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Effect of Fenvalerate™ on Various Tissues of Channa punctatus (Bloch)

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Abstract: Fenvalerate™ is a Synthetic pyrethroid and falls under the major type of broad spectrum organic insticides which is widely used in agriculture. Among the pyrethroids, Fenvalerate [RS cyano 3Phenoxy Benzyle, RS 2-4 Chlorophenyl 3 Methyl Butyrate], is used extensively and considered as the most effective pyrethroid. Hence in the present study, toxicity evaluation that is a static and continuous flow through tests was conducted to determine LC_{50} values to some fresh water fish. It is observed that the static LC_{50} values are 10% higher to continuous flow through tests. The fish were exposed to sub lethal concentration of 1/10th of 24h LC_{50} values for 10 days. Due to the toxicant influence, the proteins and glycogen levels totally decreased in the fish studied. The percentage of decrement varied in different organs of the test fish.

About Fish: Channa punctatus is fresh water spotted murrel which will have high commercial important and this can be identified with the following characters. It has elongated body, large mouth, lower jaw contains canine teeth, pelvic fins smaller than the pectoral, dorsal and anal fins, it has rounded caudal fin, dorsal side with blackish light green colour and the lateral side will have distinct black stripes.

Key words: Fenvalerate™ · Channa punctatus (Bloch) · Organs · Toxicity · Glycogen · Proteins

INTRODUCTION

The pyrethroids with alkenyl methyl cyclopentenolene alcohols are the esters of cyclopropane carboxylic acids. The action of the toxicant will depend on metabolism and mode of action in aquatic organisms. Some of them also tend to affect the biology of non-target organisms along with pests. Fenvalerate is the one among them, Hoyt *et al.* [1],Chari. [2] Elliott *et al.* [3], Tilak *et al.* [4]. The aquatic environment is the ultimate sink for all the environment pollutants. Any chemical pollutants either natural or synthetic or anthropogenic are most likely to reach the aquatic environment sooner or later [4-6].

Due to widespread use, these are transported into aquatic environments and become an integral part of the process of environmental hazard evaluation of toxic chemicals. Generally the potential impact of pollutants is more on the aquatic organisms, than terrestrial environment [7,8].

Since, Fenvalerate is being extensively used in agriculture, there is a scope to transfer to non-target organisms due to bioaccumulation and biomagnifications in existed environments. Hence the toxic impact of the toxicant to the fresh water is attempted.

MATERIALS AND METHODS

The present study was conducted at Guntur (16°.00-16° 18′ °N latitude and 80 °.45-80° 27′ °E longitude). The Channa punctatus (Bloch) were brought from local fish farms and by fisherman. The fishes were acclimatized to the laboratory conditions in well aerated and with the non-chlorinated tap water at the test medium conditions. During the period of acclimatization and experimentation the fishes were not fed. If the number of deaths exceeded 25% in any batch of the fish during acclimatization, that batch was discarded. The toxicity studies were conducted using the technical grade formulation and also commercially available formulation of Fenvalerate™ and employing static and continuous flow through systems as recommended in the report of the committee on methods for toxicity tests with aquatic organisms, EPA [9]. Solutions of desired concentrations were prepared in 95%

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acetone to get the stock solution as well as working solution as 100mg/100ml and 1mg/1ml of toxicant chemical Fenvalerate™, in both technical formulation and commercial formulation. The other precautions were followed such as use of acetone in control as recommended by, EPA [9].

Then the acclimated fishes were exposed to 1/10th concentration of 24 h static test for a period of 10 days. Then the surviving fish were taken and the functionally important tissues were separated for the estimation of glycogen and proteins. Glycogen contents were estimated by the method of Kemp *et al.* [10] and the proteins were estimated by the method of Lowery *et al.* [11].

RESULTS AND DISCUSSIONS

The amount of glycogen and proteins contents in mg/g weight of the tissues was given in Figure.1 and Table: 1 and Figure 2 and Table: 2 respectively.

The difference in significance can be observed through the above tabulated values among different fresh water species. The values with in the parenthesis are confidential limits.

