

Analysis of liver enzymes in albino rat under stress of λ -cyhalothrin and nuvan toxicity

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Abstract

Toxicity in humans is a threatening truth and much more than any disease caused by any organism as toxic substances are everywhere- in air, in water and in food. Many compounds which are essential to use for human welfare are injurious to us in every manner. Some are used as food additives and other daily use materials. However, there are some compounds which are not directly used by humans but indirectly they enter in human body and induce injuries. Pesticides are very common in these categories which are used against various pests for human welfare but they are also harmful to us via food chain. Liver is the primary site for any toxic substance and suffered first. Further, liver plays very important role in mammalian metabolism. So that any change in liver systematics will definitely affect complete metabolism of an animal. The toxic effect of λ -cyhalothrin and nuvan has been observed in albino rat through liver enzymes aspartate transaminase (AST) and alanine transaminase (ALT) as they are liver function enzymes and reflects functioning of liver. LD₅₀ of λ -cyhalothrin and nuvan has been found to be 78mg/kg body weight and 53mg/kg body weight respectively. AST and ALT level in liver has been decreased due to toxic stress induced by these compounds. Effect is more in nuvan treated rats. It is suggested that pyrethroids will be preferred for indoor use instead of nuvan where exposure chances are more for humans.

Keywords: Liver toxicity, λ -cyhalothrin, nuvan, albino rat.

Introduction

Toxicology is a very old concern to humans from the time of Stone Age to modern era. Now it is a separate branch of science and has its own importance. Toxicology deals with toxicity by any chemical or compound by intension or accidental exposure to living organisms. Excess of any compound will be harmful to life and considered under toxicity studies. In the modern era, use of chemicals and compounds that will accumulate or daily exposed to humans, are harmful in many ways. Pesticides are used for welfare of human beings but by the time, they will challenge us by showing their toxicity. They can be directly exposed to us or indirectly through food chain. Indiscriminate use of pesticides is on increase. India is one of the largest user of agricultural pesticides such as organophosphates, carbamates etc. Pesticides are toxic compounds to all living organisms however effects vary with species to species. But excessive use of these pesticides creates many problems to all of us. These days, synthetic chemical pesticides are in practice because of their active and best results. But their excessive use causes serious damage to ecosystem - terrestrial as well as aquatic and consequently the flora and fauna of surrounding. Nowadays synthetic

pyrethroids have become an economically and environment friendly group of insecticides as these possess a low mammalian toxicity, rapid decomposition in soil, leave no residue in biosphere and are stable in sunlight. 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. Lambda-cyhalothrin and nuvan has been considered for this toxicological study as they are the representative of their groups and current categories. These compounds have been selected because both are very commonly used for the protection of pulses, vegetables and food from various pests.

The toxicological studies have been done on models because it is not ethical to do this type of experiment with humans and is not practical even. The best and suitable model is one which is closely related to humans and definitely will not produce harm to the laboratory workers. Keeping these points in view, the toxic effects of these two compounds will be studied on albino rat, *Rattus norvegicus*. The selection of albino rats 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. In the present investigation, harmful effects of two compounds from two different classes lambda-cyhalothrin (pyrethroid) and nuvan (organophosphate) has been observed on liver functions of albino rats through aspartate transaminase (AST) and alanine transaminase (ALT) to apply these results on human beings.

Materials and Methods

Experimental animal:

Albino rats of 120±5g were selected from an inbred colony for the experimentation. The rats were maintained at 25±5°C temperature and 55±5% relative humidity in polypropylene cages. They were provided food pellets and clean water for survival. The cages were cleaned regularly to avoid any chance of infection.

LD₅₀ determination:

The LD₅₀ was determined by log-dose/probit regression line method (Finney, 1971). Five sets containing 5 rats each were taken and five serially diluted doses were given orally with the help of gavage tube. The doses were 40, 60, 80, 100, 120mg/kg body wt. and 20, 40, 60, 80, 100mg/kg body wt. for lambda-cyhalothrin and nuvan respectively. The rats were observed for 96 hours and then mortality was noted for further calculation. A graph has been plotted between empirical probit and log-dose and then LD₅₀ has been calculated with the help of regression line and computerized calculation. LD₅₀ of lambda-cyhalothrin and nuvan was noted as 78mg/kg body weight and 53mg/kg body weight respectively.

