Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

On the effects of deltamethrin in different organs of rats

Monol Hamed *, Marda Salam

[1]Department of Zoology, Faculty of Science, Beni-Suef University, Egypt

ARTICLE INFO

Article history:
Received 12 November 2014
Received in revised form
25 December 2014
Accepted 5 January 2015

Keywords:
Deltamethrin
Hepaatocyt
Liver enzyme
Tissue

ABSTRACT

The overuse of pesticides is one of the main reasons for high consumption in nature Deltamethrin is used with widely in agricultural that has deleterious effects on some organs of the body. High usage and easy transferring of this pesticide on and health of ecosystems and biological cycles, duo to research. For this proposes 50 adult Wistar rats about 200±15g selected and then they were divided to 5 groups include control (without treatment), sham (received physiologic serum) and 3 treatment groups. Treatment groups were injected peritoneal (2.5, 5 and 10) mg/kg/b.wt. After 14 days, blood samples were taken from all groups and for biochemical analyzes by Elisa method. Their liver was separated and sections prepared for histological study. Obtained data analyzed by using SPSS (18) and ANOVA and groups were compared in significance level ($P< 0.05$) with Tukey's test. The finding showed that concentration of Alanin amino transfrase, Aminoaspartat transfrase and Alkalin phosphotase in serum of all treatment groups, increased significantly ($P<0.05$) and total protein also decrease compared with the control group. Deltamethrin with dependent dose, effect on liver and disturbed its function. According to the results, humans should avoid the indiscriminate use of this poison and direct contact with it.

1. Introduction

Despite of deleterious effects of toxins and pesticides on environment and other living creatures, unfortunately the most efficient and perhaps the only practical way to fight against pests is now using of chemical pesticides. All chemical pesticides influence on metabolic processes of creatures they face. Synthetic pesticides have always been under concern because of their effects on agricultural products used by humans and their threat to human beings' health (Braguini et al., 2004). Deltamethrin is in the chemical class of pyrethroids and effective against insects via ingestion and direct contact (Davies, 1985).

The main ways for toxins to enter into body are through injection, digestion system, respiration, and contact with skin (Campos et al., 2008). Averagely, about forty percent of agricultural damages in the world are because of insects whereas the amount of pesticide use in agricultural farms is about three billion liters annually in the world and this amount in our country is twenty seven million liters. The pesticides are used in order to reduce the aforementioned damages. Although these materials lessen the agricultural products damage, they impose some unwelcome and dangerous effects on environment and all organism health. In this case, there should be an attempt to find reasonable solutions in order to decrease their harmful effects (Campos et al., 2008).

In addition to reckless contact at the time of spraying, eating foods infected by pesticides, entering sprayed farms, drinking infected water, inhaling toxic particles, and any kind of contact with toxins can cause organic diseases and abnormalities. Long contact with pesticides can lead to various diseases such as cancer, abortion, fetal abnormality, allergy, neurological diseases, and bad effects on endocrine which control many vital functions in animals and humans (Cengiz and Unlu, 2006). Deltamethrin is among insecticides of Pyrethroids group with molecular weight of 505.2 kd and chemical formula of $C_{22}H_{19}Br_2NO_3$. Its brand is Dessix and Bottox and is used against leafminer spot of fruit tree (Cengiz and Unlu, 2006).

Deltamethrin cause some complications such as hypertrophy of liver cells, significant increase in koopfer cells, blood circulation disorder, focal necrosis. Bad effects of Deltamethrin on some body organs, especially liver, have been reported (Evans and Halliwell, 2001).

On the other hand, Deltamethrin can also cause inflammation of immunological system (Gaziano et al., 2008), and the high amount of this toxin will lead to a 70 percent increase in absorption of Dopamine

* Corresponding Author.

and neuronal damage, and the high level of Dopamine and Glutamate cause Neurotoxic as well (Hasibur et al., 2006).

Hepatocytes, complex metabolic liver cells, contain a large amount of enzymes such as Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). These enzymes permeate into plasma as a result of liver damage, and because of this the examination of its measure in plasma is evaluated in detection and identification of liver damage (Bradberry et al., 2005). ALT exists in high amount in cytosol of hepatocytes as well and is considered as indicator of liver cells damage (Kalender et al., 2007). These two enzymes, in addition to being more sensitive to liver toxicity and its histopathological changes compared with other enzymes, can be evaluated in a shorter period of time (Hasibur et al., 2006).

