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Studies on the impact of a Cypermethrin insecticide on oxygen consumption and certain biochemical constituents of a fish *Tilapia mossambica*

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ABSTRACT
The aim of this study, was to determine the effect of pesticide pyrethroid, Cypermethrin on oxygen consumption and some biochemical parameters in the blood of a fresh water fish, *Tilapia mossambica*. The LC_{50} value was 1ppm for 24 h treatment. The rate of oxygen consumption of the fish was studied under sublethal concentration of Cypermethrin at 24, 48, 72 and 96 hours intervals. The protein and triglyceride levels were found to be decreased in all the exposure periods. The above results indicate that Cypermethrin insecticides especially Shakthi*10 is toxic to the fish *Tilapia mossambica* and the stress response showed by fish are dependent on concentration and time. This sort of studies have considerable relevance for the growing technology of aquaculture and fishery science.

Keywords: Pesticide, Cypermethrin, *Tilapia mossambica,* Biochemical and Sublethal study.

1. Introduction
Environmental pollution, especially water pollution has been increasing at an alarming rate due to rapid industrialization, civilization and green revolution [10, 11].
The pesticide enter into the aquatic ecosystem through various routes affecting adversely to the aquatic biota [5, 6, 8]. Cypermethrin is a synthetic pyrethroid used widely to control a variety of insect pests [12].
Rath S. *et al*., [13] reported a study on oxygen consumption in a cat fish, Mystus gulio exposed to heavy metals. Earlier [14] also studied the changes in protein content exposed to pesticide media. Nutritive value of fish is determined by its biochemical composition [4] Glycogen is the only immediately available reserve of blood glucose. Alteration of blood sugar level is the primary metabolic symptom in vertebrates subjected to stressful situations [3]. Effects of quinalphos and Padan on tissue glycogen of common carp, *Cyprinus carpio* (Linn) was studied by [1].
Lipids also serve as energy reserves to meet the metabolic demand for more energy to mitigate toxic stress. Lipase acts on triglycerides to meet energy demands [7]. Based on the literature cited above, it is evident that the studies on the effect of pyrethroid insecticide on fish and other aquatic organisms are very much needed. Therefore, in the present study an attempt has been made to investigate the effect of a pyrethroid insecticide, cypermethrin on the rate of oxygen consumption and biochemical changes in the blood of a fish *Tilapia mossambica*.

1.1 Objectives of the study
- To observe the LC_{50} concentration of cypermethrin to the fish Tilapia mossambica.
- To observe the impact of Sublethal concentration of cypermethrin on the rate of oxygen consumption of the fish Tilapia mossambica.
- To observe the effect of Sublethal concentration of cypermethrin on some biochemical characteristics in blood of the fish Tilapia mossambica.

2. Materials and methods
The toxicant Cypermethrin insecticide (shakthi* 10) has been used for the present study. It is a new highly active pyrethroid insecticide. It is primarily a caterpillar insecticide. The common pests in which cypermethrin is used are bollworms of cotton, fruit borer of bhindi fruit and shoot borer of sugarcane, shoot fly of wheat, Bihar hairy caterpillar of sunflower etc. It also

Acts by its Significany and repellent action.

The bulk sample of the fresh water fish, *Tilapia mossambica* (Ranging in weight 14 gm to 17 gm and in length from 7 cm to 10 cm was procured from the Periyakulam pond at Ukkadam and transported to the laboratory in well aerated polythene bag and acclimated to the ambient laboratory temperature (26±1.2) in large glass aquarium. During the period of acclimation, they were fed every day with oil cake mixed with rice flour. The water in aquarium was changed daily. The period of acclimation lasted for 2 weeks. After acclimation healthy fish were selected from stock and transferred to another glass tank. Feeding was stopped one day before the commencement of the experiment.

2.1 Analytical test for water Chemistry

The tap water from contaminants was used as dilution water for the present study. The physicochemical analysis of water used in the experiment were carried out using the method of [2].

2.2 Determination of median lethal concentration

Preliminary tests were carried out to find out the median lethal concentration of Cypermethrin to fish for 24 h and it was 1 ppm. 10 fish were introduced in each tub with 10 L of water in each which already received different concentrations of Cypermethrin for 24 h treatment. The mortality and survival of fish in the experimental tubs were recorded after 24 h. The concentration at which 50% kill of fish occurred after 24 h treatment was taken as the median lethal concentration (LC_{50}).

