ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

EFFECT OF LAMBDA CYHALOTHRIN TOXICITY ON SELECTED BIOCHEMICAL PARAMETERS IN HEPATO AND RENAL TISSUES OF ALBINO MICE

Dr. Suseela M[1*] ,Gokul K[2]

Corresponing author:[1*]*Assistant Professor, Department of Zoology, Vikrama Simhapuri University PG Centre, Kavali, Nellore, AP, India. Email: drsuseelameesala@gmail.com*

[2]*Research Scholar, Department of Zoology, Rayalseema University, Kurnool, AP, India. Email: gokulkanchi07@gmail.com*

ABSTRACT

Insecticides, including pyrethroids, are widely used worldwide to control insect pests to enhance the production of food grains and agricultural products. Pyrethroids may also be used for public health purposes to control insects like cockroaches, mosquito, ticks and flies that may act as disease vectors. In this study, an attempt was made to determine the effects of lambda (cyhalothrin) on the protein metabolism of various tissues such as liver and kidney of albino mice. The albino mice were exposed for 10 days, 20 days and 30 days at sub-lethal concentrations of 1/5 LD50 4,8 mg/kg bodyweight. The total protein and total free amino acid levels were analyzed on the 11th day, 21st day and 31st day respectively to determine changes in biochemical constituents caused by toxic stress to the mice. The results showed a significant decrease in total proteins in all tissues on different days of exposure with the exception of liver and kidney, whereas free amino acids, protease, GDH, Ammonia and urea increased in liver and kidney.

Key words: Protein metabolism, pyrethroid, Lambda cyhalothrin, Albino Mice.

INTRODUCTION

Pollutants, such as insecticides, can have a detrimental effect on certain bodily functions when they enter the body. Pyrethroids, a type of synthetic chemical analog of pyrethins, are naturally occurring insecticides found in the flowers of the Cyrysanthemum cinerariaefolum plant. Their persistent and continuous use in the higher tropical levels of the ecosystem has raised concerns about their potential negative effects on human health, both from accidental exposure at the workplace and from the presence of pyrethroids in the environment. The process of metabolism is a combination of physical and chemical activities that take place within the body's cells and are essential for the preservation of life. This includes both anabolism, which is the process of breaking down complex materials into smaller pieces, as well as

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

catabolism, the process of breaking them down into smaller pieces. Protein metabolism is the process of transforming amino acids that are easier to absorb from the intestine into portal blood, which is then sent to the liver for further processing. Certain proteins can be created in the body through the metabolism of amino acids that are found in food, while a significant number of them are created from amino acids that are not present in food.

Insecticide intake has been found to have an effect on the biochemical makeup of organisms, and biochemical indices of stress can be used to evaluate the health of organisms that have not been exposed to the toxic chemical (Nimmi, 1990). Protein is the fundamental building block of any biochemical reaction, and is closely linked to almost physiological processes that maintain a basic biochemical system in life. When an animal is exposed to any physiological stress, the physiological and biochemical changes that occur can be linked to changes in cellular proteins. Protein plays a unique role in cellular metabolism, as it is proteinaceous to all the enzymes that regulate various metabolic pathways (Michaela and, David, 2008). These enzymes are converted into amino acids, which are then incorporated into proteins or deaminated or oxidized (Murray *et al.*, 2007).

The metabolism of free amino acids in the liver is considered to be the primary pathway between the metabolism of protein and the metabolism of carbohydrates **(Murray *et al.*, 2007)**. The free amino acid content in the liver is known to vary between physiological and pathological conditions **(Schreier, 1962)**, and the digestive enzymes involved in digestion, Proteolytic and Protease, are known to break down peptide bonds in protein foods to release the amino acids required by the body. The synthesis of macro and micro molecules is a universal process in all living organisms, which involves the continual turnover of cellular components. Proteases are responsible for the breakdown of proteins to smaller peptides and eventually to amino acids.

GDH is responsible for the reversible oxidation of glutamate to amino acids like glutamate, ketoglutarate, and ammonia **(Sund *et al.*, 1977)**. It's important for nitrogen metabolism and carbohydrate metabolism in the Krebs cycle, and it's the main way to turn ammonia into the amino acid group nitrogen **(Bhargava, 1982; Babij *et al.*, 1983)**. Ammonia is toxic in the nitrogen metabolism that cells are sensitive to, and it's important for regulating acid-base levels and making purines, pyramidsines, and other amino acids. It's also one of the ways ammonia is detoxified in freshwater fish. How exposure to sub lethal doses of lambda cyhalothrin affected protein metabolism in mice were studied in the present study.

