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ANALYSIS OF HEAVY METAL LEVELS IN MUDFISH (*Clarias gariepineus*) IN ITU RIVER, AKWA IBOM STATE, SOUTHERN NIGERIA

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Abstract- The concentration level of lead (Pb), Iron (Fe), Cadmium (Cd), Nickel (Ni), and Chromium (Cr) were determined in Mudfish (*Clarias gariepineus*) muscle from three different stations; Station I (up stream), Station II (middle stream) and Station III (down stream) along Itu river in Itu Local Government area. Heavy metal concentrations were determined using Atomic Absorption Spectrophotometer (AAS). The analysis of heavy metals in the fish (muscle) indicates that among the five heavy metals tested, Fe was maximally accumulated and the mean concentrations decreased in the order of Fe(8.050)> Cr(2.667) >Pb(1.364)>Cd(0.472)>Ni(0.187) in mg/L. The same trend of metals levels were observed in the three stations. The mean levels of all these metals exceeded the standards limits set by Federal Ministry of Environment (FME), Food and Agricultural Organization (FAO) and World Health Organization (WHO). Thus, the muscle tissue of fish collected from the studied area in Itu river may pose health risk to consumers, as individuals are at the higher risk of ingestion of toxic metals at intolerable levels since the concentration of metals analyzed exceeded the maximum acceptable values stipulated by international bodies.

Keywords- *Clarias gariepineus,* Fish, Heavy metals, Concentration, Health, A.A.S

Introduction

Water body pollution by heavy metal in recent times has become a problem of increasing public concern due to their gradual increase in excess of natural background resulting to deterioration in water quality for consumption as well as threatens aquatic life including fish. The situation arises as a result of anthropogenic source including mining activities, industrial and domestic effluents, petroleum contamination and sewage disposal [1]. The danger of heavy metals is aggravated by their almost indefinite persistence in the environment. Due to their immutable nature and in contrast to many organic pollutants, which are biodegradable, heavy metals can remain in the environment for a long time [2].

Among the aquatic organisms, fish has been reported to have the high tendency to accumulate heavy metals because they are the most common aquatic organisms at higher trophic level [2]. Therefore, bioaccumulation of metals in fish can be considered as an index of metal pollution in aquatic ecosystems [3-5]. That could be a useful tool to study the biological role of metals present at higher concentration in fish [6]. Concentrations of heavy metal levels in fish depend on different factors such as ecological needs, size and age of individuals [8], their life cycle and life history feeding habits [9], season of capture, and physico-chemical parameters of water and sediment [10]. Heavy metals may enter fish bodies in three possible ways (via digestive tract, body surface and gills) [11].

Fish constitute an important source of protein for many people throughout the world and fish consumption has increased in importance among health-conscious people because it provides a healthy and low cholesterol sources of protein [11,12] and contains omega 3-fatty acids that help to reduce the risk of certain cancers [12] and cardiovascular disease [13]. Fish consumption is a major route of trace metal exposure for humans [14], and children are more at risk because of their greater intestinal absorptions [15]. Heavy metals such as copper (Cu) and zinc (Zn) are essential for fish metabolism while some others such as lead (Pb) have no recognized role in biological systems. For the normal metabolism of fish, the essential metals must be taken up from water, food or sediment. However, similar to the route of essential metals, non-essential ones are also taken up by fish and accumulate in their tissues [16,17].

In Nigeria, there have been a numbers of studies on heavy metal pollution of fish in different part of the country with the view to ascertain the degree of contamination cause by such metals [4,18-20] among others.

The aim of this study is to determine the level of some toxic metals (Pb, Fe, Cd, Ni, and Cr) in Mudfish (*Clarias gariepineus)* Itu river, Itu Local Government Area in Akwa Ibom State Nigeria. The findings of this work will contribute to knowledge and which may be of great interest to consumers of sea food (fish), so as to ascertain it suitability for consumption.

Materials and Method

Sample Collection

Sample of the mudfish from fresh water were collected from three different locations (Station I, Station II, Station III) along Itu River located at Itu Local Government Area in Akwa Ibom State, South-Eastern Nigeria. Ten samples of mudfish were randomly collected from each of the three sampling stations and were identified by an aqua culturist to ascertain fish type. The specimens were kept inside clean polythene bags and stored in a deep freezer at 10°C in the laboratory prior to treatment and analysis.

