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Assessment of Persistent Organochlorine Pesticides in Commercial Marinespecies *Ethmalosa fimbriata* (Bowdich, 1825), *Cynoglossus browni* (Chabanaud, 1949) and *Callinectes pallidus* (De Rochebrune, 1883) from Badagry Creek, Lagos, Nigeria.

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Abstract
Background*:The occurrence of organochlorine pesticides in different compartments of the aquatic ecosystem, even at trace levels and consequently in commercial biological species whichconstitutes man's diet, isn't desirable as they have toxic effects. Fishes are at the highest level of the aquatic food chain and do bio-accumulate these OCP residues, resulting in many health hazards, necessitating the assessment of their risks to man.*
Materials and Methods: *The organochlorine pesticide (OCPs) residues were measured in water, sediment, fin fish: Ethmalosa fimbriata (Bonga Shad), Cynoglossus browni (Nigerian tongue sole) and shellfish: Callinectes pallidus from Badagry Creek between June and December 2019. These species structure a big portion of the diet of residents in Badagry Division, Lagos, Nigeria. The analysis was done using Gas Chromatograph Hewlett Packard GC 5890 Series II with Electron Capture Detector. The Shimadzu GCMS QP2010 was used for confirmation.*
Results:*The organochlorine pesticides identified include α-BHC, β-BHC, γ-BHC, δ-BHC, Heptachlor, Aldrin, Heptachlor-epoxide, γ-Chlordane, Endosulfan 1, α-Chlordane, Dieldrin, Endrin, Endosulfan 11, p',p'DDT, p',p'DDD, p',p'DDE, Endrin Aldehyde, Endosulfan Sulfate, Endrin Ketone and Methoxychlor. The mean concentration of OCPs ranged from 0.14 µg/L in water -22.64µg/kg in sediment. The highest ∑OCPs were detected in sediment and Ethmalosa fimbriata. Concentrations of ∑OCPs decreased within the order of, sediment, fin fish, shellfish and water samples. In sediment,Heptachlor epoxide (1.27 ± 0.04 µg/kg) had the lowest mean concentration while Endrin Aldehyde (22.64 ± 2.83 µg/kg) was the highest concentration of pesticide residue. The principal OCP residues recorded were Gamma Chlordane, Endrin Aldehyde and Methoxichlor for Etmalosa fimbriata, sediment and water samples respectively. There was evidence of water-sediment coupling through sequestration of OCPs from water into sediment and bio-concentration of OCPs in the fish and shellfish.*
Conclusion:*The concentrations of the 20 organochlorines residues detected in this study falls below the Australian Maximum Residue Limits (MRL) of fifty to 1000µg/kg for fresh water fish by the Australian MRL in 2009 but the results were found to be above the utmost acceptable value of 0.10µg/l set by the European Union. However, the rule value of 2000 µg/kg fresh weight by WHO/FAO was not exceeded, implying that the fin and shell fishes were safe for consumption.*
Keywords:*Organochlorine, Pesticides, Residues, Diet, Risk Assessment, Health hazards*

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I. Introduction

Organochlorine pesticides are a category of toxic compounds characterized by their relative chemical and biological stability, and hence persistence within the environments (Chou and Lee, 2005). Consequently, organochlorine pesticides are placed on the highest of the list of potential environmental hazards. The persistent and widespread occurrences of organochlorine pesticides have stimulated research into the character, behavior, fate of pesticides additionally, to their metabolites within the environment. The inherent abilities of the organochlorines made them indispensable for use in industry. As a result, a category of 15,000 organochlorine

chemicals approximately has been manufactured and widely utilized in past decades as industrial products (plasticizers, solvents, lubricants, dielectric fluids) and pesticides.

OCP residues go into aquatic environments through the release of effluents, discharges of domestic sewage and industrial wastewater, atmospheric deposition, runoff from agricultural fields, leaching, equipment washing, disposal of empty containers and direct discarding of trashes into the water systems (Yang *et al*., 2005).

OCPs could distribute among the components of the ecosystem, such as water and sediment, and accumulate within the biota. As a result of their persistence, OCPs in water are often transferred into the organic phenomenon of the food chain and accumulate in aquatic organisms like plankton. Different pesticides pose varying degrees and types of risk to water quality and consequently, human health.

OCPs are among the most commonly detected pesticides round the world. Although most of them were banned in the 1970s and 1980s, they will still be found within the environment in several matrices such as water, soil and marine sediments (Essumang *et al*., 2009). Pesticides can be bio-concentrated through biogeochemical processes and may be scavenged from the water through sorption onto suspended material before they get deposited to the bottom substrate. Sediment is one among the principal reservoirs of environmental pesticides, representing a source from which residues are often released to the atmosphere, groundwater and living organisms (Xue *et al*., 2006). As a result of their low water solubility, OCPs have a robust affinity for particulate matter. They're hydrophobic compounds that tend to adsorb to suspended particulate and benthic sediments in aquatic ecosystems. Sediments function as thelast sink for them. Indirect exposure to contaminated sediments takes place when fishes prey on benthic invertebrates that are ingesting particulate substance. Direct exposure through the sediment takes place by release of contaminated particulate materials into the water column by both natural and anthropogenic processes.

