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# A COMPARATIVE STUDY ON HEAVY METAL CONCENTRATION IN CRAB (*Callinectes amnicola*) OBTAINED FROM IBENO, AKWA IBOM STATE, AKPABUYO AND NSIDUNG, CROSS RIVER STATE

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## ABSTRACT

This study was an analytical study. A reconnaissance survey was performed on the basis of which sampling points were established. A Global Positioning System (GPS) was used to establish Coordinates and elevation of the sampling points. 25 g of wet tissue (5 g dry weight) were measured into crucible, samples were dried at 135 °C for 2 hours and the dry weight was obtained. The samples were then transferred to a cool muffle furnace and the temperature was slowly raised to 450°C-500°C. Samples were removed, left to cool to room temperature and 2 ml $HNO_3$ was added and swirled before subjecting them to Atomic Absorption Spectrophotometeric(AAS Model FS 240 Varian) analysis to obtain the readings. The mean concentration of Cadmium in the crab was 0.383±0.23ppm. Arsenic had the highest mean concentration of 28.5±40.11ppm, while Nickel had the lowest mean concentration of 0.315±0.35. Chromium was below detectable limit in crabs from Akpabuyo and Nsidung rivers, and so was Nickel in crab from Nsidung river. The mean concentration of cadmium (0.2, 0.64, 0.31) and nickel (0.02, 0.610, ND) in crabs from the three rivers: Ibeno, Akpabuyo and Nsidung, was observed to be within the range of WHO standard for heavy metals in water and aquatic foods, while lead in crabs from all locations had higher mean concentrations of heavy metals, with the exception of chromium in crabs from Akpabuyo and Nsidung which were below detectable limit. The presence of these contaminants in shellfish in high concentrations can prove harmful to man and other organisms.

**Key words: Heavy Metals, Crab, Contaminants, Reconnaissance, Spectrophotometeric, Concentration**

## INTRODUCTION

Cadmium, lead, mercury, arsenic, copper, zinc, and chromium are metals of considerable health and environmental concern. They have been the subject of major studies as a result of the toxicity associated with them in the environment. Once absorbed, metals tend to accumulate in certain organs and tissues rather than distributing uniformly through the body (As-Mohana and Subromanyam 2001; Chou *et al*. 2002; Ayejuyo *et al*. 2005). The discharge of hazardous wastes into the Nigerian environment is legendary and the ultimate recipient is the water body known to be the habitat of many organisms including crabs. Crabs belong to the largest group of animals called arthropods, or joint legged animals. More specifically, they are decapods crustaceans meaning that they are arthropods with ten legs and hard shell. Crabs are related to lobsters and shrimps. They are edible and serve as a very good source of protein, vitamin B12, zinc, copper, and selenium. Crabs are low in saturated fat. They are also good source of riboflavin, niacin, iron, magnesium, and phosphorus and have high cholesterol and sodium contents (Furk and Wasgnalls 1995). specie of crab belongs to the family portunidae. It is well distributed in almost all fresh water, near the shore, rivers, and marine environment, most of which are likely to be polluted by effluents from domestic, industrial wastes, or pathogenic activities. Crabs are widely consumed in many parts of the world. In this part of the world, crab species could be boiled, grilled, or used for soup preparation as substitute for meat or to supplement protein in the diet. Young and smaller crabs are often consumed entirely without any separation. By nature, crabs have contact with water bodies, most of which have received wastes and therefore capable of harboring some toxicants, especially heavy metals. Trace metals can be accommodated in three basic reservoirs—water, biota, and sediment. Many commercial species and food chain organizations spend a major part of their life cycles living in water or on aquatic sediments, thereby providing a pathway for these contaminants to be consumed by higher aquatic life and humans (Calmano *et al*. 1996). Crabs are marine organisms and its chemical composition of toxicants may be greatly influenced by the environment, especially with increase cases of environmental pollution. Most widespread heavy metals of health and environmental concerns include cadmium, lead, zinc, mercury, arsenic,and chromium (Forstner and Wittman 1993; Seddek *et al*. 1996; Ayejuyo *et al*. 2005). It has been suggested that over one billion human beings are currently exposed to elevated concentration of these toxic metals and metalloids in the environment and several million people may be suffering from metal poisoning (Nnagu 1988). The monitoring of metals in marine organisms is of great importance for protecting the public from hazards of possible toxic effects. Heavy metals suppress the immune system, leading to major diseases in animals. This work provides correlated information on the concentration of lead,

cadmium, zinc, and chromium in various parts of male and female specie of crab *Callinectes amnicola*, with a view to assessing the buildup and distribution of the metals in the organism.

