*Journal of Environment Pollution and Human Health*, 2021, Vol. 9, No. 1, 16-21
Available online at http://pubs.sciepub.com/jephh/9/1/3
Published by Science and Education Publishing
DOI:10.12691/jephh-9-1-3

# Risk Assessment of Trace Metal Intake through Consumption of Four Fish Species from Upper Region of Barrier Lagoon Coast Waters, Southwest, Nigeria

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*Received April 21, 2021; Revised May 27, 2021; Accepted June 06, 2021*

**Abstract** This study assessed trace metals (Pb, Cr, Zn and Cu) content in the muscle tissues of four fish species (*Sarotherodon melanotheron*, *Sardinella maderensis*, *Ethmalosa fimbriata* and *Cynoglossus senegalensis*) collected bi-monthly from fishermen in the upper region of Barrier Lagoon coast waters, Nigeria. Trace metals were determined using an atomic absorption spectrophotometer (Spectra AA-240, Agilent Technologies). Human health risk due to fish species consumption was assessed using non-carcinogenic (hazard quotient) and carcinogenic (cancer risk) health risk models. The results indicated that the mean concentrations of Pb, Cr, Zn and Cu in the fish species were 3.46 to 7.36, 6.72 to 15.02, 7.28 to 10.04 and 0.38 to 1.02 mg $kg^{-1}$ wet weight, respectively. The estimated daily intake (EDI) of Pb in *Ethmalosa fimbriata* exceeded the provisional maximum tolerable daily intake (PMTDI). The hazard quotient (HQ) for Pb in *Ethmalosa fimbriata* and for Cr in all fish species were > 1, indicating consumption of those fish species may pose a risk to human health. Nevertheless, the carcinogenic risk for Pb was within acceptable level (value in between $10^{-6}$ and $10^{-4}$). Although, the investigated fish species might be safe for consumption at the current rate of ingestion of fish in Nigeria, high consumption of *Ethmalosa fimbriata* from upper region of barrier lagoon coast waters may pose a potential health risk due to elevated Pb in the fish.

***Keywords:*** *contaminants, fish, carcinogenic and non-carcinogenic risk, Provisional Maximum Tolerable Daily Intake*

**Cite This Article:** Kayode James Balogun, “Risk Assessment of Trace Metal Intake through Consumption of Four Fish Species from Upper Region of Barrier Lagoon Coast Waters, Southwest, Nigeria.” *Journal of Environment Pollution and Human Health*, vol. 9, no. 1 (2021): 16-21. doi: 10.12691/jephh-9-1-3.

## 1. Introduction

Fish is an important source of animal protein for many households in Nigeria, like many other coastal developing countries. The demand for fish in Nigeria is increasing alongside growth in population and incomes. Fish is contributing about 40% of the total animal protein consumption *per capital* in Nigeria [1]. In 2016, 14.3 million people in Nigeria were classified as undernourished [2]. Increased fish production and consumption may contribute to alleviating food and nutrition insecurity. In spite of the significant role of fish in the diet of Nigerians, one of the challenges facing Nigeria today is that of ensuring safety of protein resources to the populace.

In recent years, there has been a growing concern worldwide on the health hazards associated with consumption of trace metals contaminated fish. Trace metals are metallic chemical elements and metalloids which are toxic to the environment and humans. Trace metals enter environment by natural means and through human activities. Their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons [3]. Eight trace metals (As, Cd, Cu, Cr, Pb, Hg, Ni and Zn) are considered as high priority by the United States Environmental Protection Agency. Nigeria includes the same metals in their priority lists. These metals are commonly found in industrial effluent and waste water, all of which cause risk for human health and the environment [4]. Although trace levels of metals are required for numerous physiological and biochemical functions in living organisms, elevated levels can have deleterious effects including mutations and carcinogenesis on individual organisms [5].

Barrier Lagoon coast complex is an ecologically important lagoon system in Nigeria. The complex extends eastwards for about 200 km from the Nigerian-Benin Republic border to the western limit of the Transgressive Mud Coast and covers an area of about 208 $km^2$ [6]. Badagry creek, estimated to be more than 51 km from Lagos, is situated in the upper region of the Barrier Lagoon coast in Nigeria (Figure 1). The creek is fed by River Ajara in the Republic of Benin and the Yewa River in Nigeria while it also links Ologe lagoon. Artisanal fishermen in the upper region of Barrier Lagoon coast waters use plank canoes, and deploy surface and bottom-set gillnets, cast-nets, drift-nets, ring-nets, and beach-seines for their fishing operations.