Most of the pesticides that are used extensively for long periods in Nigeria are OCPs.The high efficacy and lower cost of OCPs compared with alternative pesticides is the reason for their continued use in Nigeria. The OCPs are widely utilized in Agriculture, also as in mosquito and tsetse control.

Organochlorine compounds exert many toxic effects on human health, such as, hormone related conditions (endometriosis, infertility), cancer of male and female genital system, developmental toxicity, neurotoxicity and immune-toxicity. The bulk of those effects could also be thanks to the power of organochlorines to change the amount of certain hormones, enzymes, growth factors and neurotransmitters.

Fishes are proper indicators for environmental pollution monitoring since they accumulate pollutants in their muscles directly from water and also through their diet, thus allowing the assessment and transfer of pollutants from end to endof the food web (Fisk *et al*., 2001).

Shellfishes are utilized in many pollution monitoring and assessment studies because they need world-wide geographical distribution and are relatively stationary. They revealhints of impuritymore than the finfishes. They're also sediment-dwelling and have a pronounced ability to concentrate persistent organic pollutants from sediments and water (Zhou *et al*., 2008).

1.1 STATEMENT OF THE MATTER

The occurrence of organochlorine pesticides in biological species and in different compartments of the aquatic ecosystem, even at trace levels, isn't desirable as they have toxic effects. Fishes are at the highest level of the aquatic food chain and do bio-accumulate these OCP residues, resultingin many diseases in man.

Pollution by persistent chemicals is potentially harmful to the organisms at higher trophic levels within the food chain. The aquatic organisms like fish are ready to accumulate several fold higher concentration of pesticide residues than the encompassing water. It's been reported that the consumption of contaminated fishes is one among the important pathways of human exposure to OCPs (Muralidharan *et al*., 2008). Data on the presence and distribution of OCPs in edible fishes are, therefore, important from the ecological and human health perspectives. The transport, dispersion and therefore the ultimate effects of pesticides in marine systems depend on their persistence, bioaccumulation and biodegradation. OCPs might be related to with organic components of soils, sediments, biological tissues and dissolved organic carbon in aquatic systems (Zhou *et al*., 2008). The indiscriminate use of pesticides in Nigeria has resulted in the occurrence of the residues in biota and other abiotic compartments (Adeyemi *et al*., 2008).

This research serves to supply data on the prevailing levels of those persistent pollutants in biotic and abiotic media within theupper extreme axis of Badagry Creek. The monitoring of fishes is a crucial indicator of the water ecosystem. Shellfishes and finfishes were collected for this study because they're important commercially available foods commonly consumed by a cross section of Nigerians.

II. Materials And Methods

2.1 STUDY AREA

Badagry Creek is found on latitude 2^0 42´ and 3^0 2´ E and between longitude 6^0 23 and 6^0 28´ N, and forms a part of the continual lagoon that stretches from Port Novo to Lagos (Fig. 3.1). It is estimated to be quite 51 km from Lagos. It's bounded in the north by the Egbado plateau and within the west by River Yewa,within the south by the Atlantic, and within the east by an expanse of the mangrove swamp. The climate is dominated by a rainy season which last from April to October. The rain is marked by two peaks in May to July, and September to October. Rainfall is typically heavier during the first period (52%), creating serious flash floods which are aggravated by the characteristic poor surface drainage conditions of the coastal lowlands

The soil in Badagry is light grey sandy type with vegetation over the low lying plains and marshes near the lagoons and creeks. The vegetation is formedfrom woody plants, shrubs, and feather palm trees within the sandy areas, while the marshy areas are covered by mangrove. The mean monthly temperature fluctuates around 30^0C. The highest temperatures occur around November to December, and February to March, when there's a brief dry season (Akintola *et al.*, 2011). The creek is shallow, with a mean depth of about 1.5 m. Its brackish nature may be a consequence of the influence of tidal sea water incursion and freshwater discharge from the adjoining rivers. Badagry creek impacts the lives of the many tribesincluding the Eguns, Ilajes and Ijaws. It is a recreational outlet, a way of livelihood and transport, a dumpsite for residential and industrial discharges and a natural shock absorber to balance forces within the natural ecological system. Other human activities relatedto the creek are fishing, aquaculture and sand mining. The fauna consists of fresh, marine and brackish water species, counting on the season. Among the fauna exploited for commercial purposes are shrimps, crabs, and finfishes.

Sample stations were selected to encompass the upper reaches of Badagry creek. Water and sediment samples were collected and fishsamples were bought from commercial fishermen at fish landing sites inAkarakumo, Gbaji, Owode Apa, Topo, Povita and Ajidotowns near Badagry.

