

HEAVY METALS CONCENTRATION IN WELL AND BOREHOLE WATER IN ALIERO METROPOLIS

ABSTRACT

The research examined the concentration of heavy metals in well and bore hole water from three different areas (Bodiga, Labana farm and Kalli) in Aliero town. The analysis was conducted using Atomic Absorption Spectroscopy. The concentration of the metals in sample A (Bodiga area) are in the order $\text{Fe } 1.638 \pm 0.01 > \text{Ni } 0.172 \pm 0.02\text{ppm} > \text{Pb } 0.113 \pm 0.02\text{ppm} > \text{Cu } 0.081 \pm 0.05\text{ppm} > \text{Mn } 0.01 \pm 0.02\text{ppm}$, and the concentration in sample B (Labana farm bore hole water) is in order of $\text{Fe } 1.260 \pm 0.016\text{ppm} > \text{Pb } 0.234 \pm 0.02\text{ppm} > \text{Mn } 0.100 \pm 0.01\text{ppm} > \text{Cu } 0.060 \pm 0.02\text{ppm}$. And in sample C (kalli well water) the concentration of metals are in order $\text{Fe } 1.973 \pm 0.01 > \text{Pb } 0.323 \pm 0.01 > \text{Mn } 0.186 \pm 0.03\text{ppm} > \text{Cu } 0.101 \pm 0.03\text{ppm} > \text{Ni } 0.012 \pm 0.03\text{ppm}$. The concentration of Fe and Pb in all the three sources of water was found to be above the WHO standards while copper, nickel, and manganese were found to be below the maximum limit of WHO standards. The inhabitants who used the water for both consumption and domestic purposes should be enlightened on the toxicological effects of these heavy metals to human health, plants and animals. There is therefore the need for proper monitoring of the water by the agencies concern.

Keywords: *Heavy metals, Wells, Bore-hole, Metropolis, water*

1. INTRODUCTION

Water is an indispensable substance for the sustenance of plants and animals including man. Water is obtainable to man as a ground and surface water in lakes and rivers [1]. Naturally all water contain impurities as they flow through streams, gather in lakes and filter through layers of soil and rock in the ground, they dissolve or absorb substances they come in

contact with, which may be harmful [2]. The acceptability of water is evaluated in terms of quality requirements for a specific use .All water made for human consumption should be potable, free from diseases causing organisms, mineral and other organic substance that could impair human health [3, 4].

Pure water is hardly found naturally due to impurities found everywhere; these impurities may include suspended colloidal or dissolved substances. These impurities are removed to an accepted limit using different method of removal or reduction. These are acceptable guidelines laid down by world health organization (WHO) for the acceptable quality for potable supplies of water, the maximum permissible and the highest desirable.

The constituent of water have been classified as major and minor constituent, these terms are used for convenience [5]. The substance that contribute 1.0% or more to the total of the inorganic solutes present are regarded as major and minor constituent, refer to the concentration but not the biological importance of the constituent. For instance chlorines, sulphate, bicarbonates, calcium, magnesium, copper, lead or chromium are referred to as the major constituent of water while the minor constituent include nitrogen, phosphate and silicon compounds [6].

Water is one of the most essential elements to life on Earth. In its purest form, it's odourless, colourless and tasteless but due to human and animal activities, it is usually contaminated with solid and human waste, effluents from chemical industries and dissolved gases [7]. The acid rain is another major water contaminants in addition, water contains some amount of mineral constituents such as iron.(Fe) magnesium (Mg), lithium (Li), zinc (Zn), copper (Cu), chromium (Cr), nickel (Ni), cobalt (Co), vanadium (V), arsenic (As), molybdenum .(Mo), selenium (Se), lead (Pb) and so many others [8]. The presence of these toxic metals sin excess concentration in the environment has been a source of worry to environmentalists, government agencies and health practitioners [9]. This is mainly due to

52 their health implications when in higher concentrations, and some of them are non-essential
 53 metals of little or no benefit to humans [10].
 54 Many of these minerals are required micronutrients such as copper and selenium.
 55 Concentrations of trace elements in water vary because of physiological, environmental and
 56 other factors [11]. Some trace elements have several roles in living organism. Some are
 57 essential components of enzymes where they attract substrate molecules and facilitate their
 58 conversion to specific end products [12]. In excessive concentrations, however trace elements
 59 such as Fe, Cd, Ni, Cu, Hg, Mn, Cr, can negatively affect growth, reproduction and other
 60 biological functions. A safe and portable drinking water should conform to certain standard
 61 set by World Health Organization [13] (i.e Cu is 2.0mg/l, Pb 0.01mg/l, Ni 0.02mg/l, Hg
 62 0.001mg/l, Cr 0.05mg/l) [14, 15].

