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Trace Metal Level of Hand Dug Well in Dareta Village, Anka, Nigeria

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ABSTRACT

Toxic metals are natural components of the environment, but human activities in mining, industry and agriculture, have been responsible for the wider diffusion of these elements. The almost ubiquitous presence of some metal pollutants facilitates their entry into the food chain and thus increases the possibility of them having toxic effects on humans and animals. Increasing pollution has given rise to concern on the intake of harmful metals in humans. These metals enter the human body through inhalation and ingestion. The intake through ingestion depends on food habit. Dareta Village is a mining community with so many mining mills in operation within the village. The trace metal levels of water from hand dug wells around Dareta Village were determined. Water samples were collected from 12 wells scattered around the village. The metals studied include Cd, Pb, Cu, and Zn. The mean trace metal concentrations and their ranges were Pb 0.279(0.25-0.869)ppm; Cd 0.0177(0.0112-0.0256)ppm; Zn 0.512 (0.248-1.842) ppm; Cu 0.182 (0.110-0.729)ppm.

INTRODUCTION

The presence of metals in groundwater and soils can pose a significant threat to human health and ecological systems. The chemical form of the metal contaminant influences its solubility, mobility, and toxicity in ground-water systems. The chemical form of metals depends on the source of the metal waste, the soil and ground-water chemistry at the site. Surface water and groundwater may be contaminated with metals from wastewater discharges or by direct contact with metals-contaminated soils, sludges, mining wastes, and debris. Metal-bearing solids at contaminated sites can originate from a wide variety of sources in the form of airborne emissions, process solid wastes, sludges or spills. The

Contaminant sources influence the heterogeneity of contaminated sites on a macroscopic and microscopic scale. Variations in contaminant concentration and matrix influence the risks associated with metal contamination and treatment options [1,2].

Unregulated inputs of metal contaminated materials into the natural environment pose a range of both short- and long-term environmental risks. These heavy metals may find their way into the human body through food, water, air or absorption through the skin [3,4). Some of these metals bioaccumulate [5,6,7]. Heavy metals which have received the most attention both in terms of sources and effects are those which are considered either (or both) as essential or toxic or show a high geochemical abundance, these include; zinc, iron, copper, molybdenum, lead, mecury and cadmium [8,9,10]. Zamfara State of Nigeria has a lot of untapped mineral resources. The natives tap these mineral crudely with so many mining sites scattered all over the state. Dareta Village is one of such mining fields. Recently, many deaths were recorded in Dareta and Bukkuyum villages of Zamfara State [11]. These deaths were attributed to lead poisoning which informed this present study. The aim of this study is to determine trace metals levels of wells in and around Dareta Village and proffer solution on how to remediate the water.

MATERIALS AND METHOD

Sample containers were thoroughly washed with detergent, rinsed with water followed by distilled water before soaking in 5% HNO_3 for about 24 h. Samples were collected in 4-litre acid-washed polypropylene containers. Water samples were kept on ice in an ice-chest and transported to

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the National Research Institute for Chemical Technology, Zaria, Nigeria (NARICT) laboratory and stored at < 4 ^oC until analyzed (normally within 1 week). The well water was digested by measuring 100ml unfiltered water into a beaker and 20ml "Analar" nitric acid solution plus 10ml of 50% hydrochloric acid solution were added. The acidified sample was then evaporated to almost dryness on a hot plate, 5ml of 50% hydrochloric acid was added and heated for 15 minutes. The beaker was removed and allowed to cool before transferring quantitatively into a 100ml volumetric flask and made up to the mark with distilled water. It was filtered and the metals were determined using a Shimadzu Atomic Absorption Spectrophotometer model AA6800 (AAS).

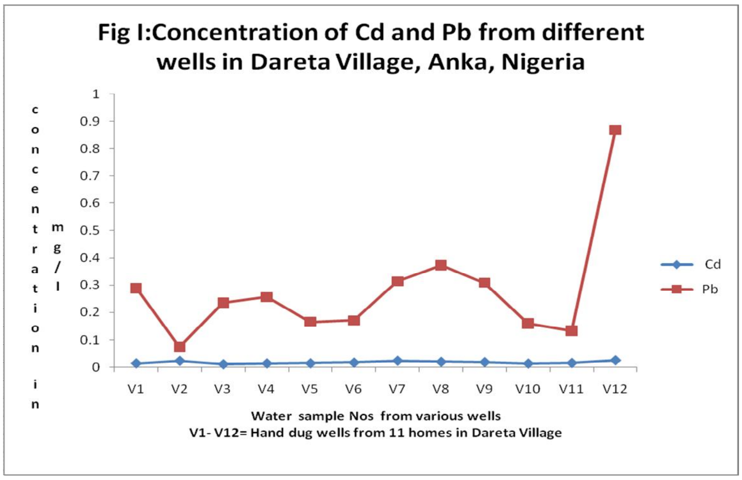
RESULTS AND DISCUSSION

Cadmium and Lead

The adverse toxic effect of cadmium and lead are well recognized. Accumulation of cadmium in the body has been linked with respiratory ailment, hypertension and damage to bones, kidney and liver [12, 13 & 14]. Lead reportedly interferes with a number of body functions, notably the central nervous system, the hematopoietic system and the kidney [12, 15 & 16].