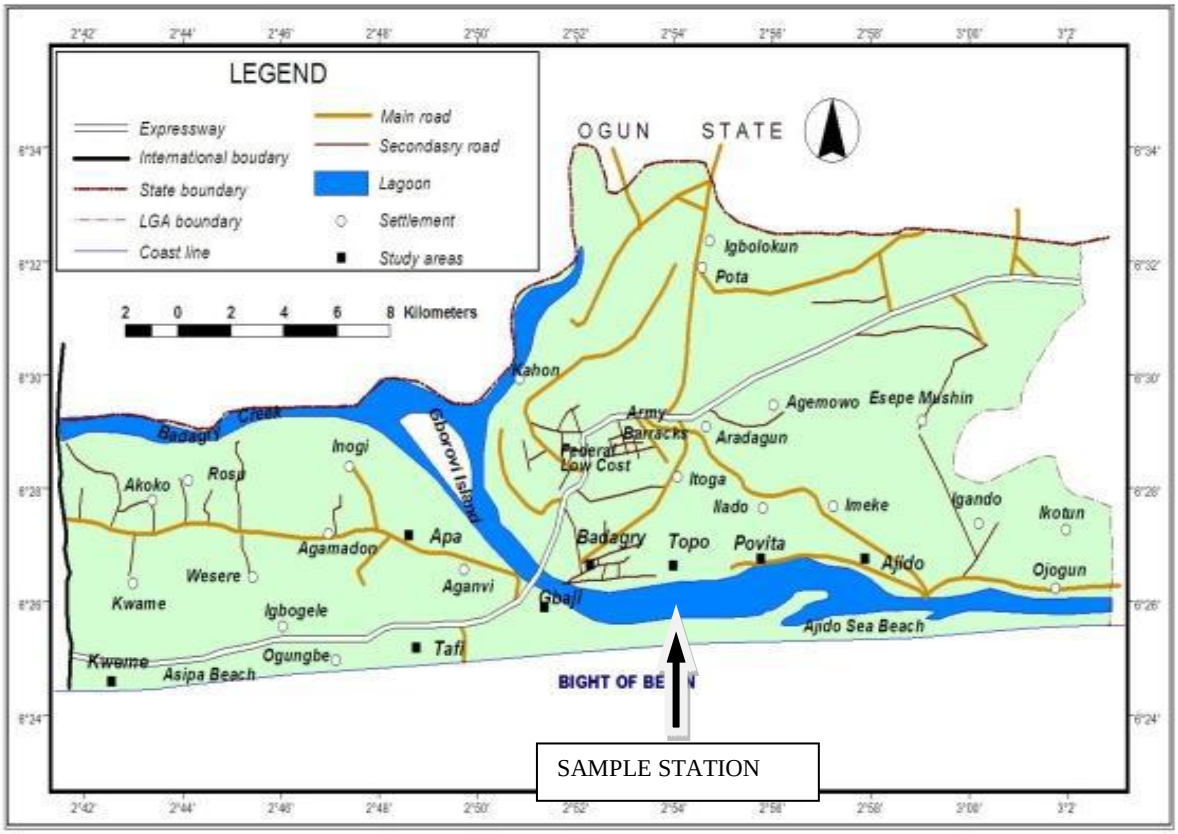

Figure 1: Map of Badagry creek.

Source: Jenyo-Oni and Adepoju, 2013.

2.2 SAMPLING STRATEGY

Samples were collected from points within a neighborhood>10 km^2 along the upper reaches of the Badagry Creeks between Akarakumo, Gbaji, Owode Apa, Topo, Povita and Ajido towns near Badagry from June to December 2019, covering both rainy and dry seasons(Figure 1).

2.3 Pretreatment of sample and storage vessels

Prior to sampling, sample bottles and glass wares were washed with detergent, rinsed with distilled water then dried. Glass containers were utilized in collecting water samples for organochlorine pesticide determination while polythene bottles were used in sampling water for physicochemical analyses.

2.4 Collection of Water Samples

Water samples were collected using three clean labelled amber glass bottles to form composite samples. The containers were rinsed 3 times with the site water before collection. Filled sample bottles were sealed and freedfrom air bubbles with glass stoppers. Samples were properly covered and stored in ice-packed coolers after collection. The water samples were refrigerated in the laboratory at 4^0C to inactivate microbes and thus preserve the integrity of the samples (Unyimadu and Udochu, 2002).

2.5. Collection of Sediment Samples

Sediment sample was obtained by a chrome steel Rigosha grab sampler, taking 0 – 5 cm surface sediments. Triplicate sediment samples were collected from each site, homogenized and subsequently packed in brown glass bottles which had been pre-washed with distilled water and *n*-hexane. The sediment samples were stored in ice-packed coolers so as to preserve the integrity of the samples. Sediment samples were refrigerated within the laboratory at 4^0C to inactivate microbes. Pebbles, shells and vegetable matter were manually removed.

2.6 Collection of Fish Samples

Freshly harvested finfishes *Ethmalosa fimbriata*; *Cynoglossus browni* and shellfish (*Callinectes pallidus*), were bought from the fishermen at the fish landing jetties in the selected stations. All the fish samples were properly labelled, separately wrapped in aluminum foil, stored in ice-packed coolers and transferred to the laboratory where they were frozen, thawed, cleaned in distilled water and the scales of the finfishes scraped off.

2.7. Determination and Identification of POPs

Methods involved in extraction of water and sediment, reduction of water extract volume, extraction of fin and shell fish, extraction of fats and oil from fin and shell fish, separation and cleanup of compounds and determination / identification of persistent organochlorine pesticides(POPs) was as described by Unyimadu *et al*, 2018 in Unyimadu et al, 2002.

