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Profile Of Some Heavy Metals In Flesh Tissues of *Pseudotolithuselongatus* (Pisces: Sciaenidae) And The Status Water Quality of Jaja Creek (Nigeria)

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Abstract: *This paper describes the profile of some heavy metals in flesh tissues of pseudotholitus elongates (Pisces: Sciaenidae) as well as the status of water quality in Jaja Creek. The study was carried out for a period of 12 months. The studies samples were purchased from commercial landings and local fishers. The fish tissues were analysed using standard analytical methods for heavy metals and trace metals. The water quality status were analysed from the water samples collected from the sampling sites using standard analytical methods. The result indicated a higher mean values of mean ($\bar{x}$) metal concentration in flesh tissues of pseudotolithuselongatus in wet season, except in cadmium. The water quality status revealed a higher mean ($\bar{x}$) values in the wet season, except in conductivity, total suspended solids (TSS), total alkalinity (TA), transparency and chloride. The concentration values of the studied parameters did not indicate any serious detenoration as they were within the approved limit of WHO (1984).*
Keywords: *Heavy metals, water quality, Jaja Creek, pseudotolithuselongitus, Nigeria.*

I. Introduction

Heavy metals in aquatic systems can originate from either natural or anthropogenic sources. However, studies have revealed that anthropogenic inputs of heavy metals in natural waters exceed that of natural inputs (Calamari et al., 1994). In natural water bodies, heavy metals occur in low concentrations, normally at the monogram to microgram per litre level. In recent times, the occurrence of heavy metal concentrations in excess loads have become a problem of increasing concern. This situation has arisen as a result of rapid growth of population, increased urbanization and expansion of industrial activities, exploration and exploitation (Akpan, 1993).

Heavy metals in aquatic environment have direct hazardous impacts on aquatic flora and fauna as well as indirect harmful impacts on the human population. Aquatic biodiversity can bioaccumulate and bioconcentrate excess heavy metal loads and their derivatives in their respective structures above the minimum or maximum level. The bioaccumulation and distribution of toxic impurities in fish and other aquatic organisms is of great interest both from the medical and ecological points of view (Akpan, 1992).

Several studies have reported the effects of heavy metals bioaccumulation on physico-chemical parameters and fisheries in Nigeria (Akpan and Ufodike, 1995; Kakulu and Osibanjo, 1986; Omoregie et al., 2002; Amoo et al., 2005 and Eletta et al., 2004) among several others. The general order in the results is the distortion of water quality and reduction in community attributes of the organisms including the biotic integrity (Akpan, 1992).

There is a dearth of information on the heavy metal concentration in the croaker (*P. elongates)* in Jaja Creek waters of the Bight of Bonny. This problem becomes worrisome due to the economic importance of the croaker as one of the important commercial fishes in the coastal waters of AkwaIbom State (Isangedighi, 2001). This is in addition of the increasing industrialization around the area.

The objectives of this study were to determine the heavy metal concentration in flesh tissue of croaker (*Pseudotolithus elongates*) and in the status of water quality of Jaja Creek in view of the economic importance of the fish and the water resource.

II. Materials And Methods

Study Area

Jaja Creek (fig.1) is located in the Niger Delta Region of Nigeria and drains into the Imo River System. It originates from Okigwe area (Imo State, Nigeria) and takes a southerly course until is empties into the Atlantic Ocean in the tropical rain forest belt with equatorial climate regime, which consists of two major seasons, a short dry season (characterized by the predominance of hot, dry north-easterly winds from the Sahara desert). This is followed by a long wet season which is characterized by the predominance of moist south-westerly winds from the Atlantic ocean, and a heavy precipitation with mean monthly rainfall of 361-615mm with a double maximum in July and September (Udo, 1995). The relative humidity is high (over 80%) because of the warm wet air masses that prevail during the period (Isangedighi, 2001).

The elevation of the area is generally less than 30m above sea level. The basic geological formation of the area is made up of loose material formed on alluvial coastal plain sand (Peter *et al.*, 1994). The terrain is flat and has a monotonous relief with flooding localized in many depressions and characterized with seasonal ponds.

