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Study on Water Quality Parameters and Some Heavy Metals in O*reochromis niloticus* in River Yadzaram Uba, Hong Local Government Area, Adamawa State, Nigeria

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Abstract**—** *A study on water quality parameters and some heavy metals in Oreochromis niloticus in river Yadzaram- Uba, was carried out, to determine the water quality parameters and some heavy metals in O. niloticus in River Yadzaram- Uba, Hong Local Government Area of Adamawa State, Nigeria. Water sample was collected from River Yadzaram Uba using sterile plastic bottles. The pH, total dissolve solid, turbidity, temperature and electrical conductivity were determined from the water sampled. Fish species of Oreochromis niloticus was sample from fish mongers in River Yadzaram- Uba. A random composite sampling technique was used without discrepancies for age in species. Copper, Zinc, Lead, Cadmium and Chromium in fish sampled were determined using Atomic Absorption Spectroscopy (Bulk Scientific, VPG 230). Data obtained was analysed by a one-way analysis of variance (ANOVA). Means were tested using the Fisher Least Significant Difference (LSD) test. The results of the study revealed that there was significant variation in water quality parameters observed in the study area. There was also a significant concentration of some heavy metals in the fish sampled at (P<0.05). Although, the concentration of heavy metals obtained in O. niloticus in this study were within the permissible limit set by WHO/FOA. The researchers therefore, recommended that O. niloticus in river Yadzaram-Uba can be consume, since the present heavy metals are within recommended levels and further study on other heavy metals in river Yadzaram- Uba should be carried out*.

Keywords**—** *Water Quality, Heavy Metals, Oreochromis niloticus, River Yadzaram, Uba*.

I. INTRODUCTION

One of the major factors that affect the beneficial use of surface waters ecosystems, such as rivers, streams and ponds for industrial, domestic and agricultural purposes, are contamination and pollution due to anthropogenic or human activities which finally end up by disposing the liquid waste into rivers and streams without treatment (Gholami *et al.*, 2020; Hamadan *et al.*, 2020). The sources of water pollution vary and involve almost every significant human activity. These include mostly the dumping of domestic wastes, sewage, agricultural and industrial effluent into water bodies (Javed and Usman, 2011; Paul, 2018). Pollution of rivers and streams flowing through agricultural areas where fungicides, pesticides and herbicides might have been applied and industrial areas where there may have been organic and inorganic waste deposits may all present varied and difficult problems due to drainage into different water bodies. Discharged effluent into a river, may affect aquatic life by depleting dissolved oxygen level in water. As dissolved oxygen drops, fish life are threatened or killed in extreme cases. In this case, dissolved oxygen may be about 3mg/l or less. As much as 9.2mg/l at 25°C is needed for support of aquatic life (Maitera, 2010).

Pollution due to heavy metals in the environment has universally become a challenge in this 21st century because these metals are virtually indestructible while most of them are hazardous in aquatic systems (Coffie, 2014). Monitoring and evaluating water quality parameters as well as intensive research on heavy metals in the aquatic environment have become important due to concerns of over accumulation and toxic effects on aquatic organisms and eventually to humans through the food chain. High levels of metals and water contamination affect living organisms and pose considerable environmental risks (Coffie, 2014; Zuliani *et al*., 2019). Heavy metals can exist in sediments and freshwater systems for several years and this can affect human health, fish and the environment. This study therefore, aimed at determination of water quality parameters (Dissolved oxygen, pH, turbidity, temperature and electrical conductivity) and some heavy metals (Ni, Pb, Cr and Cu) in *O. niloticus* in River Yadzaram- Uba, Hong Local Government Area, Adamawa State Nigeria.

II. MATERIALS AND METHODS

Water samples were collected for three months (July, August and September) from River Yadzaram- Uba, using sterile plastic bottles. The sample water collected was analysed to determined water quality parameters. Water sampled was transported in a bottle to the laboratory of Zoology Department, Adamawa State University Mubi and was analysed within two hours after collection.

