

## Studies on the toxicity of pesticide fipronil 5% SC (Mahaveer SC) on the biochemical composition of *Oreochromis mossambicus*

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### Abstract

The fish, *Oreochromis mossambicus* was treated with two different (10% and 30%) sublethal concentrations of pesticide fipronil 5% SC (LC<sub>50</sub> for 96-hour ppm - 0.006 ppm) to study on the effect in the biochemical components for a long-term exposure. In this study, biochemical compositions (carbohydrates, protein and lipids) in various tissues such as gill, intestine, kidney, liver and muscle were decreased with increase in exposure periods. Maximum decrease over control in the biochemical composition was noted in 30% sublethal concentration of pesticide fipronil on 30 days of exposure.

**Keywords:** fish, pesticide fipronil and biochemical composition

### Introduction

The environment gets polluted through several agents, particularly by a wide array of chemicals such as herbicides, pesticides and heavy metals. Pesticides vary in their chemical formulations as well as toxicity, environmental persistence and pathways of action, among the pesticides, chlorinated hydrocarbons, organophosphates and carbamates are commonly used. Several researchers have reported changes in biochemical composition of fishes due to pesticide treatment (Suneetha, 2012; Binukumarai and Sudha Saravanani, 2015; Lakshmaiah, 2016<sup>[9]</sup>; Sneha Verma and Anurag Rawat, 2017<sup>[18]</sup>; Gijare and Tantarapale, 2018<sup>[5]</sup>; Prakash Sadguru *et al.*, 2020<sup>[12]</sup>). Hence, a study on the effect of pesticide fipronil 5% SC on the biochemical components of fish, *Oreochromis mossambicus* is noteworthy.

### Materials and method

The fish *Oreochromis mossambicus* was collected from the Chellikurichy lake (Lat. 10<sup>0</sup>, 21 N<sup>0</sup>; Long.79<sup>0</sup>, 24<sup>E</sup>), Pudukkottai Ullur near Adirampattinam, Thanjavur, Tamil

Nadu. They were acclimatized in laboratory for ten days in plastic troughs. The water was renewed every 24 hours. The LC<sub>50</sub> of fipronil 5% SC for 96 hour was found out by using Probit method (Finney, 1971)<sup>[2]</sup>. For biochemical analysis *Oreochromis mossambicus* was reared in sub lethal doses (10% and 30% of 96 hour LC<sub>50</sub> - 0.006 ppm) for a period of 10, 20 and 30 days. The biochemical components such as carbohydrate (Roe, 1955), protein (Lowery *et al.*, 1951) and lipids (Folch *et al.*, 1957)<sup>[3]</sup> were estimated.

### Results and discussion

Fishes treated as control, the carbohydrate level was the highest in liver (25.41-26.11 mg/g), followed by muscle (11.12-11.35 mg/g), very low in gill (3.05-3.18 mg/g) and least in kidney (1.88-1.95 mg/g). Carbohydrate content of *Oreochromis mossambicus* was found to decreased respectively by 40.60% and 66.56% (gill), 53.11% and 73.58% (intestine), 48.69% and 57.59% (kidney), 68.56% and 87.58% (liver) and 54.26% and 69.72% (muscle) of fish exposed to 10 and 30% sublethal concentrations of pesticide fipronil 5% SC for 30 days (Table.1).

**Table1:** Carbohydrate content in selected tissues of *Oreochromis mossambicus* exposed to pesticide fipronil 5% SC (mg/g)

Tissues	10 days					20 Days					30 Days				
	G	I	K	L	M	G	I	K	L	M	G	I	K	L	M
Control	3.11± 0.22	3.45± 0.28	1.95± 0.32	25.41± 0.34	11.12± 0.41	3.18± 0.31	3.49± 0.26	1.88± 0.36	26.11± 0.35	11.35± 0.38	3.05± 0.36	3.52± 0.26	1.91± 0.28	25.92± 0.36	11.26± 0.36
10% SC	2.71± 0.26	2.64± 0.26	1.55± 0.35	17.25± 0.28	8.15± 0.38	2.15± 0.24	2.05± 0.22	1.23± 0.32	11.62± 0.31	6.46± 0.41	1.81± 0.28	1.65± 0.21	0.98± 0.34	8.15± 28	5.15± 0.38
% Variation	-12.86	-	-	-32.11	-26.71	-32.39	-	-34.57	-55.50	-43.08	-	-	-	-68.56	-54.26
30% SLC	1.93± 0.29	1.95± 0.22	1.34± 0.29	10.65± 0.31	6.31± 0.44	1.43± 0.69	1.34± 0.27	1.05± 0.34	6.14± 0.28	5.31± 0.40	1.02± 0.22	0.93± 0.28	0.81± 0.35	3.22± 34	3.41± 0.43
% Variation	-37.94	-	-	-58.09	-43.26	-55.03	-	-44.15	-76.48	-53.22	-	-	-	-87.58	69.72