*Sarotherodon melanotheron* (Rüppell, 1852), *Sardinella maderensis* (Lowe, 1838), *Ethmalosa fimbriata* (Bowdich, 1825) and *Cynoglossus senegalensis* (Kaup, 1858) are among the notable commercially important fish species for consumption in Lagos, Nigeria. Therefore, their toxic metal content should be of concern to human health. The United states Environmental Protection Agency introduced risk assessment models and their threshold for the estimation of potential health risk caused by any chemical contaminant over prolonged exposure [7]. Risk assessment as a result of exposure to trace metal is estimated using non-carcinogenic and carcinogenic risk models. These models depend on intake amount of contaminant, exposure frequency and duration, average body weight and oral reference dose. In view of the paucity of information on the risk assessment through consumption of fish species from upper region of Barrier Lagoon coast waters, Nigeria, this study was undertaken to determine the content of trace metals (Pb, Cr, Zn, and Cu) in the muscle tissues of four fish species and to assess the health effects posed by the consumption of these fish species.

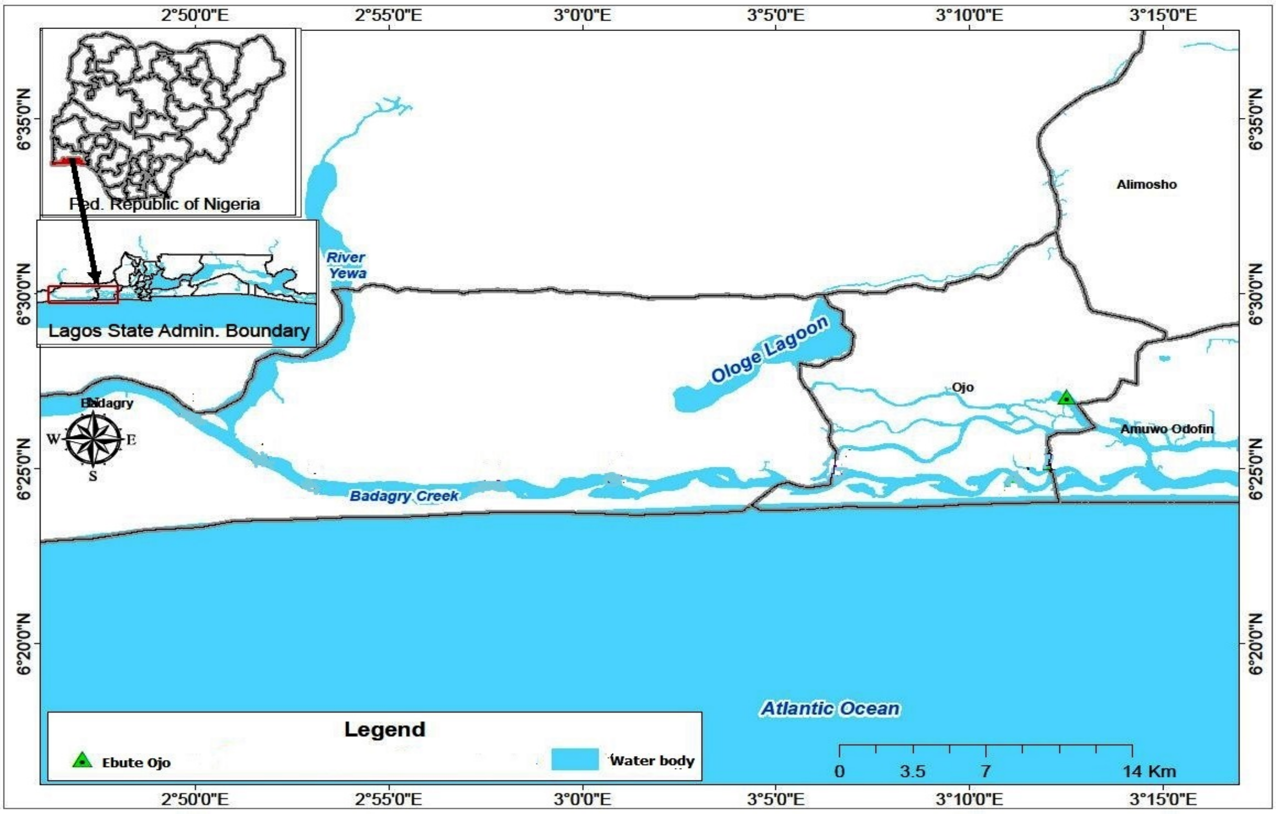


**Figure 1.** Map of Upper region of Barrier Lagoon coast waters, Nigeria and the Ojo fishermen landing where fish species were sampled

