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# Histological and Functional Changes of Japanese Quail (Coturnix Japonica) Kidneys Exposed to Cadmium

Omid Karimi,
Educated of Department of Pathobiology, Faculty of Veterinary Science, Science and Research Branch, Islamic Azad University, Tehran, Iran.
Saeed Hesaraki,
Department of Pathobiology, Faculty of Veterinary Science, Science and Research Branch, Islamic Azad University, Tehran, Iran.
Corresponding author
Seyyed Pejmane Mortazavi
Department of Pathobiology, Faculty of Veterinary Science, Science and Research Branch, Islamic Azad University, Tehran, Iran.

**ABSTRACT–** This study was conducted to determine the changes in kidneys 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. Renal histopathology showed swelling of epithelial cells of renal tubule, necrosis of renal tubules epithelium and hyperaemia. Serum BUN and creatinine levels were increased. Cadmium concentration in kidneys of experimental group was much higher ( 9.7 times)
**KEYWORDS**: Cadmium, Kidneys, Japanese quail, Histopathology and Function

## Introduction

Cadmium (Cd) is a heavy metal that is widely distributed in the environment as a result of industrial and agricultural practices [12,15]. Relatively large quantities of Cd are found in commercial phosphate fertilizer, 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 [1-20]. 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 [6,13,15]. Cadmium primarily affects the kidneys, liver and intestine [17]. 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 [10,22]. In this study, the changes in some biochemical parameters of blood and histopathological changes caused by dietary cadmium in kidneys 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 kept 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 Bun and creatinine were measured.

*Histological Examination* :

A portion of kidney 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 BUN and creatinine were determined spectrophotometrically with commercial kits.

*Cadmium Concentration:*

Cadmium concentration in the kidneys samples was determined by atomic absorption spectrometry (UNICAM939) as described by McFarland *et al*. [13].

*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 ($P<0.05$)(Table 1).

**Table 1:** Effect of cadmium on body weight gain on male Japanese quail

| 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 |

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

Serum BUN and creatinine activities were increased (Table2).

**Table 2.** Effects of cadmium on kidneys function of male Japanese quails

| Groups | BUN(mg/dl) | Creatinine(mg/dl) |
|---|---|---|
| **Control** | 3.05 ± 0.03b | .66±.2b |
| **Cadmium** | 5.09 ± 0.25a | 1.95±0.03 a |

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

Cadmium concentration in kidneys of control group and cadmium group at day 0 showed no significant difference ($P<0.05$).Cadmium concentrations were much higher in kidneys of cadmium group after60 days the experiment began (Table3).

**Table 4:** Cadmium concentration (ppm) in the liver and kidneys of male Japanese quail

| Groups | Initial kidneys concentration | Final kidneys concentration |
|---|---|---|
| **Control** | 0.31±0.01 a | 0.56±0.02 a |
| **Cadmium** | 0.37±0.02 a | 3.6±0.8b |

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

The kidneys of control quails showed a normal structure. In the cadmium group, cadmium caused swelling of epithelial cells of renal tubule, necrosis of renal tubules epithelium and hyperaemia (Fig1-3).

