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Heavy Metal Concentrations in Three Commercially Important Fish Species in the Lower Sombreiro River, Niger Delta, Nigeria

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Abstract
Concentrations of heavy metals (Fe, Cd, Cu, Co, Cr, Pb, Ni and Zn) in the tissues of three commercial fish species (Pseudotolithuselongatus, Chrisichthysnigrodigitatus and Mugilcephalus) of Sombreiro River were investigated. Heavy metal concentration in the tissues of these fishes were found to be different, however M. cephalus was observed to accumulate a higher burden of Fe, Cr, Ni, Co and Zn while Cd was not detected in all three species. The order of mean concentration of metals in the tissues of P. elongatus and C. nigrodigitatus were similar (Fe > Zn > Cr > Cu > Ni > Co >Pb> Cd) while that of M. cephalus is Fe > Zn > Cr > Ni > Cu > Co >Pb> Cd. It is concluded that M. cephalus is a better accumulator of heavy metals and is therefore most suitable for use as a biological indicator in the Sombreiro River.
Key words: Sombreiro River, Accumulation, Heavy metal, Tissue, Niger Delta

Introduction

Fish is one of the major sources of animal protein in the Niger delta- one that is relatively cheap, affordable and readily available. Inhabitants of the Niger delta coastlines are basically fish farmers- involved in one form of fishing or the other. Sombreiro River is one of the major Rivers of the Niger Delta that contributes significantly to the total fish landing from the area, and supports quite a number of fishing settlements along its coastline.

In addition to its abundant fresh water and marine resources, the Niger Delta area is noted for its rich mineral resource base – such as petroleum, whose exploration and exploitation has brought mixed fortune for the people and the environment.

Human and industrial activities result in the discharge of various pollutants into the aquatic environment, threatening the health of the population and damaging the quality of the environment by rendering water bodies unsuitable (Abowei and Sikoki, 2005). One such persistent and potentially harmful pollutant is heavy metal.Water pollution affect plants and other organisms living in these bodies of water and in almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities (Fewtrell and Colford, 2004).

Yet aquatic resources consists of extremely wide range of flora and fauna (resources) which offer a broad array of goods with potential utilitarian application in agriculture, innovative industry and the pharmaceutical industry which renders valuable benefits and services.

Heavy metals in the environment may accumulate to acutely toxic levels without visible signs (Phillips and Rainbow, 1993). Over a few decades, there has been growing interest to determine heavy metal levels in the marine environment and attention was drawn to find out concentration level of public food supplies particularly fish (Nemr, El-Sikaily and Khaled, 2003). Metals can be taken up by fish from the surrounding water, food, sediment and from suspended particulate matter. Bio-magnification of heavy metals in edible tissues of fishes (and other marine organisms) could pose health hazards to consumers (Howard, Gabriel and Horsfall, 2008).

In the study area, heavy metal burden ofTympanotonusfuscatusand Crassostreagasar (Howard, Gabriel and Onyekwere, 2012), and periwinkle (Ideriah, Briggs and Stanley, 2010) have been reported. However, the metal loadings of fishes of commercial significance have not been reported. This investigation is therefore aimed at generating baseline data to fill this gap and also to show if the three commercially important species of Pseudotolithuselongatus,Chrisichthysnigrodigitatus and Mugilcephalus (mullet) from the Sombreiro River are safe for human consumption.

Materials and Methods

i.) Study Area

The study area- Sombreiro River is located in Rivers State in the Niger Delta region of Nigeria, and lies between latitude 04^0 43` 18`` to $04^0$ 37` 37.3`` N and longitude 006^0 46` 25`` to $006^0$ 48` 56.5`` E. It is a tidal dominated river, with possible fresh water input.