Determination of Physicochemical parameters

The pH, total dissolve solid, turbidity, temperature and electrical conductivity were determined from the water sampled. Before measurement of the water sample for electrical conductivity and turbidity in the laboratory, the electrode and beaker was washed several times with distilled water. The measurement was taken at room temperature; the water sample was transferred into beaker in sufficient volume to dip the

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electrode and then the scales was set before measurement of each water sample following the method of WHO, (2011).

The pH of water sample was measured using pH meter (Jenway model 3505) at the time of collection of the water samples as described by Ali *et al*., (2000). The total dissolve solid was determined following the standard methods of (APHA 2005; Seyyed *et al*., (2014). Turbidity was measured using turbidity sensor (turbidimeter) following the standard methods of (APHA 2005). Temperature reading was taken on the site using mercury in glass thermometer as in Seyyed *et al*., (2014). Electrical conductivity was measured using a probe and a meter. Voltage was applied between two electrodes in a probe immersed in the water sample as in (APHA 2005; Seyyed *et al*., (2014).

Fish Sampling and Laboratory Measurement

Fish species of *O. niloticus* was sampled from fish mongers in River Yadzaram-Uba. A random composite sampling technique was used without discrepancies for sexes in species. Fish samples were collected in triplicate that is for three months. Samples were identified taxonomically using standard reference sources (www.fishbase.org; Hongyan *et al*., 2019) in the department of Fisheries and aquaculture, Adamawa State University Mubi.

Sample Preparation

All fish samples were thoroughly washed in venerated chopped into smaller pieces by sex and homogenized using laboratory blender. 5 g of homogenates sample was transferred into Kjeldahl flask, 25mls of digestion acid (Auaregia HCl: HNO_3) in the ratio of 3:1was added. The contents were swirled and heated gently at first until frothing stops; then more strongly until a clear pale yellow solution results, cooled and transfer into a 100 ml volumetric flask, and then it was made up to the mark with distilled water and filtered using whatman number one (no. 1) filter paper.

Determination of Heavy Metals

Heavy metals (Copper, Zinc, Lead, Cadmium and Chromium) in fish sampled were determined using Atomic Absorption Spectroscopy (Bulk Scientific, VPG 230). The filtrate was taken to the ASS (Bulk Scientific, VPG 230) in the Chemistry Laboratory of Adamawa State University, Mubi for heavy metals analysis following the method described by (AOAC, 2000; APHA, 2005; Mahmood and Alkhafaji, 2016).

Data Analysis

Data obtained were analysed by a one-way analysis of variance (ANOVA). Means were tested using the Fisher Least Significant Difference (LSD) test.

III. RESULTS

The results of water quality parameters and heavy metals concentration in water sampled are presented in Table 1. The results of turbidity shows that the highest turbidity was recorded in the month of July with the value of 9.35+0.000 which was significantly higher than the lowest turbidity 5.62+0.000 recorded in the month of September. The highest conductivity was recorded in the month of September with the value of 435.64+0.003 which was significantly higher than the lowest 325.64+0.002 recorded in the month of July. The highest Total Dissolved Solids (TDS) was recorded in the month of July with the value of 286.34+0.003 which was significantly higher than the lowest 163.26+0.001 recorded in the month of September. The highest temperature was recorded in the month of July and August with the value of 28.50+0.000 which was significantly higher than the lowest 28.00+0.000 recorded in the month of September. The highest pH value of 8.80+0.000 was recorded in the month of July which was significantly higher than the lowest 6.20+0.000 recorded in the month of September.

The highest concentration of cadmium recorded in the sample water was 0.043+0.001 recorded in the months of July and August which was not significantly higher than the lowest 0.021+0.003 recorded in the month of September. The highest concentration of chromium was recorded in the month of September with the value of 0.03+0.000 which was significantly higher than the lowest in the month of July and August with the value of 0.01+0.002. The highest concentration of copper was recorded in the month of September with the mean concentration of 3.52+0.00 which was significantly higher than the lowest 2.35+0.02 recorded in the month of July. The mean concentration of lead was the same throughout the study period July to September with the value of 0.01+0.001. The highest concentration of zinc was recorded in the month of September with the value of 4.54+0.002 which was significantly higher than the lowest 3.46+0.003 recorded in the month of July as seen in table 1.

