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# Assessment of Human Perturbations in Iko River Estuary using Bonga Shad as a Bio-indicator Organism

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**Abstract: Background:** Assessment of human perturbations in Iko River Estuary using Bonka shad as a Bio-indicator organism was conducted for one year between September, 2022 – August, 2023 with aim of understanding the levels of human perturbations going on within the estuary and the safety of consuming Bonka fish (*Ethmalosa fimbrata*) obtained from the Estuary. **Methodology:** 10 samples of *E. fimbrata* were bought from landings of artisanal fisherfolks at Iko River Estuary on a monthly basis for a period of 12 months. Fish samples were thoroughly washed with the sea water, placed in a labeled cellophane bag and preserved in ice cooled box. Samples were later transported to the laboratory prior to laboratory analysis. In the laboratory standard analytical procedure were adhered to in the preparation of samples prior to heavy metal determination using Perkin-Elmer Analysts 800 Atomic Absorption Spectrophotometer (AAS). **Results:** The concentration of heavy metals in tissue of *E. fimbrata* studied for (Cd, Cr, Cu, Fe, Mg, Ni, Pb and Zn) did not show any significant variation exception of copper. However, throughout the study duration the values of iron and zinc were observed to be generally higher than all the studied metals which was attributed to their abundance in the earth crust. Correlation analysis showed strong positive relationship between metal pairs in both season and hierarchical cluster dendrogram delineated the metals into cluster groups based on concentration gradient and source of contamination. **Conclusion:** Based on the results of findings, the concentration of heavy metal in the tissue of the studied species fell within the WHO/FAO recommended threshold limit for safe consumption of aquatic seafood. However, the result also shows evidence of bioaccumulation if the trend persists unchecked. Therefore, constant monitoring of heavy metal levels in tissues of edible aquatic organisms to prevent health related issues to man as the final consumer of this seafood's via transfer through the food chain is recommended.
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**Keywords:** Human perturbations, Iko River Estuary, *Ethmalosa fimbrata*, Bio-indicator organisms

## 1. Introduction

The Nigerian coastal region has been in the spotlight in recent years owing to the increase in anthropogenic perturbation which is considered as one of the gateways to increased pollution in the aquatic ecosystem and these pollutants are majorly heavy metals. Heavy metals are elements that have a density of over 5g/cm$^3$, are toxic and harmful to both the environment and humans (Khayatzadeh, 2010; Akpan, 2013; Akpan and Etim, 2015; Akpan, 2021). But when it comes to their effect regardless of its definition any metal may be called a toxic metal if it is toxic to any organism under any circumstances (Elbeshti, *et. al.*,2018; Okon *et al*., 2022). Heavy metals in the form of organic compounds from natural sources include weathering of metal bearing rocks and volcanic eruption while anthropogenic sources such as industrialization, mining and agricultural activities continuously enter the aquatic ecosystem where they bioaccumulate and biomagnify in the tissues of aquatic organisms hence pose serious threat to the aquatic food chain (Abiaobo *et. al.,* 2017; Abiaobo *et. al.,* 2020).

The eighth most common pollutant of heavy metals listed by Environmental Protection Agency (EPA) are As, Cd, Cr, Cu, Hg, Ni, Pb and Zn (Athar and Vohora, 2001). However, trace elements such as copper, iron and zinc are essential but not in high concentration to maintain the metabolism of human beings while, heavy metals like cadmium, chromium, mercury and lead are regarded as non-essential which pose a number of health issues to humans (Abiaobo *et. al.,* 2017). Heavy metals entered the body of organisms directly from their abiotic environment that is water, sediment and through its food / prey.

Nickel is an allergen and a potential immunomodulatory and immune-toxic agent in humans. Excessive intake of Nickel and zinc may lead to toxic effects such as carcinogenesis, mutagenesis and teratogenesis as a result of its bioaccumulation

(APHA, 2005). Heavy metals have been reported to have negative effect on metabolic processes in general and may influence the nutritional and biological status of aquatic resources (Udosen *et. al*., 2001). The threat of heavy metals to human is as a result of exposure either by ingestion (eating or drinking) and by inhalation (breathing) (Edward *et. al.*, 2013).

