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Effect of an insecticide cypermethrin on Tilapia Fish (*Oreochromis niloticus*) Fingerlings

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Abstract:

From this study it is clear that the protein (%) in muscles of O. niloticus exposed to Cypermethrin decreases with increasing the duration of the experiment, this is true for Fe and Co and that of control, while Cd shows no significant change. For control the Fe content (mg\L) was 0.17 while for Cd and Co they did not detected.

Key words: Cypermethrin, *Oreochromis niloticus*, insecticide, protein, minerals.

Introduction:

In recent years, the high rate of increase in human population and rapid pace of industrialization have created problem of disposal of waste waters. The domestic wastes and untreated or partially treated industrial effluents, supplemented with pollutants like heavy metals, pesticides and many organic compounds, have greatly contributed to massive fish death of aquatic ecosystems. These toxic chemicals and metals have changed the quality of water that affect the fish and other aquatic organisms (Dhasarathan *et al* 2000), (Pazhanisamy, and Indra. 2007).

Cypermethrin is widely used against pests all over the world to increase the production of food grains and other agricultural-products, (Usmani and Knowles, 2001) and there is increased risk of food being contaminated with the insecticide, which may harm humans and domesticated animals. Cypermethrin produces drastic effects on both the invertebrates and vertebrates (Das and Mukherjee, 2003).

Objective of the study:

The aim of this study is to assess the effects of cypermethrin on the Nile Tilapia, *Oreochromis niloticus*.The effect was assessed on the basis of the results of sublethal toxicity tests,(0.00125 mol) and comparison the results of protein, ferrous , cadmium and cobalt.

Literature Review:

Today, water quality management faces greater problems than at any time in its history. In addition to natural pollutants, varied contaminants exist in surface waters including multiple chemical compounds and different products of industrial and agricultural revolution. The insecticides constitute one group of these pollutants, both synthetic and natural, which contribute to the environmental problems. At present, it seems that the problem is more conspicuous in developing countries, where lately there has been an increase in the use of insecticides as a means of increasing agricultural productivity, without much concern to the consequences of indiscriminate application. There are many pathways by which insecticides leave their sites of application and distribute throughout the environment and enter the aquatic ecosystem. The major route of insecticides to water ecosystems in urban areas is through rainfall runoff and atmospheric deposition. Another resource of water contamination by insecticides is from municipal and industrial dischargers. Most insecticides ultimately find their way into rivers, lakes and ponds (Tarahi Tabrizi, 2001); (Honarpajouh, 2003); (Bagheri, 2007); (Shayeghi, M. Darabi, H. Abtahi, H. *et al.*, 2007); (Vryzas, Z. Vassiliou, G. Alexoudis, C *et al.*, 2009); (Werimo *et al.*, 2009); (Arjmandi *et al.*, 2010) have been found to be highly toxic to non-target organisms that inhabit natural environments close to agricultural fields. The contamination of surface waters by insecticides is known to have ill effects on the growth, survival and reproduction of aquatic animals. In the past few years, the increase of mortality among the fish in various streams, lakes and ponds around the world has drawn scholars' attention to the problems caused by insecticides and pesticides runoff associated with intense agricultural practices. Different concentrations of insecticides are present in many types of wastewater and numerous studies have found them to be toxic to aquatic organisms especially fish species (Talebi, 1998); (Banaee, M.; Mirvagefei, A. R.; Rafei, G. R. *et al.*, 2008). Fishes are particularly sensitive to the environmental contamination of water. Hence, pollutants such as insecticides may significantly damage certain physiological and biochemical processes when they enter into the organs of fishes (John, 2007); (Banaee, M. Mirvaghefei, A. R. Majazi Amiri, B. *et al.*, 2011). Authors found out that different kinds of insecticides can cause serious impairment to physiological and health status of fishes (Begum, 2004); (Monteiro, D.A. Alves de Almeida, J. Rantin, F.T. *et al.*, 2006); (Siang *et al.*, 2007);(Banaee, M. Mirvaghefi, A.R. Ahmadi, K. *et al.*, 2009).Since fishes are important sources of proteins and lipids for humans and domestic animals, so health of fishes is very important for human beings. Recently, many studies have been conducted to determine the mechanisms of insecticides in fishes, with the ultimate goal of monitoring, controlling and possibly intervening in xenobiotics exposure and its effects on the aquatic ecosystem. The information given in this study facilitates the evaluation of potential toxic hazard resulting from exposure to this insecticide.