MATERIAL AND METHODS

Chemical Substance

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Lambda Cyhalothrin (Synthetic pyrethroid) is a synthetic pyrethroid. The effective dose of Lambda is 4.8mg/kg/day administered orally in maize oil vehicle for 10 days, 20 days and 30 days depending on the body weight of the mice. The acute LD50 of intoxication of the mice is 24mg/kg body weight.

Experimental Animal

For the experiment, 30+5g albino mice were chosen from the inbred colony. The mice were kept in the laboratory because they are easy to rear, easy to handle, and have a short gestation period. Additionally, albino rats are mammals, so they can serve as a model for similar reference in the case of human beings.

The animals were fed standard pellets and water throughout the duration of the study. They were kept on a normal day / night schedule (121:12 D) and were kept at room temperature 26 °C 1 °C. After a specified period of time (i.e., 11, 21, and 31 days), both control and experimental animals were sacrificed. The tissues were quickly isolated and cleaned in physiological saline before being processed for microscopic analysis at an ice-cold temperature. The tissues were then stored in a deep freezer at a temperature of -80 °C for biochemical analysis.

Biochemical studies

In biochemical studies, Protein levels were determined using the Lowry et al. (1951) method, Free Amino Acid content was estimated using Moore and Stein's (1954) described by Colowick & Kaplan's (1957) method, Peotease was estimated using Moore & Stein's method, GDH was estimated using Lee & Lardy's (1965) method, modified by Pramilamma & Swami's (1975), Ammonia was estimated using Berg Meyer's (1965), and Urea was estimated using Natelson's (1971) method.

Statistical analysis

ANOVA and Dunnett's test were used to determine statistical significance between control and experimental data ($p<0.05$).

RESULTS:

When an organism is exposed to a Xenobiotic, its metabolism can be altered, resulting in a decrease in the synthesis of some metabolites and a disruption of the organism's functioning. This was demonstrated by the metabolic state of proteins in animals. Protein metabolism is known to be the most vulnerable physiological response to environmental stress. In this study, when albinio mice were exposed to Lambda Cyhalothrin, the protein content of liver and kidney decreased over time. From control to 30-day treated mice, there is a steady-state increase in Free Amino Acids, Protease (Protease), GDH, Ammonia and Urea. In the experimental mice treated with Lambda Cyhalothrin, there was a statistically significant increase in the free amino acids in the liver and kidney. The rise was in dose- and time-dependent in treated mice.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

The following Tables illustrate the alternations in total protein content (TPC), free amino acids (FAA), protease (Protease), GDH (Glutamate dehydrogenase), Ammonia and Urea in both the treated and control groups.

Total Proteins:

The results of total protein content of the control and experimental albino mice under Lambda cyhalothrin are presented in Table 1 and Figure 1. In experimental conditions the decrease is maximum in Liver (42.76%) of Group III treated mice for 30 days with sub lethal dose of Lambda cyhalothrin followed by Kidney (38.25%) respectively.

Free amino acids

The Free amino acid content of the control and experimental albino mice under the study are given in Table 2 and Figure 2. There is a gradual increase in the content of free amino acids from control to 30 days treated mice and the maximum increase of Free amino acid content was observed in Liver (44.06%) of 30 days treated mice followed by Kidney (40.67%).

Protease

Gradual increase in protease activity was observed from group I to group III i.e. from 10 days to 30 days treated mice. the tissues have shown increased protease activity and the maximum activity was observed in group III mice Liver (34.06%) followed by Kidney (25.69%). The data presented in Table 3 and Figure 3 results of protease activity in the control and experimental albino mice under the study.

Glutamate dehydrogenase

The data presented in Table 4 and Figure 4 shows the Glutamate dehydrogenase activity in the control and experimental albino mice treated with Lambda cyhalothrin. The experimental mice exposed to Lambda cyhalothrin showed statistically significant increase of Glutamate dehydrogenase activity in Liver (32.25%) and then Kidney (26.81%).

Ammonia

In experimental conditions the tissues have shown increased Ammonia content maximum in Liver (17.66%) followed by Kidney (15.77%). The Table 5 and Figure 5 give information regarding Ammonia levels in control and experimental albino mice exposed to Lambda cyhalothrin under the study.