63 Boreholes and wells are groundwater types that form an integral part of water supply
 64 systems in urban and rural communities of Nigeria, and so can be described as indispensable
 65 because of inadequate public water supply systems in most communities in Nigeria [16].
 66 According to Egwari and Aboaba [17], natural processes and anthropogenic activities of
 67 man can contaminate groundwater, and such activities could be domestic, agricultural or
 68 industrial in nature. Uncontrolled discharge of toxic effluents to the soil, stream and rivers
 69 by industries and indiscriminate dumping of garbage and faeces have been reported to
 70 heavily contaminate groundwater in Nigeria [18]. Anaele, [19] Reported that residential
 71 wells and boreholes water are contaminated by sewage from the numerous septic tanks,
 72 latrines, and soak away pits often sited near them. Majority of peoples drink water from
 73 these groundwater sources without any form of treatment. Indiscriminate dumping of
 74 materials laden with lead and other toxic metals on land and use of leaded gasoline had been
 75 shown to contribute to the lead load of underground water sources of many Nigerian cities

[18, 20]. The aim of this study was to investigate the concentration of heavy metals from the different sources of water in Aliero.

2. MATERIALS AND METHODS

2.1 Sampling Location

Bodiga, Kalli and Labana were located in Aliero local Government area of Kebbi State. It is on latitude $12^{\circ}16'42''\text{N}$ and 12.27833°N and longitude $4^{\circ}27'6''\text{E}$ and 4.45167°E . The town is one of the largest producers of onions in the state and in Nigeria.

2.2 Sample Collection and Preparation

Samples of water were collected from the three different sampling sites (two wells Bodiga and Kalli and one borehole labana), the well waters were collected using a plastic drawer tied to a rope and were transferred to 10litres plastic kegs after rinsing them with the well water, while that of the borehole was collected directly into the 10litres keg after rinsing with the sample water. The containers were tightly covered and stored in refrigerator 4°C in the laboratory until digestion.

2.3 Sample Digestion Procedure

50cm^3 of samples water were measured into beakers. 5cm^3 of concentrated HNO_3 were added to the measured samples. The samples were heated on a hot plate in a fume cupboard to nearly dryness with characteristic colour indicating complete digestion. After which the samples were allowed to cooled then transferred to a 50cm^3 acid washed volumetric flask and volume filled to 50 marks with deionised water. The samples were filtered and kept in sample bottles ready for atomic absorption spectrophotometer [21].

3. RESULT AND DISCUSSION

Table 1: mean concentration of Heavy metals (ppm) in well samples from Aliero metropolis

Toxic metals	Mean Concentration (ppm) for	
	Bodiga well	Kalli well
Lead	0.113 $\pm$ 0.02	0.323 $\pm$ 0.01
Iron	1.638 $\pm$ 0.01	1.973 $\pm$ 0.01
Manganese	0.172 $\pm$ 0.02	0.186 $\pm$ 0.03
Copper	0.081 $\pm$ 0.005	0.101 $\pm$ 0.03
Nickel	0.01 $\pm$ 0.02	0.012 $\pm$ 0.03

The data is mean value $\pm$ standard deviation (SD) of three replicates

Table 2: Mean concentration of Heavy metals (ppm) in Labana borehole

Toxic Metals	Lead	Iron	Manganese	Copper	Nickel
Mean concentration	0.234 $\pm$ 0.02	1.260 $\pm$ 0.02	0.100 $\pm$ 0.01	0.060 $\pm$ 0.02	ND
Borehole water					

ND not detected

Table 3: WHO permissible limits

Toxic metals	Lead	Iron	Manganese	Copper	Nickel
WHO limits	0.01	0.30	0.50	2.00	0.02

WHO world health organization

In this study it was observed that the highest concentration of Lead (0.323ppm) was found in Kalli well and the lowest (0.113ppm) was found from Bodiga well table 1. All the values were found to be far above WHO permissive limits for drinking water (0.01ppm) table 3. The highest concentration in Kalli could be as a result of the use of leaded petrol in cars, generators and water pumps because the well is located by the road side and around irrigation farms. It could also be because of the mechanic workshop which is very close to the well [22].

The highest concentration of Lead in all the three samples could pose a threat to human health that depends on the water for drinking and domestic purposes. Iron concentration in all the samples revealed by the analysis was found to be higher than the WHO permissive limits for drinking water table 3 (0.30ppm) with the highest concentration (1.973ppm) in Kalli well table 1 and the lowest (1.260ppm) in Labana borehole water table 2. The high concentration of Iron could be as a result of clay deposits in those areas [23]. Despite the highest concentration of Manganese (0.186ppm) from Kalli well table 1 and the lowest from Labana borehole (0.100ppm) table 2 all were below the WHO permissible limits (0.50ppm) table 3. The result showed that Nickel could not be detected in Labana bore hole, and in both Bodiga and Kalli (0.01 and 0.012) respectively Nickel concentration was found to be lower than the WHO permissible limits for drinking water (0.02ppm). The lowest level of Nickel could be as a result of absence of igneous rock in the study area.

In this study it was observed that Copper concentration in all the three sites were lower than the WHO permissible limits (2.00ppm) table 3. However, except of Copper the concentrations of all the metals were higher in the wells and low in the borehole. This could be because the wells are open and not deep, while the borehole is very deep and always closed.

4. CONCLUSION/RECOMMENDATION

Although heavy metals such as Fe, Mn and Cu play biochemical roles in the process of life and are required in traces, at high concentrations these heavy metals are toxic to human life and animals by affecting their reproduction and other physiological function. Constant monitoring of water in Alieri is therefore recommended so as to reduce the long term effect of these toxic metals on humans. Wells should therefore be dug deep and be properly covered to help reduce the contamination of drinking water by these heavy metals.

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