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Mercury Content of Fishes from Some Streams in Akwa Ibom State, Nigeria

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Abstract: Samples of *oreochromis nillotum*, *pomadasys jubillini*, *brycinus nurse*, *tilapia quineense* and *hermichromis fasciatus* have been analysed for their mercury content. The result of the analysis shows mean mercury content to be 0.044 ppm, 0.068 ppm, 0.036 ppm, 0.04 ppm and 0.031 ppm for *oreochromis nillotum*, *pomadasys jubillini*, *brycinus nurse*, *tilapia quineense* and *hermichromis fasciatus* respectively. This values were lower than the limit of 1 ppm for mercury in fish. The values were also comparable to range of values reported for most fishes. The mercury content of the fish were found to vary with species (with *pamadasys junillini* having the highest and *hermichromis fasciatus* having the least concentrations), length and weight of the fishes. The consumption of matured and different species of fishes is advocated in this work.

Key words: Fishes in Akwa Ibom State, Nigeria, mercury content, food chain, heavy metals

Introduction

The potential of most heavy metals to bioaccumulate, biomagnified and become transferred to man through the food chain has attracted global health concerns. Mercury is a toxic heavy metal that has led to the greatest death toll in the world (Ademoroti, 1993; Eddy and Udoh, 2006). Mercury occurs naturally in the environment. According to FDA (1999), approximately 2,700 to 6,000 tons of mercury is released annually into the atmosphere naturally by degassing from the Earth's crust and oceans. Another 2,000 to 3,000 tons are released annually into the atmosphere by human activities, primarily from burning household and industrial wastes and especially from fossil fuels such as coal.

Mercury vapor is easily transported in the atmosphere, deposited on land and water and then, in part, released again to the atmosphere. Trace amounts of mercury are soluble in bodies of water, where bacteria can cause chemical changes that transform mercury to methyl mercury, a more toxic form (Munir *et al*., 2003). Fish absorb methyl mercury from water as it passes over their gills and as they feed on aquatic organisms (Beseda *et al*., 2002). Larger predator fish may be exposed to higher levels of methyl mercury from their prey.

Fish are important in a healthy diet (Eneobong, 2001). They are a lean, low-calorie source of protein. According to Eddy and Udoh (2006), methyl mercury binds tightly to the proteins in fish tissue, including muscle and cooking does not appreciably reduce the methyl mercury content of the fish. Mercury toxicity leads to neurotoxicological disorders (Dara, 1993).

High concentration of heavy metals have been detected in several aquatic species in many parts of the world (Ikuta, 1991). According to Munir *et al*. (2003), aquatic organism can be used as more efficient monitors of environmental contamination in that they can concentrate heavy metals in their tissues. Avelar *et al*. (2000) also stated that some marine organism, notably oysters and mussels can accumulate heavy metals in their tissues at levels up to 100, 000 times higher than the levels observed in the water in which they live. This confirms that aquatic organism is better indicators for monitoring heavy metals compare to water.

The present study is aimed at analyzing fish samples that are common in the major fishing port located within Akwa Ibom State, Nigeria for their mercury content.

Materials and Methods

Sample collection: Five species of fishes were collected from five different location within the fishing areas of Akwa Ibom State as shown in Table 1. Multiple samples were collected by setting local traps but five samples were selected from each species for analysis. The length and weight of the representative samples were measured before analysis.

Analysis of samples: In order to analysed for the presence of mercury, the method recommended by A.O.A.C. (1993) was adopted. This involved, digestion, gentle heating, refluxing, dilution and absorbance reading after aspirating the digested sample into pye unicam model of atomic absorption spectrophotometer and the calculation of the concentration of mercury through the plotted calibration curve.

Results and Discussion

The result of the mean mercury content of *oreochromis niloticuc* from Inyang Udo stream was as shown by Table 2. Fig. 1 shows the plot of mercury content against weight.

