

Effect of Insecticide “Maxxthor” on Some Hematological and Oxidative Stress Parameters in Male Albino Rats

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Abstract

The present study was designed to investigate the effect of different concentrations of Maxxthor on some hematological and oxidative stress parameters in male albino rats. Twenty male rats with age of 6-8 weeks and weight of 200-250gm were equally divided into four groups as follow: G1 treated with normal saline as control group, while G2, G3 and G4 groups were treated with (0.01, 0.1, 1) mg/kg body weight of Maxxthor respectively for 40 days. The following hematological parameters were measured: red blood cell (RBC), hemoglobin (Hb), white blood cell (WBC), platelets (PLT), malondialdehyde (MDA), glutathione (GSH), catalase and vitamin E. The hematological parameters results revealed highly significant ($p < 0.01$) decrease in RBC and H, while a highly significant ($p < 0.01$) increase in WBC and PLT in all treated groups as compared with control. The oxidative stress parameters results revealed highly significant ($p < 0.01$) increase in MDA level, while highly significant ($p < 0.01$) decrease in GSH, catalase and vitamin E level were noticed in all treated groups as compared with control.

Key words: Insecticide, Maxxthor, Oxidative stress, Albino rats

Introduction

Pesticide is any substance or mixture of substance intended to preventing, destroying or controlling any pest, including vectors of human disease or animal species, unwanted plants or animals that cause damage⁽¹⁾. The extensive and random application of pesticide, and its resist to physical and chemical breakdown and metabolic degradation led to its spread within the ecosystem elements⁽²⁾, leading emergence of several ecological and health setbacks due to the accumulation of residues of pesticides in the environment components over time⁽³⁾. Synthetic pyrethroid were introduced widely for pest and disease vector control more than three decade ago⁽⁴⁾. The source of pyrethroids is the flower of the pyretherum plant *Chrysanthemum cinerariaefolium*⁽⁵⁾.

The pyrethroid pesticides are rapidly replacing other insecticides due to low mammalian toxicity and an unusually fast biodegradation⁽⁶⁾. Pyrethroid enhance sodium channel activity by shifting activation to more negative membrane potentials as well as slowing channel activation⁽⁷⁾.

Maxxthor (MAX) is pesticides belong to pyrethroid insecticides type I. The active ingredient in Max product is bifenthrin, a second generation of synthetic pyrethroid. It is featured with strong insecticides effects due to its ability to modifying the kinetic voltage-sensitive sodium channels of nerve in insects⁽⁸⁾. This disrupts the normal transmission of nerve impulses causing repetitive firing of the insect's nerve resulting in paralysis and ultimately death. Maxxthor use against termites and labeled for the long term control of wide range of pests including insect pests, vectors, spiders, ticks and turf insects. Maxxthor has shown an average termiticide effective life of 12 years, the longest average of any termiticide active

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ingredient on the market today⁽⁹⁾.The neurotoxicity of Maxxthor depend on the affinity to the voltage sodium channels in insects and mammal,where Maxxthor bind to the sodium channel transiently and stop the closing of the channel permanently,leading to permanently depolarize of the membrane,no further action potential can be generated because the resting potential will not be restored.This will result in after potentials and continuous firing of axons⁽¹⁰⁾.The presence study has been undertaken to study the effect of Maxxthor insecticide on hematological and oxidative stress parameters follow repeated treatment male albino rats for 40 days.

Materials and Methods

Experimental animals and Study Design

This study was performed on 20 healthy mature male Sprague-Dawley albino rats(*Rattus norvegicus*) with about8-10weeks age.The animals were purchased from biotechnology research center/Al-Nahrian university,in old between(6-8)weeks.The mature male were with an average weight of(200-250gm)and kept under climate controlled conditions of the animal house with temperature 22-25 C°, good ventilation, regular 12 hours light duration.Rats were randomly divided into four groups five rats for each group and treated as follow:G1was administrated with 1ml of normal saline, while G2,G3andG4 were administrated with1ml of(0.01,0.1and1mg/kg b.w.) respectively of MAX orally

once each 48 hours for 40 day.

Blood samples were collected by heart puncture and then divided into two parts.The first part put in plastic test tube contains (EDTA) for hematological tests.The second part was left in eppendrof tube to coagulation at room temperature and then centrifuged at 3000 rpm for 15 minutes. Serum was separated and stored at-20C° for oxidative stress parameters analysis.The hematological parameters(RBC,Hb ,WBC and PLT)were measured by using Coulter device.MDA was determine using Assay Kit from Linear,Spain,according to^(11,12). GSH was measured according to⁽¹³⁾by using the assay kit from Linear,Spain.Catalase was determined by using the assay kits from Linear, Spain according to⁽¹⁴⁾.Vit. E was determined by using the procedure of vit.E Elisa Kit from Linear,Spain.The Statistical⁽¹⁵⁾was used to detect the effect of difference groups in study parameters.

