

## SEASONAL VARIATION IN POLYCHLORINATED BIPHENYL AND BISPHENOL A RESIDUES IN *Oreochromis niloticus* AND *Hepsetus odoe* FROM ELEYELE LAKE, OYO STATE, NIGERIA

OLAIFA, F.E\*, A.F. OGUNDELE\* AND O. OLOWOJUNI\*\*

\*Department of Aquaculture and Fisheries Management, University of Ibadan, Oyo State, Nigeria

\*\*Department of Fisheries and Aquaculture Technology, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria

\*\*Corresponding Author: [mailto:oluwafemiolowojuni@gmail.com](mailto:mailto:oluwafemiolowojuni@gmail.com), +2348138579874

### ABSTRACT

Fish occupy the top level of the food web in aquatic ecosystems and they are amplifiers of toxic substances present at lower trophic levels. Rapid uptake of pollutant by fish poses a potential threat to human consumers of fish due to bio-magnifications along the food chain. Polychlorinated Biphenyls (PCBs) and Bisphenol A (BPA) are chemicals of global concern, due to their persistence in the environment. These chemicals can be bio-accumulated by fish via the food chain. Therefore, this study was carried out to determine the seasonal variation of PCBs and BPA in selected fish muscles from Eleyele Lake. *O. niloticus* and *H. odoe* were procured from the fishermen at the shore of the lake. Samples were wrapped with aluminum foil, labeled, placed in a cooler containing ice, and transported to the laboratory. Fish muscles were removed; extraction and clean-up were carried out using standard procedures. *H. odoe* had the highest mean concentration of PCBs ( $81.63 \pm 18.96\text{ng/g}$ ), followed by *O. niloticus* ( $16.95 \pm 8.18\text{ng/g}$ ) and this was observed for the two species during the dry season. The mean concentration of Bisphenol A in *O. niloticus* during the wet season was  $4.45 \pm 1.08\text{ng/g}$  while, in *H. odoe*, it was  $0.93 \pm 0.03\text{ng/g}$ . The concentration of BPA and PCBs was higher than the recommended standard value. Therefore, it could affect human health.

**KEYWORDS:** Wastes discharge, Contamination, Fish Health, Urbanization

### INTRODUCTION

Pollution of water bodies arises due to industrial growth, urbanization and increased human population. Aquatic ecosystems such as Lakes and rivers are fragile and at high risk of Persistent Organic Pollutants due to their persistence in the environment and significant negative effects on human health and the environment (Kaur and Dua, 2015).

Bisphenol A has become ubiquitous in the environment within the past 80 years because of its presence in a multitude of products including food and beverage packaging, flame retardants, adhesives, building materials, electronic components, and paper coatings (Fernandez *et al.*, 2012). As demand for these products has increased, so has BPA production. Daily use of plastic products is widespread in Nigeria and these plastic debris constitute about 20% of the total solid waste in Nigeria (Emeka and Lesley, 2020). Surface waters could accumulate BPA either through point source such as sewage effluent and landfill leachates or non-point source such as plastic debris entering the watershed through runoff.

PCBs contamination arises from importation of electrical transformer oils containing PCBs from developed countries such as France, United Kingdom and Japan. Between 1970s and 1980s, these transformers were widely used in the energy production sector, resulting in PCBs oil leakage into soil and underground waters (Howell *et al.*, 2008). Anthropogenic activities such as agriculture, industrial waste discharge and incineration are sources of PCBs in Nigeria (Adeyemi *et al.*, 2009).

Eleyele Lake is a vital resource for fishery, domestic water supply and flood control in Ibadan. There is no formal control of wastes around the Lake. The Lake is degrading due to various anthropogenic activities around its catchments (Olanrewaju *et al.*, 2017). The disposal and management of wastes in Oyo State, Nigeria also presents serious environmental problems as the usual methods of waste disposal such as land filling, dumping site, and incineration could lead to contamination of surface water bodies including Eleyele Lake. Hence, this study aimed at investigating the seasonal variation of organic pollutants residues in fish from Eleyele Lake.

