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Heavy Metals Concentration in Prawn (*Macrobrachium Sp)* Harvested from Oron River, in Akwa Ibom State, Nigeria

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Abstract:
The concentrations of Mercury, Cadmium, Arsenic and Lead in prawns (Macrobrachium sp) harvested from Oron river in Akwa Ibom State, Nigeria were studied. It was an analytical study. The heavy metal analysis was done according to the standard methods for heavy metal determination using the FS 240 Varian Atomic absorption spectrophotometer. Each of the specimens were weighed and individually pulverised to a uniform particle size, ten(10) grams of each pulverised sample was taken and subsequently put in a 200ml digestion conical flask. 30ml of aqua regia which constitutes 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 water bath at approximately 120^oC until the whole sample dissolves 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 analysis of the samples indicated presence of heavy metals but values obtained for arsenium and cadmium were below permitted limits set by FAO/WHO. Lead had the highest concentration in sample C, with 49.93ppm. Also, the analysis recorded highest value of Lead and lowest value of Arsenic with values of49.78±0.11and0.17±0.09 respectively. For Mercury, the highest concentration occurred in sample A and lowest in samples C and D, with concentration of 5.9ppm and 2.2ppm respectively. Arsenic recorded its highest concentration in sample C and lowest in sample B with concentration values of 2.0ppm and 0.3ppm respectively whereas Cadmium's concentration was highest in sample D and lowest in sample A with concentration values of 0.27ppm and 0.08ppm, respectively. The statistical analysis shows a significant difference at $\alpha_{0.05}$ in the mean concentrations of heavy metals recorded in the prawn samples from Oron river, Akwa Ibom State

Keywords: *Prawn, atomic, absorption, spectrophotometer, concentrations, pulverized*

1. Introduction

The term 'Heavymetals' refers to any metallic element that has a relatively high density and is toxic or poisonous at low concentrations. Examples include Mercury (Hg), Cadmium (Cd),Arsenic(As), Chronium (Cr),Thallium(Ti) and Lead(Pb) which enter our bodies through food, water,air. 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). As trace elements, some heavy metals such as copper, zinc, selenium are essential to the metabolism in the human body, however at higher concentrations, they can lead to poisoining. Essential metals at high concentrations can have sublethal toxicity effects to some organisms or lethal concequences to others; also metals at different concentrations can have again adverse health effects. Thus essential metals can have a double "toxic" threshold (Rainbow, 2007).Heavy metals are dangerous due to their immutable nature and in contrast to many organic pollutants which are biodegradable, heavy metals can remain in the enviroment for a long time. Half life of lead in blood is about 1 month and 20 – 30 years in the skeleton (WHO 1995).. Adedeji and Okocha,(2011) has shown that heavy metals in aquatic enviroment can accumulate in biota such as prawns which are an important food source for larger animals from fish to whales. 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, 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; Ravera, 2001 and Damgard,Larsen and Revsberch, 1995).Such records are easily established from studies involving bioindicators. Example of bio-indicators are grasses, mosses, lichens, fungi and algae used often in analysis of atmospheric depositions, soil quality and water purity (Jastrzebska and Buszewski, 1999; Conti, 2001).

Prawns are mainly found in the oceans.Usually they live up to depths of fifty (50) meters and usually found in rocky substratum or under rock crevices. Fresh water prawns of the genus *Macrobrachion* are decapod crustaceans belonging to the family *Paaemonidae.* The *palaemonids* and *penaeids* have been globally identified as foremost in terms of economic importance.Of about 200 species that make up the genus, four(4) species have been reported in Nigeria.They are *Macrobrachium vollenhovenii* (African river prawn), *Macrobrachium macrobrachion* (Brackish water prawn), *Macrobrachium felicinum* (Niger river prawn) and *Macrobrachium dux* (Congo river prawn) with the first two being the two largest species.These two species have been described to possess the highest commercial potential. Other species can be ranked as important in small scale shrimp sector in that they can be harvested for sale. They include *Desmocaristrispinasa* (Guinea swamp shrimp), *Palaemonmaculates* (Zaire prawn) and *Palaemonetes africanus* (Creek shrimp) (CERHD, 2007).