## 2. Methodology

### 2.1. Fish Sampling and Collection, Fish Muscle Tissue Preparation and Chemical Analysis

The fish species *Sarotherodon melanotheron*, *Sardinella moderensis*, *Ethmalosa fribriata* and *Cynogossus senegalensis* were randomly sampled from the fishermen catches on arrival at Ojo waterside jetty. On bi-monthly basis, 5 individual fish per species were procured in June, August, October and December, 2019, making a total of 20 individuals per fish species in all. The fish specimens were placed in a cooler containing ice and transported to the Nigerian Institute for Oceanography and Marine Research, Department of Biological Oceanography laboratory where for each fish specimen, total length (in centimeter) was measured using a measuring board while weight (in grams) was taken using a sensitive electrical balance, MP 2003 model. The muscle tissues of different species were extracted using forceps and scalpel, for analysis. The fish dorsal muscle tissue was used in this study because it is the most edible part of the fish. Prior to use, all glassware were soaked in diluted nitric acid for 24 h and then rinsed with distilled deionized water.

1g of fish muscle tissues were weighed into the digestion flasks. Thereafter, concentrated nitric acid (ultrapure Conc. $HNO_3$) and hydrogen peroxide $H_2O_2$ (2:1 v/v), respectively were added to each weighed samples and the resulting mixture were digested in triplicates according to AOAC method [8]. Each of the solution was allowed to cool at room temperature and subsequently filtered into a 100 mL volumetric flask. The filtrate was topped up the 100 mL mark using deionized water after which aliquots were analyzed for Pb, Cr, Zn and Cu using Atomic Absorption Spectrophotometer (Spectra AA-240, Agilent Technologies) with air-acetylene flame. The quality (analytical) control of the method was evaluated in triplicate with the certified reference materials (CRM) DORM-2 (dogfish muscle) provided by the National Research Council, Canada, Division of Chemistry. The results were in good agreement with the certified values, proving the good repeatability of the methods. The different concentrations of metals established with the certified values and the recovery percentage ranged between 92%–96%. The concentration of trace metals were expressed in milligrams per wet weight kilogram of fish muscle tissues (mg $kg^{-1}$ wet weight).

## 2.2. Statistical Analysis

The statistical analyses were performed using Minitab 16 statistical software. Shapiro- Wilk test was performed to determine whether the data set fit a normal distribution. Data were subjected to both descriptive (means ± standard deviations) and inferential statistics. One way analysis of variance (ANOVA) was employed and significant differences accepted at $P \leq 0.05$.

## 2.3. Assessment of Health Risk

In this study, the potential health risk from fish consumption was based on non-carcinogenic (estimated daily intake, hazard quotient, hazard index) and carcinogenic (cancer risk) health risk models [9].

The Estimated daily intake (EDI) of trace metals was calculated using the following Equation (1):

$$EDI = \frac{Cm \times EF \times ED \times IR}{ABW \times ATn} \quad (1)$$

Where:

Cm is the concentration of trace metals in fish muscle tissues (mg $kg^{-1}$ wet weight); EF is the exposure frequency (365 days/year); ED is the exposure duration (30 years for non-cancer risk as used by US EPA [9]; IR is the average daily ingestion rate of fish in Nigeria (0.036kg /person/day in Nigeria [10]); ABW represents the average body weight in Africa (60.7kg Adult [11]); ATn is the average exposure time for non-carcinogens (EF×ED) (365 days/year for 30 years (ATn = 10,950 days) as used in characterizing non-cancer risk [9].

The calculated EDI values were compared with Provisional Maximum Tolerable Daily Intake (PMTDI) values of 0.004, 3.3, 1.0, and 0.5 mg $kg^{-1}$ body weight/day established by FAO/WHO for Pb, Cr, Zn and Cu, respectively.