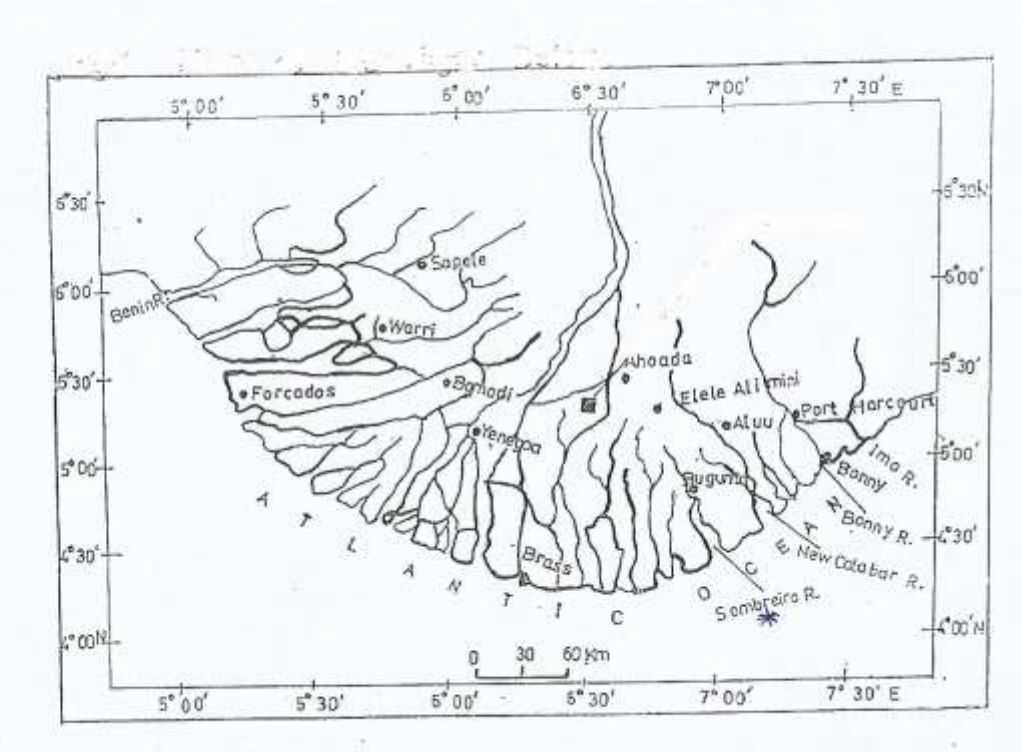

Fig. 1 Map of the Niger Delta area.

