Pollution Status of Kwabateri Reservoir in Michika Local Government, Adamawa State, Nigeria

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ABSTRACT

Study was carried out on the Pollution Status of Kwabateri Reservoir in Michika Local Government, AdamawaSstate, Nigeria. Water and fish for the heavy metal determination collected from study area twice a month in triplicate from (3) different sites (site I which is the inlet, site II the center, and site III, the outlet) for the period of 4 months (June to September, 2021). Some physico-chemical parameters were determined at the site while Heavy metal in water and C. gariepinus were determined using Atomic Absorption Spectrometer. A significant difference (P<0.05) was reported in temperature, ammonia, Dissolved Oxygen, pH, turbidity and Conductivity in relation to months in this study. A significant difference (P<0.05) in Lead, Iron, Cadmium, Copper and Chromium with regards to months was reported in this study. A significant difference (P<0.05) in Lead, Iron, Cadmium and Copper was also reported in C. gariepinus in relation to months in this study. Physico-chemical parameters of Kwabateri Reservoir have significant differences between months except for Ammonia that has no significant different (P>0.05) and is within the recommended level of WHO, NESREA and FAO. The results obtained in this study also showed wide mean concentrations of the heavy metals in the reservoir with iron (Fe) and Chromium (Cr) recording the highest and lowest levels respectively. Apart from Lead (Pb), Cadmium (Cd) and Chromium (Cr) with the present concentrations within the guideline permissible limits, the mean concentrations of the other heavy metals such as Iron and Copper exceeded their maximum permissible guideline values for the protection of human and aquatic health.

Keywords: Pollution, Physicochemical Parameters, Heavy Metal, Kwabateri reservoir.

INTRODUCTION

Pollution is an undesirable change in chemical, physical and biological characteristics of an environment which causes the health problem to all living beings. Water pollution refers to any direct or indirect alteration of physical, biological or chemical property of water or water source so as to make it less fit for any beneficial purpose for which it is expected to be used or make it harmful or potentially harmful to the welfare, health or safety of human beings and any aquatic life (Goolby *et al.*, 2001). Water pollution can also mean the contamination of water by an excess of a substance that can cause impairment to the people and or the ecosystem (Altaf *et al.*, 2013). Water pollution is a major threat to aquatic organisms. The dumping or flow of pollutants into water body results in rapid deterioration of water quality and affect the ecological balance in the long run and depending on the type and the concentration, these constituents may be toxic and therefore harmful to aquatic life (Mian *et al.*, 2011). Heavy metals unlike organic contaminants are not degraded with time, but concentration can only increase through bio-accumulation (Aksoy, 2008). Heavy metals in water find their way to the through underground seepage of effluents arising from human activities, runoff from farms and industries, leaching and dissolution of metals occurring naturally in rock and soil. However, water pollution has been focusing on other aspects of water with a minimal interest in heavy metals. Heavy metal pollution has usually been relegated. Kwabateri reservoir is located in Michika Local

Government of Adamawa State in Nigeria. Water from his reservoir is used for irrigation purposes during the dry season as well fishing activities also take place here. The aim of this research is to determine the pollution status of Kwabateri reservoir in Michika Local Government, Adamawa State, Nigeria.

MATERIALS AND METHODS

The Study Area

The research was carried out in Kwabateri reservoir which is located in Michika Local Government. The reservoir is on coordinate's 10°11′30″N 13°14′0″E on the Northern part of Adamawa State. It is situated in Kuburshosho community within Michika Local Government Area (Adebayo *et al*., 2020).

