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Variation of the concentrations of some heavy metal ions in fish and shrimps samples from Urua Otor Market in Ikot Ekpene LGA of Akwa Ibom State, Nigeria

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ABSTRACT

Background: Expeditious expansion and industrial development near the rivers have led to more stress on the river and with increased stress, the water becomes polluted with organic and inorganic substances such as organometallic compounds, cadmium and lead. The aquatic organisms, including fish and shrimps consumed from these rivers transfer of these metals into the human system which may be toxic to humans at some certain concentrations. This research work was undertaken to examine the variation of the concentrations of some heavy metal ions in fish and shrimps samples from Urua Otor Market in Ikot Ekpene, Akwa Ibom State Nigeria.

Methods: The samples obtained from Urua Otor Market in Ikot Ekpene, Akwa Ibom State, Nigeria were rapped with aluminium foil and stored at -4 °C for analysis. Dry ashing and acid digestion methods were employed in this work. AAS was used for the determination of the metal ions.

Results: Pearson correlation statistics was employed for the analysis of the results. The study showed that the heavy metal concentrations in both fish and shrimp were high with Zn 22.260 mg/kg and 43.06 mg/kg respectively. Cd were found to be the least with 2.005 mg/kg and 2.505mg/kg in fish and shrimp respectively. A strong significant and positive correlation ($p \leq 0.05$) were observed between both samples of fish and shrimp; $R^2 = 0.9333$.

Conclusion: The R^2 value of 0.9333, suggested that both organisms had a common contamination source. All the analyzed heavy metal ions were divalent except Cr^{3+}, suggesting that the effect of ionic radius might have over ridden that of the charge; thereby affecting the adsorption of those heavy metal ions

Keywords: Heavy metals, fish, shrimp, variation

1. INTRODUCTION

As a result of some human activities such as industrialization and the exploitation of the earth's natural resources the environment had been seriously polluted. Such pollutants include organic and inorganic pollutants; among the inorganic pollutants are some heavy metals. Heavy metals are those metals with density greater than 5 g/dm3. According to Ukpe and Ogoko [1] heavy metals pollution in aquatic environment could be due to improper dumping of waste and subsequent decomposition within the aquatic system. According to Jessica et al., [2] these inorganic pollutants are also being discarded into waters, soils and into the atmosphere due to the rapidly growing agricultural and metal industries, improper waste disposal, fertilizers and pesticides. Heavy metals in lakes, rivers, groundwater, and various water sources, water gets polluted by the increased concentration of heavy metals and metalloids through release from disposal of high metal wastes, growing industrial areas, leaded gasoline and paints, usage of fertilizers inland, animal manures, E-waste, sewage sludge, pesticides, wastewater irrigation, coal, etc. The aim of this study is to determine the level of heavy

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metal in fish and shrimps obtained from Urua Otor in Ikot Ekpene. These metal ions most often are consumed by aquatic organisms which bioaccumulate in their tissue since they cannot be degraded. When consumed, these metal ions are then transferred into the human system. This then results in exerting it toxicity on human system. The detrimental effects of these pollutants in fish had been documented by Akinmoladun et al., [3]. The pattern of accumulation of these heavy metals differs according to the fish species and the levels of bioaccumulation of contaminants are higher in fish which comes higher in food chain, [4]. Hasan et al., [5] had documented the adverse effects of some heavy metals on human health that may occur through the consumption of fish contaminated with trace metals, and some diseases associated with these trace metals. For instance, mercury had been implicated in neurological effects; cadmium causes carcinogenic diseases, while lead is a neurotoxin that causes a behavioral deficit in vertebrates which can lead to a decrease in survival, growth rate and learning in humans.

2.0 MATERIALS AND METHOD

2.1 Materials

2.1.1 Samples

The fish and shrimp samples were obtained from Urua Otor Market in Ikot Ekpene LGA of Akwa Ibom State. They were then rapped with aluminium foil and taken to the laboratory where they were stored at -4 °C for further work and analysis.

2.1.2 Reagents

All the chemicals used were of the highest purity and all solutions were prepared using doubly distilled water.

