ASSESSMENT OF SOME HEAVY METALS ACCUMULATION IN SOME FISH SPECIES CONSUMED IN KANO METROPOLIS

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Abstract
This study evaluated the exposure to heavy metals in three fish species (*Tilapia zilli, Clariasgariepinus* and *Oreochromisniloticus*) consumed in Kano metropolis with view to access their potential health impact to the consumers. The digested fish tissue samples were analyzed in mg/g for Cr, Cu, Ni, Cd and Pb using Atomic Absorption Spectrophotometer (Model IL250). The mean values of heavy metals concentrations showed Cr>Ni>Cu>Pb>Cd, Cr>Cu>Pb>Ni>Cd and Cr>Pb>Ni>Cu>Cd in *Oreochromisniloticus, Clariasgariepinus* and *Tilapia zilli* respectively. There was an observed variations in which O. niloticus had a higher heavy metals concentration, but not statistically significant at $P \leq 0.05$. With respect to fish tissues, Gills had the highest bioaccumulation followed by liver while the least concentration was recorded in kidney with no significant difference between the organs. The values of the heavy metals obtained from the sampling sites were within the FAO standard permissible limit for human consumption with the exception of chromium which had values above the standard limit. Although some of the heavy metal concentrations were within the permissible limits but the specific problem associated with heavy metals in the environment is their accumulation through food chain. It is therefore recommended that waste water from industries should be disposed off after suitable treatment.

Keywords: Heavy metals, bioaccumulation, fish tissues, Kano Metropolis

INTRODUCTION

The pollution of aquatic ecosystems is a worldwide problem that needs urgent attention (Dane and Sisman, 2017). Since the aquatic environment is the ultimate recipient of pollutants, increased industrial, domestic, and agricultural activities have resulted in an increasing number of freshwater systems being impacted by the pollutants present in wastewater release. Agricultural, industrial, and domestic effluents generally contain heavy metals such as Cr and are, invariably, discharged into rivers and streams, without proper treatment (Dane and Sisman, 2017). Due to their toxicity, long persistence, and bioaccumulative and non-biodegradable properties in the natural environment, metals constitute a core group of aquatic pollutants (Achuba and Osakwe, 2003). Heavy metals may precipitate, get absorbed on sediment particles, remain soluble or suspended in water and/or may be taken up by aquatic fauna upon their entry into water bodies (Carrasco). Metals are then absorbed through gills and skin and/or ingested through food to cause bioaccumulative toxicity in fish where the intensity of the toxicity is influenced by the temperature, oxygen concentration, pH and hardness of the water (Olaifa *et al.,* 2004).

Aquatic organisms such as fish and shell fish accumulate metals to the concentrations many times higher than present in water or sediment (Olaifa *et al*., 2004). They can take up metals concentrated at different levels in their different body organs (Khaled, 2004). Certain environment conditions such as salinity, PH, water accumulation in the living organisms lead to toxic concentration and cause ecological damage (Etesin and Benson, 2007). Thus, heavy metals acquired through the food chain as a result of pollution are potential chemical hazards, threatening consumers. Fish are sentinel organisms in aquatic ecosystems, and they are also considered to be the most readily usable organisms in environmental health assessments. They are preferred in toxicological research because of their well-developed osmoregulatory, endocrine, nervous, and immune systems (Song *et al*., 2012). In view of the forgoing, this study examined the heavy metal concentrations and bioaccumulation factor in tissues of some commonly consumed fish species in Kano metropolis

MATERIALS AND METHODS

Sample Collection and Preparation

108 fish samples of *Oreochromisniloticus, Clariasgariepinus, Hetrobrandus and niloticus* were obtained directly from vendors at Yankura and Court road fish markets in Kano. They were transported to the laboratory in ice cold container. The samples were authenticated using identification guide by Olasebikan and Raji (2004). Fishes (3) from each location weighing between 100g and 150g were dissected and the tissue, gills and kidney were removed and weighed, the organs were frozen and stored at 4^{o}c until required for analysis.

Sample preparation

All the glass wares and plastics were soaked overnight in 10% (v/v) nitric acid rinsed with distilled water and deionized water and dried before being used. Five (5) grams of muscle was removed using stainless steel knife and digested to a strong acid digestion (H_2O_2 +

HNO_3conc), mixture at 1:3 ratio (11) at 150^{o}c for 20 minute and allowed to cool at room temperatures, samples were processed in triplicate and then diluted to a total 50ml with distilled water and filtered through whatman No. 1 filter paper for further analyses.

Sample Digestion and Analysis of Heavy Metals.