Another enzyme which is examined to diagnose liver damage is Alkaline phosphatase which exists in most tissues; It has been observed that its level will increase because of liver diseases (Aturk et al., 2006). Since liver is the most important and the largest gland and a vital part in metabolism of different combinations and detoxification, the effects of deltamethrin on changes in liver enzymes and liver function in rats as a model of mammals have been investigated in the present study.

2. Materials and Methods

In this research, 50 adult Wistar rats about 200±15g selected and preserved in standard condition (24 hours light & 24 hours darkness) for 2 weeks. Then they were divided to 5 groups include control (without treatment), sham (received physiologic serum) and 3 treatment groups randomly. Treatment groups were injected peritoneal (2.5, 5 and 10) mg/kg/b.wt. After 14 days, blood samples were taken from all groups and for biochemical analyzes by Elisa method. Then liver was separated and sections prepared for histological study. Specimen were fixed in 10% formalin, were placed in tissue processor and dehydrated in graded series of ethanol (70%- 100%), then impregnated with paraffin and serial 4µ thickness sections were obtained and subjected to Haematoxylin and Eosin (H&E) stains. The sections were mounted with binocular light microscope (x40, x100) and photomicrograph was prepared. Obtained data analyzed by using SPSS (18) and ANOVA and groups were compared in significance level ($P< 0.05$) with Tukey's test.

3. Results

According to above results all the liver enzymes (AST, ALT and ALP) increased significant significantly and total protein decreased significantly in three treatment groups (P≤05/0).

4. Discussion

Enzymes, as biological catalysis, control all enzymatic reactions in the body and for this reason; the qualitative and quantitative changes in various enzymes reflect health and disease (Mongi et al. 2011). ALT, which catalyzes the conversion of Alanine to Pyruvate and Glutamate, is more special and dedicated to liver and is determined as the indicator of liver cells (hepatocytes) (Kalender et al., 2007). It is also stated that the increased levels of ALT, AST, and ALK enzymes represent destruction of liver cells and the leakage of these enzymes from liver cytosol into the blood flow (Mongi et al., 2011).