Urea

The experimental mice exposed to Lambda cyhalothrin showed statistically significant increase in Urea content. In experimental conditions the tissues have shown increased Urea content maximum in Liver

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

(28.16%) followed by Kidney (19.42%). The data present in the Table 6 and Figure 6 shows the content of Urea in control and experimental albino mice under the study.

DISCUSSION:

Pesticides can be used to protect us from pests, but they can also be harmful to us if they get into our food. The liver is usually the first place to get hit by any toxic substance, and it plays a big role in how our bodies metabolize proteins. In this study, they found big changes in some of the metabolites and enzymes used in protein metabolism after giving Lambda Cyhalothrin to albino mice. The deaminases worked harder to break down the nucleotides, giving us more energy to fight off the toxic effects. When they gave sub-lethal doses, it caused a big drop in total protein levels over time, depending on the dose.

The increase in free amino acids was due to the breakdown of protein to provide energy and the failure of amino acids to be incorporated into protein synthesis. Toxicants may have an effect on the hormonal balance, which may either directly or indirectly influence tissue protein levels. The exhaustion of protein levels may lead to the need to diversify energy sources in order to meet the future energy requirements during toxic stress. Jagadeesan and Mathivanan (1999), and Klassan et al. (1991) suggest that the exhaustion of protein leads to an increase in the rate of proteolysis, and that the products of this degradation may be used for metabolic purposes, which can be fed into the TCA cycle via the Aminotransferases system to meet the excess demand for energy during the removal of toxins from the body.

The increased FAA content is a direct result of (a) increased proteolysis or (b) the conversion of ammonia to keto acids which results in the synthesis of amino acids. Both of these processes contribute to the pool of amino acids. These amino acids can be used to synthesize new types of proteins and enzymes to overcome the toxic stress conditions that the animal has been exposed to (Ogata et.al., 1978; James et.al., 1982). The increase in protease activity observed in various tissues in this study is reflected in the decrease of total protein levels in tissues. Tissue specific and dose and time-dependent depletion of protein content with enhanced enzyme activities observed.

GDH activity was increased in all tissues of mice treated with lambda cyhalothrin. The increased GDH activity levels suggest that GDH plays a role in the production of ammonia and glutamate oxidation during lambda cyhalothrine toxicity. GDH activity may play a role in the increased ammonia level in this study as a function of lambda cyhalothrine stress. Due to its high toxicity, ammonia may lead to a transition from aerobiotic to anaerobiotic conditions. According to Brandt et al., (1983), large amounts of ammonia are deposited in tissues following the deamination of amino acids.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

The increased urea levels coincided with increased protein synthesis, increased transamination, and increased ammonia concentrations during Lambda Cyhalothrin Toxicosis. Therefore, an increase of urea indicates that different tissues in exposed rats are involved in the increase of ammonia toxicity, in addition to their primary role in replacing protein nitrogen to produce useful precursor products for homeostasis maintenance and dynamic balance. Elevated urea levels under Lambda cyclothrin stress suggest that the mice may have evolved to biosynthesis urea as an important pathway for detoxifying ammonia.

It can be inferred from these observations made in mice under Lambda Cyhalothrin intoxication that the changes are dose dependent and shows that higher the pesticide dose, the greater the damage to the physiological and biochemical functioning 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

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

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

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

Table 3: Changes in Protease activity (µ moles of tyrosine/mg protein/hr) levels in different tissues of control and Lambda cyhalothrin treated albino mice.

Tissues	Control	10 Days	20 Days	30 Days
Liver				
Mean	1.359	1.575	1.726	1.822
S D	±0.1017	±0.0903	±0.1296	±0.1026
PC		(15.849)	(27.005)	(34.069)

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Kidney				
Mean	0.720	0.789	0.873	0.905
S D	±0.0180	±0.0236	±0.0201	±0.0145
PC		(9.583)	(21.250)	(25.694)

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	0.2414*	0.042*
Within Groups	20	0.0115	0.00038
Total	23		

All the values are Significant at P<0.05

Table 4: Changes in Glutamate dehydrogenase (µ moles of formazon formed/mg protein/hr) levels in different tissues of control and Lambda cyhalothrin treated albino mice.

