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Assessment of heavy metals concentrations in bore-hole waters in Aliero community of Kebbi State

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ABSTRACT

Bore-hole water samples from three areas in Aliero, Metropolis of Kebbi state were analysed, using Flame Atomic Absorption Spectrophotometer (FAAS). The physicochemical values obtained were compared with the WHO permissible standards for drinking water. Some heavy metals determined were found to have levels above the WHO recommended value while others, such as Ca, Mg, Fe and Zn had values below the permissible unit. The level of the metals followed the order Cu (0.302 – 0.606mg/l) > Pb (0.047 – 0.245mg/l) > Cr (0.052 – 0.121mg/l) > Ni (0.035 – 0.087mg/l) > Co(0.03 – 0.07mg/l), except for the Fe value of K.S.U.S.T. which was estimated as 1.282mg/l. The implication of these high levels of such metals in man's health were highlighted.

Keywords: Heavy metals, Bore-hole, fresh water, anthropogenic, ecosystem, community.

INTRODUCTION

Water is an essential resource for living systems, industrial processes, agricultural production and domestic use. Ninety seven percent of the world's water is found in oceans. Only 2.5% of the world's water is non-saline fresh water [1]. However, 75% of all fresh water is bound up in glaciers and ice caps. Only 1% of fresh water is found in lakes, rivers soils and 24% is present as ground water. 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 or putrid 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 [2]. Finding adequate supplies of fresh 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, it may be a problem finding high quality fresh water at the required place, in the required quantity [3].

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. Drinking water should be suitable for human, consumption and for all usual domestic purposes [4]. The importance of water in daily living makes it imperative that thorough examinations be conducted on it before consumption [5]. A drinking water quality guideline value represents the concentrations of a constituent that those not result in any significant health risk to the consumer over a lifetime. The amount by which and for how long, any guideline value can be exceeded without endangering human health depends on the specific substance involve [6].

Heavy metals in water refers to the heavy, dense, metallic elements that occur in trace levels, but are very toxic and tend to accumulate, hence are commonly referred to as trace metals. The major anthropogenic sources of heavy metals are industrial wastes from mining sites, manufacturing and metal finishing plants, domestic waste water and run off from roads. Many of these trace metals are highly toxic to humans, such as Hg, Pb, Cd, Ni, As, and Sn. Their presence in surface and underground water at above background concentrations is undesirable [3]. Some heavy metals such as Hg, Pb, As, Cd, Fe, Co, Mn, Cr e.t.c have been identified as deleterious to aquatic ecosystem and human health [7]. Fatoki *et al.,* [8]., investigated trace metal pollution in the Umtata river and reported high levels of Al, Cd, Pb, Zn, and Cu, which may effect the "health" of the aquatic ecosystem. Also, [9]. investigated heavy metals concentrations from three streams in eggom hills in Nasarawa state and reported high levels of Mn, Ni, Fe, Co, Cr, Cd and Pb, which may affect the health of the community. This present study is therefore aimed at investigating the level of some metals in selected bore-hole within Aliero Community.

MATERIALS AND METHODS

Batch sampling which involved taking samples from the environment and performing an analysis later in the laboratory was used in this research work [3]. The water samples used for this study were randomly collected from three different sites in Aliero town; Kebbi State University of Science and Technology, General Hospital and Gangire village. The samples were collected in polyethylene bottles (1.5 litres capacity) which had been thoroughly washed, and filled with distilled water, then taken to the sampling site. The bottles were emptied and rinsed several time with the water to be collected. Also, the sample bottles were partially filled with the collected water and vigorously shaken to note the odour [3]. The sample bottles were tightly covered immediately after collection and the temperature taken. They were then stored in a refrigerator at 4^0C (Haier Thermocool) to slow down bacterial and chemical reaction rates.

Sample Treatment

Digestion of the sample is one of the storage steps taken to preserve the samples from bacterial activities and to release metals into the analytical solution [10]. From each sample, $50cm^3$ was measured into an evaporating dish and $5cm^3$ of concentrated HNO_3 was added. The samples were digested for about 30 minutes using digestion block in a fume cupboard until the solution reduces to 5 – 6mls with a characteristic colour, indicating complete digestion. Each digest was then allowed to cool and transferred to a $50cm^3$ acid washed volumetric flask and the volume brought to the $50cm^3$ mark with deionized water. Diluted digest was then filter and kept in sample bottles ready for analysis [11]. The level of each metal in the three samples were determined using Bulk 205 model FAAS while result was presented as mean value for triplicate analysis.

