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Short Communication

Distribution of Selected Trace Metal in Fish Parts from the River Nigeria

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Abstract

Three species of fish namely Chryschthys nigrodigitatus, Clarius anguillaris and Tilapia zilli obtained from the River Niger investigated to ascertain the extent of trace metal pollution. The fishes were cut into three parts namely, the gills, muscles and tails and were analysed for trace metals such as manganese, lead, cadmium, chromium, nickel and copper using the atomic absorption spectrophotometer of model pye unican SP 2900 Australia. The results obtained revealed that all the aforementioned trace metals were all detected and there were variations in the concentrations of metals in various fish parts analysed. There were evidence of bioaccumulation of metals in fishes indicating that they were highly polluted since the values exceeded the WHO set standard for fishes. A look at the mean results further indicated that the gills accumulate more metals than those of the muscles and tails. Also Tilapia zilli was observed to accumulate the highest trace metal levels than others in this study. Manganese had the highest concentrations when compared with other metals. The fishes studied can be used as indicators for environmental pollutions monitoring programme in Nigerian Rivers.

Key words: Fish parts, River Niger, trace metals, pollution monitoring, bioaccumulation.

Introduction

Urbanization and industrial activities have done much harm to the natural and aquatic environment. As a result of industrial activities which lead the acidification of water bodies, fish communities have suffered significant changes in the community composition attributed to high mortality, reproductive failure, reduced growth rate, skeletal deformities and increased uptake of heavy metals [1]. Elevated levels of the metals were recorded in the Macrobrachium macrobrahion from a non-tidal fresh water ecosystem. Generally, higher levels of heavy metals were recorded in samples from the flow station [2]. Water analysed from the River Niger at Onitsha bank was found inadmissible for human consumption. Proper physical and chemical treatment was recommended before its use as domestic water supply [3]. Pollution from human and industrial wastes dumped directly into rivers in and around major urban centres has led to various metal contamination and loss of the natural ecosystems [4]. The highest concentrations of the contaminant metals were found in soil located near the head bridge of the River Niger. The sources of these metals were attributed to the industrial and anthropogenic wastes in various sample locations [5]. Contamination of the sediment matrix by heavy metal may accumulate in fishes and other aquatic resources which may eventually get into human food chains [6]. The rapid industrialization and aquaculture practices along the rive systems and the coastal areas have brought considerable decline in the water quality of brackish waters and the estuaries [7].

The badly polluted air can cause illness and even death, the polluted water kills fish and other marine life, and the polluted soil leads to a reduction of the amount of land available for growing food. Factories discharge most of the materials that pollute the air and water [8]. The distribution of cadmium, chromium, iron, lead and mercury in the fish showed significant variation with respect to the body parts. The head and tail region had higher concentration of the metals compared to the mid region [9]. The cumulative effects of cadmium on aquatic organisms, particularly in fresh water can affect the functioning of the ecosystem [10]. The major sources of pollution in streams and rivers are the effluents from industries and untreated wastes [11]. The pollution recorded in Ora and Ebe Rivers were attributed to the activities of the Nigerian cement factory at Nkalagu in the eastern Nigeria [12]. River Niger is a trans-African link beginning from West African Coast and flows down, into the Atlantic Ocean. Asaba forms a connector between western, eastern and northern Nigeria through the River Niger. The River Niger at Asaba and Onitsha axis is the receiving ends of all pollution loads arising from these two aforementioned urban towns. All waste and anthropogenic substances are channeled into the river. Therefore it is suspected that aquatic life in the River Niger might be contaminated by some heavy metals, hence it became necessary for this study. Therefore the objectives of this study are: to determine the

concentrations of heavy metals in different parts of fish species and to determine the possible effects of heavy metals on human who consume these fishes from River Niger.