Tissues	Control	10 Days	20 Days	30 Days
Liver				
Mean	0.186	0.219	0.224	0.246
S D	±0.0076	±0.0089	±0.0052	±0.0073
PC		(13.440)	(20.430)	(32.258)
Kidney				
Mean	0.179	0.198	0.211	0.227
S D	±0.0080	±0.00114	±0.0070	±0.0238
PC		(10.614)	(17.877)	(26.815)

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	0.00506*	0.002*
Within Groups	20	0.000075	0.00009
Total	23		

All the values are Significant at P<0.05

Table 5: Changes in Ammonia levels (µ moles of ammonia/gm wet wt of tissue) in different tissues of control and Lambda cyhalothrin treated albino mice.

Tissues	Control	10 Days	20 Days	30 Days

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Liver				
Mean	7.212	7.782	8.182	8.486
S D	±0.696	±0.0451	±0.106	±0.0942
PC		(7.903)	(13.449)	(17.665)
Kidney				
Mean	2.517	2.644	2.818	2.914
S D	±0.0182	±0.0262	±0.0485	±0.777
PC		(5.045)	(11.958)	(15.772)

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	1.818*	0.188*
Within Groups	20	0.127	0.002
Total	23		

All the values are Significant at P<0.05

Table 6: Changes in Urea levels (µ moles of urea /gm wet wt of tissue) in different tissues of control and Lambda cyhalothrin treated albino mice.

Tissues	Control	10 Days	20 Days	30 Days
Liver				
Mean	3.124	3.345	3.653	4.004
S D	±0.0767	±0.0665	±0.0705	±0.0789
PC		(7.074)	(16.933)	(28.169)
Kidney				
Mean	0.628	0.670	0.725	0.750
S D	±0.0620	±0.031	±0.0119	±0.0463
PC		(6.687)	(15.445)	(19.426)

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	0.8789*	0.0176*
Within Groups	20	0.00542	0.0043
Total	23		

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

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).

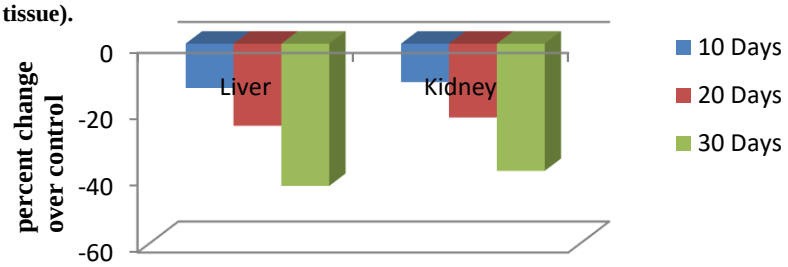


Fig 2: Changes in Free Amino Acid content in different tissues of control and Lambda cyhalothrin treated albino mice (µ moles of tyrosine /gm wet wt of tissue

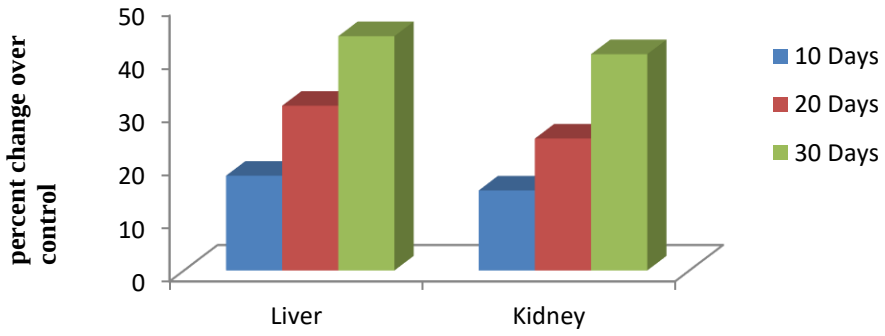
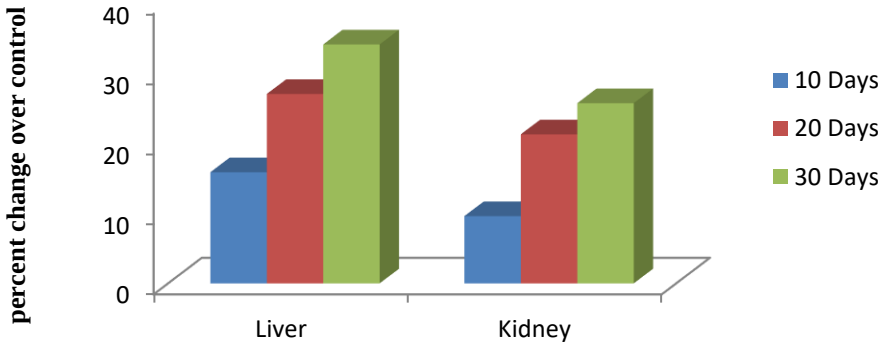


Fig 3: Changes in Protease activity (µ moles of tyrosine/mg protein/hr) levels in different tissues of control and Lambda cyhalothrin treated albino mice.



ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Fig 4: Changes in Glutamate dehydrogenase (µ moles of formazon formed/mg protein/hr) levels in different tissues of control and Lambda cyhalothrin treated albino mice.

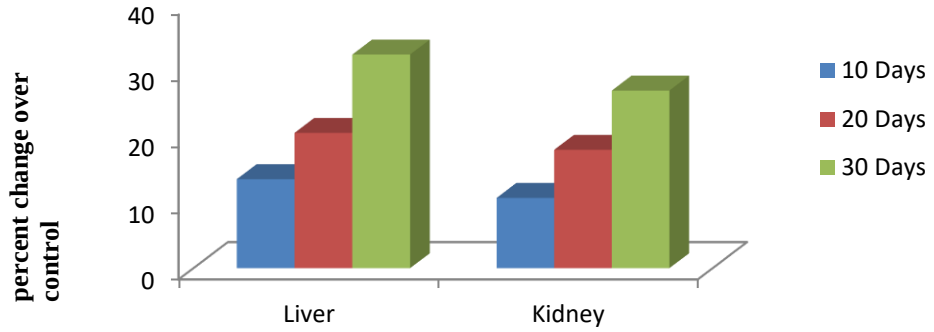
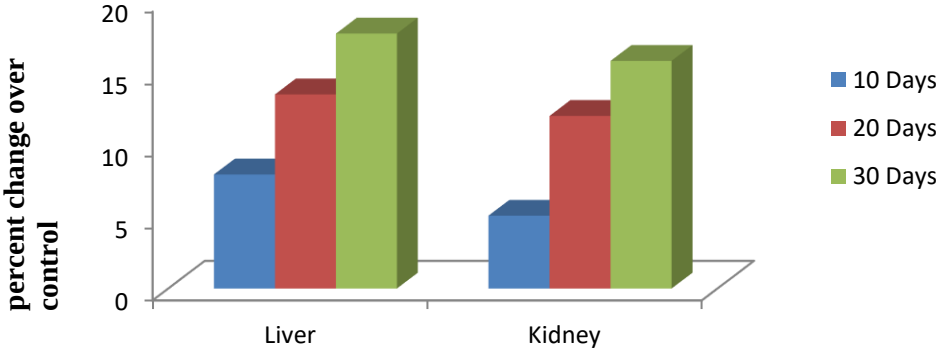
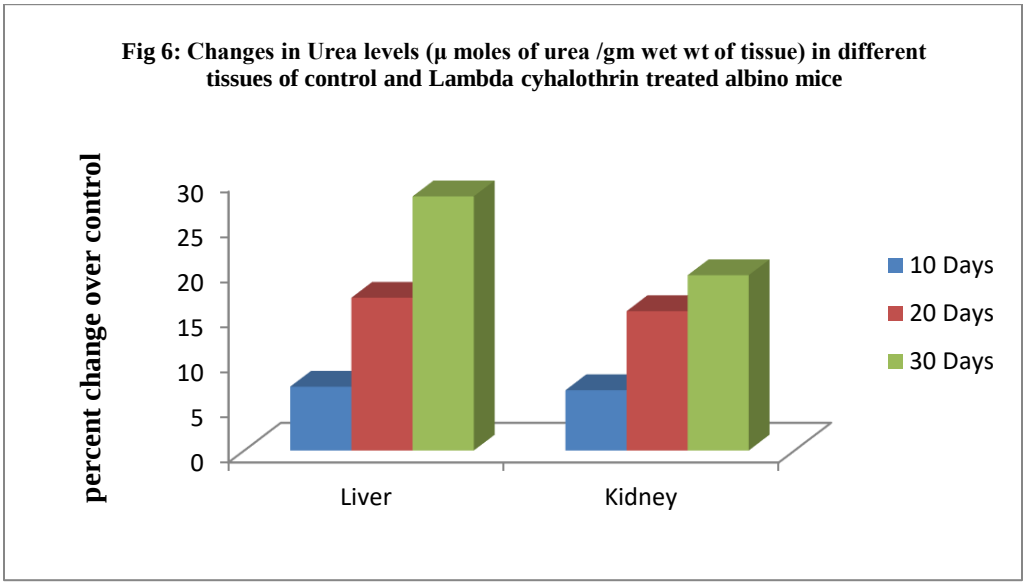


