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Impact Of Synthetic Pyrethroid Lambda Cyhalothrin On Protein Metabolism In Selected Tissues Of Albino Mice

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ABSTRACT

Pyrethroids insecticides, including lambda-cyhalothrin are widely used for the control of insect pests all over the world to increase the production of food grain and other agricultural products. It may also be used in public health applications to control insects such as cockroaches, mosquitoes, ticks and flies which may act as a disease vector. In the present study, an attempt has been made to study the effect of lambda-cyhalothrin on protein content of different tissues like liver, and kidney of the albino mice. The mice were exposed to the pesticide for a period of 10, 20 and 30 days at a sublethal concentration of 1/5th of LD50 4.8 mg/kg bw. Biochemical analysis of total proteins and total free amino acids was carried out on the 11th, 21st and 31st day of exposure to find out changes in the biochemical constituents due to toxic stress caused to the mice. The results showed a significant decline in total proteins in all the tissues during different days of exposure to lambda cyhalothrin, while total free amino acids showed an increase in liver and kidney.

Key words: Protein metabolism, synthetic pyrethroid, Free amino acids, Total Proteins

INTRODUCTION

Pollutants such as insecticides may significantly damage certain physiological and biochemical processes when they enter into the organs. Lambda cyhalothrin is a pyrethroid insecticide **Adhikari *et.al.*, (2006); John, (2007).** Pyrethroids are synthetic chemical analogues of pyrethins which are naturally occurring insecticidal compounds produced in the flowers of *Cyrysanthemum cinerariaefolum.* The persistence and continuous application of these synthetic pyrethroids may create a problem directly or indirectly in the higher tropical level of the ecosystem. Accidental exposure at the work place and their presence in the environment has aroused concern over their possible adverse effects on human health.

The intake of insecticide affects the biochemical composition of organisms. Biochemical indices of stress have been proposed to assess the health of non-target organisms exposed to toxic chemical in ecosystem **Nimmi (1990).**Protein constitutes the building block and the basic molecule for any biochemical reaction. They are intimately related with almost physiological processes, which maintain a simple biochemical system in living condition. The physiological and biochemical alterations observed in an animal under any physiological stress can be correlated with the structural and functional changes of cellular proteins. Proteins occupy a unique position in the metabolism of cell because of the proteinaceous nature of all the enzymes which mediate at various metabolic pathways **Michacla and, David, (2008).**

MATERIAL AND METHODS

Chemical Substance

Technical grade of Lambda cyhalothrin, a synthetic pyrethroid. The effective dose 4.8 mg/kg/day given orally in corn oil vehicle for 10, 20 and 30 days below their acute LD_{50} level of intoxication according to their body weight. The mouse oral LD_{50} for Lambda cyhalothrin is 24 mg/kg body weight.

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Experimental Animal

Albino mice of 30±5g were selected from an inbred colony for the experimentation. The mice were maintained in the laboratory. The selection of albino mice for experiment is based on the fact that it is easy to rear them in laboratory, easy to handle in laboratory and they possess short gestation period. Secondly, albino rat is a mammal so it can be used as a model to similar reference in case of human being.

The animals were provided with standard pellet and water throughout the study. The mice were maintained under normal day/ night schedule (12L: 12 D) at room temperature 26˚C ± 1˚C. The control and experimental animals after a stipulated period (*i.e.* on 11th, 21st and 31st day) were sacrificed and the tissues were quickly isolated, cleaned in physiological saline and processed immediately for microscopic analysis under ice-cold conditions. The tissues were also quickly isolated and were kept in deep freezer at -80°C and used for biochemical analysis.

Biochemical studies

Biochemical studies such as Protein levels were estimated by the method of **Lowry et al., (1951)**; Free amino acid content was estimated by the method of **Moore and Stein (1954)** as described by **Colowick and Kaplan (1957)**.

Statistical analysis

Statistical significance between the control and experimental data were subjected to analysis of variance (ANOVA) together with Dunnett's test ($P<0.05$).

