# Organochlorine and Organophosphorus Pesticide Residues in Fish Samples from Lake Chad, Baga, North Eastern Nigeria

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***Abstract*—The aimed of this study was to determine the levels of some organochlorine (o, p-DDE, p,p'-DDD, o,p'-DDD, p,p'-DDT, p,p'-DDT, α-BHC, γ-BHC, lindane, Endosulfan sulphate, dieldrin and aldrin and organophosphorus (Dichlorvos, Diazinon, Chlorpyrifos, fenitrothion and Fenitrothion) pesticide residues in the gills, liver, stomach, kidney and flesh of four fish species (Tilapia zilli, Clarias anguillaris Hetrotis niloticus and Oreochronmis niloticus) between the periods of September 2010 to October, 2011. Samples were collected from Kwantan turare in Lake Chad, Baga, Borno State, Nigeria. Extraction of the fish samples and de-fattening of the fish sample extracts were performed using standard procedures. Analysis of the fish samples for pesticide residues were carried out using Shimadzu GC/MS (GC – 17A), equipped with fluorescence detector. Large differences in the levels of pesticide residues were observed between tissues within each fish. The concentrations of all the organophosphorus pesticides were higher in the organs of Oreochronmis niloticus, while Hetrotis niloticus shows the lowest. For organochlorine pesticides, the organs of Tilapia zilli showed the highest concentrations, while Hetrotis niloticus shows the lowest. The highest pesticide therefore be concluded that the concentrations of pesticide in the four fishSpecies study did exceed the permissible limits set by FAO and FEPA.**

***Index Terms*—Accumulation, fish, lake chad, organochlorine, organophosphorus, pesticides.**

## I. Introduction

Various activities such as farming, fishing, forestry, construction, mining, urban development and land pollution occurring in or near the watershed of a reservoir could bring about water quality problems and disruption in fish [1].

Pesticides are used widely to improve agricultural production and also to prevent arthropod-borne diseases. But they are used improperly due to the lake of appropriate knowledge about their applications and untoward effects. The excessive usage is harmful to ecosystem and they contaminate soil, surface and underground water resources [2], [3]. Chlorinated organic pesticides are very stable in both fresh and salt water and are resistant to photo degradation [4]. They will disappear from the water with secondary mechanisms such as, absorption on sediment, biological breakdown by microflora and fauna, and absorption by fish through gills, skin and feeding. They are poorly hydrolyzed and slowly biodegrades in environment. Therefore, these compounds are persistent in food chains and are readily accumulated in animal tissues. Fish absorb these compounds directly by water or by ingesting contaminated food. In particular, Organochlorine and organophosphorus pesticides are highly stable under different environmental conditions and persistent nature and chronic adverse effects on wildlife and humans [5].

Pesticide residues problems in the fish tissues are serious, as reflected by the high pesticides concentrations recorded in the water and sediments [6]. The gills are directly in contact with water. Therefore, the concentration of pesticides in gills reflects their concentration in water where the fish live, whereas the concentrations in liver represent storage of pesticides in the water [7]. Studies on pesticide in river, lake, fish and Sediments [8] have been a major environmental focus especially during the last decade. Sediments are important sinks for various pollutants like pesticides and also play a significant role in the remobilization of contaminants in aquatic systems under favourable conditions and in interactions between water and sediment. Fish samples can be considered as one of the most significant Indicators in fresh water systems for the estimation of pesticides pollution level [8]. The region of accumulation of pesticides within fish varies with the route of uptake. Their potential use as biomonitors is therefore significant in the assessment of bioaccumulation and biomagnification of contaminants within the ecosystem [7]. Many dangerous chemical elements, if released into the environment, accumulate in the soil and sediments of water bodies.

The lower aquatic organisms absorb and transfer them through the food chain to higher trophic levels, including fish. Under acidic conditions, the free divalent ions of many pollutants may be absorbed by fish gills directly from the water [7]. Hence, concentrations of pesticides in the organs of fish are determined primarily by the level of pollution of the water and food under certain conditions, chemical elements accumulated in the silt and bottom sediments of water bodies can migrate back into the water.