**MATERIALS AND METHODS**

**STUDY AREA**

Eleyele Lake (Figure 1), an artificial lake constructed in 1942 supports fish consumption and conservation in South-west, Nigeria (Kareem *et al.*, 2016). The quest to create a modern water supply system to meet the challenge of water scarcity for Ibadan metropolis led to the construction of Eleyele Lake on River Ona. The Lake has a reservoir storage capacity of 29.5 million litres (Kareem *et al.*, 2016). Located at the north-eastern part of Ibadan, Nigeria; it is within the Longitude 7°23'49"N and Latitude 3°52'2"E. It covers a distance of 62km from its source with a surface area of 152.76hecter and maximum depth of 12m, and a mean depth of 6.5m

(Kareem *et al.*, 2016). Its basin is long and narrow and divided into two main stretches, with the narrowest part slightly over 20m and the widest slightly above 250 m. The Lake receives water during the rainy season principally from the River Ona and other associated small streams, in addition to water from run-offs. The temperature of the area ranges from 25°C-30°C (Olubunmi *et al.*, 2017). Human activities in the area include fishing, farming, agro processing and boat traffic. The Lake receives effluents discharged from cassava processing site, agricultural farm land, and waste water from domestic activities from the neighbouring homes.



Figure 1: Map of Eleyele Lake

Source: Kareem *et al.* (2016)

**SAMPLE COLLECTION**

Fish samples were collected during both wet (September and October, 2019) and dry (December, 2019) and January, 2020) seasons. The fishes (*O. niloticus* and *H. odoe*) were procured from the fishermen and identified using identification guide to freshwater fish in Nigeria (Olaosebikan and Raji, 2013). The choice of *O. niloticus* and *H. odoe* were based on their availability in the Lake. Four fish samples each for the species were collected per sampling period. The Total length, standard length and weight measurement was taken. The total length and standard length was taken using meter rule

while the weight was taken using sensitive weighing balance. The fish samples were labeled, wrapped (to avoid contamination) with aluminum foil, placed in an iced cooler and transported to the laboratory on the same day. The average weight and length of the fishes were taken, respectively.

**Extraction of Polychlorinated Biphenyl (PCB) from Fish Samples**

The procedure of Wangboje and Okotie (2021) was followed for the extraction and clean-up of PCBs. 5g of homogenized fish sample was weighed into a beaker and 25mL of a mixture of

acetone and hexane (1:1) was added. The beaker was sonicated for 10min in an ultrasonic bath and the extract was transferred to another beaker. The extraction was repeated with 10mL of the solvent mixture. The extracts were combined, concentrated to about 2.0mL

#### Clean-Up of the PCBS Extract

Clean-up of the extracts was done with a column chromatography loaded with silica gel, glass wool, anhydrous sodium sulphate and then eluted with 5mL of hexane. The purified extracts were then re-constituted in 2mL hexane.

#### Extraction of Bisphenol A

The procedure of Adeyi and Babalola (2019) was followed for the extraction and clean-up of Bisphenol A. 3 g of homogenized sample was weighed into a beaker, 5 ml of hexane and 10 ml of acetonitrile were added. The sample was sonicated for 10 min in an ultrasonic bath and the extract was transferred to another beaker. The supernatant on the sample was decanted. The extraction was done twice; the extracts were combined and concentrated to about 2.0 mL

#### Clean-Up of the Extract

Clean-up of the extracts was done with a glass syringe loaded with silica gel, glass wool and anhydrous sodium sulphate and then eluted with 5 mL of hexane. The purified extracts were re-constituted in 1 mL hexane.

#### Derivatization of the Extract

1 mL each of the extract was transferred to 10mL centrifuge tubes, 20 $\mu$ L of 5 % K<sub>2</sub>CO<sub>3</sub> solution was added until pH $\geq$ 10. 50  $\mu$ L of tetrachloroethylene, 125  $\mu$ L of acetic anhydride and 4 mL of deionized water were added. The tubes were shaken for 1 minute and centrifuged at 3,500 rpm for 2 min. 50  $\mu$ L of organic solvent phase was transferred to a vial and made up to 1000  $\mu$ L with n-hexane. 1  $\mu$ L of the extract was injected into the GC-MS system.

#### Gas Chromatography

Analyses was performed with Gas chromatography (Agilent Technologies 7890 A) equipped with 5975 Mass Spectrometry Detector (MSD). A low polar HP-5 column of 30 m length, 0.32mm i.d and 0.25  $\mu$ m film thickness was used. The injection method and volume were splitless

mode and 1.0  $\mu$ L respectively. Helium was used as a carrier gas at a flow rate 1.8 mL/min. The operating parameters were as follows: Injector temperature was set at 280°C for the detector, the MSD transfer line temperature was at 280°C. The quantitative determination of the pesticide components by Mass Spectrometry was done using Selected Ion Monitoring (SIM).

