



ISSN: 0976-3376

Available Online at <http://www.journalajst.com>

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 11, Issue, 01, pp.10631-10633, January, 2020

RESEARCH ARTICLE

ORGANOCHLORINE PESTICIDE RESIDUES IN FIVE FISH SPECIES IN THE VICINITY OF LAKE CHAD, BAGA, NIGERIAN SECTOR

^{1,*}Jonathan, B.Y., ²Maina, H. M. and ²Barminas, J. T.

¹Federal College of Freshwater Fisheries Technology, Baga, PMB 1060, Maiduguri, Borno State

²Chemistry Department Modibbo Adama University of Technology, Yola, Adamawa State

ARTICLE INFO

Article History:

Received 25th October, 2019

Received in revised form

09th November, 2019

Accepted 27th December, 2019

Published online 30th January, 2020

Key words:

Organochlorine Pesticides,
Pollutants,
Water, Fish.

ABSTRACT

This study was carried out to determine the concentration levels of some Organochlorine Pesticides (OCPs), dichlorodiphenyltrichloroethane (DDT), isomers of hexachlorocyclohexane (HCH) (alpha, beta, and delta HCH), lindane, Endosulfan I, Endosulfan II, Endosulfan sulphate, dieldrin, Permethrin, Heptachlor, Lambda-cyhalothrin and aldrin, in five fish species (*Clarias gariepinus*, *Clarias anguillaris*, *Heterotis niloticus*, *Oreochromis niloticus*, and *Tilapia zillii*) in the vicinity of Lake Chad, Baga, Nigerian sector. The OCP residues were analyzed using Gas Chromatography. The concentrations of OCP residues in fish species ranged between Endrin (0.0003 mg/kg) in *T.zillii* at Dunmba I. to delta HCH (4.677 ± 0.05 mg/kg) observed in *T.zillii* at Dumba 2. The dominant pattern of OCP residues accumulated by fishes followed this order, delta HCH > Endrin > Endosulfan I > Permethrin > Endosulfan II. The accumulation pattern of OCP residues by the fishes was as follows *T.zillii* > *C.gariepinus* > *H. niloticus* > *C.anguillaris* > *O.niloticus*. The mean concentration levels of OCP residues in the fishes were within the permissible limits of FAO/WHO (2005).

Citation: Jonathan, B.Y., Maina, H. M. and Barminas, J. T. 2020. "Organochlorine Pesticide Residues in five Fish Species in the Vicinity of Lake Chad, Baga, Nigerian Sector.", *Asian Journal of Science and Technology*, 11, (01), 10631-10633.

Copyright © 2020, Jonathan et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Organochlorine pesticides (OCPs) are chlorinated hydrocarbon chemicals used widely to improve agricultural production and also to control or prevent pests. OCPs are characterized by low aqueous solubility and high lipid solubility, they are persistent in the environment and move long distances in surface water and ground water, and air. They have a potential for bioaccumulation in the food chain, the environment and in fish, posing a great threat to human health and the environment globally. (Afful et al., 2010; Guo et al., 2008; Matsumura, 1985). Fish absorbs OCPs by drinking water or by ingesting contaminated food. The excessive usage of OCPs is harmful to the ecosystem and that they contaminate soil, surface and underground water. OCPs are persistent organic pollutants, a class of chemicals known to break down very slowly and bioaccumulate in lipid rich fatty tissues of the body (Swackhammer and Hites, 1988). The adverse health effects of OCPs in humans, includes liver toxicity, neurological, reproductive and developmental effects. High doses can cause symptoms like vomiting, diarrhea, muscle weakness, blood disorders and immune deficiencies.

The Lake Chad basin is polluted by textiles and tanneries effluents in the upstream parts of the Basin and wastewater discharged from settlements along the Chari-Logone and Komadugu-Yobe River. The cotton industry in the Republic of Chad also uses large quantities of OCPs within the Republic of Chad and therefore contributes to the pollution of the Lake (Akan et al., 2014). The study area is Baga, the Nigerian sector of Lake Chad located in Kukawa Local Government area of Borno State, Nigeria. Baga lies on latitude 12° 55' N, and longitude 13° 35' E. The major economic activities of the population in Baga are agriculture, stock breeding and fishing. Fish species were collected between the months of March 2012, March 2013 and March 2014. The objective of this research work was to determine the concentration levels of OCP residues in Five Fish species in Lake Chad, Baga, Nigerian Sector.