Lake Chad is situated at the southern fringe of the Sahara desert, east of the Sahel region between 12 ℃20 and 14 ℃20 latitude North; 13 ° and 15 ℃20 longitude East. Considered as a Ramsar site of world importance because of its biodiversity, Lake Chad is a freshwater reserve with only 5 percent of salt content and it is bordered by Cameroon, Niger, Nigeria and Chad. Its depth varies between 1.5 and 10.5 metres and it is about 215 metres above sea level, with apparently no outlet (endoreic lake). Nigeria controls a substantial geographical area of lake Chad, which is shares with the Chad Republic, and to a lesser extent Cameroon and Niger. The lake is overseen by a Lake Chad Basin

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Commission, formed by these countries, which Nigeria joined in 1962. The affluent of lake Chad within Nigeria consist of the Komadugu Yobe river from Yobe state and the Ngadda and Yedseram river systems from Borno State. The Lake Chad basin is polluted by textiles and tanneries effluents in the upstream parts of the Basin (particularly in Kano and Maroua). These industries contribute to pollution of the Lake. Wastewater discharges from settlements along the Chari-Logone and Komadugu-Yobe River courses particularly from agricultural activities, abattoirs, hotels and hospitals are also contribute to microbial and chemical pollution.

Agricultural activities within the area also causes pollution in the Lake Chad Basin, however, there is a possible pollution threat to water by agrochemicals used in agriculture within the study area, especially during periods of low flow and high temperatures. In Chad, the quantities of pesticides used are between 500 to 1 000 $m^3$ per year. The cotton industry uses the largest amounts of pesticides within the Republic of Chad in 2003. The type of pesticides currently used in Chad and is considered as highly toxic and high enough concentrations can lead to mortalities, thus reducing the abundance and diversity of vertebrate and invertebrate organisms as well as the flora of wetlands. The organophosphate insecticide, monocrotophos, has been banned in other regions of the world due to it killing birds; it is still used extensively in the cotton industries of Chad [9]. Herbicides can kill non-intended plants after entering aquatic systems decreasing the diversity of wetland flora. Pesticides can be potentially detrimental to migratory birds and there have been studies expressing concern for species in West Africa [10], [11]. In the upper parts of the Logone Basin upstream of Bongor, there are also significant amounts of pesticides used in the cotton industries. The lakes can be contaminated by agro-chemicals by the return flow of waters and also run-off and percolation from the irrigated fields [10]. The SCIP project in northern Nigeria extracts water from Lake Chad, which is applied to the irrigated fields with pesticides that are used to control pest. Surface and ground flows carry these pesticides directly into the Lake. There is an inadequate pollution regulatory framework in the Chad basin and the Lake is therefore vulnerable to increases pollution. Hence, the need for this study.

## II. Materials and Methods

### A. Sampling Area

Fish samples were collected from the Kwatan turare region of Lake Chad, Baga, Borno State, North Eastern Nigeria**.**

### B. Sample Collection

Fish samples (*Clarias Gariepinus, Hetrotis niloticus, Oreochromis niloticus and Tilapia zilli)* were caught using gill nets from Kwatan turare region of Lake Chad, Baga, Borno State, North Eastern Nigeria. Fish samples of uniform size were collected in order to avoid the possible error due to size differences. The fish were labeled with an identification number. Samples of fishes were transported to the laboratory on the same day, identified by an expert in Federal institute of fresh water fisheries, Baga, Borno State, Nigeria, and later dissected to remove the flesh, liver, stomach and gills of each species of fish and stored using 4% formalin, pending extraction and analysis.

### C. Extraction of Fish Samples for Pesticides Determination

Twenty grams (20g) of each of the fish organs were weighed into a conical flask and 20g of anhydrous sodium sulfate and 5g of sodium hydrogen carbonate were added respectively. 100 ml of 1:1 (v/v) ethyl acetate/dichloromethane mixture were added into the conical flask containing 20g of the fish samples. The content of the conical flask were mixed thoroughly by shaking the conical flask. Another 20g of anhydrous sodium sulfate were further added to the content of the flask and 20g of sodium hydrogen carbonate were added in each of the respective flask. The respective conical flask were corked tightly and the mixture shaken thoroughly for 10 min. The content in each of the respective conical flask were allowed to stand for 3h. The organic layer were decanted into a 200ml round bottom flask and evaporated using the rotary evaporator at 40 ℃. The pesticide in the rotary flask were dissolved and collected with 2 ml of ethyl acetate and transferred into a 2 ml vial and ready for the clean-up.