Aquatic organisms such as fish and shellfish accumulate metals to concentrations many times higher than present in water or sediment (Olaifa *et. al.*,2004, Al-Weher, 2008). Fish are preferred in toxicological research because of their well-developed osmolar regulatory, endocrine, nervous, and immune system (Song *et al.*, 2012). Aquatic fauna such as fish are rich sources of nutrients, they a widely consumed in Nigeria. It is of economic importance as it serves as good source of protein to many Nigerians, source of income to small scale fishers thus forming an important industry in the entire Niger Delta region of the country. *Ethmalosa fimbriata*, a clupeid fish popularly known as Bonga shad belong to the pelagic class, found in shallow coastal waters, lagoons and estuaries, sometimes also in lower courses of coastal rivers, even more than 300 km up rivers (Stiassny *et. al.*, 2007). However, their nutritional values may be affected based on the environment in which these organisms live (Nsikak *et. al*., 2007).

Iko River estuary in the Niger Delta region habours rich collection of biotopes dominated by vast areas of mangrove swamp forest (Otitoju and Otitoju, 2013). However, this region with its complex ecological form is being subjected to considerable environmental pollutants from agricultural, industrial and domestic activities as well as oil exploration and exploitation. This has resulted in the release of pollutants (hydrocarbons and heavy metals), capable of polluting the terrestrial and aquatic ecosystems (Otitoju *et. al*., 2011).

There are less reports of heavy metal concentration in Bonga fish from Iko River estuary hence, the urgent need to assess the levels of heavy metals concentrations in the tissue of this species, secondly to check the concentration levels and compare them with the permissible limit set by the World Health Organization (WHO) to ascertain the health implication of consuming Bonka shad from Iko river Estuary.

## 2.0 Materials and Methods

### 2.1 The Study Area

Iko River estuary is in Eastern Obolo Local Government Area, Akwa Ibom State, in the Niger Delta region, Nigeria. The area lies within latitude 4°0'30' N and longitude 7°40' E (Fig. 1) (Ekpe *et. al*, 1995; Udotong *et. al*. 2008; Etesin *et. al*. 2013). The river has a shallow depth ranging from 1.0 m to 7.0 m at flood and ebb tide. Iko River takes its rise from Qua Iboe River catchments and drains directly into the Atlantic Ocean at the Bight of Bony (Ekpe *et. al*, 1995). The adjoining Creeks, channels and tributaries from the Iko River estuary are significant in the provision of suitable breeding sites for the diverse aquatic resources that abound in the area. Human activities in the area include fishing by artisan fisher's folks as well as petroleum exploration and production activities (NDES, 2000; NDDC, 2004). The shoreline of Iko River estuary is fringed with mangrove and nipa vegetations, tidal mudflat and pneumatophores of *Avicenia* exposed during low tide. The macrophytes are composed of the native red mangrove; *Rhizophora racemosa*, *R. harrizonii*, *R. Mangle*, black mangrove (*Avicenia africana*) and *Laguncularia racemosa* and the exotic nipa palm (*Nypa fruticans*) (Ekwere *et. al*. 1992; Ukpong, 1995). The study area lies within the tropical rainforest zone and has two major seasons: the wet season (April to October) and the dry season (November to March). The main occupation of the inhabitants includes large scale fishing employing the use of fishing vessels, small scale fishing by artisanal fishers employing the use of fishing boats, farming activities involving the use of agrochemicals, boat construction as well as timber logging of mangrove vegetation as fuel wood.