Sample Collection and Analysis

Sample of *Pseudotolithuselongatus* were collected from the commercial landings of artisanal and local fishers at Jaja creek terminal for twelve months (January – December, 2010). Fish tissues from the study area were analyzed for heavy metals concentration and trace metal content. Fish specimens for heavy metal determination were preserved in ice chests until analysis. The flesh tissues were obtained by descaling and filleting fish samples using clean stainless instruments weighed to 5g. The tissues were ground with a mortar and homogenized with a hydrocarbon-free blender and extracted with 25.0cm^3 of analytical (spectroscopic) grade CCI_4 solution for 24 hrs. The ground mixtures were filtered many times and the absorbance measured using UV/Visible spectrophotometer (UNICAM8700).

The water quality status physico-chemical of the creek water were determined with respect to pH, conductivity, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity (TA) dissolved oxygen (DO), biochemical oxygen demand phosphate-phosphorus and sulphate. The determination of the physico-chemical parameters were done following the method described by APHA (1992). The heavy metals in water were determined using atomic absorption spectrophotometry (AAS) (PyeUnicam England, 919 Solart systems). Paired t-test was used to evaluate seasonal difference in the heavy metals and physico-chemical parameters.

III. Results and Discussions

Table 1 shows the seasonal variation in mean metal concentration in flesh tissue of *Pseudotolithuselongatus* from Jaja creek. It indicated that magnesium (Mg) in the flesh tissue of *Pseudotolithuselongatus*recorded a t-ratio value of 10.13 than other metals, while the lowest t-ratio value of 0.11 was recorded for Cadmium (Cd). The accumulation of heavy metals showed a higher concentration in the wet season than dry season.

Table 1: Seasonal variation in mean metal concentration in flesh tissues of *Pseudotolithuselongatus* from study area (Jaja creek)

Metal	Dry season	Wet season	t-ratio	Upper allowable limit WHO 1984
Pb(mg/1)	0.022	0.075	0.14	0.01
Zn(mg/1)	5.711	11.620	1.95	40.0
Fe(mg/1)	9.533	16.010	2.34	100.0
Ni(mg/1)	0.254	0.372	0.37	100
Cr(mg/1)	0.052	0.121	0.35	0.05
Mg(mg/1)	174.315	266.375	10.13	-
Mn(mg/1)	1.629	2.123	0.93	50.0
Al(mg/1)	0.014	0.069	0.12	-
Cd(mg/1)	1.200	<0.010	0.11	2.0
Cu(mg/1)	2.500	7.040	0.38	10.0

Table 2 shows the seasonal variation in mean concentration of physico-chemical parameters of water from Jaja creek. It indicated that colour recorded a t-ratio value of 10.60 while the lowest t-ratio value of 0.04 was recorded for temperature. The physico-chemical parameters of water sample from Jaja creek showed a higher trend in the wet season than dry season except in the levels of conductivity, total dissolved solids, total alkalinity, total suspended solids, temperature and chloride.

Table 2: Seasonal variation in physico-chemical parameters of water from Jaja creek

Parameters	Dry Season	Wet Season	t-ratio	Optimum Level
Colour	6.80	28.49	10.60	5.0
pH	6.49	28.49	1.7	6.5-8.5
Conductivity ms/cm	525.60	7.03	81.8	-
TSS(mg/l)	354.40	100.2	50.9	40.0
TDS(mg/l)	833.60	843.5	109.1	200
TA(mg/l)	46.70	38.60	5.1	20.0-200.0
BOD(mg/l)	2.60	3.40	0.8	1.002
DO(mg/l)	5.70	6.70	1.0	4.0
NO_3-N(μgl^{-1})	94.20	340.50	34.2	10.0

PO_4-P(μgl^{-1})	10.40	23.8	8.90	3.50
THC(mg/l)	2.60	3.20	0.60	-
Transparency	2.90	1.70	1.20	-
Temperature ^oC	25.74	25.70	0.04	27.0-28.0
CI	0.80	0.30	0.5	250.00

The concentration of heavy metals in the flesh tissue of *Pseudotolithuselongatus*(croaker) in Jaja creek varied according to season. The highest t-ratio value of 10.13 and 2.34 were recorded for Magnesium (Mg) and Iron (Fe). Iron (Fe) is often noted to cause reduction in the toxicity of other metals such as Aluminum (AI), Copper (Cu) and Lead (Pb) (Reader et al., 1989 and Annie, 1999). This according to the authors is probably due to the competition between Iron (Fe) and other metals for binding sites and or partial sequestering of metal by iron colloids.

