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TOXICITY OF THE PYRETHROID INSECTICIDE DECAMETRIN AND FENVALERATE TO A FRESH WATER FISH CLARIAS LAZERA

1- *Effect of Decamethrin and Fenvalerate on the Weights of the body, liver, spleen and gonads, and bioaccumulation of pyrethroid in the major organs*

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ABSTRACT

The Present study represented the effect of both insecticides Decamethrin and Fenvalerate on the weight of total body and the major organs. The two pyrethroids lead to general decrease in body weight, but the percentage of loss appear more pronounced with Fenvalerate especially with the high concentration.

The decrease in the body weight was accompanied by reduction in weights of liver, testis and ovaries. Spleen was not affected by different concentrations of both insecticides used.

The distribution and accumulation of both pyrethoids were studied in the tissues of liver, gonads, gills, intestine, kidney, muscles and spleen.

The present investigation showed that fenvalerate tended to accumulate in the different tissues more than Decomethrin. Moreover the intensity of accumulation of insecticide in most of the tissues studied depended on the dose used. The study clarified that bioaccumulation of decamethrin and Fenvalerate occured in the following order: liver, gonads, gills, intestine, kidney and the lowest values were noticed in the muscles and spleen.

INTRODUCTION

As human populations multiply and industrialization increase and diversifies, the problems of pollution of the environment become more critical, especially those related to water pollution.

Pesticides are considered as one of the most dangerous pollution groups in different environments. Now a days, pyrethroid replaces organophosphorous, organochlorine and carbamate insecticides. Structures similar to the naturally occuring pyrethrin, have been synthesized (Casida, 1973). These pyrethroids, have proved to be more toxic to insects, more stable, and more species - specific than natural pyrethrins (Nishizawa, 1971 and Abernathy & Casida, 1973).

Studies have been undertaken to define the biochemical consequencies of pyrethroid action on the nervous system (Aldridge et al., 1978). The pattern of motor symptoms was studied by Ray (1980).

Pyrethroid retained in the soil may become available to fish through the food chain or directly from the water sources. Brabury et al (1987), studied the effect of pyrethroid insecticide (fenvalerate on Salmo - gairdneri) and suggested that pyrethroid effects, on nervous system, respiratory surfaces and blood chemistry.

Hassan et al (1988) studied the effect of organophosphorus (Dimethoate) and pyrethroid decamethrin pesticides on plasma levels of cortisol and thryoxine and on some hematological parameteres in rabbits.

Jagan et al (1989) carried out a comparative study on the effect of fenvalerate, endosulfan and malathion on Cyprinus carpio carpio and revealed their toxicity in the order of fenvalerate > endosulfan > malathion.

Evidently, studying the toxic effects of pyrethroids on fish and bioaccumulation and the changes in body weights and the major organs are however meagre. The present study was under-taken to add some light on the effect of two pyrethroides (Decamethrin & Fenvalerate) on the previous parameters on the the most common Nile fish Clarias lazera.

MATERIAL AND METHODS

The experimental animal used was Clarias lazera. The fish were caught from different localities near Cairo. The experimental fish were of both sexes with average body weight of 326 grams and average lengths of 25 cms.

Collected mature Clarias lazera were transferred to 500 liter holding tanks. The animals were acclimatized for 10 days, during which time were fed with worms.

Two formulated synthetic pyrethroid pesticides were used.

2.5% Decamethrin.
20% Fenvalerate.
utilizing serial dilution techniques by adding one ml of pesticide solution in acetone to each aquaria to obtain final sublethal concentrations 3.6 & 7.3 ppm Decamethrin and also 3.6, 7.3 ppm Fenvalerate. Control aquaria received only one ml of acetone.

Ten specimens randomly chosen from the tanks were taken for analysis from each aquaria after exposure for 96 hours to insecticide. Body weights were recorded for each group before and after exposure to insecticide. The fish were rapidly dissected and samples from skeletal muscle, liver,

spleen, intestine, gonads, kidneys and gills are weighed and taken in tin foil papers and frozen at - 15°C for the estimation of residues of pesticides in these tissues by gas liquid chromatography according to the method described by Holden & Marsders (1969).