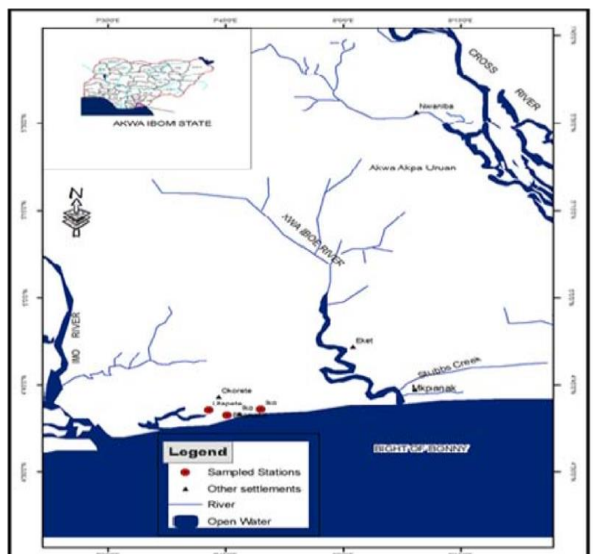


Figure 1: Map of the South Akwa Ibom State Showing the Sampled Stations

**Fig. 1: Map of Iko River Estuary showing the Major Fishing Areas.**

### 2.2 Sample Regime / Collection

Samples of Bonga fish (*Ethmalosa fimbriata*) were bought from landings of artisanal fisherfolks in the Iko River estuary on a monthly basis between September, 2022 and August 2023. The samples were then washed thoroughly with the sea water, placed in a labeled cellophane bag and preserved in ice cooled box. The samples were later transported to the zoology Unit laboratory department, of Biological Sciences Akwa Ibom State University and stored in the freezer at - 4°C prior to laboratory analysis.

**2.3 Sample Preparation**

Fish samples were removed from the freezer and allowed to thaw at room temperature, the flesh of the fish was taken using stainless steel surgical knife. The samples were then oven dried at 65° C until they attained constant weight.

**2.4 Digestion Procedure**

Dry tissue samples weighing 0.50g were digested with 5.0 ml of concentrated nitric acid ($HNO_3$), 2.0 ml of hydrogen peroxide ($H_2O_2$), and 1.0 ml distilled water was added. The vessel was sealed and placed into the rotor 8 for the microwave digestion. The digested samples were transferred to the 50.0 ml auto-sampler polypropylene vials and distilled water was added to a final total volume of 20.0 ml.

**2.5 Analysis of Heavy Metals**

The concentration of heavy metals in fish samples were analyzed using Perkin-Elmer Analysts 800 Atomic Absorption Spectrophotometer (AAS) equipped which Winlab 32™ for AA version 6.5 software, which features all the tools needed to analyze samples, report and archive data and ensure regulatory compliance. It also features a solid-state detector which is highly efficient at low wavelengths. The Analyst 800 uses a transversely heated stabilized temperature platform system to ensure the minimum influence of matrix interference possible and provides the lowest detection limits available (APHA, 2005)

**2.6 Statistical Analysis**

MS Excel was used for graphical representation of spatial variations among metal pairs and Statistical package for Social Sciences (SPSS) version 20 was employed to compute Mean, variance and standard error in the data. Paired sample t-test was used to compare seasons. The probability level was set at $p = 0.05$. Correlation analysis and Hierarchical cluster analysis was employed using R-software to test for metal association and source of contamination.

**3.0 Results**

**3.1 Heavy Metals in *Ethmalosa fimbrata***

Summary of the data obtained on seasonal range values, seasonal mean and standard error on heavy metals in *Ethmalosa fimbrata* studied between September, 2022 to August, 2023 is presented in table

3.1.1 Cadmium

Cadmium values obtained for dry and wet season ranged between 0.02 – 0.22 mg / kg and 0.01 – 0.04 mg / kg respectively. The mean cadmium values recorded for dry and wet season were 0.05 mg / kg ± 0.03 and 0.02 mg / kg ± 0.00 (Table 1). The mean monthly distribution of heavy metal in tissues of *E. fimbrata* for dry season is presented in Fig. 2. The highest concentration of cadmium was recorded in the month of December while the least was observed in the month of September. Generally, the concentration of cadmium in the tissue of *E. fimbrata* was low in the wet season when compared to the dry months. However, a slight elevation was observed in the month of July (Fig. 3).

3.1.2 Chromium

The range of chromium values obtained for dry and wet season were 0.01 – 0.01 mg / kg and 0.01 – 0.01 mg / kg respectively. The mean chromium values recorded for dry and wet season were 0.01 mg / kg ± 0.00 and 0.01 mg / kg ± 0.0 respectively (Table 1). Chromium concentration recorded in the tissue of *E. fimbrata* was low throughout the dry season (Fig. 2). Similar observations were recorded during the wet season months (Fig. 3).

