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Research Article

Assessment of Fe, Zn, Cu, Cr, Cu and Pb Content of Water from Dadi-Kowa River at Gombe State, Nigeria

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Abstract

The metals content of water from Dadi Kowa river at Gombe state, Nigeria were analyzed using an atomic absorption spectrophotometer (AAS). The result shows the metal content of samples as follows, Fe (0.582±0.131 mg/L), Zn (0.467±0.095 mg/L), Cu(0.153± 0.018 mg/L), Cd, Cr and Pb were below the detection limit. The mean values for some physiochemical parameters of the water samples are; temperature (27.80±0.8 °C), pH (6.4±0.3), TS (332.28 ± 19.64 mg/L), TSS (76.28±10.96 mg/L), TDS (256.17±21.64 mg/L), the concentrations of heavy metals in water samples were less than the permissible limit set by WHO.

Keywords: Heavy Metals; Atomic Absorption Spectrophotometer; Water; River

Introduction

Rapid urbanization, industrialization, and agricultural activities have increased the discharge of waste effluents into the natural aquatic ecosystem, and capable of rendering it environmentally unstable; leading to substantial changes within the ecosystem (Kisamo, 2003).

Discharge of large concentrations of metals into the natural environment creates a number of ecological problems. Living organisms require trace amounts of certain metals (e.g. cobalt, vanadium, strontium and zinc) for proper growth and development (Kisamo, 2003, Nnamonu et al., 2015a.). In natural aquatic ecosystems, metals occur in low concentrations, normally at the nanogram to microgram per litre level. The increase in the uptake of these heavy metals by plants and animals (must of which ends up as food for man) pose a health risk to humans (Ogidi et al., 2018). Excessive levels of essential metals can have environmental effects on aquatic organisms (Nnamonu et al., 2015b). Non- essential heavy metals of particular concentrate cadmium, chromium, mercury, lead, arsenic, and antimony pose health risk to biological organisms. The main threats to human well-being however, are associated with lead, arsenic, cadmium, and mercury (Kisamo, 2003). For certain metals, toxic levels can be just above the background concentrations normally found in nature. Therefore, it is important for us to inform ourselves about the heavy metals and to take protective measures against excessive exposure. Metal toxicity is a clinically significant condition when it occurs. If undetected or inappropriately treated, toxicity can lead to significant illness and reduction in the quality of human and animal health (Ferner, 2001). From water, all plants absorb and accumulate metals (Fe, Mn, K, Na, Zn, and Cu) which are essential for growth and development. (Langille and MacLean, 1976). In an effort to ensure sustainability of the ecosystem studies are carried out to assess the pollution load in terms of heavy metals and other chemicals having adverse effects on human health (Kisamo, 2003). The aim of this study is to assess the metals (Fe, Mn, Zn, Cd, Cu, Cr and Pd) content of the water fom Dadi Kowa River, Gombe state.

Materials and Methods

Study Site

Study site is located at Dadin Kowa in Yamaltu Deba local government area of Gombe state North East Zone of Nigeria, the site is known for presence of the Dadi Kowa dam and also agricultural activities such as crop farming and fishing.

Sample collection, preservation and pretreatment

The water samples were collected from the river at three spots at a depth of about 15cm below the water surface using plastic bottles with screw caps. The containers were pre-treated with nitric acid and rinsed with distilled water, before use. 2L of water samples were collected made into composite samples and was acidified with 5ml of nitric acid to prevent metals from adhering to the walls of the containers (APHA, 1985; Ademoroti, 1996).

Sample digestion

100mL of water sample was measured into 250mL conical flask; 5mL of concentrated HNO_3 was added and heated on a hot plate for about 15 minutes. After digestion was complete, it was removed from heating allowed to cool to room temperature and filtered into a 100mL volumetric flask using a Whatman filter paper No2. The sample solution was then made up to the 100mL mark with deionised water (Ademoroti, 1996).

Apparatus/reagents

All glass ware, including sample bottles, burette, and pipettes used were washed cleaned and rinsed with HNO_3, followed by distilled water to avoid errors arising from contamination. All reagents used were of analytical grade (Ogidi et al., 2019a).

Physio-Chemical Parameters

Temperature

The temperature of the water sample was measured using mercury in glass thermometer. The thermometer was placed vertically immersing the bulb containing the mercury in the water sample and allowed to stand till the temperature reading was steady. The thermometer reading was then recorded to the nearest 0.5°C (Ademoroti, 1996).

