International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 8, Issue 5 -2021

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.05.007

Determination of the level of iron, lead and copper in shrimps in Ogbe-Ijoh River

Okuda F.A.,* Orogu, J.O., Isoje, E.F and Malumi S.
Department of Science Laboratory Technology, Delta State Polytechnic Ozoro, Delta State, Nigeria

Corresponding author's - Okuda F.
E- mail: *okudafrank@gmail.com*

Abstract

Heavy metals are natural components of the Earth's crust. Trace amounts of some of them, including cobalt, copper and zinc, are essential micronutrients maintaining critical metabolic functions, while excessive levels can have detrimental effects. In contrast, other heavy metals such as mercury, lead and cadmium have no known vital or beneficial effect on organisms, but may have severe adverse impacts. The possible bioaccumulation of heavy metals in Shrimps was ascertained for dry and rainy seasons through laboratory analysis of concentration of Iron, Lead and Copper in fresh samples of Shrimps. Shrimps consisted of slightly different result for both season (dry and rainy) (0.002mg/kg and 0.002mg/kg), (2.815mg/kg and 2.86mg/kg) and (0.058mg/kg and 0.06mg/kg) of Lead, Iron and Copper respectively. Results indicates that seasonal variations play major roles in bioavailability of heavy metals in Shrimps. Water pollution by heavy metals resulting from anthropogenic impact has caused serious ecological problems in many parts of the world. This situation is provoked by the lack of natural elimination processes for metals. Effluents discharge into water bodies should be avoided for the sake of bioaccumulation of heavy metals.

Keywords: Water pollution, Heavy metals, Shrimps, ecological problems.

Introduction

Crustaceans form a large, diverse arthropod taxon which includes such familiar animals as crabs, lobsters, crayfish, shrimp, krill, woodlice, and barnacles. Crustaceans, such as crabs, lobster and shrimp have an exoskeleton as opposed to a true shell. The exoskeleton comprises of protein, chitin and calcium carbonate. It is made of separate plates which are connected by a thin membrane; this creates joints allowing the crustacean to move (Brandi, 2007).

Crustacean take in hazardous materials such as heavy metals, PCB, chlorinated paraffins, PAHs and pesticides which the body either stores or excretes. By storing it, the concentrations of those toxic materials in the body can increase and become greater than in the surrounding environment. This phenomenon is called bioaccumulation (Olowu, *et al.*, 2011). The accumulation of heavy metals in organisms is as a result of direct uptake from the surroundings across the body wall, from respiration or food. There is an increasing concern about the health effect in human due to continuous consumption of food contaminated with heavy metals (Chukwujindu *et al.*, 2008).

The oil exploaration activities in the region has contributed greatly to the contamination of heavy metals in the river as many of these companies discharge their wastes solid, liquid and gaseous effluents containing toxic concentration of heavy metals into the environment without any prior treatment (Odukoya and Ajayi, 1987; Jibrin and Adewuji, 2008; Oyewo, 2003).

Marine products contain many elements which are essential for human life at low concentration. However, they can become toxic at high concentrations. However, certain heavy metals such as mercury, cadmium and lead do no show essential functions in life and are toxic even at low concentration when ingested over long period. These metals were present in the aquatic environment long before human being existed. The proportion between the natural background concentration of heavy metals and anthropogenic heavy metals in aquatic organism varies from element to element. In unpolluted areas, aquatic organisms normally carry natural burden of heavy metal concentration. In heavily polluted areas, the heavy metal concentrations actually found are exceeding the natural concentration (Kalay *et al*., 2006). Aquatic organisms take up heavy metals from their food and water that passes through their gills. Accumulation takes a long time and may result in high concentrations in aged organisms. Some species, which are relatively long lived, are known for storing higher amounts of heavy metals in different organs. This work is aimed at determining the level of Lead, Copper, and Iron in shrimps in Ogbe-Ijoh, River.

Materials and Methods

Study area

Ogbe-ijoh is a community in the coastal part of Delta State and remains the administrative headquarters of Warri South West Local Government. Geographically, it is situated at Latitude $N5^{O}28^{I}40.1^{II}$ to $N5^{O}29^{I}02.2^{II}$ and Longitude $E5^{O}44^{I}10.4^{II}$ to $5^{O}44^{I}14.0^{II}$. Ogbe-ijoh is located at the banks of one of the distributaries of the Warri River which joins and enters the Forcadoes River. It is a low-lying land which a height of 5m above mean sea level and a gradient which decreases towards the river. The occupation of inhabitants is mostly fishing, water transportations and sand dredging. However, recent times has birthed the banks which industrial activities which has seen pollution levels rise above permissible limits. The community manages an average rainfall of 3000mm per annum and a temperature exceeding $34^{O}C$. this community used to be the highest producers of crustaceans during the past due to shrimping activities by the natives.