#### Statistical Analysis

Data were collected and subjected to one-way analysis of variance (ANOVA), to assess the significant variation in residues of Bisphenol A and Polychlorinated Biphenyls seasonally, values less than 0.05 (p<0.05) were considered statistically significant. All statistical calculations were performed with SPSS 25.

## RESULTS

#### Morphometric of *O. niloticus* and *H. odoe* from Eleyele lake

The length and weight of *O. niloticus* and *H. odoe* was presented in Table 1. From the result, each species was compared for the seasons and it was found out that, there was no significant difference in the weight, total and standard length of *O. niloticus* while a significant difference was observed in the weight, total and standard length of *Hepsetus odoe* seasonally.

#### PCBS and BPA Concentration in *O. niloticus* AND *H. odoe* from Eleyele lake

The analysis of homologue patterns of different PCB congeners showed that; 118, 87, 143, 170, 171, 180 and 206 were not detected in all the fish samples across the seasons. The seasonal distribution of PCBs at Eleyele Lake was high during the dry season and this was reflected in the pattern of concentration in *O. niloticus* and *H. odoe*. The dry season of *Oreochromis niloticus* (16.75 $\pm$ 8.18ng/g) and *Hepsetus odoe* (81.63 $\pm$ 18.96ng/g) had the highest mean concentration of PCBs while the lowest mean value of PCBs (4.98 $\pm$ 2.72ng/g for *O. niloticus*; 2.17 $\pm$ 0.59ng/g for *H. odoe*) were recorded in wet season. The PCBs concentration in *Oreochromis niloticus* ranged from 6.20 – 16.49ng/g while the PCBs concentration in *Hepsetus odoe* ranged from 21.50 – 55.43ng/g. There was a significant difference at (p>0.05) in some of the congeners seasonally (Table 2-3). The most dominant PCBs across the seasons and in all the fish sample were

PCB 1, PCB 5, PCB 18, PCB 44 and PCB 141. This could be as a result of their high lipophilicity and persistence in the environment.

Bisphenol A had the highest mean concentration in wet season for *O. niloticus* and *Hepsetus odoe* but not detected during the dry season. This could be that BPA had undergone degradation by bacteria or photolysis before the dry season, since its

environmental half-life is between 4.5 and 4.7days. BPA ranged from 3.56-5.92ng/g and 0.76-1.24ng/g for *Oreochromis niloticus* and *Hepsetus odoe* respectively (Table 4). The mean concentration of Bisphenol A in *Oreochromis niloticus* during the wet season was (4.45±1.08ng/g) while in *Hepsetus odoe* was (0.93±0.03ng/g).

Table 1: Morphometric of the fish samples collected seasonally season from Eleyele Lake

| Season | Fish species        | Total Length (cm)       | Standard Length (cm)    | Weight (gram)             |
|--------|---------------------|-------------------------|-------------------------|---------------------------|
| Wet    | <i>O. niloticus</i> | 16.79±0.70 <sup>a</sup> | 13.32±0.59 <sup>a</sup> | 94.25±8.06 <sup>a</sup>   |
| Dry    | <i>O. niloticus</i> | 16.63±3.37 <sup>a</sup> | 12.75±3.07 <sup>a</sup> | 108.00±65.42 <sup>a</sup> |
| Wet    | <i>H. odoe</i>      | 21.88±2.50 <sup>a</sup> | 17.50±2.04 <sup>a</sup> | 89.00±33.69 <sup>a</sup>  |
| Dry    | <i>H. odoe</i>      | 28.55±1.50 <sup>b</sup> | 23.45±0.86 <sup>b</sup> | 157.18±37.09 <sup>b</sup> |

\*Mean value with the same superscript along the column was not significantly different at p>0.05