Although Iron is rarely a toxicologically significant contaminant of fish tissues (Annie, 1999), studies have shown that residues in muscle tissues range from 1.0-150mg/kg wet weight (Annie, 1999). Iron (Fe) is slightly toxic and its presence in water systems cause more of a nuisance than a potential health hazard and would give a bitter taste (Akpan and Ufodike, 1995).

Iron concentration in the studied sample was indeed too low, when compared with the allowable limit level of 100.00mg/c (Table 10 by World Health Organization (1984). This may be due to the low bio-accumulation of iron containing, compounds and also suggests low inputs from anthropogenic sources into the creek.

Magnesium affects the aquatic biota and contributes to serious aquatic hazard in excess loads (Akpan, 2006). Annie (1999) observed that it may lead to retarded growth, development and eventually death of the biota. The level of magnesium in the flesh issue of the studied sample was noted to be within the level allowed for unpolluted natural waters. Magnesium usually enters the aquatic environment through runoffs (Akpan, 2006) and Industrial effluents (Annie, 1999).

Lead is considered to be one of the most sever environmental contaminant (Akpan, 2006). Residues exceeding 400mg/kg near waste outfall have been reported by Calamari *et al.,* (1994). The level of concentration of lead (Pb) in the sample was noted to be within the allowable limit of World Health Organization, WHO (1984). The metal often enters the aquatic system from anthropogenic sources (Calamari *etal.,* 1994). The trace level of concentration may be in connection with anthropogenic activities, especially with the speed boats used during fishing activities and as means of transportation.

Zinc (Zn) is very essential in biological processes, and its toxic effect on excess load has been reported and cited by Annie (1999) calamari *et al.*, (1994) and Biney, (1991). These include reduced skeletal calcium depuration, tetratogenic effect on embryonic larval stages and growth. The concentration of Zinc (Zn) in the sample was within the upper allowable limit of 40.0mg/l (Table 1) as specified by World Health Organization (WHO, 1994). This suggests low domestic sewage input and urban run off to the creek.

Manganese is noted to affect the skin of fishes, causes mechanical injuries (Calamari *et al.*, 1994) and therefore enhances secondary infections (Annie, 1999). Manganese enters the aquatic system through surface runoffs and industrial waters (Akpan, 2006). The manganese levels in the studied sample suggest low input from anthropogenic sources and surface runoffs. Copper is an essential element for which the biological body has low tolerance (El-Nabawi,*et al.,* 1987), and its presence in excess affects aquatic life (Akpan, 2006). When discharged into the water, copper can enter the food chain, be bio-accumulated by fish and therefore become a threat to man (Biney, 1991). This study indicates that the level of copper was low compared to the allowable limit by World Health Organization. This suggests low level of pollution of the creek from anthropogenic activities.

IV. Conclusion

Highlights from the study indicated that the level of pollutants in the creek by identified sources ****** not exceed desired/allowable limits for heavy metals. However the ability of the Creek to undergo biopurification has been demonstrated by the lower values in Creek studied species. To avoid bioaccumulation and detenoration of the aquatic resources of the Creek, it is expedient to constant place the creek under surveillance in view of the local community who depend on the creek for food fish and drinking.

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APPENDIX 1
MONTHLY VALUES OF PHYSICO-CHEMICAL PARAMETERS IN JAJA CREEK AT THE UPSTREAM AND DOWNSTREAM SITES (JANUARY – DECEMBER, 2004)