Determination of pH

The pH of the water sample was measured using a kelilong portable electronic pH meter (KL- 009 (1)). Just before the pH meter was used it was standardized with three buffer solutions of different pH values to serve as check for proper instrument response. Buffers with pH values of 2,7and 12 were used (Ademoroti, 1996).

Total solids (TS)

A dish of suitable size was cleaned and dried in an oven at temperature of 105°C, cooled to room temperature in a desiccators, 100 ml of water sample was poured into the dish, placed on a steam path and evaporated to dryness. The residue was dried in oven for about an hour at 105°C, the dish was then transferred to a desiccator, cooled to room temperature and weighed. The dish was returned to the oven and dried for another 10 minutes, reweighed after cooling to room temperature. This was repeated until constant weight was achieved. The weight of the dish was then subtracted from the final weight of dish plus residue to obtain the total solid present in the sample (Ademoroti, 1996).

$$\text{Total solids (mg/L)} = \frac{\text{weight of total solid} \times 1000}{\text{volume of sample}}.$$

Total suspended solids (TSS)

The TSS was determined by filtration of water sample using a clean filter paper. The filter paper containing the residue is placed in an evaporating dish, allowed to dry, weighed and recorded as W2. (Ademoroti, 1996).

$$TSS = \frac{(W2 - W1) \times 1000}{Vs}$$

Where; W_2 = weight of filter paper and dried residue in grams.

W_1 = weight of dry filter paper in grams.

V_s = volume of water sample in liter.

Total dissolved solid (TDS)

TDS of water in mg/L was determined by subtracting the TSS from TS of water sample (Ademoroti, 1996).

$$TDS = TS - TSS$$

Metal Analysis

Atomic absorption spectrophotometer (AAS) was employed for metal content determination , due to its accessibility, specificity, wide range of application, low detection limit, and cost effectiveness (Ogidi., 2019b).

Quality assurance

The use of blank and internal standard reference materials were employed for quality assurance to ascertain the reliability of result data (Ogidi, 2015).

Result and Discussion

Physio-Chemical Parameters of Sample Determined

Some physio-chemical parameters of the samples were determined and the values recorded in Tables 1.

Temperature of water

The mean temperature value (27.80±0.8,°C) for water at study sites was within the range (26.3 - 30.9°C) for river water at Makurdi reported in Eneji et al. (2011), the value (32°C - 26°C) for river Benue water reported in Anhawange, et al. (2012), and the mean value of 28.74±1.9°C for same river reported in Akaahan, et al. (2014). Changes in temperature affect the solubility of heavy metals, increase in temperature leads to increased solubility of metals in water.

pH water sample

The mean value (6.4±0.3) for pH of water in the study was within the range value of 6.81 for river Benue water reported in Anhawange, et al. (2012), and the mean pH for same river reported in Akaahan, et al. (2014). The pH of water was within the range (6.40 - 7.79) for the river water at Makurdi reported in Eneji et al. (2011) and the normal range (6.5 – 8.5) set by WHO. A pH value less than 6.0 increases the release of certain dissolved metals in water.

Total solid (TS) of water

TS of water ranged from 306.7 mg/L – 365 mg/L with a mean value of 332.28 ± 19.64 mg/L (Table 2). The TS of water in this study was within the range (47.0 – 947mg/L) for the river water at Makurdi reported in Eneji et al. (2011), but below the value of maximum

permissible limit (1000mg/L) set by WHO. TS values above the permissible limit indicate the presence of certain pollutants such as heavy metals.

Total suspended solid (TSS) of water

The TSS of water ranged from 306.7 mg/L – 365 mg/L. The mean value of TSS (76.28±10.96 mg/L) of water in the study was greater than the control (36.0mg/L). the TS of water in this study was within the range (20.0 - 892mg/L) for the river water at Makurdi reported in Eneji et al. (2011) but greater than the maximum value of 49.6mg/L for river Benue water reported in Anhawange, et al. (2012), and also 62.4±61.6mg/L for same river reported in Akahaan, et al. (2014). The TSS of water in this study is below the maximum permissible limit (100mg/L) set by WHO. TSS values above the permissible limit leads to increase in water temperature and the solubility of heavy metals in water.