Material and Methods

Area of Study: The River Niger is the third largest in Africa. The characteristics of the River Niger and its tributaries (fig. 1) are seen by some of the effluents discharged into the river both Asaba and Onitsha banks. The river has been the source of animal protein by the presence of fishes and invertebrates aquatic life. Urbanization contributed to the high rate of pollution through the discharge of anthropogenic wastes into the River Niger.

Sample Collection and Treatment: Three of the most common fish types, catfish (chryschthys nigrodigitatus), mudfish (Clarius Anguilla is and Tilapia fish (Tilapia zilli) were caught using hooks through the assistance of a fisherman in Asaba area of the River Niger. The fishes were labeled on the polymer buckets containing the river water and taken to the laboratory prior to further treatment.

The fishes were cut into three parts with stainless steel knife, namely, the gills, muscles and tails. These aforementioned parts were labeled and separately oven dried at 60 ^{0}C. The fish parts were crushed in a mortal with pestle and kept in the refrigerator prior to wet digestion [13, 14.]

5.00g of each fish part was digested with mixture of HNO_3 and $HClO_4$ and left overnight in a fume hood. On cooling, the clear digest was diluted to 25ml mark in a volumetric flask using deionized water. The resultant solutions were analysed for trace metals using atomic absorption spectrophotometer. All analysis was run in triplicates. Appropriate recovery studies were carried out by spiking already analysed sample with a known concentration and reanalysed. Acceptable recoveries not less than 90% was achieved for all the metals determined.

Results and Discussion

The three different species of fishes collected from the river Niger at Asaba were analysed for trace metals. The results obtained in different parts of fishes namely: gills, muscles and tails are presented in table 1 below.

Table-1
Mean and range of metals in fish parts collected from River Niger at Asaba in Mg/Kg dry weight.

S/N	Sample code	Common Name of Fish	Biological Name of Fish	Manganese Mg/Kg Dry wt	Lead Mg/Kg Dry wt	Cadmium Mg/Kg Dry wt	Nickel Mg/Kg	Chromium Mg/Kg Dry	Copper Mg/Kg Dry wt
01	CTG	Cat fish	*Chryschthys nigrodigitatus*	52.10 45.20-57.00	0.90 0.70-1.20	14.20 12.10-16.40	31.40 30.00-33.20	2.30 2.00-2.60	23.50 20.30-27.20
02	MDG	Mud fish	*Clarius anguillaris*	51.10 48.20-53.40	5.40 5.00-6.20	11.20 9.40-14.60	32.80 30.60-35.00	4.40 4.10-4.60	12.80 11.10-13.60
03	TLG	Tilapia	*Tilapia zilli*	67.80 62.40-70.60	4.30 3.50-4.90	12.10 20.00-22.40	50.80 50.10-51.50	7.30 6.15-8.40	33.20 30.00-36.50
04	CTM	Cat fish	*Chryschthys nigrodigitatus*	25.40 23.20-28.00	0.20 0.06-0.40	10.60 8.80-12.40	17.50 17.00-18.00	1.80 1.20-2.40	9.20 8.80-10.20
05	MDM	Mud fish	*Clarius anguillaris*	19.40 18.00-20.60	0.60 0.20-0.85	9.60 8.00-11.20	12.40 12.00-13.60	2.10 2.00-2.40	10.20 7.80-14.20
06	TLM	Tilapia	*Tilapia zilli*	35.50 30.50-40.50	1.10 1.00-1.60	12.10 11.10-13.70	31.90 30.60-33.00	1.10 0.90-1.70	15.80 12.95-18.60
07	CTT	Cat fish	*Chryschtys nigrodigitatus*	22.80 20.00-25.20	5.10 4.80-6.60	2.10 1.90-3.20	9.70 9.00-10.60	0.80 0.60-1.20	10.80 8.80-11.80
08	MDT	Mud fish	*Clarius Anguillaris*	21.30 20.00-22.65	6.20 4.60-9.20	1.80 0.95-2.20	10.30 10.00-11.20	0.20 0.06-6.20	11.20 10.00-12.80
09	TLT	Tilapia	*Tilapia zilli*	71.30 68.00-73.80	7.10 5.80-9.60	5.40 3.50-7.50	31.40 30.40-32.80	0.60 0.10-9.00	25.50 20.50-30.50

CTG = Catfish gill CTM = Catfish muscle
CTT = Catfish tail MDG = Mudfish gill
MDM = Mudfish MDT = Mudfish tail
TLG = Tilapia gill TLM = Tilapia muscle
TLT = Tilapia tail.