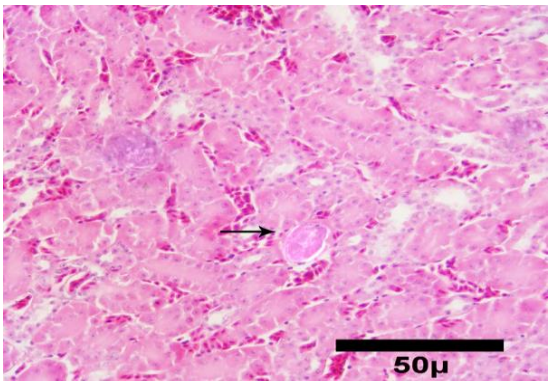


**Fig1:** Kidney of cadmium group. Necrosis of renal tubular cells (arrow). H&E X400

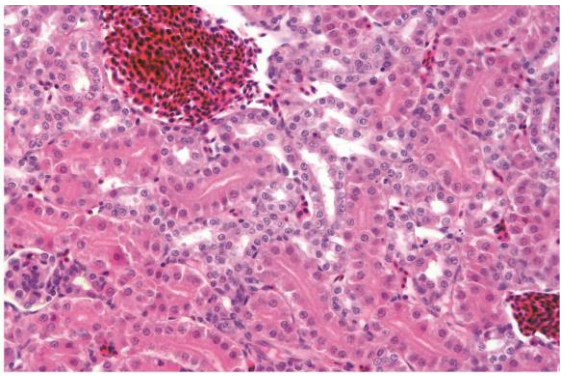

**Fig2:** Kidney of cadmium group.Hyperaemia.H&E X400

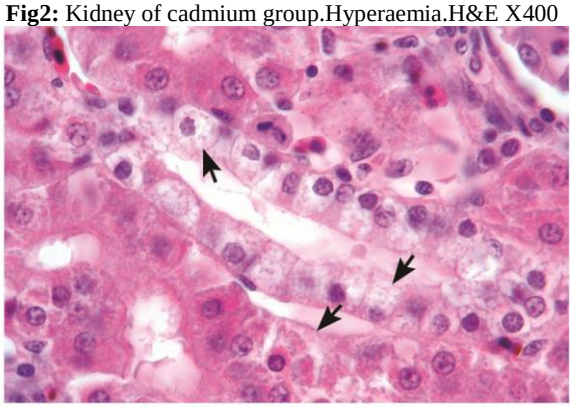

**Fig3:** Kidney of cadmium group.Swelling of epithelial cells(Arrows). H&E X1000

**Dissection**

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 [17,20]. In this study the body weight of the quail exposed to dietary cadmium decreased ($P<0.05$). Lisunora *et al*. [11] and Sant Ana *et al*. [17] observed weight loss quail exposed to dietary cadmium. Teshfam *et al*. [20] 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 increase in serum BUN and creatinine may result from the lower kidney function [19]. Increases in BUN and creatinine levels may result from the liver damage as supported by the pathological findings. .Increased in serum BUN and creatinine levels, activites in broiler exposed to dietary cadmium reported by Swapana et al. [19] and Bharavi et al[1] Cadmium in the kidney of quail dietary exposed to this metal resulted histological changes of this organ. Swelling of epithelial cells of renal tubule, necrosis of renal tubules epithelium and dilated glumeruli were changes. Hesaraki *et al*. [7] reported epithelial cells swelling, necrosis in renal tubules and hyperaemia in kidneys of broiler chicken fed a diet containing cadmium. Swelling and necrosis epithelium renal tubules and congestion in the kidneys of wild living mallards and coots with considerable concentration of lead and cadmium by Binkowski *et al*. [1] were observed. Degeneration in the epithelium of tubules, cystic dilatation and hyaline casts in the lumens of kidney tubules (arrows) of broilers fed 100 mg Cd were reported by Uyanik *et al*.[21]. This study result indicated a significant increase ($P<0.05$) in cadmium concentration in the kidneys of cadmium group compared with control group .The kidney is the primary organ for accumulation of cadmium followed by the liver [5,14,16]. Scheuhammer [18] and Lisunora *et al*. [12] reported the accumulation and deposition of cadmium administration orally in different organs of Japanese quail. 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 kideny of Japanese quail.