Table 2: Seasonal mean variation in PCBs concentration (ng/g) in *O. niloticus* from Eleyele Lake

| Congeners          | Total PCBs concentration |                         |               |                          |
|--------------------|--------------------------|-------------------------|---------------|--------------------------|
|                    | Wet season               |                         | Dry season    |                          |
|                    | Range                    | Mean ± SD               | Range         | Mean ± SD                |
| PCB 1              | 2.87 – 17.72             | 11.13±6.23 <sup>a</sup> | 2.98 – 9.96   | 0.50±0.13 <sup>b</sup>   |
| PCB 5              | 2.12 – 3.56              | 2.66±0.64 <sup>a</sup>  | 0.00          | 1.91±0.85 <sup>a</sup>   |
| PCB 18             | 0.72 – 1.24              | 0.92±0.23 <sup>a</sup>  | 0.10          | 3.71±3.68 <sup>a</sup>   |
| PCB 81             | 0.00                     | 0.00                    | 0.00          | 3.25±2.65                |
| PCB 44             | 7.84 – 13.06             | 9.79±6.29 <sup>a</sup>  | 0.90 – 3.00   | 2.65±2.05 <sup>a</sup>   |
| PCB 52             | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 118            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 87             | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 101            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 105            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 138            | 0.00                     | 0.00 <sup>a</sup>       | 0.00          | 11.84±3.68 <sup>b</sup>  |
| PCB 141            | 0.34 – 0.56              | 0.42±0.22 <sup>a</sup>  | 0.58 – 0.98   | 32.23±35.04 <sup>a</sup> |
| PCB 143            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 151            | 0.00                     | 0.00 <sup>a</sup>       | 0.00          | 59.88±16.45 <sup>b</sup> |
| PCB 153            | 0.00                     | 0.00 <sup>a</sup>       | 0.00          | 53.45±17.23 <sup>b</sup> |
| PCB 170            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 171            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 180            | 0.00                     | 0.00                    | 0.00          | 0.00                     |
| PCB 183            | 0.00                     | 0.00 <sup>a</sup>       | 0.00          | 0.08±0.03 <sup>a</sup>   |
| PCB 187            | 0.00                     | 0.00                    | 0.06 – 0.20   | 0.00                     |
| PCB 206            | 0.000                    | 0.00                    | 0.00          | 0.00                     |
| Mean concentration | ∑2.78 – 7.28             | ∑4.98±2.72              | ∑9.62 – 25.69 | ∑16.95±8.18              |

\*Mean with the same superscript along the rows are not significantly different (p>0.05) \*

PCB 1 = Chlorobiphenyl, PCB 5 = 2,3-Dichlorobiphenyl, PCB 18 = 2,2',5'-Trichlorobiphenyl, PCB 81 = 3,4,4',5'-Tetrachlorobiphenyl, PCB 44 = 2,2',3,5'-Tetrachlorobiphenyl, PCB 52 = 2,2',5,5'-Tetrachlorobiphenyl, PCB 118 = 2,2',3,4,5'-Pentachlorobiphenyl, PCB 87 = 2,2',3,4,5'- Pentachlorobiphenyl, PCB 101 = 2,2',4,5,5'-Pentachlorobiphenyl, PCB 105 = 2,3,3',4,6-Pentachlorobiphenyl, PCB 138 = 2,2',3,4,4',5'- Hexachlorobiphenyl, PCB 141 = 2,2',3,4,5,5'- Hexachlorobiphenyl, PCB 143 = 2,2',3,4,5,6'- Hexachlorobiphenyl, PCB 151 = 2,2',3,5,5',6'- Hexachlorobiphenyl, PCB 153 = 2,2',4,4',5,5'- Hexachlorobiphenyl, PCB 170 = 2,2',3,3',4,4',5'-Heptachlorobiphenyl, PCB 171 = 2,2',3,3',4,4',6- Heptachlorobiphenyl, PCB 183 = 2,2',3,4,4',5',6-Heptachlorobiphenyl, PCB 187 = 2,2',3,4',5,5',6- Heptachlorobiphenyl, PCB 206 = 2,2',3,3',4,4',5, 5',6-Nanochlorobiphenyl