Table 1: List of fish species and their origin

Fishing area	Species	Genus
Enyong creek	*Quineensis*	*Tilapia*
Akpa Atak stream	*Fasciatus*	*Hemichromic*
Inyang Udo stream	*Niloticus*	*Oreochromic*
Afia stream	*Nurse*	*Brycinus*
Iquita stream	*Jubelini*	*Pomadasys*

Table 2: Mercury content of *oreochromis niloticuc* from Inyang Udo stream

Weight of fish (g)	Total length (cm)	Concentration of Hg (ppm)
13.60	9.50	0.012
14.60	8.90	0.038
17.43	10.50	0.038
11.50	9.00	0.086

From Table 2, it can be seen that the mercury content of tilapia varies with the weight and length of the fish. It generally decreases as the weight increases up to 14g before it increases again to a maximum value below 0.04 ppm. The negative correlation between Hg content and weight (r = -0.507) confirms that the Hg content of tilapia decreases with the weight of the fish. The mercury content of tilapia varies with the length of the fish as shown by Fig. 2. The Hg content increases with length except between 14 and 15 cm. The positive correlation between Hg content of tilapia and its length (r = 0.0804, p = 0.05) confirms that on the average, the mercury content of the fish increases with length.

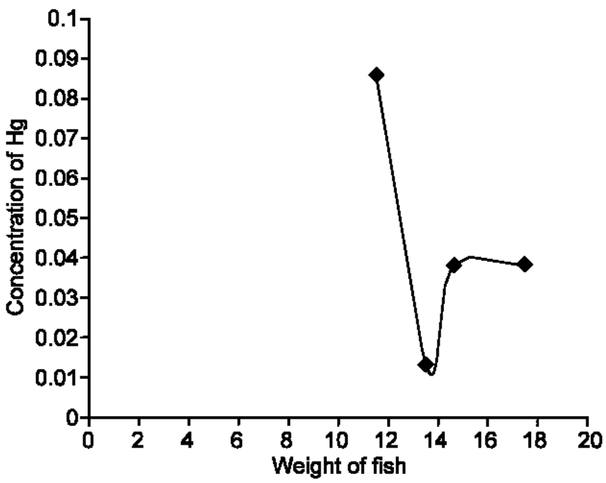

Fig. 1: Concentration of Hg in oreochromis niloticus against weight

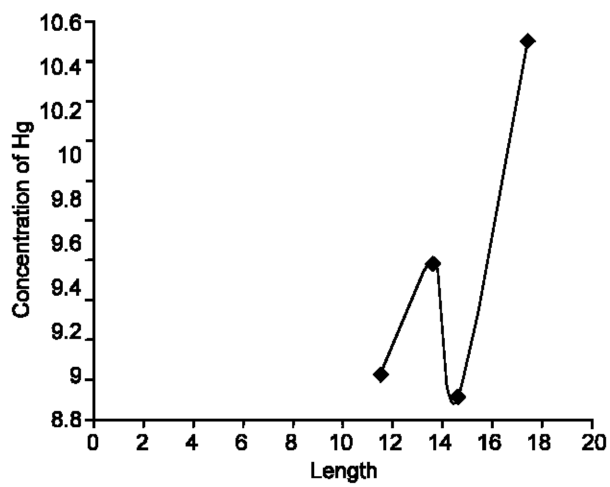

Fig. 2: Concentration of Hg against length in oreochromic niloticus

Table 3: Mercury content of *pomadasys jubelini* from Iquita stream

Weight of fish (g)	Length (cm)	Concentration of mercury (ppm)
267.947	25.50	0.056
266.958	25.00	0.086
267.938	24.50	0.023
267.982	24.50	0.086

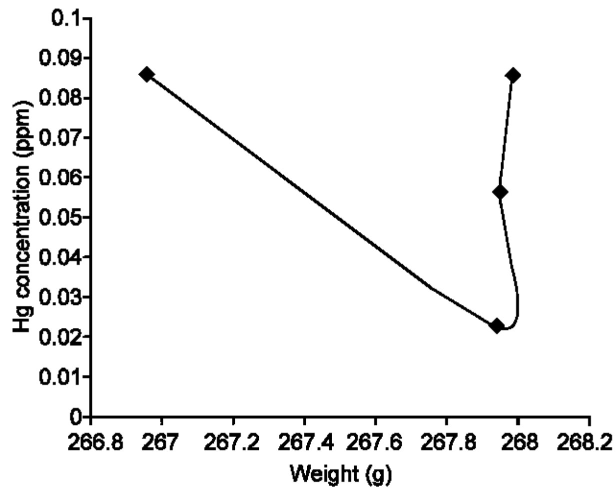

Fig. 3: Hg concentration against weight for pomadasys jubelini

The mercury content, weight and length of *pomadasys jubelini* caught from Iquita stream were as shown by Table 3.