Pollution of the marine environment by heavy metals has long been recognized as one of the important pollutants posing a threat to the marine organisms (Adedeji and Okocha, 2011). Consumption of prawns from rivers and streams polluted by heavy metals by humans is thought to lead to disorders or diseases like liver dysfunction, heart failure, food poisoining, skin cancer and internal cancers (liver, kidney, lungs),cardiovascular disease, diabetes, anaemia as well as reproductive abnormalities, immunological and neurological effects in the human body. There is no evidence that cadmium is either biologically necesary or benficial (Nordberg, Jin and Bernard 2002). At low concentrations, it is toxic to all life, including plants, fish, birds, mammals (including humans) and micro organisms (ATSDR 2008). A high dietary intake of mercury from consumption of fish has been hypothesized to increase the risk of coronery heart disease (Salonen, Seppanen and Kauhanen, 1995) . 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). Hence, it is necessary to monitor the concentration of these contaminants in prawns so that the public will be alerted when the concentration levels exceed the threshold limits.

Considerng the enormous public health implications of heavy metal contamination in surface water bodies, it becomes imperative to determine the concentration of heavy metals in prawns harvested from Oron river, Akwa Ibom State.

2. Methodology

2.1. Study Area

Oron river is located in Akwa Ibom state, Nigeria. Akwa Ibom was created in 1987, located in the coastal South Southern part of the country between latitude $4^{o}321$ and $5^{o}331$ North and longitude $7^{o}251$ and $8^{o}251$ East. Oron town is the third largest city in Akwa-Ibom state after Uyo and Eket. It has a population of around 250,000 people living within the city. Lying on the Cross River, Oron has a seaport and a Maritime Academy.The predominant occupation of the people is fishing and farming. Oron is found in the flood plain of Eastern Nigeria,with the land mainly intersected by numerous streams and tributaries flowing into Cross River. The entire coastline stretches from Uya Oron to Udung Uko. Oron is in the tropical region and has a uniformly high temperature all the year round. The two main seasons are the dry season which spans between October and April and wet season which starts around May and ends in September. There are also two prevailing winds- the South-West onshore winds which brings heavy rains and the North-East trade wind blowing across the Sahara Desert,which brings in the dry season.

Oron is rich in oil and natural gas. Most of its oil rewserves are offshore. There are 25 corked oil wells. Oron is presently rated as having one of the highest supplies of natural gas deposits in sub-Saharan Africa with large amounts of untapped natural gas and oil at Ukpata, Udung Okung and Edik Ekpu. The people have a distinct Oro language, although many speak and understand the ibibio language.

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 .In the laboratory,the specimens were analysed immediately.

The weight, number of segments as well as the total lenght 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 and subsequently put in a 200ml digestion conical flask. 30ml of aqua regia which constitutes 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 dissolves and a yellow tint of the solution appears as the digest appears. 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.Heavy metal concentration for all preparations were determined by using the Atomic absorption spectrophotometer respective lamps and wavelenghts.The values of heavy metals were expressed in parts per million(ppm) for prawn samples.

3. Results

3.1. Data Presentation

Sample	Lead(ppm)	Mercury(ppm)	Arsenic(ppm)	Cadmium(ppm)
A	49.74	5.9	1.0	0.08
B	49.68	2.7	0.3	0.22
C	49.93	2.2	2.0	0.11
D	49.81	2.2	1.6	0.27
Mean	49.78±0.11	3.25±1.78	0.17±0.09	1.23±0.74

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

Table I shows the concentration of the heavy metals analyzed for with the mean value amongst four prawn samples from Akwa Ibom State. Traces of all analyzed heavy metals were found in all four prawn samples from this location. Lead had the highest concentration in sampling point C, with concentration of 49.93ppm. Also, the prawn samples exhibited the highest value of mean under Lead and lowest value of mean under Arsenic with values of 49.78±0.11and0.17±0.09 respectively. For Mercury, the highest concentration occurred in sample A and lowest in samples C and D, with values of 5.9ppm and 2.2ppm respectively. Arsenic showed its highest concentration in sampling point C and lowest in sample B with concentrations of 2.0ppm and 0.3ppm respectively whereas Cadmium's concentration was highest in sampling point D and lowest in sample A with concentration values of 0.27ppm and 0.08ppm, respectively.