The water sample was filtered. The level of the pesticide residues was determined by gas chromatography (model 5890) using Electron Capture Detector while maintaining the subsequent conditions: Gas pressure 60psi, injector temperature- 220^{o}C, column temperature 190^{o}C, column length 200cm, id 2mm.

The spiral column was packed full of 1.5% - 17 and 1.95%V – 210 on Chromosorb WHP80/100 mesh. There were no peaks when solvents and blanks were chromatographed, before the samples were analyzed under an equivalent condition. Known standards were dissolved in n-hexane, stored at 4^{o}C and also chromatographed. The injection volume was automatic and therefore the compounds were sorted by signal. The retention time in minutes were used to identify the compounds present within the samples.Weights of samples analyzed were: Water = 200mlFish = 3g, Shrimp= 2g, Sediment =2g and Crab = 2g

CALCULATION:

Concentration of OCP in Sample Extracts (μg/Kg/L) = $\frac{\text{Concentration (ppm) X 1000}}{\text{Weight of sample}}$

III. Results

Water, sediment,*Ethmalosa fimbriata*, *Cynoglossus browni* and *Callinectus pallidus*samples were analyzed for organochlorine pesticides residues.All the samples had detectable concentrations of 20 organochlorine pesticides residues. The organochlorine pesticides observed in the samples were: α-BHC, β-BHC, γ-BHC, δ-BHC, Heptachlor, Aldrin, Heptachlor-epoxide, γ-Chlordane, Endosulfan 1, α-Chlordane, Dieldrin, p',p'DDE, Endrin, Endosulfan 11, p',p'DDD, Endrin Aldehyde, Endosulfan Sulfate, p',p'DDT, Endrin Ketone and Methoxychlor (Table 1).

Table 1: Showing the mean concentration of persistent organochlorine pesticide residues in allsamples within the period of study.

Organochlorine Pesticides	WATER	SEDIMENT	*Etmalosa fimbriata* (BONGA)	*Cynoglosus brownie* (TONGUESOLE)	*Callinectes pallidus* (CRAB)
Alpha BHC	0.29 ± 0.11	2.10 ± 1.20	2.11 ± 1.39	2.23 ± 0.49	**4.05 ± 0.19**
Beta BHC	0.28 ± 0.19	2.37 ± 1.40	2.20 ± 0.85	2.25 ± 0.37	1.86 ± 0.57
Gamma BHC	**1.08 ± 0.14**	1.97 ± 1.00	1.87 ± 0.18	1.95 ± 1.12	2.58 ± 1.64
Delta BHC	0.59 ± 0.22	8.63 ± 0.92	2.67 ± 0.04	2.51 ± 1.87	3.63 ± 1.27
Heptachlor	**0.14 ± 0.02**	2.24 ± 0.28	1.35 ± 0.36	3.00 ± 0.91	2.05 ± 1.18
Aldrin	0.81 ± 0.18	5.21 ± 0.57	2.48 ± 0.54	2.58 ± 1.57	2.11 ± 0.82
Heptachlor-epoxide	0.59 ± 0,76	**1.27 ± 0.04**	3.03 ± 1.81	3.07 ± 0.70	1.92 ± 0.56
Gamma Chlordane	0.48 ± 0.48	2.22 ± 0.34	**6.12 ± 5.29**	**1.20 ± 0.22**	1.67 ± 0.34
Endosulfan 1	0.32 ± 0.08	1.45 ± 0.34	3.27 ± 0.90	2.65 ± 1.56	**1.29 ± 0.06**
Alpha Chlordane	0.45 ± 0.24	1.36 ± 0.02	**1.30 ± 0.07**	2.57 ± 1.18	2.17 ± 1.49
Dieldrin	0.39 ± 0.28	5.63 ± 1.98	2.80 ± 1.33	2.68 ± 2.36	3.30 ± 1.58
p',p'DDE	0.50 ± 0.07	4.88 ± 0.29	1.52 ± 0.19	2.48 ± 2.03	3.32 ± 1.19
Endrin	0.43 ± 0.36	5.58 ± 0.65	2.24 ± 0.31	1.92 ± 0.60	1.56 ± 0.35
Endosulfan 11	0.72 ± 0.32	4.83 ± 0.24	2.68 ± 2.10	1.93 ± 0.46	3.03 ± 0.60
p',p'DDD	0.48 ± 0.36	11.87 ± 0.46	1.94 ± 0.64	1.88 ± 0.61	2.98 ± 0.53
Endrin Aldehyde	0.72 ± 0.01	**22.64 ± 2.83**	3.15 ± 0.40	**3.73 ± 0.41**	1.83 ± 0.28
Endosulfan Sulfate	0.65 ± 0.02	6.28 ± 0.55	2.28 ± 0.11	2.33 ± 0.41	2.44 ± 0.07
p',p'DDT	0.39 ± 0.01	12.27 ± 3.99	2.21 ± 0.43	2.64 ± 2.03	2.16 ± 1.28
Endrin Ketone	0.57 ± 0.24	13.57 ± 3.42	3.16 ± 0.45	1.76 ± 0.61	2.36 ± 0.62
Methoxychlor	**1.27 ± 0.67**	5.76 ± 1.24	1.73 ± 0.33	2.96 ± 0.55	1.35 ± 0.14
TOTAL	11.14	122.13	50.11	48.32	47.66