Fig. 3 and 4 show plots of Hg content of *pomadasys jubelini* against weight and length respectively. From Fig. 3, it can be seen that the mercury content of this fish decreases linearly with weight up to 268g after which it stars to increase. Similarly, the mercury content of the fish decreases as the length of the fish increase. Correlation between the concentration of Hg and the weight of the fish was negative (r = -0.485) but positive for length (r = 0.113).

Table 4 shows the concentration of Hg, weight and length of *brycinus nurse* caught from Afia stream. The variation of the measured concentration with weight and length are shown by Fig. 5 and 6 respectively. Fig. 5 shows a quadratic relationship between the

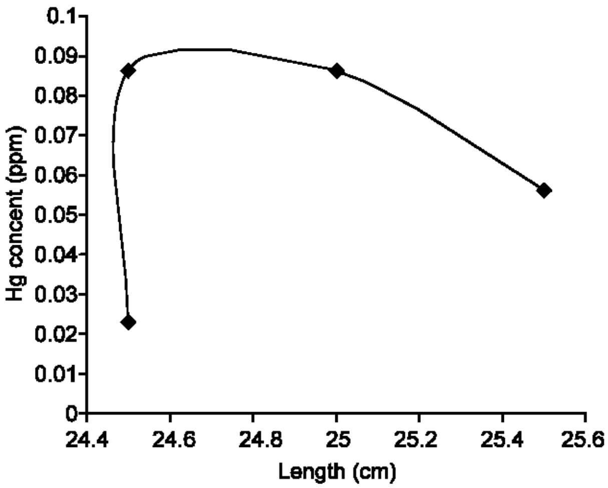

Fig. 4: Hg content against length for pamadasys jubelini

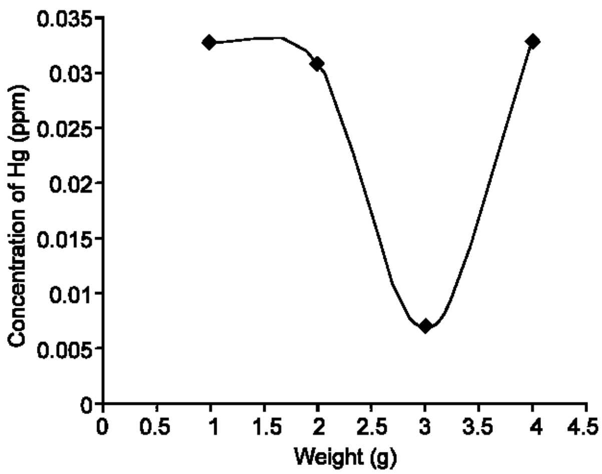

Fig. 5: Hg content of brycinus nurse against weight

Table 4: Hg content of *brycinus nurse* from Afia stream

Weight of fish (g)	Length of fish (cm)	Hg concentration (ppm)
58.056	16.00	0.007
56.300	15.25	0.033
57.300	15.85	0.031
58.784	15.85	0.033

Table 5: Hg content of *tilapia quineensis* from Enyong creek

Weight of fish (g)	Length of fish (cm)	Hg content (ppm)
248.68	24.00	0.012
245.53	25.00	0.011
240.39	25.25	0.028
248.942	24.50	0.028

concentration of mercury in the fish and its weight. From Fig. 5, it can be stated that the concentration of Hg in brycinus nurse varies quadratically with the weight of the fish. Fig. 6 shows a linear relationship indicating a decrease as the length increases. The linearity of graph

