



ABSTRACT

The objectives of this research is to the determine the concentration of organic pollutants in the two species of fishes namely *Oreochromis niloticus* and *Synodontis schall* using the method describe by Olaifa et al, (2004) and Petruschen et al, (2004). The two species of fishes namely *Oreochromis niloticus* and *Synodontis schall* obtained at a

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ETERMINATION OF ORGANIC POLLUTANTS IN SELECTED FISH SAMPLES OBTAINED FROM KAINJI LAKE NEW BUSSA NIGER STATE

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Introduction

ORGANIC POLLUTANTS

Persistent organic pollutant(pops) are organic compound that are resistant to environmental degradation through chemical, biological and photolytic process

Because of this they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulation in human and animal tissue through the food chain, and pose a risk of causing adverse effects to human health and the environment. Many POPs were in the past used as pesticides, other are used in industrial processes either intentionally or as by products (Roter et al). Toxicants enter fish through the body surface, the highly permeable gill epithelial



distance of 50 m, 100 m and 150 m from Kanji dam were investigated for organic pollutants. The control sample was obtained from Yangba river along Wawa road in New Bussa, Niger State.. The organic pollutants were extracted from the fish using a 170cm³ of solvent mixture of hexane and dichloromethane (1:1), the extracts were collected into 60cm³ vials and treated with sodium sulphate. The eluate collected from the clean-up of the extract was collected in a beaker and evaporated to dryness with the aid of rotatory evaporator. The dry component was then dissolved in 5cm³ iso-octane for HPLC analysis. For the Organic pollutants, cyclohexane namely; 9-oxabicyclohexane and cyclopentan-1,1 [3-(2-cyclopentyldecyl)] was found at a concentration of 0.220 mg/Kg and 0.215 mg/Kg respectively in *Oreochromis niloticus* at a distance 50m away from the dam, while it was absent at a distance of 100 and 150m respectively. For *Synodontis schall*, 1,1-bicycloheptyl and cyclohexane-1-ethylmethyl was found at a concentration of 0.315 mg/Kg and 0.147 mg/Kg respectively. From the table concentration of n-alkane namely undecane, dodecane, pentadecane and hexadecane was found 50 and 100m away from the dam site, while they are absent at 150m away from the dam. For *Synodontis schall*, n-alkane namely; tetradecane and hexadecane was found at low concentration at 50m and 100m away from the dam. Iso-alkane were not present in *Oreochromis niloticus*, while it was present in *Synodontis schall* at 50, 100 and 150m respectively away from the dam. The iso-alkanes present were octane-2,7-dimethyl, octane-2-methyl, decane-3,7-dimethyl, decane-2,6,8-trimethyl. The organic pollutants present in the fishes species were within the acceptable limit of Standard Organization of Nigeria (SON), World Health Organization (WHO) and other international regulatory bodies.

membranes and through ingestion/gastrointestinal absorption. As industrial production took off in the post second world war period, organic got into the environment in larger amount as the use of synthetic chemical increased. Lindane – HCH (hexachlorocyclohexane) for example is resorted to be a possible human carcinogen (class 2B) by the international Agency of Research on



Cancer(IARC) and class B2/C by the United State Environmental Protection Agency USEPA (Pope *et al*, 2006)

In 1995, the United Nations Environment Programme Governing Council (CG) decided to begin investigating pops case, initially beginning with aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, polychlorinated dibenzo-p-dioxine, polychlorinated dibenzofurans and toxaphene known as the “dirty dozen” (, Ritter *et al* 2007). Since then, substances such as carcinogenic polycyclic aromatic hydrocarbons (PAHs) and certain brominated flame –retardants, as well as some organometallic compounds such as tributyltin (TBT) has been included in this list. Persistent Bio accumulative and toxic (PBTs) or TOMP (Toxic organic micro pollutants), which are classified as unintentionally produced substances (Dioxin like compounds), are also in the group of compounds that makes up persistent organic pollutant (Ritter,*etal* 2007)

Intentionally produced Chemicals

N-Alkanes

N-Alkanes are compounds of carbon and hydrogen only with carbon and carbon single bonds, consisting of straight-chain structures. They all conform to the general formula $C_n H_{2n + 2}$, where n is the number of carbons in the chain, and sometimes are called paraffin hydrocarbons, open-chain, saturated hydrocarbons, or acyclic hydrocarbon. Alkanes are a major fraction (>50%) of the crude oil from which mineral oils are obtained through refining, defining upon the oil source. Alkanes are saturated hydrocarbons and chemically very inert as a polar molecules (Labinger and Bercaw, 2002). Anthropogenic hydrocarbon contamination of soil is a global issue throughout the industrialized world (Macleod *et al*, 2001; Brassington *et al*, 2007). According to Bauman (1988), volatility represents transfer of the compound from the product or liquid phase to the air phase. In a similar work by (Frankenberger, 1992; Bossert and Bartha, 1986) indicated that n-alkanes greater than C_{18} exhibit no substantial volatilization at ambient temperatures; however, lighter fraction ($>C_{18}$) as subject to volatilization.