Collection of sample/preparation

Freshly caught samples of shrimps were obtained from Ogbe-ijoh River and used for determination of the level of Iron, Lead and Copper. The grab method was deployed in collection of these samples and stored in the freezer prior to use.

Each species of sample was properly rinsed with distilled water to remove sand, debris and other external adherents. Prior to analysis, each set of samples were oven dried and crush in a mortar using a pestle to fine particles before being sieved.

Materials

The following are the materials used in carrying out the experiment.

Table 1: List of Apparatus Used for Analysis

Material	Manufacturer	Chemical Formula
Measuring Cylinder	Pyrex	-
Beaker	Pyrex	-
Distilled Water Holder	Pyrex	-
Stirring Rod	Pyrex	-
Volumetric Flask	Pyrex	-
Mortar	-	-
Pestle	-	-
Sieve	-	-
Filter Paper	-	-
Oven	-	-
Atomic Absorption Spectrophotometer-Varian 200		
Hydrogen Trioxonitrate (v) Acid	-	HNO_3
Distilled water	-	H_2O
Hydrofluoric Acid	-	HF
Perchloric Acid	-	$HCLO_4$

Table 2: List of Parameters Analyzed per Season

S/N	PARAMETERS
1	Lead
2	Iron
3	Copper

Method

The determination of the level of Iron, Lead and Copper in Shrimps in Ogbe-Ijoh River was conducted as follows;

Digestion of sample and analysis

To isolate the trace metals from the food samples, the organic matter content of the organisms was destroyed by wet digestion. 2.0g of each dried sample was weighed into a $300cm^3$ conical flask. 1ml of concentrated $HCLO^4$, 3ml of HNO_3 and 1ml of Concentrated HF was then added under a fume hood. The flask was then heated until a dense white fume appeared. It was lately heated strongly for 30seconds. The flask was allowed to cool afterwards and 40-50ml of distilled water was then added. The resulting solution was later filtered completely with a wash bottle into a 100ml pyrex volumetric flask. The solution was then made up to the 100ml mark with distilled water. The sample extract and the standard solution were both aspirated into the air-acetylene flame of varian 200 Atomic Absorption Spectrometer.

Results

The following are the result gotten from laboratory analysis of Iron, Lead and Copper concentrations of Shrimps in Ogbe-Ijoh River.

Table 3: Iron, Lead and Copper Contents of Shrimps in the dry Season

S/N	Iron, Lead and Copper Content (mg/kg)		
	Parameters	**Shrimps**	**WHO 2011**
i	Iron	3.623±0.007	0.4
ii	Lead	0.025±0.000	0.2
iii	Copper	0.123±0.004	0.2

Table 4: Iron, Lead and Copper Contents of Shrimps in the rainy Season

S/N	Iron, Lead and CopperContent (mg/kg)		
	Parameters	**Shrimps**	**WHO 2011**
i	Iron	3.380±0.040	0.4
ii	Lead	0.045±0.000	0.2
iii	Copper	0.037±0.001	0.2

Discussion

Several researches revealed heavy metal content in crustacean, the source of these heavy metals, the toxic effect of heavy content and the effects on man who in turn consumes them. Heavy metals such as iron, copper and lead are toxic metals which affect the nervous systems and causes damaging effect to the brain and kidney. These toxic chemicals find their way into water stream by domestic activities such as disposal of waste paint materials, batteries and galvanized pipes. Most of these metals become dissolved in water due to the acidic nature of most marine habitats. Industrial discharge of waste is another major contributing factor.

