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Toxicity of Sumithion in Albino Rats: Hematological and Biochemical Studies

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Abstract: This study was carried out to investigate the hematological and biochemical effects of the organophosphate insecticide, sumithion, in albino rats. Animals were treated with sumathion at a dose level of 60 mg kg^{-1} body weight (1/4 LD_{50}) daily for 12 days. It was found that erythrocytes (RBCs) count, haemoglobin contents, Mean Corpuscle Volume (MCV) and Mean Corpuscle Haemoglobin Concentration (MCHC) were almost similar in control and treated animals. On the other hand, the results showed that the haemotocrite value, number of leucocytes (WBCs) as well as the lymphocytes percentage were significantly increased in treated animals The platelets were significantly decreased. The results also showed that serum total protein was decreased while triglycerides showed insignificant increase in comparison with control. Cholesterol and creatinine significantly increased after 12 days of treatment. Histological examination of kidney of treated rats revealed impairment of the renal tissues.

Key words: Sumithion, rats, biochemistry, hematology

INTRODUCTION

The widespread use of pesticides in agriculture and forestry conservation programs has prompted the need for evaluation of the hazards of such materials to wildlife. Recent reports have emphasized that the probability of exposure exists within the indoor living space, as well as in the agricultural and industrial workplace (Russel and Overstreet, 1987). Moreover, Reinert (1984) reported that the indoor use of pesticides may create a different and more direct exposure situation. Owing to the extensive use of these chemicals, they are responsible for numerous cases of poisoning in human and non-target wildlife. Newer chemical insecticides are synthesized, introduced and widely used in pest control programs (Mc Eween and Stephenson, 1979). These chemicals fall in one of the essential groups: organophosphorus, organochlorine, carbamate and pyrethroids. The toxicity of insecticides to mammalian animals has received much attention in recent years. Animals exposed to these insecticides exhibited changes in their physiological activities. Insecticides were found to affect protein, triglycerides and cholesterol contents in several animal tissues (Soliman *et al*., 1983; Saleh *et al*., 1986; Singh and Paul, 1987). Many investigators observed changes in the blood indices (RBCS, WBCS, haemoglobin contents and haematocrit value) in different animals treated with organophosphate, organochlorine and carbamate insecticides (Huston and Mathway, 1976; Reena *et al*., 1989; Meerdink, 1989; Tasheva and Hristeva, 1993).

The present research was conducted to study the hematological and biochemical effect of the organophosphate insecticide, Sumithion, widely used in Saudi Arabia, in albino rats.

MATERIALS AND METHODS

Animals: Adult male albino rats (Rattus norvigicus), weighing 350±5 g. were used. Animals were kept in the laboratory under constant conditions of temperature (24±2°C) for at least one week before and throughout the experimental work, being maintained on a standard diet. Besides, fresh shaw and water were available *ad libitum.*

Insecticide used: Sumithion (fenitrothion): it is an organophosphate insecticide used for control of many agricultural pests. It is obtained from Gupa Company, India.

Experimental design
Animals were divided into two groups:
Group (1): Animals in this group were orally given the organophosphate insecticide sumithion at a dose level of 60 mg kg^{-1} body weight (1/4 LD_{50}) daily for 12 days.

Group (2): Animals in this group were used as controls and were kept under the same conditions of the experimental groups.

Hematological study: For hematological study, blood was collected from control and treated animals after 3, 6, 9 and 12 days of treatment. The hematological parameters: Red Blood Cells Count (RBCS), hemoglobin content (Hb), hematocrit value (HCT%), Mean Cell Hemoglobin Concentration (MCHC), Mean Corpuscle Volume (MCV), Mean Cell Hemoglobin (MCH), White Blood Cells Count (WBCS), lymphocytes percentage and blood platelets were measured by a fully automated Coulter counter (Coulter Electronics Limited, England).

Biochemical study: Sera were obtained by centrifugation of the blood Samples and stored at 2O°C until assayed for the biochemical parameters. Total proteins, albumin, cholesterol, triglycerides and creatinine were measured using a fully automated Hitachi 911 analyzer (Tokyo, Japan). A commercial randox kits (Randox Laboratories, Ltd., Ardomre, Crumlin, United Kingdom) were used in these analysis.

Histological study: kidneys were removed and fixed in Bouin's fluid for 24 h. After fixation, the tissues were dehydrated through ascending grades of ethanol. Thereafter, it was cleared in xylene and finally embedded in paraffin wax. Using a rotary microtome, specimens were sectioned at 5 μm and sections were mounted on clean slides and stained with haematoxylin and eosin.