### D. Clean-Up of Fish Extracts Using Silica Gel

Deactivated silica gel with a total weighed of ten gram (10g) was placed in a 10 mm glass chromatographic column and 3 g of anhydrous sodium sulfate were added. 10 ml of 1:1 (v/v) ethyl acetate/dichloromethane mixture were used to wet and rinse the column. The 2 ml extract residue in the vial were transferred into the column and the extract vial rinsed (three times) with 2 ml ethyl acetate. The column were eluted with 80 ml portion of ethyl acetate/dichloromethane at a rate of 5 ml/min into a conical flask as fraction one. Further elution was conducted with 50 ml portion of ethyl acetate/dichloromethane for the second elution. The first and second extract was mixed together. All the fractions of each sample were concentrated to dryness using a rotary evaporator at 40 ℃. The extract were dissolved in 2 ml ethyl acetate and collected in avail for gas chromatograph analysis.

### E. De-Fattening of the Fish Extract

The 2ml extract for pesticides analysis were transfer into a 100 ml separator funnel and fifty (50) ml of 1:1 (v/v) hexane/acetonitrile solution were added. The separator funnels were gradually shaken gently for 3 min while the gas pressure was released. The separator funnels with the content were allowed to stand for 20 min so as to allow separation of the organic solvents. The fraction that contained the acetonitrile fractions of the pesticides were collected into a 50 ml beaker, while the other fractions that contained the fat in the hexane solvent phase was discarded. The acetonitrile fraction that contained the pesticides extract was further cleaned-up by using 25 ml of the pure hexane. The acetonitrile fraction was concentrated to dryness using rotary evaporator at 40 ℃. The extract from the de-fattening process were further dissolve using 2ml of ethyl acetate and collected into a 2 ml vial. The vial containing the pesticides

extracts were stored in the refrigerator at 4 ℃ for GCMS analysis.

### F. Determination of Pesticide Residues

The SHIMADZU GC/MS (GC – 17A), equipped with fluorescence detector were used for the chromatographic separation and were achieve by using a 35% diphenyl/65% dimethyl polysiloxane column. The oven were programmed as follows: initial temperature 40 $^{O}$C, 1.5 min, to 150 $^{O}$C, 15.0 min, 5 $^{O}$C/min to 200 $^{O}$C, 7.5 min, 25 $^{O}$C/min to 290 $^{O}$C with a final hold time of 12 min and a constant column flow rate of 1 ml/min. The detection of pesticides were perform using the GC-ion trap MS with optional MSn mode. The scanning mode offer enhances selectivity over either full scan or selected ion monitoring (SIM). In SIM at the elution time of each pesticide, the ration of the intensity of matrix ions increase exponentially versus that of the pesticide ions as the concentration of the pesticide approach the detection limit, decrease the accuracy at lower levels. The GC-ion trap MS were operate in MSn mode and perform tandem MS function by injecting ions into the ion trap and destabilizing matrix ions, isolating only the pesticide ions. The retention time, peak area and peak height of the sample were compared with those of the standards for quantization.

### G. Data Handling

Data collected were subjected to one-way analysis of variance (ANOVA) were used to assess whether pesticide residues varied significantly between fish and organs samples, possibilities less than 0.05 ($p$<0.05) were considered statistically significant. All statistical calculations were performed with SPSS 9.0 for Windows.

