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The Effect Of Lead On The Performance Of Male Rabbits And Some Physiological Parameters

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SUMMARY

Twenty-four mature male New-Zealand white rabbits at 6 months of age and 3.07 kg body weight, were divided into 4 equal groups. The animals were lefted without any treatment for 6 weeks (preliminary) and then were given drinking water containing 0, 100, 500 and 2500 ppm Pb for 6 weeks (treatment) and thereafter lefted for 6 weeks (recovery period). Lead exposure decreased significantly ($p<0.05$) the body weight (6.35%) and feed intake (28.75%), however the effect on water intake was negligible. Respiration rate and rectal temperature were declined by lead acetate treatment in all treated groups. A slight decrease in the weights of testis, adrenal and spleen were observed in lead treated rabbits, meanwhile, liver and kidney weights were increased. Hemoglobin concentration (Hb), red blood cell (RBC) counts, packed cell volume (PCV) and total leucocyte counts were significantly and gradually declined. However, blood glucose was significantly ($p<0.05$) increased in lead acetate treated rabbits and the effect was dose-dependent.

Keywords: Rabbits, lead exposure, physiological parameters

INTRODUCTION

Lead is one of the heavy metals widely distributed in the environment and in some industrial areas. Lead accumulates in the body of man and animals through water, food, air, dust and soil. A number of studies have been done on the effect of lead on the body weight of different species of animals.

Flora and Tandon (1990) exposed of male rat to lead acetate (10 mg/kg) for 8 weeks and they found a significant loss in weight gain. Hammond *et al.* (1989) showed a decreased in body weight and weight gain in a weanling rats exposed to lead acetate of doses 0, 250 and 500 ppm supplied in drinking water. El-Shaarrawi *et al.* (1988) found that exposure of male chickens to lead acetate in doses 0,750 and 1500 ppm in the diet caused a significant decrease in live body weight. Hsu (1981) reported an increase in the relative weights of the liver, kidney and spleen of rats, pups born of dams receiving of diet supplemented with 0.5% lead acetate.

Analysis of blood showed that treatment of animals with lead induced a significant decline in hemoglobin (Hb) concentration, packed cell volume (PCV) and the

erythrocyte (RBC) counts (Terayama and Muratsugu, 1986; Ryden and Walsh, 1987; Hsu, 1981; Sobotka *et al.*, 1975). Additionally experimental animals exposure to lead caused elevation in blood and urine glucose. Treatment of male chickens with lead acetate (0, 750 and 1500 ppm Pb) for three months, caused insignificant rise in plasma glucose concentration (El-Shaarrawi *et al.*, 1988).

In Alexandria district there are great number of industrial units use lead in their products, and thus marked amount of lead may transfer to air, soil, water and plants growing near these units. Therefore, the purpose of the present study was to investigate the effect of exposure to lead acetate on the body weight, feed and water intake, organs weight and on some blood characteristics of male rabbits.

MATERIALS AND METHODS

Twenty four mature male New-Zealand white rabbits at 6 months of age with 3.07/p> 0.05 kg body weight were divided randomly into four equal groups of 6 rabbits each. They were housed individually in cages, feed and water were provided ad. libitum. The ingredients components and chemical composition of the diet as determined according to A.O.A.C. (1980) are shown in Table (1). Lead acetate $(CH_3COO)_2Pb. H_2O$ supplements were added in drinking water of the different experimental groups as follows: Group 1 control group (0 ppm), group 2 low dose (100 ppm), group 3 medium dose (500 ppm) and group 4 high dose (2500 ppm). The doses of lead were calculated as lead. The experiment continued for 18 weeks: a preliminary period (6 weeks) without any treatment, followed by the treatment period (6 weeks) then the last 6 weeks were considered as a recovery period without any treatment.

