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Analysis of Heavy Metals Concentration in Prawn (*Macrobrachium Sp)* Harveted from Gberikoko River, in Sapele Delta State; Nigeria

Kalu. O. Obasi
Lecturer, Department of Biological Science, Federal University of Technology, Owerri, Nigeria
Enemchukwu, S.
Graduate Student, Department of Biotechnology, Federal University of Technology, Owerri, Nigeria
Okereke, J. N.
Lecturer, Department of Biotechnology, Federal University of Technology, Owerri, Nigeria
Ezeji, E. U.
Lecturer, Department of Biotechnology, Federal University of Technology, Owerri, Nigeria
Oparaigbo, M. I.
Lecturer, Department of Physical and Health Education, Alvan Ikoku University, Owerri, Nigeria

Abstract:
The concentrations of selected heavy metals: cadmium, arsenic, lead and mercury in prawn (Macrobrachium sp) were analyzed. The morphometric records of the prawn samples were taken. The specimens were subsequently weighed and individually pulverised to a uniform particle size. Ten(10)grams of each pulverised sample were put in a 200ml digestion conical flask, 30ml of aqua regia, which constitutes of hydrochloric acid, nitric acid and hydroflouric acid in the ratio 1:3:1 was added and placed uprightly for 10-15 minutes. The mixture was heated in a waterbath until the whole sample dissolved and a yellow tint of the solution appeared. The solution was filtered using a filter paper into centrifuge tubes and made up to 50ml mark with deionized water. It was transferred into sample vials for analysis. The heavy metal analysis was done according to the standard methods for heavy metal determination using the FS 240 Varian Atomic Absorption Spectrophotometer. Lead had the highest concentration in sample F and the lowest in sample H, with concentrations of 1.75ppm and 1.54ppm respectively. Also, the prawn samples exhibited the highest record of Mercury and lowest mean value of Arsenic with values of 6.9±3.95and0.00±0.00 respectively. For Mercury, the highest concentrations occurred in sample G and lowest in F, with concentrations of 12.6ppm and 4.1ppm respectively. Arsenic showed its highest concentration in sample F and lowest in sample H with concentrations of 0.65ppm and 0.64ppm, respectively, whereas Cadmium wasn't detected in any of the samples. From the analysis of data, since $F > F_{crit}$ and $p < 0.05$, there is a significant difference in the mean concentrations of the prawn samples from Gberikoko river in Sapele, Delta State Nigeria.

Keywords: *Prawn, Concentration, metals, spectrophotometer, Gberikoko, Mercury, Pulverized.*

1. Introduction

Heavy metals occur in low concentrations in natural aquatic ecosystems. In recent times, the natural background of the aquatic ecosystem has become a problem of increasing public concern. Due to industrialization, the number of factories and population has increased rapidly. Domestic wastes water and industrial effluents are transported by rivers and coastal waters. Much smaller quantities of metals are added to the sea by direct discharges of industrial and other waste and the dumping of sewage sludge (Clark,Frid and Attril 1997).Other sources of heavy metal pollution in water bodies include mining activities, urban storm water runoffs, leaching of metals from garbage and solid wastes dump sites.e.t.c

The *macrobrachium* species are highly cherished by the people of Niger Delta. They are used as condiments in domestic and commercial cuisines because of their high protein value. As with other sea foods, prawns are also highly rich in calcium, iodine but low in food energy. Its consumption is considered healthy for the circulatory system because it lacks significant levels of saturated fats. Consumption of prawns from heavy metal polluted habitat by humans is thought to lead to diseases such as Parkinson's disease, still births, liver dysfunction, food poisoning e.t.c. Pollution of the marine environment by heavy metals has long been recognized as one of the important factors posing a threat to the marine organisms (Adedeji and Okocha. 2011). Some heavy metals escape into the marine environment, causing toxic and other adverse effects (Chapman, Allen and Z'Graggen 1996). Essential metals at high concentrations can have sublethal toxicity effects to some organisms or lethal consequences to others. Also metals at different

concentrations can have again adverse health effects. Thus, essential metals can have a double "toxic" threshold (Rainbow 2007). Methyl mercury poisoning has a latency of 1 month or longer after acute exposure, and the main symptoms relate to nervous system damage (Weiss, Clarkson and Simon. 2002). There is also evidence that certain genetic and environmental factors can increase the detrimental effects of lead on neural development, thereby rendering certain children more vulnerable to lead neurotoxicity (Lidsky and Schneider 2003). At low concentrations, Cadmium is toxic to all life, including plants, fish, birds, mammals (including humans) and microorganisms (ATSDR 2008)

The sampled prawns from both locations are highly priced and in high demand in the market, but it has been observed that there is a significant reduction of the natural stock of prawns in our coastal waters. This may be due to the enviromental degradation which is detrimental to the abundance and lifecycle of the prawn species.