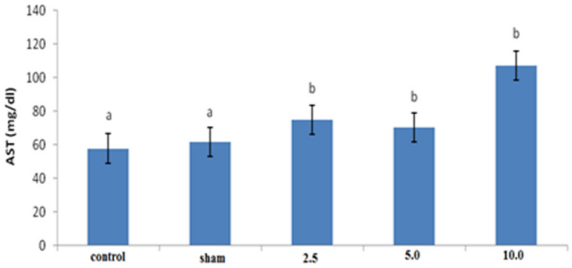


Fig. 1: Mean of Aspartic amino transfrase in serum

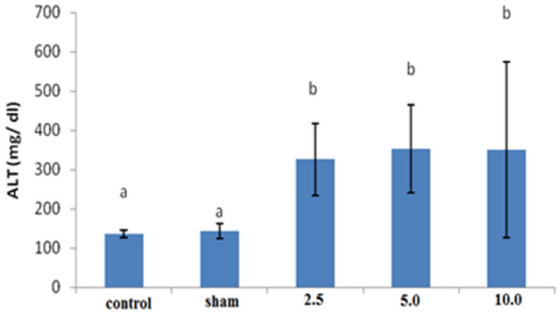


Fig. 2: Mean of Alanine Aminotransferase concentration in serum

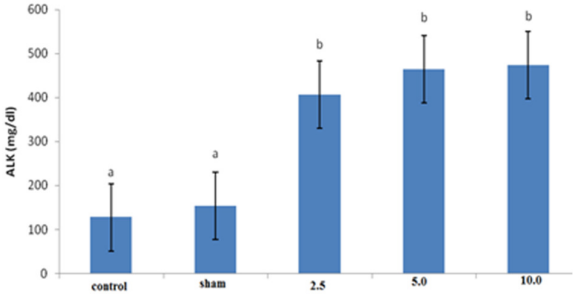


Fig. 3: Mean of Alkaline Phosphatase concentration in serum

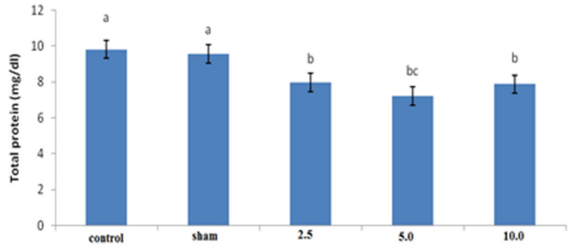
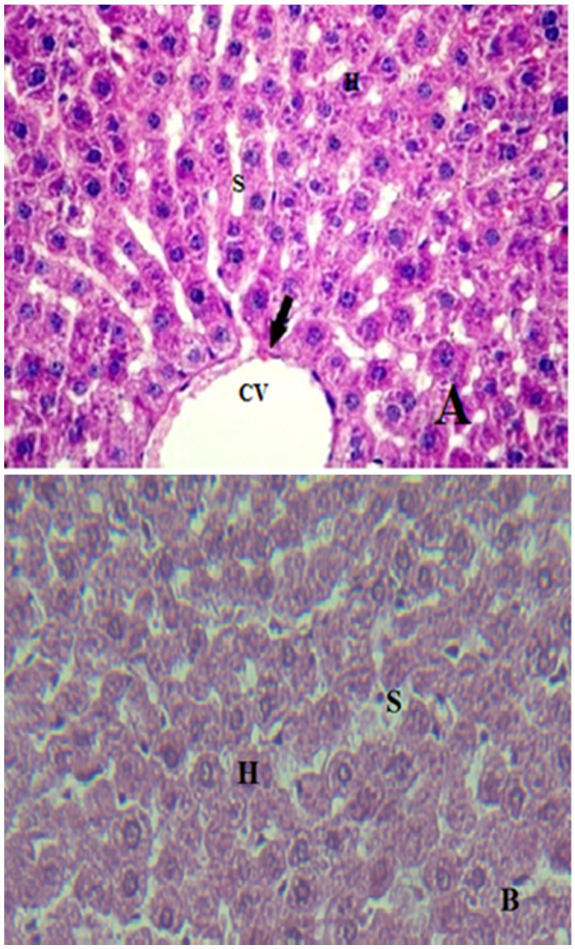


Fig. 4: Mean of total protein concentration in serum

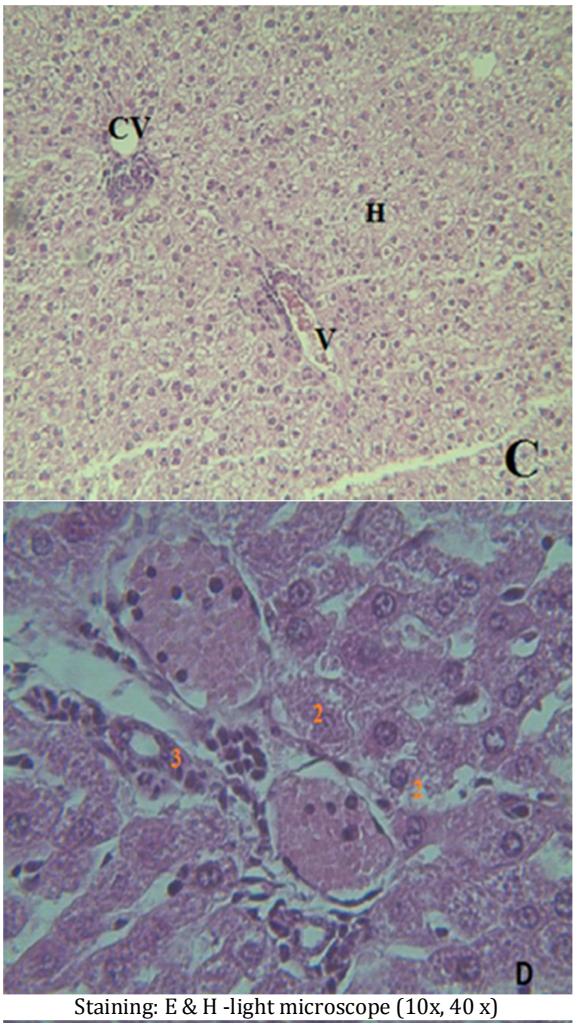
On the other hand, the increase in enzymatic activity of Amino transferase (ALT), Phosphatases, and Lactate dehydrogenase in plasma has been

investigated after using Deltamethrin (Evans and Halliwell, 2001).