Physical and chemical characteristics

N-alkanes are generally chemically very inert and show a remarkably smooth gradation of physical properties. As n increase, in each additionally CH_2 , there is a fairly constant increment to the boiling point and density, and to a lesser extent to the melting point. N-alkanes are classified as lighter fraction ($<C_{18}$) and heavier fraction ($>C_{18}$) (Bossert and Bartha, 1986). The lighter fraction n-alkanes can easily vapourized depending on the environmental factors such as high summer temperature, relatively density, wind speed, soil types, oil composition, solar radiation and thickness of the oil layer affect the rate of their vapourization, particularly when soil begin to dry out. While the heavier n-alkanes are resistance to biodegration due to their bioconcentration and sorption to the soils and sediments (Bonrony *et al.*, 2007)

Sources

N-alkanes are component of mineral oil obtained from distillation of petroleum crude oils (Emmanuel *et al.*, 2009). There are several sources of n-alkanes which include anthropogenic such as mineral oils obtained from petroleum distillation (petrogenic), coal burning and other industrial activities, and natural sources such as terrestrial plant waxes, phytoplankton, bacteria, and diagenetic transformation of biogenic precursors. N-alkanes are released to the environment through accidents, as releases from industries, or as by products from commercial or private uses (Doyle. 1994). However, when n-alkanes is releases directly to water through spills or leaks, the lighter fractions will float into water and form thin surface films while heavier fraction will accumulate in the sediment at the bottom of the water, which may affect bottom feeding fish and organisms (Frankenberger, 1992).

Environmental fate

N-alkanes released to environmental media involves unintentionally leakage or spillage, (Doyle, 1994). N-alkanes may occur in soils in four different forms depending on their properties, dissolved in water as the case of lower molecular mass (LMM) n-alkanes, sorbed on soil particle in the case of higher



molecular mass (HMM), n-alkanes comprises the soil gas and due to their limited solubility, forming an individual liquid phase known as NAPL (non-aqueous phase liquid). NAPLs can generally be divided into two individual groups according to their specific gravity i.e denser than water (dense - DNAPLs) and less dense than water (Lighter - LNAPLs). A group of DNAPLs consists of denser oil fractions such as tar, which comprises mostly aromatic hydrocarbons. The vast majority of commonly used oil substances (e.g fuels and light gas oils) are less dense than water (LNAPLs). (Frantisek *et al*, 2003).

Toxicity

Related to environmental or aquatic toxicology, alkanes are generally not of much toxicological concern other than fire or explosion hazard. The main concern seems to be potential effects on the CNS or as general asphyxiants or irritants (Roy *et al*, 1997). The potency of the CNS effects depends on the structure of the individual hydrocarbon molecules. N-alkanes within the C₅-C₉ carbon range, when inhaled or ingested interact with the cell of CNS (Andrews and Snyder, 1986), thereby causing central nervous system (CNS) disturbances like disorientation, euphoria, giddiness, and confusion, progressing to unconsciousness, paralysis, convulsion, and death from respiratory or cardiac arrest (Browning, 1965). While n-alkanes in the range between C₁₀-C₂₁, when ingested, courses change in serum chemistry and liver weight (Mattie, *et al*, 1995). And within the C₁₉-C₃₅ carbon range have no inhalation toxicity data because hydrocarbon constituents in their fraction are not volatile and inhalation is not a like exposure pathway but through ingestion, it may cause changes in body and liver weight (Smith *et al*, 1996).

Isoalkanes

Iso-alkanes are compounds of carbon and hydrogen only with carbon to carbon single bonds and branched structure conform to the general formula C_n H_{2n+2}. Isoalkanes are obtained by n-alkanes hyroisomerization (Galadima *et al*, 2009). Isoalkanes are saturated hydrocarbons and chemically very inert as a polar molecules like n-alkanes (Labinger and Vercaw, 2002). Anthropogenic



hydrocarbon contamination of soil is a global issue throughout the industrialized world (Macleod *et al*, 2001; Brassington *et al*, 2007). Isoalkanes tends to be more resistant than n-alkanes of the same carbon number (John *et al*, 2016), although, they have similar properties.

Physical and chemical properties

Branched or iso-alkanes are less water soluble, non-volatile and more persistence in nature than n-alkanes as such, they tend to have low mobility because the compounds were absorbed by soil organic carbon than n-alkanes (Coleman *et al*, 1984). In another report by (Dragun, 1988), volatilization and biodegradation rates are directly independent upon extents of partitioning. The C₁₂ isoalkanes and the heavier structure (>C₁₅), will partition to sediment if released to water while the lighter (>C₁₂) components are expected to partition mainly to air, but if released solely to soil, many of the heavier components are expected to remain in the soil and the lighter components (<C₁₀) partitioning to air based on their high Henry's law constants (Environment Canada, 2014). In biodegradation, micro-organisms in soils are able to degrade a variety of petroleum hydrocarbons, although at very different rate (Kestner, 1994; Holliger and Zehnder, 1997; Bregnard *et al*, 1998).

Sources

Isoalkanes are component of mineral oils obtained from catalytic cracking of long straight chain n-alkanes (Kaplan, *et al*, 2010). There are several sources of isoalkanes which include anthropogenic such as mineral oils obtained from petroleum distillation (pethrogenic), coal burning and other industrial activities, and natural sources such as terrestrial plant waxes, phytoplankton, bacteria, and diagenetic transformation of biogenic precursors. Isoalkanes are released to the environment through accidents, as releases from industries or as by products from commercial or private uses (Doyle, 1994). However, when isoalkanes are releases directly to water through spills or leaks, the lighter (<C₁₂) fractions will in water and form thin surface films while heavier (>C₁₅) fractions tend to partition heavily into the solid phases, (the sediment) at the



bottom of the water, which may affect bottom-feeding fish and organisms, and when in air, they associate with atmospheric particulates (Abrajano *et al*, 2003; Frankenberger, 1992).