Fig.I gives the concentration of Cadmium and lead from the 12 wells sampled in Dareta Village. The lead and cadmium Concentration ranged from 0.25-0.869 ppm and 0.0112-0.0256 ppm respectively. The maximum contaminant level (MCL) of 0.005 mg/l [17] for cadmium above which the may be detrimental effects to the 'health'0f consumers of such water was exceeded by all the wells [18]. These high levels of cadmium may be attributed to the large number of mining grinding mills scattered in and around the village. Almost every compound in the village crushes stones from the mines.

The United States Environmental Protection Agency has classified lead (Pb) as being potentially hazardous and toxic to most forms of life [17]. Lead has been found to be responsible for quite a number of ailments in humans, such as chronic neurological disorders especially in fetuses and children. The Lowest Observe Adverse Effect Level (LOAEL) of lead for children (causing developmental toxicity) is 0.1mg/L in blood. This level is associated with diminishing IQ score in children [19].

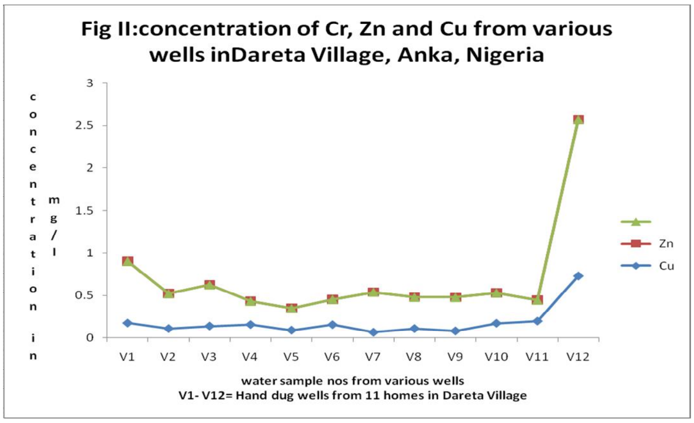


From Fig. I, lead concentration is high in all the well water. This result is higher than the maximum allowable limit of 0.01mg/L [20]. These high levels may be attributable to the high level of lead in the mined stones brought home to be crushed, or mineralization of the underground soils.

Zinc and copper

Zn is one of the earliest known trace metal and a common environmental pollutant, which is widely distributed in the aquatic environment. It has been found to have low toxicity effect in man. However, prolonged consumption of large doses can result in some health complications such as fatigue, dizziness and neutropenia [21]. Studies have also shown that Zn could be toxic to some aquatic organisms such as fish [22 & 23].

Zinc is distributed widely throughout the human body, and is deposited relatively slowly in the skeleton, where it is bound for long periods. Approximately 98% of the zinc in normal human plasma is protein bound. The principal carrier protein is albumin which binds about 80-85% of plasma zinc; approximately 15% is bound to $_2$-acroglobulin, less than 2% to retinol-binding protein and less than 1-2% of zinc is free or ultrafiltrable [24, 25 & 26]. Zinc is found in high concentrations in the choroid plexus, prostate, kidney, liver, lung, spleen, and brain (particularly the cerebellum and hippocampus). From fig. II Zn concentration ranged from 0.248-1.842 mg/l, with well no 12 (V12) having the highest value. This could be due to higher milling activities around well V12, or high level of mineralization of zinc from the soil. This trend was also observed for well V1 recording the second highest concentration 0.725 mg/l



Copper (Cu) is intimately related to the aerobic degradation of organic matter [27] and has been shown to cause acute gastrointestinal discomfort and nausea at concentrations above 3 mg/l [18]. From fig. II copper concentration ranged from 0.110 to 0.729 mg/l. With well V12 having the highest concentration.

Conclusion

From the results recorded, trace metal levels in all the wells are high; these may all be attributable to the mining activities in and around Dareta Village. To ameliorate these challenges, the government needs to set up a water treatment plant that will be able to reduce the trace metal to WHO acceptable limits.

Further studies need to be carried out on the top soils and underground soils around the village to determine the level of trace metals.

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