Body Weights:

Body weights of fish were recorded before and after experiment to calculate the percentage of variation in body weights.

Body Component Index:

The liver, spleen, testes and ovaries of each fish were separately removed and weighted.

The wet weights of these organs were compared with the total fresh weight of fish to obtain values for the body component index as determined by Giese (1967).

RESULTS AND DISCUSSION

a) Body weight and ratios of liver, spleen and gonads:

The data showing the effect of different doses of decamethrin and Fenvalerate on the body weights & ratios of liver, spleen and gonads are shown in table (1): From this table it appears that both insecticides lead to a general decrease. The decrease in body weight in Clarias lazera appears to be due to cessation of feeding as the amount of food given to the experimental animal nearly remained unchanged.

Moreover, during dissection of Clarias lazera for taking different samples for chemical analysis, it was observed that the stomach and whole intestine were free from food and full of air bubbles.

From the present data one can dieduce that the decrease in body weight was accompanied by reduction in liver ratios in treatd fish than normal controls. Spleen was not affected by different doses of insecticide and so its ratio remained more or less constant. The effect of different doses of two pyrethroids used on gonads, weights were totally different but very clear with higher dose of decamthrin with testis and also with high dose of Fenvalerate on ovaries (Table 1).

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Yanni (1962) working on the same experimental animal, studied the effect of starvation on reltaive weights of organs of Clarias lazera. He found a decrease in liver ratio reaching 0.6 after 2 months of starvation, a value which is very near to that recorded after using high dose of Decamethrin for dour days only. This fact indicates that there are other factors, than inhibition of feeding resulting from the high damage and accumulation of pesticide within the liver tissues of the fish.

A similar decrease in the body weight and organs has been arrived by some authors after using Endrin, Dieldrin; DPT. Dimethoate; sevin and tri-m-butyline on different species of fish. (Grand & Mehrle 1970, Argyle et al 1975; Lingareja & Venugopalan (1978); and Leeuwangh et al 1981).

In contarary, Hansen et al (1976) found that relative liver weights were higher in treated fish than in controls after using Aroclor (R) 242.

In brief, the previous discussion indicates that some doses of pesticides stimulated growth in some species of fish while others did not, but on the other hand led to a loss in body weights and other organs. In the present work the two pesticides used (decamethrin & Fenvalerate) did not

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stimulate growth in Nile fish Clarias lazera and led to a decrease in body weight and the major organs.

b) Bioaccumulation of pyrethroid in the tissues:

The distribution and accumulation of both pesticides Decamethrin and Fenvalerate were studied in the tissues of liver, gonads, gills, intestine, kidney, muscles and spleen. The data are shown in table (2). From the data one can notice that Fenvalerate tended to accumulate in the different tissues more than Decamethrin. Moreover the intensity of accumulation of pesticide in most of the tissues studied depended on the dose used. Thus, in case of liver the mean values were (24.81±0.53) and (50.75±1.01) ppb after the concentration of low and high doses of decamethrin and (40.91 ± 0.19) and (60.65 ± 0.39)ppb after using Fenvalerate. Also the same result was obtained in gonads. the other hand the accumulation of pesticide depends on the tissue itself thus, decamethrin and Fenvalerate tended to accumulate in liver, gonads and gills then follows the intestine and kidney and lowest values were noticed in the muscle and spleen.

The present data runs in full agreement with Grazenda et al., (1971) after using Dieldrin on goldfish Carasius auratus. They found that the residues increased in different organs with increasing the doses and also found that the

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muscle had the lowest values; while highest values were recorded in gonads, liver then kidney.

In addition, Pierce (1978) and Raffenot (1979) found the same results by using PCP (pentachlorophenol) and PCB (Polychlorinated biphenyls).