Statistical analysis: The results are given as mean±standard deviation (SD). Significance of the differences was tested by the Student t-test. The levels of significance were taken at $p<0.05$.

RESULTS

Data in Table 1 showed that the mean red blood cells counts and the hemoglobin contents were insignificantly changed in the treated animals during the period of treatment. The hematocrit value became significantly increased after 9 and 12 days of treatment and the percentages were 45±0.6 and 46±3.2 in treated animals in comparison with 35.5±0.3 in controls. The Mean Corpuscle Hemoglobin Concentration (MCHC), the Mean Corpuscle Volume (MCV) and the Mean Corpuscle Hemoglobin (MCH) appeared insignificantly changed during the periods of treatment. The number of blood platelets was significantly decreased after 12 days. The number of leucocytes (WBCS) and lymphocytes percentage were significantly increased after 9 and 12 days.

Results in Table 2 showed that serum total proteins were significantly reduced in the treated rats after 12 days of exposure to the insecticides. Albumin changed slightly

Table 1: Effect of sumithion on blood parameters of experimental animals.

	Treatments				
Parameters	Control	3 days	6 days	9 days	12 days
Rbcs 10^6 mm^{-3}	7.8±0.25	7.9±0.3	8.8±1.2	7.4±0.9	8.4±0.3
Hb gm dL^{-1}	16.72±0.6	14.9±1.1	16.6±0.9	15.2±1.0	15.7±1.2
HCT%	35.5±0.3	41.9±2.3	42.4±1.4	45.6±0.6	46.3±3.2*
MCHC g dL^{-1}	35±0.6	35.5±1.3	35.8±0.8	35.8±1.2	36.5±1.3
MCV mm^3	52±3.1	51.1±1.6	52.1±1.4	53.8±0.9	50.8±1.1
MCH pg	18.6±1.1	18.1±2.1	18.6±1.3	19.3±0.3	18.6±0.6
Platelets 10^3 L^{-1}	814±4.7	774±31.2	871±10.2	843±5.3	526±28.8*
WBCS 10^3 mm^{-3}	5.7±0.5	5.5±1.7	5.3±2.34	75±1.9*	9.4±1.4*
Lymphocyte%	74.5±0.2	77.6±4.1	74.5±1.5	81±2.3*	87±4.1*

(*):significant at $p<0.05$

Table 2: Effect of sumithion on biochemical parameters in sera of experimental animals.

	Treatments				
Parameters	Control	3 days	6 days	9 days	12 days
Total proteins (g dL^{-1})	6.2±0.3	5.7±1.5	5.9±1.6	6.1±1.8	3.9±0.7*
Triglycerides (mg dL^{-1})	53±0.7	48±0.9	50.0±1.3	52±2.3	56±2.6
Albumin (g dL^{-1})	3.2±0.1	3.7±0.1	3.6±0.2	3.6±0.04	3.7±0.3
Creatinine (mg L^{-1})	0.8±0.01	0.87±0.04	0.92±0.1	1.1±0.2	1.24±0.15*
Cholesterol (mg dL^{-1})	56±1.2	54±2.1	56±2.1	59±1.9	66±1.9*

* Significant at $p<0.05$

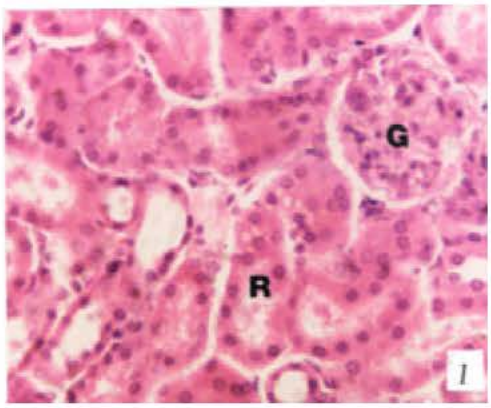

Fig. 1: Section in the kidney of a control rat showing renal tubules (R) and glomerulus (G), X400.

in comparison in control animals. On the other hand, serum triglycerides value was insignificantly increased and cholesterol value was significantly increased after 12 days of treatment. Data in Table 2 also showed that there was an elevation in creatinine in the serum of treated animals compared with that of control. This increase was significant ($p<0.05$) after 12 days of treatment.