Total dissolved solid (TDS) of water

TDS value ranged from 225 mg/L – 285 mg/L. The mean value of TDS (256.17±21.64 mg/L) of water in the study was higher than the control value of 65.3mg/L, maximum value of 6.81mg/L for river Benue water reported in Anhawange, et al. (2012), and also the mean value, 46.4±60.5mg/L for same river reported in Akahaan, et al. (2014).The TDS of water in this study was below the maximum permissible limit (500mg/L- 1000mg/L) set by WHO. TDS values above the required permissible limit makes water unpalatable and indicate the presence of pollutants such as metals and also gives an indication of the quantity of dissolved minerals in water bodies (Gereikidan and Samuel, 2005).

Samples	*Temp(^{0}C)*	*pH*	*TS (mg/L)*	*TSS (mg/L)*	*TDS (mg/L)*
WS1	27	6.1	338.0	79.0	261.0
WS2	28	6.7	327.0	71.0	256.0
WS3	28	6.2	306.7	67.7	239.0
WS4	29	6.0	365.0	80.0	285.0
WS5	28	6.8	321.0	95.0	225.0
WS6	27	6.5	336.0	65.0	271.0

Table 1: Physio-Chemical Parameters of Samples.

Parameters	*Min*	*Max*	*Mean*	*Std. Dev*
Temp (^{0}C)	27.0	29.0	27.80	0.80
pH	6.0	6.8	6.40	0.30
TS (mg/L)	306.7	338	332.28	19.64
TSS (mg/L)	65.0	95.0	76.28	10.96
TDS (mg/L)	225	285	256.17	21.64

Table 2: Descriptive Statistics of Samples Physio-Chemical Parameters.

Metals Content of Water

Iron: The mean concentration of Fe in water (0.582±0.131 mg/L) in this study was greater than the value 0.26mg/L at Olege Lagoon, Lagos reported in Ndimele and Jimoh, (2011), but less than the maximum value 5.62mg/L at Mwazan Region in Tanzania reported in Kisamo, (2003), 0.751mg/L at Makurdi reported in Eneji et al. (2011), and less than the limit (1.0 mg/L) set by WHO.

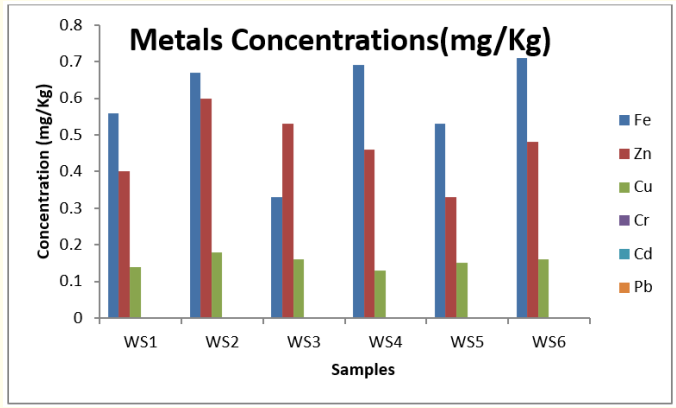
Zinc: The mean concentration of Zn in water (0.467±0.095 mg/L) in this study was more than the maximum value 0.08 mg/L at Mwazan Region in Tanzania reported in Kisamo, (2003), and 0.079 mg/L reported in Eneji et al. (2011), but less than 0.56 mg/L reported in Ndimele and Jimoh, (2011) and the limit set by WHO. Zn is relevant for immune functions, wound healing and thyroid

function (Debjit and Kumar, 2010).

Copper: The mean concentration of Cu in water (0.153± 0.018 mg/L) in this study was more than the value 0.01mg/L at Mwazan Region in Tanzania reported in Kisamo, (2003), and 0.056mg/L at Makurdi reported in Eneji et al. (2011), but less than the limit (1.0mg/L) set by WHO.

Cd, Cr and ***Pb*** in the samples were all below the detection limits, these metals are of great concern, due to the fact that they pose health risk to humans and animals even at minute concentrations (Ogidi et al., 2020).

The metals content of water samples is due to the dumping of electronic waste, batteries, metallic alloys, and municipal waste containing metals, industrial waste, sewage, sludge, and organic manure, containers of agrochemicals, agricultural chemicals and eroding of top soil into the river (Nnamonu et al., 2015b).