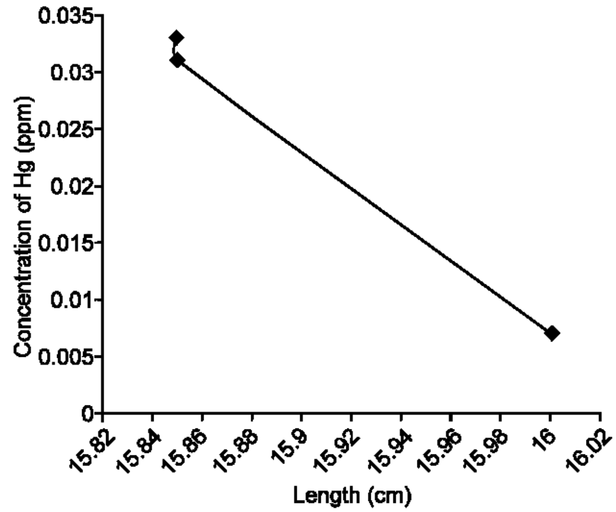

Fig. 6: Hg concentration against length of brycinus nurse

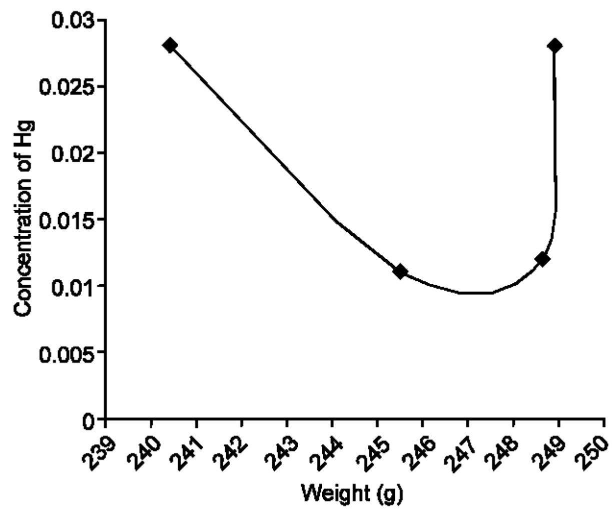

Fig. 7: Hg content of tilapia quineensis against weight

6 is confirm by the significant negative correlation observed between Hg concentration and length in this case (r = -0.997).

Table 5 shows the concentration of Hg, weight and length of *tilapia quineensis* species caught from Enyong creek. The variation of concentration of Hg with weight and length of the fish are shown by Fig. 7 and 8 respectively.

Table 6 shows the concentration of mercury, weight and length in *hemichromic fasciatus* from Akpa Atak Eka stream. Fig. 9 and 10 show plots of Hg concentrations against weight and length respectively. Correlation between the concentration of Hg and the weight of the fish was negative (r = -0.111) and positive for the length (r = 0.318). Fig. 10 also shows that the concentration of Hg in *hermichromis fasciatus* increases as the length of

