ESTIMATION OF POLYBROMINATED DIPHENYL ETHERS (PBDES) CONTAMINATION LEVELS IN SEDIMENT AND CRAB (*Callinectes amnicola*) FROM SOME SELECTED AREA OF EPE LAGOON

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Abstract: Polybrominated diphenyl ethers (PBDEs) are flame retardant that persist, bioaccumulate and biomagnify in aquatic organisms with accompanied deleterious effect. The PBDEs levels was assessed in sediments and Crabs (*Callinectes amnicola*) collected from Oro-oguro (stations 1) and Orugbo (stations 2) in Epe lagoon, Nigeria. Samples were analyzed using Gas Chromatography coupled with Electron Capture Detector (GC-ECD). Sediments BDE (28, 47, and 183) were detected in both stations at concentrations lower than Federal Environmental Quality Guidelines for PBDEs Environment Canada (150 ng/g) and European Union (310 ng/g). The total mean concentration of PBDEs ranged from 37.77 – 67.66 ng/g) in station 2 and 1, respectively. BDE 28 had the highest concentration (32.20 ng/g) of the congeners detected while congener BDE 47 had the lowest concentration (3.25 ng/g). BDE 7, BDE 28, BDE 47 and BDE 99 were detected in *C. amnicola* sampled from both stations. BDE 28 was highest in stations 1 and 2 (144.79 and 2611.29 ng/g), respectively which was significantly higher relative to the Canada Environmental Quality Guidelines (120 ng/g). The total PBDEs concentration was higher in station 2 (2730.67 ng/g) than station 1 (183.18 ng/g). Total organic carbon was higher in sediment (2.496 mg/g) from station 2 than station 1 (1.872 mg/g). Derivation of Biota-Sediment Accumulation Factor (BSAF) for BDE (7 and 28) congeners was greater than 1 in both stations. Thus, a reflection of an unhealthy state of the environment that calls for regular monitoring to ensure conservation of the inhabitants.

Keywords: Organic pollutants, polybrominated diphenyl ethers, bioaccumulation, Epe Lagoon, *C. amnicola*

Introduction

Polybrominated diphenyl ethers (PBDEs) are halogenated organic flame retardants that delay the onset or inhibit fire (Kierkegaard, 2007; Talsness, 2008; McKenzie, 2009); a component in the manufacture of commercial and consumer products (textiles paint, textiles, building materials, automobiles, polyurethane foams used in furniture, mattresses, carpets, car seats, plastics and electrical appliances). Polybrominated diphenyl ethers functions mainly by scavenging oxidizing free radicals that are produced during combustion. Formulations of PBDE congener groups such as TriBDEs, HexaBDEs, HeptaBDE and NonaBDE vary in percentages (La Gardia *et al*., 2012; UNEP, 2010a; Winid, 2015).

Polybrominated diphenyl ethers have emerged as a major environmental pollutant due to their recalcitrant property with the ability to bioaccumulate resulting in toxicity. Within highly populated areas, elevated concentrations of PBDEs have been detected in air, water, sediment and soil associated with or in proximity to manufacturing, recycling, and waste disposal facilities; a point source of PBDEs in abiotic media (Faiyiga and Ipinmoroti, 2017). PBDEs are persistent, lipophilic and bioaccumulate in fat tissues of animals. Humans could be exposed to PBDEs by consuming contaminated foods, especially those with a high fat content, such as fatty fish and crabs. Their presence in the environment is perceived as a major threat (Vonderheide *et al*., 2008) being potential carcinogens and endocrine disruptors. These were some of the reasons their production and use were banned by the European Union (EU) in August 2004 (BSEF, 2006).