Experimental protocol:

1/10th of LD₅₀ has been taken as experimental dose which was divided equally according to experimental protocol i.e. divided by experimental days viz. 7, 15 and 30. Additionally, 45 days set is to observe recovery status of albino rat. The albino rats were divided in three sets viz. control (without treatment), lambda-cyhalothrin treated and nuvan treated. Further, each set was divided in four sub-sets- 7days, 15days, 30days and 45days. In 45days set, there was no dose after 30days. There were three replicates for each sub-set.

Enzyme assay:

Experimental rats of control and experimental sets were taken and liver was excised out for further biochemical estimations. Autopsy was done as per experimental protocol on specified days as 7, 15, 30 and 45. The estimations of aspartate transaminase (AST) and alanine transaminase (ALT) in liver were done by the method of Reitman and Frankel (1957). The data generated will be analyzed statistically according to Fischer and Yates (1950).

Results

The results are tabulated in Table-1 & 2. There has been an increase in aspartate transaminase and alanine transaminase in liver which is significant at various levels after lambda-cyhalothrin and nuvan treatment in albino rats. The toxic effect was clearer in nuvan treatment as compared to lambda-cyhalothrin treatment which reflects difference in mode of action and toxicity of these two pesticides. The increase is with increased treatment from 7 to 45 days. However, increase was more at early treatment (7 and 15days), while come to moderate at 30 and 45days. This suggests the resistance developed by body in time against toxic stress and repulsion of toxic effects by its self defense system.

Discussion

Liver is a target organ and primary site of detoxification and is generally the major site of intense metabolism and is therefore prone to various disorders as a consequence of exposure to the toxins of extrinsic as well as intrinsic forms. Liver plays important role in metabolism to maintain energy level and structural stability of body (Guyton and Hall, 2002). It is also site of biotransformation by which a toxic compound has been transformed in less harmful form to reduce toxicity (Hodgson, 2004). However, this will damage the liver cells and produce hepatotoxicity. Alanine transaminase (ALT) is an enzyme that helps metabolize protein. When the liver is damaged, ALT is increased in liver and released in the bloodstream. Aspartate transaminase (AST) is an enzyme plays a role in the metabolism of the amino acid alanine. An increase in AST levels may indicate liver damage or disease. Aspartate transaminase 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.

Table-1: Aspartate transaminase (unit/ml) in liver of albino rat after λ -cyhalothrin and nuvan treatment

Days	Control	λ -cyhalothrin treatment	Nuvan treatment
	Mean \pm S.Em.	Mean \pm S.Em.	Mean \pm S.Em.
7	130.1 \pm 0.56	160.7 \pm 0.99***	168.0 \pm 0.90****
15	130.5 \pm 0.62	165.5 \pm 1.10****	169.1 \pm 1.00****
30	139.9 \pm 0.51	166.0 \pm 0.91****	171.0 \pm 1.01****
45	131.4 \pm 0.90	168.9 \pm 0.60****	174.1 \pm 0.88****

*** - P<0.01, **** - P<0.001

Table-2: Alanine transaminase (unit/ml) in liver of albino rat after λ -cyhalothrin and nuvan treatment

Days	Control	λ -cyhalothrin treatment	Nuvan treatment
	Mean \pm S.Em.	Mean \pm S.Em.	Mean \pm S.Em.
7	92.5 \pm 0.60	109.0 \pm 0.57***	111.3 \pm 1.10****
15	95.0 \pm 0.33	117.6 \pm 0.67***	123.5 \pm 0.67****
30	95.0 \pm 0.33	119.9 \pm 0.67****	128.3 \pm 0.33****
45	94.2 \pm 0.67	121.0 \pm 0.33****	130.0 \pm 0.33****

*** - P<0.01, **** - P<0.001

Increased levels in liver are the result of treatment and indicative of toxic liver necrosis (Poli *et al.*, 1987). 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 (1977), Srivastava *et al.* (1989), Rao and Banerji (1990), Rahman *et al.* (1996), Rahman *et al.* (2001) and Sahni and Saxena (2001) in albino rat after β and γ isomers of hexachlorohexane treatment, in rat after dichlorvos treatment, in rat after aroclor 1260 treatment, in rats after *Azadirachta indica* treatment, in albino rats after *Azadirachta indica* treatment and in *Mus musculus* after difethialone treatment respectively. 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 (Bandyopadhyay *et al.*, 1999). This

increase in transaminase activity leads to cellular damage and releasing the enzyme in sinusoidal spaces to intralobular vein (Rahman *et al.*, 2001).

Conclusion

The results of present study are mirror to reveal extent of toxicity of pesticides used by human beings to non-target organisms and for human beings too. Liver damage is first indication of toxicity as it encounters firstly by any toxic stress. Sound concern is to be given on this issue by health concerned agencies.

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