data system converts the change in the intensity into an absorbance.

Results

Table 1: Results of the mean concentration of some of the selected heavy metals in Sample A.

Parameter, ppm	1st	2nd	3rd	Mean	Stdev
Lead	0.069	0.068	0.069	0.069	0.0005
Cadmium	0.015	0.018	0.018	0.017	0.0014
Chromium	0.01	0.01	0.01	0.01	0
Zinc	0	0	0	0	0
Copper	0.004	0.004	0.003	0.004	0.0005

Table 2: Results of the mean concentration of some of the selected heavy metals in Sample B.

Parameter, ppm	1st	2nd	3rd	Mean	Stdev
Lead	0.026	0.025	0.025	0.025	0.0005
Cadmium	0.013	0.012	0.012	0.012	0.0005
Chromium	0.001	0.001	0.001	0.001	0
Zinc	0.027	0.029	0.029	0.028	0.0009
Copper	0.007	0.007	0.006	0.007	0.0005

Table 3: Results of the mean concentration of some of the selected heavy metals in Sample C

Parameter, ppm	1st	2nd	3rd	Mean	Stdev
Lead	0.001	0.001	0.001	0.001	0
Cadmium	0.008	0.006	0.007	0.007	0.0008
Chromium	0.011	0.012	0.013	0.012	0.0008
Zinc	0.006Q	0.006	0.005	0.006	0.0004
Copper	0.001	0.001	0.001	0.001	0

Table 4: Results of the mean concentration of some of the selected heavy metals in Sample D

Parameter, ppm	1st	2nd	3rd	Mean	Stdev
Lead	0.05	0.054	0.052	0.052	0.0016
Cadmium	0.005	0.004	0.005	0.005	0.0005
Chromium	0	0	0	0	0
Zinc	0.003	0.003	0.003	0.003	0
Copper	0	0.001	0	0.0003	0.0005

Table 5: Results of the mean concentration of some of the selected heavy metals in Sample E

Parameter, ppm	1st	2nd	3rd	Mean	Stdev
Lead	0.045	0.04	0.042	0.042	0.0021
Cadmium	0.005	0.004	0.004	0.004	0.0005
Chromium	0.002	0.002	0.002	0.002	0
Zinc	0.007	0.006	0.006	0.006	0.0005
Copper	0.003	0.007	0.001	0.003	0

Table 6: Results of the Mean Concentration of some of the Selected Heavy Metals in all the Sample Locations

Parameter, mg/l	Sample A	Sample B	Sample C	Sample D	Sample E	WHO (2011)
Lead	0.069	0.025	0.001	0.052	0.042	0.01
Cadmium	0.017	0.012	0.007	0.005	0.004	0.003
Chromium	0.01	0.001	0.012	0	0.002	0.05
Zinc	0	0.028	0.006	0.003	0.006	3.0
Copper	0.004	0.007	0.001	0.0003	0.003	2.0

Discussion

The results in Table 6 and Figure 1 showed that lead concentrations in the water samples ranged from 0.001 – 0.069 mg/l with Sample A showing the highest concentration of 0.069 mg/l while Sample C showed the least concentration of 0.001 mg/l. Apart from Sample C, Samples A, B, D and E have higher concentrations of lead when compared with WHO permissible limit of drinking water of 0.01 mg/l. The value obtained was lower than that obtained by Okoro *et al* (2017). High concentrations above the recommended limit in drinking water are known to cause dehydration and gastro-intestinal irritation (Jidanna *et al*, 2014).Studies showed that water with high concentration of lead is not fit for drinking because of its toxic effects in the body. When lead is high in water it can lead to anaemia and stomach cramp and it may lead to memory loss and in severe cases it can lead to stroke.