According to reports it has been shown that Nigeria is one of the African countries that serve as e-waste dumping ground; an important source of PBDEs in the environment (Wang *et al.*, 2005; Leung *et al.*, 2007).Studies have shown that PBDEs have been detected in virtually every part of the environment (Lee *et al.*, 2004) such as indoor and outdoor settings (Oros *et al.*, 2005), water bodies (Siddiqi *et al.*, 2003; ATSDR, 2017), particles and sediments in aquatic media (Covaci *et al.*, 2005; Adewuyi and Adeleye, 2013; Wu *et al*., 2015), terrestrial mammals and birds (Sellström *et al.*, 1993), marine mammals (Haglund *et al.*, 1997), fish (Hale *et al.*, 2001), and humans (Kalantzi *et al.*, 2009; Thomas *et al.*, 2006; USEPA, 2010) at detrimental levels. There is a growing concern about their toxicity and persistence in the environment (Ikonomou *et al*., 2002; Akortia *et al*., 2016; Fayiga and Ipinmoroti, 2017). Especially since their occurrence and toxicity has been reported in virtually every continent indicating a global problem (McKenzie, 2009; UNEPa, 2010; Zhang *et al*., 2016). This warrants a consistent and regular monitoring of these different compartments. Benthic organisms are widely accepted as useful indicators for assessing pollution impacts in the aquatic environment. The bioaccumulative tendencies of PBDE congeners make them a problem to the overall health and quality of the environment. This can result in the manifestation of chronic effects on organisms in contaminated ecosystems. Many of the organisms that bioaccumulate PBDEs are part of the human diet such as the blue crab (Abowei and George, 2009) and are usually harvested for sustenance and food consumption by the local population. It is important to understand their distribution across various ecosystems since they can undergo long-range transport and be distributed in the environment. This study was conducted to assess the level of PBDEs in sediments and tissues of *Callinectes amnicola* collected at the Oro-oguro and Orugbo stations in Epe lagoon.

Materials and Methods

Description of study area

Epe Lagoon lies between longitude $5^0$30' - $5^0$40'E and latitude $3^0$50' – 4^0 10'N and has a surface area of about 225 km^2 and a maximum depth of 6 m. The lagoon is sandwiched between the Lagos and Lekki Lagoons. However, a large area of the lagoon is relatively shallow with a minimum depth of 1 m and the vegetation surrounding the lagoon is of the mangrove swampy type (Balogun, 1987). The Lagoon opens into the Gulf of Guinea via Lagos harbor (Adeogun *et al*., 2015). Epe Lagoon serves as a source of income and sustenance for the fishing communities. Two stations Oro-Oguro (1) and Orugbo (2) were selected along Epe lagoon for collection of sediment and *C. amnicola* samples used for this study based on the immensity of anthropogenic activity (Table 1 and Fig. 1).

Table 1: Description of sampled locations

Station	Sample locations	GPS Coordinates	Site Description	Type of wastes disposed
1	Oro-oguro	N 06^0 36.178' E 003^0 50.333'	Fishing community, houses along the coast and dense vegetation on the banks of the Lagoon, artificial ponds on the water	Human wastes, oils and fuel from boats, plastics, decayed plants
2	Orugbo	N 06^0 37.162' E 003^0 46.466'	Fishing village, small community with wooden structures, lush vegetation,	Human wastes, organic materials,