Many hypotheses were put down to explain the maximum deposition of pollutant substances in liver tissues. The first hypothesis was given by El-Bishry., (1979) who suggested the transport of DDT and Endrin from the gills of Anqiulla Vulgaris to the liver via blood stream.

The second hypothesis says that the accumulation of pesticides tends to increase in fatty organs as well as organs in direct contact with environment. Thus pesticide molecules must first be adsorbed to the surface in contact with water i.e. gills then adsorbed into lipid contents of the animal system by diffusion or active transport. In addition lipid richness of various organs is a decreasing order in liver, gonads, intestine, kidney and muscles Argyle et al (1975) and Hansen et al; (1976).

The third hypothesis says that liver is the main site of biotransformation of pesticides, thus leading to storage of pesticide residues.

These three hypotheses may explain why Decamethrin and Fenvalerate used in the present work - accumulate largely within the tissue of the liver of Clarias lazera. Thus the liver was assumed to have high fat content (4.96%) thus was found to contain maximum deposition of pesticide. While the muscles which are poor in fat (2.85%) showed the lowest accumulation of pollutant substances.

The present investigation confirmed that more accumulation of residues of two pyrethroids used in liver is more dangerous and affect the principal physiological functions.

Moreover, accumulation of residues of pesticides in the tissues of gonads in high rate possibly interfere with ovary development and affects reproduction and spawning in this Nile fish Clarias lazera.

Fortunately, decamethrin and Fenvalerate are localized in liver, gills and gonads but not in muscles and these three organs were discarded when the animals are processed as food for human consumption. In the muscle tissues accumulation of both pesticides was insignificant, thus the edible skeletal muscle had the least residue - well below that considered hazardous to human health.

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Table (1): The effect of Decamethrin and Fenvalerate on the body weight and the major organs (liver, spleen and gonads) in Clarias lazera after 96 hours exposure.

body weight & the experimental organs	Control	Concentration of Decamethrin		Concentrations of Fenvalerate	
		3.6 ppm	7.3ppm	3.6ppm	7.3 ppm
Body weight	1.08±0.02	4.69*±1.07	5.22*±1.44	3.08*±0.25	7.72*±1.51
Liver	0.198±0.05	0.91±0.05	0.69±0.05	0.94±0.06	0.83±0.03
Spleen	0.10±0.01	0.10±0.008	0.11±6.008	0.13±0.008	0.11±0.01
Testes	0.20±0.05	0.33±0.10	0.52*±05	0.41±0.90	0.38±0.07
Overies	1.08±1.46	5.15*±1.36	2.53±059	4.43±0.87	6.93*±1.64

- The data is represented as mean ± S.E. (Standard error).
- The data is expressed as ratios loss.
- * The value is statistically significant at P<0.05.

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Table (2) : Comparison of mean values of residues (in p.p.b) in different tissues of normal Clarias lazera and those exposed to low and high doses of Decamethrin and Fenvalerate (3.6, 7.3 p.p.m).

Fish group	Pesticide residues (in p.p.b) in						
	Liver	Muscle	Spleen	Intestine	Gonads	Kidney	Gills
Normal	1.41±0.20	-	-	0.63±0.14	0.62±0.24	-	0.62±0.1
Exposed to low dose (3.6p.p.m) Decamethrin	24.81±0.53	2.13±0.04	1.13±0.06	17.94±0.16	22.22±0.26	11.04±0.21	20.33±0.2
Exposed to high dose (7.3p.p.m) Decamethrin	50.75±1.01	5.12±0.09	1.93±0.15	35.84±0.31	49.61±0.17	20.31±0.37	41.16±0.
Exposed to low dose (3.6p.p.m) Fenvalerate	40.91±0.19	9.11±0.08	3.89±0.05	28.64±0.26	34.66±0.19	14.75±0.17	26.95±0.2
Exposed to high dose(7.3p.p.m) Fenvalerate	60.65±0.39	10.91±0.09	6.45±0.09	39.69±0.18	52.76±0.61	24.80±0.12	50.09±0.3