

EFFECT OF CYFLUTHRIN (SYNTHETIC PYRETHROID –SOLFAC 050EW) ON ASPARTATE AND ALANINE AMINOTRANSFERASE PROFILES IN ACUTE AND SUB-CHRONIC STUDY WITH SWISS ALBINO MICE

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ABSTRACT

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. Toxic effect of sub chronic and acute dose exposure of a synthetic pyrethroid, Cyfluthrin under the trade name Solfac 050EW, on the serum aminotransferase were observed in this study. Oral administration of sub-chronic dose (one-fourth of the recommended dose) of Cyfluthrin for 15 days and 30 days showed significant increase in Alanine transaminase (ALT) content and Aspartate transaminase (AST) content as compared to control group. For acute studies (double the recommended dose), after oral administration of Cyfluthrin for 3 hrs, 24 hrs and 15 days, a highly significant increase in content of ALT and AST was observed as compared to control group. The present study suggests that Cyfluthrin (Solfac 050EW) shows significant toxic effects on serum aminotransferase of Swiss Albino Mice.

Keywords: Synthetic Pyrethroid, ALT, AST, Solfac 050 EW

INTRODUCTION

Cyfluthrin is a broad spectrum synthetic type II pyrethroid insecticide and acaricide. It is present in the market in a variety of formulations under the trade name Baythroid as wettable powder, emulsifiable concentrates, oil-in-water emulsions, concentrates and dusts. Major world-wide uses are for pest control, industrial hygiene and vector control. Cyfluthrin is a synthetic pyrethroid insecticide which is effective against a wide variety of agricultural and public health pests, particularly members of Lepidoptera, Coleoptera, Hemiptera and Diptera orders⁽¹⁾. It is a commonly used household insecticide in India sold under the trade names "Baygon" and "Solfac". Its mode of action is characterized by interference with nervous transmission, due to inhibition of membrane sodium channel systems in the target organism. A toxicity study was planned to assess the hepatotoxic potential of cyfluthrin that is widely used as a household insecticide to control mosquitoes, flies and cockroaches. Cyfluthrin is a neurotoxin inducing alterations in nerve membranes, causing abnormal sodium and potassium flow. This results in the repetitive discharges from the neurons, causing convulsions and also blockage of further nerve impulses⁽²⁾. Laboratory animals exposed to high doses of cyfluthrin have shown toxic effects like convulsions, salivation, ataxia, weakness, and apathy⁽³⁾. Cyfluthrin is also known to cause weight loss, changes in blood chemistry and liver weights in rats. It has been reported to cause miscarriages and resorptions in rabbits⁽⁴⁾. It is reported to be neurotoxic, hepatotoxic and haematotoxic in rats and to cause miscarriages and resorptions in pregnant rabbits⁽⁵⁾.

Liver plays important role in metabolism to maintain energy level and structural stability of body⁽⁶⁾. Liver play a major role in detoxification and excretion of many endogenous and exogenous compounds. Any type of injury (due to systemic drug, food preservatives, agrochemicals and addiction to alcohol) or impairment of its function cause health complications.⁽⁷⁾It is also site of biotransformation by which a toxic compound has been transformed in less harmful form to reduce toxicity⁽⁸⁾. However, this will damage the liver cells and produce hepatotoxicity. In addition serum levels of many biochemical markers like SGOT, SGPT, triglycerides, cholesterol, bilirubin, alkaline phosphatase, are elevated^(9,10). Alanine transaminase (ALT) is an enzyme that helps metabolize protein. Liver damage is always associated with cellular necrosis, increase in tissue lipid peroxidation and depletion in the tissue GSH levels. Aspartate transaminase (AST) is the mitochondrial enzyme, predominantly found in the liver, skeletal muscles and kidneys. Alanine transaminase is a cytosolic enzyme, which is more

specific for the liver than aspartate transaminase. Serum glutamate oxaloacetate transaminase and serum glutamate of pyruvate transaminase activity are known toxicity markers in the study of hepatotoxicity of chemicals.⁽¹¹⁾ In addition, transaminase (AST and ALT) are important enzymes in the biological processes. They play a role in amino acids catabolism and biosynthesis. Consequently, they are considering as specific indicators for liver damage⁽¹²⁾ and responsible for detoxification processes, metabolism and biosynthesis of energetic macromolecules for different essential functions⁽¹³⁾. An increase in the activity of alanine aminotransferase, and aspartate aminotransferase activity showed the dose-dependent phenomenon.

MATERIALS AND METHODS

Swiss Albino mice were housed in an air cooled room and a colony was maintained. Mice were fed on standard mice feed (mixed seeds and pellets) and water was given *ad libitum*. For all the present studies adult male mice (4-6 weeks old) were used. Animals were divided into two groups:

Group I (Control I): Animals were given distilled water as vehicle orally.

Group II (Acute): Animals were given high dose dissolved in distilled water orally and was given once. The dose administered to the animals was calculated according to the concentration of cyfluthrin recommended (8 ml in 1000 litre) for use in field sprays which came out to be 1.6 μ l in 100 μ l of distilled water – double of the recommended dose. Autopsy was conducted after 3 hrs, 24 hrs, and 15 days after the dose administration.