2.3 Measurement of oxygen consumption

The oxygen consumption of fish was measured by using a simple glass respiratory chamber. One litre dechlorinated tap water was taken in a respiratory chamber and healthy fish was introduced into it and serves as control. The water surface was covered by a layer of liquid paraffin. The whole chamber with fish was kept in glass trough containing the fish was allowed for one hour to respire the dissolved oxygen present in the water in the respiratory chamber. Similarly, the fishes were introduced in sublethal concentration of cypermethrin for 15 and 30 days of exposure and a separate control was maintained for each exposure. The dissolved oxygen content of water sample was estimated by Winkler's method [15].

2.4 Sublethal toxicity

The tanks were designated as I and II representing control and experimental respectively. Hundred fishes were introduced in tank I containing 100 L of water in which no toxicant was added. Tank II filled with 100 L of water and $1/10^{th}$ of the LC_{50} 24 h values of Cypermethrin (0.1 ppm) was added and mixed well. Then, 100 healthy fishes selected from the tank (Stock) were transferred into the experimental tank. Fish were fed with *ad libitum* daily before the water replacement. The turnover time of water in both control and experimental tank was renewed with toxicant daily. After the exposure period of 15 and 30 days are over, 15 fishes were randomly selected from each control and experimental tanks and analyzed. The blood samples were subjected to analysis of different parameters viz. Protein, Glucose, Cholesterol and Triglycerides. The data of results obtained from different studies were analyzed statistically according to [6].

3. Results and discussion

The physical and chemical properties of water used in the present study was determined. The measured values were always within the maximum permissible limit of [2] indicating an unpolluted nature of the water. The values are represented in Table 1.

Table 1: Physical and chemical characteristics of the water used for the study

Sl. No.	Parameters	Value
1	Temperature (^{o}C)	26±1.2
2	P^{H}	7.4±0.75
3	Dissolved oxygen (mg/l)	5.65±1.08
4	Alkalinity (mg/l)	115±1.80
5	Salinity(mg/l)	0.55±0.24
6	Total hardness	214.25±1.51
7	Calcium	140.00±3.86
8	Magnesium(mg/l)	32.25±1.2

24 hour LC_{50} of Cypermethrin to the fish was found to be 1ppm.There were no behavioural changes in the control. Oxygen consumption of control and treated fishes at 24 hour exposure was 0.462 ml/gm/hr, 0.446 ml/gm/hr respectively.

The oxygen consumption of control fish at 48 hours, 72 hours and 92 hours also showed marked changes. And that of treated during 24, 48, 72 and 96 hours of exposure showed 0.446, 0.094, 0.194 and 0.197 ml/gm/hr respectively (Table 2 and Fig.1).

Table 2: Oxygen consumption (ml/gm/hr) of the fish Tilapia mossambica exposed to varying periods of Cypermethrin toxicity.

Experiment	Exposure periods			
	24 hr	48 hr	72 hr	96 hr
Control	0.460^{a}	0.143^{b}	0.303^{b}	0.392^{b}
Treated	0.446^{b}	0.094^{a}	0.194^{a}	0.197^{a}
SED	LSD (5%)	LSD (1%)		
0.004	0.009	0.012		

In column, the mean followed by a common letters are not significantly different at 5% level by DMRT.

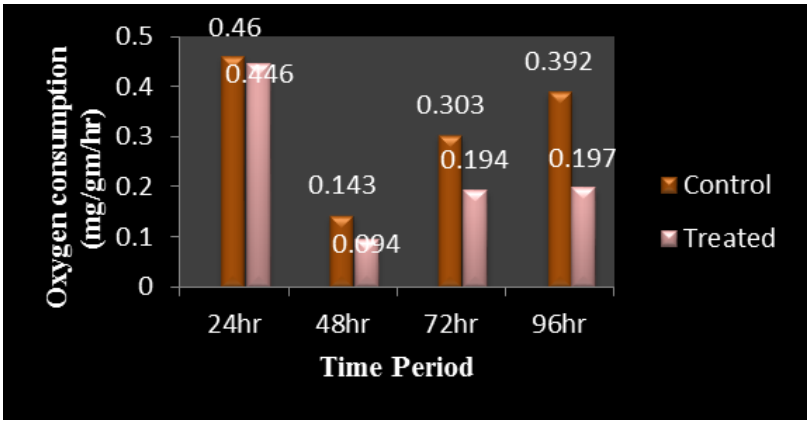

Fig 1: Oxygen consumption (ml/gm/hr) of the fish Tilapia mossambica exposed to varying periods of Cypermethrin toxicity.

The protein level decreased in experimental fish from that of control during the exposure periods. Reduction in the protein content observed in the present study may be due to proteolysis under toxicant stress [9]. It should be 1.52 and 1.20gm/dl respectively (Table 3 and Fig.2).

