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# HEAVY METALS BIOACCUMULATION IN WATER AND SOME ORGANS OF *Oreochromis niloticus* OF WASAI RESERVOIR, KANO STATE NIGERIA

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***ABSTRACT***
***Heavy metals contamination of water and food sources in the urban centers poses a threat to public health concerned. Efforts need to be concerted to tackle the menace. One such strategy is to identify the levels of heavy metals contamination of the food sources so as to provide lasting solution to the problem. This research was conducted to assess the levels of heavy metals bioaccumulation in water and Oreochromis niloticus in Wasai Reservoir, Kano State. Four different locations were mapped out as sampling stations. Heavy metals concentration in water of Wasai Reservoir was analyzed as well as their bioaccumulation in gills, and muscles of O. niloticus. The experiment was arranged in Completely Randomized Design with three replications. The data obtained were analyzed using Analysis of Variance with Tuckey's Test used to separate significant means. The result for the level of heavy metals in surface water of Wasai Reservoir revealed significant difference (P<0.05) in the levels of heavy metals in different locations with months. The result also showed that the levels of heavy metals were higher in station 1 due to high discharge from anthropogenic activities carried out in the area. More so, the levels of heavy metals bioaccumulation in gills and muscles of Oreochromis niloticus are above tolerable limits. The trend in the heavy metal's bioaccumulation in the tissues and organs of the fish species followed the following order: Cr>Pb>Cd with their accumulation in gills above tolerable limits (Cr 0.26 mg/l, Pb 0.12 mg/l, Cd 0.35 mg/l). Thus, the gills of the fish species obtained from Wasai Reservoir especially during the dry season of the year should be discarded and not be consumed by the populace.***

***Keywords: Bioaccumulation, Fish, Heavy metals, Wasai, Reservoir***

## INTRODUCTION

Freshwater pollutions have not only shown serious ecological threat but also bring about environmental toxicity in many water bodies in developing countries (Nigeria inclusive). However, many aquatic environments have been contaminated with pollutants from both natural and anthropogenic activities such as discharge from chemical companies, agricultural activities, solid waste disposal, and flooding (Ali *et al*., 2019). In Nigeria, Rapid industrialization and urbanization have caused contamination of the environment by heavy metals, and their rates of mobilization and transport in the environment have greatly accelerated since 1940s (Hashem *et al.*, 2017). Heavy metals are generally defined as metals required in trace amounts but considered as toxic above certain limits in living organisms (Maitra, 2016: Karahan, 2022). Malik *et al.*, (2012) reported that since fish are situated at the bottom of the aquatic food chain, they may amass heavy metals from the sediment thereby passing it to human through fish consumption and leading to severe health issues. This is because pollutants from solid waste, industrial effluents and agricultural run-off are quickly deposited into rivers.

Wasai Reservoir serves as a sink of one of Jakara River where domestic and industrial effluents, mechanics and agricultural wastes are being discharged into within the metropolitan Kano (Imam, 2012). The Reservoir receives pollutants which are heavy metals such as mercury, lead, aluminum, cadmium, zinc, nickel, chromium and cobalt, which may probably accumulate in fish (Adeboyejo *et al.,* 2023: Bwala *et al.,* 2023: Mendoza *et al.,* 2023). Although trace metals are essential for normal physiological processes, high concentrations are toxic, affecting various organs and tissues in fish (Serezli *et al*., 2011). It also causes death of fish and their absence in polluted areas, hence affecting ecological balance.

The Jakara River is a perennial channel in the reservoir catchment area (Figure 1). The Jakara River originates from Jakara Quarters at the North Western part of Kano metropolis (Ibrahim and Said, 2010) and flows from there in sinuous pattern draining most part of the Kano metropolis as it meanders down slope in a north–east direction. The Jakara River was known to be perennial stream that flows throughout the year. Never the less, the present contributions by the Jakara River and consequently the yields at the reservoir are far from natural. The entire urban Kano discharge domestic effluents into Jakara River directly or through tributaries to it. One important tributary to the Jakara River is the Getsi River (Figure 1), which is known to drain the entire Bompai industrial area. Additionally, the effluents of Kano abattoir are discharged directly into the Jakara River on continuing basis. The area in terms of geology falls within the tip end of the Basement complex adjoining the Chad formation, which is characterized by disappearing type of streams. Jakara dam is one of the most grossly polluted dam in West Africa, because during the dry season all the streams that feed it dry up with the exception of the major Jakara stream which sustain it.