Table 1. Composition and chemical analysis of the experimental diet

Ingredients	%
Hay	48
Wheat bran	18
Corn	16
Soybean meal	14
Molasses	3
Limestone	0.5
Vitamins and trace elements mix	0.1
Salt	0.4
Chemical analysis	
Crude protein (CP)	17.0
Ether extract (EE)	2.75
Crude fiber (CF)	12.3
Nitrogen free extract (NFE)	44.78
Ash	6.59

Body weight of each animal was recorded weekly throughout the 18-weeks experimental period. Feed and water intake were recorded daily for each animal. Respiration rate (RR) and rectal temperature (RT) of each animal were measured weekly. Blood samples were collected from the ear vein of all the animals every other weeks throughout the 18-weeks experimental period. Whole blood was

analyzed after collection for glucose concentration by using the O-toluidine methods (Hyvarinen and Nikkila, 1962), hemoglobin concentration by the cyanomethemoglobin method (Eilers, 1967), red blood cell counts, counting according to Luker and Luker (1971), packed cell volume (PCV) using Wintrobe hematocrit tubes and total leucocyte counts (LC) counted according to Hepler (1966).

Two animals from each group were slaughtered at the end of both the treatment and the recovery periods. Weights of liver, kidney, testis, spleen and adrenal gland were also recorded in the sacrificed animals.

The results were analyzed statistically according to the Statistic Analysis System (SAS USER's GUIDE, 1985).

RESULTS AND DISCUSSION

Comparing with the control group, the body weight of male rabbit treated with lead acetate decreased significantly ($p<0.05$). Thus during the treatment period rabbits receiving 100, 500 and 2500 ppm lead acetate supplements showed 6.30, 6.03 and 8.49% decrease in body weight, respectively, than the body weight of control group (Table 2). During the recovery period the body weight of the treated groups were returned to the control level. The decrease in body weight of lead-treated rabbits is in agreement with Flore and Tandon (1990);Cory-Slechta *et al.* (1989); Hammond *et al.* (1989) and Hsu (1981) in rats, El-Shaarrawi *et al.* (1988) in chickens and Mautino and Bell (1986) in ducks. Reduction of body weight of lead-exposed animals may be due to nutritional disturbance,alteration in hormones that regulate metabolism and growth, direct toxic effect of lead on different tissue and/or suppressive effect on the immune response.

Lead acetate treatment resulted in a significant decrease ($p<<0.05$) in feed intake and an insignificant decrease of water intake (Table 2). Rabbits receiving 100, 500 and 2500 ppm lead acetate supplements showed 22.40, 22.03 and 41.82% decrease in feed intake, respectively, than that of control group. Decreasing of food consumption is mainly ascribable to depression of appetite (Morley and Levine, 1985). Lead may depress appetite as a result of effects at sites remote from gastrointestinal tract, e.g. brain centers involved in the regulation of food consumption. The slight decrease in water intake can be attributed to the presence of lead in drinking water causing changes in the properties of water which make the water unbalatable.

Thus, calculation of the total amounts of lead ingested in drinking water was about 16.3, 84 and 370 mg lead/Kg B.W. for the 2nd , 3rd and 4th groups, respectively. Several studies reported the ability of lead to reduce the number of antibody-forming cells (Koller *et al.*, 1976) and to diminish the phagocytic function of the reticuloendothelial system (Trejo *et al.*, 1972). These effects will decrease the ability of animals to overcome the adverse effects of different stressors and consequently led to body weight loss in mature animals.

The effect of lead acetate on organs weight are presented in Figure (1). Lead acetate treatment resulted in a decline in adrenal and testis weight in all treated groups, and this effect was returned almostly to the control level during the recovery period. Moreover, lead acetate treatment resulted in an increase in liver, kidney in all treated groups. Spleen weight declined slightly during the treatment particularly in the high dose treated group. However, a marked depression in spleen weight was recorded in mice treated with lead (Hillam and Ozkan, 1986).