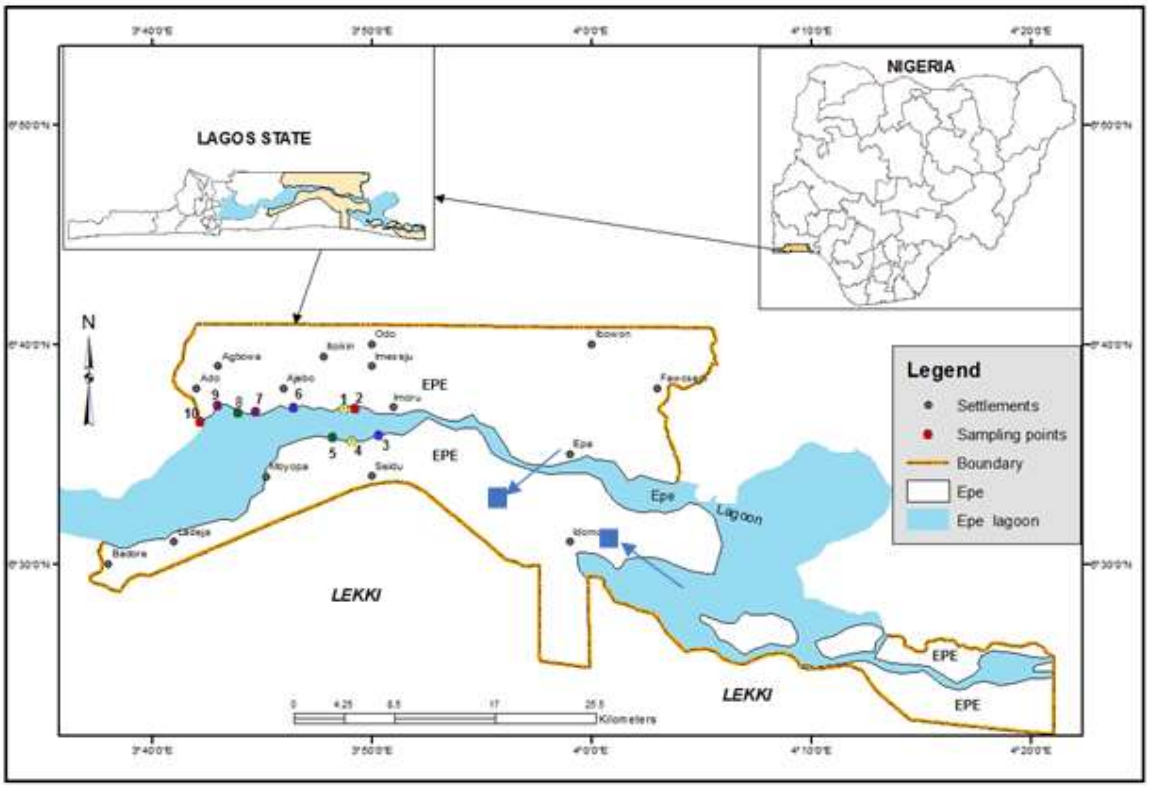

Fig. 1: Epe Lagoon showing the sampled stations

Sediment and animal samples collection

Sediment samples

Sediment samples were collected from the two selected stations along the Epe lagoon using the stainless steel Van Veen Grab of 0.1 m^2 at each sampling station. To avoid contamination, stainless steel scoops, sieves and buckets were used in the collection of the sample. The sediments were collected in three (3) replicates and homogenized to produce a single composite sample for each station. The sediment samples were kept in aluminum foil and stored in an ice cooler at a temperature of 4°C before it was conveyed to the laboratory.

Callinectes amincola samples

Callinectes amincola (crab) samples were collected in triplicates from both stations using a stainless steel Van Veen Grab of 0.1 m^2 and sieved with a 2 mm mesh stainless steel sieves from the two (2) stations. The collected samples were kept in aluminium foil, and at a temperature of 4°C until transported to the laboratory for analysis. Stainless steel, scoops, sieves and buckets were used in the collection to avoid interference with the organic sample analyzed for persistent organic pollutant.

Sampling periods

Sample collection was carried out for three months; April, June and September 2017. Timing of the sampling periods was distributed into April (Late dry season/early rainy season), July and September (middle of rainy season) for the sampling. These periods were selected due to information regarding the availability of crab samples in the lagoon, high tides and accessibility to sampling stations due to the presence of water Hyacinth in the lagoon.

Samples extraction and clean-up

Crushed sediment and crab tissue samples (5 g) each were separately mixed with sodium sulphate anhydrous in ratio 1:1 respectively (to remove any residual moisture) and homogenized using an agate mortar and pestle. The each dried samples were then extracted using 200 ml n-Hexane as a solvent, the solution was shaken vigorously for 1 hour with the aid of an electronic shaker, and filtered using Whatman filter paper. The solution was stored overnight for complete separation of hexanic phases and evaporation of the solvent. The extraction solutions of samples were cleaned up using solvent-rinsed chromatographic columns (15 - 250 mm), packed with a plug of glass wool followed by 5 g deactivated silica gel and topped up with sodium tetraoxosulphate (VI). The columns were pre-rinsed with 15 mL hexane after which 2 mL of the analyte was added to the column and eluted with 60 mL hexane. The extracts were concentrated to approximately 2 mL using a rotary evaporator and kept in a sample vial for gas chromatographic analysis (Adewuyi and Adeleye, 2013).