The principal pesticide components in water were γ BHC (1.08 ± 0.14 µg/L) and Methoxichlor (1.27 ± 0.67 µg/L). Endrin Aldehyde(22.64 ± 2.83 µg/kg)had the highest concentration in sediment (figure 2) within the period of study.Total sum ∑ OCP concentration decreased in the order of sediment (122.13 µg/kg), *Etmalosa fimbriata* (50.11 µg/kg), *Cynoglosus brownie* (48.32), *Callinectes pallidus* (47.66) and water (11.14 µg/L). The minimum and maximum mean residue values in water were for Heptachlor (0.14 ± 0.02 µg/L) and Methoxichlor (1.27 ± 0.67µg/L) respectively. Heptachlor epoxide (1.27 ± 0.04 µg/kg) had the lowest mean concentration in sediment while Endrin Aldehyde (22.64 ± 2.83 µg/kg) was the highest concentration of pesticide residue in sediment. There was evidence of water-sediment coupling through sequestration of OCPs from water into sediment (Figure 2).

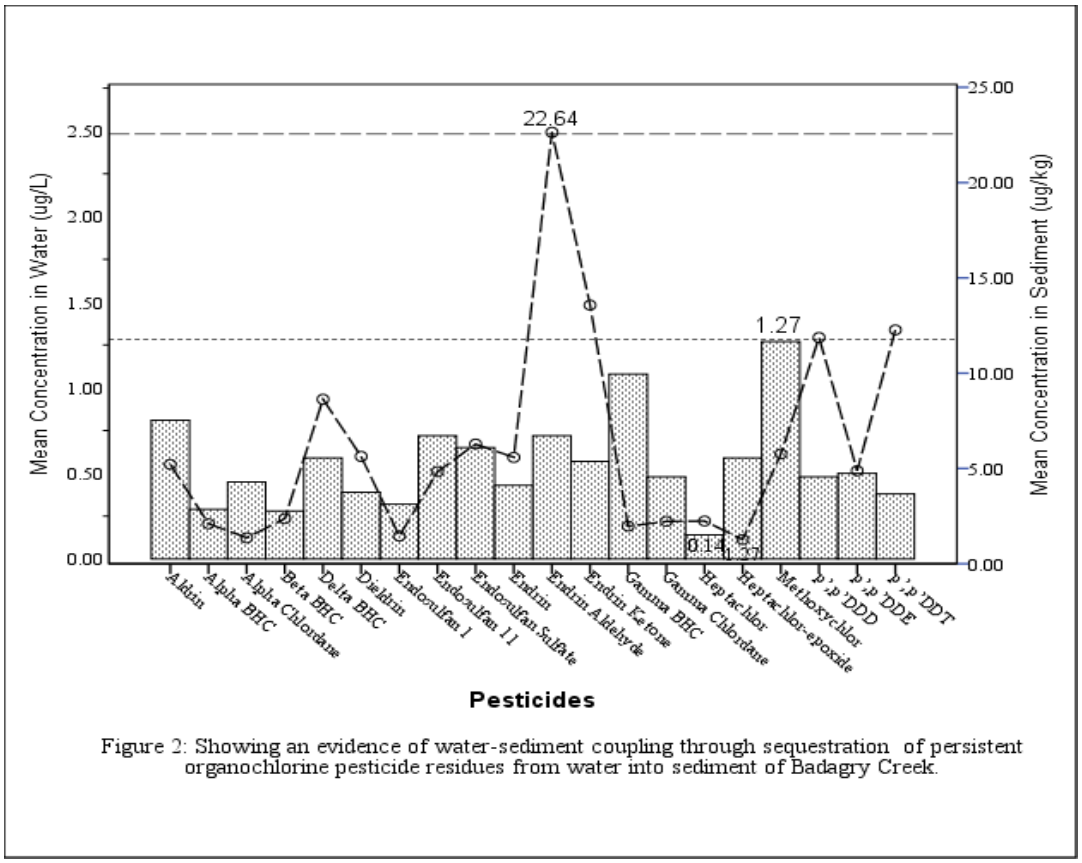

Figure 2: Showing an evidence of water-sediment coupling through sequestration of persistent organochlorine pesticide residues from water into sediment of Badagry Creek.

In *Etmalosa fimbriata*, Gama Chlordane (6.12 ± 5.29) was the principal pesticide and Alpha Chlordane had the lowest concentration (1.30 ± 0.07). The concentration of Endrin Aldehyde was maximum (3.73 ± 0.41 µg/kg) in *Cynoglosus brownie* and Gama Chlordane was minimal here at 1.20 ± 0.22 µg/kg.,Apparently, the highest and lowest OCP residues in *Callinectes pallidus* were Alpha BHC = 4.05 ± 0.19µg/kg and Endosulfan I = 1.29 ± 0.06µg/kg (Figure 3).