Based on the public health risk for human consumers and the aquaculture potential (marketability) of prawns, there is need to investigate the concentrations of Lead, cadmium, mercury and arsenic in prawns harvested from Gberikoko river, Sapele Delta State Nigeria. Despite the progress made in the treatment of enviromental wastes, heavy metals still pose great health hazards to humans and aquatic biota. Unlike other classes of pollutants which can be biodegraded and destroyed completely, heavy metals cannot be degraded or destroyed rather some can be methylated to more toxic forms while others can be complexed to stable and less toxic compounds. Exposure is often defined as a function of concentration and time between a human and the environment with a contamination of a specific concentration for an interval of time (NRC 1991). Exposure doesn't result only from the presence of a harmful agent in the environment. The key word in the definition of exposure is contact (Berglund, Elinder and Jarup 2001).With time, some bounded metals are released in their free state or complex state by natural chemical processes or anthropogenic activities into aquatic enviroment where they interfere with biota. Some biota, for example prawns can accumulate and magnify these metals and since the knowledge base about the chemistry and concentration of the metals in the tissues of aquatic biota has increased with time compared to what it used to be three decades ago. Continous monitoring of the aquatic environment is therefore a necessity.

AIM

The present study is important not only from the human health point of view, but it also presents a comparative account of heavy metals, in edible shell fishes from locations that are physico-chemically different.

2. Methodology

2.1. Study Area

Gberikoko river is located in Sapele in Delta state. Delta state was created in 1991, located between longitude $5^{o}00$ and $6^{o}45$ East and latitude $5^{o}00$ and $6^{o}30$ North. Delta state is an oil and agricultural producing state of Nigeria, situated in the region known as the Delta State, South South geopolitical zone with a population of 4,098,291(males: 2,674,306, female: 2,024,085). The capital city is Asaba located at the northern end of the state, with an estimated area of 762 square kilometer. Other major towns include Warri, Sapele and Ogwashi Uku. Delta state is generally low lying without remarkable hills. The state has a wide coastal belt interlace with rivulets and streams, which form part of the Niger-Delta.

2.2. Laboratory Analysis

The heavy metal analysis was done according to the standard methods for heavy metal determination using the FS 240 Varian Atomic absorption spectrophotometer.

The weight, number of segments as well as the total length of individual whole specimens were measured and counted. Each of the specimens were weighed and individually pulverised to a uniform particle size,ten(10)grams of each pulverised sample was correctly weighed using an analytical balance were put in a 200ml digestion conical flask.30ml of aqua regia which constitutes of hydrochloric acid, nitric acid and hydroflouric acid in the ratio 1:3:1 was added and placed uprightly for 10-15 minutes. The mixture was heated in a waterbath at approximately $120^{o}C$ until the whole sample dissolved and a yellow tint of the solution appeared. The solution was filtered using a filter paper into centrifuge tubes and made up to 50ml mark with deionized water. It was transferred into sample vials for analysis. Reagent blanks were prepared accordingly to test the purity of the reagents. Heavy metal concentration for all preparations were determined by using the Atomic absorption spectrophotometer respective lamps and wavelenghts applicable to the different metals analyzed. The values of heavy metals were expressed in parts per million(ppm) for prawn samples.

3. Results

Sample	Lead (ppm)	Mercury (ppm)	Arsenic (ppm)	Cadmium (ppm)
E	1.66	6.5	0.00	0.00
F	1.75	4.1	0.65	0.00
G	1.62	12.6	0.00	0.00
H	1.54	4.4	0.64	0.00
Mean	1.64±0.21	6.9±3.95	0.00±0.00	0.65±0.53

Table 1: Concentration of the Heavy metals in Prawn Samples from Gberikoko River

Table 1, which shows the concentration of the heavy metals in the prawn samples from Delta State. Traces of analysed heavy metals were found in all four prawn samples from this location except for Cadmium and Arsenic. Lead had the highest concentration in

sample F and the lowest in sample H, with concentration of 1.75ppm and 1.54ppm respectively. Also, the prawn samples exhibited the highest recorded value under Mercury and lowest value under Arsenic with records of 6.9±3.95 and 0.00±0.00 respectively. For Mercury, the highest concentration occurred in G and lowest in F, with concentrations of 12.6ppm and 4.1ppm respectively. Arsenic showed its highest concentration in sample F and lowest in sample H with concentrations of 0.65ppm and 0.64ppm respectively whereas Cadmium wasn't detected in any of the samples.