Gas chromatography- electron capture detector (GC-ECD) analysis

A gas chromatograph model Agilent-7890 series equipped with ^{63}Ni Electron Capture Detector (μECD) of activity 15 mCi with an auto sampler and J and W 122 – 4732 DB-17ms: 30 m x 250 μm x 0.25 μm fused Silica capillary column (50% Phenyl-methyl polysiloxane proprietary) was used for separation of the analytes. The GC temperature ramp (Table 2) was injected with 1 μL in a splitless mode. All samples were run in triplicate.

Table 2: Gas chromatograph conditions

Condition	Value
Carrier gas flow(Helium)	1.0 ml/min
Make up gas flow(Nitrogen)	29.0 ml/min
Oven program	100°C for 0.5 min, 100 – 200°C at 30°C/min hold for 4 min, 200 – 300°C at 15°C/min hold for 4 min, 300°C hold for 5 min.
Injection temperature	250^0C
Detector temperature	250^0C

Instrument calibration was performed from the analysis of nine (9) compounds of PBDEs (99% purity). Retention times were established by using five points calibration range of 0.01 to 0.05 μg/ml for BDE 7, 28, 47, 100, 99, 154, 153, 183 and 209 PBDEs standard mixes obtained from Accustandard Inc. United State. The concentrations of PBDEs were determined by extrapolation of peak area using the calibration curves of the standards (Adewuyi and Adeleye, 2013).

Grain size analysis of sediments

The sediment samples were wet-sieved to remove all the clay, silt sized particles and oven dried. Exactly 150 ml of sodium hexametaphosphate solution was added to 200 g of the oven dried sample mixed with 200 ml of water to cover sediment mixture. The solution was allowed to stand for 30 min; the solution was washed carefully through the 750 μg sieve. The residue was backwashed for the suspension to settle, then water was decanted and the remaining soil-water suspension was placed in the oven to dry for 24 h.

The oven dried residue was weighed, and the procedure for dry sieving analysis was repeated. 200 g of the oven dried soil sample, was passed through sieves of different mesh sizes arranged in descending order, with the largest size (2.36 mm) at the top, a receiver was placed beneath the smallest size (75 μg). The weighed sediments were transferred into the topper most sieve and place the lid on. The sediment samples were agitated by lateral motion accompanied by a jarring action so as to keep the soil moving continuously over the sieve surface for 10 minutes. After which each sieve was shaken separately over a clear tray, until no more material passed through. The material retained in the tray was returned to the next smaller sieve that was in turn shaken. The material retained on each sieve was weighed and the amount recorded.

Sedimentation by hydrometer method

The suspension that passed through the smallest sieve (75 μg) was transferred into a one litre measuring cylinder and distilled water was added up to the 1 litre graduation mark. Rubber stoppers were used to block the opening of the cylinder, to enable rigorous end–over-end shaking of soil suspension, then the suspension was placed gently on the table to settle. A stop watch was used to measure time and the hydrometer was immersed into the suspension to a depth slightly below its floating position and allowed to float freely. Hydrometer readings were taken at the upper rim of the meniscus after periods of 0.5, 1, 2 and 4 min. The hydrometer was removed, rinsed in distilled water then placed in the cylinder containing distilled water and dispersant (sodium-hexametaphosphate solution) at the same temperature of the soil suspension. The hydrometer was re-inserted into the soil suspension and readings were recorded after period of 8, 30 min; 2, 8 and 24 h from the start of the sedimentation and twice during the following day. Temperature was recorded during the first 15 min and after every subsequent reading. To calculate the true hydrometer reading, Rh (mm), this equation was used;

$$Rh = Rh' + C_m$$

Where: C_m– meniscus Correction (0.5); Rh' – the observed hydrometer reading

The equivalent particle diameter, D (mm) was calculated from the equation;

$$D = 0.005531 \sqrt{} nH_t / (P_s - 1)t$$

Where: n – Dynamic viscosity of water at the test temperature; H_t- Effective depth at which the density of the suspension is measured (mm); P_s– The particle density (Mg/m^3); t – The elapsed time (mm); 0.005531 is a constant