**References:**

1. Bharavai,K.,A. Gopala Reddy.,G.S.Rao and S.V.Rama Rao,2010. Reversal of cadmium-induced oxidative stress in chicken by hebal adaptogens Withania somnifera and Ocimum sanctum,Toxicology International.17(2):59-63.
2. Binkowski, L.J., K. Sawicka Kapusta., J. Szarek.,E. Stryzewska and M. Felsmann, 2013. Histopathology of liver and kidneys of wild living Mallards anas platyrhynchos and Coots fulica atra with considerable concentration of lead and cadmium , Science of the Total Enviroment. 450-451: 326-333.
3. Brzoska, M.M., J. Moniuszko_Jakoniuk., B. Pilat Marcinkiewicz. And B. Sawicki, 2003.Liver and kidney function and histology in rats exposed to cadmium and ethanol, Alcohol and Alcoholism., 38(1): 2-10.
4. Chapatwala, K.D, M.Boykin, A. Butts and B. Rajanna,1982.Effect of intraperitoneally injected cadmium on renal and hepatic gluconeogenic enzymes in rats, Drug. Chem. Toxicol. 5(3): 305-317.
5. Cigankova, V., V. Almasiova and K. Holovska, 2010. Morphological changes in duodenal epithelium of Japanese quail after chronic cadmium exposure, Polish Journal of Environmental Studies., 19(2): 275-282.
6. Garcia Fernands, A.J., A.J. Sanches Garcia., M. Gomes Zapata and A. Luna, 1996. Distribution of cadmium in blood and tissues of wild birds, Archive of Environmental Contamination and Toxicology, 30: 252-258.
7. Hesaraki, S., M.J. Gharagozlou, J. Salar Amoli, S. Bokaee and A. Javaheri Vaighan, 2008. Histopathological and ultrastructural changes of kidneys in response to cadmium chloride toxicity in broiler chicken. Journal of Veterinary Research, 65(4): 281-288.
8. Holovska, K., A. Sobekova.,V. Almaslova and V. Cigankova, 2013. Morphological changes in the liver and the response of antioxidant enzymes after turkeys chronic exposure to cadmium. Polish Journal of Environmental Studies, 22(5): 1371-1379.
9. Jihen, E.H., M. Imed., H. Patina and A. Kerkein, 2008. Protective effects of selenium (se) and zing (zn) on cadmium (cd) toxicity in the liver and kidneys of the rat: histology and accumulation. Food Chemical Toxicology, 46: 3522-3527.
10. Khandelwal, S., Agnihotri, N. and Tandon, S.K.: Biochemical response to cadmium: dose-time effect. Biol. Trace Elem. Res. 29: 157-164, 1991.
11. Lisunova, L.I., V.S. Tokarev and N.V. Konstantinova, 2008. Physiological effect of cadmium on Japanese quail (Coturnix japonica).Russian Agricultural Sciences, 34(1): 51-52.
12. Liu, J.,W. Qu and M.B. Kadiiska, 2009. Role of oxidative stress in cadmium toxicity and carcinogenesis .Toxicology and Applied Pharmacology, 238: 272-279.
13. McFarland, C., L.I. Bendell Young, C. Guglielmo and T.D. Williams, 2002. Kidney, liver and bone cadmium content in the western sandpiper in relation to migration. Journal of Environmental Monitoring, 4: 791-795.
14. Novelli, E.L. E.P. Vieira, N.L. Rodrigues and B.O. Ribas, 1998. Risk assessment of cadmium toxicity on hepatic and renal tissue of rats, Environ. Res.79(2): 102-105.
15. Salinska, A., T. Wlostowski and E. Olenska, 2013. Differential susceptibility to cadmium-induced liver and kidney injury in wild and laboratory-Bred bank voles myodes glareolus. Archive of Environmental Contamination and Toxicology, 65: 324-331.
16. Sant Ana, M.G., R. Moraes and M.M. Bernardi, 2003. Toxicity of cadmium in Japanese quail: Evaluation of body weight, hepatic and renal function and cellular immune response. Environmental Research, 99: 273-277.
17. Sarkar, A., G. Ravindran and V. Krishnamurthy, 2013. A brief review on the cadmium toxicity: from cellular to organ level. International Journal of Bio-Technology and Research, 3(1): 17-36 .
18. Scheuhammer, A.M., 1998. The dose-dependent deposition of cadmium into organs of Japanese quail following oral administration. Toxicology and Applied Pharmacology, 95: 153-161.
19. Swapana,G.and A. Gopala Reddy,2011.Effect of cadmium on organ biomarkers and evaluation of certain adaptogenes in broilers ,Toxicology International.18(1):47-49.
20. Teshfam,M., M.J.Gharagozlu,J.Salar amoli and H.Hassanpour,2006.Morphological alteration of the small intestine mucosa following oral administration of cadmium in broiler chicken, Journal ofApplied Animal Research,29(1):65-68.
21. Uyanik,F.,M.Eren.,A. Atasever , G.Tun oku and A.H.Kolsuz, 2001. Changes in some biochemical parameters and organs of broiler exposed to cadmium and effects of zing on cadmium induced alteration,Israel Journal of Veterinary Medicine.56(4):128-134.
22. Valee,B.Land D.D.Ulmer,1972.Biochemical effects of mercury,cadmium and lead,Annu.Rev.Biochem,41:91-128.