Environmental Fate

Various environmental compartments were reported as receiving media for isoalkanes which include air, water and soil depending on their molecular structure. The lighter component (C₆-C₉) are highly volatile, with vapour pressures ranging from 320 to 2.8×10^4 Pa, are likely to remain in air, while the heavier (>C₁₂) and up to C₃₀ components, are low to moderately volatile, with vapour pressures ranging from 0.009 to 165 Pa, and are expected to partition out of air (Environment Canada, 2014). Aside from the C₃₀ isoalkanes, the C₃₀ to C₅₀ representative structures will partition almost entirely to soil. It released is to water, most C₉ representative structures will remain in water while C₁₅ representative structures will partition largely to sediment. Volatilization from water surface is not expect to be an important fate process despite the presence of some representative structures with moderate to very high estimated Henry's law constants, they will partition to sediment. It is likely, with a release situation into water where the component is not immediately in constant with sediments or suspended matter, that the moderate to high Henry's law constants will drive the C₉-C₂₀ representative structures out of the water. The tendencies for evaporation and sorption are competing and the exact nature of the release would dictate how the substance will behave (Environment Canada,2013).

Toxicity

The toxicity of isoalkanes is similar to all alkanes' family, because they have similar absorption, distribution, metabolism, and excretion properties. It is also apparent that the pharmacokinetic properties of these molecules are more dependent on carbon chain length than difference in chemical structure. Isoalkanes in the C₅-C₂₀ range are absorbed in the small intestine from which



they are distributed to tissues including liver, kidneys, adipose tissues and brain (Battig *et al*, 1954; Riala *et al*. 1984)

Cycloalkanes

Cycloalkanes are compounds with one or more rings of carbon atoms (e.g cyclopentanes and cyclohexanes), and have the general formula C_nH_{2n} . The majority of cycloalkanes in crude oil and refined petroleum products have an alkyl substituent(s). The cycloalkanes are present in high concentrations in crude oil and several refined petroleum products, but they are the least well characterized because of analytical difficulties. They can be single, fused, or linked by a single carbon-carbon bond; contain aromatic rings; or have alkyl substituent, either branched or linear. Cyclopentane and cyclohexane derivatives tend to be the main cycloalkanes in petroleum products. (Potter and Simmons, 1998; Howard *et al*, 2005).

Physical and Chemical Properties

Generally, the melting point, the boiling point and the density of cycloalkanes increase as the number of carbons increases. This trend occurs because of the greater number of bonds that are in higher membered rings, thus making the bonds harder to break. Cycloalkanes have higher London Dispersion forces because the ring shape allows for a greater area of contact. Ring strain also causes certain cycloalkanes to be more reactive (Vollhardt *et al*, 2007). Cycloalkanes are non-polar and insoluble in water. The forces of attraction between their molecules are induced dipole/induced dipole attractive forces.

Source

There are several sources of cycloalkanes which include anthropogenic such as mineral oils obtained from petroleum distillation (petrogenic), coal burning and other industrial activities, and natural sources such as terrestrial plant waxes, phytoplankton, bacteria, and diagenetic transformation of biogenic precursors.



Environmental Fate

Potential releases of cycloalkanes to the environment consist of releases within facilities using the substance or from activities associated with processing these substances as well as releases related to transportation (e.g spills or leaks) of these substances between industrial facilities. When released in water, cycloalkanes tend to be more water soluble than aliphatics and aromatics of the same number (Gustafson *et al*, 1997). But if the released is on soil, all representatives structures of cycloalkanes are expected to have high sorption to soil. (i.e expected to be immobile with >99% remaining in the soil). Volatilization from moist soil surface may be an important fate process based upon estimated Henry's law constant values of 5.1 to 1.3×10^6 m³/mol. Lower molecular weight representative structures based upon their moderate vapour pressure (Pancirov and Brown, 1975).

Toxicity

Toxicity of cycloalkanes depends on the properties and molecular structure of the compound, low molecular weight can evaporate and absorption is through inhalation (Dahl *et al*, 1988) and are eliminated primarily by exhalation (Filser *et al*, 1983, unpublished data summarized by Galvin and Marashi, 1999). Higher molecular weight, less volatile are relatively well absorbed, metabolized to water-soluble forms and excreted as urinary metabolites. Data from (Zahlsen *et al*, 1993) indicate that normal and isoparaffinic hydrocarbons with C₈-C₁₀ and C₈ cycloparaffinic hydrocarbons reach similar steady state concentrations in the brain, and then decline with increasing molecular weight. However, hydrocarbons with carbon number C₁₂, exposure by the inhalation route is expected to be limited because of their low vapour pressures, and may be further METHODS

SAMPLING AND PRESERVATION

Three samples each of sub adult sizes (115-180 g body weight) of fish species namely *Oreochromis niloticus* and *Synodontis schall* was collected. This size range was to avoid different states of reproductive physiology. The use of



older fish species was avoided as Dusek *et al* (2005) reported that older predator fish species living in moderately and heavy polluted sites show negligible statistical differences.

Fish samples was collected with cast net from Kainji lake at 150 metres, 100 meters, and 50 meters to the dam site which serve as the sampling point. The control sample were collected from Yangba river along Wawa road and each of the fish species were collected at each sampling point making a total of eight fish samples. A canoe was used as sampling craft and at each point the canoe was stopped for samples to be collected.