Total organic carbon analysis of sediments

Potassium dichromate ($K_2Cr_2O_2$) and concentrated Tetraoxosuphate (IV) H_2SO_4 was added to 1 g of sediment. The solution was swirled and allowed to cool. The solution was gently boiled, to enable complete digestion (Mebius, 1960). Water was added to halt the reaction. After sample digestion, the solution was centrifuged and filtered to remove any suspended particles and placed in a calorimeter set to measure the light absorbance at a wavelength of 601. Colorimetric quantitation of TOC was performed through the measurement of the colour change that resulted from the presence of Cr^{3+} in the solution.

Biota-sediment accumulation factor

In this study, BSAF was considered as a measure of the biotic fate of PBDEs and defined using the following equation:

BSAF =

$$\frac{concetration\ of\ PBDEs\ in\ crab\ tissue}{concetration\ of\ PBDEs\ in\ sediment}$$ **(Burkhard, 2009)**

A theoretical BSAF value between 1 and 2 was considered as a threshold value for bioaccumulation (Burkhard, 2009). BSAF = 2 was chosen as the limit value.

Statistical analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 and Microsoft Excel Statistical Software. The physicochemical parameters for each sample station were subjected to one-way Analysis of Variance (ANOVA) and Duncan Multiple Range Test. The PBDEs concentration for each sample station and sample type was subjected to two way analysis of variance (ANOVA) and Duncan Multiple Range Test. Pearson correlation analyzed the grain size, TOC and ∑PBDEs.

Results and Discussion

PBDE concentration in the sediment

Nine (9) PBDEs congeners were analysed (BDE 7, BDE 28, BDE 47, BDE 99, BDE 100, BDE 153, BDE 154, BDE 183 and BDE 209) in sediments (Table 3). This corroborates with the findings of Zhang *et al*. (2016). The authors published a review of the concentration of PBDEs in sediments from different countries and the mean concentration of the PBDEs in sediments recorded in this study was within the range of values that were reported. A similar study at Lagos Lagoon (Adewuyi and Adeleye, 2013) had higher concentration of PBDEs and more congeners were detected compared to that

detected in this study though results are still in range of the reported concentrations.

The results (Table 3) also showed that BDE 7, BDE 28 and BDE 47 were dominant in both stations at concentrations lower than Federal Environmental Quality Guidelines for PBDEs Environment Canada (150 ng/g) and European Union (310 ng/g). The dominance of congeners BDE 7, BDE 28 and BDE 47 observed in this study were in line with the results from other studies (Song *et al*., 2004, 2005b; Xian *et al*., 2008; Hu *et al*., 2010; Simmons, 2013). However, heavier congeners were not detected in this study compared to similar evaluations on sediments (Adewuyi and Adeleye, 2013; Zhang *et al*., 2016). These lighter and more toxic PBDE congeners can biomagnify readily in aquatic food webs, with increased risk to the health of fish and benthic organisms (Ross *et al*., 2009). Heavier PBDE congeners that were not detected in this study could probably be due to the long distance from point source (Epe Lagoon to the industrial areas, commercial areas or major markets in Lagos state). Another probable reason could be as a result of degradation into smaller congeners before entrance into the Lagoon. The degradation could be attributed to photodegradation or photolytic debromination of large PBDEs into lighter congeners (Raff and Hites, 2007; Shih and Wang, 2009; Daso *et al*., 2013).

The total mean concentration of PBDEs ranged from 37.77 - 67.66 ng/g in station 2 and 1, respectively. BDE 28 had the highest concentration (32.20 ng/g) of the congeners detected in all stations while congener BDE 47 had the lowest concentration (3.25 ng/g). This could be explained by the larger number of inhabitants and human activities present at Oro-oguro station (1) compared to Orugbo station (2) and the non-uniformity in the discharge of PBDE compounds into the Lagoon. Furthermore, the absence of heavier hexaBDEs and heptaBDEs in this study suggested the absence of major point sources of PBDE contaminants in and around the Lagoon. Xu *et al*. (2009) studied sediment samples from Nongkang River in China that was in the vicinity of a PBDE manufacturing plant (point source) and detected heavier congeners in sediments at close proximity to the source. Adewuyi and Adeleye, (2013) detected more congeners in the Lagos Lagoon especially in areas that were closer to industrial activities.