MATERIALS AND METHODS

Sampling Sites and Sample Collection: Fish samples were collected from two sampling sites, Dumba 1 and Dumba 2, Lake Chad, Baga, Nigerian Sector. Five species of fish *Clarias anguillaris*, *Clarias gariepinus*, *Heterotis niloticus*, *Tilapia zillii* and *Oreochromis niloticus* were randomly caught by the local fishermen using gill nets and Malian traps, and they were

*Corresponding author: Jonathan, B.Y.,

Federal College of Freshwater Fisheries Technology, Baga, PMB 1060, Maiduguri, Borno State.

transported to the laboratory in a plastic bag for further analysis. (Ozturk et al., 2009). Approximately 10 samples of each fish species were caught.

Sample Preparations: Fish samples were washed with distilled water in the laboratory and, scales of *H. niloticus*, *T. zilli* and *O. Niloticus* were removed. The muscle tissues of the fish samples were removed and were oven-dried at 105°C to a constant weight and were ground to powder in a mortar to obtain a homogenous composite. OCP residues in fish samples were extracted using Soxhlet Extraction (Öztürük et al., 2009).

Fish Samples Extraction for OCP Residues Analysis: A 10 g sample of each fish species were placed into a beaker containing 50 g anhydrous sodium sulfate and mixed thoroughly. The sample mixture for each fish species was transferred into an extraction thimble and placed in a Soxhlet extractor. The mixture for each fish species were extracted with 150 ml of acetone: n-hexane (20:80 v/v) at 50°C for 4 hours. (Therdteppitak and Yammeng, 2003). The extracts for each fish species were filtered, concentrated to 1 ml using vacuum rotary evaporator. Each of the raw extracts was then dissolved in 10 ml hexane and passed through pre-conditioned octadecyl C-18 columns at a rate of 2 ml min⁻¹ to clean up.

The column was washed with 1 ml, 30% methanol followed by 1 ml ultrapure water and was allowed to dry. The sample (analyte) which was trapped in the column was eluted 5 times with 0.5 ml aliquots of hexane to recover the OCP residues. Hexane in the sample was then allowed to evaporate off leaving the residue alone in the vial. The dried sample was dissolved in 1 cm³ portion of n-hexane containing 1 mg/L aldrin as internal standard mixed thoroughly with a whirl mixer. 1 µl of each final residue solution were injected onto the Gas Chromatography (GC) at flow rate of 1 cm³/min (Darkoet al., 2008).

RESULTS

The mean concentration of OCPs, in the muscular tissues of fishes ranged between alpha HCH 0.763 ± 0.02 to 0.775 ± 0.02 mg/kg; beta HCH 0.0273 to 0.578 ± 0.01 mg/kg; delta HCH 0.0017 to 4.667 ± 0.05 mg/kg; Lindane 1.011 ± 0.05 mg/kg; Heptachlor 0.0005 to 0.657 ± 0.05 mg/kg; Aldrin 0.0033 mg/kg; Endosulfan I 0.0051 to 2.13.5 ± 0.05 mg/kg; Dieldrin 0.105 ± 0.01 mg/kg; Endrin 0.0003 to 3.079 ± 0.05 mg/kg; Endosulfan II 0.019 to 1.117 ± 0.05 mg/kg; P' DDD 0.0077 mg/kg; Endosulfan sulphate 0.104 ± 0.01 to 0.735 ± 0.02 mg/kg; P' DDT 0.0225 to 0.300 ± 0.01 mg/kg; Permethrin

Table 1. Mean Concentration of OCPs (mg/kg) in Muscle Tissues of Five Fishes from Dumba 1, Lake Chad, Nigerian Sector