Results and Discussion

Hematological parameters

Results of current study as shown in Table(1) revealed highly significant(p<0.01)decrease in red blood cell RBC and hemoglobin(Hb)in all treated groups with Maxxthor insecticide as compared with control group. While there is highly significant(p<0.01)increase in white blood cell(WBC) and platelets(PLT)in all treated groups as compared with control group .

Table(1): Effect of Maxxthor(0.01,0.1and1mg/gk.b.wt.)on Hematological parameters(RBC,Hb ,WBC and PLT)of rats after 40 day of treatment

Group	Mean ± SE			
	RBC 10 ¹² /L	Hb g/dl	WBC 10 ⁹ /L	PLT 10 ⁹ /L
G1:Control	6.78 ± 0.14 a	13.84 ± 0.15 a	6.02 ± 0.11 c	202.50 ± 6.39 d
G2:treated with 0.01 mg/kg/b.wt. of Maxxthor	6.07 ± 0.27 b	12.45 ± 0.23 b	6.30 ± 0.11 c	241.90 ± 3.47 c
G3: treated with 0. 1 mg/kg/b.wt. of Maxxthor	5.62 ± 0.21 bc	11.47 ± 0.26 c	6.86 ± 0.12 b	274.30 ± 4.45 b

Cont... Table(1): Effect of Maxxthor(0.01,0.1and1mg/gk.b.wt.)on Hematological parameters(RBC,Hb ,WBC and PLT)of rats after 40 day of treatment

G4: treated with 1 mg/kg/b.wt. of Maxxthor	5.21 ± 0.23 c	10.40 ± 0.23 d	7.65 ± 0.13 a	351.10 ± 10.41 a
LSD value	0.623 **	0.637 **	0.340 **	19.304 **
Means having with the different letters in same column differed significantly, ** (P<0.01). Means having with similar letters in same column non- significantly different, ** (P<0.01).				

The present finding was similar to⁽¹⁶⁾finding who observed significant decrease in RBC count and Hb level with increasing in WBC count after treated Wistar rats with cypermethrin for 28days.Also the results is agreement with the work⁽¹⁷⁾who find significant decrease in RBC count and hemoglobin level and explained the decrease of Hb due to an increase in the rate at which Hb is destroyed.Same results of WBC count represented by⁽¹⁸⁾ who report that sublethal poisoning with higher dose of bifenthrin caused anemia and elevation in WBC count after injected mice with bifenthrin. Wafa ⁽¹⁹⁾ report significant elevation in platelet counts in workers exposed to pesticides than in controls .

The reason for the significant decrease in the number of red blood cells as a result of the effect of the pesticide may be due to its inhibition of the substance(glutathione) that found inside the red blood cell and responsible for protecting it from the influence of toxic substances⁽²⁰⁾. This results could be explained that maxxthor pesticide affect on erthropoietin release in the kidney which is the hormone regulator of RBC production⁽²¹⁾.Sadowska-Woda *et al.*⁽²²⁾study demonstrated that bifenthrin induce oxidative stress causes enhanced lipid peroxidation and decrease antioxidant enzyme activities in human peripheral blood.RBC are particularly sensitive to oxidation damage due to the presence of high content of poly unsaturated fatty acid in their membranes and high cellular concentration of oxygen and hemoglobin⁽²³⁾. On the other hand Hb in erythrocytes is major source production of free radicals when it interacts with pyrthroid pesticide giving rise to free radicals leading to membrane lipid peroxidation and hemolysis⁽²⁴⁾.

Other explanation reported by⁽²⁵⁾that show any reduction in RBC count may be due to reduction rate of RBC formation in bone marrow or increasing rate of RBC breakdown,also increase red blood cell membrane fragility and alter membrane flexibility led to reduces the life span of circulating erythrocytes and increased risk of hemolysis⁽²⁶⁾.Hemolysis of blood cells may cause the decrease in erythrocyte count in pyrthroid intoxication which in turn tend to be responsible for the reduction of hemoglobin percentage⁽²⁷⁾.Reduction in Hb content can be related to the impaired biosynthesis of heme in bone marrow⁽²⁸⁾.In addition reduced hemoglobin content accordance with RBC reducing could be explained that pesticide cause damage to erythrocyte membrane that lead to hemolysis or damage of blood iron level⁽²⁹⁾.Olsen ³⁰⁾suggest when assessing hematological toxicity,any increase or decrease in blood parameters indicates excess or suppression of blood cell respectively or an imbalance between production of blood cells and distraction.