## III. Results

### A. Concentrations of Organochlorine Pesticide Residues

The mean concentrations of some organochlorine pesticides (dichlorodiphenyl dichloroethylene, (o,p'-DDE), 4,4-dichlorodiphenyl dichloroethan (p, p' dichlorodiphenyl dichloroethan (o,p'-DDD), 4,4-dichlorodiphenyl trichloroethane (p,p'-DDT), Alpha BHC, Gamma BHC, metoxichlor, lindane, Endosulfan sulphate, dieldrin and aldrin) residues in the liver, gills, stomach and flesh of *Tilapia zilli* from Lake Chad are presented in Fig. 1. The concentrations of these pesticides in the liver of *Tilapia zilli* range from 1.56 to 6.76 µg/g; 1.27 to 4.56µg/g gills; 1.22 to 4.04 µg/g stomach and 1.06 to 3.73 µg/g flesh. The concentrations of some organochlorine pesticides (o,p-DDE, p,p'-DDD, o,p'-DDD, p,p'-DDT, Alpha BHC, Gamma BHC, metoxichlor, lindane, Endosulfan, dieldrin and aldrin ) residues in liver, gills, stomach and flesh of *Clarias Gariepinus* from Lake Chad are presented in Fig. 2. The levels of these pesticides in the liver range from 2.49 to 8.34µg/g liver; 2.42 to 6.54µg/g gills; 1.88 to 5.36 µg/g stomach and 1.54 to 4.54 µg/g flesh. The concentrations of organochlorine pesticides (o,p'-DDE, p,p'-DDD, o,p'-DDD, p,p'-DDT, Alpha BHC, Gamma BHC, metoxichlor, lindane, Endosulfan, dieldrin and aldrin) residues in different organ of *Hetrotis niloticus* are as presented in Fig. 3. The concentrations of pesticides in the liver of Hetrotis niloticus ranged from 1.45 to 5.23 µg/g; 1.32 to 3.54 µg/g gills 1.03 to 3.02 µg/g stomach and 0.54 to 1.67 µg/g flesh. Fig. 4 represent the mean concentrations of some organochlorine pesticides residue (o, p'-DDE, p,p'-DDD, o,p'-DDD, p,p'-DDT, Alpha BHC, Gamma BHC, metoxichlor, lindane, Endosulfan, dieldrin and aldrin) in different organ of *Oreochromis niloticus* from from Lake Chad. The concentrations of the above pesticides in the liver of *Oreochromis niloticus* range from 2.11 to 6.76 µg/g; 2.54 60 6.11 µg/g gills; 1.85 to 3.65 µg/g stomach and 0.98 to 2.66 µg/g flesh. The maximum concentrations of all the pesticides were significantly observed in the liver, while flesh shows the minimum value.

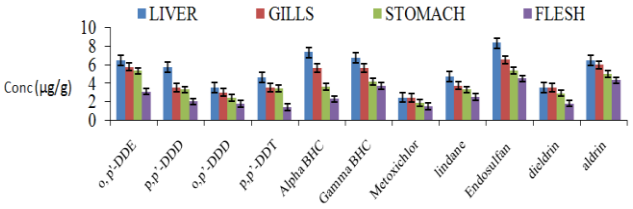


Fig. 1. Mean concentrations of some oganochlorine pesticide residues in different organs of *tilapia zilli* from Lake Chad.

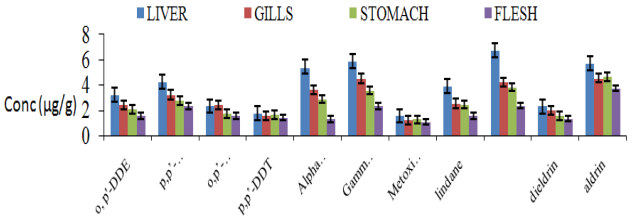


Fig. 2. Mean concentrations of some oganochlorine pesticide residues in different organs of *clarias grareipinus* from Lake Chad.

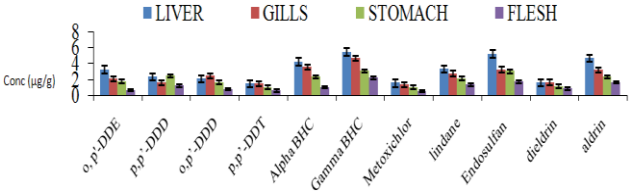


Fig. 3. Mean concentrations of some oganochlorine pesticide residues in different organs of *hetrotis niloticus* from Lake Chad.

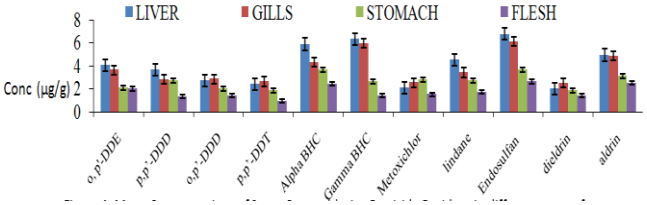


Fig. 4. Mean concentrations of some oganochlorine pesticide residues in different organs of *oreochromis niloticus* from Lake Chad.