Nutritive value of fish:

Fish provides a good source of protein and essential micronutrients. Studies on the nutritive value of fish have great importance as they have a direct impact on human health, In addition to its vital roles in solving the problems of protein deficiency malnutrition and to overcome increasing demand for animal protein source (Munro, 1975).

Protein content of fish flesh does not show any regular cycle throughout the year (Love, 1960). (Geiger and Borgstrom 1962) noticed an inverse relationship between protein and fat contents, and recorded that moisture content and the relative size of the fish are factors affecting the protein content. They also determined the range of protein in fish flesh between 30 – 90 % of the dry weight.

Moisture content of fish body does not seem to be constant in view of the inter–relationship with many biological and physiological factors. Variations coincide with the spawning season were mentioned by (Love 1960).

Fat content shows a wide range of variations exemplified by decreases in times of food scarcity indicated by (Love, 1960).

Materials and Methods:

The fish used was *Oreochromis. niloticus* supplied from Fisheries Research Center at Al-Shagara 10 km South of Khartoum. The experiment was carried out in the laboratory of Fisheries Research Center, where a series of glass aquaria measuring 80cm X30cmX35cm fitted with the necessary aeration facilities and tubing for siphoning were used. Adequate light and room temperature were maintained.

The aquarium was stocked with 10 fry and their length range was 10-12cm,and weight range was 40- 50g.

Fishes were acclimatized in laboratory condition, for 7 days fed with wheat bran and procedure for toxicity was done. After that fishes were exposed to sublethal concentration of cypermethrim (0.00625 ul/lit) at 24, 48, 72, and 96 hours.The fishes were sacrified and fresh(wet) tissues of muscle were isolated for total protein and minerals determination.

Protein content:

Protein content was determined by the Micro – Kjeldahl method, and applying the factor 6.25 to the nitrogen content of the sample, as described by (AOAC 1990). The protein percentage was given by the following formula:

$$\text{Protein \%} = \frac{(V_2 - V_1) \text{ X N X } 14}{1000 \text{ X Wt.}} \text{ X } 100 \text{ X } 6.25$$

Where:

V_1 = Volume of HCl used in titration.

V_2 = Volume of HCl used in blank titration.

N = Normality of HCL used in titration.

14/1000 = Conversion ratio from ammonium sulphate to nitrogen.

Wt. = Weight of sample.

6.25 = Conversion factor from nitrogen to protein.

Minerals content:

Minerals were determined by further analysis of ash following the method described by (Koddebush 1988).

In another aquarium fishes of the same length were kept and fed wheat bran, this aquarium was kept as control.

Results:

The parameters used include: protein, and some minerals namely: ferrous, cadmium, and cobalt. The results for protein obtained were illustrated in table (1) and Figure (1).For minerals the results are shown in table(2) and figures (2,3, and 4).

Table (1) Mean protein values of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin at different times intervals.

Time	24 Hrs	48 Hrs	72 Hrs	96 Hrs
Mean Protein	23.04	22.75	19.54	24.21
Control	24.50	16.63	22.75	

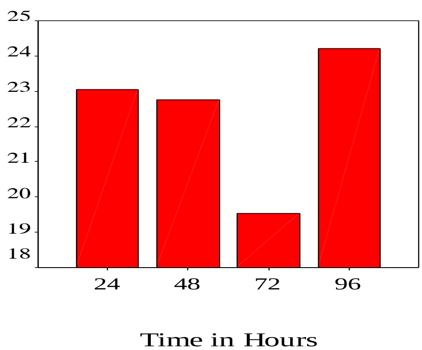

Figure (1) Mean protein values in muscles of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin to different time intervals.

From table (1) and figure (1) it is clear that protein content decreases with increasing the duration of the experiment, and this is in agreement with that of (Tantarpale 2011), who studied the impact of cypermethrin on total protein in muscle and liver of freshwater fish *Channa striatus*.

The present study is coincides with the reported data that the protein content was decreased in liver, by (Vasantharaja et al 2012),who studied the acute toxicity of cypermethrin on the fresh water fish *Cirrhinus mrigala*. For control the protein decreases with increasing time duration.