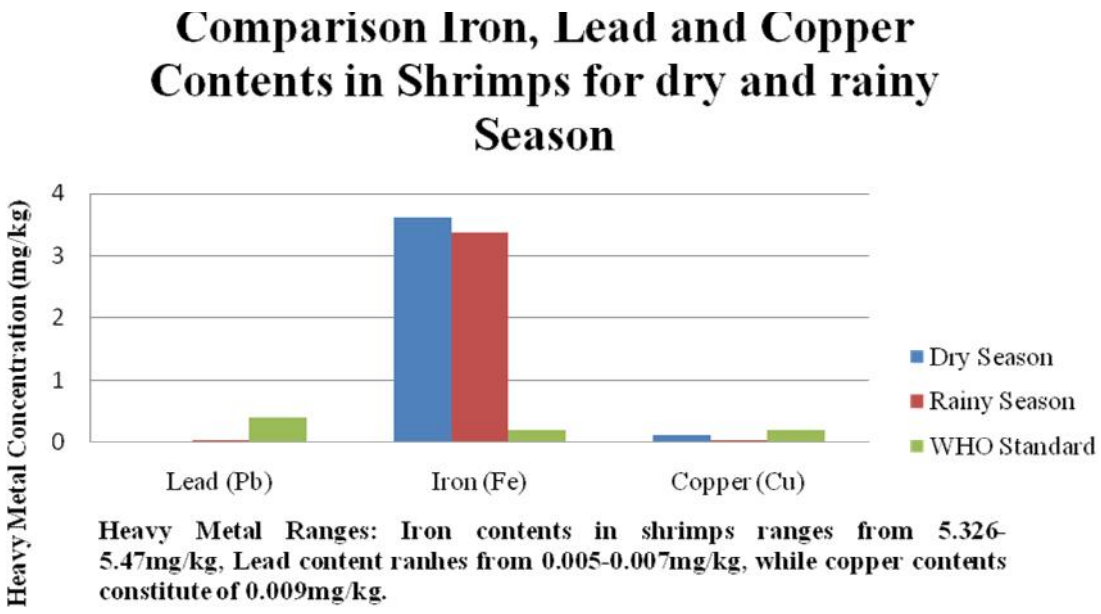

Figure 1: Comparison of Iron, Lead and Copper Contents in Shrimps for dry and rainy season.

The presence of heavy metals in shrimps is an indication of bioaccumulation by these marine organisms. It was observed from laboratory analysis that the concentration of observed values (3.62mg/kg) of iron contents in shrimps was significantly higher than values by internationally recommended limits (0.2mg/kg). Similar study by Mitra *et al.*, (2012), reveals distribution of iron and other heavy metals in shrimps and attributes the presence of these metals factories and industries along the river bank. The presence of this content is as a result of constant corrosion processes of boats and vessels as well as waste discharge. However, smelting and refining of metals, steel manufacturing, and metal plating that mobilized iron by the human activities may lead to the iron contamination in marine environment. These human activities will release iron and its runoff to the aquatic system. Much of this iron is in the form of suspended particulates in water. Other heavy metals such as copper and lead were also found in minute amounts and within allowable limits. Lead (Pb) is physiological and neurological toxic to humans. Acute Pb poisoning may results in a dysfunction in the kidney, reproduction system, liver and brain resulting in sickness and death (Odum, 2000). Pb heads the threats even at extremely low concentrations (Kazemipor, 2008). A notably serious effect of lead toxicity is its teratogenic effect. Lead poisoning also causes inhibition of the synthesis of haemoglobin; cardiovascular system and acute and chronic damage to the central nervous system (CNS) and peripheral nervous system (PNS).

It is therefore of concerns to consumers of shrimps to be watchful as excess intake can result in serious health effects.

Conclusion and Recommendations

Conclusion

These results show the presence of Iron, Lead and Copper in shrimps which are attributed to anthropogenic activities and concentrations increase which is attributed to seasonal variations. Overall results showed high levels of iron content up to 5mg/kg. Statistical test also shows a no significant different in results from laboratory test on heavy metals contents in crustaceans during the dry and rainy seasons although a slight increase was observed.

Recommendations

From the above given conclusion, it is hereby recommended that Effluents discharge into water bodies (especially Ogbe-Ijoh River) should be avoided for the sake of bioaccumulation of heavy metals.

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Website: www.ijarbs.com

Subject: Aquatic Biology

Quick Response Code

DOI:10.22192/ijarbs.2021.08.05.007

How to cite this article:
Okuda F.A., Orogu, J.O., Isoje, E.F and Malumi S. (2021). Determination of the level of iron, lead and copper in shrimps in Ogbe-Ijoh River. Int. J. Adv. Res. Biol. Sci. 8(5): 56-61.
DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.05.007