Sample Preparation (Dry Ashing Method) -ASTM D482 - 91

The samples were oven dried to constant weight at 105°C. The samples were then grounded using mortar and pestle and sieved through 2mm mesh size to remove coarse materials. A quantity of 0.5g of sample was placed in the crucible charred. The ash obtained was dissolved in dilute HCl (1:1) and made up to mark in a 100ml volumetric flask. The digested sample was then analyzed for the various toxic metals required using Unicam Solar 969 Atomic Absorption Spectrophotometer.

Results and Discussion

Discussion of Findings

[Table-1] present the results of toxic metals concentrations analyzed and further depicted in [Fig-1]. The result revealed that the concentration of metals at the various stations varied. The average concentration of the metals in the fish sample is in the order: Fe (8.050)> Cr (2.667) >Pb (1.364)>Cd (0.472)>Ni (0.187) in mg/L.

Table 1- Concentration of Toxic metals in Mudfish (*Clarias gariepineus)*

Element	Pb (mg/L)	Fe (mg/L)	Cd (mg/L)	Ni (mg/L)	Cr (mg/L)
STATION I	1.321	7.681	0.472	0.147	2.064
STATION II	1.485	7.682	0.085	0.267	3.065
STATION III	1.284	8.787	0.482	0.147	2.872
MEAN VALUE	1.363	8.05	0.346	0.187	2.6667
FAO	0.5	NS	0.5	NS	NS
WHO/EPA	0.01	<0.3	0.003	0.07	0.05

NS: Not Stated; Station I: Up stream; Station II: Middle stream; Station III: Down stream

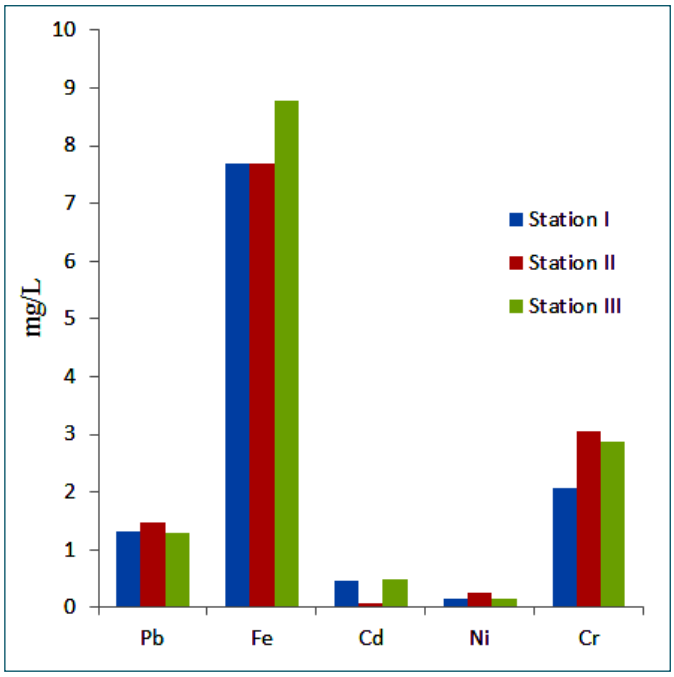

Fig. 1- Levels of Heavy Metals in *Clarius gariepinues*

Table 2- Order of mean metal concentration in the Mudfish (*Clarias gariepineus*)

Station	Metal Concentration
I	Fe>Cr>Pb>Cd>Ni
II	Fe>Cr>Pb>Ni>Cd
III	Fe>Cr>Pb>Cd>Ni

All the heavy metals (Pb, Fe, Cd, Cr and Ni) studied showed higher levels than standard limits stipulated by FAO, WHO and EPA. This may be attributed to the evident discharged of huge amounts of effluent from Le-Meridian Five Star Hotel, boat activities and domestic wastes generated by the inhabitants of Itu community which gets directly or indirectly into the beach. Dumping wastes into rivers contribute to the larger problem of river pollution, which can seriously damage the marine environment and cause health hazards to people. The high levels of these metals contained in the fish sample suggest that the water body may also be likely polluted by heavy metals. This correlate with the studies reported by [4,18-20] that there exist a remarkable relationship between heavy metals concentrations in aquatic organisms, water body and sediments.

The concentration of Fe in fish samples were extremely higher compared to the concentration of the other heavy metals that were analyzed in the fish samples. All the Stations recorded higher level of iron with Station II (down stream) which is the area close to Five Star Hotel Complex recorded the highest concentration of Fe. This could be attributed to the direct and untreated domestic wastes that are discharged from the Hotel complex into the beach leading to the high level of Fe in this fish samples. Uzairu, et al [20] reported the possible effect of iron on fish to include decrease in the protein, carbohydrate and lipid content of the edible part of fish. High iron content leads to primary heamochromatisis (genetic effect) or secondary hemochromatisis in severe cases and thalassaemia [19]. The recommended dietary allowance varies considerably based on age, gender and sources of iron (WHO 1991). Comparing these results with WHO and EPA limits, the mean value of Fe at these stations were far higher than the standard, this therefore is an indication of fish contamination.