## MATERIALS AND METHODS

### Study area

This study was carried out in three rivers, Ibeno river in Akwa Ibom State, Akpabuyo and Nsidung rivers of Cross River State, Nigeria. Ibeno river in Akwa Ibom State lies between latitudes 4°32'N and 5°33'N, and longitudes 7°25'E and 8°25'E (Onu *et al*, 2021). Akpabuyo River, lies between latitudes N 6° 10' 1.3152", and longitude E 8° 39' 36.2124 in Cross River State. Akwa Ibom State is located in the coastal southern part of the country, in the South-South geopolitical zone, and is bordered on the east by Cross River State, on the west by Rivers State and Abia State, and on the south by the Atlantic Ocean and the southernmost tip of Cross River State (Adamu *et al*, 2015). Akwa Ibom is one of Nigeria's 36 states, with a population of over five million people in 2016. The state was created on September 23, 1987, by Ibrahim Babangida from the former Cross River State and is currently the highest oil- and gas-producing state in the country. The state's capital is Uyo, with over 500,000 inhabitants. Akwa Ibom has an airport and a proposed construction of a seaport at Ibaka, Oron. The state also has a 30,000-seat sports complex which is shaped like the Allianz Arena stadium. Akwa Ibom state is also home to the Ibom E-Library, an information centre. In addition to English, the main spoken languages are Ibibio, Annang, Ekid, Oron and Obolo.

Cross River State derives its name from the Cross River which passes through the state. It is a coastal state located in the Niger Delta region, and occupies 20,156 square kilometers. It shares boundaries with Benue State to the north, Ebonyi and Abia States to the west, to the east by Sud-Ouest Province, claimed by both Ambazonia and Cameroon Republic, and to the south by Akwa-Ibom and the Atlantic Ocean. The state is made up of 18 Local Government Councils. The South-South State was created on 27 May 1967 from the former Eastern Region, Nigeria by the General Yakubu Gowon regime. Its name was changed to Cross River State in the 1976 state creation exercise by the then General Murtala Mohammed regime from South

Eastern State. Its capital is Calabar. Its major towns are Calabar Municipality, Akamkpa, Biase, Calabar South, Ikom, Igede, Obubra, Odukpani, Ogoja, Bekwarra, Ugep, Obudu, Obanliku, Akpabuyo, Ofutop, Iso-bendghe, Danare, Boki, Yala, Bendeghe Ekiem, Etomi, Ediba, Itigidi, Ugep, Ukpe and Ukelle.