Results and Discussions

The exposure of an organism to a xenobiotic can modify the synthesis of certain metabolites and disturb the functionality of the organism **Rodriguez-Ortega *et.al.*, (2003).** The physiological activity of animal was indicated by the metabolic status of proteins **Nelson and Cox (2005)**, **Harper (2005)** and **Sathyanarayana (2005).** Protein metabolism is considered the most sensitive physiological responding to environmental stress. The alternations of total protein content and free amino acids in the treatments and control group are presented in Table 1 and 2.

The protein content in the tested tissues of mice was found to decline with increasing exposure days 10, 20, 30 respectively. The maximum protein content of 144.090 ±1.4742 mg/ gm wet tissue (control) and minimum of 71.818±1.5656 mg/ gm wet tissue (30 days) were recorded in liver and kidney tissues respectively. The decrease in protein content in different tissues of mice indicated that the active degradation of protein under lambda-cyhalothrin stress. Proteins are mainly involved in the architecture of the cell, which is the chief source of nitrogenous metabolism. Thus the depletion of protein fraction in liver, and kidney tissues may have been due to their degradation and possible utilization for metabolic purposes. A defect in protein synthesis by the action of toxicants can also decrease the protein content in different tissues. An altered relationship between the ribosomes and the membranes of the endoplasmic reticulum may also produce a defect in protein synthesis. Depletion of proteins might also be attributed to the destruction or necrosis of cellular function and consequent impairment in protein synthetic machinery as suggested by **David *et al*. (2004). Ali *et al*. (2011; 2014)** demonstrated that breakdown of protein into free amino acids as well as the decrease in RNA, due to the insecticidal stress, could result in the decrease in total protein.

In the liver, the free amino acids increased from 10th day to 30th day in the animals exposed to the sublethal concentration. A similar trend observed in the liver was also seen in kidney of the animals in experimental groups. The levels of free amino acids in kidney showed an elevation by the

10th day reaching to a maximum of on the 30th day.

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Increases in free amino acid levels were the result of breakdown of protein for energy and impaired incorporation of amino acids in protein synthesis. The toxicants may affect the hormonal balance which could directly or indirectly affect the tissue protein levels **(Khillare YK, and Wagh SB (1988); Morthy and Priyamvada, 1982; and Singh *et.al.* (1986).**

The enhanced FAA levels may be channelled for energy synthesis and other metabolic reactions **(Kovacs and Seglen, 1981)**. The elevated FAA levels are utilized for energy production by feeding them as keto acids into the TCA cycle through aminotransferases to contribute energy needs during toxic stress. Increases in free amino acid levels were the result of breakdown of protein for energy and impaired incorporation of amino acids in protein synthesis **(Singh *et al.*, 1996)**.

From these observations made in the mice under Lambda cyhalothrin intoxication, it is concluded that the changes are dependent on the dose of pesticide. High dose caused more damage to the physiological, biochemical activities of the mice.

Table 1: Changes in Total Protein content in different tissues of control and Lambda cyhalothrin treated albino mice (mg/gm wet wt of tissue).

Tissues	Control	10 Days	20 Days	30 Days
Liver				
Mean	144.090	124.866	109.390	82.466
S D	±1.4742	±2.0040	±1.138	±1.079
PC		(-13.341)	(-24.694)	(-42.767)
Kidney				
Mean	116.314	102.870	90.500	71.818
S D	±2.6990	±0.538	±2.093	±1.5656
PC		(-11.558)	(-22.193)	(-38.255)

Values are mean of six individual observations

±SD-Standard Deviation; PC - Percent Change over control

One Way Anova

Source of Variation	DF	Liver	Kidney
		Mean Squares	Mean Squares
Between Groups	3	4066.653*	2146.610*
Within Groups	20	2.613	3.602
Total	23		

All the values are Significant at P<0.05

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Table 2: Changes in Free Amino Acid content in different tissues of control and Lambda cyhalothrin treated albino mice (µ moles of tyrosine /gm wet wt of tissue).