Table 3: Seasonal mean variation in PCBs concentration (ng/g) in *H. odoe* from Eleyele Lake

| Congeners          | Total PCBs concentration |                        |                 |                            |
|--------------------|--------------------------|------------------------|-----------------|----------------------------|
|                    | Wet season               |                        | Dry season      |                            |
|                    | Range                    | Mean ± SD              | Range           | Mean ± SD                  |
| PCB 1              | 2.98 – 9.96              | 7.46±1.78 <sup>a</sup> | 250.80 – 824.56 | 627.00±141.02 <sup>b</sup> |
| PCB 5              | 0.00                     | 0.00 <sup>a</sup>      | 1.02 – 1.72     | 1.30±1.37 <sup>a</sup>     |
| PCB 18             | 0.10                     | 0.24±0.06 <sup>a</sup> | 0.48 – 0.82     | 0.61±0.41 <sup>a</sup>     |
| PCB 81             | 0.00                     | 0.00 <sup>a</sup>      | 4.00 – 13.32    | 10.00±2.36 <sup>b</sup>    |
| PCB 44             | 0.90 – 3.00              | 2.24±0.54 <sup>a</sup> | 3.34 – 5.56     | 4.17±2.59 <sup>a</sup>     |
| PCB 52             | 0.00                     | 0.00 <sup>a</sup>      | 0.08 – 0.32     | 0.23±0.07 <sup>a</sup>     |
| PCB 118            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 87             | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 101            | 0.00                     | 0.00 <sup>a</sup>      | 23.80 – 79.32   | 59.50±14.11 <sup>b</sup>   |
| PCB 105            | 0.00                     | 0.00 <sup>a</sup>      | 63.68 – 106.12  | 79.60±18.88 <sup>b</sup>   |
| PCB 138            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 141            | 0.58 – 0.98              | 0.73±0.56 <sup>a</sup> | 5.88 – 9.80     | 7.36±1.74 <sup>b</sup>     |
| PCB 143            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 151            | 0.00                     | 0.00 <sup>a</sup>      | 53.36 – 88.92   | 66.81±15.74 <sup>b</sup>   |
| PCB 153            | 0.00                     | 0.00 <sup>a</sup>      | 96.00 – 160.00  | 120.00±28.47 <sup>b</sup>  |
| PCB 170            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 171            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 180            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| PCB 183            | 0.00                     | 0.00 <sup>a</sup>      | 2.36 – 3.96     | 2.97±0.70 <sup>b</sup>     |
| PCB 187            | 0.06 – 0.20              | 0.16±0.03 <sup>a</sup> | 0.00            | 0.00 <sup>a</sup>          |
| PCB 206            | 0.00                     | 0.00                   | 0.00            | 0.00                       |
| Mean concentration | ∑0.92-3.00               | ∑2.17±0.59             | ∑42.07 – 107.89 | ∑81.63±18.96               |

\*Mean with the same superscript along the rows are not significantly different (p>0.05) \*

PCB 1 = Chlorobiphenyl, PCB 5 = 2,3-Dichlorobiphenyl, PCB 18 = 2,2',5-Trichlorobiphenyl, PCB 81 = 3,4,4',5 Tetrachlorobiphenyl, PCB 44 = 2,2',3,5'-Tetrachlorobiphenyl, PCB 52 = 2,2',5,5'-Tetrachlorobiphenyl, PCB 118 = 2,2',3,4,5'-Pentachlorobiphenyl, PCB 87 = 2,2',3,4,5'- Pentachlorobiphenyl, PCB 101 = 2,2',4,5,5'- Pentachlorobiphenyl, PCB 105 = 2,3,3',4,6-Pentachlorobiphenyl, PCB 138 = 2,2',3,4,4',5'- Hexachlorobiphenyl, PCB 141 = 2,2',3,4,5,5'- Hexachlorobiphenyl, PCB 143 = 2,2',3,4,5,6'- Hexachlorobiphenyl, PCB 151 = 2,2',3,5,5',6- Hexachlorobiphenyl, PCB 153 = 2,2',4,4',5,5'- Hexachlorobiphenyl, PCB 170 = 2,2',3,3',4,4',5- Heptachlorobiphenyl, PCB 171 = 2,2',3,3',4,4',6- Heptachlorobiphenyl, PCB 183 = 2,2',3,4,4',5',6- Heptachlorobiphenyl, PCB 187 = 2,2',3,4',5,5',6- Heptachlorobiphenyl, PCB 206 = 2,2',3,3',4,4',5, 5',6- Nanchlorobiphenyl