The samples was wrapped with polythene bags and stored in an iced plastic box and subsequently transported to Fishery Department of Usmanu Danfodiyo University, Sokoto for sample identification and then stored in a deep freezer at a temperature of 0°C (-273.16K) at the laboratory of Sokoto Energy Research Centre for subsequent analysis.

Sampling site and location

The study was conducted at Kainji Dam and Yangba river both within Kainji Metropolis.

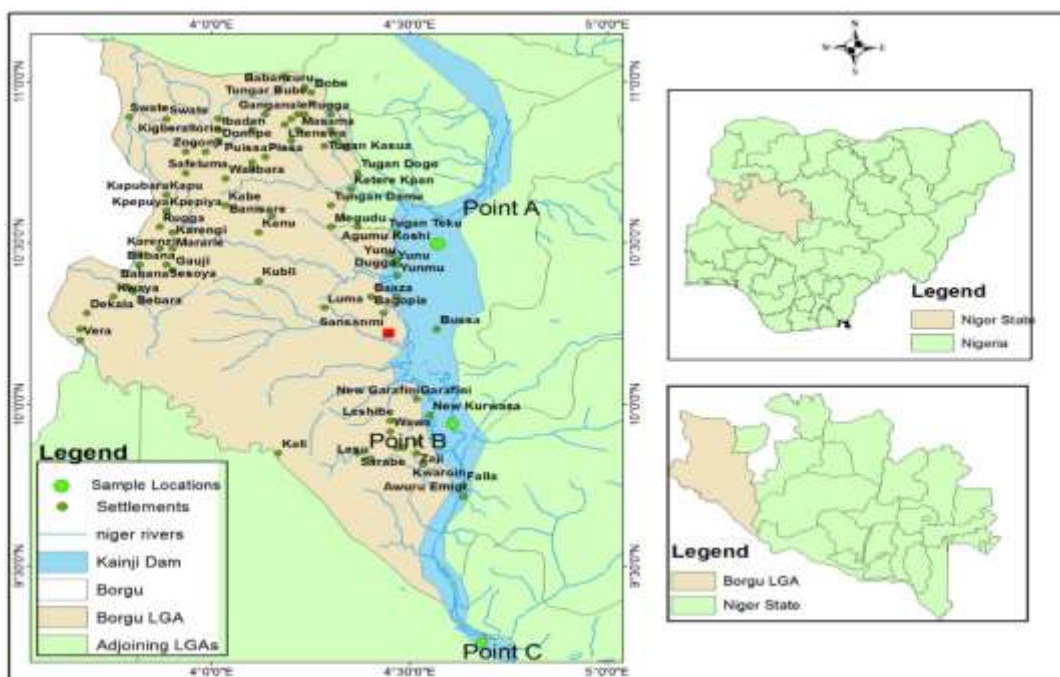




Figure 1: Map of Kainji Dam illustrating sampling point A, B and C and settlements around the dam