4.1.3 Copper

Seasonal range values for copper recorded in the tissues of *E. fimbrata* for dry and wet season range between 0.13 – 1.33 mg / kg and 0.14 – 1.29 mg / kg respectively. The seasonal mean copper values recorded for dry and wet season were 0.33 mg / kg ± 0.19 and 0.96 mg / kg ± 0.18 respectively (Table 1). A uniform concentration of copper was observed and recorded in the tissues of *E. fimbrata* during the dry month's exception of February which had and elevated concentration (Fig. 2). Variations in copper concentration was observed during the wet season, with the least concentration recorded in the month of May and highest recorded in the month of September and October respectively (Fig. 3).

3.1.4 Iron

The range concentration of iron values noted for dry and wet season were 1.26 – 1.37 mg / kg and 1.03– 1.36 mg / kg respectively. The mean values recorded for dry and wet season were 1.32 ± 0.02 mg / kg and 1.18± 0.06 mg / kg respectively (Table 1). The concentration of iron was relatively high in all the dry months with slight variations as presented in Fig. 2. The trend was however different in the wet season with the highest concentration recorded in the month of May and the least values were observed in the months of September and October respectively (Fig. 3).

3.1.5 Magnesium

The values obtained for magnesium for dry and wet season was in the range of 0.15– 0.17 mg / kg and 0.16 – 1.63 mg / kg respectively. The mean magnesium values recorded for dry and wet season were 0.17 ± 0.03 mg/kg and 0.66 ± 0.31 mg / kg respectively (Table 1). The concentration of magnesium during the dry season was observed to be uniformed (Fig. 2). However, similar observation was observed for May, June, July and August during the wet season but with slight variation as the concentration of magnesium was observed to be higher in the months of September and October respectively (Fig. 3).

3.1.6 Nickel

Nickel values for dry and wet season range between 0.01– 0.03 mg / kg and 0.01 – 0.20 mg / kg respectively**.** Mean values for dry and wet season were 0.02 ± 0.00 mg/kg and 0.07 ± 0.03 mg / kg respectively (Table 1). The concentration of nickel throughout the study duration was relatively low in both season exception May and August which the concentration was slightly higher than the other months (Fig. 2 and 3).

3.1.7 Lead

The range lead concentration recorded in the tissues of *E. fimbrata* for dry and wet season range between 0.04 – 0.13 mg / kg and 0.02 – 0.23 mg / kg respectively**.** The mean concentration of lead for dry and wet season were **0.07** ± 0.01 mg/kg and 0.12 ± 0.03 mg / kg respectively (Table 1). Lead concentration in the tissue of *E. fimbrata* were relatively low during the dry season with slight variation observed in the months of March and April 2023 (Fig. 2). The concentration of lead observed or the wet season was a bit higher when compared to the dry season with least recorded in September and highest recorded in October (Fig. 3).

3.1.8 Zinc

Zinc values range from 1.32 – 1.77 mg /kg and 1.31– 1.57 mg / kg for dry and wet season respectively. The mean zinc values recorded for dry and wet season were 1.54 ± 0.06 mg/kg and 1.42 ± 0.04 mg/kg respectively (Table 1). The concentration of zinc was observed to be higher throughout the dry season when compared to other metals.

However, the concentration was relatively in the months of December, January and February with the least concentration recorded in the month of November (Fig. 2). Similar observation was recorded in the wet season with high concentration of zinc recorded in the tissue of *E. fimbrata* in all the months with the least recorded in the month of June and the highest recorded in the month of September (Fig. 3).