Organochlorine Pesticides	Fish Species				
	<i>C. anguillaris</i>	<i>C. gariepinus</i>	<i>H. niloticus</i>	<i>O. niloticus</i>	<i>T. zillii</i>
beta HCH	0.0579	<5x10 ⁻⁵	0.0273	0.578 ± 0.01	0.0618
Lindane	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	1.011 ± 0.05	<5x10 ⁻⁵
delta HCH	0.0017	2.0660 ± 0.02	<5x10 ⁻⁵	0.0360	0.0031
Heptachlor	0.0005	0.657 ± 0.05	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Aldrin	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	0.0033
Endosulfan I	0.0166	<5x10 ⁻⁵	0.007	0.114 ± 0.02	0.0051
Dieldrin	<5x10 ⁻⁵	0.105 ± 0.01	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Endrin	<5x10 ⁻⁵	2.910 ± 0.05	0.0173	0.835 ± 0.02	0.0003
Endosulfan II	0.0555	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
P' DDD	0.0077	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Endosulfan Sulphate	0.0478	0.182 ± 0.02	<5x10 ⁻⁵	<5x10 ⁻⁵	0.0088
P' DDT	0.0746	0.0510	0.0225	0.30 ± 0.01	<5x10 ⁻⁵
Lambda-cyhalothrin	0.0310	<5x10 ⁻⁵	0.0061	0.134 ± 0.01	0.0033
Permethrin	1.2715 ± 0.05	<5x10 ⁻⁵	0.1787 ± 0.02	<5x10 ⁻⁵	<5x10 ⁻⁵

<5x10⁻⁵: less than detection limit

Values are Mean ± Standard Deviation

Table 2. Mean Concentrations of OCPs (mg/kg) in Muscle tissues of five fishes from Dumba 2, Lake Chad, and Nigerian Sector

Organochlorine Pesticides	Fish Species				
	<i>C. anguillaris</i>	<i>C. gariepinus</i>	<i>H. niloticus</i>	<i>O. niloticus</i>	<i>T. zillii</i>
alpha HCH	0.763 ± 0.02	<5x10 ⁻⁵	0.775 ± 0.02	<5x10 ⁻⁵	<5x10 ⁻⁵
beta HCH	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Lindane	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
delta HCH	1.865 ± 0.05	1.997 ± 0.05	1.478 ± 0.05	<10 ⁻⁵	4.677 ± 0.05
Heptachlor	0.018	0.466	0.274 ± 0.01	<10 ⁻⁵	0.264 ± 0.02
Aldrin	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Endosulfan I	<5x10 ⁻⁵	0.120	2.135 ± 0.05	0.422 ± 0.02	0.725 ± 0.05
Dieldrin	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Endrin	<5x10 ⁻⁵	3.079 ± 0.05	0.394 ± 0.02	<5x10 ⁻⁵	2.318 ± 0.20
Endosulfan II	0.150 ± 0.01	<5x10 ⁻⁵	0.019	<5x10 ⁻⁵	1.117 ± 0.05
P' DDD	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵
Endosulfan Sulphate	0.104 ± 0.01	<5x10 ⁻⁵	0.518 ± 0.02	0.270 ± 0.02	0.735 ± 0.02
P' DDT	<5x10 ⁻⁵	0.057	0.082	0.044	0.042
Lambda-cyhalothrin	<5x10 ⁻⁵	<5x10 ⁻⁵	0.272 ± 0.02	0.329 ± 0.02	0.026
Permethrin	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵	<5x10 ⁻⁵

<5x10⁻⁵: less than detection limit

Values are Mean ± Standard Deviation

0.1787 ± 0.02 to 1.27.5 ± 0.05 mg/kg (Tables 1 and 2). Delta HCH showed a maximum concentration of 4.677 ± 0.05 mg/kg, observed in *T.zillii*, at Dumba 2, Endrin (3.079 ± 0.05) in *C. gariepinus* at Dumba 2 (Table 2) and a minimum concentration, Endrin 0.0003 mg/kg in *T.zillii* at Dunmba I (Table 1). In Tables 1 and 2, lindane, Aldrin, Dieldrin, P' DDD, Endosulfan II and Permethrin, and beta HCH in Table 2 only, are less than the detection limit (<5x10⁻⁵).

DISCUSSION

In this study, delta HCH was indicated the most abundant OCP residues in fish sample. delta HCH accumulation was the highest and that it was observed in *T.zillii*, at Dumba 2, while the lowest value was Endrin observed in *T.zillii* at Dunmba I. Isomers of HCH are used commercially as an insecticide on fruits, vegetables, forest crops, and animals (ATSDR, 2005a). The differences in feeding habits, metabolic capacity and trophic position explains most of the variations in OCPs levels between the different fish species. The possible reasons for the presence of high level of delta HCHs in the fish samples may be due to its current usage in vector control. In spite of the adverse side effect of pesticides, OCPs constitute a necessary part of modern agriculture due to its increase in food supply, low cost and versatility in industry, agriculture and public health (Tanabe *et al.*, 1994). Organochlorine pesticides tend to accumulate in living organisms especially in aquatic organisms such as fish species and they substantially settle on the sediments. The dominant pattern of OCP residues accumulated by fishes followed this order, delta HCH > Endosulfansulphate > Aldrin. The accumulation pattern of OCP residues by the fishes was as follows *T.zillii* > *C.gariepinus* > *H. niloticus* > *O.niloticus* > *C.anguillaris*.