Table 3: Mean PBDE concentrations (ng/g) in sediment samples in comparison with environmental quality guidelines and standards

PBDE Congeners	Oro-Oguro (ng/g)	Orugbo (ng/g)	Canada FEQGs (ng/g)	EU FEQGs (ng/g)
F- BDE 7	28.49±0.34	10.68±2.21		
BDE 28	34.20±0.92	23.84±0.69	44	-
BDE 47	4.98±0.46	3.25±1.63	39	-
BDE 99	ND	ND	0.4	-
BDE 100	ND	ND	0.4	-
BDE 153	ND	ND	440	-
BDE 154	ND	ND	440	-
BDE 183	ND	ND	-	-
BDE 209	ND	ND	19	-
∑PBDE	67.66±1.72	37.77±4.53	150	310

*FEQG: Federal Environmental quality standards adopted by Canada ND: Not detected; ∑PBDE: the total concentration of PBDE in sediments from each sampled stations; ±: standard error

Table 4: Mean PBDE concentrations in *C. amnicola* from the sampling stations compared to environmental quality guidelines

PBDE Congeners	Oro-Oguro (ng/g)	Orugbo (ng/g)	Environment Canada EQGs (ng/g)
F- BDE 7	36.76 ± 1.39	113.87 ± 7.83	
BDE 28	144.79 ± 7.92	2611.29±148.28	120
BDE 47	1.6314 ± 2.83	1.09 ± 0.89	88
BDE 99	ND	4.40± 0.63	1
BDE 100	ND	ND	1
BDE 153	ND	ND	420
BDE 154	ND	ND	420
BDE 183	ND	ND	–
BDE 209	ND	ND	19
Total ∑PBDE	183.18±12.14	2730.67±157.63	

∑PBDE- total sum of PBDE concentration;
ND- not detected; F-Figures not available

Occurrence of PBDE concentration in the C. amnicola

Four (4) congeners; BDE 7, BDE 28, BDE 47 and BDE 99 was detected in *C. amnicola* sampled from both stations. BDE 28 was highest in stations 1 and 2 (144.79 and 2611.29 ng/g), respectively which was significantly higher relative to the Canada Environmental Quality Guidelines (120 ng/g). The total PBDEs concentration (Table 4) was higher in station 2 (2730.67 ng/g) than station 1 (183.18 ng/g).

Distribution pattern of PBDE in sediment and C. amnicola in sampled stations

Congeners BDE 7, BDE 28, BDE 47 and BDE 99 were detected in the sediment and *C. amnicola* collected at the two sampling stations during the sampling period. Station 2 showed the highest concentration of ∑PBDEs in the crab samples whereas station 1 had a higher PBDE concentration in the sediments during the three (3) months of sampling (Fig. 2).

The crabs had highest overall mean concentration of PBDEs congeners (Fig. 2). In the first sampling month, only the crab samples showed PBDE concentration at detectable levels although the concentrations were significantly low. For three months of sampling, the crabs had higher concentration of PBDEs compared to the sediment in both stations with the exception of station 2 sediment samples collected in June (Fig. 2). Station 2 had a higher overall concentration of PBDEs than station 1 throughout the period of the study. The ∑PBDEs concentration trend in the samples was detected highest in June followed by September while the lowest concentration was in April. The mean concentration of PBDE congeners (BDE 7, BDE 28, BDE 47 and BDE 99) detected in *C. amnicola* samples from station 2 which were higher than that obtained at station 1 in the three months sampling period had a similar evaluation in crab (*Sesarma dehaani*) as reported by Gao *et al*. (2009). The authors also detected a similar congener profile to this study although there were also heavier PBDE congeners detected. Magalhães *et al*. (2012) investigated the concentration of PBDEs and other organic compounds in crab (*Hepatus pudibundus* and *Callinectes danae*) samples from Santos Bay, Brazil and found PBDE of 24 ng/g in *C. danae* which was lower than what was reported in this study. A comparison of the mean concentration of the crab samples to the Environmental Canada environmental quality guidelines indicated that the crabs from both stations contained high mean concentrations of PBDEs. This implies that consumption of the crabs collected at both stations could probably pose a significant risk to public health. Hu *et al*. (2010) analysed some of biological samples including crabs (*Eriocheir sinensis*) which was part of the food chain of the Baiyangdian Lake, North China. The authors detected a wide

range of PBDE congeners in the crab samples including the congeners detected in this study.