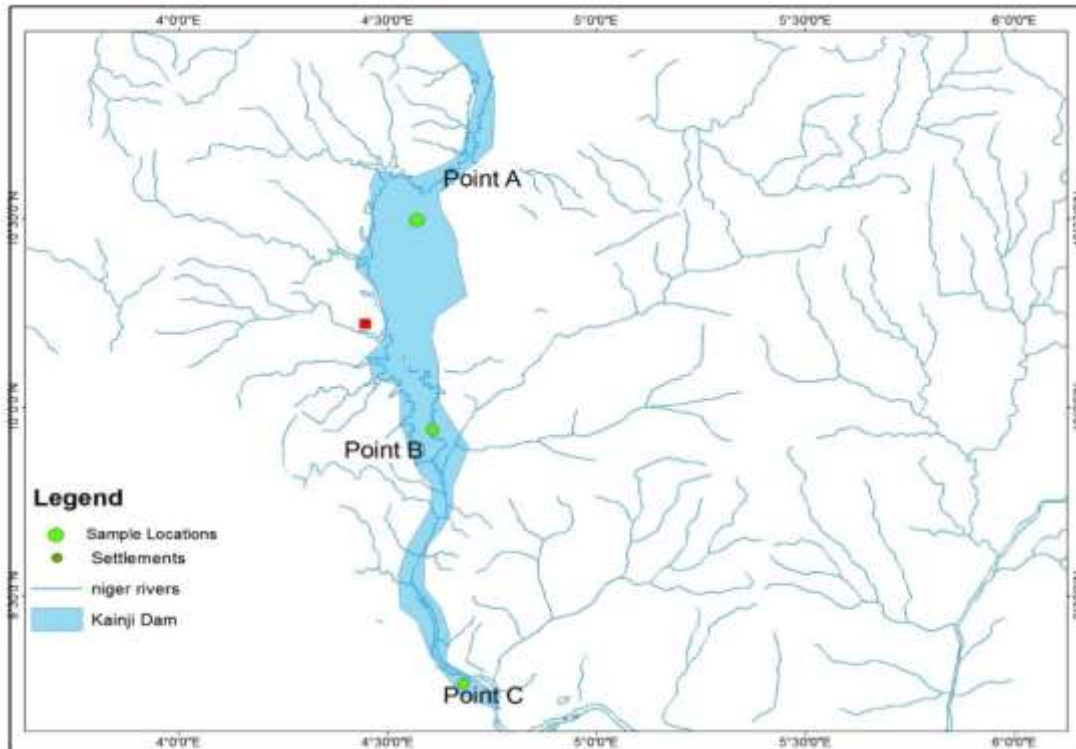


Figure 2: Map of Kainji Dam illustrating sampling point A, B and C

DESCRIPTION OF SAMPLING SITE

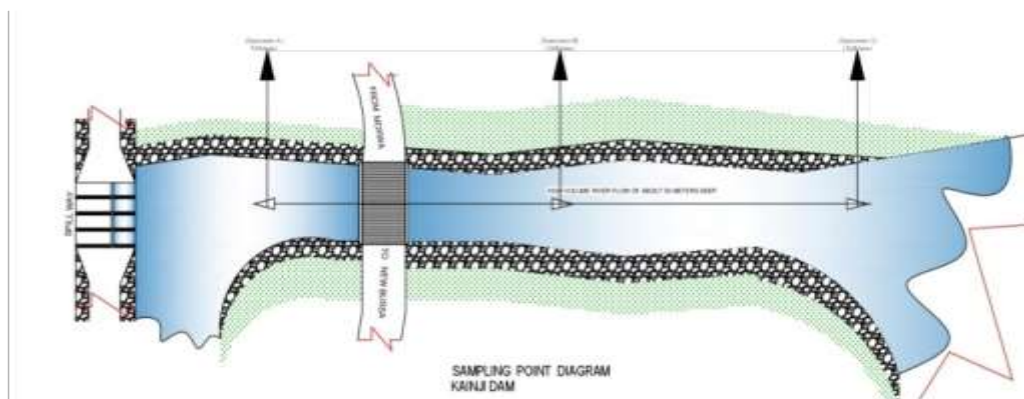


Figure 3: Drawing illustrating the direction of movement from Mokwa to Kainji Dam

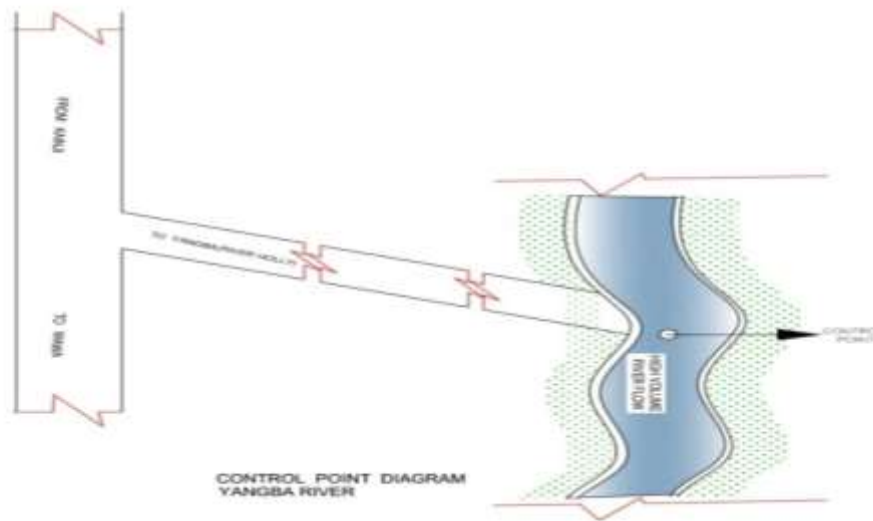


Figure 4: Drawing illustrating the direction of movement from Kainji Dam to Yangba river along wawa road

Kainji Lake is in the Niger State North Central, Nigeria and it is located on the river Niger, between Latitude $9^{\circ}30'N$ to $11^{\circ}N$ and $4^{\circ}0'0''$ to $5^{\circ}0'0''E$, it covers an area of 128 Km. The Kainji Lake is a booming agricultural zone with plants like vegetables (tomato, pepper, vegetables etc.), cereals (maize, guinea corn etc.) planted on both sides of the lake bank throughout the year. Fertilizers, herbicides and insecticides are used on these crops and are eventually washed into the rivers via surface run off. Petrol powered water pumps are used to irrigate the farm lands in the dry season and this enables petroleum wastes to get into the river. Most of the industries (the local solid mineral mining states and power generating industry, that is, Kainji Hydro-electric power generation company, located in Kainji) discharge their wastes directly into the lake while in some instances, the wastes are discharged into rivers and streams that that empty into the lake.

Trade wastes (Trans-automechanics, metal fabrication/finishing, abattoirs, local tanneries etc.) are also directly or indirectly discharged into the river. Domestic sewage and refuse also find their way into the river from the many settlements along the river via leaching, direct discharge and surface run off.



All these wastes point to potential pollution of the river. Indeed, fish caught on part of the lake where human population and industries are concentrated are usually darker in colour than those caught in areas with lower human and industrial concentration.

The Yagba river is located 40km to the eastern part of Kainji dam and is equally well known for agricultural activities but no industry is sited within the territory.

SAMPLE PRE-TREATMENT

- a) Cutting: Fish samples were dissected with plastic knife to separate the muscles from the head/viscera.
- b) Washing: glassware, plastic containers, crucibles, pestle, and mortar, were washed with liquid soap, rinsed with distilled water and then soaked in 10% HNO₃ solution for 24 hrs. (Todorovi *et al*, 2001). They were then washed with distilled water and dried in oven 60°c for 5 hours.