Fig 5: Changes in Ammonia levels (µ moles of ammonia/gm wet wt of tissue) in different tissues of control and Lambda cyhalothrin treated albino mice



ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022



ACKNOWLEDGMENTS:

Authors are thankful to Department of Zoology, Rayalseema University, Kurnool, and Department of Zoology, VSU PG Centre, Kavali, Nellore, AP, India for providing necessary facilities to carryout present research work.

REFERENCES:

Babij P, S.M. Maththews and M.J. Rennie s Change in blood ammonia, lactate and amino acids in relation to workload during bicycle exercise in man. *Eur. J. Physiol.*, 50: 405-411.

Bergmeyer H.V (1965). "*In: Methods of Enzymatic Analysis*", (ed). H.V. Bergmeyer, Academic Press, New York, 401.

Bhargava D (1982). Fatigue induced changes in carbohydrate and protein metabolism and their modulation by pyridoxal-5-phosphate in the gastrocnemius muscle of *Bufo melanostictus*. Ph.D. Thesis, Sri Venkateswara University, Tirupati, India.

Brandt R.T, J.A. Paterson and D.K. Bowman (1983). Nutrition Reports International. 28: 219.

Colowick S.P and Kaplan (1957). In Methods of Enzymology, Academic Press, New York, 501.

Jagadeesan G and A. Mathivanan (1999). Organic constituent changes induced by 3 different sublethal concentrations of mercury and recovery in the liver tissue of *Labeo rohita* finger lings. *Poll. Res.*, 18(2): 177-181.

James D.Y, E.C. Janice and M.R. Keith (1982). Effects of chronic exposures to pesticides in animal systems (Eds. Jamice, E.C. and James, D.Y.) Raven Press, New York.

ISSN PRINT 2319 1775 Online 2320 7876

 UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, 2022

Klassan C.D (1991). Heavy metal and heavy antagonists. In gilman, A.G; L.S.Goodman, Gilman. Eds. Pharmacological basis of terapentics. 1615. London, Bailliere, Tindall.

Lee, Y.L., and Lardy, H.A. (1965): Influence of thyroid hormones on L-glycerophosphate dehydrogenase and other dehydrogenases in various organs of the rat. J. Biol. Chem. 240, 1427-1436.

Lowry O.H. N.J Rosenbrough, A.L Farr and R.S Randall (1951). Protein measurement with folin-phenol reagent. Journal of Biological Chemistry, 193: 265-273.

Michael MC, David LN (2008). Lehinger principles of biochemistry, Edn 5, New York 2008; 570-572.

Moore S and W.H. Stein (1954). Modified ninhydrin reagent for the photometric determination of amino acids and related compounds. Journal of Biological Chemistry, 221: 907-913.

Murray R.K, Granner D.K, Mayes P.A. and Rodwell V.W (2007). In: *Harper's Illustrated Biochemistry*. International 26th Edition, The McGraw-Hill Companies, Inc. pp 46, 47.

Natelson S (1971). Total cholesterol procedure (Libermann Burchard reagent) or free fatty acids in serum. In: Techniques of clinical chemistry 111 Edn. Charles. C. Thomas. Publishers, Spring field Illinois, U.S.A., pp. 263-268.

Nimmi AJ (1990). Review of biochemical methods and other indicators to assess fish health in aquatic ecosystems containing toxic chemical. J Great lakes Res 1990; 16:529-541.

Ogata S.E, S.K.H. Foung and M.A. Holiday (1978). The effect of starvation and refeeding on muscle protein synthesis and the catabolism in the young rat. *J. Nutr.*, 108: 759-765.

Pramilamma, Y., and Swami, K.S. (1975): Glutamate dehydrogenase activity in the normal and denervated Gastrocnemius muscles of frog. Current Science. 44, 739

Schreier K (1962). " In: Amino acid pools". J.T. Holden Ed., Elsevier, Amsterdam, p.263.

Sund H, H. Dieter, R. Koberstein and I. Rasched (1977). GDH: Chemical modification and ligand binding. *Journal of Molecular Catalysis.*, 2: 1-23.