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MORPHOLOGICAL AND FUNCTIONAL CHANGES OF JAPANESE QUAIL (COTURNIX JAPONICA) LIVER EXPOSED TO CADMIUM

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ABSTRACT

This study was conducted to determine the changes in liver function and histological changes of liver caused by dietary cadmium in male Japanese quail. One hundred 30 days old, male Japanese quail were evenly distributed into experiment group and control group, which was fed a basal diet. In experiment group 25 mg/kg Cd was added to the basal diet. Water and feed were provided ad libitum. In experiment group live weight was reduced and histopathological changes were increased number of kuppfer cells, vacular degeneration and hepatocyte single cells necrosis. Serum total protein and globulin levels, AST and ALT activities were increased while albumin concentration was decreased.

Key words: Japanese Quail (Coturnix Japonica), Cadmium

INTRODUCTION

Cadmium (Cd) is a heavy metal that is widely distributed in the environment as a result of industrial and agricultural practices [11,14]. Relatively large quantities of Cd are found in commercial phosphate fertiliser, thus the increases in soil and plant Cd contents may lead to increases in dietary Cd. In recent years, Cd poses a potential environmental hazard due to excess in its industrial use [18-1].

The source of cadmium intake is mostly food, and most of the cadmium that is absorbed after oral exposure mainly accumulates in the kidneys and liver [6,12,14]. Cadmium primarily affects the kidneys, liver and intestine [16]. The biochemical alterations occur prior to morphological changes in the organs, and the changes in certain enzyme levels in extracellular fluids may reflect the extent of Cd-induced damage in target organs [9,20]. In this study, the changes in some biochemical parameters of blood and histopathological changes caused by dietary cadmium in liver of male Japanese quail were investigated.

MATERIALS AND METHODS

Animals and Experimental Design One-hundred 30 days-old male Japanese quail were obtained from a research farm (The center for research and education on agriculture and natural resources of Yazd, Iran) and randomly divided into two groups. The control group took no cadmium and cadmium group was given formula feed containing 25 ppm of cadmium (cdcl2.merk) for 60 days. The cadmium content in feed (0.006 ppm) and water (0.003ppm) used in this experiment varied below the limit value. The birds were keept in cages under microclimatic conditions favorable for their growth and welfare. The food composition was corn (36.7%), wheat grain (15%), soybean meal (35.4%), corn gluten meal(8.9%),calcium diphosphate, calcium carbonate, common salt, DL methionine, Lysine hydrochlorid, L.threonine,B complex and other mineral and vitamins premix . Fifteen birds from each group on days 0 and 60 were randomly selected and weighed after slaughter and necropsy was. The liver samples were prepared for histological section .To evaluate of liver function , Serum concentration of total protein, albumin, globulin, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were measured.

Histological Examination:

A portion of liver was fixed in 10% buffered formalin, dehydrated in ethanol and xylene, embedded in paraffin, cut into 5-6um sections, and stained with hematoxylin and eosin for microscopic examination.Serum Biochemical Examination :

Serum concentration of total protein, albumin, globulin, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were determined spectrophotometrically with commercial kits.

Statistical Analysis:

The data was subjected to statistical analyzing using one way ANOVA by

applying statistical package for social sciences (spss) 12th version. Differences between means were tested using Duncans Multiple comparison test and significance was set at $p<0.05$.

RESULTS

At the time of setting up the experiment the body weight of both groups were practically the same. After 60 days the body weight gain of the cadmium quails , compared with the control birds decreased ($P<0.01$) (Table 1).

Different letters in the same column indicate statistically significant difference ($P<0.05$)

Serum total protein and globulin levels, AST and ALT activities were increased while albumin concentration were decreased. AlT activity didn't change (Table2).

The liver of control quails showed a normal structure. In the cadmium group, cadmium caused increased number of kupffer cells, vacuolar degeneration and single cells necrosis (Fig1-3).

Table 1: Effect of cadmium on body weight gain on male Japanese quail(15)

Groups	Initial body weight(gr)	Final body weight(gr)	Change (gr)
Control	236.6±3.6a	279.1±4.6 a	43.5±1 a
Cadmium	233.8±4.2 a	250.2±6.2 b	17.6±2 b

Table 2.Effects of cadmium on liver function of male Japanese quails(15)

Groups	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Alb/Glob	AST (U/L)	ALT (U/L)	ALP (U/L)
Control	3.06 ± 0.05b	1.26± 0. 4 b	2.12 ±0.1 b	0.62 ±0.3 b	13.65 ±1.06 b	20.46 ± 2.33 b	1246.3 ± 26 a
Cadmium	5.09 ± 0.25a	0.95 ±0.03 a	2.95 ±0.16 a	0.36 ±0.5 a	17.23 ± 8.28a	25.88 ± 2.75a	1352.06 ± 39.02 a

Different letters in the same column indicate statistically significant difference (P<0.05)