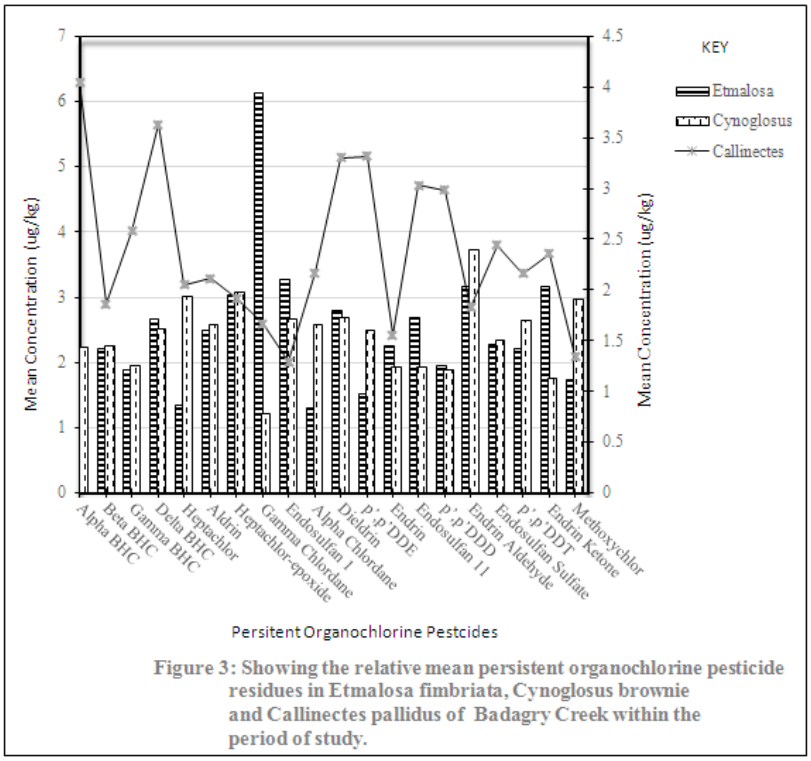

Figure 3: Showing the relative mean persistent organochlorine pesticide residues in Etmalosa fimbriata, Cynoglosus brownie and Callinectes pallidus of Badagry Creek within the period of study.

The levels of OCPs in the finfishes were above residues in water and lower to residues within the sediments. The distribution patterns of the entire OCP contaminants in the samples largely followed within the order of: sediment > fish > shellfish > water. The residue distribution pattern in the biological samples was as follows: *Ethmalosa fimbriata* > *Cynoglossus browni* > *Callinectes pallidus*. The principal OCP residues recorded were Gamma Chlordane, Endrin Aldehyde and Methoxichlor for *Etmalosa fimbriata*, sediment and water samples respectively (Figure 4).

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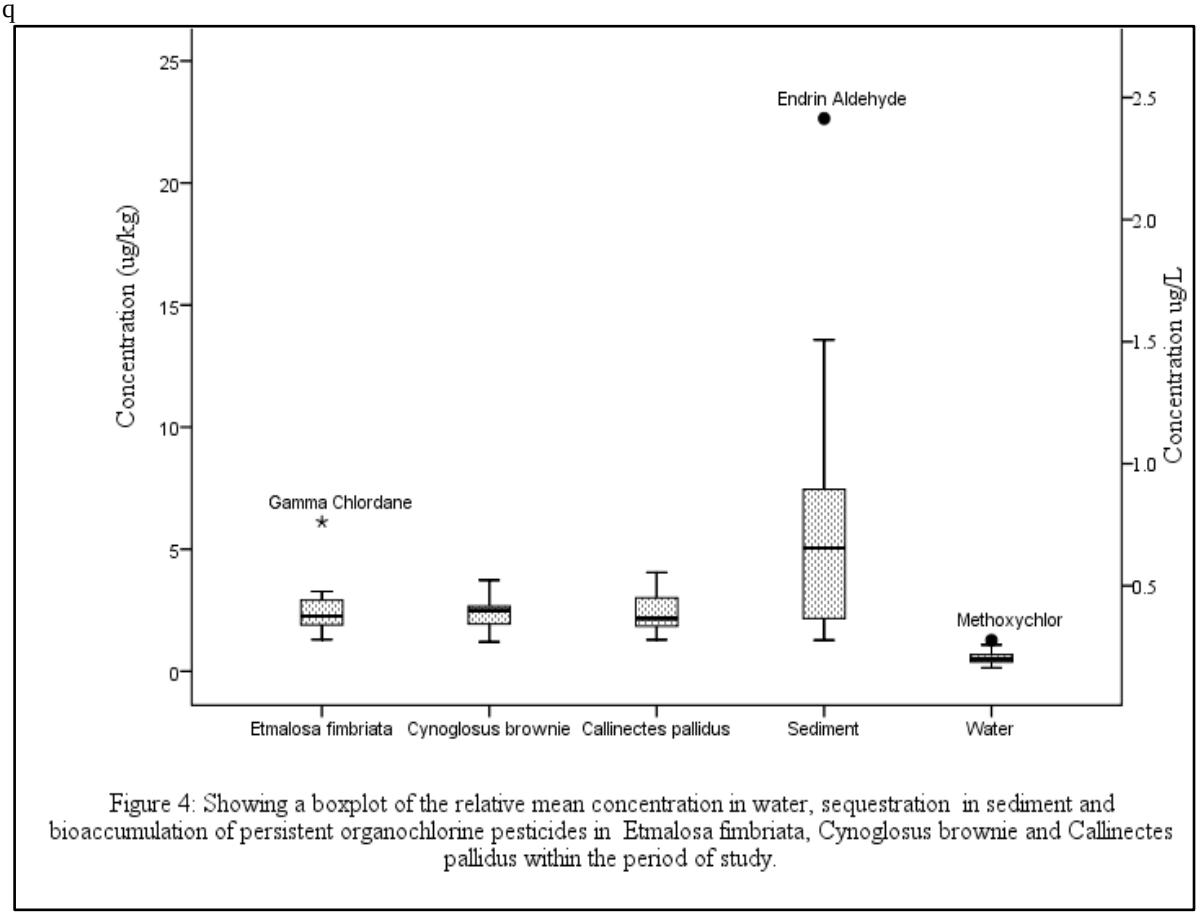