Table (2) Minerals values of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin at different times intervals.

Minerals\Time	24Hrs	48Hrs	72Hrs	96Hrs.	Control
Fe (mg\L)	0.26	0.16	0.30	0.21	0.17
Cd (mg\L)	0.01	0.01	0.01	0.01	ND
Co (mg\L)	0.02	0.01	0.01	0.01	ND

(ND means Not detected).

From table (2), it is clear that (Fe) decreases with increasing the duration of the experiment, while (Cd) shows no significant change, (Co) decreases with increasing time duration. while for control the minerals (Fe) value was 0.17 while for (Cd) and (Co) they did not detected.

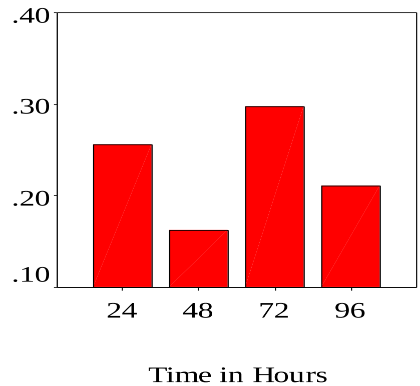

Figure (2) Mean Fe values in muscles of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin to different time intervals.

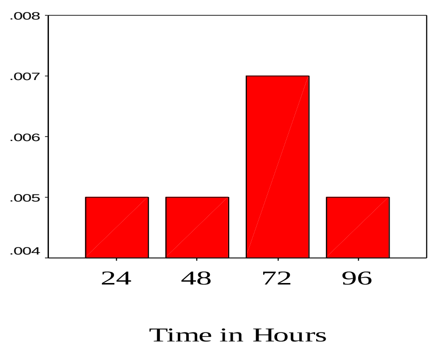

Figure (3) Mean Cd values in muscles of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin to different time intervals.

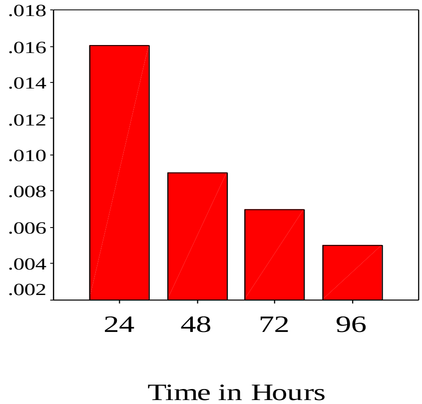

Figure (4) Mean Co values in muscles of *O. niloticus* exposed to 0.0065mol concentration of cypermethrin to different time intervals.

Discussion and conclusion:

The developing countries of the world are facing a global challenge of feeding their explosively growing population. At the same time, the pests are becoming one of the major causes of pre and post-harvest loses of crops. The different types of broad-spectrum, effective pesticides have been invented as a solution to this pest problem. However, Among these, the pyrethroid group of insecticides are commonly being used. This study describes only one pyrethroid insecticides namely cypermethrin, which is extensively being used in different indoor and outdoor applications in order to kill the insects-pests.

Water pollution is a major problem of this century and addition of pollutants changes the natural qualities of water (Voltz *et al;* 2005). Pesticides are known to contaminate a number of inland water bodies closer to areas of pesticide applications. Although pesticides are needed for the management of pests, their harmful effects on non-target organisms cannot be ignored. Pesticides leave residues in water and mud even several days after being sprayed in the adjacent crop fields. Pesticides affect growth and nutritional value of fish, when their concentration in water exceeds the critical maximum limit (Arunachalam *et al;* 1980). There productive potential of fish is affected, when reared in water containing pesticide residues (Moore and Waring, 2001). (Abhilash and Prakasam 2005) reported alterations in the cellular morphology of pesticide treated fish. The physiological functions of fish get altered upon exposure to different pesticide concentrations (Gupta and Saxena, 2006).(Marigoudar *et al.* 2009) reported changes in the behavioural responses of fishes when exposed to pesticides beyond the maximum tolerance level.