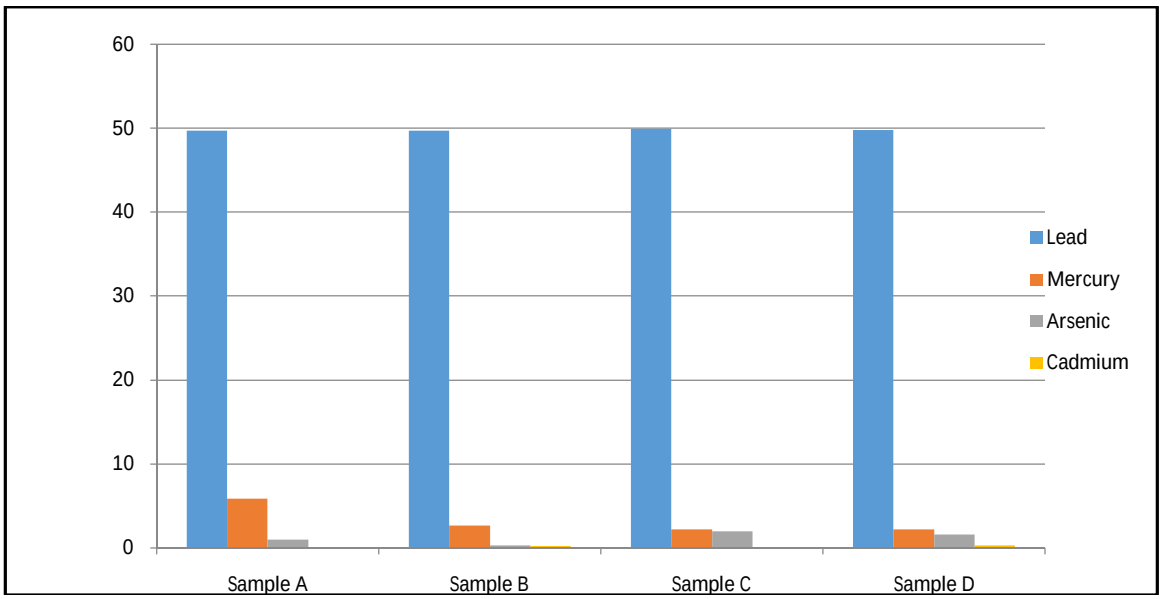

Figure 1: Bar Chart Distribution of the Selected Heavy Metals Concentration (ppm) in Prawn Samples from Oron River.

