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RESEARCH ARTICLE

IMPACT OF CYPERMETHRIN ON SERUM CORTISOL LEVEL IN THE INDIAN MAJOR CARP  
*LABEO ROHITA*

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ABSTRACT

The toxic effect of cypermethrin on the serum cortisol of *Labeo rohita* was studied. The fish were exposed for 24, 48, 72 and 96 hours in 10 and 20% sub lethal concentrations of 96 h LC<sub>50</sub> of cypermethrin (0.0037 ppm). There is no much significant variation in the plasma cortisol level of the control fish at different experimental periods. But in the cypermethrin fish there is an eloquent increase in the plasma cortisol level with increase in concentration and time of exposure.

INTRODUCTION

Usage of pesticide is a critical concern; it may have an adverse effect on the delicate ecosystem. Such impact caused stress to the aquatic organisms including fishes. The primary response to such stress in animal is envisaged in the hormone profile in the blood. Fishes are reported to respond on exposure to various pesticides by way of exhibiting changes in the profile of various hormones (Hontela, 1997). The response to stress in fish is characterized by the stimulation of the hypothalamus, which results in the activation of the neuro-endocrine system and a subsequent cascade of metabolic and physiological changes (Wedgemeyer, 1990; Lowe and Davison, 2005). These changes enhance the tolerance of organism to face an environmental variation or an adverse situation while maintaining a homeostasis (Mazeaud et al., 1977 and Pickering, 1981). Under conditions of stress, body of the fish emits immediate responses recognized as primary and secondary responses. The primary response is the perception of an altered state by the central nervous system and the release of the stress hormones, cortisol and catecholamines into the blood stream by the endocrine system (Ramdall and Perry, 1992), causing changes in the blood and tissue chemistry (Barton, 1997 and Begg and Pankhurst, 2004).

This entire metabolic pathway produces a burst of energy to prepare the fish for an emergency situation (Rottman et al., 1992). Cortisol is the principal glucocorticoid secreted by the internal tissue (steroidogenic cells) located in the head-kidney of teleost fishes (Iwama et al., 1999). Cortisol, as a stress responsive hormone under toxic condition, has been widely studied on exposure of fish to different types of pesticides. Alteration in the serum cortisol level in the fish *Clarias batrachus* when exposed to lambda cyalothrin has been reported (Saravanan et al., 2009). Benguira et al. (2002) observed different levels of changes in serum cortisol as a stress response on exposure to O,p DDD and p,p DDD compounds in the rainbow trout *Oncorhynchus mykiss*. Disruption in the cortisol secretion was reported in the copper exposed rainbow trout *Oncorhynchus mykiss* (Gagnon et al., 2006). In the present study, the elevated levels of cortisol due to stress induced by the pesticide cypermethrin in the Indian major carp *Labeo rohita* was assessed.

MATERIALS AND METHODS

Fish fingerlings were exposed to cypermethrin in the water at two sublethal concentrations viz., 10% and 20% of the LC<sub>50</sub> value. (0.05732 ppm) Fishes were collected for estimation after 24h, 48h, 72h and 96h of exposure. The collected fish was wiped with a dry cloth to remove water. Caudal peduncle was cut with a sharp blade and the blood was collected in a vial

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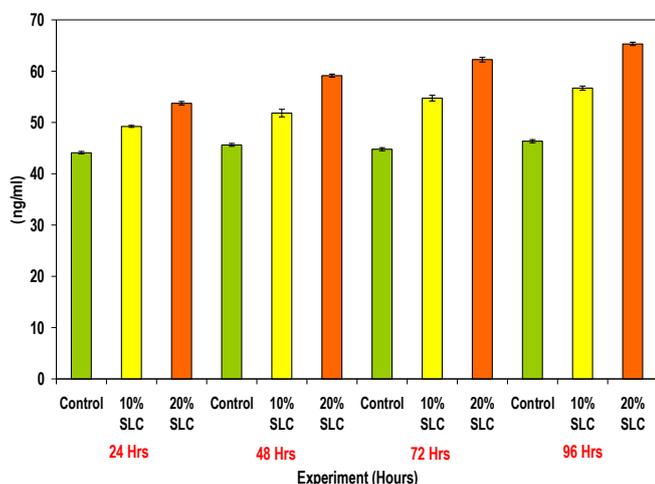
by using 6% EDTA as anticoagulant. Serum was separated, and was used for cortisol estimation. The amount of cortisol was estimated by Chemi Luminescence Immune Assay (CLIA) technique (Roda et al., 2000). Plasma cortisol level of the control and cypermethrin exposed *Labeo rohita* was expressed as ng/ml.