### B. Concentrations of Organophosphorus

#### 1) Pesticide residues

The mean concentrations of some organophosphrous pesticides (Dichlorvos, Diazinon, Chlorpyrifos, and Fenitrothion) in different organ of *Tilapia zilli*is are presented in Fig. 5. The concentrations of the organophosphrous pesticides in the liver of *Tilapia zilli* ranged from 1.77 to 3.21 µg/g; 1.54 to 2.67µg/g gills; 1.32 to 2.01 µg/g stomach and 1.13 to 1.97µg/g flesh. The highest concentration of this pesticide was significantly recorded in the liver, while flesh recorded the lowest value; also most abundant organophosphrous pesticide residue recorded was chlorpyrifos with values ranging from 1.97 to

3.21 µg/g, while diazinon recorded the lowest values ranging from 1.13 to 1.77 µg/g. The order of tissues pesticide bioaccumulation are in the order of liver>gills>stomach>flesh. Fig. 6 present the concentrations of some organophosphrous pesticide residues (Dichlorvos, Diazinon, Chlorpyrifos, and Fenitrothion) in different organs of *Clarius garipinus* from Lake Chad. The concentrations of these pesticides in the liver of *Clarius garipinus* ranged from 1.56 to 3.78 µg/g liver; 2.32 to 3.45 µg/g gills; 1.99 to 2.87 µg/g stomach 1.44 and 2.54 µg/g flesh. The concentrations of some organophosphrous pesticide residues (Dichlorvos, Diazinon, Chlorpyrifos, and Fenitrothion) in different organs of Hetrotius *niloticus* are as presented in Fig. 7. The Concentrations of these pesticides in the liver of *Hetrotius niloticus* ranged from 1.65 to 2.88 µg/g liver; 01.47 to 2.11 µg/g gills; 1.21 to 1.89 µg/g stomach and 1.17 to 1.43 µg/g flesh. Fig. 8 present the concentrations of some pesticide residues in different organs of *Oreochromis niloticus* from Lake Chad. The levels of this pesticide in the liver ranges from 2.54 to 4.54 µg/g liver; 2.14 to 4.01 µg/g gills; 1.65 to 3.76 µg/g stomach and 1.12 to 1.85 µg/g flesh. The highest concentration of 4.54 µg/g was significantly recorded in liver, while flesh recorded the lowest value of 1..12 µg/g. The highest concentrations of this pesticide were significantly recorded in liver, while flesh recorded the lowest values.

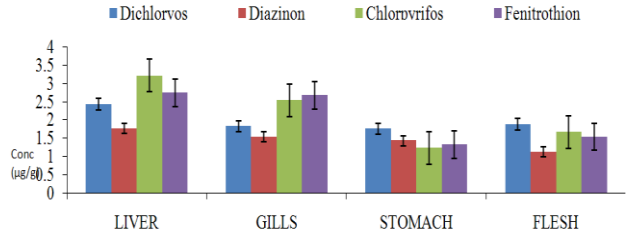

Fig. 5. Mean concentrations and standard error of some oganophosphrous pesticide residues in different organs of *tilapia zilli* from Lake Chad.

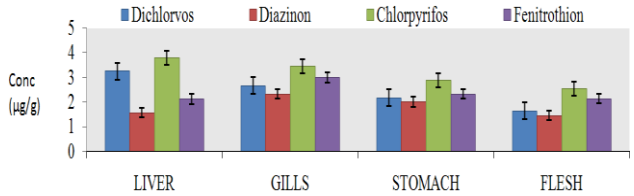

Fig. 6. Mean concentrations and standard error of some oganophosphrous pesticide residues in different organs of *clarias grareipinus* from Lake Chad.

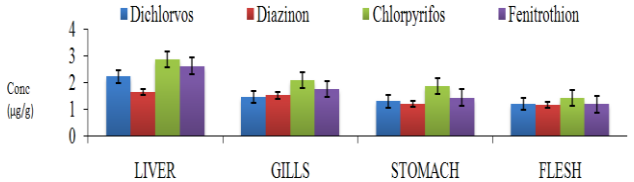

Fig. 7. Mean concentrations of some oganophosphrous pesticide residues in different organs of *hetrotis niloticus* from Lake Chad.

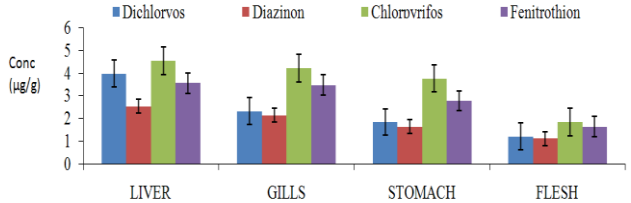

Fig. 8. Mean concentrations and standard error of some oganophosphrous pesticide residues in different organs of *oreochromis niloticus* from Lake Chad.