Cypermethrin is an important insecticide in agriculture, its toxicity to aquatic fish has been ascertain as a result of flow from agricultural land near aquatic rivers or lake because of irrigational farming. The evidence of effect on some biochemical parameter in the blood and organs of the fish should make us reduce it incidences into aquatic bodies, (Ojutiku *et al* 2013).

This is in agreement with this study and that of (El-Nemaki *et al* 2008) who studied the impact of water resources on tilapia production at El-Abbassa fish farm in Egypt , and their study concerned some heavy metals (Fe,Cu,Zn,Cd, and Pb) From their study it is clear that the concentrations of heavy metals (Fe, Cu, Zn, Cd and pb) were higher in the ponds received agriculture drainage water compared with those received irrigation water. Their study revealed that the agriculture drainage water had higher phytoplankton density and higher pH value (9.25) and this decrease the heavy metals toxicity. (Malcolm, 1995) stated that the toxicity of heavy metals is usually reduced as pH increase because at higher pH the metals bind to form hydroxide and carbonate complexes which are considered less toxic to fish than the metal ions. Also, (Saleh, 1988) found that the concentrations of heavy metals in plankton were 1000 to 4000 times higher than those in water. The results agree with (Saeed, 2000) who stated that the agriculture drainage water usually contains higher Fe level than the irrigation water.

The values of heavy metals (Fe, Cu, Zn, Cd and pb) in fish muscle from ponds that received irrigation water were higher compared to those that received agriculture drainage water. Although the ponds with irrigation water contain lower concentration of heavy metals than those received agriculture drainage water. Their results might be related to the higher density of phytoplankton in the agriculture drainage water. (Voight, 2003) and (kucuksezgin et al., 2006) stated that phytoplankton occurred in the ecosystem could absorb and accumulate heavy metals. It is noticed that the heavy metals accumulation in liver was higher than that deposed in muscles.Bioaccumulation in liver may be because liver being the responsible organ in controlling the toxicity of heavy metals. Similar results were obtained by (Benson et al. ,2006) and (Ali,2007). They also agree with (Elnemaki and Badawy, 2005 & 2006) who found out that Fe, Cu, Zn and pb concentrations in the carp and mullet liver were higher than those in the fish muscles. The previous investigations reported negative correlation between the heavy metals concentration and the phytoplankton density in water, and this agreed with their results.

REFERENCES:

Abhilash, R. and Prakasam, V.R (2005), Toxic,physico-morphological and behavioural responses of *Oreochromis mossambicus* exposed to commercial grade endosulfan. Environment Ecology, 54(2), pp. 234-238.

Ali, A. N. (2007). Ecological study on some water characteristics used in fish farms and their relation to fish productivity. Ph. D. Thesis. Al-Azhar Unive. Fac Sci. Chemistry dept. Egypt.

AOAC (1990). Official methods of analysis 14th edition. Association of American Analytical chemist, Washington D.C U.S.A.

Arjmandi, R.Tavakol, M. and Shayeghi, M. (2010). Determination of organophosphorus insecticide residues in the rice paddies. International Journal Environmental Science Technology, 7 (1): 175-182.

Arunachalam, S., Jeyalakshmi, K.and Aboubucker.S (1980), Toxic and sublethal effects of carbaryl on a fresh water Cat fish, *Mystus vittatus*. Archives ofEnvironmental Contamination Toxicology, 9, pp. 307- 316.

Bagheri, F. (2007) Study of pesticide residues (Diazinon, Azinphosmethyl) in the rivers of Golestan province (Gorgan Roud and Gharehsou), M.Sc. Thesis, Tehran University of Medical Science. Tehran, Iran, 1-125.

Banaee, M.; Mirvagefei, A. R.; Rafei, G. R. and Majazi Amiri, B. (2008). Effect of sublethal diazinon concentrations on blood plasma biochemistry. International *Jounal Environmental Research*, 2(2):189-198.

Banaee, M. Mirvaghefi, A.R. Ahmadi, K. and Ashori, R. (2009). The effect of diazinon on histophatological changes of testis and ovaries of common carp (*Cyprinus carpio*).Scientific Journal of Marine Biology, 1(2): 25-35.