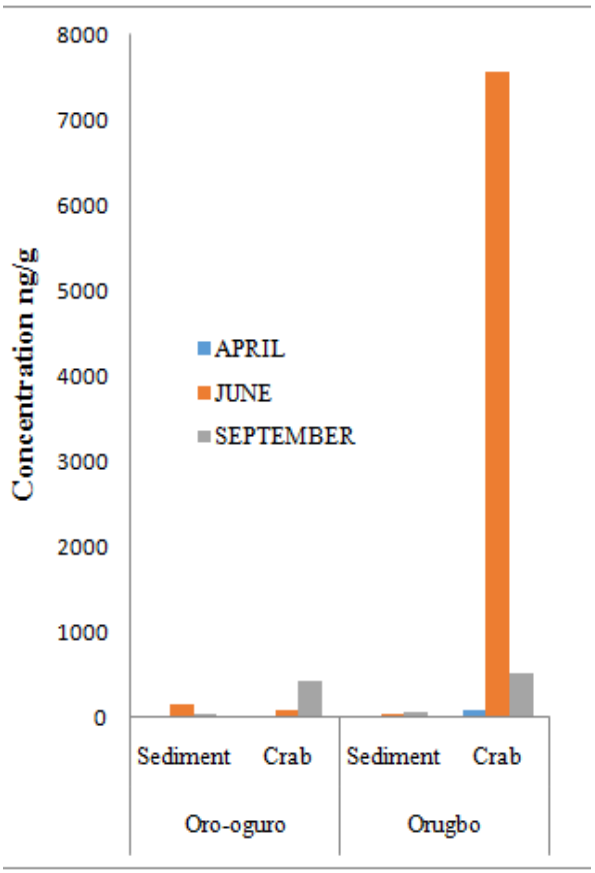

Fig. 2: PBDE distribution in Oro-oguro (1) and Orugbo (2)

Table 5: Particle size analysis and total organic carbon of sediment from Epe Lagoon

Sampling stations	Total organic carbon (mg/g)	Sand %	Silt %	Clay %	Description of Sediments
Oro-Oguro (1)	2.496	44	21	35	Dark Grey Clay loamy soil
Orugbo (2)	1.872	60	7	33	Dark grey Sandy Clay loam

Physiochemical parameters of the sediments from the sample stations

Sediment collected from both sites during the study had high percentage of sand and clay. The sediments were dark grey color at both locations (Table 5). Particle distribution of sediment from station 2 had the higher percentage of sand particles (60%) while sediment from station 1 had higher percentage of silt (21%) and clay particles (35%). Station 2 had the Total organic carbon was higher in the sediment collected from (2.496 mg/g) compared to the sediment collected at station 1 (1.872 mg/g) (Table 5).

Furthermore, the results of this study showed a variation between the concentrations of PBDEs in the sediments that could be attributed to the difference in the Total Organic Carbon (TOC). PBDEs can be readily adsorbed on the particulate matters in aquatic environments due to their high hydrophobicities and settle to form part of the sediment (Li *et al*., 2012). Previous research (Pan *et al*., 2010; Zhao *et al*., 2010) have shown positive relationships between the concentration of PBDEs and other organic compounds with organic matter present in sediment (Ali *et al*., 2015; Zhang *et al*., 2016). This is because TOC could provide a greater sorptive capacity/affinity for PBDEs in the sediments (Li *et al*., 2010; Akortia *et al*., 2016). This theory can be used to explain the variation between PBDE concentration in station 1 sediment and station 2 sediment.