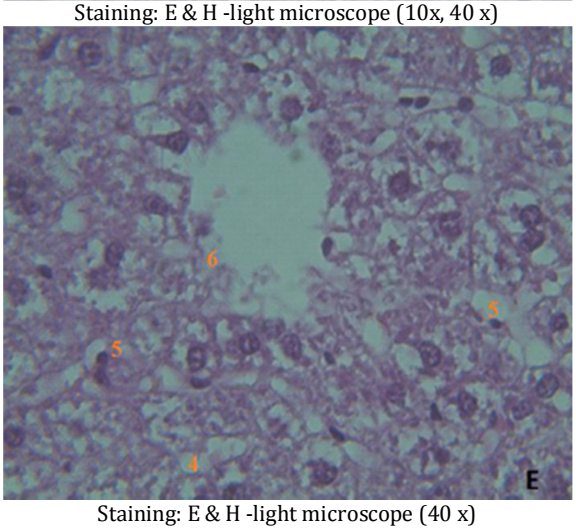
The obtained results in this study, agreeing with the above mentioned results, indicate damage to liver tissue for reason induction of oxidative stress due to deltamethrin use. Deltamethrin causes membrane lipid peroxidation (LPO) and disturbs the function of cell membrane; it changes membrane permeability and the function of liver's antioxidant enzymes. Subsequently, the transfer of ions and various materials as well as concentration gradients on both sides of the membrane along with the transportation of chemical messenger will be disrupted by membrane receptors. This will cause the penetration of mentioned enzymes from liver's cytoplasm into blood flow.



Staining: H&E -light microscope (10 x)



Staining: E & H -light microscope (10x, 40 x)



Staining: E & H -light microscope (40 x)

Fig. 5: Light micrographs of liver tissue in control group (A), sham group (B) and treatment groups include group 1 (C),group 1 (E). And group 1 (F) Liver tissue as blood sinusoids (s) and hepatocytes (H) are normal in in control group (A) and sham group (B). Granularity in hepatocyte, degeneration of hepatocyte (2) and moderate infiltration of inflammatory cells (3) were seen in treatment groups (C), blood sinosoids (1) are dilated and congested with blood and hepatocytes (2 , 3) are granulated (D).Vein is widely dilated (4) and kupfercells are in sinusoid (5),

Eosinophilic cytoplasm and inflammation(6) were in in treatment group 3 (E).

Although there have been some reports about an increase in serum alkaline phosphatase levels in bile duct obstruction, Hepatitis, Cirrhosis, and accumulation of fatty deposits in liver, and chemical agents and various drugs have also been reported as having influence on its level, it is not considered as an indicator of liver damage. Alkaline phosphatase is also increased in bone defects and cardiac lesions, 2010), it sometimes increases even without any liver or bone damages. Due to the fact that the toxin has entered into the blood, and it is likely that it has affected some other tissues as well, so its increase in all treated groups is quite justifiable, especially when the increase of two other enzymes has been observed in the study. So hepatic damage obviously probably was resulted oxidative stress by free radical production (Kalender et al., 2011). Liver enzyme incrassation due to the oxidative stress resulted from free radical production.

Liver is a place to synthesize and metabolize the most of plasma's proteins, and any kind of disorder in its natural function will affect the total concentration of plasma's protein. Deltamethrin is absorbed when administered orally and solvent type can affect the rate of absorption. In this research, the rats gavaged deltamethrin that was solved in physiologic serum but unexpectedly, obtained results were not the same administered orally. It is noteworthy that the rats. Although human skin is less permeable than rat skin (rats absorbed 3.6% of the deltamethrin applied to their skin) but probably they received this toxin after feeding plant material containing residues of it (Burr and Ray, 2004). Obvious study showed that the mechanism of action of deltamethrin, is the same for target and non-target organisms (Amweg et al., 2006). Although Tomlin (2006) reported that deltamethrin is practically non-toxic to birds and it is less toxic to mammals compared to insects but observation of respiratory defects and salivation in rat and hyper excitibility, and impaired body movement in dog (Davies; 1985) so human must avoid although no human data were found on the chronic health effects of deltamethrin.When liver tissue damaged, these lymphocytic invasion around the portal triad (Fig. 5-C-E) indicate the presence of smaller vessels in the fibrous mass that can't seen by light microscope.

This toxin acts on nerve membranes by delaying the closing of the activation gate for the sodium ion channel and change permeability of the nerve to sodium and produces a series of repetitive nerve signals in sensory organs, nerves, and muscles (Joy et al., 1994. Despite this, various studies have also shown that deltamethrin, in comparison with other toxins, especially organophosphorus toxins, has less bad effects on mammals (Aturk et al., 2008; Mongi et al., 2011).

Decrease in total protein concentration, due to its incomplete synthesis in the liver, will cause incomplete intestinal absorption and protein loss because of improper functioning of the liver (Padayatty et al., 2004). On the contrary, no significant changes were seen in the treatment groups depends on dose of toxin, in this study. It is also stated that, after being eaten it by rats, its excretion takes 2 to 4 days (Cengiz and Unlu, 2006) and durability of this toxin in water due to accelerate this action.

5. Conclusions

According to obtained results, deltamethrin has toxicity in rat hepatocytes and due to its toxic effect may be the same for human. Since They should be avoided direct confrontation with this toxin.

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