The hazard quotient (HQ) is an estimate of the non-carcinogenic risk level due to exposure of pollutant. HQ is calculated from the following Equation (2):

$$HQ = \frac{EDI}{RfDo} \quad (2)$$

Where,

The RfDo (oral reference dose) for Pb, Cr, Zn, and Cu were 0.004, 0.003, 0.3, and 0.04 mg $kg^{-1}$ /day, respectively [12].

A summation of the hazard quotients for all metals to which an individual is exposed was used to calculate the hazard index [9], using the following Equation (3):

$$HI = HQ(Pb) + HQ(Cr) + HQ(Zn) + HQ(Cu), \quad (3)$$

Where, HI is the Hazard Index, HQ is the Hazard Quotient for trace metals (Pb, Cr, Zn and Cu) intake. HI greater than 1 (> 1) suggests a likelihood of adverse effects on consumer health.

Carcinogenic risk was evaluated by using cancer risk (CR). The method for estimating CR was provided in USEPA Region III Risk-Based Concentration Table [9] and the model is as shown in the following Equation (4):

$$CR = \begin{pmatrix} Cm \times IR \times 10^{-3} \\ \times CPSo \times EF \times ED \end{pmatrix} / (ABW \times ATc), \quad (4)$$

Where; CR is the target cancer risk, Cm is the trace metal concentration in fish muscle tissues (mg $kg^{-1}$ wet weight), IR is the fish ingestion rate (kg/day), CPSo is the carcinogenic potency slope, oral (mg $kg^{-1}$ body weight / day), ABW is the average body weight and ATc is the averaging time, carcinogens (days /year).

The lifetime cancer risk of $10^{-6}$ (1 in a million) or less can be considered as acceptable, whereas a lifetime risk of $10^{-3}$ or greater is considered serious and requires attention. The level of risk from $10^{-6}$ to $10^{-4}$ may also be up to standard but requires a case-specific judgment [9].

# 3. Results and Discussion

## 3.1. Trace Metal Concentrations in the Fish Species

The levels of trace metals in the muscle tissues of *Sarotherodon melanotheron Sardinella moderensis Ethmalosa fribriata* and *Cynoglossus senegalensis* from upper region of Barrier Lagoon coast waters, Southwest, Nigeria are presented in Table 1. The trace metal concentrations vary among the different fish species. The variability in trace metal contents in species may be due to a number of factors which includes their differences in species, feeding habits and accumulation capacities of the species. The concentration of trace metals recorded in the studied fish species follow the order of Cr > Zn > Pb > Cu (Table 1).

The mean concentrations of Pb in the species samples were in the range of 3.46 ± 1.52 mg $kg^{-1}$ in *Sarotherodon melanotheron* to 7.36 ± 1.86 mg $kg^{-1}$ in *Ethmalosa fribriata*. The obtained results were similar to a range of 3.19 to 5.88 mg $kg^{-1}$ in the eight fish species from Epe Lagoon, Nigeria reported by Taiwo *et al.* [13]. In literature, high Lead concentration of 9.58 – 23.77 mg $kg^{-1}$ was reported in muscle of *Tilapia guineensis* fish from Badagry creek, Nigeria [14]. In Ghana, published Pb contents varied from 4.32–10.85 mg $kg^{-1}$ in fish species from Fosu Lagoon [15]. Lead in the fish species exceeds the permissible levels of 0.5 mg/kg established by FAO [16]. Lead occurs naturally in the environment. However, elevated levels found in the environment are as a result of human activities. The automobile traffic emissions from leaded petroleum, emissions from heavy-duty generator and Pb based paints and battery manufacturing around the Lagos water body catchment could have contributed to the elevated Pb concentration [14]. Lead is a persistent and non-biodegradable heavy metal, which has been characterized by US EPA as high priority hazardous substance.