Conclusion

The study shows that the heavy metals Fe, Zn, and Cu were present in all the samples but Cd, Cr and Pb were below the detection limit. The concentrations of heavy metals in water were less than the permissible limit set by WHO. The river water is moderately safe for consumption and domestic use in terms of the metals content of the river water. The presence of metals in river water could be due to the presence of dump site, agricultural activities, indiscriminate dumping of domestic, industrial and agricultural waste at study site. Metal poisoning pose great risk to man, thus there is need to monitor the heavy metal content of water bodies on regular bases.

References

1. Ademoroti CMA. "Standard Methods of Water and Effluent Analysis". Foludex press (1996).
2. Anhwange BA, Agbaji EC and Gimba EC. "Impact assessment of human activities and seasonal variation on river Benue, within Makurdi metropolis". International Journal of Science and Technology 2.5 (2012) 248-253.
3. APHA. "Standard Method for the Examination of Water and Waste Water". 16th Edtn., American Public Health Association, Washington, DC., USA (1985).
4. Akaahan TJA, Araoye PA and Azua ET. "Physio-chemical characteristics and macro invertebrates of river Benue at Makurdi, Benue state, Nigeria". The International Journal of Science and Technology (2014).
5. Eneji IS, Sha'ato R and Annune PA. "An assessment of heavy metals loading in River Benue in the Makurdi metropolitan area in Central Nigeria". Enviromental Monitoring Assess 184 (2011): 201-207.
6. FAO/WHO. "Codex Alimentarious Commission food additives and contaminants". Joint FAO/WHO food standard program. ALI-

NORM. 01/ 12A (2001): 1-289.

7. Ferner DJ. "Heavy metals". eMed.j 2.5 (2001): 1.
8. Gebrekidan M and Samuel Z. "Concentration of Heavy metals in Drinking Water from Urban Areas of the Tigray Region, Northern Ethiopia". MEJS 3.1 (2011): 105-121.
9. Kisamo DS. "Environmental Harzards Associated with Heavy Metals In Lake Victoria Basin (East Africa), Tazania". Afr Newslett on Occup Health and Sefty 13 (2003): 64- 69.
10. Langille WM and MacLean KS. "Some essential nutrients in forest plants as related to species, plant parts, season and location". Plant Soil 45 (1976): 17-25.
11. Nnamonu LA, Ogidi A Ogidi and Eneji IS. "Analysis of Heavy Metals Content of Fluted Pumpkin (Telfairia occidentalis) Leaves Cultivated on the South Bank of River Benue, Nigeria". Food Science and Quality Management (www.iiste.org) 39 (2015a): 1-9.
12. Nnamonu LA, Ogidi A Ogidi and Eneji IS. "Assay of Heavy Metals in Water Hyacinth (Eichhornia crassipes) Growing in River Benue, Nigeria and Its Safety as Food". International Research Journal of Pure &Applied Chemistry, sciencedomain international (www.sciencedomain.org) 9.1 (2015b): 1-9.
13. Ndimele PE and Jimoh AA. "Water Hyacinth {Eichornia crassipes (Mart.) Solms.} in Phytoremediation of Heavy Metal Polluted Water of Ologe Lagoon, Lagos, Nigeria". Res. J. Environ. Sci 5 (2011): 424-433.
14. Ogidi A Ogidi. "Comparative Assessment of Heavy Metals in Fluted Pumpkin (Telfaria occidentalis), Water Hyacinth (Eichhornia crassipes), Water and Soil from River Benue". (M.Sc Thesis) Department of Chemistry, University of Agriculture, Makurdi, Benue state, Nigeria (2015): 1-115.
15. Ogidi A Ogidi., et al. "Heavy Metal Content of Agricultural Soils at Pindiga, Akko Local Government Area of Gombe State, Nigeria". International Journal of Advance Research 6.11 (2018): 223-233.
16. Ogidi A Ogidi., et al. "Heavy Metal Content of Agricultural Soils at Tumu, Akko Local Government Area of Gombe State, Nigeria". International Journal of Scientific and Research Publications 9.2 (2019a): 745-748.
17. Ogidi Adam Ogidi., et al. "Heavy Metal Content of Agricultural Soils at Kashere, Akko Local Government Area of Gombe State, Nigeria". International Journal of Scientific and Research Publications 9.3 (2019b): 745-748.
18. Ogidi Adam Ogidi., et al. "Determination of Heavy Metals in Soils at Gombe Town, Gombe, North Estern Nigeria". International Journal of Scientific and Research Publications 10.9 (2020): 644-649.

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