**TABLE I:**
**Seasonal range, mean variation, standard error of Heavy Metal measured in Tissue of *Ethmalosa fimbrata* Caught from Iko River Estuary for wet and dry season (September, 2022 – August, 2023).**

Where: S.E = Standard Error, WHO = World Health Organisation.

| Heavy Metals | Units | Range (dry Season) | Range (Wet Season) | Mean ± S.E (Dry Season) | Mean ± S.E (Wet Season) | Maximum limit WHO/FEPA (mg/kg) |
|---|---|---|---|---|---|---|
| Cadmium | mg/kg | 0.02–0.22 | 0.01– 0.04 | 0.05 ± 0.03 | 0.02± 0.00 | 0.5 |
| Chromium | mg/kg | 0.01-0.01 | 0.01-0.01 | 0.01±0.00 | 0.01±0.00 | 0.5 |
| Copper | mg/kg | 0.13-1.33 | 0.14-1.29 | 0.33±0.19 | 0.96±0.18 | 3.0 |
| Iron | mg/kg | 1.26-1.37 | 1.03-1.36 | 1.32±0.02 | 1.18±0.06 | 0.5 |
| Magnesium | mg/kg | 0.15-0.17 | 0.16-1.63 | 0.17±0.03 | 0.66±0.31 | 0.5 |
| Nickel | mg/kg | 0.01-0.03 | 0.01-0.20 | 0.02±0.00 | 0.07±0.03 | 0.5 |
| Lead | mg/kg | 0.04-0.13 | 0.02-0.23 | 0.07±0.01 | 0.12±0.03 | 2.0 |
| Zinc | mg/kg | 1.32-1.67 | 1.31-1.57 | 1.54±0.06 | 1.42±0.04 | 30 |

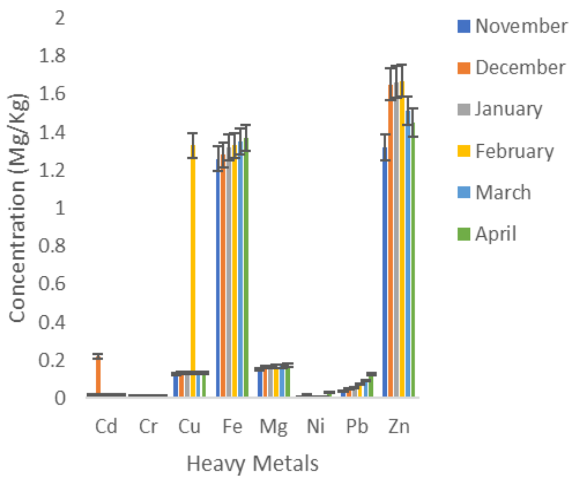


**Fig. 2: Mean Heavy Metal Concentration (Mg/Kg) in the Tissue of *Ethmalosa fimbrata* (Dry Season)**

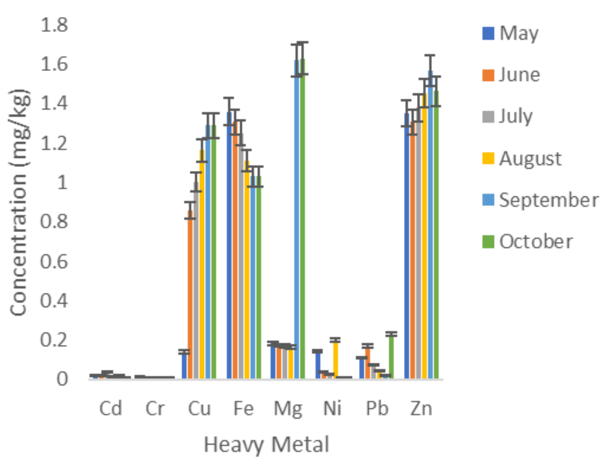


**Fig. 3: Mean Heavy Metal Concentration (Mg/Kg) in the Tissue of *Ethmalosa fimbrata* (Wet Season)**

**3.2 Mean Seasonal variation of Dry and Wet values of Heavy Metal measured in Tissue of *Ethmalosa fimbrata* Caught from Iko River Estuary (September, 2022 – August, 2023).**

The result of mean dry and wet season value of heavy metal in the tissue of *Ethmalosa fimbrata* is presented in Table 2. The mean concentration of cadmium was observed to be higher in the wet season than the dry season but with no significant difference at p = 0.05. Similarly, copper, magnesium, nickel and lead concentration were relatively higher during the wet season than the dry season but no significant difference was observed at p = 0.05 exception for copper which showed significant at p = 0.05. The value for chromium for each season was uniform with no significant variation at p = 0.05. The concentration of zinc was relatively high in the dry season than in the wet season with no significant variation at p = 0.05.