The signs of fenvalerate™ poisoning in fish include loss of schooling behavior, swimming near the water surface, hyper activity, erratic movements and loss of buoyancy, elevated cough rates increased gill mucus secretion, flaring of the gill arches, head shaking and restlessness and finally the fish is died (Braudbury and Coats [12], Tilak *et al.* [13]. In the present study, the static values of LC_{50} are higher than the continuous flow through systems. The higher values are in agreement with the earlier authors report. The 20% E.C. formulation is more toxic than technical grade. This indicates the involvement of other ingredients in enhancing the toxic action than the technical grade.

The decreased glycogen synthesis is attributed due to inhibition of hormones and enzymes when the fish is under the influence of toxicants. During this time the conversion of carbohydrates into amino acids may be possible. Hence, the decreasing trend in glycogen contents was noticed. Similar observations were explained by Gaiton *et al.* [14], Stamp and Lesker [15], Edwards [16], Srinivasa Murthy[17] Anita Sussan *et al.* [18] Tilak *et al.* [13], [19],

When exposed to sub lethal concentrations of Fenvalerate™ of both technical grade and 20% E.C. formulation, the total protein contents drastically decreased in the tissues of *Channa punctatus*. The decreasing trend can be observed in the given Figure.2 and Table 2.

The decreasing trend is due to the variation and gradual difference in metabolic caliber of different tissues of the test fish due to the influence of the toxicant. Though the muscle is rich in protein, it forms mechanical tissue intended for mobility, even then it is not participating in metabolism because of the toxic stress. Due to this, the stored proteins are consumed (degeneration of the proteins) for their normal survival. Hence, the present decreasing trend is justifiable.

Table 1: The amount of glycogen mg/g wet weight of the tissues of fish *Channa punctatus* on exposure to sub lethal and lethal concentrations of Fenvalerate™ technical grade and 20% E.C. formulation

Sl.No	Tissues	Control mg/g	20%E.C S.L mg/g	T.G.S.L mg/g	20% EC Lethal mg/g	T.G. Lethal mg/g
1	Gill	35.10±0.1720	26.60±0.1414 (-)24.22	18.74±0.1414 (-)46,61	19.95±0.1854 (-)43.16	24.18±0.2154 (-)31.11
2	Liver	82.22±0.2059	67.72±0.1414 (-)17.64	33.86±0.1414 (-)58.82	53.21±0.2154 (-)35.28	47.16±0.2154 (-)42.64
3	Kidney	25.39±0.2059	20.56±0.316 (-)19.03	18.74±0.1720 (-)26.20	16.93±0.1720 (-)33.32	14.51±0.1326 (-)42.85
4	Brain	13.30±0.1854	10.88±0.2135 (-)18.20	9.67±0.2135 (-)27.30	9.67±0.2653 (-)27.30	9.07±0.2315 (-)31.81
5	Muscle	35.07±0.2	19.95±0.1854 (-)43.12	16.32±0.1720 (-)53.50	15.12±0.1720 (-)56.90	7.25±0.1854 (-)79.33

Each value is mean of 5 individual observations ± Indicates standard deviation (-) Indicates % decrease.

Table 2: The amount of protein mg/g wet weight of the tissues of fish *Channa punctatus* on exposure to sub lethal and lethal concentrations of Fenvalerate™ technical grade and 20% E.C. formulation

Sl.No	Tissues	Controlmg/g	20%E.C S.L mg/g	T.G.S.Lmg/g	20% EC Lethal mg/g	T.G. Lethal mg/g
1	Gill	55±0.1720	40±0.1720 (-)27.27	36±0.172 (-)34,55	32±0.1414 (-)41.20	29±0.144 (-)47.28
2	Liver	65±01541	59±0.1541 (-)9.23	45±0.141 (-)30.78	46±0.141 (-)29.23	39±0.172 (-)40.00
3	Kidney	60±0.2607	55±0.3261 (-)8.33	38±0.2059 (-)36.67	49±0.2059 (-)18.33	30±0.228 (-)50.00
4	Brain	73±0.2607	62±0.664 (-)15.10	49±0.2 (-)32.90	510±.2712 (-)30.12	39±0.2416 (-)46.60
5	Muscle	90±0.2416	66±0.2315 (-)26.67	59±0.2607 (-)34.44	52±0.20 (-)42.22	41±0.2416 (-)54.44