## IV. Discussion

### A. Organochlorine Pesticide Residues

#### 1) Endosulfan

Organochlorine pesticides tend to accumulate in living organisms especially in aquatic organisms and they substantially settle on the sediments [12]. The result of this work indicates that endosulfan is the most abundant pesticides residue in fish sample. Endosulfan accumulation was the highest in all the organs, but its highest value was observed in the liver of *Tilapia zilli*, while the lowest value was observed in flesh of *Hetrotis niloticus*. Despite the adverse side effect of pesticides, organochlorine pesticides (OCPs) form an integral component of modern agriculture. The benefit are increase supply of food, but problems arise when significant amount of the chemicals are left on the field as residue which tend to affect non target organisms and river bodies are one of the main recipient of pesticide residues generated on the field. These results are in agreement with the study carried out by [13] which indicate high level of Endosulfan residue in fish. However, level of this pesticide residues were also reported in lagos lagoon [14] were extremely low compared to the level recorded in this work. The concentrations endosulfan in the organ of the four fish samples were much higher than the WHO and FAO [15] set maximum residue limit (MRL) 0.1 µg/kg and the Acceptable Daily Intake value (ADI) of 0.006 µg/kg. Agricultural runoff is the primary source of this pesticide in aquatic ecosystems.

#### 2) p,p'-DDT, o,p'-DDD p,p'-DDD and o,p'-DDE

The highest levels of p,p'DDT and its metabolites in the present study were observed in the liver of *Tilapia zilli*, while the flesh of *Hetroties niloticus* recorded the lowest value, This outcome is expected because of the high lipophilic and hydrophobic nature of the compound, and the possibility of being retained on the organic phase of sediment and organisms [14]-[16]. The detection of p,p'-DDE is an indication of photochemical degradation of p,p'-DDT [17] Although the use of DDT has being banned in the Nigeria in 2008, but still in used. DDT and its DDE and DDD metabolites persist in the environment and are known to bioaccumulate in aquatic organism [14]. DDT, DDD, and DDE have all been classified by NAFDAC as probable human carcinogens. DDT and its metabolites were detected in the four species of fish; similar studies reported that there is a widespread of DDT and its metabolites in tissue of fish samples [18], [19]. The concentrations of DDT and its metabolites in all the fish samples were much higher than the WHO and FAO [15] set maximum residue limit (MRL) of 1.0 µg/kg, indicating contamination of the aquatic environment by pesticides.

#### 3) Dieldrin, Aldrin

The highest level of Dieldrin and Aldrin were recorded in the liver of *Tilapia zilli*, while the least value was recorded in the flesh of *Hetrotis niloticus.* Other work also reported the highest level of aldrin and dieldrin in the aquatic environment [19], dieldrin is a chlorinated cyclodiene that was widely used in Nigeria. The National Agency for Food and Drug Administration and Control (NAFDAC) has banned the sale and supply of 30 different agrochemical

products in the country which include dieldrin and aldrin. Because the toxicity of this persistent pesticide posed an imminent danger to human health, NAFDAC banned the most major uses of dieldrin and aldrin in 2008, but the product is still in used because the low cost and affordability. In 1984 and 1985, the U.S. The concentration of dieldrin was slightly significantly higher than that of aldrin in all the species of fish studied. This could be an indication that there is more dieldrin in the environment compared to aldrin. This trend is supported by the fact that aldrin photolysis to dieldrin in the environment. These results are in agreement with those of the United States Department of Health and Human services (USDHHS) reported that aldrin is readily and rapidly converted into dieldrin in plant and animal tissues. This is so because dieldrin is extremely non-polar and therefore has a strong tendency to adsorb tightly to lipids such as animal fat and plant waxes. It is for this reason that dieldrin bioconcentrates and biomagnifies through the terrestrial and aquatic food webs. [20] pointed out dieldrin is one of the most persistent chemicals known. He also reported that dieldrins bioaccumulation in animal tissue is due to its resistance to degradation and biologic metabolism. Dieldrin is not easily metabolised in water and has limited capacity of being digested and excreted from the body. It is, however, easily absorbed and transported throughout the blood of vertebrates and hemolymph of invertebrates. The concentrations of aldrin and dieldrin in all fish samples were much higher than the WHO and FAO [15] set maximum residue limit (MRL) of 0.2 µg/kg and the Acceptable Daily Intake values (ADIs) of 0.0001 µg/kg.