In the present investigation, the carbohydrate content of *Oreochromis mossambicus* tissues showed a decrease when it was treated with sub lethal doses of fipronil 5% SC. Sastry Abad and Siddiqui (1982)<sup>[16]</sup> observed fall in liver and muscle sugar level in *Channa punctatus* when exposed to Sevin. Verma Saita Rani *et al.* (1983) have shown that the

pesticides thiothox and dichlorvos caused a decline in the muscle glycogen level in freshwater fishes. These results were confirmity with the reports on carbohydrate level in *Oreochromis mossambicus*, when treated with chlorpyrifos (Padmini Kadam and Rajaram Patil, 2016)<sup>[11]</sup>. Lakshmaiah (2016)<sup>[9]</sup> observed decreased carbohydrate content in the

*Cyprinus carpio* exposed to lethal and sublethal concentrations of phorate. Ghazala *et al.* (2019) [4] reported decrease in carbohydrate content in major carp after exposure to pesticide.

In fish *Oreochromis mossambicus*, kept as control, highest level of protein content was in muscle (35.13-35.65mg/g), followed by liver (28.15-26.35 mg/g) and intestine (21.15-21.35 mg/g). Moderate values were observed in gill (17.32-17.51 mg/g), while lowest protein levels were seen in kidney (14.28-14.45 mg/g). Decrease in protein levels was

noted in all the tissues of fish exposed to the fipronil 5% SC (Table.2). The maximum decrease of protein content was observed in various tissues of fish exposed to 30% sublethal concentration of fipronil 5% SC reared for 30 days: 56.96% in gill, 56.79% in intestine, 65.55% in kidney, 61.43% in liver and 82.09% in muscle. Though the decrease in tissue protein of the 10% sub lethal concentration of fipronil 5% SC exposed fish showed the same trend, the change was of a lower magnitude than for 30% sub lethal concentration exposure.

**Table 2:** Protein content in selected tissues of *Oreochromis mossambicus* exposed to pesticide fipronil 5% SC (mg/g)

Tissues	10 days					20 Days					30 Days				
	G	I	K	L	M	G	I	K	L	M	G	I	K	L	M
Control	17.32±0.43	21.15±0.35	14.32±0.32	26.35±0.41	35.13±0.38	75.51±0.42	21.35±0.36	14.45±0.26	26.15±0.28	35.65±0.36	17.45±0.37	21.22±0.28	14.28±0.26	26.21±0.37	35.28±0.42
10% SLC	15.11±0.47	18.55±0.38	11.35±0.35	21.15±0.39	24.14±0.31	11.32±0.35	16.11±0.34	8.92±0.31	17.15±0.36	18.16±0.29	19.11±0.42	13.21±0.36	6.97±0.31	14.65±0.31	11.55±0.37
%Variation	-12.76	-12.29	-20.74	-19.73	-31.28	-35.35	-24.54	-38.27	-34.42	-49.06	-47.79	-37.75	-51.19	-44.11	-67.26
30% SLC	12.21±0.41	15.32±0.31	9.31±0.28	18.15±0.35	18.56±0.28	9.32±0.39	13.16±0.36	6.17±0.27	14.32±0.33	12.56±0.35	7.51±0.36	9.17±0.34	4.92±0.37	10.11±0.29	6.32±0.35
%Variation	-29.50	-27.57	-34.99	-31.12	-47.17	-46.77	-38.36	-57.30	-45.24	-64.77	-56.96	-56.79	-65.55	-61.43	-82.09

Values are mean ± SD of five observations. (–) indicate % decrease over control. (G- gill, I-intestine, K-kidney, L-liver, M-muscle)

In this work, the protein content of *Oreochromis mossambicus* was decreased at all exposure periods (Table. 2). The observed decline in tissue protein on treatment with sub lethal concentrations of fipronil 5% SC was suggestive of proteolytic activity, possibly to meet the excess energy demands under toxic conditions. Vasanthi and Binukumari (2015) recorded depletion in the protein content in the freshwater fish *Cyprinus carpio* exposed to pesticide methoxychlor. Revathi and Krishnamurthy (2018) [15] reported decrease in protein content of *Channa striatus* exposed to chlorpyrifos.