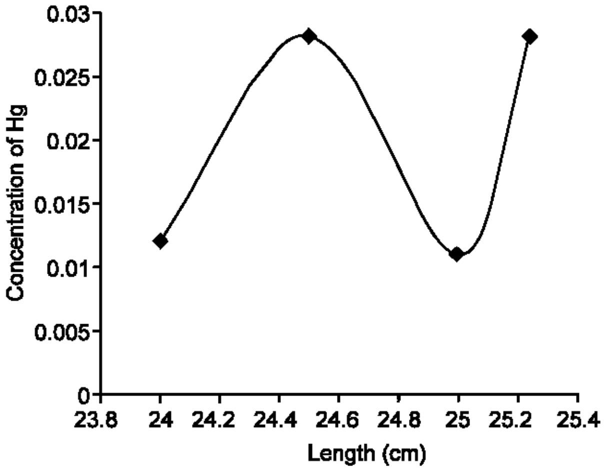

Fig. 8: Hg content of tilapia quineensis against weight

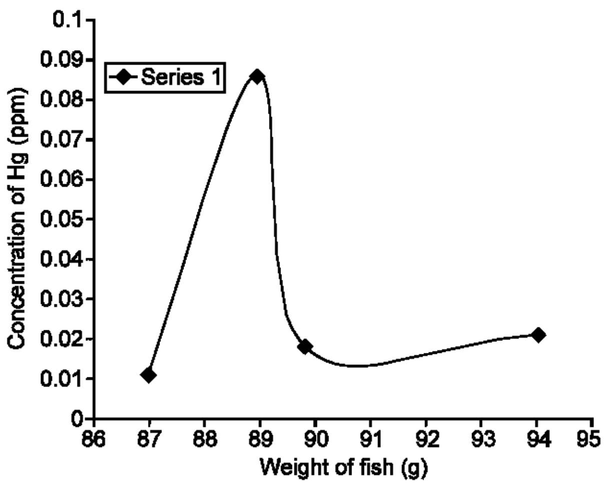

Fig. 9: Hg content of hemichromis fasciatus against weight

Table 6: Hg concentration in *heichromic fasciatus* from Akpa Atak Eka

Weight of fish (g)	Length of fish (cm)	Concentration of Hg (ppm)
89.801	22.50	0.018
88.947	23.00	0.086
86.989	22.50	0.011
94.041	16.25	0.021

Table 7: Mean length, weight and concentration of Hg in all the fish samples

Sites	Species	Mean weight (g)	Mean length (cm)	Hg concentration (ppm)
Inyang Udo	Oreochromis nilloticus	14.284	9.475	0.044
Iquita stream	Pomadasys jubelini	267.706	24.875	0.063
Afia stream	Bryclinus nurse	57.610	15.738	0.026
Enyong creek	Tilapia guineensis	245.610	24.688	0.021
Akpa Atak Eka	Hemichromis fasciatus	90.124	21.063	0.034

the fish increases. But Fig. 9 shows that the concentration also increases (at first) with weight but starts to decrease after certain value.

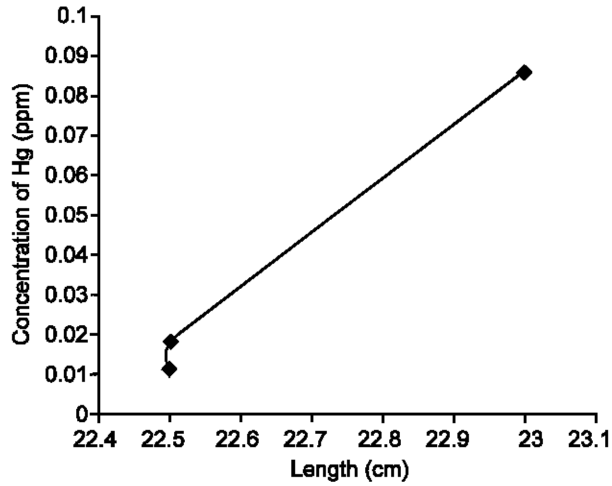

Fig. 10: Hg concentration in hemichromis fasciatus against length

Table 8: Mercury content of some fishes in the world

Species	Range (ppm)	Average (ppm)
Domestic Samples		
Catfish	ND- 0.16	ND
Cod	ND-0.17	0.13
Crab	ND-0.27	0.13
Flounder	ND	ND
Hake	ND	ND
Halibut	0.12- 0.63	0.24
Pollock	ND	ND
Salmon (canned)	ND	ND
Salmon (fresh or frozen)	ND	ND
Shark	0.30-3.52	0.84
Swordfish	0.36-1.68	0.88
Tuna (canned)	ND- 0.34	0.20
Tuna (fresh or frozen)	ND- 0.76	0.38
Import Samples		
Pollock	ND-0.78	0.16
Shark	ND-0.70	0.36
Swordfish	0.80-1.61	0.86
Tuna (canned)	ND-0.39	0.14
Tuna (fresh of frozen)	ND-0.75	0.27

Source: Foulke (1994)

Table 7 show the mean concentration of Hg, weight and length of all the fish samples considered during the study.

From Table 7, it can be seen that pomadasys jubeline has the highest weight.

Length and concentration of mercury while oreochromis niloticus has the least weight and length.

The values obtained for the mercury content of the fishes in this works compares well with values obtained in other part of the world as shown by Table 8 and 9.