The increase in WBC count may be due to the activation of the animal's defense mechanism and immune system against the toxic effect of Maxxthor pesticide as the WBC rise as a result of any infection and any form of cell toxicity or inflammation⁽³¹⁾.Poisoning mice with high dose of alpha-cypermethrin had stronger stimulatory effect on phagocytic activity with significant increase in monocyte and lymphocytes were observed in the blood of male mice treated with same pesticide⁽³²⁾.An elevation in platelets could be explained to release of stored platelet from the spleen⁽³³⁾.Platelets are highly active in the host defense against pathogens and have ability to modulate leukocyte function such phagocytosis⁽³⁴⁾.

Oxidative stress parameters

Data in Table(2) show highly significant ($p < 0.01$) increase in MDA level in G3 and G4 when compared with control groups, while there were no significant ($p < 0.01$) differences between G2 and control group. In the same time, results in table(2) revealed highly significant ($p < 0.01$) decrease in GSH, catalase and vitamin E. in all treated groups with Maxxthor as compared with control group.

Table(2): Effect of Maxxthor(0.01, 0.1 and 1 mg/gk. b.wt.) on oxidative stress parameters(MDA,GSH ,CAT and Vit.E) of rats after 40day of treatment

Group	Mean ± SE			
	MDA nmol/ml	GSH μmol/ml	CAT μmol/ml	Vit. E ng/ml
G1:Control	2.03 ± 0.12 c	63.43 ± 1.27 a	0.620 ± 0.01 a	43.15 ± 0.67 a
G2: treated with 0.01 mg/kg/b.wt. of Maxxthor	2.34 ± 0.13 bc	57.98 ± 1.51 b	0.509 ± 0.01 b	39.06 ± 0.73 b
G3: treated with 0.1 mg/kg/b.wt. of Maxxthor	2.67 ± 0.15 b	50.71 ± 1.48 c	0.413 ± 0.01 c	33.55 ± 0.92 c
G4: treated with 1 mg/kg/b.wt. of Maxxthor	3.11 ± 0.17 a	42.66 ± 1.40 d	0.322 ± 0.04 d	28.85 ± 0.87 d
LSD value	0.420 **	4.076 **	0.056 **	2.305 **
Means having with the different letters in same column differed significantly , ** ($P < 0.01$). Mean having similar letters in the same column are non significantly different , ** ($p > 0.01$) .				

The results of this study pass parallel with⁽³⁵⁾ who report increase blood MDA level and decrease in GSH and CAT level after treated rat with bifenthrin. Exposure to pyrethroid for three weeks led to increase in lipid peroxidation and decrease in GSH and catalase⁽³⁶⁾. The increment in MDA (Lipid peroxidation marker) could be explained by⁽³⁷⁾ who suggested that the formation of oxygen free radicals can be a major factor in the toxicity of pesticides. Catalase as endogenous antioxidant enzymes that scavenge harmful ROS, is favorable target for pesticide toxicity, and plays a fatal role during the oxidative stress as an adaptive response of cells⁽³⁸⁾. On the other hand⁽³⁹⁾ reported that pyrethroids induced oxidative damage might be they could penetrate easily

to the cell membrane due to their lipophilicity and caused lipid peroxidation. Pesticide induce oxidative stress leading to lipid peroxidation and exhaustion of internal antioxidants⁽⁴⁰⁾. The reduction of GSH content could be explained by GSH use for conjugation as an antioxidant by neutralizing the free radicals. Other explanation is that this depletion is due to an increase of degeneration of GSH during oxidation stress caused by pyrethroid⁽⁴¹⁾. Rouabani⁽⁴²⁾ suggest that the metabolism of pyrethroid generate ROS which in turn could led to an decrease in GSH rate linked to an increase in MDA, because increase of lipid peroxidation and depletion the reservoir of GSH⁽⁴³⁾. Decline of catalase level could be explained by the massive rate of free radicals that cause saturation

in side and inhibition related to degradation in another side⁽⁴⁴⁾.

Vitamin E is the major lipid soluble antioxidant and the major effective chain-breaking antioxidant within the cell membrane where it guards membrane fatty acids from lipid peroxidation⁽⁴⁵⁾. In addition,⁽⁴⁶⁾ observed that vit. E is able to reduce the cutaneous paresthesia caused by pyrethroids.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: Non

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