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Assessment of Heavy Metals Concentration in Ground Water from Various Locations of Gezawa Local Government Area of Kano State

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Abstract: The purpose of this research is to assess the level of some heavy metals in ground water samples from Gezawa Local Government Area of Kano state. Water samples were collected from ten point designated as A_1-A_{10} for the assessment of heavy metals. The levels of heavy metals in the water sample were determined using atomic absorption spectrophotometer (AAS). The concentrations of Cd, Cr, Pb and Zn in the water sample are within the maximum contaminant level set by Standard Organization of Nigeria (SON) and World Health Organization (WHO) except for lead in point A_1 and A_4.

Keywords: Heavy Metals, Ground Water, Gezawa, Assessment Water Samples

1. Introduction

Heavy metals contamination of global environment arises from natural sources directly or indirectly from anthropogenic activities such as rapid industrialization, urbanization, energy generation, improper waste management and other local and/or regional anthropogenic sources [1]. A large quantity of heavy metals associated will anthropogenic activities have seen released into the atmosphere from where they can reach the soil environment and aquatic ecosystem through both dry and wet deposition processes. Apart from soil environment and aquatic ecosystem, atmospheric inorganic contaminants of natural origin or anthropogenic sources that contained heavy metals and or trace elements such as cadmium(cd), chromium(Cr), cobalt (Co), Copper (Cu), Nickel (Ni), Lead (Pb) and Zinc (Zn) at high concentrations could led to serious ecological consequences and pose human health risks [2]. A heavy metals are potentially hazardous to humans and various ecological receptors because of their toxicity, persistence, bio-accumulative and non-biodegradable nature. Therefore monitoring and evaluation of heavy metal concentration in soils, groundwater and atmospheric environment is imperative in order to identify hazards to human health to prevent bioaccumulation in the food chain and further degradation of the ecosystem [3] [4]. According to [3] Monitoring and assessment of heavy metals concentrations in the environment contribute towards effective understanding of biogeochemical processes and gauging ecosystem health.

1.1. Sources of Heavy Metal

Apart from emission from natural sources (meteoric biogenic, terrestrial, marine, volcanic, forest fires, erosion and surface winds), heavy metals from anthropogenic sources are introduced into the environment mainly via three routes:

a) Deposition of atmospheric particulates
b) Disposal of metal enriched sewage sludge and sewages effluents.
c) Emissions from automobiles, metal mining, petroleum production and fossil fuel combustion.

Combustion of fossil fuels is the principal anthropogenic sources of Be, Co, Hg, Mo, Ni, Sb, Se, Sn, and V, as well as a large contributor of As, Cr, Cu, Mn, and Zn, while industrial metallurgical processes produce the largest emission of As, Cd, Cu, Ni, and Zn Pacyna 1998 as cited in [3]. However, other sources and mechanisms such as re-suspension of local soil dust through rainfall precipitation and reaching from higher plants might significantly contributes to atmospheric deposition of heavy metals, Micheal, 1986; Tuncel, 2001 as cited in [3]. However, other sources and mechanisms such as re-suspension of local soil dust through rainfall precipitation and reaching from higher plants might significantly contributes to atmospheric deposition of heavy metals.

Table 1. *Anthropogenic sources of heavy metals in the environment.*

1	Arsenic (As): pesticides and wood preservative
2	Cadmium (Cd): Paints and pigments plastic stabilizers, electroplating incineration of cadmium containing plastics, phosphate fertilizers.
3	Chromium (Cr): Tanneries, steel industries, fly ash
4	Copper (Cu): Pesticides, fertilizers
5	Mercury (Hg): Release from Au-Ag mining and coal combustion, medical waste.
6	Nickel (Ni): Industrial effluents, kitchen appliances, surgical instruments, steel alloys, automobile batteries.
7	Lead (Pb): Aerial emission from combustion of leaded petrol, battery manufacture, herbicides and insecticides.

Source: [5]

1.2. Harmful Effects of Heavy Metals

Heavy metals have adverse effects on human health and therefore heavy metal contamination of food chain deserves special attention. May heavy metals and metalloids are toxic and can cause undesirable effects and severe problems even at very low concentrations [5]. Heavy metals cause oxidative stress [5] [6] by formation of free radicals. Oxidative stress refers to enhanced generation of reactive oxygen species (ROS), which can overwhelm cells intrinsic antioxidant defense can lead to cell damage or death, Das et al, 2008; Krystofora et al., 2009; Sanchesz-Chardi et al., 2009 cited in [5]. Furthermore, they can replace essential metals in pigments or enzymes disrupting their function [5] [7]. Regarding their toxicities, the most problematic heavy metals are As, Cd, Cr, Cu, Hg, Pb, Sn, and Zn, Wright, 2007; Ghosh, 2010 cited in [5]. Out of these, As, Cd, Hg, and Pb are non-essential heavy metals while Cu and Zn are essential heavy metals (trace elements).

2. Materials and Method

In the preparation of reagents, chemicals of analytical grade were used with de-ionized water. All glass wares were cleaned and rinsed with detergents and immersed in 25% nitric acid and finally rinsed with de-ionized water [8].