Table 2. Changes in body weight, feed intake and water intake of male rabbits treated with lead acetate (mean±SE)

Groups[1]	Body weigh (Kg)			Feed intake ($Kg^{0.75}$/day)			Water intake ($Kg^{0.75}$/day)		
(ppm Pb)	I	II	III	I	II	III	I	II	III
Control	3.35 ±0.04	3.65 ±0.04	3.78 ±0.05	82.44 ±2.15^{ab}	77.41 ±2.15^{b}	53.47 ±2.63^{de}	219.4 ±55.53	165.29 ±5.53	198.84 ±6.78
Low dose	3.25 ±0.04	3.42 ±0.04	3.65 ±0.05	86.72 ±2.15^{a}	60.07 ±2.15^{cd}	46.67 ±2.63^{ef}	213.15 ±5.53	163.23 ±5.53	189.44 ±6.78
Medium dose	3.37 ±0.04	3.43 ±0.04	3.73 ±0.05	84.03 ±2.15^{a}	60.36 ±2.15^{c}	49.59 ±2.63^{ef}	222.76 ±5.53	168.10 ±5.53	205.05 ±6.78
High dose	3.30 ±0.04	3.34 ±0.04	3.64 ±0.05	80.84 ±2.15^{ab}	45.03 ±2.15^{f}	36.65 ±2.63^{g}	217.44 ±5.53	147.96 ±5.53	197.88 ±6.78

a,b,c,d,e,f,g Means with small superscript differ significanty at 5% level

1 Control = 0.0 Pb, Low= 100 ppm Pb, Medium dose= 500 ppm Pb and High dose= 2500 ppm Pb

I= Preliminary period, II= Treatment Period and III= Recovery period.