The digestion was carried according to procedure adopted by Ibrahim (2009) and Edet *et al*. (2004). Tissues were homogenized and grinded into a powder 0.1g of each dry tissue was weighed out and transferred into 100cm^3 Pyrex beaker. 5cm^3 of concentrated nitric acid was added and the beaker with its content was placed in a hot plate and heated at 40^{o}c, after heating for 15minute another 5cm^3 of concentrated nitric acid, 10cm^3 of concentrated sulphuric acid were added and the temperature of the plate was gradually increased to 100^{o}c. The solution was set diluted with 100cm^3 of distilled water. The resulting solution was boiled until all the tissues were dissolved. And again set to cool. The digest was transferred into 100cm^3 volumetric flask and made up to the mark with distilled water. The digest were kept in plastic bottles and the concentrations of heavy metals, Pb, Cr, Ni and Cd were determined using Atomic Absorption Spectrophotometer (buck scientific model) in soil Science Laboratory of Bayero University, Kano Nigeria following the standard procedures given in APHA (1995).

Statistical Analysis

Data obtained were analyze using Analysis of Variance (ANOVA) to determine any significant difference between the means or otherwise.

Results and Discussion

The mean concentration of Cd, Pb, Cr, Ni and Cu in the gills, kidney and liver of *Oreochromisniloticus* obtained from Yankura and Court road is presented in table 1. From the heavy metals analysed mean concentration of Ni, Cr and Cu were significantly higher ($P< 0.05$) in the gills compared with kidney and liver from both sampling sites. This might be due to the direct contact by the gills with contaminated environment where the fish was collected. This is in tandem with findings of Galadima and Garba (2012). The bioaccumulation of the metals in all the tissues examined is in the order of Cr>Ni>Cu>Pb>Cd. This trend of accumulation may perhaps be attributed difference in the affinity of the metals to the fish tissue, metabolic disposition of the organ, route of absorption and age of the fish (Edet *et al*., 2014 and Samson, 2015).

Table 1: Mean values of heavy metals examined in *Oreochromisniloticus* sold at Fish market of Yankura and Court Road, Kano -Nigeria

Location	Organ	Cr (mg/g)	Cu (mg/g)	Pb(mg/g)	Ni (mg/g)	Cd (mg/g)
Yankura	liver	0.50 ± 0.02a	0.03 ± 0.01[a]	0.04 ± 0.21[a]	0.43 ± 0.21[a]	0.00 ± 0.00
Court road		0.03 ± 0.00[ab]	0.01 ± 0.10[a]	0.01 ± 0.00[a]	0.01 ± 0.01[a]	0.00± 0.00
Yankura	Gills	1.26 ± 0.31[a]	0.41 ± 0.41[a]	0.17 ± 0.10[a]	0.70 ± 0.20[a]	0.00 ± 0.00
Court road		0.02 ± 0.00[a]	0.00 ± 0.00	0.00 ± 0.00[a]	0.03 ± 0.00[a]	0.00± 0.00
Yankura	Kidney	1.07 ± 2.01[a]	0.49 ± 0.14[ab]	0.63 ± 0.21[ab]	0.80 ± 0.14[a]	0.00 ± 0.00
Court road		0.01 ± 0.00[a]	0.01 ± 0.01[a]	0.00 ± 0.00[a]	0.01 ± 0.00[a]	0.00 ± 0.00

Values are mean±S.D, values with the same superscripts within the same column are considered significantly different ($p > 0.05$)

Table 2, illustrates the bioaccumulation of heavy metals examined in *Clariasgariepinus* in which liver tissues from Yankura fish market had the highest mean concentration of Cr, Cu Pb and Ni with the exception of Cadmium which was beyond detection limit in all the samples from the two locations. Statistically there was no significant difference between the heavy metals concentrations from the two sampling sites ($p<0.05$). The accumulation of these metals to the liver could be due to its role in body metabolites storage and detoxification as reported by Lin *et al*. (2004) and Edet *et al*. (2015). Shinn et al. (2009) reported that the levels of heavy metals in fish liver can be used to monitor the extent to which water is polluted by these elements. This is due to the fact that the concentration of metals in fish liver is proportional to those in the aquatic environment. The high mean concentration of Cu and Ni obtained in this study is in consistent with the work of Farombi *et al*. (2007), Muhammadi *et al.* (2011) and Samson (2015). Edet *et al*. (2015) reported that the harmful effect of Copper is largely attributed to its cupric ($Cu2+$) form which is commonly found in the fish species.