A similar depletion of protein content has been observed in liver, kidney and brain of *Channa punctatus* exposed to

chlorpyrifos (Revathi *et al.*, 2020) [13]. Gul – e- Zehra Naqvi *et al.* (2017) [6] also observed decline in total protein content of *Oreochromis mossambicus* treated with pyrethroid pesticides and herbicide.

The lipid content in the control fishes were found highest in liver (14.52-14.65 mg/g) followed by intestine (10.15-10.35 mg/g), muscle (8.16-8.28 mg/g), gill (4.43-4.65 mg/g) and least in kidney (4.35-4.46 mg/g). Fishes treated to sub lethal doses of fipronil 5% SC, significant decrease were recorded in the content of lipid in all the tissues on fipronil 5% SC exposure (Table.3)

**Table 3:** Lipid content in selected tissues of *Oreochromis mossambicus* exposed to pesticide fipronil 5% SC (mg/g)

Tissues	10 days					20 Days					30 Days				
	G	I	K	L	M	G	I	K	L	M	G	I	K	L	M
Control	4.43±0.08	10.15±0.22	4.35±0.32	14.52±0.34	8.16±0.27	4.65±0.16	10.18±0.19	4.46±0.25	14.65±0.23	8.19±0.21	4.56±0.19	10.35±0.17	4.35±0.25	14.60±0.22	8.28±0.32
10% SLC	3.78±0.21	8.14±0.23	3.64±0.28	11.28±0.26	6.17±0.31	3.13±0.19	7.36±0.26	2.72±0.23	7.68±0.26	5.32±0.35	2.72±0.22	6.72±0.21	26.16±0.23	6.11±0.27	3.11±0.35
% Variation	-14.67	-19.80	-60.32	-22.31	-24.39	-32.69	-27.70	-39.01	-47.58	-35.04	-40.35	-35.07	-50.34	-58.15	-62.44
30% SLC	2.76±0.24	6.64±0.25	2.25±0.26	8.16±0.24	4.11±0.35	2.15±0.23	4.68±0.29	1.68±0.17	6.19±0.25	2.95±0.33	1.68±0.26	3.35±0.18	1.12±0.28	4.21±0.22	2.21±0.34
% Variation	-37.70	-34.58	-48.28	-43.80	-49.63	-53.76	-54.03	-62.33	-57.25	-63.98	-63.16	-67.63	-74.25	-71.16	-73.31

The fish exposed to the 10% sub lethal concentration of fipronil 5% SC for 30 days, the concentration of lipid decreased to 40.35(gill), 35.07 (intestine), 50.34(kidney), 58.15(liver) and 62.44% (muscle) while the fishes treated with 30% sublethal doses of fipronil 5% SC for 30 days showed decreased lipid content in all the tissues: 63.16% (gill), 67.63% (intestine), 74.25% (kidney), 71.16% (liver) and 73.31%(muscle). In the 10% sublethal concentration of the fipronil 5% SC the decrease in lipid content was to a lesser extent (Table.3).

The lipid content was gradually decreases in various tissues of *Oreochromis mossambicus* was observed after chronic exposure to pesticide fipronil 5% SC. Lakshmaiah

(2016) observed decreased lipid content of *Cyprinus carpio* when exposed to phorate<sup>9</sup>. Similar decline in lipid content has also been observed by Sathick *et al.* (2019) [17] in *Mystus gulio* when exposed to monocrotophos.

Juginu Mankuzhiyil Sivanandam and Binu kumari (2021) [8] reported significant decrease in lipid content of *Labeo rohita* when exposed to endosulfan. Decrease of lipid content in *Oreochromis mossambicus* in the present investigation may have been due to the utilization of lipids for energy demand under stress condition (Harper *et al.*, 1977) [7].

## Conclusion

In conclusion, it may be pointed out that the changes observed in biochemical components is due to fipronil 5% SC which was found to be toxic to fishes, as a result, survival of the fish would not be possible. Hence steps to be taken to prevent its contamination into aquatic system.

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