Researches conducted in relation to the reservoir such as that of Imam (2012) reported the presence of heavy metals in the surface water and the concentrations of chromium, iron, copper, zinc and lead was above the FEPA (2011) standard limit for effluents discharge into the surface. Similarly, Jamila and Sule (2020) reported the presence of heavy metals in River Getsi which is a tributary of Wasai Reservoir but none of these studies focused on assessing the bioaccumulation of heavy metals in *O. niloticus* (the most abundant fish species consumed in the area). This study determined the level of heavy metals bioaccumulation in surface water and *O. niloticus* of Wasai Reservoir.

## MATERIALS AND METHODS

### Study Area

The Wasai- Reservoir is situated on the Jakara river at a point about 2 km South–East of Wasai village in Minjibir Local Government Area of Kano State (Amin, 1992). It is situated on latitude 12$^o$N and 13$^o$N and longitude 8$^o$E and 9$^o$E. The reservoir was constructed in 1976 for recycling purposes. The dam has a maximum height of 9.33 m, while reservoir has a surface area of 1,250 hectares and a total storage capacity of 65.38 m$^3$, this places the reservoir among the medium size man-made lakes in Kano state (Figure 1).

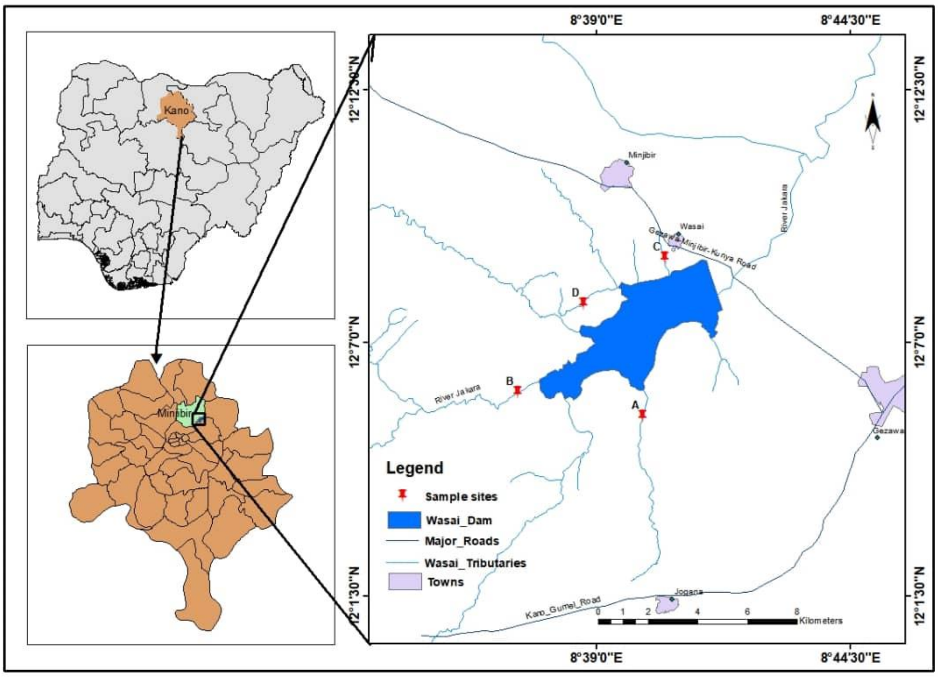


**Figure 1: Map of study area showing the sampling Stations**
(Source: GIS Lab Department of Geography Using Arc GIS 10.3 Software)

**Sampling Station**

Four sampling stations were identified and designated for the purpose of this study, namely A, B, C, and D respectively. Transect sampling across the basin was carried out, starting from the two tributaries i.e. Jakara river, the confluence where the two rivers meet, the entry point where the water drains into the Wasai Reservoir, the spillway of the reservoir. Samplings were conducted from 06:00 am-07:00 am monthly. Water and fish samples were collected from the reservoir during the period from September, 2018 to June, 2019.