Table 2: Mean values of heavy metals examined in *Clariasgariepinus* sold at Fish market of Yankura and Court Road, Kano -Nigeria

Location	Organ	Cr (mg/g)	Cu (mg/g)	Pb(mg/g)	Ni (mg/g)	Cd (mg/g)
Yankura	liver	0.45 ± 0.02a	0.01 ± 0.00[a]	0.68 ± 0.21[a]	0.43 ± 0.21[a]	0.00 ± 0.00
Court road		0.23 ± 0.164[ab]	0.10 ± 0.10[a]	0.17 ± 0.01[a]	0.36 ± 0.03[a]	0.00± 0.00
Yankura	Gills	2.82 ± 0.59*	0.01 ± 0.00[a]	0.97 ± 0.18[a]	0.63 ± 0.31[a]	0.00 ± 0.00
Court road		0.92 ± 0.63[a]	0.49 ± 0.41[a]	0.50 ± 0.2[a]	0.94 ± 0.13[a]	0.00± 0.00
Yankura	Kidney	2.07 ± 2.01[a]	0.49 ± 0.14[ab]	0.93 ± 0.21[ab]	0.80 ± 0.14[a]	0.00 ± 0.00
Court road		0.63 ± 0.53[a]	0.29 ± 0.01[a]	0.02 ± 0.21[a]	0.41 ± 0.00[a]	0.00 ± 0.00

Values are mean±S.D, values with the same superscripts within the same column are considered significantly different ($p > 0.05$)

The mean concentration of Cr, Cu, Ni, Pb and Cd in the gills, kidney and liver of *Tilapia zilli* is presented in Table 3. The concentrations of Cr and Pb fish species obtained from Yankura had the highest value of 2.82 ± 0.59 and 0.87 ± 0.01 in the gills. The highest concentration in the gills is attributed to the direct contact with the contaminated medium and has the thinnest epithelium when compared to other organs as reported by Edet *et al*. (2015). The concentration of Cr and Pb were higher than the standard limit of 0.5 permissible limit and 0.5 approved by FAO (2006).

Comparative assessment of metals concentration in the gills, liver and kidney was significantly higher (P<0.05) in fish species obtained from Yankura and court road. This could be attributed to the source of the fishes inwhich fish obtained from yankura market were from many sources including Jakara Reservoir which has been reported to have high concentration of heavy metals above the standard permissible limit for human consumption as reported by Imam (2012). The mean concentration of Cr and Pb in fish was within the range reported by Nyirenda *et al.* (2011) and was within standard limit of 0.5mg/g set by FAO (2006). The mean concentration of all the heavy metals in Yankura and court road is in consistence to the work of Imam (2012). The mean concentration of Ni and Pb in the present study is higher than the standard permissible limit approved by FAO (2006) of 0.01 and 0.01mg/g respectively. Lead, for instance, has been reported to have toxicological implication in biotic organisms. Lead has resulted in lead poisoning that cause learning disabilities, behavioural problem, kidney damage and poisoning of several vital enzyme systems in the central nervous system in young children exposed to lead oxide in Zamfara State (Galadima and Garba, 2012). Some of the clinical implications of these heavy metals include muscular weakness and fatigue, which are more pronounced in the fingers, wrist, toes, forearm, headache, insomnia and irritability (Edet *et al*., 2015).

Table 3: Mean values of heavy metals examined in *Tilapia zilli* sold at Fish market of Yankura and Court Road, Kano -Nigeria

Location	Organ	Cr (mg/g)	Cu (mg/g)	Pb (mg/g)	Ni (mg/g)	Cd (mg/g)
Yankura	liver	0.63 ± 0.53a	0.68 ± 0.738^{a}	0.64 ± 0.21^{a}	0.43 ± 0.21^{a}	0.00 ± 0.00
Court road		0.23 ± 0.164^{ab}	0.02 ± 0.10^{a}	0.87 ± 0.01^{a}	0.36 ± 0.03^{a}	0.00± 0.00
Yankura	Gills	2.82 ± 0.59^{a}	0.41 ± 0.41^{a}	0.77 ± 0.18^{a}	0.63 ± 0.31^{a}	0.00 ± 0.00
Court road		0.02 ± 0.63^{a}	0.49 ± 0.41^{a}	0.80 ± 0.2^{a}	0.94 ± 0.13^{a}	0.00± 0.00
Yankura	Kidney	2.07 ± 2.01^{a}	0.49 ± 0.14^{ab}	0.63 ± 0.21^{ab}	0.80 ± 0.14^{a}	0.00 ± 0.00
Court road		0.63 ± 0.53^{a}	0.29 ± 0.01^{a}	0.8 ± 0.21^{a}	0.41 ± 0.00^{a}	0.00 ± 0.00

Values are mean±S.D, values with the same superscripts within the same column are considered significantly different (p > 0.05)

CONCLUSION AND RECOMMENDATIONS

The present findings revealed that all the tissues of *Tilapia zilli*, *Clariasgariepinus* and *Oreochromisniloticus* contain relatively various levels of heavy metals with the exception of Cadmium. The values of the heavy metals obtained from the sampling sites were within the FAO (2006) permissible limit for human consumption but the specific problem associated with heavy metals in the environment is their accumulation through food chain with long term effect. It is therefore recommended that regular monitoring is commendable. Further studies on histopathological and reproductive system alteration in the tissues are recommended.

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