Banaee, M. Mirvaghefei, A. R. Majazi Amiri, B. Rafei, G.R. and Nematdost, B. (2011).Hematological and Histopathological Study of Experimental Diazinon Poisoning in common carp fish (*Cyprinus carpio*). Journal of Fisheries (Iranian Journal of Natural Resources), 64(1): 1-14.

Begum, G. (2004). Carbofuran insecticide induced biochemical alterations in liver and muscle tissues of the fish *Clarias batrachus* (linn) and recovery response. Aquatic Toxicology, 66: 83–92.

Benson, N. U., M. U. Etesin, J. P. Essien, I. U. Umoren and M. A. Umoh. (2006). Tissue elemental levels in fin-fishes from Imo river system, Nigeria: assessment of liver/muscle concentrations ratio. J. Fisheries and Aquatic Sci. 1 (3. 277-283).

Das, B.K and Mukherjee, S.C (2003). Toxicity of cypermethrin in Labeorohita fingerlings: Biochemicalmenzymatic and haematological consequences.comp.Biochem.Physiol., 134(C):109-121.

Dhasarathan. P., Palaniappan, R. and Ranjit Singh, A.J.A. (2000) Effect of endosulfan and butachlor on the digestive enzyme and proximate composition of the fish, *cyprinus carpio Indian J. Environ. And Ecoplan.,* 3(3):611-614

El nemeki, F. A and T. E. Badawy. (2006). Impact of different water resources and seasonal variations on the heavy metals concentration in Grass carp. Ctenopharyngod on idella. African. J. Biol Sci. 2. 2:67-74.

El nemeki, F. A and T. E. Badawy.(2005). Effect of water quality and seasonal variations on heavy metals concentrations in Mugil cephalus tissues, at El-Abbassa fish farm Egypt. Ain shams Science. Bulletin.43:33-44.

EL-Nemaki,F.A., Nema A. Ali, Mohamed M. Zeinhom and Olfat A. Radwan (2008) Impacts of different water resources on the ecological parameters and the quality of tilapia production at EL-Abbassa fish farms in Egypt. 8th International Symposium on Tilapia in Aquaculture 2008.

Geiger, E. and Borgstrom, G. (1962). Fish Protein Nutritive Aspects. Chap. 2 in Borgstrom, G. (ed.) "Fish as Food" Vol. II, Academic Press. New York, San Francisco and London pp. 29–114.

Gupta,P. and Saxena, P.G (2006), biochemical and haematological studies in freshwater fish *Channa Punctatus* exposed to synthetic pyrethroids. Pollution Research, 25(3), pp. 499-502.

Honarpajouh, K. (2003). Study and Identification of OP pesticides residues (Azinphosmethyl and Diazinon) in the Mahabad and Siminerood Rivers, M.Sc. Thesis, Tehran University of Medical Science. Tehran, Iran, pp. 95.

John, P.J. (2007). Alteration of certain blood parameters of freshwater teleost *Mystus vittatus* after chronic exposure to metasystox and sevin. Fish Physiology Biochemistry, 33:15-20.

Koddebush, L. (1988). Investigations on the Utilization of Different Sources of Phosphorus by Lactating Goats. Ph. D. Thesis, University of Bonn, Germany.

Kucuksezgin, F., A. Kontas, O. Alto, E. Uluturham and E. Darilmaz. (2006). Assessment of marine pollution in Izmir bay. Nutrient, heavy metal and total hydrocarbon concentrations. Environ. Int. 32: 41-51.

Love, R. M. (1960). Water Content of Cod *Gadus callarius* (L.) Muscle. Nature 185: pp. 692.

http://www.intechopen.com/books/insecticides-basic-and-other-applications/adverse-effect-ofinsecticides-on-various-aspects-of-fish-s-biology-and-physiology

Malcolm, J. (1995). Text book of environmental biology of fishes. First edition. Printed in Great Britain by T. J. Press (Padstow) LTD. Padstow. Cornwall.

Marigoudar, S.R; Ahmed, R.N. and David, M (2009), impact of Cypermethrin onbehavioural responses in the fresh water teleost, *Labeo rohita* Hamilton. World Journal of Zoology, 4 (1), pp. 19-23.

Monteiro, D.A. Alves de Almeida, J. Rantin, F.T. and Kalinin, A.L. (2006). Oxidative stress biomarkers in the freshwater characid fish, *Brycon cephalus*, exposed to organophosphorus insecticide Folisuper 600 (methyl parathion). Comparative Biochemistry and Physiology, Part C 143: 141–149.