*4) Hexachlorobenzene, Lindane, α-BHC and β-BHC*

The highest levels of these pesticides were recorded in the liver Tilapia zilli, while the least value was recorded in the flesh of *Hetrotis Niloticus*. Hexachlorobenzene is a fungicide that was widely used as a seed protecting in Nigeria. The use of hexachlorobenzene and the presence of hexachlorobenzene residues in food are banned in many countries including Nigeria [21], but are still in used by farmers. Lindane is a mixture of homologues of hexachlorocyclohexane ($C_6H_6Cl_6$), whose major component (99 percent) is the gamma isomer. It is commonly referred to as either HCH (hexachlorocyclohexane) or BHC (benzene hexachloride). Lindane is used primarily in seed treatments, soil treatments for tobacco transplants, foliage applications on fruit and nut trees and vegetables, and wood and timber protection. The concentrations of this pesticide in all the fish samples were much higher than the WHO and FAO [15] set maximum residue limit (MRLs) of 0.01 µg/kg for α-BHC and γ-BHC.

*B. Organophosphorus Pesticide Residues*

The highest values of organophosphrous pesticide residues were detected in the liver of *Oreochromis niloticus*, while the least value was detected in the flesh of *Hetrotis niloticus*. The organophosphrous (Ops) pesticides are much more resistant to microbial degradation and have a propensity to concentrate in lipid rich tissues of aquatic organisms and most mammals. These properties lead directly to their most undesirable characteristics – the environmental persistence, bio-concentration, and bio-magnification through the food chain. Dichlorvos, Diazinon, Chlorpyrifos and Fenitrothion which are readily deactivated and degraded by micro-organisms and therefore do accumulate [22]. Among the OPs detemined, Chlorpyrifos shows the highest concentration followed by Fenitrothion, while Diazinon shows the lowest value. These pesticides are widely used as agricultural insecticides and also have many uses in households for pest control. The concentrations of organophosphrous pesticide residues (diazinon, chlorpyrifos and fenitrothion) detected in this study were above the WHO and FAO [15] set maximum residue limits (MRLs) of 0.04 µg/kg for diazion, 0.30 µg/kg for Chlorpyrifos and 0.01 µg/kg for Fenitrothion. The Acceptable Daily Intake values (ADIs) of Diazinon, Chlorpyrifos, Fenitrothion for fish samples are 0.0002 µg/kg diazinon, 0.01 µg/kg Chlorpyrifos and 0.005 µg/kg Fenitrothion respectively. The results obtained from the present study exceeded this Acceptable Daily Intake values and this may be attributed to the presence of this pesticide in the aquatic environment. The maximum residue limits (MRL) is the maximum amount of the pesticide residue which is found in food substances that will not cause any health effect or hazard [23]. These pesticides were significantly higher in the liver and gills of all the fishes studied than other organs, such high levels is due to the fact that fresh water fishes gills might be expected to be the primary rout for the uptake of water pollutants; while the liver serve as a storage organs for vast variety of nutrient. High accumulation of this pesticide in the gills and liver can also be as a result of detoxicating mechanisms and may originate from pesticides deposited in the sediments and food in the aquatic environment. However, the liver is the preferred organs for pesticides accumulation as could be deduced from the present study. Accumulation of pesticides in different species is the function of their respective membrane permeability and enzyme system, which is highly species specific and because of this fact pesticides accumulated in different organs in the fish as observed in the study.

## V. Conclusion

Endosulfan was the most abundant pesticides residue in the studied tissues of all the fish species. The concentrations of all the organophosphorus pesticides were higher in the organs of *Oreochronmis niloticus*, while *Hetrotis niloticus* shows the lowest. For organochlorine pesticides, the organs of *Tilapia zilli* showed the highest concentrations, while *Hetrotis niloticus* shows the lowest. This study revealed that pesticide residue levels in the fish samples study were above the maximum residue limits (MRLs) and acceptable dietary intake (ADI) and could be an important process of transferring pesticides to humans. It also indicated the extensive presence and usage of these pesticides in the study environment, which include recent use of this pesticide for pest control. Thus, the use of these pesticides to control pest by farmers within the study area with little or no knowledge must be checked through adequate control so as to stop the trade of those pesticides that are banned.

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