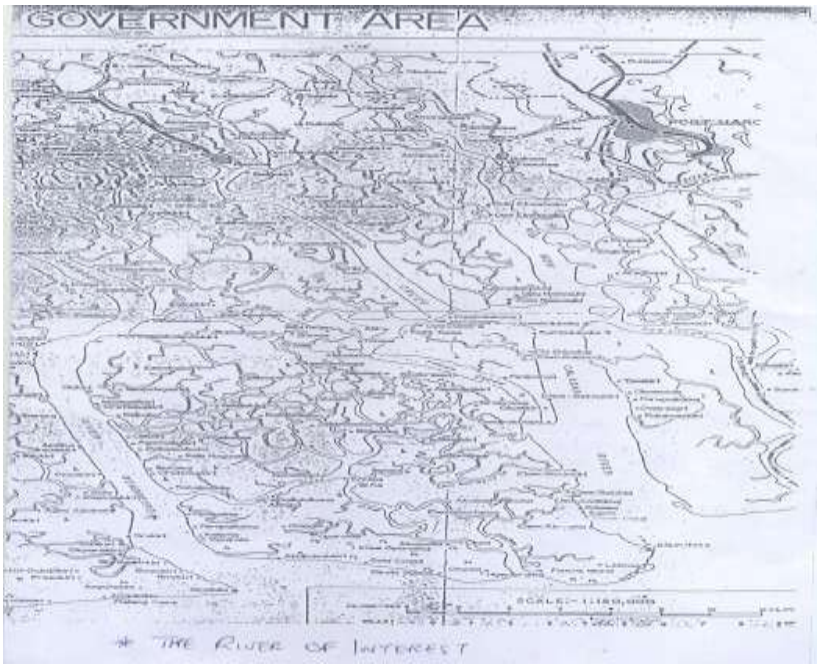

Figure 2: Map of the study area – Sombreiro River

ii.) Sampling and Analysis

Three very common and commercially important fish species, Pseudotolithuselongatus, Chrisichthysnigrodigitatus and Mugilcephalus (mullet) locally called "ana", "singi" and "deke" respectively were purchased from local fishermen in the lower reaches of the Sombreiro River between January and March, 2013. Identification of the fish species was carried out to specie level with the aid of species identification sheets for fishery purposes by FAO (1990), as well as that of Idodo – Umeh (2003) and Sikoki and Francis (2007). A total of ten samples from each species was taken and preserved in a cold box before transporting to the laboratory for analysis. Samples were kept frozen in the laboratory prior to analysis. A quantity of the fish tissue was oven- dried at 105^0C to a constant weight and blended into fine powder, and digested with a freshly prepared concentrated nitric acid and hydrogen peroxide (1:1) as in Adeyeye and Ayoola (2012). Reagent blanks to test the purity of the reagents were prepared and standards of the metals in solution were used to calibrate the instrument. Concentrations of the different metals were determined from the atomic absorption spectrophotometer using different cathode lamps.

RESULT AND DISCUSSION

The mean concentration of heavy metals in the tissues of the three fish species – Pseudotolithuselongatus, ChrisichthyesnigrodigitatusandMugilcephalusare presented in Table 1. The result indicates that different species of fish in the same environment show varying ability to accumulate different heavy metals in their tissues. In all three species, concentration of cadmium was the least (0.0mg/kg), while Iron was found to be most concentrated in the tissue of all the fishes ranging from 48.31 to 67.43mg/kg.

Table 1: Mean heavy metal concentration in mg/kg in tissues of three commercial fishes of Sombreiro River.

	Fe	Cr	Cu	Ni	Cd	Co	Pb	Zn
Psuedotolithus Elongatus	59.63± 2.12	6.30± 0.62	5.31± 0.55	2.89± 0.28	0.0	1.71± 0.18	0.23± 0.03	11.61± 1.26
Mugil cephalus	67.43± 1.91	9.91± 0.98	2.7± 0.09	4.17± 0.33	0.0	2.35± 0.15	0.17± 0.06	21.37± 1.34
Chrisichthyes nigrodigitatus	48.31± 3.35	7.41± 0.78	4.84± 0.33	3.69± 0.54	0.0	0.74± 0.10	0.21± 0.03	17.40± 1.48

The highest levels of Iron, Chromium, Nickel, Cobalt and Zinc were detected in M. cephalus while those of Copper and Lead were found in P. elongatus. Similarly, the lowest concentration of Chromium, Nickel and Zinc were observed in P. elongatus, those of Iron and Cobalt was detected in C. nigrodigitatus while M. cephalus had the lowest values of Copper and Lead.

The order of mean concentration of metals in the tissues of P. elongatus and C. nigrodigitatus were similar, Fe > Zn > Cr > Cu > Ni > Co >Pb> Cd but that of M. cephalus – Fe > Zn > Cr > Ni > Cu> Co >Pb> Cd was slightly different as shown in Table 2 below.

Table 2: Order of Mean Metal Concentration in three commercial fish species of Sombreiro River

Fish Specie	Order of Metal Concentration
P. elongatus	Fe > Zn>Cr>Cu>Ni>Co>Pb>Cd
M. cephalus	Fe>Zn>Cr>Ni>Cu>Co>Pb>Cd
C. nigrodigitatus	Fe>Zn>Cr>Cu>Ni>Co>Pb>Cd

The finding of this investigation is in agreement with the submission of Kalay, Ay and Canli (1999) that different fish species contained strikingly different metal level in their tissue. This is taught to be as a result of the differences in their food and feeding habits as well as their ecology.

