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Heavy metal concentration in some organs of *Clarias gariepinus* (African Catfish) from Okilo Creek, Rivers State, Nigeria

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ABSTRACT

The concentration of some heavy metals (Cd, Fe, Pb, Cu, Ni and Cr) in the different organs (Liver, Gills, Muscle and Kidney) was determined in the African Catfish – Clariasgariepinus from Okilo creek, in Rivers State, Nigeria. The concentration of cadmium (0.001mg/kg) was uniform in all the organs studied, however, that of iron and lead ranged from 28.665 – 58.817 and 0.039 – 0.577 respectively. Similarly, the concentration of Copper, Nickel and Chromium in the different organs under investigation fluctuated from 0.934 – 3.702; 1.243 – 3.689 and 0.09 – 2.859 respectively. The order of metal concentration in the organs concerned are as follows – Liver – Fe > Ni > Cu > Cr >Pb> Cd; Gills – Fe > Ni > Cu > Cr >Pb> Cd; Muscle – Fe > Cu > Ni > Cr >Pb> Cd and kidney- Fe > Cu > Ni > Cr >Pb> Cd. The accumulation of heavy metals by the different organs in the investigation showed that the kidney is the highest accumulator followed by the liver, muscle and gills. The concentration of lead and copper in the kidney and chromium in the muscle, liver and kidney are above the stated limits of different authorities thus making the consumption of catfish from the study area a potential health hazard.

Key words: Accumulator, Heavy metal, Okilo creek,Cat fish, kidney

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INTRODUCTION

Increased human activities through industrialization, urbanization, population growth and overall man's greed to overexploit Mother Nature have created a serious threat to all kinds of life in the form of pollution which has now become a global problem[1]. Because all other life forms depend directly or indirectly on water, aquatic pollution is often regarded as one of greater concern. Most environmental problems arise when production of goods and services leads to the release of pollutants which eventually accumulates in water. Humanand industrial activities result in the release of different typesof pollutants into the aquatic environment, which threatens the health of the population and damage the quality of the environment by rendering water environments unsuitable [2]. One of such persistent and potentially harmful pollutant is heavy metal.

Heavy metals on reaching the aquatic ecosystem deteriorate the life sustaining quality of water and cause damages to both Flora and Fauna[3]. It can affect aquatic organisms and pose a risk to fish consumers, such as human and other wildlife.In fresh water body's fish are the most suitable indicative factors for the estimation of trace metal pollution [4], and therefore serves as an early warning indicator of water quality problem and or sediment contamination [5]. Fish have been shown to accumulate and retain heavy metals from the environment [6], and the rate of accumulation in different fish tissues is dependent upon concentration of exposure media, duration, salinity, temperature, hardness and metabolism of the fish [7].

Fish is the cheapest and most readily available source of protein in the coastal communities of Rivers State, and in the study area, catfish (*Clariasgariepinus)* represents one of the most sought after fish with high commercial value. [8] had concluded earlier that it is the most widely consumed fresh water fish in Nigeria. Metal contamination of catfish therefore has the potential to adversely affect a large percentage of the population within a very short time. This therefore makes the need to ascertain its heavy metal loading in the Okilo creek inevitable with a view to forestall a possible transfer of toxic heavy metals to man.

MATERIALS AND METHODS

The Okilo Creek is a fresh water body that serves as the major communication link between Abua (Ogbema waterside) and Odual Communities (such as Emelegho, Adadaetc) in the Abua/Odual Local Government Area of Rivers State. The axis where fish samples were collected lies between latitude $4^0$46.455' to $4^0$49.208'N and longitude $6^0$36.09' to $6^0$34.274'E.

The vegetation fringing the creek at the left and right banks consists of riverine forest mainly *Raphia*, *Calamas sp*. (swamp cane), *Pandamus*etc, and aquatic macrophytes such as *Typhalotifolia* (cat tail), *Potamogetomsp* (pond weed) etc. The creek receives sewage, domestic/household wastes as well as agricultural and light industrial effluents and may have been contaminated.

10 Fish samples were purchased from local fishermen along the coasts of the OkiloCreek. The samples were stored in an ice chest, before transporting to the laboratory for identification and heavy metal analysis. Identification of the fish to specie level was achieved with the aid of species identification sheet for fishery purposes by [9], as well as that of [10].

In the laboratory fish samples were preserved in a refrigerator; latter samples were carefully dissected and different organs were obtained and oven dried until ready for acid digestion.The different organs weregrinded into fine particles out of which 2.0g weight of each organ was measured into 100ml beaker (Pyrex beaker) containing 10ml of nitric acid and 3ml of per chloric acid. 50ml of distilled water was then added and the beaker placed on the hot plate until its volume reduced to 20-30ml, it was then filtered and the filtrate made up to a known volume of 50ml. Then aspiration of an aliquot of this filtrate was made into the flame AAS after an appropriate standard of interest and hollow cathode lamp had been installed. The final concentration is calculated based on dry weights as this discounts the variability due to inner parts differences in the moisture content of organisms with the formula:

DRV in PPm
Where,
D = dilution factor
R = AAS reading
V = final volume
Standard method of examination of water and waste water [11].