Manganese, lead, cadmium, nickel chromium and copper contents in gills, muscles and tails of fishes analysed were all detected and there metal variations as recorded in table 1. Manganese concentration in the aforementioned fish parts was highest among other metals analysed. Generally, all the metals analysed in fish parts were elevated when compared with the who on health criteria and other supporting information on water quality[15]. These high metal concentrations obtained were not surprise due to the nature by which industrial and anthropogenic wastes are continuously being discharged into the River Niger through Asaba and Onitsha spots. All pollution loads ends up through gutters and air into the River Niger. A study carried in the same river revealed that fishes in River Niger are highly contaminated by heavy metals [16]. Also these levels exceeded those metal values obtained in fishes from Iyede-Ame River [17]. Trace metals concentrations in *Tilapia zill's* parts (gill, muscle and tail) in this study exceeded those of *Chryschthys nigroditatus* and *Clarius anguillaris*. This is an indication that the uptakes of trace metals rate by *Tilipia zilli* are higher than those of *Chryschthys nigroditatus* and *Clarius anguillaris*. Therefore *Tiliapa zilli* is a good bioaccumulator of heavy metals in Nigerian rivers and it can be used as indicators for environmental pollution monitoring.

A further look at the results revealed that the gills of the fishes analysed for metal contents accumulate trace metals when compared with the muscles and tails. This may be due to the fact that, the fish traps food through its gills .Accumulation of metals in fish has been observed in various tissues, mainly in livers and in gills [18]. On the other hand, less accumulation has been observed in muscle [19]. Therefore the finding in this study is in agreement with the findings of the above mentioned authors. The values of manganese, lead, cadmium and nickel observed in this study are higher than those reported in fresh water catfish *(Macrobrachium macrobrachion*) from a non-tidal freshwater ecosystem in the Niger Delta region [20]. These high values of metals in fish parts could be dangerous to the health of those who consume fishes of the river Niger.

Trace elements have been known to cause health problems such as cancer, brain damage, kidney and liver problems in human beings. The three fishes used in this study is a representative of other species of fishes in River Niger, since they bioaccumulate trace metals in them, they are toxic and have shown the evidence that they are contaminated as they contain elevated concentrations of the selected metals studied. Much dependant on the fishes of the River Niger for consumption should be avoided; instead fish pond should be established by both individual and government to enable people free of eating fishes from the Nigerian rivers. This study is an indication that River Niger which is the largest river in Nigeria is highly polluted.

Conclusion

The three species of fishes analysed for trace metals were all detected. The mean results obtained in fish parts were elevated and the concentrations of metals exceeded the WHO set standard for fishing. Thus indication that River Niger is highly polluted. The results further revealed that the gills trap more trace metals than the muscles and tails. Also *Tilapia zilli* was observed to have the highest metal concentrations indicating that it has higher rate of bioaccumulation of trace metals when compared with those of *Chryschthys nigrodigitatus* and *Clarius anguillaris*. As a result of the elevated concentrations of metals in the fishes studied, it is dangerous for the consumers of fishes from this River Niger which is the Nigerian largest river.

The only way to avoid eating of fishes from Nigerian rivers is to established fish ponds. This will go a long way in minimizing the extent of people consuming the local fishes from the Nigerian river. These trace metals in fishes when consumed could lead to health problems such as cancer, brain damage, kidney and liver problems.

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