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Research Article

Trace elements as an indicator of quality of drinking water in Kano State Water treatment Plants

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Abstract

This study involved the determination of trace elements in Kano State water treatment plants. Drinking water samples were collected from water treatment plants and analyzed for some dangerous and carcinogenic trace elements such as Cadmium. Cobalt, Chromium, Copper, Manganese and Magnesium using Atomic Absorption Spectrotometer. The results of the study showed that the concentration ranges of metals in the samples as follows; 0.01-0.07mg/L for Cd, 0.005-0.03mg/L for Co, 0.01-0.04mg/L for Cr, 0.01.0.018 mg/L for Cu, 0.015 – 0.018 mg/L^{-1} for Mg, 0.005 – 0.05 mg/L^{-1} for Mn. The results therefore connotes that the concentrations of the various elements are within the permissible limit of the WHO drinking water quality guidelines hence, the water is safe for drinking.

Keywords: Kano state water treatment plant, trace elements, water quality, WHO standard

INTRODUCTION

Good drinking water quality is essential for well being of all people. Contaminated water has serious implication on health and economic status of the population. Trace elements are among the water contaminants that find their way into water supplies as a result of inadequate treatment disposal of wastes and industrial discharge. Water contaminated with sewage is estimated to kill about two million children every year, even in the absence of anthropogenic source, there is tendency for natural levels of metals and other chemicals to be harmful to human health. This was observed recently in Zamfara state, northern Nigeria where about 163 people lost their lives between March and June 2010 as a result of lead poison in drinking water (Wikipedia, 2010).

Utilization of the minerals by the body is jeopardized by presence of toxic elements such as lead, cadmium, mercury and aluminum. Fortunately, elements in the diet can also protect against toxic elements. Zinc, calcium, and vitamin C protects against cadmium (Aswalhanarayana, 2004). The principal objective of the present study is to investigate the input and distribution of trace elements and examine the pollution levels and quality of drinking water in Kano state with respect to the most important heavy metals. Lots of applications of the solid phase extraction for metal determination in natural water samples including drinking waters has been presented by researchers.

This study was conducted with the view to determine the concentrations chromium, cobalt, cupper, magnesium and manganese in drinking water samples from Kano State water treatment plans and compared with WHO (2004) threshold limits.

MATERIALS AND METHODS

Reagents and Glass Wares

In the preparation of reagents, chemicals of analytical grade purity and deionized water were used. All glassware was cleaned by immersion in 25% nitric acid overnight and were washed with detergent solution. Samples were evaporated to dryness and the residues were digested with 0.25moldm^{-3} NHO_3 acid for atomic absorption spectrotometer analysis trace metals.

Study Area

Kano is one of the most popular Hausa land, politically, economically, socially and religiously. Kano lies in the geographical location within the open Sudan savannah area and covers an area of about 1630 square miles. Large percentage of Kano people engage in different commercial activities ranging from farming, trading, industrialization and other traditional occupation such as fishing, dyeing, weaving etc.

Twenty different water samples were collected in twenty sampling sites and coded as follows: Magaga, (A) Kafin Chiri, (B) Kusalla, (C)Tamburawa I, (D) Tamburawa II, (E) Challawa I, (F) Challwa II, (G) Chiromawa, (H) Tudun Wada, (I) Tomas, (J) Bagwai, (K) Gaya, (L) Rano, (M) Guzu-Guzu, (N) Kura, (O) Tiga, (P) Phada, (Q) Watari, (R) Wudil, (S) Garin Babba,(T)