Table 3: Protein level (gm/dl) in the blood of the fish Tilapia mossambica exposed to Sublethal concentration of Cypermethrin

Experiment	Exposure periods	
	15 days	30 days
Control	2.81a	2.52b
Treated	1.52a	1.20a
SED	LSD (5%)	LSD (1%)
0.15	0.43	0.43
0.10	0.30	0.30
0.10	0.30	0.30

In column, the mean followed by a common letters are not significantly different at 5% level by DMRT.

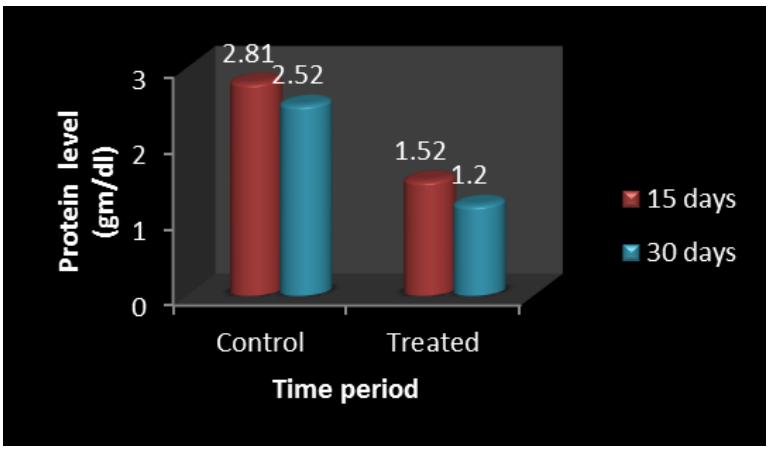

Fig 2: Protein level (gm/dl) in the blood of the fish Tilapia mossambica exposed to sublethal concentration of Cypermethrin.

In treated fishes glucose level was found to be increased throughout the exposure periods. The depletion in the level of glycogen indicates their utilization to overcome pesticide stress. The blood glucose in control and treated during the exposure of 15 and 30 days showed 42.55, 42.43, 63.51, 52.58 respectively. Shown in Table 4 and Fig.3.

Table 4: Glucose level (mg/dl) in the blood of the fish Tilapia mossambica exposed to sublethal concentration of Cypermethrin

Experiment	Exposure periods	
	15 days	30 days
Control	42.55a	42.43b
Treated	63.52b	52.58b
SED	LSD (5%)	LSD (1%)
0.13	0.28	0.39

In column, the mean followed by a common letters are not significantly different at 5% level by DMRT.

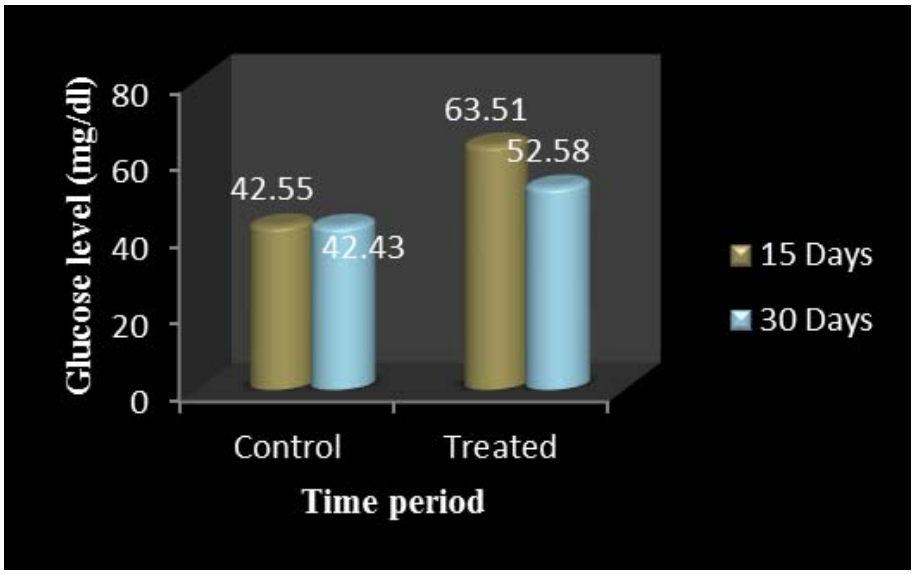

Fig 3: Glucose level (mg/dl) in the blood of the fish Tilapia mossambica exposed to Sublethal concentration of Cypermethrin

The blood cholesterol level in control and treated were found to be 81.48, 80, 49, 72.34, 66.38 mg/dl respectively. The cholesterol level decreased in treated from that of control. A significant decrease in triglyceride level observed in the fish was due to the increase in the breakdown of lipids possibly to meet extra energy demand. Shown in Table 5 and Fig.4.