The percentage of the sand, silt and clay particles in the sediment collected at both sampling stations that showed that the sediment collected at the selected areas of Epe Lagoon were mostly loamy in nature with high organic carbon content. This also supports the range of concentration of PBDEs found in the sediment as Rayne *et al*. (2003) theorized that PBDE concentrations of congeners occurred most among sediment with smaller grains. This is because smaller grain size of the sediment provides more surface area to which the PBDE congeners can adsorb to thus prolonging their half life and increasing their retention time in the sediment (Hale *et al*., 2012). Station 1 showed a higher level of TOC than the station 2; this supports the higher PBDE concentration that was detected in Oro-oguro station during the study.

Biota-sediment accumulation factor (BSAF)

The result showed that BDE 7 and BDE 28 congeners had BSAF higher than 1 (Fig. 3) at both stations during the sampling period. Station 2 had higher BSAF values for the two PBDE congeners (BDE 7= 10.66 and BDE 28= 109.54) compared to station 1 (BDE 7= 3.87 and BDE 28= 12.70).

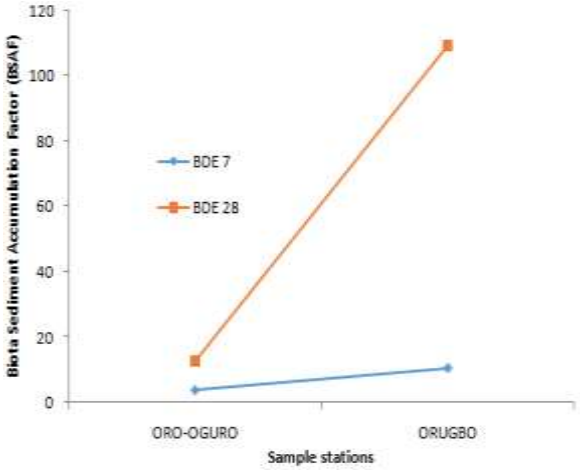

Fig. 3: Biota sediment accumulation factor of Oro-oguro and Orugbo stations

Evaluation of Biota-sedimentation accumulation factor (BSAF) for both sites used in the study showed that there was a high level of accumulation of PBDEs in the crabs which could have adverse effects on the crabs and accumulate in people that consume them. Bioaccumulation of these primary congeners could be attributed to the feeding habits of *C. amnicola*. They feed on other organic matter such as (shrimps, algae, fish and, plants) present in the Lagoon that could be described as organic matter (Chindah *et al*., 2000; Arimoro and Idoro, 2007; Adeogun *et al*., 2015). The crab (*C. amnicola*) can store accumulated organic compounds in its tissues. Lee and Kim (2015) reviewed some previous work on PBDEs in biota and the authors observed a trend in which studies reported significant concentrations of PBDE congeners in the edible parts of crabs used for those studies. PBDE congeners are lipophilic therefore, have the tendency to bioaccumulate in the fatty tissues of the crabs and other biota (La Guardia *et al*., 2012; Akortia *et al*., 2016; Fayiga and Ipinmoroti, 2017).

The findings of the study are indication that the selected stations and Crab's tissue collected in Epe Lagoon are

contaminated withPBDEs; a risk to organisms connected in the food web.

Conclusion

This study evaluated the Polybrominated diphenyl ethers in the sediment and *C. amincola* of selected stations of Epe Lagoon. The findings revealed that the environmental health of the Lagoon and could serve as a future reference on the state of our natural environment that could be used in making policies and guidelines with respect to public health by the relevant agencies. It will also provide data needed in the national and international efforts to minimize the spread of PBDEs and other POPs in the environment.

Recommendation

The freshwater and benthic organisms of the Epe Lagoon serve as a source of food and livelihood for the communities living around the Lagoon. This study has shown the need for monitoring the environmental quality of the Lagoon to serve as early warning against contamination and subsequent public health challenges. Further studies along the Epe Lagoon are recommended in order to fully understand the spread and distribution of PBDEs and other pollutants in the area. The use of PBDE containing products also needs to be regularly monitored and controlled to reduce their escape into the environment.

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Conflict of Interest

Authors have declared that there is no conflict of interest reported in this work

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