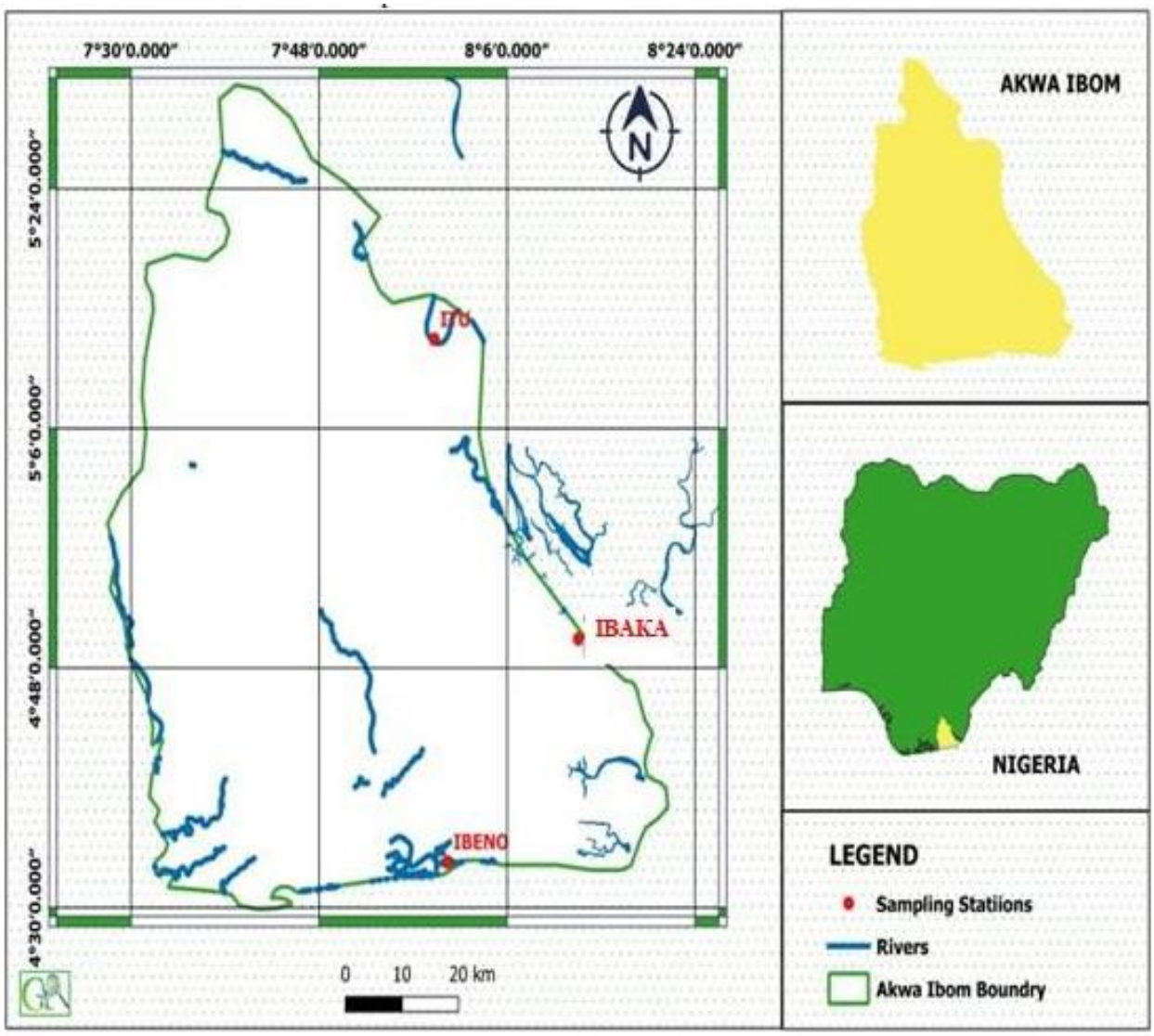


**Fig. 1: MAP OF AKWA IBOM STATE SHOWING IBENO LGA**

**Source: Author**

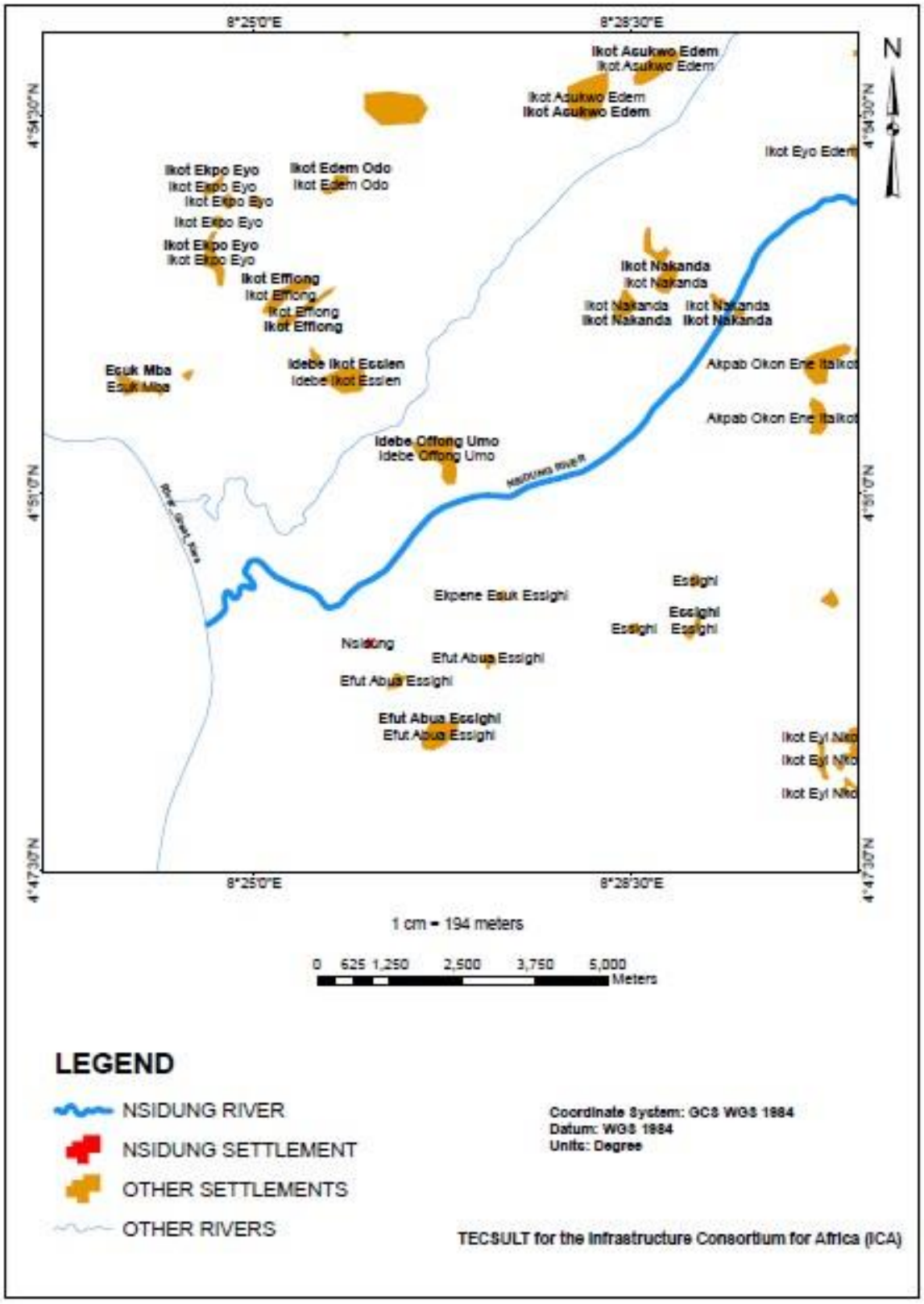


**Fig. 2: MAP OF CROSS RIVER STATE SHOWING AKPABUYO AND NSIDUNG LGA**

**Source: Author**

**Sample Collection and Preparation for Heavy metal analysis**

A reconnaissance survey was performed to have first-hand information on the study area and to establish the sampling points. A Global Positioning System was used to establish Coordinates and elevation of sampling points. Water, sediment and shellfish (Crab) samples were collected from Ibeno river in Akwa Ibom State, Akpabuyo and Nsidung Rivers in Cross River State respectively. Sample sites were selected based on the nature of anthropogenic activities carried out in the area. Crab samples were picked randomly, washed thoroughly and placed in an ice pack with ice cubes for preservation then taken to the laboratory for analysis. 25 g of wet tissue (5 g dry weight) were measured into crucible, samples were dried at 135 °C for 2 hours and the dry weight was obtained. The samples were then transferred to a cool muffle furnace and the temperature was slowly raised to 450°C-500°C. Samples were removed, left to cool to room temperature and 2 ml HNO3 was added and swirled before subjecting them to Atomic Absorption Spectrophotometeric (AAS Model FS 240 Varian) analysis to obtain the readings. Data generated were subjected to statistical analysis.