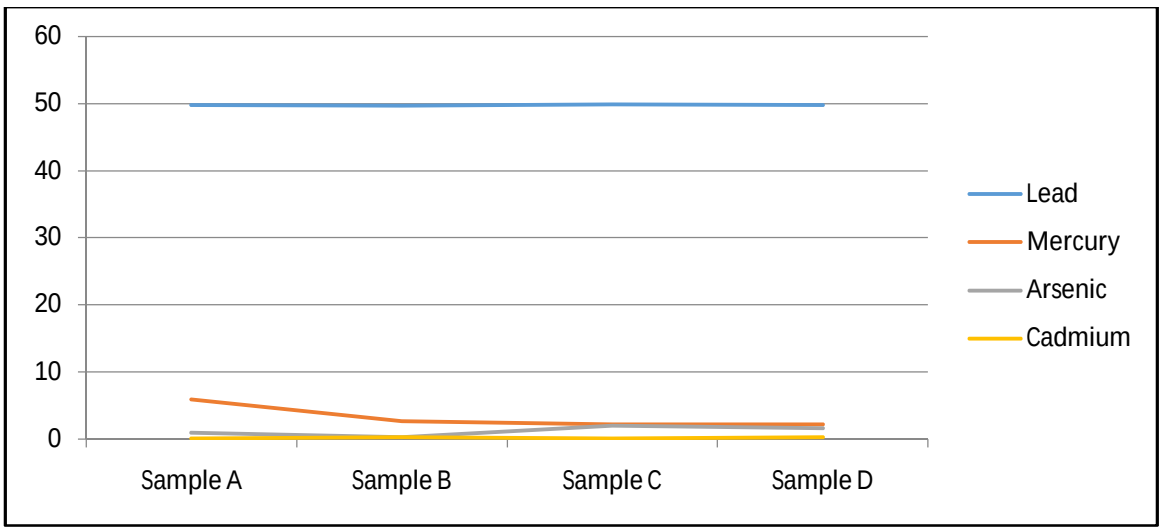

Figure 2: Line Graph Distribution of Heavy Metals Concentration (ppm) in Prawn Samples from OronRiver.

4. Data Analysis

Samples	Metal Concentrations(ppm)			
	Pd	Hg	As	Cd
A	49.74	5.90	1.00	0.08
B	49.68	2.70	0.50	0.22
C	49.93	2.20	2.00	0.11
D	49.80	2.20	1.60	0.27

Groups	Count	Sum	Average	Variance
Column 1	4	199.15	49.7875	0.011425
Column 2	4	13	3.25	3.176667
Column 3	4	5.1	1.275	0.435833
Column 4	4	0.68	0.17	0.008067

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6995.705919	3	2331.902	2568.18	4.14E-17	3.490295
Within Groups	10.895975	12	0.907998			
Total	7006.601894	15				

Table 2

The analysis of data from the samples A to D, since $F > F_{crit}$ and $p < 0.05$, shows a significant difference in the mean concentrations of the prawn samples from Akwa Ibom State

5. Discussion and Conclusion

Water Body	Lead(Pb)	Mercury(Hg)	Cadmium(Cd)	Arsenic(As)	Source
Oron River	49.78 ±0.11	3.25 ±1.78	0.171 ±0.09	1.23 ±0.74	
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

The findings of this work clearly indicate that there were high concentrations of Mercury and Lead in commercially important prawns sampled from Oron river. Pollution of the marine environment by heavy metals has long been recognized as one of the important pollutants posing a threat to the marine organisms (Adedeji and Okocha.2011). The general population is primarily exposed to mercury via food, fish and dental amalgam being major sources of methyl mercury exposure (Sallsten, Thoren, Barregard and Schutz,1996), This calls for urgent regulations in order to maintain water quality. Specifically, the result of this study indicates that of all the metals analysed in prawn samples from Oron river in Akwa Ibom state, lead has the highest concentration while cadmium had the least mean concentration (Pb>Hg>As>Cd). 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 Schneier 2003). Adults take up to 10 - 15% of lead that is ingested whereas pregnant women and children may absorb up to 50% via the gastrointestinal tract. Lead in blood is bound to erythrocytes and elimination is slow released from this body compartment. Half life of lead in blood is about 1 month and 20 – 30 years in the skeleton (WHO 1995).

The analysis of the samples indicated presence of heavy metals, but values obtained for arsenium and cadmium were below permitted limits set by FAO/WHO, (2004). At low concentrations, cadmium is toxic to all life, including plants, fish, birds, mammals (including humans) and micro organisms (ATSDR 2008).(Bergmann, Couillard, Doyle and Dixon 2005) carried out a study that used comparative acute toxicity testing of 63 heavy metals, cadmium was the most toxic metal. This points to the fact that the shell fish can be a source of health hazarads if adequate precautions are not taken.

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