2.2 Methods

2.2.1 Sample Preparation

2.2.1.1 Methods of Digestion

The digestion methods employed in this study were acid digestion and dry ashing. Each of the samples were placed in a crucible and dried at 105°C in an oven with assisted air circulation to remove all residual water before ashing. The crucible was then placed in the muffle furnace and gradually heated (50°C every 30 min) from room temperature to 550°C and ashed for two hours. After cooling, the residual ash was dissolved in 8 ml of HNO_3 and the digests were then solubilised and filtered for instrumental analysis.

2.2.1.2 Instrumentation

To determine the metal ion, Atomic Absorption Spectrophotometer (GBC 932 plus, GBC Scientific Equipment Ltd.) was used.

2.3 Statistical Analysis

Results obtained were presented as the mean of three determinations and standard deviation of the concentrations in (mg/kg). Pearson correlation statistics using Statistical Package for Social Sciences (SPSS version 16) program was used to determine the correlation coefficient of the concentrations of the heavy metal in both the fish and shrimp samples. Statistical significance correlation was taken at ($p \leq 0.05$) between the different samples.

3.0 RESULTS

Table 1: Concentration of heavy metals ions in fish

Metal ion	Conc. (mg/kg)
Cu	1.145 ± 0.0001
Zn	22.260 ± 0.0045
Pb	0.240 ± 0.0003
Ni	4.880 ± 0.0061
Cr	8.620 ± 0.0093
Cd	2.005 ± 0.0023
Co	6.015 ± 0.0081

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Table 2: Concentration of heavy metals ions in shrimp

Metal ion	Conc (mg/kg
Cu	6.595 ± 0.0043
Zn	43.060 ± 0.0230
Pb	2.135 ± 0.0031
Ni	8.830 ± 0.0149
Cr	14.280 ± 0.0079
Cd	2.505 ± 0.0032
Co	20.060 ± 0.0175

Table 3: Mean concentration of fish and shrimp sample in mg/kg

Metal ion	Fish (mg/kg	Shrimp (mg/kg)
Cu	1.145	6.595
Zn	22.26	43.06
Pb	0.240	2.135
Ni	4.880	8.830
Cr	8.620	14.280
Cd	2.005	2.505
Co	6.015	20.060

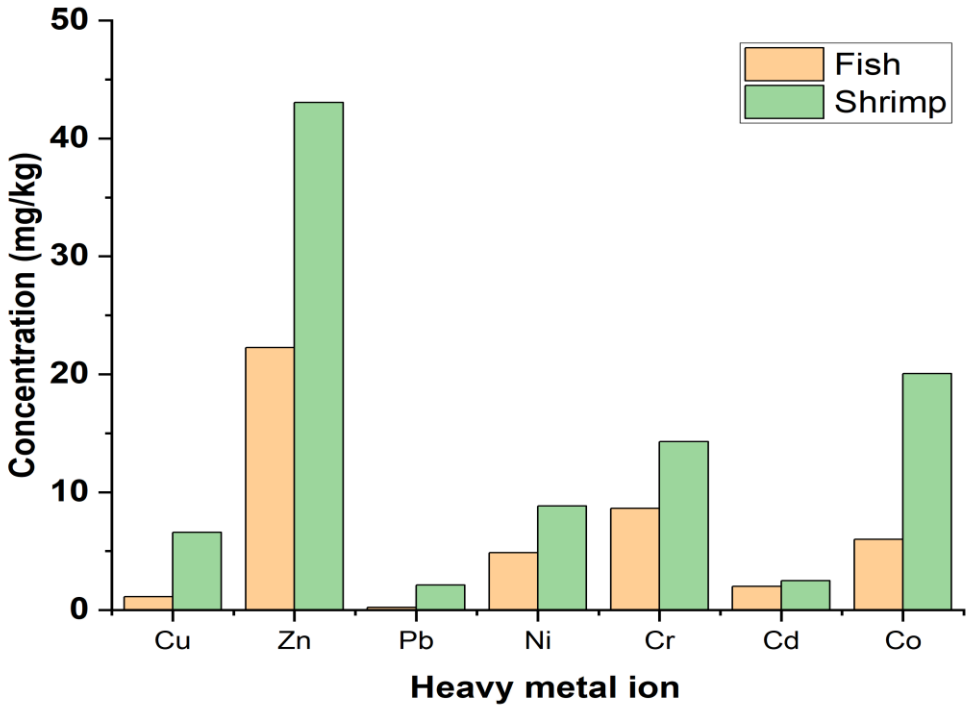

Figure. 1: Variation of the concentrations of some heavy metal ions in shrimps and fish samples from Urua Otor Market in Ikot Ikpene