## RESULTS AND DISCUSSION

The plasma cortisol level in the control and cypermethrin exposed *Labeo rohita* at different span of exposure are given in the Table 1 and represented in the Fig.1. There is no much significant variation in the plasma cortisol level of the control fish at different experimental periods. But in the cypermethrin fish there is an eloquent increase in the plasma cortisol level with increase in concentration and time of exposure. The chemical coordination by endocrine system in organism is known to regulate a number of hormone dependent physiological functions essential for the survival of the organism both in normal as well as in an altered environmental conditions. The potential target of xenobiotics is the endocrine coordinating system and its vulnerability resides in part in the finely tuned mechanisms through which the endocrine control system operates in animals (Hontela, 1997). The xenobiotic compounds entering into the environment can have either direct adverse effects on the endocrine gland and tissues or their effects can be indirect through alterations of homeostasis and activities of non-endocrine organs (Brown, 1993).

**Table 1: Plasma cortisol level (ng/ml) of *Labeo rohita* exposed to the sublethal concentrations of Cypermethrin**

Duration of exposure (Hours)	Experiment	Plasma Cortisol Level (ng/ml)
24	Control	44.100 ± 0.23
	10% SLC	49.238 ± 0.18
	20% SLC	53.753 ± 0.34
48	Control	45.629 ± 0.27
	10% SLC	51.831 ± 0.73
	20% SLC	59.134 ± 0.29
72	Control	44.766 ± 0.30
	10% SLC	54.734 ± 0.56
	20% SLC	62.252 ± 0.45
96	Control	46.345 ± 0.29
	10% SLC	56.715 ± 0.39
	20% SLC	65.317 ± 0.33



**Fig. 1: Plasma cortisol level (ng/ml) of *Labeo rohita* exposed to the sublethal concentrations of Cypermethrin**

Cortisol is the principal glucocorticoid secreted by the steroidogenic cells of the internal tissue located in the head-kidney of teleost fish (Iwama et al., 1999). Cortisol is released by the activation of the hypothalamus-pituitary-internal axis (Mommensen et al., 1999). When an organism undergoes stress conditions, the hypothalamus releases corticotropin-releasing factor into circulating blood. This polypeptide further stimulates the secretion of adrenocorticotrophic hormone from the anterior pituitary gland (Fryer and Lederis, 1986) which finally activates the release of cortisol by the internal tissue (Mommensen et al., 1999). Elicitation of serum cortisol level due to stress caused by xenobiotic compounds is evident through the perusal of available literature. Bennette and Wolke (1987) investigated the increase in serum cortisol level in the rainbow trout *Salmo gairdneri* on exposure to sublethal concentrations of Endrin and they suggested that the elevated cortisol could be towards immune repression. Similar elevated levels in serum cortisol on exposure to carbaryl in *Salmo gairdneri* was reported by Balow and Rosenthal (2001). *Sardotherodon mossambicus* exposed individually to varying concentrations of Dimecron and Cuman L exhibited increased levels of Plasma cortisol upon different exposure period (Jasmin Christal et al., 2003).

Barton and Iwama, 1991 stated that the secondary responses in fish occur as a consequence of the released stress hormones, which causes changes in the blood and tissue chemistry i.e., an increase of plasma glucose (Barton, 1997 & Begg and Pankhurst 2004). This entire metabolic pathway produces a burst of energy to prepare the fish for an emergency situation (Rottman et al., 1992). In the present investigation an eloquent raise in serum cortisol level was witnessed in *Labeo rohita* on exposure to the pesticide cypermethrin. It is attributed that the elevated level of plasma cortisol could be towards the induction of secondary response of the fish for the sudden release of energy to an emergency situation or may be for immune repression.

## CONCLUSION

The pesticide cypermethrin causes stress in the fish *Labeo rohita*, which is characterized by the stimulation of the hypothalamus, this in turn results in the activation of the neuro-endocrine system and the release of the stress hormone cortisol into the blood. The elevated level of cortisol in the serum activates the target tissue to produce a burst of energy to prepare the fish for an emergency situation.

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