**Table 1. Mean ± St. Dev. with range in parentheses of length, weight and concentrations of Pb, Cr, Zn and Cu in fish species (mg kg$^{-1}$ wet weight), from upper region of Barrier Lagoon coast waters, Southwest, Nigeria**

| | *Sarotherodon melanotheron* | *Sardinella moderensis* | *Ethmalosa fribriata* | *Cynoglossus senegalensis* | *P* Value |
|---|---|---|---|---|---|
| *n* | 20 | 20 | 20 | 20 | |
| *Length (cm)* | *19.03 ± 3.21 (15.0 – 22.50)* | *20.32 ± 3.70 (17.2 – 25.60)* | *18.05 ± 1.14 (16.5 – 19.2)* | *25.61 ± 3.59 (21.4 – 29.0)* | |
| *Weight (g)* | *145.88 ± 13.99 (88.50 – 185.5)* | *107.5 ± 16.96 (52.0 – 160.2)* | *134.60 ± 22.67 (80.50 – 205.0)* | *89.25 ± 11.98 (86.0 – 128.3)* | |
| Pb | 3.46 ± 1.52 (1.85 - 5.40) | 4.80 ± 2.15 (2.45 - 7.54) | 7.36 ± 1.86 (4.04 - 8.60) | 4. 02 ± 1.64 (0.30 - 10.90) | $P$ = 0.55 |
| Cr | 15.02 ± 4.22 (10.47 - 20.25) | 11.24 ± 5.75 (6.24 - 15.50) | 6.72 ± 2.95 (3.72 - 9.36) | 12.04 ± 7.35 (5.04 -23.10) | $P$ = 0.18 |
| Zn | 8.12 ± 0.45 (7.45 -8.68) | 10.04 ± 3.50 (7.68 -13.40) | 8.65 ± 2.86 (4.10 - 14.48) | 7.28 ± 5.30 (3.28 - 10.76) | $P$ = 0.53 |
| Cu | 0.46 ± 0.06 (0.45 - 0.75) | 0.53 ± 1.05 (0.40 - 1.00) | 1.02 ± 0.23 (0.50 - 1.50) | 0.38 ± 0.15 (0.30 - 0.50) | $P$ = 0.06 |

The Cr levels ranging between 6.72 ± 2.95 mg kg$^{-1}$ wet weight in *Ethmalosa fribriata* and 15.02 ± 4.22 mg kg$^{-1}$ wet weight in *Sarotherodon melanotheron* were higher than the FAO / WHO permissible limit of 1.0 mg/kg. Balogun, [14] in earlier study, reported elevated Cr contents range of 22.36 – 176.42 mg kg$^{-1}$ in muscle tissues of *Tilapia guineensis* fish from Badagry creek, Nigeria. The author opined that Cr high concentration might have resulted from the human activities in the water body catchment area, arising from discharges of effluents and wastewaters from electro-painting, dyeing and printing industries, textiles and metal finishing industries. Chromium is a naturally occurring element which can be beneficial and harmful to the environment and human health. The common soluble forms of chromium in the environment are as a result of contamination by industrial emissions. Studies have reported that Chromium VI is the most dangerous form of chromium and may cause health problems such as allergic reactions, skin rash, ulcers, weakened immune system, kidney and liver damage, and even death [17].

The highest mean concentration (10.04 ± 3.50 mg kg$^{-1}$) of zinc was detected in *Sardinella moderensis*, and the minimum mean values of 7.28 ± 5.30 mg kg$^{-1}$ was recorded in *Cynoglossus senegalensis* (Table 1). The results of present study are similar with the range of 5.73 – 11.42 mg kg$^{-1}$ reported in the fish of Qinzhou Bay [18]. However, in Ghana, Zn levels varied between 18.25 to 23.15 mg kg$^{-1}$ in fish from Fosu Lagoon [15]. Taiwo, *et al.* [13] published a range of 8.73 – 15.78 mg kg$^{-1}$ in eight fish species from Epe Lagoon, Nigeria. Zn contents in this study were below the level (30 mg kg$^{-1}$) proposed by FAO [16]. Zinc is a trace element that is essential for human health. However, high zinc ingestion can cause health problems such as stomach cramps, anemia, skin irritations, vomiting and nausea [19]. Elevated zinc intake can also damage the pancreas and disturb the protein metabolism, and cause arteriosclerosis.