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4.0 DISCUSSIONS

Table1 shows the Concentration of heavy metals ions in fish while Table 2 shows the Concentration of heavy metals ions in shrimp. Table 3 show the Mean concentrations of fish and shrimp sample in mg/kg. These are also represented in Figs 1, 2, and 3 respectively. Fig. 1 shows the variation of the copper, zinc, lead, nickel, chromium, cadmium and cobalt concentrations in fish and shrimp samples. From the plot, the most abundant heavy metal ion in the two samples is Zn^{2+} while the least is Pb^{2+}. Zn^{2+} showed mean maximum concentration of 22.20 and 43.06 mg/Kg in fish and shrimp samples respectively. The significant difference between the mean concentrations of zinc in the two samples suggest that the enrichment percentage of fish and shrimp are not the same concerning Zn^{+}. Cd^{2+} showed measured concentrations of 2.005 and 2.500 mg./kg in fish and shrimp respectively. Observed mean concentrations of copper ions were 1.145 and 6.595 mg/kg in fish and shrimp samples respectively while Pb^{2+} showed concentration average of 0.240 and 2.135 mg/kg in the respective samples. Ni^{2+} also showed a significant presence in fish (mean = 4.800 mg/kg) and in the shrimp samples (mean = 8.830 mg/kg). However, the concentrations of Cr^{3+} in the fish (8.620 mg/kg) and shrimp (14.280 mg/kg) were relatively higher than those observed for Ni^{2+}, Pb^{2+}, Cu^{2+} and Cd^{2+} but lower than those of Co^{2+} (which recorded concentrations of 6.015 and 20.060 mg/kg). One of the significant factors that can affects the concentrations of heavy metals in marine organism is the charge and size of the ions [6], [7]. However, all the analyzed heavy metal ions are divalent except Cr^{3+}, indicating that the effect of ionic radius would override that of charge. The ionic radium of Cu^{2+}, Zn^{2+}, Pb^{2+}, Ni^{2+}, Cr^{3+}, Cd^{2+} and Co^{2+} are 73, 74, 140,63, 75.5, 97 and 79 ppm respectively. In most cases, the lower the ionic radius, the higher the tendency towards adsorption and penetration into the flesh [8]. However, there was no perfect correlation between ionic radius and concentrations of heavy metal in both fish and shrimps. This implies that other factors (such as biochemical factors, species of organism) must have played some leading roles in the determination of the concentrations of heavy metal ions in fish and shrimps. Pearson correlation coefficient for the concentrations of the heavy metal in both the fish and shrimp samples were 0.9660 indicating a strong significant and positive correlation ($p \leq 0.05$) between the different levels of heavy metal ions in both samples. Descriptive statistical analysis of the mean concentrations in both samples showed that the means values for the fish and shrimp samples were 6.4521 and 13.9235 mg/kg indicating that the shrimp showed higher levels of concentrations, even with higher deviation (14.3511) than the fish (7.5695) samples. Also, R^2 values obtained from the plot of concentration of the heavy metal in the fish against concentrations in the shrimp gave 0.9333, which also suggest that both organisms have a common contamination source.

5.0 CONCLUSION

This study evaluated the variations of some heavy metals in fish and shrimp obtained from Urua Otor Market in Ikot Ekpene Local Government Area of Akwa Ibom State. According to the findings, the highest concentrations of the metals were that of Zn in both fish and shrimp while Pb was least in both fish and shrimp. The concentrations however were found to be within the acceptable limit in food samples. Considering the bio-accommodation and bioavailability of these metals in the human body, the result can be concluded that there is no risk for continuous consumption from the source; and it is therefore recommended that appropriate measures be taken to constantly monitor the presence of these metals in fish shrimp species as it may affect human health.

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Conflict of interest
The author has no relevant financial or non-financial interests to disclose.

Contribution of the authors
The work was designed by Dr. Richard A. Ukpe. The initial draft was also written by the author who also carried out the benchwork.

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