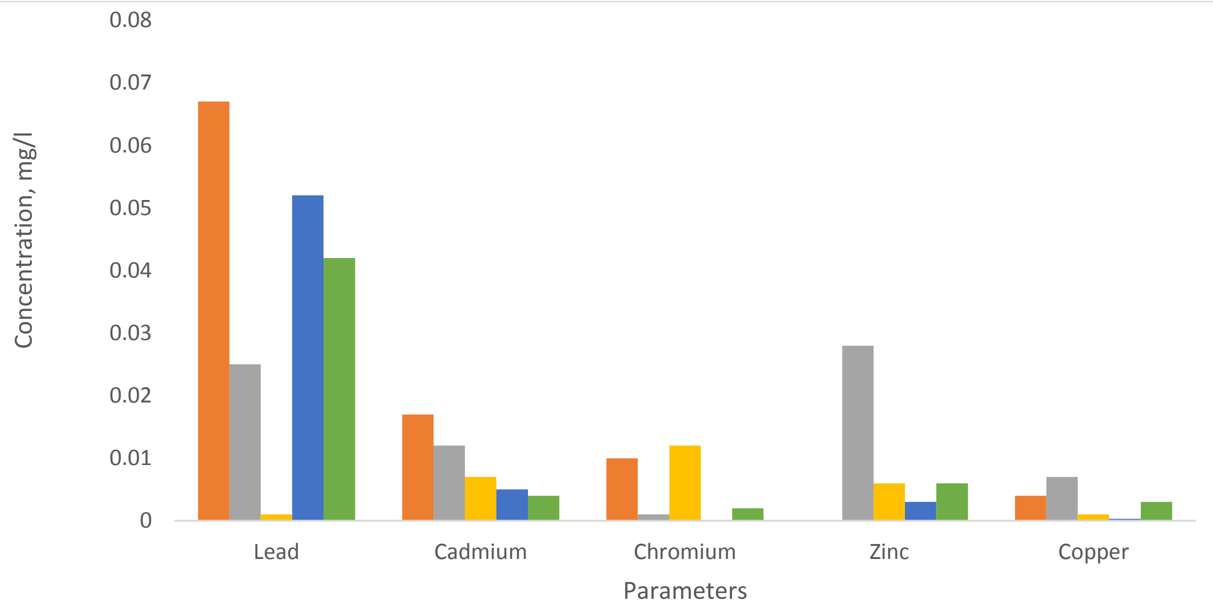

Fig. 1: Bar chart of the mean concentaration of some selected heavy metals

The results in Table 6 and Figure 1 showed that cadmium concentrations in the water samples ranged from 0.004 – 0.017 mg/l with Sample A showing the highest concentration of 0.017 mg/l. The high concentration of cadmium is likely because of certain fertilizers which are harmful to the body and it is not good when found in water in any concentration. High concentration of cadmium in water can lead to kidney, liver, bone and blood damage.

The results in Table 6 and Figure 1 showed that chromium concentrations in the water samples ranged from 0 – 0.012 mg/l with Sample C showing the highest concentration of 0.012 mg/l. The samples are below the concentration of chromium when compared with WHO permissible limit of drinking water of 0.05 mg/l which means that the water is fit for drinking.

The results in Table 5 and Figure 1 showed that zinc concentration in the water samples ranged from 0 – 0.028 mg/l with Sample B having the highest concentration of 0.028 mg/l. The concentrations of zinc when compared with the WHO (2011) 3.0 mg/l drinking water were lower and hence pose no threat. Zinc IS co-factor and plays a vital role I the human body and animals. The low concentration implies that the boreholes do not have caustic taste and it is good for drinking.

The results in Table 6 and Figure 1 showed that copper concentration in the water samples ranged from 0.00 – 0.997 mg/l with Sample B showing the highest concentration of 0.007 mg/l. The samples are below the concentration of copper when compared with WHO permissible limit of drinking water of 2 mg/l which means that the water is good for consumption. Copper is one of the essential metals needed by man for life sustenance, it helps in building man's immune system and development of brain. However, high concentration of copper in the human body can lead to kidney and liver problems and eventual damage.

Conclusion

The study revealed that the concentration levels of heavy metals, with exception of chromium, zinc and chromium, in the different boreholes within the Oso Edda are at levels that needed to be controlled, especially when they are above the WHO (2011) allowable limits for drinking water.

Recommendations

It is strongly recommended that one of the treatment methods should be employed by either government agencies or individual owners of boreholes towards remedying the pollution effect of heavy metals contamination.

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