Copper had the lowest levels of all the trace metals investigated in the fish species. Copper low level in the fish had been attributed to low levels of binding proteins in the muscle tissues [20]. The mean concentration of Cu ranging from 0.38 ± 0.15 mg kg$^{-1}$ in *Cynoglossus senegalensis* to 1.02 ± 0.23 mg kg$^{-1}$ in *Ethmalosa fribriata* were below the recommended limit of 30 mg kg$^{-1}$ proposed by FAO / WHO. Copper concentration in the present study was lower than the range from 2.04 to 3.31 mg kg$^{-1}$ reported in the work of Taiwo *et al.* [13] in eight fish species from Epe Lagoon, Nigeria. However, copper contents were slightly higher than a range of 0.18 to 0.52 mg kg$^{-1}$ previously reported by Balogun, [14] in *Tilapia guineensis* muscle tissues from Badagry creek, Nigeria and 0.10 – 0.35 mg kg$^{-1}$ obtained in fish from Fosu Lagoon, Ghana [15]. Copper is a very common substance which spreads through the environment through natural phenomena and can be elevated in the environment by human activities which can cause health problems. High uptakes of copper may cause liver and kidney damage and even death.

## 3.2. Assessment of Potential Health Risk

Table 2 presents the estimated daily intake of trace metals (mg kg$^{-1}$ wet weight/day) for individual from consumption of fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria. The EDI ranged from 0.0021 - 0.0044, 0.0040 - 0.0089, 0.0043 - 0.0060, and 0.0002 - 0.0006 mg kg$^{-1}$ / day for Pb, Cr, Zn and Cu, respectively. The highest and lowest daily intakes of Pb (0.0044 and 0.0021 mg kg$^{-1}$) were observed in *Ethmalosa fribriata* and *Sarotherodon melanotheron*, respectively. For Cr, the lowest daily intake (0.0040 mg kg$^{-1}$) was obtained in *Ethmalosa fribriata* while the highest daily intake of 0.0089 mg kg$^{-1}$ was in *Sarotherodon melanotheron*. Zn maximum (0.0060 mg kg$^{-1}$) and minimum (0.0043 mg kg$^{-1}$) daily intakes was observed in *Sardinella moderensis* and *Cynoglossus senegalensis*, respectively. Cu daily intake was highest (0.0006 mg kg$^{-1}$) in *Ethmalosa fribriata* and lowest (0.0002 mg kg$^{-1}$) in *Cynoglossus senegalensis.* For all the fish species, the EDI of Cr, Zn, and Cu were less than the FAO/WHO PMTDI respective values of 3.3, 1.0, and 0.5 mg kg$^{-1}$ body weight, an indication that these metals did not pose a risk to human health. Except *Ethmalosa fribriata*, EDI of Pb in the fish species was lower than the FAO/WHO PMTDI value of 0.00357 mg kg$^{-1}$ body weight. Therefore, the major concern was Pb in *Ethmalosa fribriata* fish.

**Table 2. Estimated daily intake of metals (mg kg$^{-1}$ wet weight / day) from consumption of fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria**

| | *Sarotherodon melanotheron* | *Sardinella moderensis* | *Ethmalosa fribriata* | *Cynoglossus senegalensis* | PMTDI |
|---|---|---|---|---|---|
| Pb | 0.0021 | 0.0028 | 0.0044 | 0.0025 | 0.00357 |
| Cr | 0.0089 | 0.0067 | 0.0040 | 0.0071 | 3.3 |
| Zn | 0.0048 | 0.0060 | 0.0051 | 0.0043 | 1.0 |
| Cu | 0.0003 | 0.0003 | 0.0006 | 0.0002 | 0.5 |

The average body weight of African: 60.7kg [11]
PMTDI (Provisional Maximum Tolerable Daily Intake) in mg/kg /body weight /day, set by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) [21].

## 3.3. Non-carcinogenic Risk Assessment

The calculated values of HQ and HI of fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria, are presented in Table 3. HQ greater than 1 implies the estimated exposure exceeded the USEPA standard dose for the contaminant of interest and is expected to cause adverse effects on human health.

The HQ values for the trace metals in the fish species followed the order of Cr > Zn >Pb > Cu. The hazard quotient (HQ) for Cr in all the fish species were greater than 1 (> 1), indicating consumption of these fish species may pose a risk to human health. Chromium (VI) compounds are toxins and known human carcinogens, whereas chromium (III) is less toxic and an essential nutrient for human [22]. Nevertheless, there are still gaps in the knowledge of the risk estimate of chromium and its effects in humans. The calculated HQ for Pb varied from 0.513 in *Sarotherodon melanotheron* to 1.091 in *Ethmalosa fribriata* (Table 3). HQ value for Pb in *Ethmalosa fribriata* from upper region of Barrier lagoon coast waters suggested consumers may experience health risks through the consumption of the fish. A study reported Pb having the highest THQ in the different fish species from Asafo Market, Ghana [23].