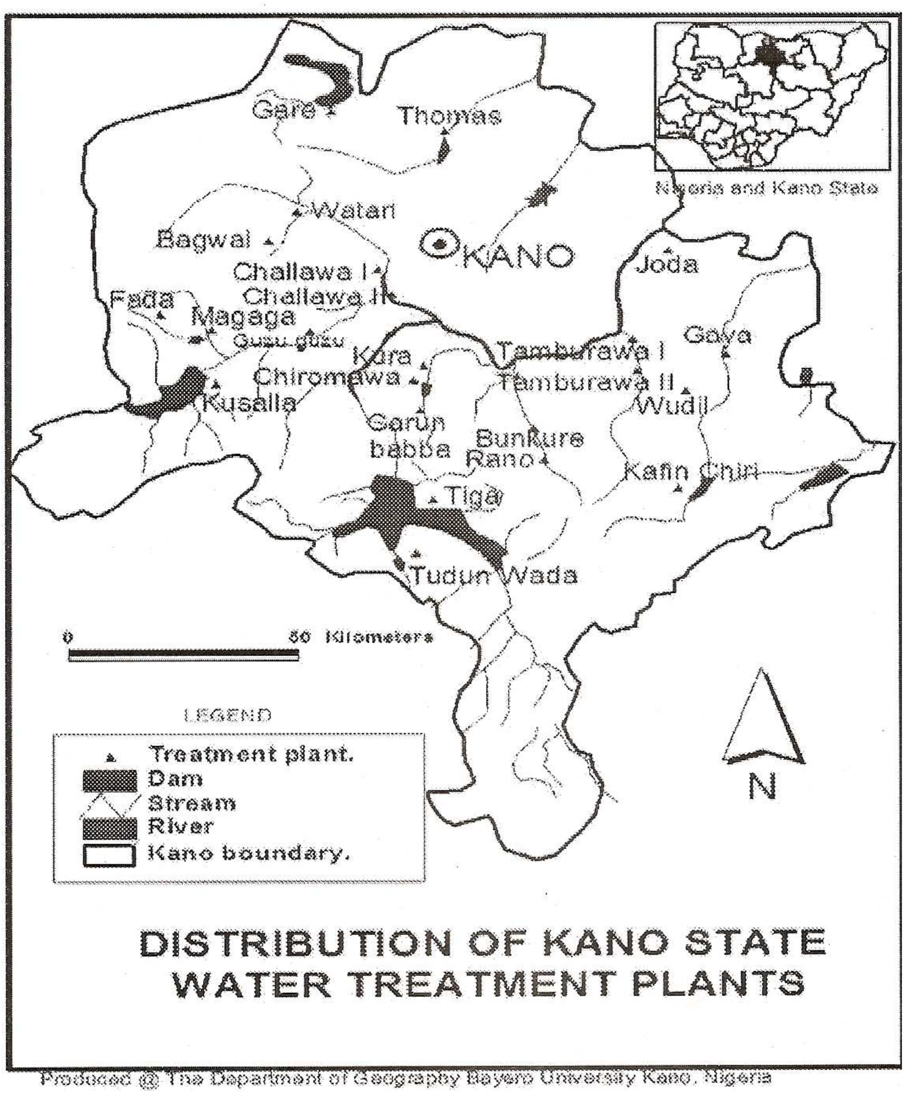

Figure 1. Distribution of Kano State water treating plants

Sample Collection and Preparation

Water samples were obtained from Kano State water treatment plants. Twenty different water samples were collected using a plastic polythene container and preserved with 2mL conc HNO_3 to pH <2.

Elemental Analysis of Water Sample

Five liters of the water samples were evaporated to dryness using pyrex beaker and hot plate. The residues were digested with 50cm^3 of 0.25moldm-^{3} nitric acid and transferred into 120cm^3 plastic container for atomic absorption spectrotometer (AAS analysis). Metals concentrations were extrapolated from the standard calibration curve.

Statistical Analysis

All data generated were analyzed statistically by calculating mean, standard deviation and coefficient of variation. The method used was desirable by Steel and Torne (1960).

RESULT AND DISCUSSION

Investigations of the quality of drinking water samples have been continuously performed by researchers around the world. Mineral and trace elements are both essential to human health and maintaining adequate levels and balance in every tissue, fluid, cells and organ in the body may be the key considerations. If the body requires more than 100mg of a mineral each day, the substance is labeled a mineral. If the body requires less than this, it is labeled a trace mineral. Pure water dose not exist in nature. The contamination of water is directly related to the degree of contamination of our environment. Rain water collects impurities while passing through the air stream and reverse collect impurities from surface run off and through the discharge of sewage and industrial efficient. These are carried to the rivers, lakes or reservoirs that supply our drinking water. The metabolisms of vitamin B_{12} and the food stuffs provide the most significant sources of cobalt (e.g. background level) in the human body. Background levels of cobalt are not known to be associated with adverse health effects in human.

The concentration of cadmium in the samples analyzed is shown in the table I: minimum concentrations of 0.01 mg/L^{-1} were observed in sample (A), C, I, N and a maximum concentrations of 0.07 mg/L-1 was observed in sample (S). the concentrations of cadmium in all the sample analyzed were high than W.H.O (2004) limit of 0.003 mg/L^{-1} except in sample (T), which is not detected. Cadmium bearing products such as automobile tyres, fungicides and fertilizer application practiced in the sampling areas may contribute to high concentration.

Cobalt concentrations in the samples analyzed is shown in table 1: The concentration range from 0.000mg/L^{-1} – 0.03 mg/L^{-1}. All the sample analyzed have concentrations within W.H.O (2004) threshold limit of 0.05 mg/L^{-1} except in sample A,B, and P which is not detected. Low concentration of cobalt in the sample many be attributed to the domestic agricultural effluents[1].