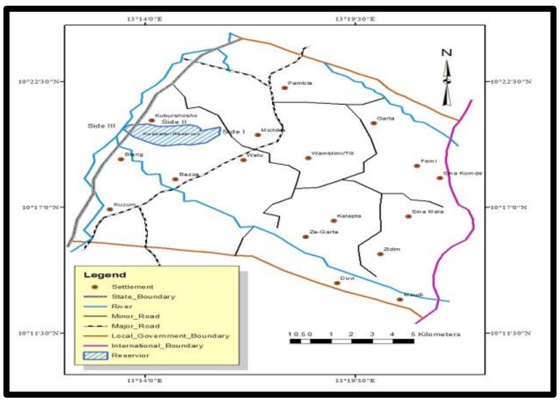

FIGURE 1: The Study Area

SAMPLING PROCEDURE AND ANALYSIS

Water sample was collected from study area twice a month in triplicate from (3) different sites (site I which is the inlet, site II the center, and site III, the outlet) for the period of 4 months (June to September, 2021). Some physico-chemical parameters were determined at the site such as temperature, electrical conductivity, turbidity, pH and dissolve oxygen while ammonia was determined in the laboratory using a specified instrument as recommended by Ali *et al.*, (2000). Water and fish for the heavy metal determination were also sampled. The water and fish samples were then taken to laboratory for the heavy metals determination. The *Clarias gariepinus* was used for heavy metals analysis. Heavy metals such as Lead, Iron, Cadmium, Copper and Chromium in water and *C. gariepinus* were determined using Atomic Absorption Spectrometer.

Data Analysis

Data obtained in this study was analyzed using One-way Analysis of Variance (ANOVA) and means was separated using LSD.

RESULTS

Monthly Physicochemical Parameters of Kwabateri Reservoir

The results of the monthly physico-chemical parameters obtained in this study are presented on Table 1. A significant difference (P<0.05) was reported in temperature, ammonia, Dissolved Oxygen, pH, turbidity and Conductivity in relation to months in this study. The month of June recorded the highest temperature, Ammonia and Conductivity (26.49±0.01[a,] 0.50±0.09[a] and 82.97±0.41[a]). The month August recorded the highest pH and Dissolved Oxygen (7.55±0.08[a] and5.84±0.13[b]) and the month of September recorded the highest turbidity (11.69±0.14[a] and5.84±0.13[b]).

Monthly mean Heavy Metals in Water of Kwabateri Reservoir

The results of the heavy metals obtained in this study are presented on Table 2. A significant difference (P<0.05) in Lead, Iron, Cadmium, Copper and Chromium with regards to months was reported in this study. The month of June recorded the highest Lead, Iron and Copper (0.02±0.1[a]1.04±0.01[a]and 3.67± 0.01[a]). The month of July recorded the highest Cadmium value (0.03±0.0[a]) and the month of September recorded the highest Chromium value (0.02±0.4[a]).

Monthly mean Heavy Metals in *C. gariepinus* of Kwabateri Reservoir

The results of the monthly mean heavy metals obtained in this study are presented on Table 3. A significant difference (P<0.05) in Lead, Iron, Cadmium and Copper was also reported in *C. gariepinus* in relation to months in this study. Lead and Cadmium recorded the highest value in August (0.14±0.81[a] and0.02±0.01[b]). Iron and Copper recorded the highest value in September (0.14±0.81[a] and 35.96±0.42[a]). Copper recorded a non-significant difference with no value recorded at all.

Table 1: Monthly Physicochemical Parameters of Kwabateri Reservoir

	Temp	Ammonia	Dis.Oxygen	pH	Turbidity	Cond
June	26.49±0.01[a]	0.50±0.09[a]	5.26±0.13[a]	6.83±0.01[b]	9.97±0.14[b]	82.97±0.41[a]
July	26.08±0.01[b]	0.25±0.09[b]	5.28±0.13[a]	7.23±0.08[a]	11.43±0.14[a]	82.80±0.41[a]
August	26.15±0.01[b]	0.21±0.09[b]	5.84±0.13[b]	7.55±0.08[a]	9.96±0.14[b]	81.43±0.01[c]
Sept	25.07±0.01[c]	0.08±0.09[c]	5.74±0.01[b]	7.25±0.08[a]	11.69±0.14[a]	82.42±0.41[b]

