

Assessment of hematotoxicity in *Heteropneustes fossilis* under stress of lambda-cyhalothrin

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Abstract

Pesticides are very common in these categories which are used against various pests for human welfare but they are also harmful to us via food chain. Pesticides are used from ancient times in agriculture and in repelling insects from houses. There are many categories of insecticides such as pyrethroids, organochlorine, organophosphate, carbamate and natural compounds. Natural compounds are very costly and not used in general. Pyrethroids are used in house (In all mosquito repellents- coils, mats and liquids) and organophosphates mainly used in agriculture. All these categories affect humans by direct or indirect mechanisms. To assess this damage, lambda cyhalothrin has been selected to observe their effects fishes and the primary effects have been observed on haematology.

Keywords: *Heteropneustes fossilis*, lambda-cyhalothrin, hematotoxicity

Introduction

The freshwater is polluted due to entry of excess sewage water, industrial effluents and large number of pesticides in natural and agricultural pest management. The pesticides like organophosphates are regularly used in agricultural pest management for food production but through their excessive and indiscriminate use in agriculture pest management and public health operations. The rapidly increasing use of insecticides in agriculture poses serious hazards to aquatic animals.

Fisheries provide an important source of food, employment, income, and recreation for people throughout the world. Appreciations of fisheries and aquatic ecosystems have been accompanied by increasing concern about the effects of growing human populations and activity on aquatic life and water quality. Out of the many links associated to man's negative impact on other neighboring environment, pesticides are one group of toxic compounds linked to human use that have a profound effect on aquatic life and water quality. Among the commonest pesticides used by farmers is monocrotophos organophosphate insecticide which is widely used on cotton, maize, sorghum, rice, sugarcane, vegetable and tobacco pests

Although ecotoxicological manifestations of organophosphorous intoxication have been documented by several workers in various organs of fishes but despite our best efforts, we could not gather any information regarding the adverse effect of organophosphorous on the some system deeply viz. health profile of fishes. As healthy organs of fish are an important determinant of its breeding potential, and thus any toxicological factor adversely affecting the histoanatomy of liver will definitely hamper the gross production of fishes.

A hematological analysis is routinely used in mining the physiological state of animals h is known to be affected by different environmental factors and is used as a guide in the diagnosis of many diseases in both animals and humans (Solomon and Okomoda, 2012) ^[11].

Materials and Methods

Selection, rearing and maintenance of fish

Heteropneustes fossilis a catfish belongs to the family Heteropneustidae. It is commonly known as Asian Stinging catfish or fossil cat. It is found in India, Pakistan, Nepal, Srilanka, Thailand and Myanmar. In Sri Lanka, this fish is called Hunga by the Sinhala speaking community, in India it's called singhi. Tap water stored in large aquarium for dechlorination was used as a diluent medium. The water of aquarium was changed after every two days or even earlier when it gave foul smell.

Experimental protocol

To assess the effect of selected experimental compound lambda cyhalothrin, the fish, *Heteropneustes fossilis* were grouped in to five sets, four acute and one control each consisting six. The total erythrocyte count and hemoglobin concentration was estimated by the Wintrobe *et al.* (1981) ^[12] method and data was analyzed statistically (Fisher and Yates, 1950) ^[4]. In order to estimate the LC50 value, the fishes of different experimental sets have been treated with different concentrations of test compound. The mortality number of fishes at different time intervals i.e. 24 hrs, 48 hrs, 72 hrs and 96 hrs and percentage mortality for 96 hrs have been calculated which was used as final mortality for calculation as per international standards for fishes. The mortality number showed a corresponding increase with the increasing concentrations of the test compounds. Based on LC50, sublethal concentration was 1/10th of LC50.

Results and Discussion

The total erythrocyte count and hemoglobin concentration has been found to be decreased after exposure of lambda cyhalothrin as shown in tables 1&2 with fig. 1&2.

Normal blood cells have limited life spans; they must be replenished in precise numbers by a continuously renewing population of progenitor cells. Homeostasis of the blood requires that proliferation of these cells be efficient yet

strictly constrained. Many distinctive types of mature blood cells must arise from these progenitors by a controlled process of commitment to, and execution of, complex programs of differentiation. Thus, developing red blood cells must produce large quantities of hemoglobin but not the myeloperoxidase characteristic of granulocytes, the immunoglobulins characteristic of lymphocytes, or the fibrinogen receptors characteristic of platelets.

Similarly, the maintenance of normal amounts of coagulant and anticoagulant proteins in the circulation requires exquisitely regulated production, destruction, and interaction of the components. Understanding the basic biologic principles underlying cell growth, differentiation, and protein biosynthesis requires a thorough knowledge of the structure and regulated expression of genes because the gene is now known to be the fundamental unit by which biologic information is stored, transmitted, and expressed in a regulated fashion. Genes were originally characterized as mathematical units of inheritance. They are now known to consist of molecules of deoxyribonucleic acid (DNA). By virtue of their ability to store information in the form of nucleotide sequences, to transmit it by means of semiconservative replication to daughter cells during mitosis and meiosis, and to express it by directing the incorporation of amino acids into proteins, DNA molecules are the chemical transducers of genetic information flow. Efforts to understand the biochemical means by which this

transduction is accomplished have given rise to the discipline of molecular genetics.