**TABLE 2:**
**Mean Seasonal variation of Dry and Wet values of Heavy Metal measured in Tissue of *Ethmalosa fimbrta* Caught from Iko River Estuary (September, 2022 – August, 2023).**

| Heavy Metals | Dry | Wet | t-value |
|---|---|---|---|
| Cd | 0.054 | 0.021 | 0.98583 |
| Cr | 0.013 | 0.012 | 2.06977 |
| Cu | 0.331 | 0.957 | 2.3438* |
| Fe | 1.318 | 1.181 | 2.2455 |
| Mg | 0.165 | 0.656 | 1.6047 |
| Ni | 0.015 | 0.072 | 1.7435 |
| Pb | 0.073 | 0.108 | 0.9716 |
| Zn | 1.543 | 1.4205 | 1.7670 |

$t_{crit}$ = 2.281

**3.3 Correlation and hierarchical cluster dendrogram based on heavy metals in Tissue of *Ethmalosa fimbrata* (dry season)**

The dry season correlations between the heavy metals in the flesh of *Ethmalosa fimbrata* are presented in Fig. 4. Chromium had significant positive correlations with Mg (r = 0.92, p<0.01) and Fe (r = 0.90, p<0.05) while Magnesium had significant positive correlations with Pb (r = 0.84, p<0.05) and Fe (r = 0.91, p <0.05). on the other hand, Fe had a significant positive correlation with Pb (r = 0.92, p<0.01). The cluster dendrogram of heavy metals in the fish during the dry season is shown in Figure 5. From, the dendrogram, three cluster groups were delineated. Two bi-factor groups consisting of (Cd and Ni), (Cu and Zn) and one poly-factor group (Cr, Mg, Fe and Pb).