The concentration of iron (43.31 – 67.43mg/kg) observed in this study is higher than the 0.80 – 1.92 mg/kg (for different organs) reported by Adeyeye and Ayoola (2012) but is much lower than the 143.43±22.68 to 2439±1387mg/kg shown by Ahmed et al (2003) in fish tissues from South Mediterranean waters in Egypt.

The metal cadmium (0.0mg/kg) was not detected in all three species in this investigation as was the case in the study of Yilmaz, (2003) in Iskenderun Bay (Mugilcephalus andTrachurusmediterraneus. Thisis however, in clear contrast with the reports of Ekeanyanwuet al (2010) in Okumeshi River (Tilapia), Edem, et al (2009) in Henshaw Beach, Calabar (Oreochromisniliticus) both in the Niger Delta and elsewhere Canli and Atli (2003) in the Northeast Mediterraneanand Dural, Goksu and Ozak (2007) from the Tuzla Lagoon.

Concentration of zinc fluctuated from 11.67 – 21.37mg/kg, this is lower than the 84.76 – 136.9 mg/kg gotten from Oreochromisniloticus in the Koycegiz Lake by Yilmaz (2009) and 21.01±2.38 - 49±4.33mg/kg recorded by Ahmed et al(2003), but is higher than other reports from the Niger Delta Ekeanyanwuet al (2010) and Edemet al, (2009). It is however closely related to the 8.96 – 20.35 mg/kg observed in the various organs of Clariasgariepinus from the Ogun River (Farombiet al, 2007).

Copper level in the tissue of fishes in this study is closely related to that (4.55 – 5.00mg/kg) reported by Farombiet al, (2007), but lower than the 3.91 – 114.3mg/kg from various organs of O. niloticus (Yilmaz, 2009) and higher than the 0.44±0.09 – 1.86±0.14, 0.15±0.05 – 0.88±0.25 and 0.12 – 0.54 mg/kg observed by Ahmed et al (2003), Adeyeye and Ayoola (2012) and Akan et al, (2009) respectively.

The concentration of lead in fish tissues of Sombreiro River (0.17 – 0.23mg/kg) were lower than the values reported by Farombi et al (2007) and Yilmaz, (2009) but is favourably related to the concentration recorded by Akan et al (2009) and Edemet al (2009). Nevertheless Adeyeye and Ayoola (2012) in their investigation did not detect lead in all the samples analyzed.

A comparative analysis of the result reveals that cadmium was not detected in all three species, the highest concentration of iron, chromium, nickel, zinc and cobalt were recorded in M. cephaluswhile C. nigrodigitatusproduced the highest concentration of copper and lead. This shows M. cephalus as the best accumulator of heavy metals and affirms the conclusion and recommendation of Yilmaz (2009) that M. cephalus is adequate and most suitable for use as bio-monitor of trace metal pollution and as such should be used as biological indicator.

REFERENCES

Abowei, J. F. N and F. D. Sikoki. (2005): Water Pollution Management and Control, Double Trust Publications Company, Port Harcourt.

Adeyeye, A. and Ayoola, P.B. (2012): Heavy metal concentrationsin some organs of African Catfish (Clariasgariepinus)fromEko- Ende Dam, Ikirun, Nigeria. Continental J. Applied Sciences 7(1): 14 – 18.

Ahmed, El Nemr, Amany El-Sikaily and AzzaKhaled (2003): Heavy metals concentration in some fish tissuesfrom South Mediterranean waters, Egypt. Egypt J. Aquat.Biol. and Fish. 7(3): 155 – 172.

Akam, J.C., Abdulrahman, F.L, Sobipo, O. A. and Akandu, P.I. (2009): Bioaccumulation of some heavy metals of six fresh water fishes caught from Lake Chad in DoronBuhari, Maiduguri, Borno State, Nigeria. J. Appli. Sci. Environ. Sanitation 4(2): 103 – 114.

Canli, M. and Atli, G. (2003): The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, and Zn) levels and the size of six Mediterranean Fish species. Environ. Pollut.121 (1): 129 – 136.