Each value is mean of 5 individual observations ± Indicates standard deviation (-) Indicates % decrease

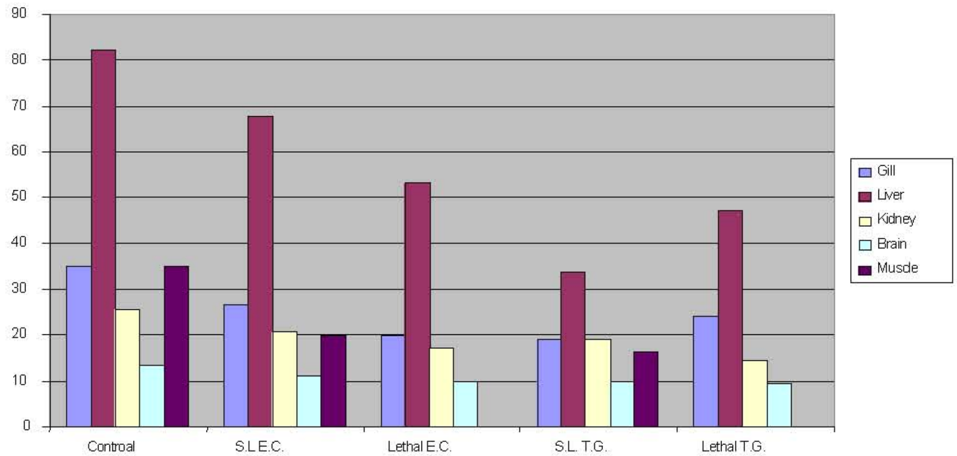

Fig. 1: Decreasing trend in glycogen content in various organs of the fishes exposed

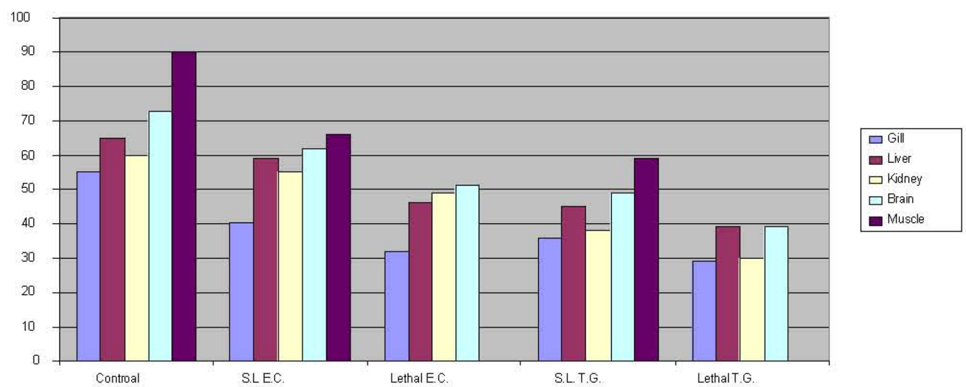

Fig. 2: Protein levels of different organs studied in the exposed fish

Similar observations were noticed bye the several earlier authors such as Prosser and Brown [20], Adams and Miller. [21], Malla Reddy and Basha Mohideen [22], Jeba Kumar *et.al.* [23], Pandibaskaran [24], Tilak *et al.* [13].

During protein metabolism the removal of amino group from different amino acids was observed, due to this the elevated levels of the AAT and ALAT in the exposed fish was noticed, this is because of the break down of the proteins. Similar observations were reported by Campbell [25], Kabeer *et al.* [26], Girija [27], Radhaiah and Jayantha Rao [28], Malla reddy *et al.* [29], Tilak *et al.* [19].

The increased Proteolysis enhances transformation which results in the elevation of ammonia levels, consequently the level of urea are also elevated. The increased levels are due to the failure of kidney tissue or malfunction due to the toxicant stress Radhaiah and Jayantha Rao [30], Tilak *et al.* [19].

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