**Water Sampling**

Samples were collected in 250 mL plastic bottle for chemicals parameters analysis. The sampling were carried out midstream by dipping the sample plastic bottle to approximately 20 - 30 cm below the water surface, projecting the mouth of the containers against the direction of flow direction. Water samples for heavy metals analysis was collected in 1L bottles, with 2 drops of $HNO_3$ (APHA, 2005).

**Fish Samples Collection**

A total of two hundred *O. niloticus* adult and fingerlings male and female were procured from local fishermen around the reservoir. Fish samples obtained were immediately kept in pre-cleaned polythene bags, sealed, labeled and kept in ice boxes for transportation to the Biological Science Laboratory, Bayero University, Kano. The samples were dissected for gills, liver and muscles followed by oven dry at 105$^{o}$C for 24 h and then powdered using motar and pestle.

**Preparation Water Samples for Heavy Metals Analysis**

Three samples of water from each sampling site were homogenized before digestion. A preservative, nitric (V) acid ($HNO_3$) was added to the original sample in order to ensure that metals do not adhere to the walls of the container.

Sample aliquots for digestion were taken after vigorous shaking to ensure suspension of solids that may have settled. Water samples were digested on a hot plate using hydrochloric acid (HCl) and $HNO_3$ on a volume: volume ratio (1:0.5 %).

**Preparation of Fish Organs Samples**

The fishes were washed with distilled water in the laboratory. Dissection was done using a sharp stainless steel knife and each organs of interest such as gills and muscles were isolated. The organs of investigation were kept in oven and dried at a temperature of 105°C following the method of Eneji *et al*. (2011). $10_g$ portion of the grounded samples were carefully weighed using digital chemical balance, 10 ml of $HNO_3$ and 2 ml of $HClO_3$ were added and heated over a hot plate for one hour. After complete digestion, the residue was diluted with 0.2 % v/v $HNO_3$ to 20 mL (APHA, 2005).

Bio-Accumulation Factor (BAF) was calculated according to Evans and Engel (1994) formula:

$$BAF = \frac{M_{tissue}\ (mg/l)}{M_{water}(mg/l)}$$

Where:

$M_{tissue}$ = Metal concentration in the tissue of fish

$M_{water}$= Metal concentration in water

**Data Analyses**

Data collected were subjected to analysis of variance (ANOVA) with Least Significant Difference used to separate significant means at 5 % level. SAS (2012) Version 9.1 was used for the analyses.

**RESULTS**

The result for the level of chromium in water of Wasai Reservoir with highest level of 0.41 mg/L in samples collected at station 4 in May 2019 (Table 1). This is followed by the value of 0.37 mg/L obtained at station 3 in October 2018. The lowest chromium level of 0.02 mg/L in the water samples was found at station 4 in September, 2018.