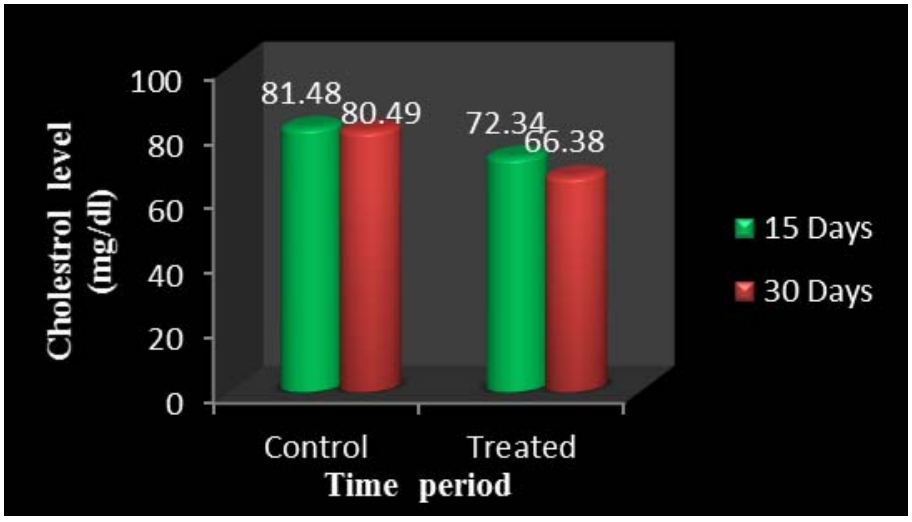

Fig 4: Cholesterol level (mg/dl) in the blood of the fish Tilapia mossambica exposed to Sublethal concentration of Cypermethrin.

Table 5. Cholesterol level (mg/dl) in the blood of the fish Tilapia mossambica exposed to Sublethal concentration of Cypermethrin

Experiment	Exposure periods	
	15 days	30 days
Control	81.48b	80.49b
Treated	72.34a	66.38a
SED	LSD (5%)	LSD (1%)
0.27	0.56	0.78

In column, the mean followed by a common letters are not significantly different at 5% level by DMRT.

The triglyceride level in control and treated was found to be 162.38, 161.37, 126.36, 105.36 respectively. It shown in Table 6 and Fig.5. Biochemical evaluation of the fish Tilapia mossambica exposed to sublethal concentration of Cypermethrin indicates that all the parameters are decreased except glucose which was in increased condition

Table 6: Triglycerides level (mg/dl) in the blood of the fish Tilapia mossambica exposed to sublethal concentration of Cypermethrin

Experiment	Exposure periods	
	15 days	30 days
Control	162.38b	161.37b
Treated	126.36a	105.36a
SED 0.34	LSD (5%) 0.72	LSD (1%) 0.99

In column, the mean followed by a common letters are not significantly different at 5% level by DMRT.

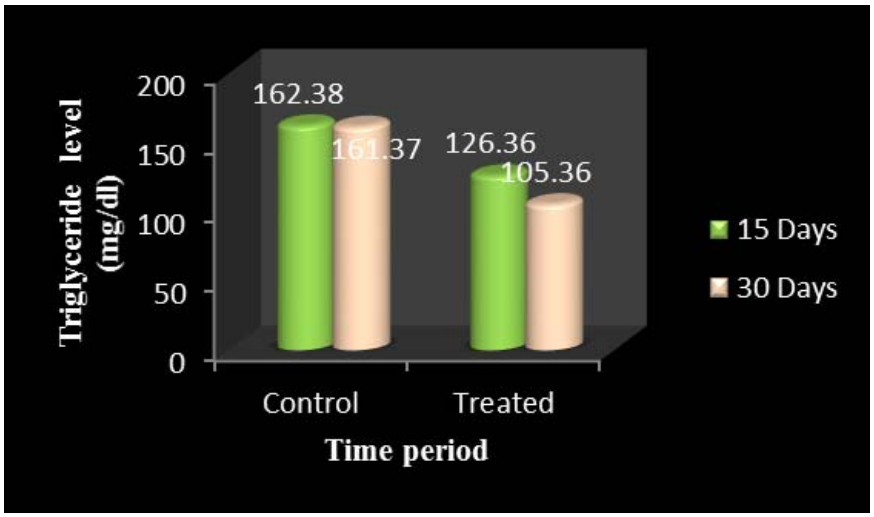

Fig 5: Triglycerides level (mg/dl) in the blood of the fish Tilapia mossambica exposed to sublethal concentration of Cypermethrin

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