Figure 4: Showing a boxplot of the relative mean concentration in water, sequestration in sediment and bioaccumulation of persistent organochlorine pesticides in Etmalosa fimbriata, Cynoglosus brownie and Callinectes pallidus within the period of study.

IV. Discussion

Pesticides are highly toxic, synthetic organic compounds that are widely used in agriculture and the industries (Adeboyejo *et al.*, 2011;). Pesticides usage in Nigeria had soared within the past decades such that over 21 differing types of organophosphates, organochlorine and carbamates insecticides have been introduced into the Nigeria market. Out of the broadly classified pesticides, organochlorine pesticides (OCPs) constitute the foremost, widely used for agricultural purposes despite their ban in other countries (Adeyemi *et al.*, 2008).

Owing to direct application to the soil surface or application to crops for destroying, preventing, repelling or fighting against pests, animals, fungi and microorganisms, may also enter spring water and surface water as run-offs (Ezemonye *et al.*, 2009). Other sources through which pesticides ingresswater bodies include through point sources like sewage treatment plants, sewer overflows and poor management practices of farmers or from atmospheric deposition (Shukla *et al.*, 2006). Environmental contaminants like hydrocarbons, heavy metals and pesticides are known to have direct toxic effects when released into the aquatic environment.

The distribution of chlorinated contaminants within the marine and riverine environment isclaimed to be a function of the physicochemical properties of the ecosystem.

The concentrations of residues didn't follow any particular pattern during the course of the study. The concentrations of OCP residues obtained during this study were lower in comparison to the residues obtained by Clarke *et al.*, (2013) in Ologe lagoon and Adeboyejo *et al.*, (2011) in Lagos lagoon complex. The mean pesticide residues obtained were higher than those obtained by Tongo (1985) from studies administered out in some rivers in Nigeria. In similar investigations administered out on Gomti River, India (Malik *et al*., 2008) and Beijing Guanting reservoir, China (Xue *et al*., 2006), the entire OCP concentration levels were within the permissible limits (USEPA, 2006).

It was observed that the amount of OCPs in samples collected from the same site in different seasons varied. These dissimilarities in concentration could be ascribed to tidal changes and water turbulence which might give rise to a mixing tendency as earlier reported by Ize-Iyamu *et al.* (2007). The pesticides uptake in fish is either through bio-concentration from water through gills or epithelial tissues and through food resulting in eventual bio-magnification in several organisms, occupying successive trophic levels (Murty,1986).

There was no consistent pattern in the pesticide accumulation by the fish species studied. However, the concentrations of the 20 organochlorines residues detected during this study fell below the Australian Maximum Residue Limits (MRL) of fifty to 1000µg/kg for fresh water fish (Australian MRL, 2009). The Maximum Residue Level (MRL) is the maximum amount of the pesticide residue which if found in food substances that will not cause any health effect or hazard (Gerken *et al*., 2001). The 'MRL' is the utmost concentration of a pesticide residue (expressed as mg/kg) recommended by the Codex Alimentarius Commission to be legally permitted in food commodities and animals feeds (FAO, 1986).

In earlier studies, the averagevalue of OCPs in fish samples from rivers in Edo State, Nigeria stretched from 0.36 to 0.71ng/g. In Ogun River, the residues ranged from 0.06 to 19ng/g while a variety of 0.01 to 8.92mg/kg was obtained within the studies by Adeyemi *et al*., (2008). During this study, the entire detectable concentration of OCP residues of the biological sample ranged from 44.34µg/kg in *C. pallidus* to 53.72µg/g in *E. fimbriata* and were of enhanced levels in comparison to studies in R. Ogun and R. Niger (Unyimadu *et al*, 2002; Unyimadu*et al*., 2018) but with much reduced levels with reference to studies conducted by Adeyemi *et al.* (2008) in Lagos Lagoon. The amount of OCP were all within permissible limits.

The detection of endosulfan sulphate is asign that metabolism of the parent endosulfan occurred via oxidation (Wandiga, 1995). The highest concentration of endosulfan-sulfate, 2.62µg/kg was measured in *Cynoglossus browni*.