**Table1: Mean Levels of Chromium concentration mg/L at Wasai Reservoir, Kano state**

| Months | 1 | 2 | 3 | 4 | F | WHO (2003) |
|---|---|---|---|---|---|---|
| SEPT | 0.11 ± 0.01[a] | 0.12 ± 0.01[a] | 0.04 ± 0.01[a] | 0.02 ± 0.01[a] | 1.315 | |
| OCT | 0.33 ± 0.12[d] | 0.04 ± 0.01[a] | 0.37 ± 0.06[e] | 0.24 ± 0.04[c] | 12.99 | 0.05 |
| NOV | 0.15 ± 0.02[abc] | 0.22 ± 0.01[bcde] | 0.22 ± 0.01[c] | 0.24 ± 0.04[b] | 18.700 | |
| DEC | 0.15 ± 0.01[abc] | 0.21 ± 0.02[bcd] | 0.20 ± 0.01[c] | 0.12 ± 0.01[b] | 46.924 | |
| JAN | 0.13 ± 0.02[ab] | 0.16 ± 0.01[bc] | 0.33 ± 0.03[de] | 0.13 ± 0.01[b] | 88.892 | |
| FEB | 0.15 ± 0.01[abc] | 0.31 ± 0.02[de] | 0.33 ± 0.03[de] | 0.14 ± 0.01[b] | 91.914 | |
| MAR | 0.31 ± 0.01[d] | 0.13 ± 0.01[bc] | 0.31 ± 0.01[d] | 0.23 ± 0.02[c] | 125.14 | |
| APRIL | 0.20 ± 0.01[bc] | 0.28 ± 0.04[de] | 0.22 ± 0.01[c] | 0.25 ± 0.04[c] | 4.963 | |
| MAY | 0.21 ± 0.01[c] | 0.32 ± 0.01[e] | 0.23 ± 0.01[c] | 0.41 ± 0.01[d] | 301.20 | |
| JUNE | 0.21 ± 0.01[d] | 0.22 ± 0.03[c] | 0.15 ± 0.01[b] | 0.13 ± 0.01[b] | 30.87 | |
| Mean | 0.195 | 0.201 | 0.240 | 0.191 | 0.206 | |
| F | 10.366 | 9.213 | 45.288 | 67.712 | | |
| P-Value | 0.000 | 0.000 | 0.000 | 0.000 | | |

Values represent mean ± standard deviation, the same superscripts across a row are not significantly different at P=0.05

More so, the result for the levels of lead in water samples of Wasai Reservoir is shown in Table 2. The result indicated an increasing trend from the month of September, October to June in both the study stations along Wasai Reservoir. The highest value of Pb (0.055 mg/L) was found at station 3 in April 2019. This is followed by the value of 0.051 mg/L obtained at station 1 in February, 2019. The lowest values of Pb in the water samples (0.002 mg/L) were found in September and October at station 2.

The levels of cadmium in water samples obtained from Wasai Reservoir Kano state is presented in Table 3. The result indicated highest value of Cd (0.045 mg/L) in May 2019 at station 2. This is followed by a mean value of 0.042 mg/L at the same station in March 2019. The least Cd value of 0.003 mg/L was found in December 2018 at station 1.

**Table 2: Mean Levels of Lead in mg/L in Wasai Reservoir of Kano state**

| **Month** | **1** | **2** | **3** | **4** | Mean | **F** | **WHO (2003)** |
|---|---|---|---|---|---|---|---|
| SEPT | 0.025 ± 0.008$^{bc}$ | 0.008 ± 0.001$^{a}$ | 0.029 ± 0.016$^{bc}$ | 0.022 ± 0.011$^{b}$ | 0.021 | 2.156 | 0.05 |
| OCT | 0.028 ± 0.007$^{bc}$ | 0.008 ± 0.001$^{a}$ | 0.034 ± 0.013$^{c}$ | 0.024 ± 0.006$^{bc}$ | 0.0235 | 5.53 | |
| NOV | 0.02 ± 0.002$^{ab}$ | 0.02 ± 0.006$^{e}$ | 0.029 ± 0.003$^{bc}$ | 0.033 ± 0.006$^{cd}$ | 0.0255 | 6.574 | |
| DEC | 0.019 ± 0.001$^{ab}$ | 0.022 ± 0.001$^{b}$ | 0.029 ± 0.004$^{bc}$ | 0.034 ± 0.006$^{d}$ | 0.0265 | 8.598 | |
| JAN | 0.05 ± 0.001$^{d}$ | 0.02 ± 0.000$^{b}$ | 0.031 ± 0.002$^{bc}$ | 0.037 ± 0.003$^{d}$ | 0.0345 | 7.404 | |
| FEB | 0.051 ± 0.011$^{d}$ | 0.020 ± 0.001$^{b}$ | 0.025 ± 0.004$^{bc}$ | 0.038 ± 0.006$^{d}$ | 0.0335 | 11.86 | |
| MAR | 0.020 ± 0.009$^{ab}$ | 0.019 ± 0.001$^{b}$ | 0.009 ± 0.001$^{a}$ | 0.017 ± 0.005$^{ab}$ | 0.01625 | 2.485 | |
| APRIL | 0.036 ± 0.005$^{cd}$ | 0.043 ± 0.005$^{d}$ | 0.055 ± 0.005$^{a}$ | 0.009 ± 0.001$^{a}$ | 0.03575 | 49.39 | |
| MAY | 0.009 ± 0.001$^{a}$ | 0.040 ± 0.010$^{cd}$ | 0.037 ± 0.005$^{c}$ | 0.043 ± 0.005$^{d}$ | 0.03225 | 17.06 | |
| JUNE | 0.030 ± 0.010$^{bc}$ | 0.033 ± 0.005$^{c}$ | 0.018 ± 0.01$^{ab}$ | 0.018 ± 0.002$^{ab}$ | 0.02475 | 5.380 | |
| Mean | 0.288 | 0.0233 | 0.00296 | 0.0275 | 0.085 | | |
| F | 7.820 | 20.572 | 7.460 | 9.712 | | | |
| P-Value | 0.000 | 0.000 | 0.000 | 0.000 | | | |