RESULTS AND DISCUSSION

The mean concentrations of heavy metals in the different organs of catfish from the study area are presented in Table1.The result showed that iron accumulated in the organs of catfish more than the other metals. It is closely followed by Nickel, Copper, Chromium, Lead and Cadmium in decreasing order of concentration. The mean concentration of Nickel and Chromium in different organs in descending order is as follows; kidney, liver, muscleand gills. The concentrations of Lead and Copper in the different organs are kidney, muscle, gills & liver and kidney, muscle, liver and gills respectively. However for iron the highest concentration was found in the liver followed by kidney, muscle and gills while Cadmium was shown to have a uniform concentration in all the organs. Fe gained the highest concentration among the studied heavy metals in all the fish organs. The data showed that, among the four organs, the kidney attained the highest accumulation of the heavy metals, followed by the liver, muscle and gills. The overall heavy metal concentration in fish sample was Fe > Ni > Cu > Cr > Pb > Cd.

Table 1: Mean values (±SD) of heavy metal concentration (mg/kg) in the different organs of Catfish from Okilo Creek, Rivers State

Organ	Cd	Fe	Pb	Cu	Ni	Cr
Muscle	0.001±0.0	39.112±0.951	0.062±0.009	2.743±0.113	2.327±0.201	0.660±0.077
Liver	0.001±0.0	58.817±1.112	0.039±0.009	1.164±0.006	2.617±0.046	1.035±0.014
Gills	0.001±0.0	28.665±0.511	0.048±0.024	0.934±0.572	1.243±0.128	0.090±0.050
Kidney	0.001±0.0	49.516±1.913	0.577±0.114	3.702±0.062	3.689±0.156	2.859±0.105
Permissible Limits						
1.[12]	0.5	-	0.5	30	-	-
2. [13]	0.5	400	3	30	5	0.3
3. [14]	-	146	0.12	3.28	-	-

Theconcentration of iron in the different organs of catfish in this study fluctuated from 28.665 obtained from the gills to 58.817 gotten from the Liver. This is lower than the range of 143.34 – 2439.16 reported by [15], but much higher than the 0.12 – 0.34 recorded by [16] as well as that (0.33 – 0.40) of [17]. It is however comparable to the reported range of 46.12 – 72.17 by [18]. The order of accumulation of iron by the various organs in this study (Liver > Kidney > Muscle > Gills) contrasts slightly with that (Liver > Intestine > Gill) of [17] and [16] who reported an order of Liver > Gill > Kidney. Variation in the concentration of lead was lowest in the Liver (0.039) and highest in the Kidney (0.557). This compares favorably with that of [18] but falls short of the 1.9 – 3.40 reported by [19]. While [19], [16] and [20]implicated the Liver as the highest accumulator of lead, the study of [6] and [17] revealed the muscle and gill respectively as the highest accumulator. However, in this investigation the kidney accumulated lead more than the other organs.

The lowest and highest accumulations of copper in this study were observed in the gill and kidney respectively, which is in agreement with the report of [17] and [21]. However, it is at variancewith that of [20] and [6] who both reported liver as the highest accumulator of copper, and that of [19] who showed kidney to be the highest accumulator of copper. The concentration of chromium which fluctuated from 0.66 (in muscle tissue) to 2.859 (gotten in kidney) is low when compared to the range of 6.30 – 9.91 reported by [23]. [22]recorded the highest concentration of chromium in the gills followed by the liver and finally muscle tissue, as against the order of kidney, liver, gills and muscle gotten in this study.

The concentration of nickel (1.243 – 3.689mg/kg) observed in this investigation is comparable to the 2.89 – 4.17mg/kg reported by [23] in the tissues of three fish species from Sombreiro River. However, nickel was not detected by [15] in their study of heavy metal concentrations from some fish tissues from South Mediterranean waters, Egypt. The order of accumulation of nickel in this study (Kidney > Liver > Muscle > Gills) contrast with that of (Liver > Gills > Muscle) reported by [15].

Concentration of Cadmium in the target organs of this study showed a uniform concentration of 0.001mg/kg throughout the investigation; however the investigations of [19] and [17] showed the liver as the highest accumulator of cadmium followed by the gills and kidney.Though there were variations in the accumulation of heavy metals by the different organs of catfish analysis of variance (ANOVA) revealed that such variations were not significant, however there was a significant difference between the concentrations of the various metals in the organs studied at $p < 0.05$ level of confidence.

The concentration of lead in kidney (0.577) is higher than the stated limits of 0.5 and 0.12 in the tissues of aquatic organisms by [12] and IAEA [14] respectively. Similarly, the metal burden of lead and copper in the kidney 0.577 and 3.702 are above their IAEA [14] stated limits of 0.12 and 3.28 respectively. The [13] stated limits of chromium in the tissues of aquatic organisms is 0.3 mg/kg, this value is lower than the observed concentrations 0.66, 1.035 and 2.859mg/kg gotten from the muscle, liver and kidney respectively. These metals (lead, copper and chromium) have all been implicated as being toxic to the human body; therefore the continued consumption of catfish (*Clariasgariepinus)* from the Okilo creek, in River State is likely to cause health hazards.

CONCLUSION

The order of concentrations of heavy metals in the different organs studied did not conform to any particular trend, however the general order is Fe > Ni > Cu > Cr >Pb> Cd. The kidney accumulated metals more than all other organs studied, followed by the liver, muscle and gills. The elevated concentration of lead and copper in the kidney and

chromium in the muscle, liver and kidney above stated limits exposes consumers of catfish from the Okilo creek to health risks.

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