Means with the same superscript on the same row are not significantly different (P>0.05)

Table 2: Monthly Mean Heavy Metals in Water of Kwabateri Reservoir

Months	Lead(mg/l)	Iron(mg/l)	Cadmiu(mg/l)	Copper(mg/l)	Chrom(mg/l)
June	0.02±0.1[a]	1.04±0.01[a]	0.02±0.4[b]	3.67± 0.01[a]	0.00±0.0[b]
July	0.01±0.5[b]	0.04± 0.01[b]	0.03±0.0[a]	2.34± 0.01[a]	0.00±0.0[b]
August	0.01±0.1[a]	0.04± 0.01[b]	0.02±0.0[b]	2.38±0.01[a]	0.00±0.0[b]
Sept	0.01±0.2[a]	0.02±0.36[b]	0.02±0.0[b]	0.00± 0.00[b]	0.02±0.4[a]

Means with the same superscript on the same row are not significantly different (P>0.05)

Table 3: Monthly mean Heavy Metals in *C gariepinus* of Kwabateri Reservoir

Months	Lead(mg/l)	Iron(mg/l)	Cadmium(mg/l)	Copper(mg/l)	Chrom(mg/l)
June	0.00± 0.00[b]	3.99± 0.01[c]	0.00± 0.00[a]	25.89± 0.01[c]	0.00±0.00[a]
July	0.00± 0.00[b]	6.98± 0.01[c]	0.00± 0.00[a]	28.04± 0.01[c]	0.00±0.00[a]
August	0.14±0.81[a]	7.36±0.32[b]	0.02±0.01[b]	32.18±0.09[b]	0.00±0.00[a]
Sept	0.01± 0.13[a]	8.90± 0.23[a]	0.01± 0.06[a]	35.96±0.42[a]	0.00±0.00[a]

Means with the same superscript on the same row are not significantly different (p>0.05)

Discussion

The Physicochemical parameters of the reservoir are influenced by natural and anthropogenic processes. In this study, the water temperature, ammonia, pH, Turbidity, Dissolved oxygen and Conductivity were all significantly different (P<0.05) in relation to months. All the Physicochemical parameters investigated were within the recommended range for fresh water fisheries. The mean temperature in the study area was within the NESREA's set standard of 25^0C ranges as being most suitable for the existence and development of aquatic life, despite the agricultural and domestic activities in and within the reservoir; this is in conformity with the result of Lawson (2011). Boyd (1999) suggest an optimum growth temperature range of 26-28^{o}C for fishes in tropical and subtropical waters which is in agreement with what is obtained in this study. Temperature has a large impact on the biological activity of aquatic organisms. It affects metabolic activities, growth, feeding, reproduction, distribution and migratory behaviors of aquatic organisms (Suski *et al.*, 2006). Dissolved oxygen (DO) is an important limnological parameter considered by Boyd (1989) as the most critical water quality variable in aquaculture. Survival of aquatic organisms especially fishes depend upon the level of DO in water. DO in liquid provides a source of oxygen needed for the oxidation of organic matter; when the concentration is high, very low or lacking, it causes the water body to become dead or devoid of aquatic life (Chukwu, 2008). Anoxia occurs when dissolved oxygen levels in the environment decrease to the point where aquatic life can no longer be supported. Low DO level is an indication of high organic matter content and consequently high rate of decomposition. The most common cause of low DO in an aquatic ecosystem is high concentration of biodegradable organic matter including sewage in the water, resulting in a high BOD. This problem is further exacerbated at high temperatures (Zweig *et al.*, 1999) but in this study it was no so as the value obtained was within the recommended level for the survival of aquatic organisms especially fish. The pH was not static, it changes over time and in fact it changes over the course of a single day. The pH of the water body is affected by several factors (Rai *et al.*, 2011) such as agricultural runoff, mining, or infiltration of untreated wastewater. The pH status of this reservoir is within NESREA and EU (Chapman, 1996) permissible limit (6-9) for the protection, survival and development of aquatic life. It is also within the natural background level of 6.5-8.5 that exist in most natural waters (Mechenich and Andrews, 2006). The pH value obtained in this study agrees with those documented by Boyd (1981). The low turbidity observed in June may be due to suspended matter created by inflow of water as recommended by Ufodike and Garba (1992) which to served that decrease in water transparency reduces production of natural food in water. The Conductivity level of the reservoir is within the 200µS/cm limit stipulated by NESREA, (2011) for the survival of aquatic organisms in fresh water. The result of heavy metals in water of Kwabateri Reservoir showed that heavy metals generally exist in low levels. This agrees with the results of heavy metals reported in the study by Adakole, *et al.*, (2008) where their result is in conformity with the result obtained in this present study. The concentrations of heavy metals in Kwabateri Reservoir were significantly different ($P<0.05$) and also are within NESREA (2011) stipulated limits for heavy metals in freshwater. The values of Lead, cadmium and chromium indeed and the other heavy metals detected in Kwabateri Reservoir might not pose acute or immediate threat to fishes but could be sufficient hazard in the long-run due to the cumulative effect of the heavy metals. The relatively high concentration of copper and iron in the reservoir may be as a result of the direct release of public waste including sewage into the reservoir, anthropogenic activities around the lake and vehicular emissions.