Values represent mean ± standard deviation, the same superscripts across a row are not significantly different at P=0.05

**Table 3: Mean Levels of Cadmium in Wasai Reservoir Kano State**

| Months | 1 | 2 | 3 | 4 | Mean | F | WHO (2003) |
|---|---|---|---|---|---|---|---|
| SEPT | 0.022 ± 0.001$^{d}$ | 0.014 ± 0.001$^{b}$ | 0.033±0.002$^{b}$ | 0.021 ± 0.001$^{b}$ | 0.0225 | 91.486 | 0.01 |
| OCT | 0.021 ± 0.003$^{cd}$ | 0.022 ± 0.004$^{cd}$ | 0.032±0.002$^{b}$ | 0.031 ± 0.002$^{c}$ | 0.0265 | 11.754 | |
| NOV | 0.006 ± 0.002$^{a}$ | 0.004 ± 0.002$^{a}$ | 0.024±0.002$^{a}$ | 0.015 ± 0.005$^{a}$ | 0.01225 | 21.110 | |
| DEC | 0.003 ± 0.001$^{a}$ | 0.022 ± 0.001$^{cd}$ | 0.031±0.001$^{b}$ | 0.011 ± 0.002$^{a}$ | 0.01675 | 113.22 | |
| JAN | 0.032 ± 0.001$^{e}$ | 0.023 ± 0.001$^{cd}$ | 0.034±0.004$^{b}$ | 0.022 ± 0.001$^{b}$ | 0.02775 | 44.083 | |
| FEB | 0.032 ± 0.001$^{e}$ | 0.025 ± 0.002$^{d}$ | 0.024±0.005$^{a}$ | 0.032 ±0.001$^{c}$ | 0.02825 | 8.455 | |
| MAR | 0.018 ± 0.001$^{c}$ | 0.042 ± 0.008$^{e}$ | 0.041±0.001$^{c}$ | 0.023 ± 0.002$^{b}$ | 0.031 | 23.562 | |
| APRIL | 0.022 ± 0.002$^{d}$ | 0.015 ± 0.002$^{bc}$ | 0.032±0.002$^{b}$ | 0.023 ± 0.003$^{b}$ | 0.023 | 27.959 | |
| MAY | 0.021 ± 0.001$^{cd}$ | 0.045 ± 0.009$^{e}$ | 0.041±0.001$^{c}$ | 0.022 ± 0.001$^{b}$ | 0.03225 | 19.664 | |
| JUNE | 0.013 ± 0.002$^{b}$ | 0.022 ± 0.003$^{cd}$ | 0.044 ± 0.003$^{c}$ | 0.031 ± 0.001$^{c}$ | 0.0275 | 71.288 | |
| Mean | 0.019 | 0.234 | 0.0330 | 0.0231 | 0.079 | | |
| F | 64.707 | 22.022 | 21.929 | 26.298 | | | |
| P-Value | 0.000 | 0.000 | 0.000 | 0.000 | | | |

Values represent mean ± standard deviation, the same superscripts across a row are not significantly different at P=0.05. The result for the heavy metals accumulation in the muscles of *O. niloticus* obtained from Wasai reservoir is presented in Table 4. The result showed that, the highest accumulation of Pb (0.08 mg/L) in the fish species is found in January and March 2019. Similarly, the highest value of Cd (0.24 mg/L) accumulated in the muscles of *O. niloticus* in June 2019. The highest value of Cr (0.35 mg/L) was found in September, 2018. The trend for heavy metals bioaccumulation in the fish showed that Cr>Pb>Cd.

