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ASSESSMENT OF SELECTED HEAVY METALS CONCENTRATIONS IN SHALLOW-WELL WATERS IN BARATON, TILALWA, CHEPTERIT AND KAPSABET REGIONS OF NANDI COUNTY

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Abstract

Well water samples from three areas in Baraton, Tilalwa, Chepterit and Kapsabet were analyzed, using Atomic Absorption Spectrophotometer (AAS). 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. The level of the metals followed the order Zn (0.013 – 11.38) > Cu (0.00 – 0.013mg/l) > Pb, Cd (0.00). The implications of these high levels of such metals in man's health have been highlighted.

Keywords: Heavy metals, wells, fresh water, anthropogenic, ecosystem

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 (Itodo & Itodo, cited in Elinge, Itodo, Peni, Birnin-Yauri, & Mbongo, 2011). 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 (WHO, cited in Elinge et al., 2011).

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, it may be a problem finding high quality fresh water at the required place, in the required quantity (Radojavic & Vladimir, cited in Raji, Ibrahim, Tytler, & Ehinmidu, 2016). 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 (WHO, 1997). The importance of water in daily living makes it imperative that thorough examinations be conducted on it before consumption (Ademoroti, 1996).

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 involved (AWA, cited in Elinge et al., 2011).

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 (Radojavic & Vladimir, cited in Raji et al., 2016). 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 (Bhatia, 2001). This present study is therefore aimed at investigating the level of some metals in selected wells within Baraton, Tilawa, Chepterit and Kapsabet communities.

Materials and Methods

Sampling

Batch sampling which involved taking samples from the environment and performing an analysis later in the laboratory was used in this research work (Radojavic & Vladimir, cited in Raji et al., 2016). The water samples used for this study were randomly collected from three different sites in each of the study regions. 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 (Radojavic & Vladimir, cited in Raji et al., 2016). The sample bottles were tightly covered immediately after collection and the temperature taken. They were then stored in a refrigerator at 4°C (Haier Thermocool) to slow down bacterial and chemical reaction rates.

Sample Treatment and Analysis

Digestion of the sample is one of the storage steps that was taken to preserve the samples from bacterial activities and to release metals into the analytical solution [10]. From each sample, 50cm3 was measured into an evaporating dish and 5cm3 of concentrated HNO3 was added. The samples were digested for about 30 minutes using digestion block in a fume cupboard until the solution reduced to between 5 – 6mls with a characteristic colour, indicating complete digestion. Each digest was then allowed to cool and transferred to a 50cm3 acid washed volumetric flask and the volume brought to the 50cm3 mark with deionized water. Diluted digest was then filter and kept in sample bottles ready for analysis (Udoh, Omemesa, & Singh, cited in Elinge et al., 2011). The level of each metal in the three samples were determined using Bulk 205 model AAS while result was presented as mean value for triplicate analysis.

Results and Discussion

The results from the AAS analysis on the three samples are shown in Table 1.

Table 1

Mean Concentration of Heavy Metals (mg/L) in Well Samples within Baraton, Tilalwa, Chepterit and Kapsabet Communities

Toxic Metals	**Mean conc. (mg/l)**				
	Baraton	**Tilalwa**	**Chepterit**	**Kapsabet**	**WHO Permissive Limits**
Copper	0.017±0.02	0	0.005±0.3	1.37±0.01	2
Zinc	0.012±0.01	0.003±0.02	0.025±0.00	3.11±5.35	3
Lead	0	0	0	0.017±0.02	0.01
Cadmium	0	0	0	0	0.03

It was revealed that the samples collected from three out of four regions had lead levels below the WHO standard of 0.01mg/l. The highest level of lead 0.017mg/l was found in kapsabet. 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 (Udoh, Omemesa, & Singh, cited in Elinge et al., 2011). The result of the analysis also revealed that the sample at the Kapsabet had the highest value of copper, while Tilalwa has the least with 0.00mg/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 (WHO, 1997). The AAS result revealed the presence of zinc in all the sampled areas but with negligible level in Baraton, Tilalwa and Chepterit compared to the WHO permissible standard of 3.00mg/l in drinking water. However, Kapsabet showed extremely high levels of Zinc of 3.11mg/l. Cd was not detected in all the tested areas.

There was no significant difference in the concentration of metals (Copper, Zinc, Cadmium and Lead) using the significance level of 0.05. Moreover, there was no significant difference in concentration of metals per region (Baraton, Tilalwa, Chepterit and Kapsabet).

Conclusion

The study revealed the presence of Pb, Zn and Cu in the test samples. However, Zn in Kapsabet exceeded the permissible limits recommended by WHO and exerts a potential source for water borne diseases and other health hazards associated with heavy metals.

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