TABLE 1: Mean of the Physicochemical Composition and Heavy Metals Levels (mg/L) of Water Samples

Parameters	July	August	September
Conductivity (uS/cm)	$325.64+0.002^{c}$	$398.96+0.001^{b}$	$435.64+0.003^{a}$
TDS	$286.34+0.003^{a}$	$221.13+0.002^{b}$	$163.26+0.001^{c}$
Temperature (^{o}C)	$28.50+0.000^{a}$	$28.50+0.000^{a}$	$28.00+0.000^{b}$
Turbidity (NUT)	$9.35+0.000^{a}$	$6.95+0.000^{b}$	$5.62+0.000^{c}$
pH	$8.80+0.000^{a}$	$8.70+0.000^{b}$	$6.20+0.000^{C}$
Cadmium (Cd)	$0.04+0.001^{a}$	$0.04+0.001^{a}$	$0.02+0.003^{a}$
Chromium (Cr)	$0.01+0.002^{b}$	$0.01+0.002^{b}$	$0.03+0.001^{a}$
Copper (Cu)	$2.35+0.002^{b}$	$2.36+0.002^{b}$	$3.52+0.000^{a}$
Lead (Pb)	$0.01+0.001^{b}$	$0.01+0.001^{b}$	$0.01+0.001^{b}$
Zinc (Zn)	$3.46+0.003^{b}$	$4.12+0.003^{b}$	$4.54+0.002^{b}$

Mean in the same row having the same superscripts are not significantly different (p>0.05)

The results of heavy metals concentration in *O. niloticus* is presented in Table 2. The results revealed that the concentration of lead in all the three months sampled was the same 0.00+0.00 mg/g throughout the study period. The highest mean concentration of Zn (8.45+0.23mg/g) was recorded in the month of September which was significantly higher than the lowest recorded in the month of July with the value of 4.97+0.02mg/g. The results of cadmium in *O. nilotitus* revealed that there was no significantly difference between the concentrations recorded in all the three months of the study period, with the value of 0.032+0.00mg/g. The highest mean concentration of copper in *O. nilotitus* was recorded in the month of September with the value of 0.06+0.04mm/g which was significantly higher than the lowest recorded in the month of July with the value of 0.04+0.03mg/g. The results of

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chromium was found to have the same value (0.04+0.000mg/g) throughout the study period, there is no significant difference in the mean concentration of chromium in *O. niloticus* studied.

TABLE 2: Concentration of Heavy Metals in Tilapia fish (*Orechromis niloticus)* mg/g)

Heavy Metals	July	August	September
Cadmium (Cd)	0.32+0.000[a]	0.32+0.000[b]	0.32+0.000[a]
Chromium (Cr)	0.04+0.000[a]	0.04+0.000[a]	0.04+0.000[a]
Copper (Cu)	0.04+0.003[b]	0.05+0.004[b]	0.06+0.004[b]
Lead (Pb)	0.00+0.000[a]	0.00+0.000[a]	0.00+0.000[a]
Zinc (Zn)	4.97+0.002[c]	6.63+0.004[b]	8.45+0.023[a]

Mean in the same row having the same superscripts are not significantly different (p>0.05)

Study on the comparison between the male and female *O. niloticus* the results was presented in Table 3: The results of heavy metals composition of *O. niloticus* revealed that there was no significant different in the mean concentration of heavy metals studied. The highest mean concentration of zinc was found in female with the value of 6.75+0.007mg/g which was not significantly higher than the lowest found in male with the value of 6.62+0.004mg/g. The highest concentration of copper was recorded in male with the value of 3.90+0.013mg/g which was not significantly higher than the lowest found in female with the value of 3.87+0.004mg/g. The mean concentration of lead in both male and female *O. niloticus* was the same with the value of 0.00+0.000mg/g. Male and female *O. niloticus* have the same mean concentration of chromium 0.04+0.000mg/g, there was no significant differences between the mean concentration of chromium in *O. niloticus* by sex.