This present study constitutes a case of passive monitoring within the Kwabateri Reservoir ecosystem where organisms (fish species) already present naturally in the ecosystem were examined to study the levels of heavy metals in them. The absorption of heavy metals is to a large extent a function of their chemical forms and properties. Pulmonary intake causes the most rapid absorption and distribution through the body of fish via the circulatory system. Absorption through the intestinal tract is influenced by pH, rate of movement through the tract and presence of other materials among others. Combination of these factors can decrease or increase metal absorption (Manahan, 1992). It has also been documented by Campbell *et al*., (1997) that bottom sediment composition including the metal speciation, nature of complexes, metal-metal interactions and other factors such as temperature, pH, dissolved oxygen and organic ligands play an important role in respect to bioavailability of elements and concentration in the tissues of consumer organisms.

Results from this study showed that there is significant difference ($P<0.05$) in all the heavy metal found in the reservoir and the concentration of these heavy metals in the fish was the same with the concentrations in the surrounding waters from which the fishes were sampled except for Iron and Copper. This may either be due to the fact that these fishes have bio-accumulated heavy metals over time from their diet; or because the heavy metals are lipophilic and as such reside and accumulate in fatty tissues (Ekpo *et al*., 2008). Furthermore, it was seen that copper accumulated in the fish tissues is at concentrations far above WHO, FEPA and FAO stipulated limits for heavy metals in fish. According to Arnot and Gobas (2006) and Barron (2003), bioaccumulation is the result of competing rates of chemical uptakes and elimination. It can be assumed therefore, that for fishes of Kwabateri Reservoir, the rate of uptake of elements is higher than the rate of elimination.

Conclusion

In conclusion therefore, Physico-chemical parameters of Kwabateri Reservoir have significant differences between months except for Ammonia that has no significant different ($P>0.05$) and is within the recommended level of WHO, NESREA and FAO. The results obtained in this study also showed wide mean concentrations of the heavy metals in the reservoir with iron (Fe) and Chromium (Cr) recording the highest and lowest levels respectively. Apart from Lead (Pb), Cadmium (Cd) and Chromium (Cr) with the present concentrations within the guideline permissible limits, the mean concentrations of the other heavy metals such as Iron and Copper exceeded their maximum permissible guideline values for the protection of human and aquatic health.

Recommendations

It is therefore recommended that the results of this study can serve as baseline data for further research on the reservoir.

Acknowledgement

The authors would like to acknowledge Mr Saminu Abdulkarim Department of Chemistry. Adamawa State University, Mubi Nigeria for their laboratory assistance.

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