Table 4: Seasonal concentration of BPA (ng/g) in *O. niloticus* and *H. odoe* at Eleyele Lake

| Species             | Wet season |      |                        | Dry season |      |           |
|---------------------|------------|------|------------------------|------------|------|-----------|
|                     | Min        | Max  | Mean ± SD              | Min        | Max  | Mean ± SD |
| <i>O. niloticus</i> | 3.56       | 5.92 | 4.45±1.08 <sup>a</sup> | 0.00       | 0.00 | 0.00±0.00 |
| <i>H. odoe</i>      | 0.76       | 1.24 | 0.93±0.03 <sup>b</sup> | 0.00       | 0.00 | 0.00±0.00 |

\*Mean with the same superscript along the row are not significantly different (p>0.05) \*

**DISCUSSION**

The present study revealed the levels of Polychlorinated Biphenyls and Bisphenol A residues in fish (*O. niloticus* and *Hepsetus odoe*) muscle from Eleyele Lake. PCBs and BPA levels in the study area showed a seasonal pattern of change. The values of PCBs remained high during the dry

season as compared to the wet season. The higher BPA concentration found in the fishes obtained in wet season may be due to the high inflow of water carrying plastic materials into Eleyele Lake which could have led to the bioaccumulation of BPA in the fish during this period. The average concentration of PCBs in *Oreochromis niloticus* and *Hepsetus odoe*

ranged 13.85ng/g – 35.96ng/g. This range was above the range (8.0 - 13.0 ng/g) of PCBs collected in 40 fresh water fish samples from various locations in Oyo and Ogun States, Nigeria (Osibanjo and Bamgbose,1990) while similar studies in South Eastern Nigeria revealed 0.7 – 14.0 ng/g PCBs per fresh weight of fish (Adeyemi *et al.*, 2009). The concentration of PCBs in fish are controlled by many factors such as species, age, size, gender, growth rate, and food choice (Ashley *et al.*, 2000). Feeding habits of the organism or the position of the fish in the food chain also play an important role in the accumulation of the persistent organic pollutant. The species at higher trophic levels accumulate high PCBs than the ones at the lower trophic levels (Adeyemi *et al.*, 2008). *Oreochromis niloticus* primarily an herbivorous Cichlidae, its diet is dominated by phytoplankton while *Hepsetus odoe* is carnivorous species that mostly feed on detritus. The maximum PCB levels were found in *Hepsetus odoe*, which was expected, considering their high trophic level position. This result is similar to Brázová *et al.* (2011) who reported that predator fish species show good characteristics for PCB bio-indication in the water reservoir of Zemplínskašírava. The present study also revealed that, the seasonal mean concentration of detected PCBs across the fish species were significantly above the limit of 0.014ng/g set by European Union Standard, 2015.

BPA concentrations in the fish samples varied from 0 - 4.45±1.08ng/g (dry season to wet season) in *Oreochromis niloticus* and 0 - 0.93±0.03ng/g (dry season to wet season) in *Hepsetus odoe*. The concentration of BPA reported in this study was above the recommended value (0.04ng/g) of European Food Safety and Authority (2015). Exposure of humans to BPA primarily occurs through the hydrolysis of epoxy resins and polycarbonate plastics. BPA could bio-accumulates in the aquatic animals as it gets into the environment through wastewater and sewage treatment discharges, and landfill leachates; and natural degradation of polycarbonate plastics (Environment Canada, 2008). Aquatic food has been reported to have higher concentration of BPA than other foods category (Adeyi and Babalola, 2019). In Singapore, Basheer *et al.* (2004) found 13.3 – 213.1ng/g of BPA in prawn, crab, blood cockle, white clam, squid, and fish purchased from local supermarkets, indicating the potential for human exposure by eating contaminated seafood. BPA is systemically toxic to various taxa, including daphnids (Brennan *et al.*,

2006). The BPA levels of in *Oreochromis niloticus* and *Hepsetus odoe* obtained in wet season was significantly higher ( $p<0.05$ ) compared with dry season.

## CONCLUSION

Concentrations of BPA and PCBs found in the study could affect human health. Therefore, regular monitoring of Eleyele Lake is important and effective methods of waste disposal should be adopted to reduce the level of contaminants in the Lake.