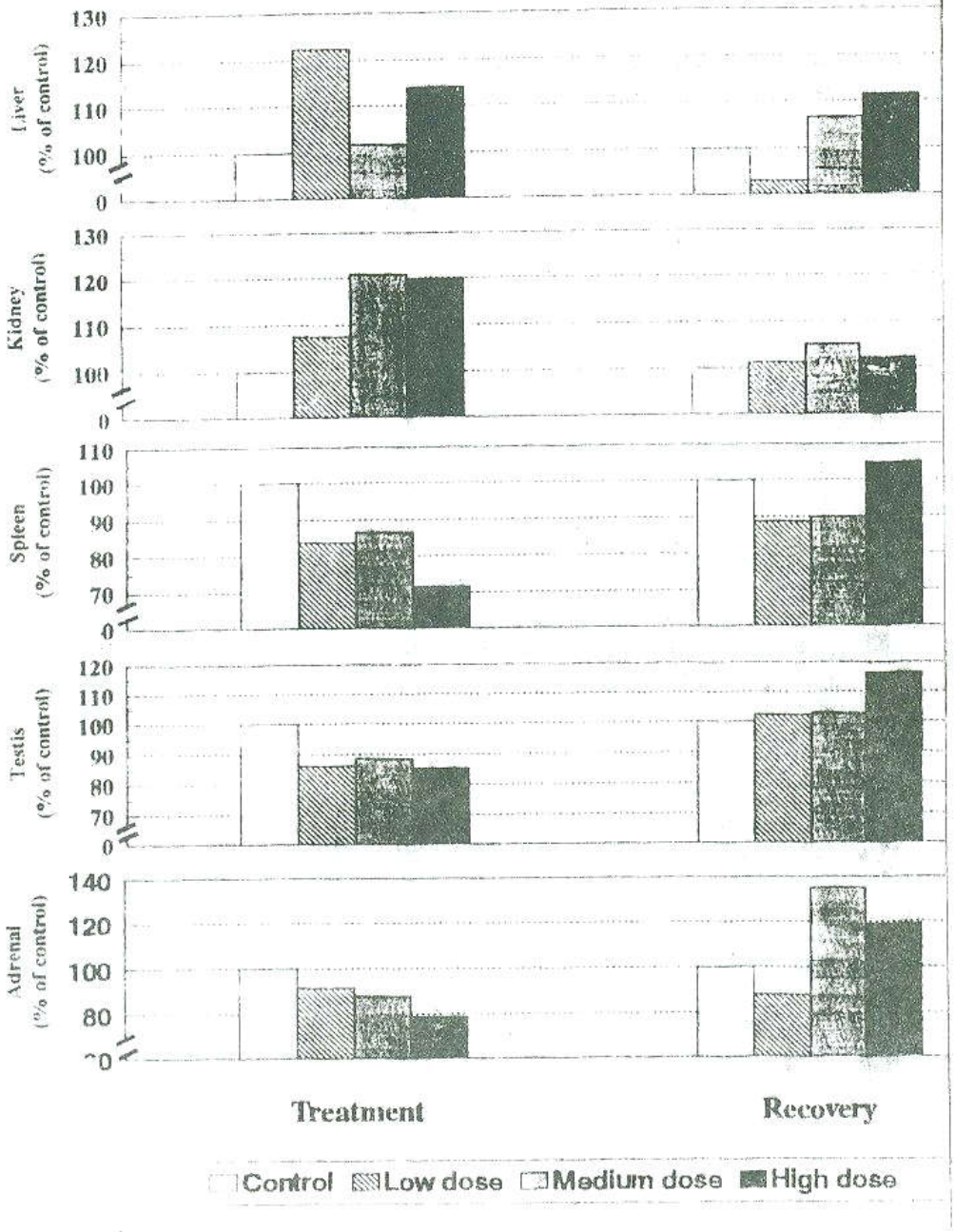

Fig 1. Changes in liver, kidney, spleen, testis and adrenal weights in male rabbits treated with lead acetate.

Exposure of male rabbits to lead toxicity significantly decreased in respiration rate, RR and rectal temperature, RT, (Figure 2). The decreases in RR and RT may reflect the toxic effect of lead either centrally and/or peripherally. Thus, lead may a lter the activity of the nerve centers regulating RT and RR in the central nervous system. It may also affect the mitochondria (Goyer and Krall, 1969), and other cellular machinery responsible for energy production.

Hematological alteration due to lead exposure are shown in Figure (3). Hemoglobin concentration, red blood cell counts and packed cell volume were decreased ($p<<0.05$) gradually in rabbits treated with lead acetate. The magnitude of the changes are dose-dependent, low dose had a negligable effect. These results are in agreement with those of Terayama and Muratsugu (1988), Ryden and Walsh (1987) and Sobotka *et al.* (1975) in male rats and El-Shaarrawi *et al.* (1988) in male chickens. The decreases in Hb, PCV and RBC values, particullarly in high dose treated animals may be due to the influence of lead on the biosynthesis of heme, thus inhibiting the synthesis of hemoglobin (Waldron, 1966). Stopping of lead treatment during recovery period, although enhancing the RBC and PCV values but values of Hb did not completely recovered until the end of the recovery period.

Lead acetate treatment caused a decline ($p<0.05$) in total leucocyte counts LC, especially in high dose treated animals. Such effects are in a good agreement with those of Hillam and Ozkan (1986) and Koller and Kovacic (1974) in mice and Luster *et al.* (1978) in rabbits. The lead induced leucopenia indicates some in vivo cytotoxicity of lead.

The changes in blood glucose during treatment of male rabbits with lead acetate are shown in Figure (4) which indicated that blood glucose was markedly increased ($p<0.05$) and the effect was dose-dependent. Thus, rabbits receiving 100, 500 and 2500 ppm lead acetate supplements showed 18.93, 26.45 and 40.24% increase in blood glucose, respectively, comparing with that of control group. These results were in accordance with those reported by El-Shaarrawi *et al.* (1988) in male chickens. The effect of lead on glucose was attributed to stimulation of gluconeogenic enzymes, delays the release of insulin from the pancreas and suppression of its activity, also increases of c-AMP levels, which in turn result in increased glucose levels (Kacew and Singhal, 1980).

Thus, from the present results it can be concluded that exposure of animals to lead, is capable of inducing marked alterations in several physio-metabolic functions including body weight, feed and water intake, blood components, which affect the pr oductive performance of animals. The magnitude of effect was dose-dependent. Accordingly, attention must be taken to avoid severe pollution of feed stuff and drinking water with leaded compounds particularly near the industrial zones.