**Table 4: Mean Levels of Heavy Metals in the Muscles of *Oreochromis niloticus* from Wasai Reservoir**

| Month | Pb | Cd | Cr |
|---|---|---|---|
| SEPT | 0.03 ± 0.01 | 0.017 ± 0.005 | 0.35 ± 0.03 |
| OCT | 0.02 ± 0.006 | 0.019 ± 0.01 | 0.09 ± 0.05 |
| NOV | 0.06 ± 0.01 | 0.015 ± 0.004 | 0.04 ± 0.01 |
| DEC | 0.02 ± 0.004 | 0.013 ± 0.00 | 0.17 ± 0.11 |
| JAN | 0.08 ± 0.02 | 0.017 ± 0.004 | 0.04 ± 0.002 |
| FEB | 0.02 ± 0.001 | 0.020 ± 0.003 | 0.04 ± 0.03 |
| MAR | 0.08 ± 0.01 | 0.133 ± 0.015 | 0.32 ± 0.03 |
| APRIL | 0.06 ± 0.007 | 0.022 ± 0.002 | 0.133 ± 0.01 |
| MAY | 0.03 ± 0.002 | 0.022 ± 0.007 | 0.04 ± 0.01 |
| JUNE | 0.04 ± 0.006 | 0.024 ± 0.002 | 0.07 ± 0.01 |
| Mean | 0.044 | 0.0302 | 0.1293 |
| BAF | 0.05 | 0.383 | 0.62 |
| FAO (2004) | 0.05 | 0.01 | 0.05 |
| F | 17.134 | 82.921 | 20.786 |
| P-Value | 0.000 | 0.000 | 0.000 |

The result for the bioaccumulation of heavy metals in the gills of *O. niloticus* from Wasai Reservoir (Table 5) showed that the highest Pb value (0.12 mg/L) was found in March 2019. Similarly, the highest value of Cd (0.35 mg/L) bio accumulated in the gills was found in March, 2019. More so, the bioaccumulation of Cr in the gills of *O. niloticus* obtained from Wasai Reservoir showed highest values of 0.26 mg/L in the month of March. The pattern of bioaccumulation followed the trend: Cd > Cr > Pb in the gills.

**Table 5: Mean Levels of Heavy Metals in the Gills of *Oreochromis niloticus* from Wasai Reservoir**

| Month | Pb | P- Value | Cd | P- Value | Cr |
|---|---|---|---|---|---|
| SEPT | 0.07 ± 0.003 | 0.170 | 0.06 ± 0.02 | 0.238 | 0.23 ± 0.17 |
| OCT | 0.11 ± 0.07 | 0.810 | 0.05 ± 0.01 | 0.251 | 0.07 ± 0.04 |
| NOV | 0.07 ± 0.02 | 0.957 | 0.03 ± 0.01 | 0.494 | 0.19 ± 0.005 |
| DEC | 0.09 ± 0.004 | 0.670 | 0.02 ± 0.001 | 0.770 | 0.02 ± 0.007 |
| JAN | 0.08 ± 0.001 | 0.536 | 0.04 ± 0.005 | 0.877 | 0.04 ± 0.005 |
| FEB | 0.08 ± 0.004 | 0.119 | 0.03 ± 0.002 | 0.834 | 0.05 ± 0.01 |
| MAR | 0.12 ± 0.01 | 1.000 | 0.35 ± 0.05 | 1.000 | 0.26 ± 0.01 |
| APRIL | 0.08 ± 0.006 | 0.238 | 0.04 ± 0.003 | 0.652 | 0.07 ± 0.02 |
| MAY | 0.09 ± 0.005 | 0.599 | 0.04 ± 0.07 | 0.786 | 0.05 ± 0.007 |
| JUNE | 0.09 ± 0.002 | 0.255 | 0.04 ± 0.004 | 0.016 | 0.07 ± 0.00 |
| Mean | 0.096 | | 0.007 | | 0.0105 |
| BAF | 1.12 | | 0.088 | | 0.05 |
| F | 1.417 | | 75.156 | | 7.144 |
| P-Value | 0.246 | | 0.000 | | 0.000 |