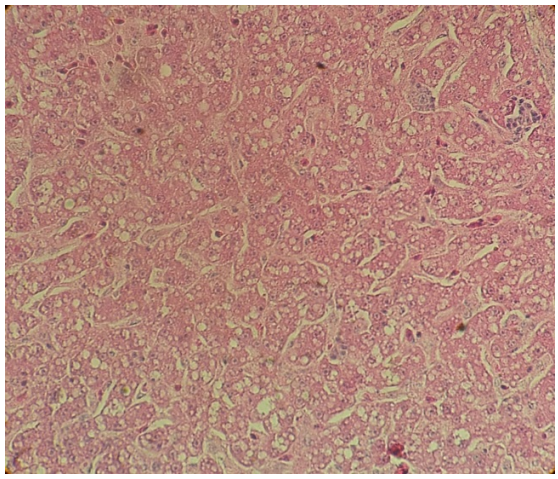

Figure1.Vacular degeneration in liver of quails fed 25 mg Cd/kg diet .H&E, X 100

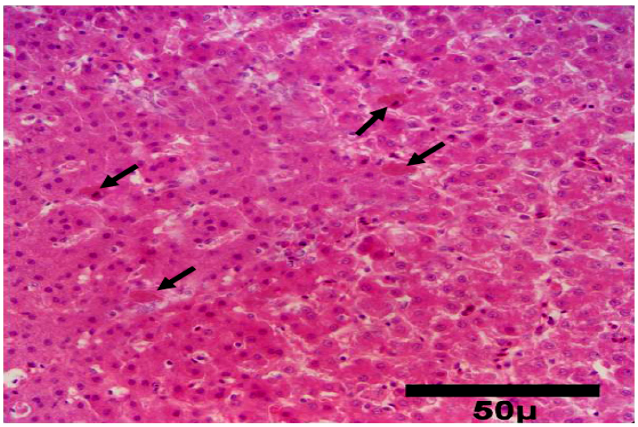

Figure 2: Single cells necrosis of hepatocytes (arrows) in liver of quails fed 25 mg Cd/kg diet. H&E, X 100.

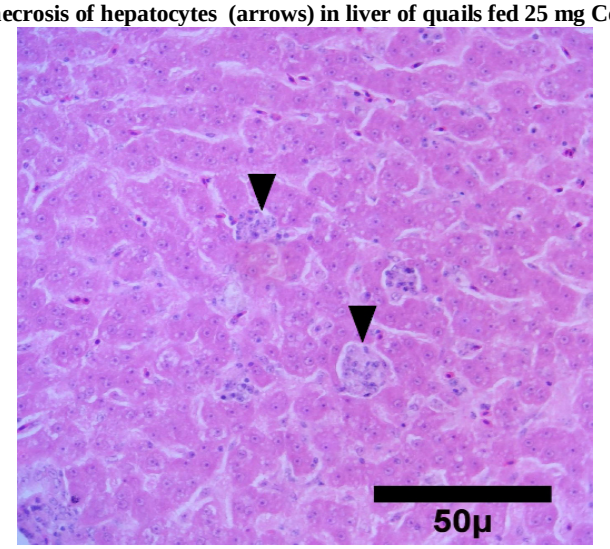

Figure 3: Increase in Kuppfer cells (arrowheads) in the liver of quails fed 25 mg Cd /kg diet. H&E, X 100.

DISCUSSION

Exposure to cadmium occurs mainly through ingestion of contaminated water and food. Cadmium has a long biological half- life (20-30years) and primarily affects the kidney and liver [16,18]. In this study the body weight of the quail exposed to dietary cadmium decreased ($P<0.05$). Lisunora et al. [10] and Sant Ana et al. [15] observed weight loss quail exposed to dietary cadmium. Teshfam et al. [18] reported a reduction in body weight of broiler chicken given 50 or 100 ppm dietary cadmium could have been a result of altered intestinal mucosa. Cigankova et al. [5] observed an adverse effect of cadmium on structure and ultrastructure of duodenal epithelium of Japanese quail

In the present study, the reductions in serum albumin, increases in globulin levels and alterations in alb/glob ratio may result from the lower liver function [19]. Since the albumin levels decreased, the increases in globulin levels may elevate the total protein

[12,13]. increases in AST and ALT levels may result from the liver damage as supported by the pathological findings[17,19] .Increased in serum total protein and globulin levels, AST and ALT activites in broiler exposed to dietary cadmium reported by Uyanik et al.[19]. Swapana et al. [17] and Bharavi et al[1] observed increase in serum ALT levels in broiler exposed to cadmium.Sant Ana et al.[16] reported increased serum activities of ALT and AST without change of ALP in Japanese quail exposed to a solution of 100 ppm cadmium diluted in purified water for 30 days.

Cadmium in the liver of quail dietary exposed to this metal resulted histological changes of this organ. Single cells necrosis of hepatocytes , vacular degeneration and increase in kuppfer cells were changes. Sinusoid dilation, increased kupffer cells, leukocyte infiltration, single cells necrosis and vacuolar degeneration in liver of rat exposed to orally cadmium by Brzoska et al. [3], Jihen et al. [8] and Salinska et al. [14] were reported. Holovska et al. [7] observed pronounced changes in the liver of turkeys from cadmium group, such as hyperaemia, dilation of sinusoid, accumulation of inflammatory cells and sporadically necrotizing hepatocytes. Congestion, steatosis of hepatocytes, necrosis of single hepatocytes and leukocyte infiltration in the liver of wild living mallards and coots with considerable concentration of lead and cadmium by Binkowski et al. [2] were observed.

Our results showed that exposure to dietary cadmium (25ppm) for 60 days significantly ($P<0.05$) reduced the body weight gain and induced histological and functional changes in liver of Japanese quail.

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