Tissues	Control	10 Days	20 Days	30 Days
Liver				
Mean	21.883	25.785	28.664	31.527
S D	±1.3490	±0.8964	±1.3190	±1.1999
PC		(17.825)	(30.984)	(44.064)
Kidney				
Mean	18.258	21.005	22.789	25.685
S D	±1.3083	±1.3521	±1.2755	±1.1985
PC		(15.045)	(24.816)	(40.678)

Values are mean of six individual observations

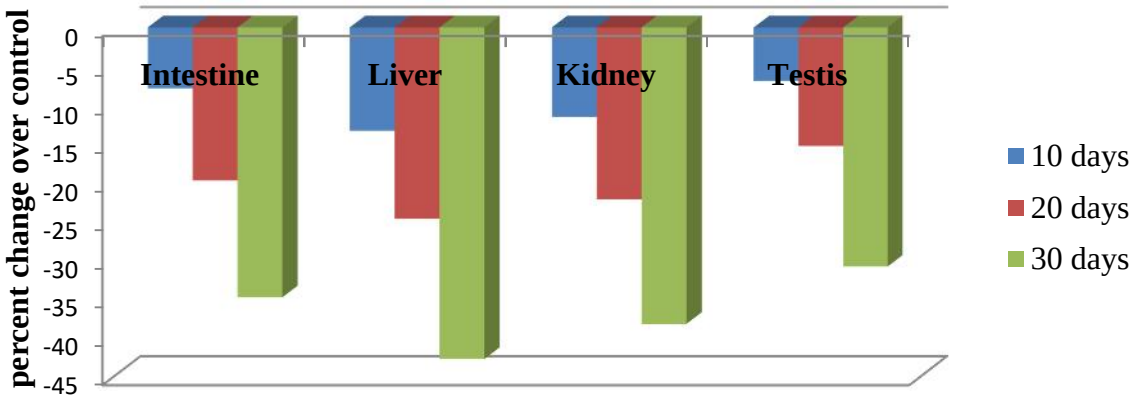
±SD-Standard Deviation; PC - Percent Change over control

One Way Anova

Source of Variation	DF	Liver	Kidney
		Mean Squares	Mean Squares
Between Groups	3	101.855*	58.359*
Within Groups	20	1.451	1.651
Total	23		

All the values are Significant at P<0.05

Fig: 1 Changes in Total Protein content in different tissues of control and Lambda cyhalothrin treated Albino mice (mg/gm wet wt of tissue).



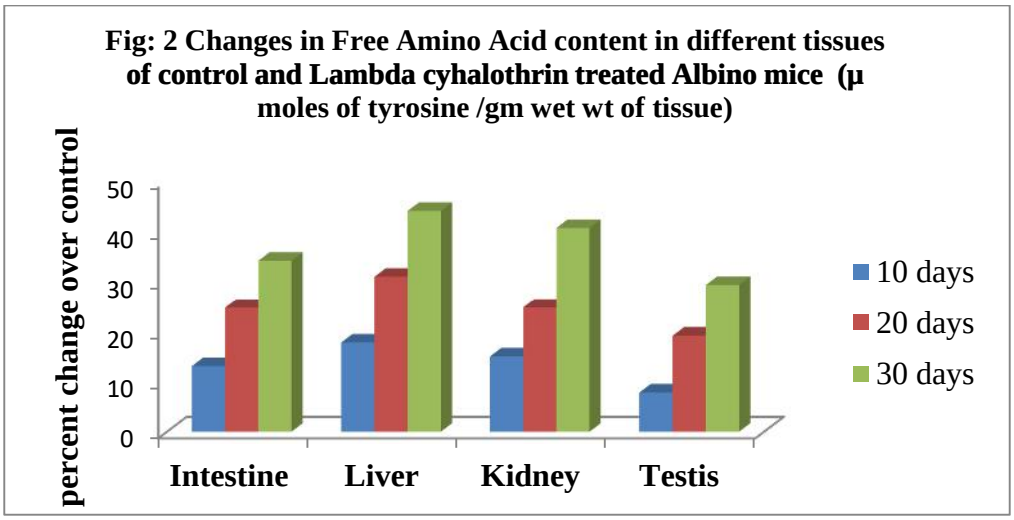


Fig: 2 Changes in Free Amino Acid content in different tissues of control and Lambda cyhalothrin treated Albino mice (µ moles of tyrosine /gm wet wt of tissue)

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