## RESULTS AND DISCUSSION

***Comparison of Heavy Metal Concentration in Crabs from Ibeno, Akpabuyo and Nsidung***

Concentration of heavy metals determined in the crabs obtained from the three rivers (Ibeno, Akpabuyo and Nsidung) are presented in Table 1. The comparison between the concentrations of crabs collected from Ibeno and Akpabuyo, Ibeno and Nsidung, Akpabuyo and Nsidung at the same period are shown in table 2, 3 and 4 respectively. A total of 8 heavy metals (Cadmium, Nickel, Manganese, Mercury, Lead, Arsenic, Silver, Chromium) were analyzed in the crab samples. The levels of metals can be seen to follow a pattern where Mn and As occur at much higher concentrations, while the remaining metals Cd, Ni, Hg, Pb, Ar, Cr were not particularly high. This indicates that heavy metals are relatively low in concentration within the area. The ranges of concentrations of heavy metals are as follows: 0.20-0.64 ppm for Cd, 0.020-0.610 ppm for Nickel, 0.55-58.76ppm for Manganese, 0.570-13.93 ppm for Mercury, 0.845 – 14.949 ppm for Lead, 0.05 – 74.50 ppm for Arsenic, 0.130 – 1.060 ppm for Silver. Crabs from Akpabuyo had the highest Heavy metal concentration compared to crabs obtained from Ibeno and Nsidung rivers. Arsenic had the highest mean concentration of 28.5±40.11ppm, while Nickel had the lowest mean concentration of 0.315±0.35. Chromium was below detectable limit in Crabs obtained from Akpabuyo and Nsidung and also Nickel was not detected in crabs from Nsidung. The order of crabs according to heavy metal accumulation is as follows: C2 (Akpabuyo), C3 (Nsidung) and C1 (Ibeno). However, in the case of crabs from Ibeno and Akpabuyo, the highest amounts of Lead, and Cadmium which are the major hazardous metals were seen in crabs from Akpabuyo.

**Table 1:** ***Distribution of Heavy Metal Concentration in Crabs from Ibeno, Akpabuyo and Nsidung***

| Sample | Cd (ppm) | Ni (ppm) | Mn (ppm) | Hg (ppm) | Pb (ppm) | As (ppm) | Ag (ppm) | Cr (ppm) |
|---|---|---|---|---|---|---|---|---|
| C1 | 0.200 | 0.020 | 0.550 | 0.570 | 0.845 | 0.050 | 0.260 | 3.225 |
| C2 | 0.640 | 0.610 | 58.760 | 13.930 | 14.949 | 74.500 | 1.060 | ND |
| C3 | 0.310 | ND | 23.680 | 7.730 | 4.280 | 11.400 | 0.130 | ND |
| Mean | 0.383 | 0.315 | 27.663 | 7.410 | 6.691 | 28.650 | 0.483 | 3.225 |
| Std | 0.228983 | 0.346554 | 29.30872 | 6.685746 | 7.354699 | 40.11075 | 0.50362 | 1.861955 |

***C1 = Ibeno C2 = Akpabuyo C3 = Nsidung***

***Table 2: Comparison of Heavy Metal Concentration in Crabs from Ibeno and Akpabuyo***

Heavy metal accumulation levels in crabs from Ibeno were relatively low compared to crabs from Akpabuyo. All

| Sample | Cd (ppm) | Ni (ppm) | Mn (ppm) | Hg (ppm) | Pb (ppm) | As (ppm) | Ag (ppm) | Cr (ppm) |
|---|---|---|---|---|---|---|---|---|
| C1 | 0.200 | 0.020 | 0.550 | 0.570 | 0.845 | 0.050 | 0.260 | 3.225 |
| C2 | 0.640 | 0.610 | 58.760 | 13.930 | 14.949 | 74.500 | 1.060 | ND |
| Mean | 0.420 | 0.315 | 29.655 | 7.250 | 7.897 | 37.275 | 0.660 | 3.225 |
| Std | 0.311127 | 0.417193 | 41.16069 | 9.446947 | 9.973034 | 52.64415 | 0.565685 | 2.280419 |

***C1 = Ibeno C2 = Akpabuyo***

***Table 3: Comparison of Heavy Metal Concentration in Crabs from Ibeno and Nsidung***

| Sample | Cd (ppm) | Ni (ppm) | Mn (ppm) | Hg (ppm) | Pb (ppm) | As (ppm) | Ag (ppm) | Cr (ppm) |
|---|---|---|---|---|---|---|---|---|
| C1 | 0.200 | 0.020 | 0.550 | 0.570 | 0.845 | 0.050 | 0.260 | 3.225 |
| C3 | 0.310 | ND | 23.680 | 7.730 | 4.280 | 11.400 | 0.130 | ND |
| Mean | 0.255 | 0.020 | 12.115 | 4.150 | 2.563 | 5.725 | 0.195 | 3.225 |
| Std | 0.077782 | 0.014142 | 16.35538 | 5.062885 | 2.428912 | 8.025662 | 0.091924 | 2.280419 |