**Table 3. Hazard Quotients (HQs) and Hazard Index (HI) for the trace metals analyzed in fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria**

| | *Sarotherodon melanotheron* | *Sardinella moderensis* | *Ethmalosa fribriata* | *Cynoglossus senegalensis* |
|---|---|---|---|---|
| Pb | 0.5130 | 0.7117 | 1.0913 | 0.6227 |
| Cr | 2.9694 | 2.2221 | 1.3285 | 2.3802 |
| Zn | 0.0161 | 0.0198 | 0.0171 | 0.0144 |
| Cu | 0.0068 | 0.0079 | 0.0151 | 0.0056 |
| | | | | |
| HI | 3.5053 | 2.9615 | 2.4520 | 3.0229 |

## 3.4. Carcinogenic Risk Assessment

Presently, Chromium metal and trivalent chromium compounds are not classifiable as a human carcinogen [12]. Therefore, carcinogenic risk assessment was not evaluated for Cr ingestion via consumption of investigated fish species.

The cancer risk (CR) through consumption of fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria are presented in Table 4. The cancer lifetime risk from Pb ingestion in fish was in the order of *Ethmalosa fribriata* ($3.93 \times 10^{-5}$) > *Sardinella moderensis* ($2.56 \times 10^{-5}$) > *Cynoglossus senegalensis* ($2.24 \times 10^{-5}$) > *Sarotherodon melanotheron* ($1.85 \times 10^{-5}$) (Table 4). The value of cancer risks (CR) below $10^{-6}$ are considered as negligible, above $10^{-4}$ are considered unacceptable, and lying in between $10^{-6}$ and $10^{-4}$ are considered as acceptable [12]. Therefore, the CR value of Pb in the present study was considered acceptable, indicating no potential cancer risk from consumption of these fish species. A cancer risk of $6.75 \times 10^{-5}$ for Pb ingestion was reported in the fish species from Asafo Market, Ghana [23].

**Table 4. Carcinogenic Risk (CR) of consumption of fish species from upper region of Barrier Lagoon coast waters, Southwest, Nigeria**

| | *Sarotherodon melanotheron* | *Sardinella moderensis* | *Ethmalosa fribriata* | *Cynoglossus senegalensis* |
|---|---|---|---|---|
| Pb | 1.85E-05 | 2.56E-05 | 3.93E-05 | 2.24E-05 |

# 4. Conclusion

The present study provides information on the concentrations of trace metals (Pb, Cr, Zn, and Cu) in *Sarotherodon melanotheron*, *Sardinella moderensis, Ethmalosa fribriata* and *Cynoglossus senegalensis* from upper region of Barrier Lagoon coast waters, Southwest, Nigeria. The trace metal concentrations varied in the investigated fish species. The concentrations of trace metal in the fish species were below the regulatory limits set by FAO and WHO, except for Pb, in all the fish species studied. The EDI of the trace metals through fish consumption were less than the FAO/WHO PMTDI values, except for EDI of Pb in *Ethmalosa fribriata*. The HQ values show that adverse human health may occur from consumption of *Ethmalosa fribriata* because of elevated Pb. Nevertheless, the carcinogenic risk of Pb in the *Ethmalosa fribriata* was found within the acceptable levels (value in between $10^{-6}$ and $10^{-4}$). Although the investigated fish species might be safe for consumption at the current rate of ingestion of fish in Nigeria, high consumption of *Ethmalosa fimbriata* fish from upper region of Barrier Lagoon coast waters, may pose a potential health risk caused by elevated Pb in the fish. It is recommended that, to ensure fish consumer safety, it is imperative to monitor trace metals regularly in these fish species and other edible species of the Nigeria coastal waters.

# Acknowledgements

The authors would like to acknowledge Mr. Akin Fashade of the Department of Physical and Chemical Oceanography, Nigerian Institute for Oceanography and Marine Research, Lagos for assisting in digestion of the fish species used in this study.

# Conflict of Interest

The authors declare that they have no conflict of interest.

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