## DISCUSSION

Heavy metals are believed to be potent toxic substances due to their slow degradation rate and long half-life period (Prajapati *et al*., 2012). The results from the present study revealed that fish exhibited wide range of variations in inter specific metal concentration in all organs. Several studies indicated high metal concentration to feeding habitat of the fish. Khalid (2004) argued that Sirivutas being an herbivore thus bioaccumulate higher metal concentration in their flesh than the carnivore Sargus. This suggestion is in an agreement with the current study as *O. niloticus* (herbivore) recorded higher concentration. However, the heavy metals level in water and their bioaccumulation in the tissues and organs of fish species in the study area differed significantly. This finding is in compliance with the result obtained by Prajapati *et al.* (2012) who reported similar finding between Tiga dam reservoir and the tissues of *Auchenoglanis occidentalis*. The accumulation of these heavy metals differs with sampling stations and months and fish tissues and organs. This variation found within even same species depends on many factors such as age of the fish migratory ability of fish, differential exposure and health conditions (Ekweozor *et al*., 2017). High concentrations of Cd have been found to lead to chronic kidney dysfunction. Cd can bioaccumulate at all levels of aquatic and terrestrial food chains (Moses *et al.,* 2018).

The concentrations of Cd in fish muscles and gills analyzed in this study were above the 0.01 mg/kg maximum permissible level in fish as described by WHO (2004) standard. This finding is in agreement with that of Christof *et al*. (2019) who reported that, Cd even if not detected in gills can be traced at lower concentration. Chromium act as regulator of metabolisms of glucose and cholesterol but in higher concentration chromium is proof to be toxic. The values of Cr obtained by the present study agrees with that of Nafiu *et al*. (2018) in tissues of *Tilapia zilli* obtained from Kafinchiri reservoir, Kano state. The Chromium level recorded in this study is lower than 29.8–31.6 ppm in *Tilapia zilli* from River Benue by Ishaq *et al*. (2011). Cr might have come from mechanic paint sprays, car-wash detergents, lubricating oils and domestic chemicals by the inhabitants along the reservoir tributaries as reported by Yilmaz (2009).

Lead is non-essential element that constitutes body burden and a great threat to life if present in substantial quantity. It is toxic even at minimal concentrations and has no known function in biochemical processes (Moses *et al.*, 2018). The standard level of Pb was reported to be 0.5 mg/kg dry weight (FAO, 2007). Similar to Cd, lead concentration in this work was also found to be lower than the recommended limit. The values of Pb obtained by this study are in line with that of the work of Faye-ofori *et al*. (2015) who reported 0.039 mg/kg.

The presence of various concentrations of heavy metals accumulated in surface water of Wasai reservoir reported by this study is in agreement with the findings of Haruna and Farafara (2021) who reported high concentration of heavy metals in water of Geidem reservoir, Yobe state. This unveils the adverse health effects threatened by direct consumption of this heavy metals polluted water to the public. The high concentrations may probably be due to the high levels of municipal wastes the reservoir receives from domestic and industrial effluents coupled with agricultural fields' runoffs.

## CONCLUSION

Concentrations level of Lead, Cadmium and Chromium (Pb=0.05 mg/kg, Cd=0.045 mg/kg, Cr=0.41 mg/kg) in Wasai water reservoir were above tolerable limits (Pb=0.5. Cd= 0.01 and Cr= 0.05 mg/kg). The concentrations in the gills, and muscles of *O. niloticus* (Pb= 0.07 - 0.12 mg/kg in gills and 0.02-0.08 mg/kg in muscles; Cd= 0.02 - 0.35 mg/kg in gills, 0.019 - 0.02 mg/kg in muscles; Cr= 0.02 - 0.26 mg/kg in gills, 0.04 - 0.32 mg/kg in muscles). The BAF values are above tolerable limits (Pb=0.5. Cd= 0.01 and Cr= 0.05 mg/kg).

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