SAMPLE PREPARATION FOR ANALYSIS OF ORGANIC POLLUTANT

Method

Extraction of the organic pollutants from the fish samples was according to method adopted by Petruschan, (2004). The fish samples were removed from the freezer where they were kept for preservation and allowed to thaw. A representative portion of each fish species was mixed. A 10g portion was homogenized with 70 g anhydrous sodium sulphate and transferred into cellulose thimble and stored in a desiccator for 12 hrs. It was inserted into a soxhlet apparatus and subjected to extraction for 8 hrs (7 cycle per hours) using 170 cm³ of solvent mixture of hexane and dichloromethane (1:1). The extract was collected into 60 cm³ vials and further treated with sodium sulphate to remove any possible humidity. The clean-up of the extract was carried out by eluting it in a column contain silica using the mixture of hexane and dichloromethane (1:2). 10 cm³ of the solvent was initially used to elute the compound, followed by 50 cm³. The eluate was collected separately in a beaker, it was then added together and evaporated to dryness with the aid of



rotatory evaporator. The dry component was then dissolved in 5 cm³ iso-octane for HPLC analysis.

A single injection of isocratic test standard and sample is made under the condition given below: Flow rate was 1.5 cm³/minute and stop time was 8 minutes. The solvent used was iso-octane at an ambient temperature. Wavelength of running the analysis was 254 nm at an injection volume of 10µl.

ANALYSIS OF SAMPLE FOR ORGANIC POLLUTANTS USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

The sample extract of about 10 µl was measured with the aid of micro-spring and introduced into the High Performance Liquid Chromatography (HPLC). The solvent used to run the sample was iso-octane. The model of the HPLC machine was Shimadzu with serial number of **L20224402332** and detector SPD-20AV inserted with the deuterium lamp for system check. The column is pinnacle DBC18 and the column length is 150 mm with inner-diameter of 4.6 mm. Petroleum and Standard of DDT, Dimethoate and Endosulfan were used as standard in running the sample. The spectrum of the read out of the machine shows the chromatogram of various constituent compounds, the retention time and the peak area. The retention time and peak height was interpolated with the standard retention time of various organic compounds in the machine library, this was used to identify the constituent organic compounds in each sample.

Quantitative analysis of the compound was carried out using the following

$$\text{Percentage Concentration} = \frac{\text{Area percentage}}{\text{Area}} \times \frac{100}{10} \dots\dots\dots (1)$$

$$\text{Concentration (mg/g)} = \frac{\text{Conc.in percentage}}{10} \dots\dots\dots (2)$$

Where:Area percentage: is the area of the signal of the concentration obtained relative the concentration of other analyte in the sample.Area: is the area of the signal depicting the actual concentration of the organic pollutant



Organic pollutants

The concentration of organic pollutants in the two fish species are presented in Tables 3.3 to 3.9. The chromatograph are presented in the Appendices.

Table 3.3: Concentration of n-alkanes (mg/kg) in *Oreochromis niloticus* at different meters away from Kainji dam

Organic Pollutant	Concentration at different distances in meters (mg/kg)		
	50 m	100 m	150 m
N-Alkanes			
Undecane	0.145±0.011	0.145±0.011	N.D
Dodecane	Nd	1.457±1.030	N.D
Pentadecane	0.143±0.010	N.D	N.D
Hexadecane	1.457±1.030	N.D	N.D
Cyclo-hexane			
9-oxabicyclohexane	0.220±0.156	N.D	N.D
Cyclopentan-1, 1-[3-(2-cyclopentyldecyl)]	0.215±0.152	N.D	N.D
Alkylbenzene			
Benzene-1,2-dicarboxylic acid	2.042±1.750	2.011±1.737	N.D
Benzene-1,1-dimethyldecyl	2.205±1.819	2.200±1.789	N.D

N.D = Not Detected

Table 3.4: The concentration of N-Alkane (mg/kg) in *Synodontis schall* at different meters away from Kainji dam

Organic Pollutant	Concentration at different distances in meters (mg/kg)		
	50 m	100 m	150 m
N-Alkanes			
Decane	0.014±0.010	0.012±0.009	N.D
Undecane	1.449±1.025	1.428±1.010	N.D
Tridecane	N.D	1.402±0.991	N.D
Pentadecane	0.452±0.320	N.D	N.D
Octadecane	1.468±1.038	N.D	N.D



Iso-Alkanes			
Octane-2,7-dimethyl	2.039±1.749	2.012±1.736	2.000±1.721
Octane-2-methyl	2.040±1.748	2.036±1.748	N.D
Decane-3,7-dimethyl	2.033±1.745	N.D	2.014±1.737
Decane-2,6,8-trimethyl	2.311±1.862	N.D	2.300±1.850
Cyclo-hexane			
1,1-bicycloheptyl	0.135±0.095	N.D	N.D
Cyclohexane-1-ethyl-1-methyl	0.147±0.104	N.D	N.D
Alkylbenzene			
Benzene(1-ethyldecyl)			
Benzene(3-ethyl-5,5-diethylhexyl)	0.215±0.152	N.D	N.D
Benzene-1,1-[1,2-bis(2,2-dimethylpropyl)-1,2-ethanedecyl]bis	0.223±0.158	N.D	N.D
	0.211±0.149	N.D	N.D