Group III (Control II): Animals were given distilled water as vehicle orally daily.

Group IV (Subchronic): Animals were given low doses dissolved in distilled water orally continuously for 1 month. The dose administered to the animal was calculated according to the concentration and it came out to be 0.2 μ l in 100 μ l of distilled water – one fourth of the recommended dose. Autopsy was conducted after 15 days and 30 days.

Quantitative biochemical estimation of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were estimated by using ALT and AST kit (Liquimax SGPT (ALT) and Liquimax SGOT (AST) based on IFCC Method). Blood samples were collected, centrifuged and supernatant serum was collected content at each autopsy interval was estimated.

RESULT

On the acute dose administration the value ALT in experimental animal increase significantly ($p < 0.001$) as compared to control at all

the autopsy interval, that is, 3 hrs, 24 hrs and 15 days. The value of AST at acute dose increased significantly ($p < 0.001$) at autopsy interval 3hrs, 24 hrs and 15 days in experimental group as compared to control.(Table 1)

Table I: Effect of Cyfluthrin (Synthetic Pyrethroid –Solfac 050EW) on Aspartate and Alanine Aminotransferase Profiles in Acute Study with Swiss Albino Mice

Group	Autopsy interval		
	3 Hours	24 hours	15 Days
Group I (AST: IU/L)	227±10.21	141±8.05	221.33±10.85
Group II (AST :IU/L)	525.33±5.85***	785.33±1.65***	793±4.16***
Group I (ALT: IU/L)	145±2.60	235±2.88	241.66±4.40
Group II (ALT: IU/L)	890±1.196***	905±2.30***	918.33±4.40***

Significance in relation to control,* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Sub chronic dose showed significant ($p < 0.001$) increase in ALT concentration in experimental group as compared to control at autopsy interval of 15 days and 30 days. Sub chronic dose also

exhibited increasing trend in AST concentration in experimental group as compared to control at autopsy interval of 15 days and 30 days ($p < 0.001$). (Table 2)

Table II: Effect of Cyfluthrin (Synthetic Pyrethroid –Solfac 050EW) on Aspartate and Alanine Aminotransferase Profiles in Sub-chronic Study with Swiss Albino Mice

Group	Autopsy Interval	
	15 days	30 Days
Group I (AST: IU/L)	155±1.24	163.33±.72
Group II (AST :IU/L)	952.66±.72	883.66±.88***
Group I (ALT: IU/L)	213±2	271±2.08
Group II (ALT: IU/L)	708.33±4.40***	988.33±1.66***

Significance in relation to control,* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DISCUSSION

An increase in the activity of these enzymes is termed as the early recognition of toxic hepatitis. A significant increase in these enzyme activities was observed at higher dose, indicating liver damage. The present results showed a significant increase in the activities of both AST and ALT in the serum of treated mice. Hayes *et al.*⁽¹⁴⁾ reported that one of the most indicators for liver damage and function is increase in the activities of serum transaminase (AST and ALT) in the serum. This increase may be indicative of initial cell injury occurring in advance of gross hepatic pathology, since not only distinct cellular damage but also any condition leading to changes in membrane permeability also causes a generalized release of enzymes from the cell⁽¹⁵⁾. Increased levels in liver are the result of treatment and indicative of toxic liver necrosis⁽¹⁶⁾. Several studies have showed that the activities of transaminases were increased in human and animals after exposure to pesticides⁽¹⁷⁻²¹⁾.

In the present investigation marked increase in liver ALT and AST under stress of pesticides has been observed. This elevation in above said parameters has been well supported by Srinivasan and Radhakrishnamurthy⁽²²⁾, Srivastava *et al.*⁽²³⁾, Rao and Banerji⁽²⁴⁾, Rahman *et al.*⁽²⁵⁾, Rahman *et al.*⁽²⁶⁾ and Sahni and Saxena⁽²⁷⁾ in albino rat. The increase in transaminase activity in the liver is indicative of liver damage that occurs due to formation of reactive oxygen species and reactive intermediates after the treatment of pesticides⁽²⁸⁾. This increase in transaminase activity leads to cellular damage and releasing the enzyme in sinusoidal spaces to intralobular vein⁽²⁶⁾.

In addition, Palanivelu *et al.*⁽²⁹⁾ suggested that liver is rich in SGOT and SGPT (AST and ALT), and damage to it could result in liberation of large quantities of these enzymes into the blood. Hence, an increase in the activity of these enzymes (SGOT/AST and SGPT/ALT) after the pollutants treatment is a sensitive indicator of cellular damage^(29,30). The rise in serum levels of AST and ALT has been attributed to the damaged structural integrity of the liver, because they are cytoplasmic in location and released into circulation after cellular damages⁽³¹⁾. Therefore, higher activities of these enzymes registered in the present investigation may be ascribed to damage caused to liver by Cyfluthrin.

CONCLUSION

The transaminase enzymes are considered as indicator for tissue damage, especially in serum, that is explained by the degree of

exposure and the severity of toxic symptoms. In the present study, the results have confirmed those recorded by many authors working on different insecticides/pesticides. Elevation of serum biomarker enzymes such as ALT and AST in experimental mice of both the doses is indicator of impaired liver function.

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