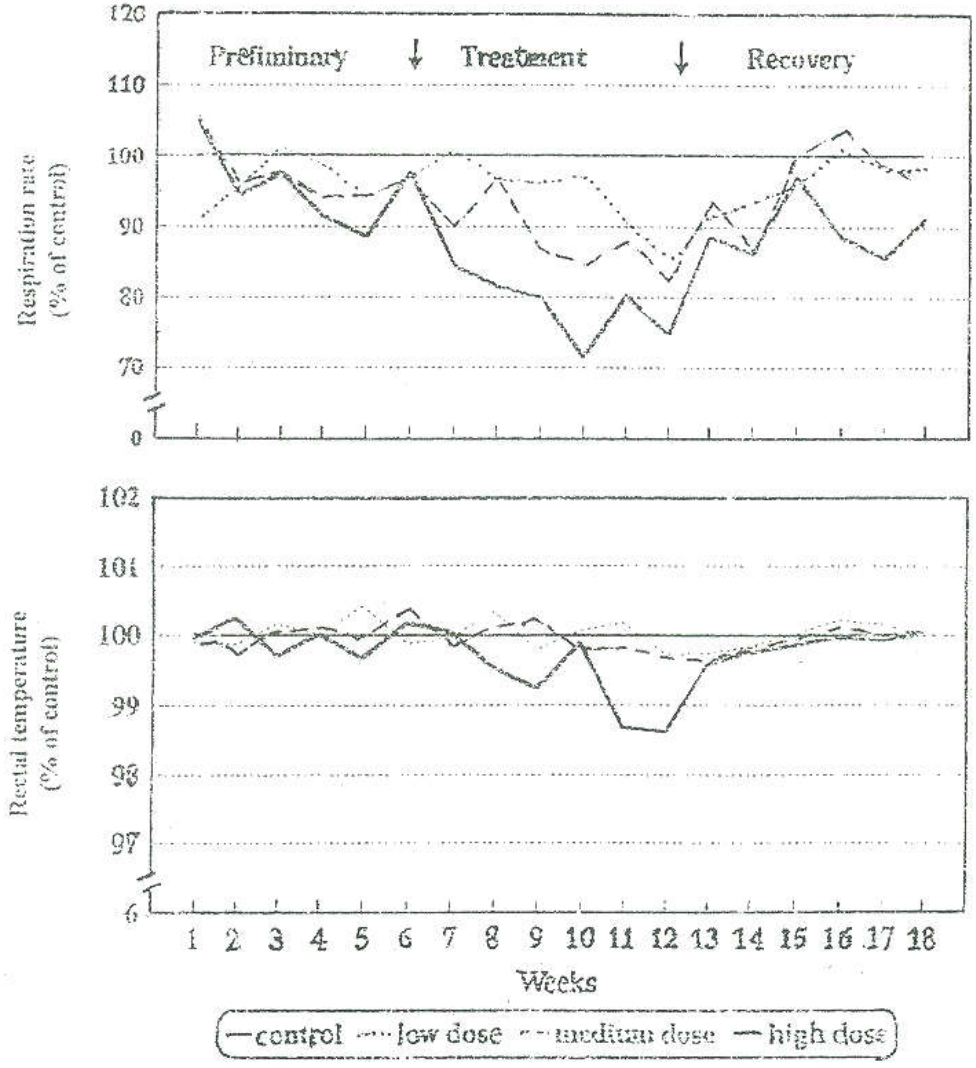

Fig. 2. Changes in respiration rate (RR) and rectal temperature (RT) during treatmen of rabbits with lead acetate.