N.D = Not Detected

DISCUSSION OF RESULT OF ORGANIC POLLUTANTS

The concentration of alkenes, namely undecane *oreochromis niloticus* was the same i.e. 0.145 m/kg at 50 m and 100 m to the dam, while dodecane was found at concentration of 1.457 m/kg at 100 m only, penta decane and hexadecane was found at 50 m away from the dam with concentration of 0.143 m and 1.457 mg/kg respectively. Alkylbenzene was found at 50 m and 100 m respectively with varying concentration between 2.042 to 2.205 mg/kg respectively (Table 3.3). Iso-alkane was not present in *Oreochromis niloticus*, while it was present in *Synodontis schall* at 50, 100 and 150m respectively with the concentration been, 2.039, 2.040, 2.033, 2.311, 2.012, 2.036, 2.000, 2.014, 2.300 (Table 3.4), the iso-alkane are; Octane-2-methyl, decane-3,7-dimethyl and decane- 2,6,8-trimethyl. From the result it shows that the heavier alkane are less mobile than the lower fraction in the environment as reported by (Frankenberger,1992). This may be attributed to its high fat content which makes it easy to bio-concentrate the isoalkanes (Preston,1993).

This further shows that the river is polluted with organic pollutant from the petroleum product and engine oil. While from *Synodontis schall*, alkylbenzene was found only at 50 m away from the dam. The alkylbenzene compound found



were Benzene(1-ethyldecyl), Benzene(3-ethyl-5,5-diethylhexyl) and Benzene-1,1-[1,2-bis(2,2-dimethylpropyl)-1,2-ethanedecylbis at a concentration of 0.215, 0.223 and 0.211 mg/kg respectively (**Table 3.4**). The result obtain is in agreement with the result reported by Fabrizio Galberti who determine organic pollutant in *Synodontis schall* and *Oreochromis niloticus* obtain from keejhar lake Pakistan. isoalkane was 2.300, cyclohexane compound was 0.221 mg/kg and Alkybenzene compound was 2.200 mg/kg and 0.220mg/kg for the two species of fish respectively (**Table 3.3 & Table 3.4**). From the Analysis of Variance (ANOVA) among the organic pollutant in the fish samples calculated in **Appendix IV**. The results shows that there is significant different in the concentration of organic pollutant in the fish samples at $p \leq 0.05$. The result further indicated that the fish samples contain some organic pollutant but they are within the allowable or tolerance level as obtained from Human Health Benchmark Guidelines table for chlorinated paraffin listed in the **Appendix XI**

CONCLUSION

Going by this result it could be inferred that the concentration of Organic pollutants in the studied fish sample were within their acceptable limit set by World Health Organization (WHO), and National Agency for Food Administration and Control(NAFDAC).

REFERENCES

- Abdul Kashan, M.D and Singh, B.R (1999) Heavy metal contamination of soil and vegetation in the vicinity of industries in Bangladesh water, a, and soil pollution 115: 347-361
- Adakole, J.A (1995) the effect of pollution on a stretch of River Kubanni, Zaria. M.Sc. Thesis. Dept. of Biological Science, Ahmadu Bello University. Zaria, Nigeria.
- Agarwal, S.K (2002) Pollution Management, vol. 2-Water Pollution A.P.H publishing corporation New Delhi p37-45
- Aizawa, H (1989): *Metabolic Maps of pesticides*, vol. 2, Academic Press, San Diego, California, USA, P 19
- Albaiges, J. (2005): Persistent Organic Pollutants in the Mediterranean Sea, Hdb. Env, Chem. Vol. 5, Part K: DOI 10.1007/b107145, Springer-Verlag, Berlin, *Monitoring of pesticides in the Environment* P. 351.
- Albro, PW, Fishbein L, (1970). Absorption of aliphatic hydrocarbons by rats, *Biochem Biophys Aca*, 219, 437-446
- Ali, U., Syed, J and Malik, R. (2014); "Organochlorine Pesticides (OCPs) in South Asian Region: a Review," *Science of the Total Environment*, 476-477: 705-717
- Amoo, I.A Adebayo (2005) evaluation of heavy metals in fishes, water and sediments of lake Kainji food, *Agric. and environ* (3(1): 209-212
- Andrews, L S. & Snyder, R. (1986) Toxic effects of solvents and vapors. In *Toxicology: the basic science of poisons*. Klaasen C.D., Ambur M.O. and Doull J. [Eds], MacMillan Publishing Co. , New York: 636-668
- Arthurs P, Stiver W.H, Zytner R.G (1995). Passive volatilization of Gasoline from Soil. *J Soil Contam* 4:1-13
- Bae,D.,Genings.,Raymond, S.H.T and Campain, J.A (200) Toxicological Interaction among , Cadmium and Lead in Human Karatinocytes
- Baeyens, W., Leermaker, M.,Geiter, M.D., Nguyen, H.L, Permentier, K., Pamutrakal, S and Elskens, M.(2005). Over view of trace metal contermination in the Scheldt Estuary and effect of regulatory measures. *Hydrobiologia* 540:141-154
- Bailey, H., Deanovic L., Reyes, E., Kimball, T., Larson, K., Cortright, K., Conner, V., and Hinton, E., (2012): "Diazinon and Chlorpyifos in Urban Waterways in Northern California, USA", *Environmental Toxicology and Chemistry*, 19:82