Most insecticides affect the behavioral patterns of fish by interfering with the nervous systems [the activity of acetylcholinesterase (AChE)] and consequently lead to disorders in the fish response to environmental stimuli and mobility. Inhibition of AChE in fish is reported to be accompanied by an increase in acetylcholine (ACh) levels that can be dangerous since it will impact feeding capability, swimming activity, identification and spatial orientation of the fish species (Banaee *et al.*, 2008) [1]. Irregular, erratic and darting swimming movements, hyper excitability, loss of equilibrium and sinking to the bottom was reported in *Heteropneustes fossilis* upon lambda cyhalothrin exposure. Marigoudar *et al.*, 2009 [7] indicating that pesticides can affect nervous system of fishes. In present study, exposed group showed significant variability in TEC, Hb between pesticide treated and untreated control sets. Reduction in hematological values was observed indicating anemia in the pesticide exposed fish which may be due to erythropoiesis, haemosynthesis and osmoregulatory dysfunction or due to increase in the rate of erythrocyte destruction in haematopoietic organ (Seth and Sexena, 2003). Prusty *et al.* (2011) [9] and Kumar *et al.* (2012) who had also reported reduction in RBC count, hemoglobin concentration and WBC, HCT in *L. rohita* upon chlorpyrifos and pyrethroid and λ -cyhalothrin exposure respectively.

Table 1: Total Erythrocyte Count ($10^{12}/l$) in *Heteropneustes fossilis* under stress of lambda cyhalothrin

S. No.	Duration	No. of fishes	Total Erythrocyte Count ($10^{12}/l$)	
			Control	Treatment
			Mean \pm S.Em.	Mean \pm S.Em.
1.	24hrs	6	3.20 \pm 1.25	2.55 \pm 1.90*
2.	48hrs	6	3.20 \pm 1.25	2.10 \pm 0.95**
3.	72hrs	6	3.20 \pm 1.25	1.90 \pm 0.90***
4.	96hrs	6	3.20 \pm 1.25	1.55 \pm 0.67****

* Non-significant, **Significant, *** Highly significant, **** Very highly significant

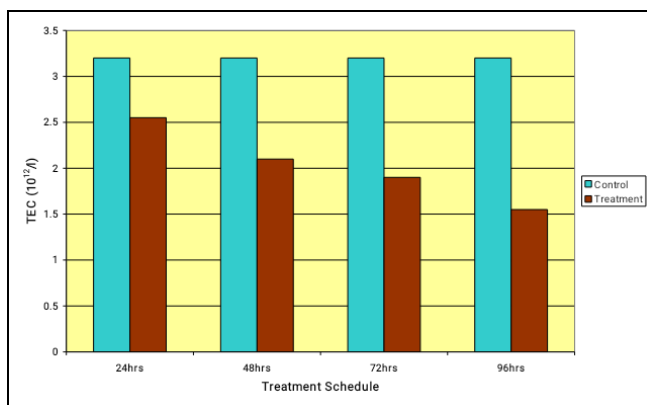


Fig 1

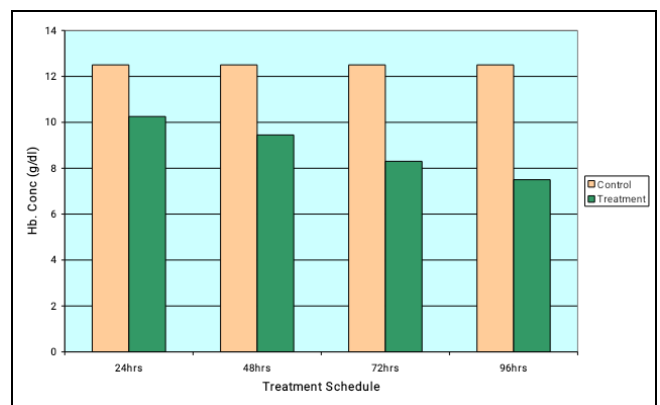


Fig 2

Table 2: Hb. Conc. (g/dl) in *Heteropneustes fossilis* under stress of lambda cyhalothrin

S. No.	Duration	No. of fishes	Hb. Conc. (g/dl)	
			Control	Treatment
			Mean \pm S.Em.	Mean \pm S.Em.
1.	24hrs	6	12.50 \pm 0.90	10.25 \pm 0.55*
2.	48hrs	6	12.50 \pm 0.90	9.45 \pm 0.67***
3.	72hrs	6	12.50 \pm 0.90	8.30 \pm 0.33***
4.	96hrs	6	12.50 \pm 0.90	7.50 \pm 0.50****

* Non-significant, **Significant, *** Highly significant, **** Very highly significant

This decrease in TEC in fishes after treatment is due to toxic effect of insecticides on bone marrow cells and disturbance in erythropoiesis which is the RBC formation process. In the present study, decrease in haemoglobin concentration may be correlated with decrease in total erythrocyte count (Guyton and Hall, 1996) [5].

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