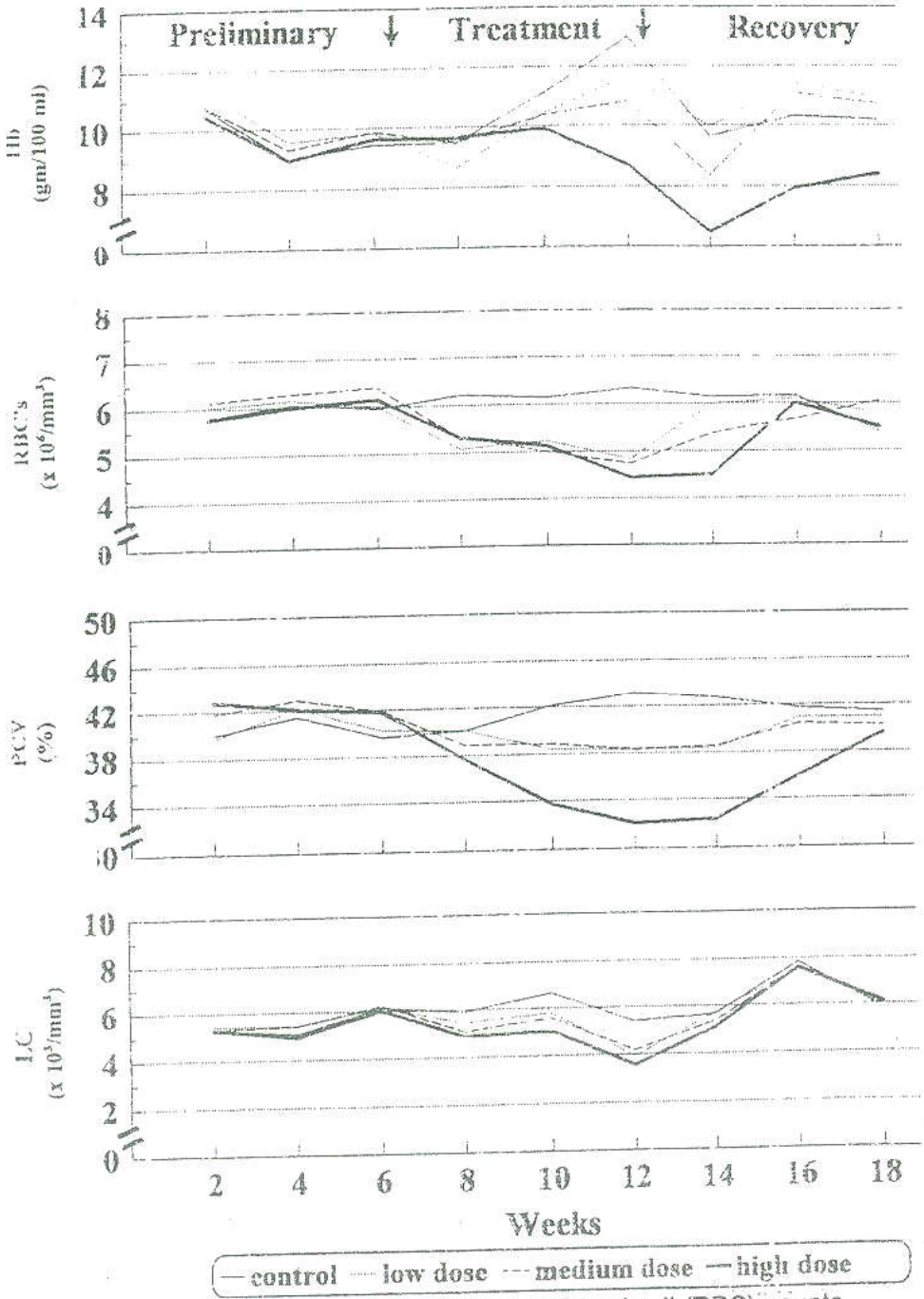

Fig. 3. Changes in blood hemoglobin (Hb), red blood cell (RBC) counts, packed cell volume (PCV) and total leucocyte counts (LC) during treatment of rabbits with lead acetate.