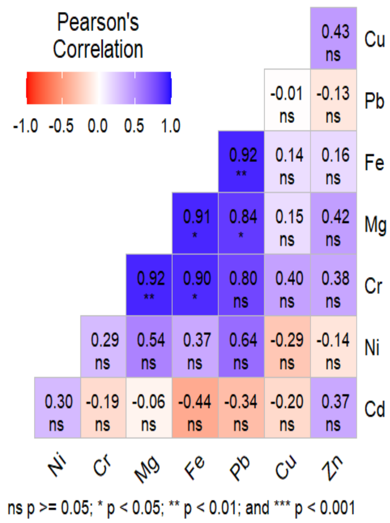


**Fig. 4: Dry season Heavy metal correlation in the flesh of *Ethmalosa fimbrata***

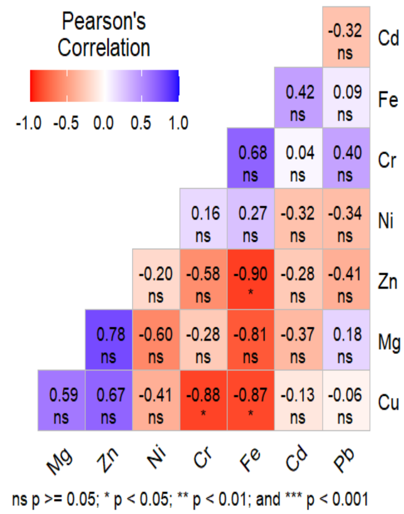


**Fig. 6: Wet season Heavy metal correlation in the flesh of *Ethmalosa fimbrata***

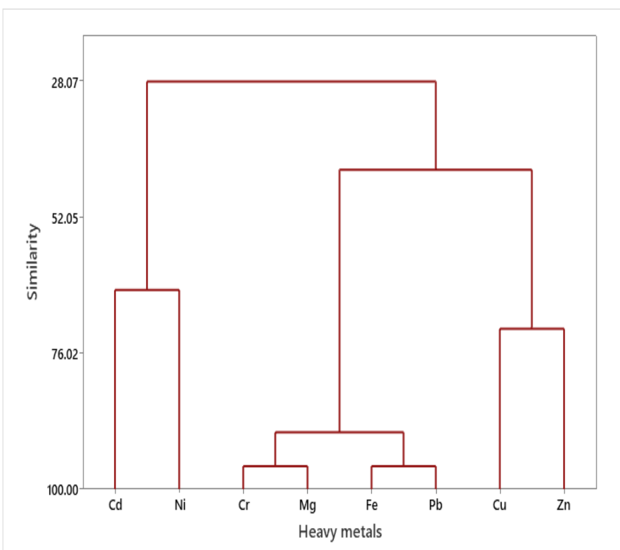


**Fig 5: Dry season Dendrogram for Heavy Metals in *Ethmalosa fimbrata***

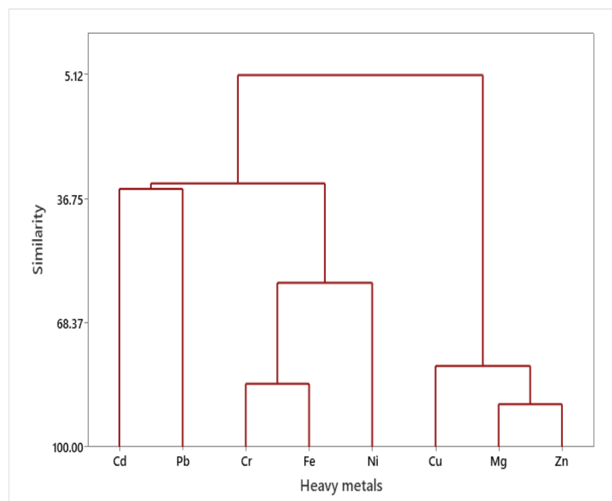


**Fig 7: Wet season Dendrogram for Heavy Metals in *Ethmalosa fimbrata***

### 3.4 Correlation and hierarchical cluster dendrogram based on heavy metals in Tissue of *Ethmalosa fimbrata* (wet season)

During the wet season, significant negative correlation was observed between the following metal pairs: Copper - Iron (r = -0.87, p<0.05), Copper – Chromium (r = -0.88, p<0.05) and Zinc– iron (r = -0.90) (Fig. 6). The cluster dendrogram of heavy metals in the tissue of *E. fimbrata* during the wet season is shown in Figure 7. From, the dendrogram, three cluster groups were delineated. A bi-factor group consisting of Cd and Pb and two tri-factor groups (Cr, Fe and Ni) (Cu, Mg and Zn).

## 4.0 Discussion

### 4.1 Heavy metal concentration in the tissues of *Ethmalosa fimbrata*

The concentration of heavy metals; (Cadmium, Chromium, Copper, Iron, Magnesium, Nickel, Lead and Zinc) in the tissue of *Ethmalosa fimbrata* caught from Iko River estuary indicates a low level of metal pollution. The possible explanation for this could be that the source of the samples (*E. fimbrata*) from artisanal fishermen were collected in area of the river that is relatively unpolluted or the ability of the organism to assimilate these metals during the duration of study.

Interesting pattern was observed for heavy metal accumulation in the tissue of the studied organism. The pattern followed the trend Zn>Fe>Cu>Mg>Pb>Cd>Ni>Cr for dry season while slight variation was observed for the wet season which followed the trend Zn>Fe>Cu>Mg>Pb>Ni>Cd>Cr. It was observed that zinc and iron were the most dominant metals in both seasons while the least for both seasons was chromium. Inyang-Etoh and George (2019) reported similar trend of zinc and iron dominance in tissues of *Tilapia Zilli* caught from Imo River. The high dominance of zinc and iron has been confirmed by earlier assertions reported by George *et. al*., (2021a) when reporting on trace metal concentration in tissues of *Tilapia zilli* caught from Orashi river; George *et. al*., (2021b) during their studies on monitoring and evaluation of trace metal concentration in tissues of *Clarias gariepinus* caught from Orashi river, Niger Delta. The high concentration of zinc and iron recorded during the studies can be attributed to three basic factors (1) the abundance of zinc and iron in the earth crust, (2) the dissolution of zinc from oil pipelines fixed across the water body by oil companies and the use of iron coagulants or the corrosion of steel and cast iron pipes during the process of water distribution and thirdly the preferential uptake of these metals by the organisms as essential trace metals for metabolic processes and other functions needed by the organisms.

