

ORIGINAL RESEARCH ARTICLE

Biochemical Modulations Induced By Metasystox In Fresh Water Snakeheaded Fish *Channa striata* Blood

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ABSTRACT

Metasystox is one of the pesticides extensively used in agricultural practices throughout the world. *Channa striata* were exposed to sublethal concentrations (5 mg L^{-1}) of metasystox for 15 d to assess the alterations in the level of blood glucose, lactate, sodium and potassium in blood plasma. Significant alterations in all the biochemical parameters were found to be dose dependent. Elevated levels of blood glucose and depressed lactate, sodium and potassium in blood further indicated lower metabolic rate after 15 d of exposure. Significant decline in triglycerides content was observed in fish exposed to both sublethal concentrations of metasystox. It was concluded that metasystox is poisonous and had a significant effect on the behaviour and biochemical system, which adversely affected the health of the fish. The authors suggested that increase in glucose (hyperglycaemia) which was dose and duration dependent in the sub lethal exposure to metasystox may be considered to be manifestation of stress induced by the toxicants and analysis of biochemical parameters in the fish blood may serve as useful indices in environmental biomonitoring.

Keywords: *Channa striata*, Metasystox, blood glucose, lactate, sodium and potassium

INTRODUCTION

The indiscriminate use of pesticides to boost agricultural production has affected the ichthyofauna either directly or indirectly. Any changes in the natural ecosystem leads to conspicuous architectural changes in the aquatic organisms, especially fish. Since fish are great nutritional significance and their intoxication by pesticides causes retardation of growth and deterioration in the nutritional values (Livingston, 1977). Altered biochemical and immunological changes in response to pesticides usually lead to irreversible and detrimental disturbance of integrated functions, such as a behaviour, digestion, growth, reproduction and above all survival, which in turn may cause many changes at the population level (Cleveland, Fairchild and Little, 1999). Pesticide induced stress causes elevation in blood glucose, corticosteroid hormones and catecholamines that have been linked to impairment of immune and circulatory functions and lowered diseases resistance (Melamed *et al.*, 1999). The present research was

focused on the blood chemistry of snakeheaded *Channa striata*.

MATERIALS AND METHODS

Snakeheaded healthy *Channa striata* with no lesions or other indications of disease (weight : 20 –25 g and length: 10 –13 cm) were collected and acclimated to the laboratory conditions for 15 days before experimentation. During acclimation, the natural day and night photoperiods was maintained. During the time of acclimatization, the fish were fed with fish food feed two times a day (9.00 am and 7.00 pm). Feeding stopped 24 hours prior to the commencement of the experiment. Technical grade metasystox (Oxydemeton – methyl, 0, 0 –dimethyl – S- 2 (ethyl sulfinyl) ethyl phosphorothioate) of 95% purity was obtained from Bayer LTD, Bombay. A stock solution of metasystox was made in acetone (1mg /ml) and suitable quantities of this solution were added to the aquaria to obtain the desired concentrations. Lethal ($L_c 50 / 48hr$) concentration (5 mg / l) was calculated by a probit

method (Finney, 1964) and approximately 1/3 of the LC 50/48 hr concentration (1.7 mg / l) was chosen for sublethal exposure. At this concentration, the fish survived even after prolonged periods of exposure (Natarajan, 1984). Some biochemical changes in the fish *Channa striata* exposed to acute concentrations of metasystox was determined: Blood glucose was determined by spectrophotometrically (610 nm) using the GOD-period method (Boehringer – Mannheim). Lactate was estimated by Lang and Michal (1974). Sodium and potassium concentration were determined using the methods of Svobodora *et al.* (1991). Statistical significance of difference between control and treated groups of different exposure period were tested by using 't' test (Zar, 1984).

RESULT AND DISCUSSION

Blood glucose has been considered the most sensitive parameters in detecting sublethal stress responses (Wedemeyr *et al.*, 1990; Fivelstad *et al.*, 1995). Pollutants, particularly pesticides may exert general stress-effects i.e., increases in cortisol and catecholamines in plasma. Elevated concentration of these hormones induced increase in blood glucose (Nakano and Tomlinson, 1967; Schreck and Lorz, 1978). Elevated cortisol also facilitates sodium uptake from the environment in freshwater fish (Eddy, 1981) and affects potassium balance by decreasing plasma potassium (Hiroshige, 1992). Furthermore, it is reported that significant correlation between urine noradrenaline and potassium were reported (Saito and Konishi, 1991). These could therefore, account for the increase in glucose and decrease in potassium and remaining sodium in blood plasma. Sublethal metasystox elevated blood glucose and lactate level initially, registered a fall in their profile at 30 d duration. Sodium ion increased insignificantly at 15 d and inhibited at 30 d period.

Potassium ion was consistently suppressed at all times of experimentation (Table 1). Blood glucose though increased initially declined sharply during later period. Several workers have reported similar hyperglycemic effect in the freshwater fish like *Heteropneustes fossilis* and *Anabas testudineus* (Kumar and Patri, 2000) following pesticide exposure. The present investigation on *C. striata* confirms the works of Natarajan (1984) with regards to hyperglycemia. Hyperglycemia, generally believed to be a response to stressful condition and reaction to stress, is a feature of adaptation. The fall in the blood lactate level signals the switch over from anaerobic to aerobic phase in metabolism. Sodium is the chief regulator of osmotic pressure of the body fluid. It initiates and maintains the concentration of heart and involuntary muscles and excites the nerves. Grant and Mehrle (1970) reported that a high dose of endrin in gold fish caused sodium and chloride ion loss in due to complete failure of osmoregulatory process. Potassium is the main intracellular cation involved in several physiological functions viz., nerve and muscle function, acid base balance and osmotic pressure. Larsson *et al.* (1981) reported a pronounced decrease in potassium level during long term exposure of flounders to acute cadmium stress. They argued that disturbed potassium regulation might be due to an impaired active reabsorption of potassium in renal tubules (Gill *et al.*, 1989). It results by mobilization of reserve biochemicals into immediate sources of energy in form of glucose. It must, however, be pointed out that in some cases the acute exposure of metasystox to *Channa striata* adversely affects the blood biochemistry. Effluent discharge or pesticide application limits should be sorted to minimize the mortality rate and modulations in biochemistry of this species in an aquatic environment.

Table 1. Blood chemistry values of control and Metasystox exposed snake head *Channa striata*

Parameters	Control	Metasystox exposed			
		15 days	% change	30 days	% change
Glucose (mg/100ml)	76.14 ± 6.02	100.31 ± 7.52	+31.74*	81.00 ± 5.91	+6.38
Lactate (mg/100ml)	12.00 ± 1.24	17.51 ± 2.13	+45.92*	15.02 ± 2.10	+25.17*
Sodium (mmol/l)	268 ± 8.14	276 ± 9.00	+2.99	251 ± 6.01	-6.34
Potassium (mmol/l)	9.4 ± 1.3	8.1 ± 1.9	-13.89**	8.8 ± 1.5	-6.38

Data are given as Mean ± S.E. N= 6, *P<0.05, **P<0.001, others N.S

+ and – indicate percent increase and decrease over control values

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