## REFERENCES

- Adeyemi, D., Ukpo, G., Anyakora, C. and Unyimadu, J.P (2008). Organochlorine Pesticide Residues in Fish Samples from Lagos Lagoon, Nigeria. *American Journal of Environmental Sciences*, 4 (6): 649-653.
- Adeyemi, D., Ukpo, G., Anyakora, C., and Paul, J. (2009) Polychlorinated biphenyl in fish samples from Lagos Lagoon, Nigeria. *African Journal of Biotechnology*, 8 (12): 2811-2815
- Adeyi, A.A and Babalola, B.A (2019). Bisphenol-A (BPA) in Foods commonly consumed in Southwest Nigeria and its Human Health Risk. *Nature Research*, 9:17458, p1-13.
- Ashley, J.T., Secor, D.H. and Zlokovitz, E (2000). Linking habitat use of Hudson River striped bass to the accumulation of Polychlorinated Biphenyls congener. *Environment and Science Technology* 34:1023–9.
- Basheer, C., Lee, H. K. and Tan, K.S (2004). Endocrine disrupting alkyl phenols and Bisphenol A in coastal waters and supermarket seafood from Singapore. *Marine Pollution Bulletin*, 48: 1161-7.
- Brázová, T., Hanzelová, V., Miklisová, D., Šalgovičová, D. and Turčeková, L (2011). Biomonitoring of polychlorinated biphenyls (PCBs) in heavily polluted aquatic environment in different fish species. *Environmental Monitoring and Assessment*, 184:6553–6561
- Brennan, S.J., Brougham, C.A., Roche, J.J. and Fogarty, A.M (2006). Multi-generational effects of four selected environmental oestrogens on *Daphnia magna*. *Chemosphere*, 64: 49-55.
- Emeka, D. and Lesley, H. (2020). Perception of plastic pollution and waste amongst young

- people in Nigeria. *Social Science Research Network*, Pp27
- Environment Canada (2008). Screening Assessment for the Challenge: Phenol, 4, 4'-(1-methylethylidene) bis-(Bisphenol A). Chemical Abstracts Service Registry Number 80-05-7, 35–60
- European Food Safety Authority. (2015). Scientific Opinion on the risks to public health related to the presence of bisphenol A in foodstuffs: Executive summary. *European Food Safety Authority Journal*, 13(1):3978
- Fernandez, S., Huang, Y., Snider, K., Zhou, Y., Pogash, T., Russo, J. (2012). Expression and DNA methylation changes in human breast epithelial cells after bisphenol A exposure. *International Journal of Oncology*, 41:369–377.
- Howell, N.L, Suarez, M.P, Rifai, H.S and Koenig, L (2008). Concentrations of polychlorinated biphenyls (PCBs) in water, sediment, and aquatic biota in the Houston Ship Channel, Texas. *Chemosphere*, 70:593– 606.
- Kareem, O.K, Ajani, E.K., Orisasona, O., Olanrewaju, A.N. (2016). The Sex ratio, Gonadosomatic index, Diet composition and Fecundity of African pike, *Hepsetus odoe* (Bloch, 1794) in Eleyele Lake, Nigeria. *Journal of Fisheries and Livestock Production*, 3: 139.
- Kareem, O.K., Ajani, E.K, Orisasona, O and Olanrewaju, A.N (2016). The Sex ratio, Gonadosomatic index, Diet composition and Fecundity of African pike, *Hepsetus odoe* (Bloch, 1794) in Eleyele Lake, Nigeria. *Journal of Fisheries and Livestock Production*, 3: 139-145.
- Kaur, R. and Dua, A. (2015). 96h LC50, behavioural alterations and histopathological effects due to wastewater toxicity in a freshwater fish *Channa punctatus*. *Environmental Science and Pollution Research*, 22:5100-5110
- Kumolu-Johnson, C.A. and Ndimele, P.E. (2010). Length-weight relationships and condition factors of twenty one fish species in Ologe lagoon, Lagos, Nigeria. *Asian Journal of Agricultural Science*, 2 (4): 174- 179.
- Olubunmi A, Folake B.A, Omokhafe O.I. (2017). Biology of Length-Weight Relationship and Condition Factor of Some Cichlids in Eleyele Lake, Oyo State, Nigeria. *Journal of Fisheries and Aquaculture Development JFAD*, pp122.
- Osibanjo, O. and Bamigbose. (1990). Review of chlorinated substance in marine fish and shellfish of Nigeria. *Marine Pollution Bulletin*, 21: 581- 586.
- Wangboje, O.M and Okotie, D.O (2021). Polychlorinated Biphenyls in Imported Fish. *European Journal of Agriculture and Food Sciences*, 3(1). 90-96