TABLE 3: Comparison of Mean Concentration of Heavy Metals in Male and Female Tilapia fish (*O. niloticus)* (mg/g)

Heavy Metals	Male	Female
Cadmium (Cd)	0.33+0.000[a]	0.31+0.000[a]
Chromium (Cr)	0.04+0.000[a]	0.04+0.000[a]
Copper (Cu)	0.06+0.013[a]	0.005+0.004[a]
Lead (Pb)	0.00+0.000[a]	0.00+0.000[a]
Zinc (Zn)	6.62+0.004[c]	6.75+0.007[b]

Mean in the same row having the same superscripts are not significantly different (p>0.05)

IV. Discussion

The findings of this research revealed that there was significant variation in water quality parameters observed in the months of this study and the study area. There was also a statistical significant mean concentration of some heavy metals in the water sampled from the study area, but all the study heavy metals were in within the permissible limit set by FAO/ WHO. The result of this study is in not line with the finding of Fianko *et al*. (2013), who analyzed tannery effluent water from groundwater in rural communities within the Tema District, Ghana for physicochemical parameters of the waste water such as TDS, TS, TSS, conductivity, alkalinity, chloride, COD, BOD and Cr were determined by standard methods and concluded that the concentrations of parameters were higher than the limit set by the Federal Ministry of Environment for discharge of effluents by tannery sector. This may be as a result of water pollution by anthropogenic activities. Paul (2018), reported that the sources of water pollution vary and involve almost every significant human activity. These include mostly the dumping of domestic wastes, sewage, agricultural and industrial effluent into water bodies. The significant variation in water quality parameters found in this study concur with Adefemi *et al.*, (2007), who reported in their result on assessment of physicochemical quality of Maji dams in Ekiti State, Nigeria. They discovered the status of sampled waters from four major dams assessed for three years period (wet and dry season), the parameters were higher in dry season than wet season and their statistical analysis conducted revealed that most of the physicochemical parameters are significantly different except temperature, conductivity and dissolved solids at $P < 0.05$.

The results of heavy metals composition of *Oreochromis niloticus* revealed that zinc, copper, chromium and cadmium were found in *O. niloticus* in river Yadzaram Uba, even though, all these Heavy metals found were within permissible limits set by FOA/WHO. The presences of these heavy metals found in *O. niloticus* could be due to the fact there are appreciable concentration of these heavy metals in the sampled water. Fish accumulate toxic chemicals directly from the water and through their diet, and contaminant residues may ultimately reach concentrations hundreds or thousands of times above those measured in the water, sediment and food as stated by Osman *et al.,* (2007). The result of this study is also in line with the result of Akan *et al*., (2007), who reported that the Bioaccumulation of some heavy metals in fish samples from River Benue in Vinikilang, Adamawa State, Nigeria, were within the tolerable level as set by (WHO, 2000; FAO, 2003; EU, 2006). The concentration of lead recorded in this study is below the permissible limit set by WHO of 0.01mg/l WHO in drinking water guideline level (Neji *et al*., 2010; Zuliani *et al*., 2019).

V. Conclusion

The findings of the study revealed that there is significant variation in water quality parameters between the months. And there appreciable concentration of heavy metals in the sampled water. The heavy metals recorded in *O. niloticus* sampled from river Yadzaram Uba, revealed that there is presence of zinc, copper, cadmium and chromium. The concentrations of heavy metals found in O. niloticus in this study were within the permissible limits set by FAO/WHO. The comparison between the composition of heavy metals in male and female *O. niloticus* revealed that there was no significant difference in the mean concentration of heavy metals in the studied sampled of *O. niloticus* Of River Yadzaram-Uba, Hong Local Govrnment, Adamawa State, Nigeria.

Recommendations

Based on the findings of this study the following are recommended;

1. Environmental agencies should set regulation on the use and discharge of agricultural waste, effluent and other waste in river Yadzaram-Uba should be enforce.
2. Further study on other heavy metals and other fish species in river Yadzaram should be carried out.
3. *O. niloticus* can be consumed, since the presences of heavy metals are below recommended levels.

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