Moore, A. and Waring, C.P (2001), the effect of a synthetic pyrethroid pesticide onsome aspects of reproduction in Atlantic salmon *Salmo salar* L. Aquatic Toxicology,52 (1), pp. 1-12.

Munro, H. (1975). Impact of Nutritional Research on Human Health and Survival. In Labuza, T. P. (ed.) "The Nutrition Crisis" West Publishing Co. USA.

Ojutiku,R.O. F.P Asuwaju I.O Ayanda R.A Obande and O.O Agbelege (2013). Effect of Acute Toxicity of Cypermethrin on Some biochemical Parameters of Juveniles of *Claria Gariepinus*. (Burchell, 1822) *International Journal of Engineering Science Invention, Volume 2 Issue 3 PP.01-07*

Pazhanisamy, K and N. Indra. (2007). Toxic effects of arsenic on protein content in the fish, Labeo rohita (Hamilton). *Nature Environment and pollution Technology* 6(1): 113-116.

Saeed, M. S. (2000). A study on factors affecting fish production from certain fish farms in the delta. M. Sc. Thesis. Ins. Environmental studies and Research. Ain Shams Univ. Egypt

Saleh, M. A., A. S. Mostafa, M. F. Mostafa, A. S. Magdi, S. A. L. Mohamed and L. W. Bobby .(1988). Inorganic pollution of man-made lakes of Wadi El-Raiyan and its impact on aquaculture and wildlife of the surrounding Egyptian desert. Arch. Environ. Contam. Toxicol. 17: 391- 403.

Shayeghi, M. Darabi, H. Abtahi, H. Sadeghi, M. Pakbaz, F. and Golestaneh., S.R. (2007).Assessment of persistence and residue of diazinon and malathion in three Rivers (Mond, Shahpour and Dalaky) of Bushehr province in 2004-2005 years. Iranian South Medical Journals 10(1) 54-60.

Siang, H.Y. Yee, L.M. and Seng, C.T. (2007). Acute toxicity of organochlorine insecticide endosulfan and its effect on behaviour and some hematological parameters of Asian swamp eel (*Monopterus albus*, Zuiew). Pesticide Biochemistry and Physiology, 89: 46–53.

Talebi, K. (1998). Diazinon Residues in the Basins of Anzali Lagoon, Iran. Bulletin Environmental Contamination Toxicology, 61: 477-483.

Tantarpale, S.A.(2011). Cypermethrin impact on total protein in muscle and liver of the freshwater fish *Channa striatus. Science Research Reporter* 1(3):155-158

Tarahi Tabrizi, S. (2001). Study of pesticide residues (diazinon, malathion, metasytoux) in the Tabriz Nahand River, M.Sc. Thesis, Tehran University of Medical Science, Tehran, Iran, 1-88.

Usmani, K.A and C.O. Knowles,(2001). Toxicity of pyrethroids and effect of synergists to:larval and adult HelicoverpaZea, Spodopterafrugiperda, and Agrotis ipsilon (Lepidoptera Noctuidae). *J. Econ.Entomol.*, 94: 868–73.

Vasantharaja,C. K. Pugazhendy, S. Venkatesan, M.Meenambal, S.and

Voight, R. H. (2003). Concentrations of mercury and cadmium in some coastal fishes from the Fumash and Estman parts of the Gulf of Finland. Proceeding of Estonian Acad. Sci. Biol. Ecol. 52: 305-318.,

Voltz, M; Louchart, X; Andrieux, P. and Lennartz, B (2005), process of water contamination by pesticides at catchment scale in mediteranean areas. Geophysical Research, 7, pp.10634.

Vryzas, Z. Vassiliou, G. Alexoudis, C. and Papadopoulou-Mourkidou, E. (2009). Spatial and temporal distribution of pesticide residues in surface waters in northeastern Greece. Water Research, 43: 1-10.

Werimo, K. Bergwerff, A.A. and Seinen, W. (2009). Residue levels of organochlorines and organophosphates in water, fish and sediments from Lake Victoria-Kenyan portion. Aquatic Ecosystem Health & Management 12 337-341.