Concerning the histological results, Fig. 1 showed kidney of control rat. Animals treated with sumithion for 12 days showed many histopathological alterations. The renal tubules rendered so highly damage that they

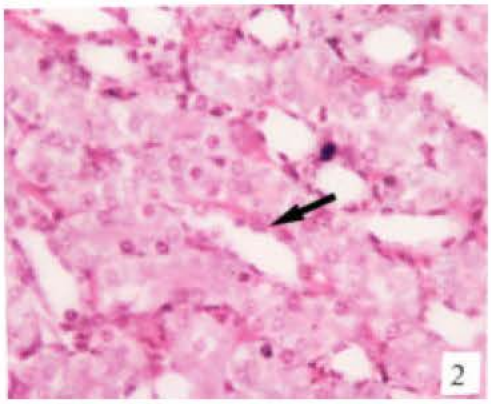

Fig. 2: Section in the kidney of sumithion-treated rat showing degenerated tubules (arrow), X400

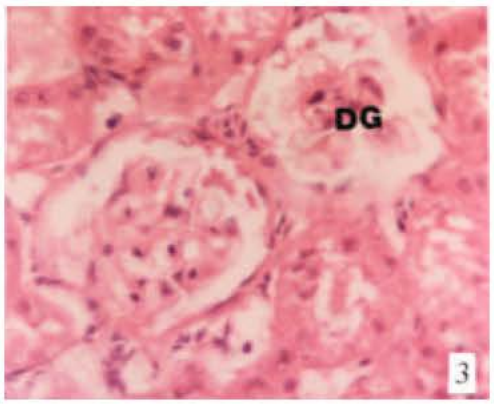

Fig. 3: Section in the kidney of sumithion-treated rat showing atrophied glomerulus (DG), X400

have almost lost their characteristic appearance and their lining epithelial cells became undistinguished and their contents were intermixed with each other (Fig. 2). The walls of Bowman's capsule were eroded and the glomeruli were atrophied and in some sections appeared as empty spaces containing amorphous cellular derbis (Fig. 3).

DISCUSSION

The present research studied the hazardous effects of the organophosphate insecticide, sumithion. The results revealed that erythrocyte count, hemoglobin contents, Mean Corpuscle Hemoglobin Concentration (MCHC), Mean Corpuscle Volume (MCV) and Mean Corpuscle Hemoglobin (MCH) were almost similar in the control and animals treated with sumithion for 12 days. In contrast to these findings, some investigators observed hematological changes in mammalian animals treated with organophosphate, organochiorine and carbamate insecticides (Huston and Mathway, 1976, Zaleska-Ferlijan and Kosicka. 1982; Reena *et al*., 1989, Meerdink, 1989, Tasheva and Hristeva, 1993). On the other hand, the results showed that the number of leucocytes as well as lymphocyte percentage significantly increased in the treated rats. This means that the defense mechanism represented in the leucocytes could compensate the toxic effects of these insecticides. The number of circulating blood platelets was significantly reduced in animals treated with sumithion. This result is in agreement with that of Zaleska-Ferlijan and Kosicks, (1982), Tasheva and Hristeve, (1993) and Saleh *et al*. (1998) using other insecticides.

The biochemical results, indicated that serum total proteins was decreased in animals treated with sumithion. This result come in agreement with that of Imamura *et al*. (1983), Ahmed *et al*. (1989) and Badawy *et al*. (1992) who reported a decrease in serum total protein in insecticides-treated animals. Conversely, Reena *et al*. (1989) reported that total serum proteins were not changed in rats after treatment with dimethoate. Insignificant increase in triglycerids and significant increase in cholesterol were recorded in sera of animals treated with sumithion. A similar result was obtained by Gupta *et al*. (1994) in rats treated with carbofuran. Saleh *et al*. (1998) reported that pyrethroid insecticides affected triglycerides and cholesterol in different experimental mammals. On the contrary, Saleh (1990) found that treating pigeon with cypermethrin caused decrease in total lipids, triglycerids and cholestral in the serum. It is speculated that treating rats with sumithion increased tissue lipogenesis and probably this has been achieved through acceleration of acetyl-Co A to be the precursor of cholesterol biosynthesis. An increase in serum creatinine was recorded in sumithion-treated rats. Abu-El-Zahab *et al*. (1993) and Sakr *et al*. (2001) obtained the same results in rats treated with pyrethroids. Treating animals with sumithion induced many histopathological alterations in the kidney. Similarly, Abdeen *et al*. (1994) reported that treating mice with fenvalerate induced renal damage of the epithelial linning of the renal tubule, ruptured of the distal tubules and enlargement of the glomerulei with hydropic degeneration. Subchronic feeding of decarboxy fenvalerate was found to induce glomerulonephrosis in kidney of rats (Parken *et al*., 1986).Thus, the elevation in creatinine together with the histopathological results indicated that sumithion induced kidney injury in rats.

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