In most cases, conversion of DDT into DDE is initiated by soil micro-organisms immediately after it enters the environment. Other factors like alkaline, pH, light, or heat may also produce chemical changes within the original DDT molecule. Thus, the above observation may be due to metabolic conversion and/or de-hydro-chlorination in the warm, rather alkaline waters of the Badagry creek and it's the rationale for the lower DDT concentration in water compared to sediment and high DDT concentration in sediments could also be due to slow degradation of DDT. Moreover, because the volatility of DDE is several times greater than that of DDT. Since the presence of the first compound suggests recent inputs of DDT to the aquatic ecosystem. It may thus be concluded that there was continuing contribution of DDT to the Badagry creek in recent times.

OCPs residues in shellfish was found to be moderately high compared to water and this agrees with the work of Ize-Iyamu *et al.,* (2007) which states that pesticides concentration settles at the bottom of the water and have a tendency to bind with the sediment and also bio-accumulate within the tissue of the shellfish thanks to their behavioral and feeding adaptation with the sediment.

Pre-dominance of Heptachlor epoxide suggests the decomposition of Heptachlor to Heptachlor epoxide. The results of this study are according to the findings of Sarkar *et al.,* 1997) that the volatilization of heptachlor occurs in warmer climate of tropical regions. Methoxychlor is tightly bound to soil and is insoluble in water, so it's not expected to be very mobile in moist soils. Since Methoxychlor breaks down sluggishly and gradually in air, water and soil by sunlight and microscopic organisms, it takes several months, thus, explaining its high concentration in sediments (ATSDR 2002). The POPs residue in shellfish was found to be high in samples analyzed compare to the concentration of the sediment. This agrees with the work done by (Ize-iyamu *et al.,* 2007) which states that pesticides concentration settle at the bottom of the water which tends to bind with the sediment and also bio accumulate within the tissue of shell fish (*Callinectes pallidus*) due to their behavioral and feeding adaptation with the sediment. Therespective values of Aldrin and Dieldrin between October and November showed that there was a gradual oxidation of Aldrin to form active compound Dieldrin which tends to be biomagnified as it passes along the food chain. They're by-product of varied industrial processes (i.e bleaching paper pulp, chemicals and pesticides manufacture). They produce dioxins when not appropriately disposed or burnt with refuse. Long-term exposure has proven toxic to a really wide selection of animals including humans (Kegley *et al.,* 2007). Nevertheless, the amount of POPs residue detected altogether in the shellfish samples were lower relative thereto in finfish samples. This mighthave attributed to the pesticide being lipophilic; they reside and accumulate in fatty tissues. Pesticides enter fishes not only by ingestion but also through dermal absorption and respiration. When these chemicals are taken in by the fish, they bio-accumulate, bio magnify and remain within the fish till they're caught and consumed by man or eaten by bigger fishes which are eventually eaten by humans. This study reviews that organism at or near the highest of their food cycle, like humans have higher concentrations of POPs which can be hazardous to man's health causing carcinogenic, respiratory, reproductive problems and brain damage especially in children (Eskenazi, 2009).

The commercial insecticide HCH or BHC may be a mixture of various isomers mainly α, β, δ and γ-BHC (Lindane). Other isomers within the group are delta and epsilon. Lindane (γ -BHC) has been used as an insecticide and is the most toxic. β -BHC is the most symmetric and stable isomer; it's also the foremost

persistent in nature. β -BHC is eliminated five times more slowly from the body than other isomers and features a much higher ability to accumulate within the fat tissue than Lindane (Unyimadu *et al*, 2018). The isomers α, β, δ and γ -BHC were detected in the study therein order of frequency and were those mostly encountered within the analysis of the pesticides residues, which show they're in use in the surrounding of the creek.

However,Lindane is restricted to be used as seed dressing only. Lindane is very volatile, and, when applied to field crops in particular a high proportion (up to 90%) of the pesticide enters the atmosphere and is later deposited by rain. Lindane is additionally rapidly degraded within the environment (Howard 1991).This explains the low levels of lindane in the analysis of the OCP residues compare to other OCP residues.

The finfish (*Ethmalosa fimbriata*) had significantly higher concentration (56.72µg/kg) of OCPS that far exceeds 10µg/kg which is the recommended guideline for the protection of freshwater aquatic life in Canada (Japhet, 2011), this agrees with (Osibanjo *et al*, 2002). The concentrations of OCPs detected in finfish samples during this study are much higher in comparison to Federal Environmental Protection Agency (FEPA) allowable limit of <0.01 ppm (FEPA, 1991).

Although OCPs are reported to have been gradually abandoned owing to pest resistance and international concern, DDT seems to have continued to be secretly employed by farmers (NEMA, 2000). Its residues have also been detected in fish samples from Lake Edward andalso in soil samples in western Uganda (Japhet, 2011). The results of this study showed that investigated fish samples contained detected concentration of DDT, but at concentrations below maximum residue limit (MRL).

V. Conclusion

This study showed that Badagry creek gets polluted due to discharge of chemicals.The concentrations of the 20 organochlorines residues detected in this study falls below the Australian Maximum Residue Limits (MRL) of fifty to 1000µg/kg for fresh water fish by the Australian MRL in 2009 but the results were found to be above the utmost acceptable value of 0.10µg/l set by the European Union. However, the rule value of 2000 µg/kg fresh weight by WHO/FAO was not exceeded, implying that the fin and shell fishes were safe for consumption

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