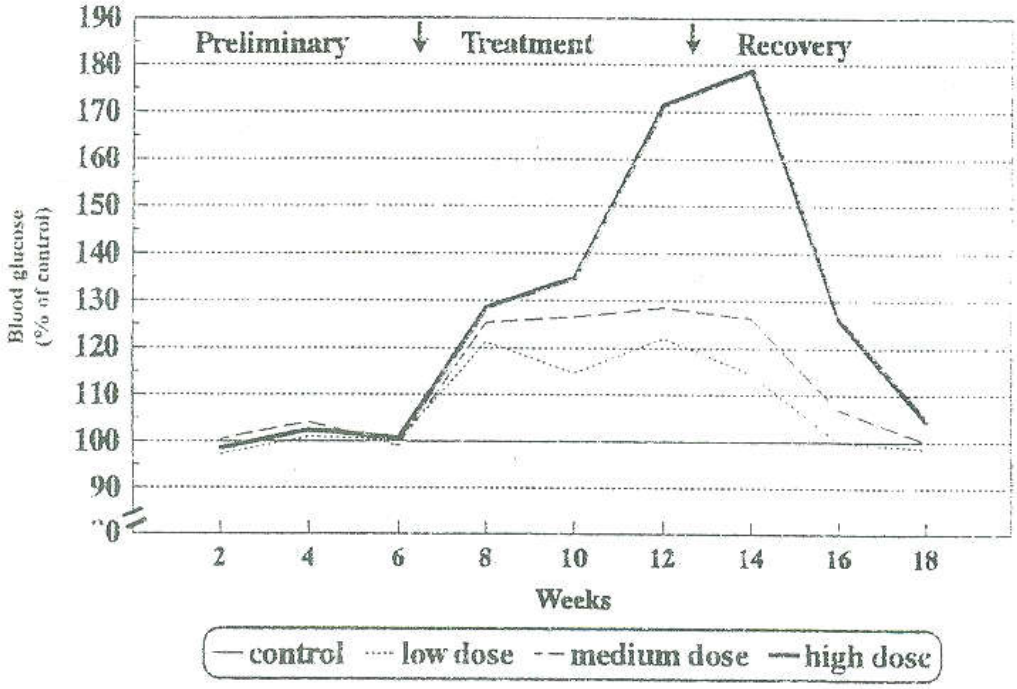

Fig. 4. Changes in blood glucose during treatment of rabbits with lead acetate.

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تأثير المعاملة بالرصاص علي النمو وبعض المعايير الفسيولوجية لذكور الارانب

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أستخدم لإجراء هذه التجربة ٢٤ ذكر أرنب من النوع النيوزيلندي عند عمر ٦ شهور وكان متوسط وزن الجسم ٣،٠٧ كيلوجرام . قسمت الارانب الي اربعة مجاميع متساوية واعطي الرصاص في صورة خلات الرصاص مضافة الي ماء الشرب وفي اربعة مستويات وهي صفر, ١٠٠, ٥٠٠, ٢٥٠٠ جزء في المليون/ لتر. واستغرقت الدراسة ١٨ اسبوعاً مقسمة بالتساوي الي ٣ فترات هي: فترة ما قبل المعاملة - فترة المعاملة - فترة الاستعادة.

خلال فترة التجربة تم تقدير وزن الجسم ومعدل استهلاك الغذاء والماء ودرجة حرارة الجسم ومعدل التنفس اسبوعيا. ثم أخذت عينات دم مرة كل اسبوعين وقدر بها تركيز الهيموجلوبين وعدد كرات الدم الحمراء والحجم النسبي لكرات الدم وعدد كرات الدم البيضاء وتركيز الجلوكوز.

النتائج التي تم الحصول عليها يمكن تلخيصها في الاتي:-

١- المعاملة بالرصاص أدت الي حدوث انخفاض معنوي في وزن الجسم مقداره ٦،٨٥ ٪ وصاحب ذلك انخفاض في الغذاء المتناول ومقداره ٢٨،٧٥ ٪ عن المجموعة الغير معاملة وأيضا انخفاض في مستوي الماء المتناول عند جميع مستويات الرصاص المعطاه.

٢- حدث انخفاض معنوي وتدريجي في درجة حرارة الجسم ومعدل تنفس الحيوانات المعاملة بالرصاص عند جميع مستويات الرصاص المعطاه.

٣- المعاملة بالرصاص أدت الي حدوث انخفاض بسيط في وزن الخصية والطحال والغدة فوق الكلوية في حين حدث زيادة بسيطة في وزن الكبد والكلية.

٤- تحليل الدم اظهر حدوث انخفاض معنوي وتدريجي في تركيز الهيموجلوبين وعدد كرات الدم الحمراء والحجم النسبي لكرات الدم وعدد كرات الدم البيضاء في الحيوانات المعاملة بالرصاص خلال فترة المعاملة.

٥- إرتفع تركيز الجلوكوز في الدم إرتفاعا معنويا بمقدار ٢٨،٥٤ ٪ عند معاملة ذكور الارانب بالرصاص.