Parameters		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Mean	Paired t-test
Temperature (^oC)	UpStream	26.40	25.00	26.30	25.90	25.40	26.40	25.30	25.40	25.30	26.80	25.30	25.00	25.70	0.415 P = 0.05 NS
	DownStream	26.50	25.30	26.00	25.80	25.20	26.40	25.20	26.30	25.70	25.90	25.40	25.20	25.70	
Transparency (m)	UpStream	3.00	2.65	3.00	2.10	2.13	2.50	1.20	1.15	2.00	1.00	2.60	4.00	2.30	2.88 P = 0.05S
	DownStream	2.05	2.50	2.50	2.00	2.00	0.840	1.000	0.805	1.00	1.84	2.00	1.95	1.70	
TSS(mg/l)	UpStream	200.50	256.00	220.00	500.000	800.70	110.00	150.00	1200.00	1300.00	1500.00	650.00	300.00	595.90	2.47 P = 0.05S
	DownStream	210.00	220.00	270.0	650.00	950.00	1000.70	1200.80	1500.70	1400.00	1700.00	700.00	350.00	849.00	
TDS(mg/l)	UpStream	900.50	950.00	900.00	500.50	350.70	300.00	80.70	100.50	85.50	90.50	850.00	900.80	500.80	3.21 P =0.05S
	DownStream	900.00	950.00	980.50	650.00	450.80	450.00	100.50	150.00	120.50	140.00	800.00	1000.50	557.70	
TS(mg/l)	UpStream	20.90	20.95	21.30	24.10	24.50	23.20	25.12	23.35	21.75	23.45	18.00	15.25	21.80	3.05 p=0.05 S
	DownStream	22.70	21.80	23.50	24.30	25.60	23.50	26.05	24.15	22.78	24.55	19.55	17.35	23.00	
DO(mg/l)	UpStream	5.50	5.55	5.40	5.90	6.40	6.90	6.85	6.90	6.50	6.80	6.00	5.70	6.20	3.26 p=0.05 S
	DownStream	6.30	6.80	6.88	6.60	6.70	5.55	6.50	6.80	6.50	5.40	5.90	6.20	6.30	
BOD(mg/l)	UpStream	2.70	3.70	3.50	3.70	3.20	2.90	2.70	2.30	2.40	2.20	3.00	3.40	3.00	3.37 p=0.05 S
	DownStream	2.90	3.80	3.90	3.70	3.80	3.20	2.80	2.85	2.50	3.60	3.50	3.60	3.30	
TA(mg/l)	UpStream	45.50	30.80	35.80	48.20	45.70	57.80	60.70	45.00	46.00	30.00	40.50	25.80	42.70	1.01 p=0.05 NS
	DownStream	47.80	35.00	37.20	39.30	35.00	47.20	57.07	50.20	50.00	46.50	42.30	35.50	43.60	
pH	UpStream	8.10	7.45	6.50	6.10	6.20	6.10	6.15	6.20	6.45	7.20	6.90	7.80	6.70	3.41 P =0.05S
	DownStream	6.85	6.80	6.70	6.20	6.18	7.00	6.20	6.30	7.00	6.85	6.90	7.40	6.70	
Conductivity (μScm)	UpStream	400.70	600.20	600.40	200.50	150.70	155.20	60.50	63.70	100.70	70.25	650.40	701.30	312.9	4.51 P=0.05 S
	DownStream	480.80	680.80	680.20	350.42	180.70	155.20	80.90	90.50	110.20	95.40	700.20	740.50	364.30	
PO_4-P(µg/l)	UpStream	26.00	5.000	7.00	7.50	33.00	33.00	8.00	26.00	23.00	20.00	9.00	8.00	17.10	2.23 P=0.05 S
	DownStream	26.00	3.50	8.00	26.8	36.00	46.00	7.10	38.00	26.8	25.00	7.80	7.10	21.50	
NO_3-N(µg/l)	UpStream	35.00	80.00	280.00	90.00	840.00	703.00	202.00	204.00	60.00	34.00	20.00	60.00	217.30	0.096 P=0.05 S
	DownStream	38.00	83.00	354.00	70.00	50.00	605.00	285.00	222.00	350.00	600.00	24.00	30.00	225.9	
Cl-(mg/l)	UpStream	0.900	0.980	0.890	0.780	0.321	0.2210	0.2525	0.2621	0.2370	0.240	0.480	0.580	0.5000	26.3 P=0.05 S
	DownStream	1.000	1.252	0.908	0.790	0.480	0.200	0.2610	0.2700	0.2120	0.270	0.580	0.700	0.6000	
THC(mg/l)	UpStream	2.500	2.400	2.800	2.900	2.600	3.500	3.000	4.000	3.510	2.510	2.700	2.330	2.9000	1.30 P=0.05 NS
	DownStream	2.200	2.200	3.000	3.010	3.200	2.010	1.700	3.000	2.800	2.600	2.500	2.005	2.5000	