2.1. Sampling Area

Gezawa Local Government geographically lies between 12.22°N and 12.33°S and between 10.00°N and 10.00°E. It is located about 37km from the northern part of Kano city (state capital) and with population of 282,328 comprising of 138,948 females and 143,380 males. The local government occupies an area of 477km^2 which comprise of one district of 59 towns and villages [9]. Gezawa has a population of 14,192 inhabitants and average rainfall for the area is 8.42kmm. Gezawa Local Government is bordered with Gabasawa local government to the east, Nassarawa local government to the west, Minjibir local government to the north and Warawa local government to the south [10].

2.2. Sampling Point

Water samples were collected ten point designated as A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9 and A_{10}. [11].

2.3. Sampling Techniques

Ten samples of well water were collected from different areas of Gezawa Local Government of Kano State using clean new polythene plastic containers (10L) which were covered with black polythene bags to prevent growth of algae. The temperature was determined immediately after sampling and the sample was stored at a cold temperature, this is to prevent the growth of microorganism. However, the sampling was conducted between the hours of 12 pm to 5 pm [8].

2.4. Digestion of Water Samples for Heavy Metals Determination

Heavy metals (cadmium, chromium, lead and zinc) were determined using atomic absorption spectrophotometer (AA Unicam 969). The water samples were digested as follows. 100ml of the sample were transferred into a beaker and 5ml concentrated HNO_3 were added. The beaker with the content was placed on a hot plate and evaporated down to about 20ml. The beaker was cooled and another 5ml concentrated HNO_3 was also added. The beaker was returned to the heat plate. The heating was continued and then small portion of HNO_3 was added until the solution appeared light coloured and clear. The beakers were washed with distilled water and the sample was filtered to remove some insoluble materials that could clog the atomizer. The volume was adjusted to 100ml with distilled water [12]. Dissolved concentrations of heavy metals in the water samples were determined using atomic absorption spectrophotometer (AAS, Unicam 969) as described in the manufacturer's instructions manual [8].

3. Result

The demand of safety water increased, as of now the main source of our drinking water in Gezawa (Rural areas) is

mainly well water. Present improvement of analytical methods which allow for the detection of impurities even at lower concentration make it easier to assess the quality of the water we drink.

The results of heavy metals (Cd, Cr, Pb and Zn) analyzed in well water sample from some sampling site (A_1-A_{10}) across Gezawa Local Government Area of Kano are presented in table 2:

Table 2. *Levels of heavy metals of sample water.*

s/no.	Cd (mg/l)	Cr (mg/l)	Pb (mg/l)	Zn (mg/l)
A_1	0.05	0.45	0.31	2.31
A_2	0.01	0.11	0.13	1.85
A_3	0.03	0.02	0.14	2.00
A_4	0.01	0.05	0.28	1.20
A_5	0.02	0.15	0.16	2.84
A_6	0.05	0.14	0.11	2.03
A_7	0.02	0.12	0.19	2.11
A_8	0.02	0.3	0.02	2.11
A_9	0.0 ND	0.01	0.10	1.70
A_{10}	0.01	0.11	0.08	1.00

ND: Not detected.

4. Discussion

The heavy metals analyzed were Cd, Cr, Pb and Zn. From the results (Table 2) it can be seen that all the samples ware within the safe limit recommended by [13] except for lead in A_1 and A_4 which is higher than the maximum contaminant level of 0.01 mg/l [14]. This may be due to the closeness of A_1 to wase dam which receives different contaminant from river Jakara and could be due to the present of industries, in case of A_4 may be from sewage and industrial waste, refuse which may include lead battery that could ultimately leach into the ground thereby contaminating the water.

5. Conclusion

Heavy metals assessment of well water samples from Gezawa L. G. A of Kano was conducted most of the sampling sites (A_2-A_3, A_5-A_{10}) were found to be within the recommended levels set by WHO and SON with exception of lead (Pb).

The heavy metals concentrations related to the proximity of the sampling Area with contaminated area that is industries and wase dam which is believed to have contain a lot of contaminants (pollutants) such as sewage industrial effluents, dumping effuse that may include ear batteries (lead accumulator) and some other environmental pollutants.

However, since some of the results indicate high levels above the standard set by WHO and SON safe limits there is the tendency of high potential health hazards to the inhabitants of the areas that these water sources for drinking and other domestic purpose without treatment.

Recommendation

As the results indicated some of the sampling points (A_1 and A_4) analyzed showed higher concentration above the WHO and SON contaminant level, the following steps may lower the concentration. Domestic and industrial waste should be property disposed or recycled. Relevant agencies should make concerted efforts to control, regulate and educate the community on indiscriminate waste disposal from domestic and industries within the study area and also further research should be carried out to assess the levels of some other parameters. Phytoremediation can be introduced to reduce the levels of the heavy metals contamination.

The limitation of this research is that physicochemical parameters, trivalent metals ions and microbial analysis was not conducted and this can be done for further research work.

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