***C1 = Ibeno C3 = Nsidung***

***Table 4: Comparison of Heavy Metal Concentration in Crabs from Akpabuyo and Nsidung***

| Sample | Cd (ppm) | Ni (ppm) | Mn (ppm) | Hg (ppm) | Pb (ppm) | As (ppm) | Ag (ppm) | Cr (ppm) |
|---|---|---|---|---|---|---|---|---|
| C2 | 0.640 | 0.610 | 58.760 | 13.930 | 14.949 | 74.500 | 1.060 | ND |
| C3 | 0.310 | 0.000 | 23.680 | 7.730 | 4.280 | 11.400 | 0.130 | ND |
| Mean | 0.475 | 0.305 | 41.220 | 10.830 | 9.615 | 42.950 | 0.595 | 0.000 |
| Std | 0.233345 | 0.431335 | 24.80531 | 4.384062 | 7.544122 | 44.61844 | 0.657609 | 0 |

***C2 = Akpabuyo C3 = Nsidung***

## DISCUSSION

Williams *et al*. (2007) reported higher concentration of trace metals in fine grain muddy sediments of Igbede and Ojo rivers in Nigeria coastlines compared to the coarse and sandy deposits of Ojora coastline. In another work, Ayejuyo *et al*. (2005) reported various levels of trace metals in sediments in water arising from indiscriminate dumping of human and industrial wastes into rivers freely flowing in and out of fish ponds. Interaction between the biota and habitat environment is becoming consistent and robust (Sager and Pusco 1991; Adeyeye 1994; Udoh *et al*. 1999; Adeyeye and Ayejuyo 2002; Ayejuyo *et al*. 2003; Ayejuyo *et al*. 2005; Adekoya *et al*. 2006). Lots of studies have shown that marine organisms are great accumulators of Lead and Cadmium. However, the quantity accumulated from the environment is important as this could have an adverse effect on the health of humans who consume these organisms as food for survival. This study was carried out to answer some of these pressing questions. Some major hazardous metals include: - Lead and Cadmium. In this research, a comparative examination of the data in tables 2,3, and 4 showed that considerable differences occurred in the metal concentrations of crabs in Akpabuyo, and Ibeno. The concentrations of heavy metals in crabs from Akpabuyo were relatively higher than the concentrations in crabs collected from Ibeno. This could be as a result of the activities that take place in the area. The mean concentration of cadmium (0.2, 0.64, 0.31) and nickel (0.02, 0.610, ND) in crabs from the three rivers: Ibeno, Akpabuyo and Nsidung respectively, was observed to be within the range of WHO standard for heavy metals in water and aquatic foods, while lead in crabs from all locations had higher mean concentrations of heavy metals, with the exception of chromium in crabs from Akpabuyo and Nsidung which were below detectable limits. The high level of the metal concentration obtained could be due to bioaccumulation of the metal and this would indicate an outset of metal contamination in the river body. Studies have shown that there is bioaccumulation of metals and there is always significant increase in the accumulation of zinc, lead, and copper in crabs (As Mohana and Subromanyam 2001). This can be associated with contaminants from anthropogenic sources, atmospheric deposition, refuse incineration, domestic waste, particulates possibly from automobile exhaust. It is not uncommon to find waste of various types of metal-based materials such as batteries, iron rods, and food cans among others around the environment where the crabs are found. Since these metal pollutants are nondegradable and resistant in the water bodies, bioaccumulation will likely occur because crabs absorb metals and ingest food at a faster rate than they are able to metabolise and excrete them, leading to a net gain of the pollutants in their body tissue (Fullick 1994).

## CONCLUSION

From the results of the analysis obtained, it is concluded that the crabs from Akpabuyo accumulated more heavy metals as compared to the crabs from Ibeno and Nsidung. These concentrations were observed to be above the WHO and NAFDAC consumable standards for consumption. Cadmium has been reported not to have any known function in biological systems and even when present in small amounts can be toxic to organisms. Also, its concentration in natural freshwater is typically around 0.01 g/l. From the analysis, crabs sampled from Ibeno and Nsidung may be considered safe for consumption while crabs sampled from Akpabuyo may be unsafe for consumption. However, the need for continuous monitoring is important in order to prevent bioaccumulation.

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