Chromium concentration in the sample analysed is shown in table 1: the concentration ranged between 0.01 mg/L^{-1} and 0.04 mg/L^{-1}. High concentration of chromium in the water samples may attribute to anthropogenic activities.

Chromium is used in the metabolism and storage of fats, proteins and carbohydrates by the body. Chromium occurs in the environment primarily in two-valence state, trivalent chromium (III) and hexavalent chromium (Vi). Chromium (III) is much less toxic than chromium (Vi).

The body has several systems for reducing chromium (vi) to chromium (III). This chromium (vi) detoxication lads to increased levels of chromium (III)[23].

Variations in copper concentrations in the samples are shown in Table 1: the concentration ranged between 0.01 mg/L^{-1} and 0.018 mg/L^{-1}. Copper is an essential nutrient, but at high dose, it has been shown to cause stomach and intestinal distress, livers and kidney and anemia.

Copper is intimately involved with number of other vitamins and minerals. Copper and zinc levels are very closely interrelated. If an excess of one is found in the diet, the other will likely be deficient.

Magnesium concentrations in the analyzed samples are shown in table 1: the concentrations range between 0.01 mg/L^{-1} – 0.087 mg/L^{-1} . all the samples analysed haves concentrations within the W.H.O. (2004) threshold limit of 20.0 mg/L^{-1} . High dose of magnesium in food supplement may cause nerve problems and depressions.

Table 1: show the concentration of magnesium in the samples. The concentration range between 0.002mgL^{-1} and 0.05mgL^{-1}. All the samples analysed have concentrations within the WHO (2004) threshold limit of 0.40 mg/L^{-1} . The concentration obtained in this study is lower than 0.09 mg/L^{-1} – 2.83 mg/L^{-1}.

Table 1: Shows the Relative Distribution of the Metals that Occurred in the Analysed Water Treatment Plants.

Sample Code	Cd Mg/l	Co Mg/l	Cr Mg/l	Cu Mg/l	Mg Mg/l	Mn Mg/l
A.	0.01	0.00	0.03	0.05	0.015	0.005
B.	0.03	0.00	0.03	0.01	0.03	0.050
C	0.01	0.01	0.02	0.01	0.03	0.040
D.	0.02	0.005	0.05	0.07	0.015	0.035
E.	0.02	0.005	0.05	0.05	0.035	0.035
F.	0.02	0.015	0.03	0.04	0.02	0.002
G.	0.02	0.015	0.01	0.018	0.02	0.002
H.	0.03	0.025	0.04	0.011	0.025	0.050
I.	0.01	0.02	0.04	0.016	0.01	0.050
J.	0.03	0.03	0.04	0.015	0.03	0.050
K.	0.02	0.005	0.04	0.04	0.018	0.040
L.	0.02	0.005	0.04	0.04	0.018	0.040
M.	0.02	0.02	0.01	0.02	0.205	0.050
N.	0.01	0.025	0.02	0.016	0.0165	0.040
O.	0.05	0.00	0.01	0.011	0.0115	0.035
P.	0.04	0.03	0.03	0.04	0.021	0.030
Q.	0.03	0.005	0.02	0.05	0.018	0.015
R.	0.06	0.02	0.02	0.01	0.175	0.010
S.	0.07	0.01	0.02	0.05	0.175	0.05
T.	0.00	0.02	0.01	0.02	0.045	0.025
Mean	**0.026**	**0.01324**	**0.026**	**0.047**	**0.0873**	**0.0372**
Standard Deviation	**0.0175**	**0.01002**	**0.0119**	**0.0428**	**0.0785**	**0.0171**

CONCLUSION

The concentrations of the investigated metals ions in drinking water samples from kano state water treatment plans were found to the below the guidelines of drinking water given by the world health organization (WHO) (2004) except cadmium are of concern contaminants due to the fact that concentration of these metals are above WHO (2004) threshold limit of 0.003 mg/L^{-1} in the samples. The studies will be disseminated to the community leaders.

RECOMMENDATION

Treated water circulating for the distribution system should: -

a. Have properly installed and maintained treatment and online system so that the information about quality wills the available.

b. Be checked routinely to detect possible problems.

c. Provide the consumer with drinking water of sufficient quantity by constructing more water treatment plans.
d. Remove the old water distribution pipes over 70 years and replace it with new ones.
e. Water board should have modern and latest equipment and mobile laboratory equipment for proper sampling testing and analysis.
f. Proper sanitation should be strictly observed around the vicinity of the water treatment plans.
g. Proper means of covering water in the treatment plans should be provided so as to avoid water contamination during windy period.
h. Special methods for the removal of trace metals should be employed e.g. ion exchange resins, reverse osmosis etc.

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