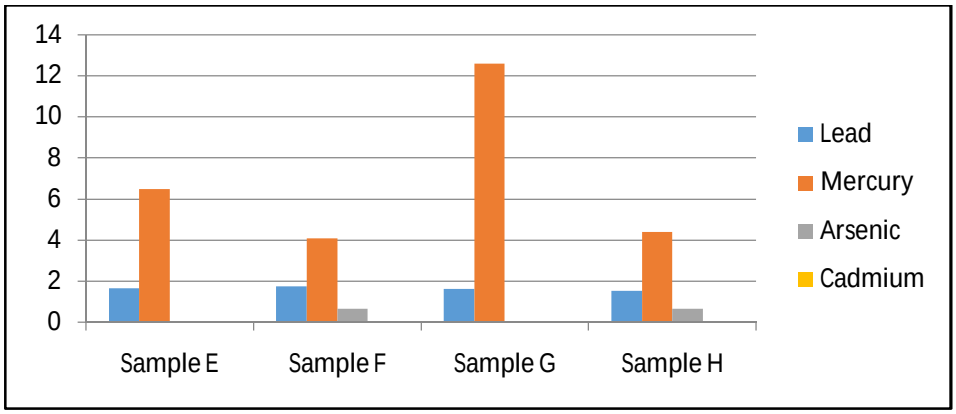

Figure 1: Bar Chart Distribution of The Selected Heavy Metals Concentration (ppm) in Prawn Samples from Gberikoko River.

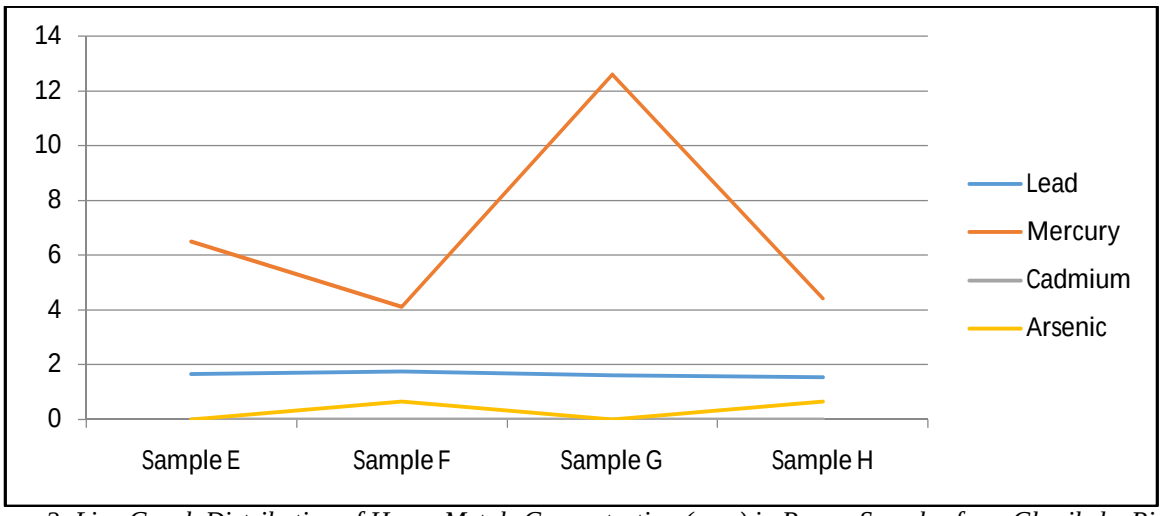

Figure 2: Line Graph Distribution of Heavy Metals Concentration (ppm) in Prawn Samples from Gberikoko River.

4. Data Analysis

Samples	Metal Concentrations			
	Pd	Hg	As	Cd
E	1.66	6.50	0.00	0.00
F	1.75	4.10	0.65	0.00
G	1.62	12.60	0.00	0.00
H	1.54	4.40	0.64	0.00

Groups	Count	Sum	Average	Variance		
Column 1	4	6.57	1.6425	0.007625		
Column 2	4	27.6	6.9	15.58		
Column 3	4	1.29	0.3225	0.138692		
Column 4	4	0	0	0		
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	123.059	3	41.01968	10.43338	0.00116	3.490295
Within Groups	47.17895	12	3.931579			
Total	170.238	15				

Table 2

From the analysis of data from the samples E to H, since $F > F_{crit}$ and $p < 0.05$,there is a significant difference in the mean concentrations of the prawn samples from Delta State.