The presence of higher levels of OCP residues in fishes could be attributed to the sprays of pesticides from the large farm lands around Lake Chad which have sharp slopes toward the sampling sites of the Lake, so, OCP residues can enter into them more easily. It could also be due to the fact that OCPs are highly soluble in fatty tissues of fishes. The results of this research work are in agreement with Akan *et al.*, 2014. The concentration levels of OCP residues in the fishes were within the permissible limits of FAO/WHO, 2005.

Conclusion

Delta HCH was the most abundant OCP residue in the muscular tissues of the fish species studied. The concentration levels of OCP residues in the fishes were within the permissible limits of FAO/WHO, 2005. The presence of OCPs in the fish samples indicates that farmers within the study area use OCPs for pest control. Therefore, there is the need to check the use of OCPs to control pest by farmers with little or no knowledge of the adverse effects of pesticides.

Acknowledgement

I am obligated to Prof. H.M Maina, Prof. J.T Barminas of Chemistry Department Modibbo Adama University of Technology, Yola, Adamawa State and Dr (Mrs.)

Rose Obande for their guidance and advice. Thank you very much. I am highly grateful for their help and consistent confidence in me in the course of this research work. Special thanks to the laboratory technologist of National Agency for Food and Drug Administration and Control (NAFDAC) Lagos, for analyzing the samples.

REFERENCES

- Afful, S., A.K. Anim and Y. Serfor-Armah, 2010. Spectrum of Organochlorine Pesticide Residues in fish samples from the Densu Basin. *Res. J. Environ. Earth Sci.*, 2(3): 133-138.
- Agency for Toxic Substances and Disease Registry (ATSDR) 2005a. Toxicological Profile for Hexachlorocyclohexane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
- Akan, J. C., Abdulrahman, F. I., and Z. M. Chellube, 2014. Organochlorine and Organo phosphorus Pesticide Residues in Fish Samples from Lake Chad, Baga, North Eastern Nigeria. *Int'l Jour. of Innovation, Manag. and Techno*, Vol.5 (2) 2014
- Darko, G., O. Akoto and C. Opong 2008. Persistent Organochlorines Pesticide residues in fish, sediment and water from Lake 'Uisomtwi, Ghana. *Chemo*. 92(1): 21-24
- Food and Agriculture Organisation of the United Nations (2005), *International Code of Conduct on the Distribution and Use of Pesticides*. 10-25
- Guo, Y., X.Z. Meng, H.L. Tang and E.Y. Zeng, 2008. Tissue distribution of Organochlorine Pesticides in fish collected from the Pearl River delta, China: Implications for fishery input source and bioaccumulation. *Environ. Pollut.*, 155: 150-156.
- Matsumura, F. 1985. Toxicology of Insecticides. 2 Edition. Phenum Press, New York
- Öztürk, M., Ozozen, G., Minareci, O and Minareci, E. 2009. Determination of Heavy Metals in fish. Water and Sediments of Avsar Dam Lake in Turkey, *Health Sci. Eng.* 6(2): 73-80.
- Swackhamer, O and Hites, R.A. 1988. Occurrence and bioaccumulation of Organochlorine compounds in fish from Siskiwit lake, Isle Royale, Lake Superior. *Environ Sci Technol* 22:543-548.
- Tanabe, S., Iwata, H. and Tatsukawa, R. 1994. Global contamination by persistent organochlorines and their ecotoxicological impact on marine mammals, *Science of the total Environment*, vol. 154(2-3) pp. 163-177.
- Therdteppitak, A. and K. Yammeng 2003. Discrimination of Organochlorines Pesticides in commercial fish by gas chromatography with electron capture detector and confirmation by gas chromatography-mass spectroscopy. *Sci. Asia*. 29: 127-134.
- World Health Organization 1989. DDT and its derivatives-environmental aspects. Environmental Health criteria 83 WHO, Geneva pp12