From Table 1 to 9, it can be seen that the mercury content of fishes varies with species of fish and may also vary with the age, length and weight of the fish. However, the measured concentration of mercury in the

Table 9: Mercury content of some fishes

Fish	Hg content (ppm)
Shark	0.988
Swordfish	0.976
Tilefish (gulf of mexico)	1.450
Anchovies	0.043
Butterfish	0.058
Catfish	0.049
Cod	0.095
Crab 1	0.060
Crawfish	0.033
Lobster (spiny)	0.09
Mackerel chub	0.08
(Pacific)	0.088
Mullet	0.046
Oyster	0.012
Salmon	0.013
Tilapaia	0.010

Sources: FDA (2000, 2004)

fish samples were below the FDA limit of 1 ppm indicating that these fishes are not contaminated by mercury.

Nearly all fish contain trace amounts of methyl mercury, some more than others. In areas where there is industrial mercury pollution, the levels in the fish can be quite elevated. In general, however, methyl mercury levels for most fish range from less than 0.01 ppm to 0.5 ppm (Table 8 and 9). It's only in a few species of fish that methyl mercury levels reach FDA limit for human consumption of 1 ppm implying that the streams in Akwa Ibom State (Nigeria) are not polluted with respect to mercury. However, certain species of very large tuna, typically sold as fresh steaks or sushi, can have levels over 1 ppm (Eddy and Udoh, 2006).

Conclusion: From the result of the present study, most of the fishes in Akwa Ibom State streams are not polluted with respect to mercury. However, the mercury content of fishes in the streams tend to vary with length and weight of the respective fish and also according to the species of fish. This suggest that the consumption of fishes in the state should not be restricted to one particular species so that human system will not bioaccumulation excessive amount of mercury as this heavy metal has no known biological function in the body.

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References

A.O.A.C., 1993. Association of Official Analytical Chemists: Official Methods of Analysis 15th Ed. Washington D.C.

Ademoroti, C.M.A., 1993. Environmental Chemistry and Toxicology, Foludex Press Limited, Ibadan, Nigeria, pp: 150.

Avelar, W.E.P., F.L.M. Mantelatto, A.C. Tomazelli, D.M.L. Silva, T. Shuhama and J.L.C. Lopes, 2000. The marine mussel perna perna (molusca, bivalvia, mytillidae) as an indicator of contamination by heavy metals in the ubatuba bay, Sao paula, Brazil, Air and Soil Pollut., 118: 65-72.

Beseda, V., J. Fumega and A. Vaamonde, 2002. Temporal trends of Cd, Cu, Hg, Pband Zn in mussel (mytillus galloprovincialis) from the Spanish north-Atlantic coast. 1991-1999. Sci. Total Environ., 288: 239-253.

Dara, S.S., 1993. Environmental chemistry and pollution. Chand pub. New Delhi, India.

Eddy, N.O. and C.L. Udoh, 2006. Introduction to environmental chemistry. Edited by Ekop, A.S. Patom Pub. Nigeria.

Eneobong, H.N., 2001. Eating right, a nutritional guide. Nigeria: Zoompter Print Communications Ltd., Calabar, Nigeria University of Calabar Press.

FDA, 1999. Food code, US. Department of Health and Human Services, Public Health Service, Food and Drug Adminsistration, Washington DC 20204.

FDA, 2000. National Marine Fisheries Service Survey of Trace Elements in the Fishery Resource" Report 1978.

FDA, 2004. The Occurrence of Mercury in the Fishery Resources of the Gulf of Mexico" Report.

Foulke, E.J., 1994. Mercury in fish: Cause for concern. FDA report. FDA consumers J.

Ikuta, K., 1991. Estimates for depuration periods of copper, cadmium and zinc in a pacific oyster under field condition. Bull. Fac. Agri. Miyazaki Univb\., 35: 1-12.

Munir, Z.L.G., A. Mustafa, C. Fatma and F. Oziem, 2003. Bioaccumulation of some heavy metals (Cd, Fe, Zn, Cu) in two *Bivalvia species* (*Pinctada radiate leach*, 1814 and *Brachidontes pharaonis fischer*, 1870). Turk. J. Vet. Anim. Sci., 29: 89-93.