5. Discussion and Conclusion

Water Body	Lead(Pb)	Mercury(Hg)	Cadmium(Cd)	Arsenic(As)	Source
Gberikoko River	1.64 ±0.21	6.9 ±3.95	0.00 ±0.00	0.65 ±0.53	
WHO/FAO 2004(Maximum levels)	1.5	0.5	0.2	5.0	[29]

Table 3: Comparison of the mean metal concentration (ppm) in prawn specimens with those of FAO/WHO (2004) standards

Mercury had the highest mean concentration and cadmium likewise had the least mean concentration in prawns sourced from Gberikoko River in Delta State (Hg>Pb>As>Cd).

The high concentrations of Mercury and Lead in commercially important prawns sampled from Gberikoko river is a cause of concern and requires regular monitoring of water quality around point sources.

All analyzed metals were present in all samples but values obtained for arsenium and cadmium were below permitted limits set by FAO/WHO, (2004). The general population is primarily exposed to mercury via food, fish being a major source of methyl mercury exposure, and dental amalgam (Sallsten, Thoren, Barregard and Schutz 1996). The concentration of compounds that underwent bioaccumulation may be different; depending on numerous factors such as pollutant concentration and physiochemical forms, properties of semipermeable membranes, the physiological condition of the organism, physical characteristics of the environment, kind and amount of food, level of its contamination, kind of organisms and kind of pollutants (Jastrzebska and Buszewski 1999; Raverao 2001 and Damgard, Larsen and Revsberch 1995).

Therefore the shellfish from the locations containing levels of Lead and Mercury should be a cause for concern to public health analysts, policy makers and general public. The heavy metals can have toxic effects on different organs There is also evidence that certain genetic and environmental factors can increase the detrimental effects of lead on neural development, thereby rendering certain children more vulnerable to lead neurotoxicity (Lidsky and Schneider 2003). A high dietary intake of mercury from consumption of fish has been hypothesized to increase the risk of coronary heart disease (Salonen, Seppanen and Kauhanen 1995)

6. References

i. Adedeji, O.B and Okocha, R.C.(2011).Bioconcentration of Heavy metals in prawns and water from Epe Lagoon and Asejire River in South West Nigeria. JApp Sc in Env Sant. 6 No 3:377-384.
ii. ATSDR (2008).ATSDR Medical Fact Sheet.,Division of Toxicology and Enviromental Medicine. Agency For Toxic Substances and Diseases Registry.Accessed on June 2014 from http://www.atsdr.cdc.govtfacts5.pdf.
iii. Berglund, M., Elinder, C.G., Jarup, L. (2001).Human Exposure Assessment.An introduction.WHO/SDE/OEH/01.3.
iv. Chapman, P.M., Allen, H.E., Z'Graggen, M.N (1996).Evaluation of bioaccumulation factors in regulating metals.Environ Sci Technol 30(10):448A-452A.
v. Clark, R.B., Frid, C., Attrill, M.(1997). Marine pollution 4th edition.Oxford University Press.Oxford chapter metals pp 61-79.
vi. Damgaard, L.R., Larsen, L.H.,Revsberch N.P.(1995).Microscale biosensors for enviromental monitoring. Trends in Anal Chem 14(7),300.
vii. FAO/WHO (2004). List of Maximum levels as recommended for contaminants by the Joint FAO/WHO Codex Alimentarius Commission.
viii. Jastrzebska, A., Buszewski, B.(1999).Application of biomonitoring in ecoanalytics.Chem Inz Ekol 6(11), 1097.
ix. Lidsky,T.I., Schneider, J.S.(2003). Lead neurotoxicity in children basic mechanisms and clinical correlates.Brain J 126:5-19.
x. NRC. (1991).Human Exposure Assesment for Airbone pollutants.Advances and Opportunities.Washington,DC: National Research Council,National Academy Press.
xi. Rainbow,P.S.(2007).Trace metal bioaccumulation:Models,metabolic availaibility and toxicity.Review.Environ Int 33:576-582.
xii. Ravera, O (2001).Scientific and legal aspects of biological monitoring in fresh water. J. Limnol 60(1),63.
xiii. Sallsten, G., Thoren, J., Barregard, L., Schutz, A.(1996).Long term use of nicotine chewing gum and mercury exposure from dental amalgam fillings. J Dent Res 175:594-598.
xiv. Salonen, J.T., Seppanen, K., Kauhanen, J. (1995).Intake of mercury from fish,lipids peroxidation and the risk of myocordial infarction and coronary,cardsiovascular and any death in Eastern Finnish Men,91:645-655.
xv. Weiss, B., Clarkson, T.W., Simon, W.(2002).Silent latency period in methyl mercury poisoining and in neuro degenerative disease.Environ Health Perspect 110(Suppl 5):851-854.