RESULTS AND DISCUSSION

The result of the FAAS analysis on the three samples are shown in Table 1 Below

Table 1: Mean concentration of heavy metals (mg/L) in bore – hole samples within Aliero Community

Toxic	Mean conc. (mg/l) for:			
Metals	KSUSTA	GEN. HOSP	GAN. VILL	WHO Permissive limits
Lead	0.067 ± 0.02	0.047 ± 0.01	0.245 ± 0.01	0.01
Copper	0.302 ± 0.01	0.606 ± 0.01	0.437 ± 0.01	2.00
Nickel	0.035 ± 0.00	0.087 ± 0.00	0.038 ± 0.01	0.02
Iron	1.282 ± 0.01	0.172 ± 0.02	0.41 ± 0.02	0.30
Chromium	0.052 ±0.04	0.092 ± 0.1	0.121 ± 0.02	0.05
Zinc	0.141 ± 0.04	0.019 ± 0.1	0.069 ± 0.1	3.00
Cobalt	0.07 ± 0.01	0.03 ± 0.00	0.05 ± 0.01	0.01

KSUST - Kebbi State University of Science and Technology, Gen Hosp: - General Hospital and Gan. Vill - Gangire Village.

The highest level of calcium was found to be 6.705 mg/l and the least 0.474 mg/l in K.S.U.S.T and Gen. Hospital respectively. The levels fall below the WHO standard (200mg/l) for drinking water (Table 1). The law level of calcium could be as a result of low level of weathering of rocks such as limestone, gypsum e.t.c.. The highest level of magnesium was found to be 4.02mg/l while the least is 0.20 mg/l K.S.U.S.T and Gan. Vill. respectively. They also fall below the WHO standard of 150mg/l for drinking water. This could be as a result of the low weathering of rocks like dolomite, limestone and gypsum in these areas [3]. The highest level of lead was found in Gan. vill. Sample with 0.245 mg/l and the least in Gen Hosp. with 0.045 mg/l in table1, it is seen that all the samples has lead level above the WHO standard of 0.01mg/l. This could be as a result of the use of leaded petrol in cars, generators and even some mechanic workshops around these areas especially battery chargers [11].

The result of the analysis also revealed that the sample at Gen. Hosp. had the highest value of copper, while K.S.U.S.T has the least with 0.302mg/l. All three sample fall below the WHO permissible level of 2.00mg/l. This may be as a result of the low pH and some geological factors [4]. The AAS result revealed the presence of zinc in all the sample but with negligible level in each, compared to the WHO permissible standard of 3.00mg/l in drinking water. Gen. Hosp. has the lowest value of 0.019mg/l while K.S.U.S.T. has the highest (0.141 mg/l). The result of the analysis recorded the highest level of iron in K.S.U.S.T with (1.282mg/l) which is very high compared to the WHO standard of 0.30mg/l in drinking water. The samples at General Hospital and Gangire Village has low levels below the WHO permissible level. The high level of iron could be as a result of clay, deposits in the area. Also the presence of iron, is responsible for the brownish – red colour of the water when allowed to stay for some minutes [12]. Table 1 also showed that the three samples has levels of cobalt higher than WHO limit for drinking water. The highest level was recorded in Gangire Village, while the lowest was recorded for the General Hospital. The presence of cobalt could be the result of the oily deposits on the container after allowing the water to stay undisturbed for a day [13]. The highest level of Nickel recorded was 0.087 mg/l in General Hospital while the least was 0.035mg/l in Kebbi State University of Science and Technology. All the samples have nickel level higher than WHO permissible level for drinking water (0.02mg/l). The presence of nickel could be as a result of the igneous rocks found in the study area [14]. The level of chromium as revealed by the AAS analysis in Table 1, was estimated as the highest while a least level of 0.052 mg/l was presented for the Kebbi State University of Science and Technology water sample. Both water samples from General Hospital and Gangire Village has a higher chromium level compared to the WHO standards of 0.05mg/l for drinking water. The high level of chromium in these two samples could be due to the presence of chromium in varying concentrations in nearly all uncontaminated aquatic and terrestrial ecosystem. Also, the presence of chromium in soaps and detergents used for washing and bathing could be responsible for the high chromium level in the two samples [15]. The chromium level above the WHO limit could pose a threat to human health in these localities.

CONCLUSION

In this study, the Authors added to database, the heavy metal concentration in bore – hole within Aliero. The study revealed that Pb, Cu, Fe (K.S.U.S.T), and Cr levels in the test samples exceeds the permissible limits recommended by WHO. The concentrations of Ca, Mg, Zn and Fe in the samples fell below the standard limits of WHO Generally, the study revealed the expected low quality of drinking water in third world countries like Nigeria. This is more pronounced in the water sample form Gandire village which is a rural settlement and exerts a potential source for water borne diseases and other health hazards associated with heavy metals.

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