Dural, M., Goksu, M. Z. I. and Ozak, A. A. (2007): Investigation of heavy metal levels in economically important fish species captured from the Tuzla Lagoon. Food Chem. 102, 415 – 421.

Edem, C.A., Osabor, V., Iniama, G., Etiuma, R. and Eke, J. (2009): Distribution of heavy metals in bones, gills, liver, and muscles of (Tilapia) Oreochromisniloticus from Henshaw Town Beach market, in Calabar, Nigeria. Pak. J. Nutrition, 8(8): 1209 – 1211.

Ekeanyanwu, C.R., Ogbuinyi, C.A. and Etienjirhevwe, O. F. (2010): Trace metals distribution in fish tissues, bottom sediments and water from Okumeshi River in Delta State, Nigeria. Ethiopian J. Environ. Studies and Management, 3(3): 12 -17.

FAO (1990): Field guide to the Commercial Marine Resources of the Gulf of Guinea. FAO Species Identification Sheets for Fishery Purposes.FAO Regional Office for Africa.Pp 266.

Farombi, E.O., Adelowo, O.A. and Ajimoko, Y.R. (2007): Biomakers of oxidative stress and heavy metal levels as indicators of environmental pollution in African catfish (Clariasgariepinus) from Nigeria Ogun River. Int. J. Environ. Res. Public Health, 4(2): 158 – 165.

Fewtell and Colford (2004).Water sanitation and hygiene interventions and diarrhoea systematic review and meta-analysis.(Health Nutrition and population HNP).

Howard, I. C., Gabriel, U. U. (Snr.) and Horsfall, M. (Jr.) (2008): Trace metals in the tissues and shells of Tympanotonusfuscatus Var. radula from the mangrove swamps of the Bukuma oil field, Niger Delta. European Journal of Scientific Research 24 (4): 468 – 476.

Howard, I.C., Gabriel, U.U. and Onyekwere, B.C. (2012): Bio concentration patterns of some trace metals in Tympanotonusfuscatus (Var. Radula) and Crassostreagasar from the tidal flats of the Sombreiro River, Niger Delta. JNES 7(3): 114 – 123.

Ideriah, T.J.K., Braide, S.A. and Briggs, A.O. (2006): Distribution of lead and total hydrocarbon in tissues of Periwinkles (Tympanotonusfuscatus and Pachymelaniaaurita) in the upper Bonny River, Nigeria. J. Appl. Sci. Environ. Mgt. 10(2): 145 – 150.

Idodo – Umeh, G. (2003): Freshwater Fishes of Nigeria (Taxonomy, Ecological notes, Diet and Utilization) IdodoUmeh Publishers, Ltd., Benin City. 232pp.

Kalay, M., Ay, O. and Canli, M. (1999): Heavy metal concentration in fish tissue from the Northeast Mediterranean Sea. Bull. Environ. Contam.Toxicol. 63:673 – 681.

Phillips, D. J. H. and Rainbow, P. S. (1993): Biomonitoring of trace aquatic contaminants. In: Environmental Management Series. Series editors Cairns,J. (Jnr) and Harrison, R. M. Elsevier Applied Science London. 371pp

Sikoki, F.D. and Francis, A. (2007): An Atlas of Fin Fishes of the Andoni River in Niger Delta, Nigeria.Molsyfen United Services. Pp 68

Yilmaz, A. B. (2003): Levels of heavy metals (Fe, Cu, Ni, Cr, Pb and Zn) in tissue ofMugilcephalusand Trachurusmediterraneus from Iskenderun Bay Turkey. Environ. Res. 92: 277 – 281.

Yilmaz, F. (2009): The comparison of heavy metal concentrations (Cd, Cu, Mn, Pb and Zn) in tissues of three economically important fish (Anguilla anguilla, Mugilcephalus and Oreochromisniloticus) inhabiting Koycegiz Lake- Mugla (Turkey). Turkish J. Sci. Technol. 4(1): 7- 15.