- Barth, J., Grathwohl, P., and Jones K., (2007): "Introduction to Special Issue Aqua Terra: Pollutant Behaviour in the Soil, Sediment, Ground, and Surface Water System" *Environmental Pollution*, 148(3): 693
- Barthram, J., (2012): Water and Health in Europe: A Joint Report from the European Environment Agency and the WHO Regional Office for Europe, World Health Organization (WHO) *Regional publications European series*, 93: 190-199
- Battig K, Grandjean E, Turrian V. (1956). Health damage after continuous exposure to trimethylbenzene in a painting shop. *Z Prev Med*, 1, 389-403
- Bauman B.J (1988). Soils contaminated by motor fuels: Research activities and perspectives of the American Petroleum Institute. In: *Petroleum contaminated soils*, vol. 1. Chelsea, MI: Lewis Publishers, 3-19.
- Berger N, Randoux G, Ottmann and Vuarchex P, (1997). "Review on insulating fluids", *CigrWG15.02, Electra*, No 171, Avril
- Biney,C.,Amuzu,T.,Calamari,D.,Kaba, N.Mbome,I.L.,Naeve,H.,Ochumba, P.B.O., Osibanjo, O., Radengonde, V and Saad,M.A.H.(1994). Review of Heavy metals.In:D.Calamari,(Ed).Review of pollution in Ethe African Enviroment.CFA/FAO,Rome.
- Boffetta, p., Jourenkova, n.& Gustavsson, P.(1997). Cancer risk from occupational exposure to polycyclic aromatic hydrocarbons .*cancer cause control* 8:444-472.
- Bonroy J., van de Steene J., van de Velde, R. van Estvelde G., Verplancke, H., Verfaillie, F & Boucneau G (2007), Monitored natural attenuation of domestic fuel oil in the unsaturated zone. In *In Situ and On-Site Bioremediation – 2007*, Proceedings of the Ninth International in Situ and On-Site Bioremediation Symposium, eds, Gavaskar, A.R & Silver, C.F Columbus, OH: Battelle Press.
- Bossert ID, Bartha R, (1986). Structure -biodegradability relationships of polycyclic aromatic hydrocarbons in soil. *Bull Environ Contam Toxicol*, 37(4):490-495.
- Botkin,D.B.and Keller,E.A.(1998).Enviromental science.Earth as a living planet.2nd ed.Jonh wiley & sons Inc.,New York.pp645-648.
- Brassington K, Hough R, Paton G, Semple K, Risdon G, Croosley J, Hay I, Askari K, Pollard SJT (2007) *Crit Rev Env Science Technol* 37:199
- Bregnard T.P.A, Hohener P, Haner A & Zeyer J, 1996.Degradation of weathered diesel fuel by micro-organisms from a contaminated aquifer in aerobic and anaerobic microcosm. *Environ/ Toxicol Chem*. 15:299-307
- Budavari S,O'Neil MJ,Smith A,et al.,eds.1989.The Merck Index:An encyclopedia of chemicals,drugs,and biologicals.Rahway,NJ:Merck and Co.,Inc,4269.
- Carey, J.,Cook, P., Giesy, J., Hodson,P., Muir, D., Owens,W. & Solomon,K.(1998). Ecotoxicological risk assessment of the chlorinated Organic Chemicals.Pensacola:SETAC Press.375p..
- Chaloux N, Takada H, Baypna J.M (1995). Molecular markers in Tokyo Bay sediments-sources and distribution. *Marine Environmental Research*, Vol. 40, No 1, pp 77-92.
- Cheung,K .C and Wong,M.H.(2006).Risk assessment of heavy metal contamination in shrimp farming in Mai Po Nature Reserve,Hong Kong.*Environmental Geochemistry and health* 28(1-2):24-33
- Chen, B.,Xuan, X., Zhu, L., Wang, J., (2004) Distribution of polycyclic aromatic hydrocarbons in Surface waters,sediments and soils of Hangzhou city, China.*water research*.
- Coleman E, Munch J.W, Streicher R.P (1984). The identification and measurement of components in gasoline, kerosene, and No. 2 fuel oil that partitions into the aqueous phase after mixing. *Arch EnvContTox* 13:171-178.
- Cooper, J, Mattie D. (1996). Developmental toxicity of JP-8 jet fuel in the rat. *J ApplToxicol*, 16, 197-200
- Culotta,L.,De Stefano.c.,Gianguzza,A., Mannino,M.R.&Orecchio,S.(2006).The PAH composition of surface sediments from stagone coastal lagoon,Marsala (Italy).*Marine Chemistry* 99:117-127.
- Dahl A, Damon E, Mauderly J, Rothenberg S, Seller F, McClellan R (1988). Uptake of 19 hydrocarbon vapors inhaled by F344 rats, *Fundam Appl Toxicol*, 10, 262-269.
- De, A. (2003): *Environmental Chemistry*, 5th ed., New Age International Limited: New Delhi; p. 192. diesel fuel by microorganisms from a contaminated aquifer in aerobic and anaerobic microcosms. *Environ. Toxicol/ Chem*. 15:299-307.
- De Wit, C.A. (2002). An overview of brominated flame retardants in the environment.*Chemosphere* 46:583-624
- Doyle Jack, 1994. *Crude awakening: the oil mess in America*. Washington DC: Friends of the earth.
- Dragun J, (1988). Microbial degradation of petroleum products in soil. In: Calabrese E, Kostecki P, eds. *Soils contaminated by petroleum: Environmental and public health effects*. New York, NY: John Wiley and Sons, 289-298.
- E/ectrica/ Insuation Magazine* 29 (5) 13-25, <http://www.research.atet/ublication/257630457>
- Eide,1996. sign, statistics and interpretation of kinetics and possible interactions. *Arch Toxicol*, 70, 397-404