The mean concentration of Pb was recorded as (1.3637mg/L) which is remarkably higher than the value reported by Milam, et al [21]. In all the stations, Pb concentration exceeded the recommended limit recommended by WHO/EPA. Station II (middle stream) which is the central area of the river under study recorded the highest concentration of Pb while the lowest concentration of Pb was recorded at station III. This could be attributed to the combined effect of boat exhaust systems, spillage of oil, other petroleum from mechanized boats employed for fishing and the discharge of sewage effluent into the water [12]. Further anthropogenic activities, prevalent in this study area might also play a key role in the accumulation of Pb in fish muscle [1] along side with mineralization of organic matter. On comparing these results with WHO/EPA limits the mean value of Pb was far higher than the limits for Pb which is an indication that the fish is polluted. Consumption of Pb polluted fish especially by human can lead to serious health hazards. Lead poisoning, especially among children consuming food items contaminated by lead damages the central nervous system, causing mental impairment, affecting oxygen transport in the body and causing digestive problems, long term exposure to lead can cause coma, or death [14]. Lead is a poisonous metal that can damage nervous connections especially in young children and cause blood and brain disorders. Human consumption of contaminated fish with the potential for adverse health effects has been identified in Great Lakes region [7]. A pair-matched study from Canada reported that fish eaters from this environment had relatively higher blood lead levels than non-fish eaters [16]. A Michigan study reported that mean blood lead levels were significantly higher in fish eaters than among control group [20].

The highest concentration of Cd was observed at station II (middle stream) which is the area close to the Le-meridian Hotel, and the lowest concentration of Cd was observed at station I. this is possible due to estuarial deposit from Itu River. Compairing the result with WHO/EPA standard limit, the mean value of Cd was higher than the standard limit for Cd. This indicates that the fish is cadmium polluted. Cadmium interferes with the body major metabolic processes and can also lead to cancer and teratogeneis. Cadmium is known to be one of most harmful heavy metals and is capable of inducing renal, hepatic and testicular injury [8].

Cadmium like some other HMs such as Pb and Hg has no biological function in human system [16]. Kidney damage, testicular tissue destruction, high blood pressure and red blood cells destruction are some adverse effects of acute cadmium toxicity [17].

The highest concentration of Ni was found at station II while the lowest value was observed at station I. With WHO/EPA limits, it can be observe that the mean value of Ni is far higher than the standard set by the body indicating the toxicity of the Ni. Exposure to nickel metal and soluble compounds should not exceed 0.005mg/L in nickel equivalents per 40-hour work week. Nickel sulfide fume and dust is believed to be carcinogenic and various other nickel compounds may as well. Overexposures lead to lung cancer, asthma-like symptoms and various organ problems.

Chromium recorded the highest value at station II and lowest value at station I. The mean value of Cr obtained exceeded the level when compared with standard limit set by WHO/EPA, the result shows that the fish sample is chromium polluted. Exposure and ingestion of Cr^{+6} containing substances may result weak immune system, likely suffer with lung cancer, ulcer and liver damages. Long term exposure to chromium can cause kidney, liver and nerve tissue damage, many chromium compounds are carcinogenic [22].

The quantitative analysis of possible relationships was carried out among the five metals analyzed. The data shows equal negative and positive correlations among different pairs of variables. Therefore, the variation of these metals concentrations shows the same trend from one sampling point to another one. Chromium and lead show a high level of correlation with Nickel (r = 0.6489 and 0.9776 respectively) while there was a positive correlation between Cr and Pb (r = 0.5024) Fe and Cd (r = 0.5187).

Conclusion

Present study provides information on the concentration of heavy metals in fish (mudfish) from Itu river. Based on the sample analyzed, metal concentrations found in the fish (muscle) were heavily accumulated with metals, and the concentrations were above the standard limit set by law bodies and therefore, individuals consuming such fish may face considerable risk from ingestion of toxic metals at unacceptable concentrations and may cause threat to human life. Hence, necessary measures are required to stop unnecessary direct or untreated dumping of domestic/industrial waste into the water body. Finally, this work may provide valuable database for future research on Itu River.

Conflicts of Interest: None Declared.

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