The results of metal concentration in tissue of *Pseudolithus senegalensis* and *Ethmalosa fimbrata* obtained from Lagos by Bolawa *et. al*., (2012) does not align with the present findings. The authors reported high cadmium and lead in the tissue of these organisms. The variation observed in dominance of these metals in each of the study may be attributed to the nature of soil around each of the study area, nature of anthropogenic activities and industries sited in each study within each study area.

Heavy metals such as cadmium, lead, nickel and chromium are regarded as non-essential metal because of their toxicity to aquatic organisms even at minute concentrations, their tendency to be incorporated into the food chain and their ability to persists in the environment over a long period without being degraded is a serious environmental concern to environmentalist and policy makers. However, the concentrations of these metals recorded during the study did not exceed the WHO maximum permissible limit. The results of findings are at variance with earlier assertion made by Nwabueze (2011) who reported high levels of zinc, cadmium and nickel in tissues of *E. fimbrata* from Forcados River that exceeded WHO tolerable limit for these metals.

Significant variation in season was not observed throughout the study duration exception of copper (Cu). The absence of significance during the study may be attributed to several factors such as; similar source of anthropogenic activities in both season, species uptake level during the study duration, feeding habits of the species in both season and moderate level of pollution in both seasons. The significance observed for copper may be attributed to feeding habits of the species during the wet season with high preference for plants that might have accumulated copper.

Positive correlation was observed for Cr-Fe, Cr-Mg, Mg-Pb, Mg-Fe and Fe-Pb during the dry season. During the wet season the trend differed with negative correlated observed for Cu-Fe, Cu-Cr and Zn-Fe. Positive correlations between metals pairs denotes that an increase in one of these parameters leads to a corresponding increase in the other while negative correlation implies that increase in one of these parameters will lead to a corresponding decrease in the other (i.e inverse correlation). Positive correlation observed between metal pairs during the dry season portrays a direct relationship between metal pairs with both variables moving in the same direction while negative correlation depicts an indirect relationship between metal pairs with both variables moving in opposite direction.

The agglomeration patterns observed in the cluster dendrogram representing the metal pairs in Tissue of *E. fimbrata* for dry season delineated three cluster groups (two bi-factor and one poly-factor group). Similarly, three cluster groups (one bi-factor and two tri-factor groups) were observed during the wet season. The cluster dendrogram assorts the metals in line with concentration gradient. Similar observations have been observed by earlier researchers (Essumang, *et. al.* 2012 and Benson and Essien, 2012).

**4.2 Conclusion**

The elemental concentrations of heavy metals observed in the tissues of *Ethmalosa fimbrata*, during the study were within permissible limit as recommended by WHO/FAO. The trend in heavy metals observed in all the studied species during the study duration recorded iron and zinc as the most dominant metals which was attributed to its abundance in the earth crust. The near absence of seasonal significant during the study duration was attributed to several factors such as; similar source of anthropogenic activities in both season, species uptake level during the study duration, feeding habits of the species in both season and moderate level of pollution in both seasons. Strong positive correlation observed between metal pairs portends that pairing metals may likely have homogenous source of anthropogenic activities, accumulation potentials and (or) chemical association. Dendrograms resulting from hierarchical cluster analysis indicated multiple cluster groups based on concentration gradient and similar sources of contaminants. The high concentrations of iron and zinc in the study organisms calls for concern as this may result in deleterious health effects to consumers of these aquatic species overtime. *E. fimbrata* is a common commercial aquatic species consumed in Nigeria, notably the Niger Delta Region by most rural dwellers and riverine communities owing to their cheap source. However, this study emphasizes the essence of constant monitoring of heavy metal levels in tissues of edible aquatic organisms to prevent health related issues to man as the final consumer of this seafood's via transfer through the food chain.

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