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SEMEN QUALITY, HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF DIFFERENT COCKERELS STRAINS EXPOSED TO CADMIUM

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SUMMARY

Seventy-eight one-year-old males of three different strains, 27-Rhode Island Red (RIR), 28-Hungarian (NHx), and 23-Hungarian White (WH) chickens were randomly divided into three groups and housed in individual cages. Birds were offered a basal diet (1), basal diet supplemented with 50 ppm cadmium (2) and basal diet supplemented with 75 ppm cadmium (3) for five weeks, to evaluate the effects of cadmium on body weight, semen quality, blood hematological and biochemical parameters of different cockerels strains. Furthermore, morphohistological characteristics of testis and liver were studied.

The results indicated significant differences among treatments and strains for body weight. Cadmium supplementation caused a significant reduction in body weight that was more pronounced in birds fed 75 ppm (-25.08%) than in those fed 50 ppm (-16.62%). Data showed a direct effect of cadmium on the reproductive ability, since there were noticeable decrease in semen volume and relative sperm density and increase in sperm abnormality. Repeatability estimates of semen volume, concentration and abnormalities were 0.167, 0.167 and 0.413, respectively.

Data demonstrated that following the exposure to cadmium, the serum concentrations of total protein and albumin decreased significantly. However, the decrease was concomitant with an increase in the activities of AST and γ GT indicating the occurrence of liver damage. Data clearly showed that diet supplemented with cadmium caused a significant depression in serum concentrations of minerals and had a positive effect with the level of cadmium. The present study indicated that cadmium treatments decreased significantly all hematological parameters.

Moreover, the correlations between traits studied had certain directions (significant positive or negative values) as a result of cadmium intake. It is worth to mention that both of Hungarian strains had almost the same genetic

constitution, therefore that differences between them were in general not significant.

Keywords: Poultry, cadmium, semen, hematology, biochemical parameters

INTRODUCTION

Since the beginning of this century human environment has been undergoing profound changes in the wake of modern scientific and technological development associated with high polluted atmosphere by different levels of many heavy metals (cadmium, lead...etc). Increasing use of metals is one measure of man's progress and human populations are simultaneously exposed to complex mixture of metals through air, water and food. They provide pathways by which cadmium like other minerals may be dissipated and affect animals *(Kostial, 1986).* There is an increasing interest to investigate the tolerance of animals against the adverse effects of such metals on their performance.

Cadmium causes many serious diseases and dysfunction of organs. The adverse effect of cadmium on reproductive system has been recognized by Assennato *et al. (1986).* Cadmium induced testicular necrosis in several animal species, probably through a direct toxic effect on testicular arteries (Elinder, *1986).* Abaza *et al. (1996)* indicated a direct effect of cadmium on the testis function of Gödöllõ New Hampshire cockerels associated with decrease in semen volume, density and motility; while percentages of sperm abnormalities were increased. Anke *et al. (1989)* reported that cadmium toxicity affected the growth and production in wide range of microorganisms, animals and humans. Feeding different types of chickens on diets polluted with cadmium led to a dysfunction in metabolic and physiological systems (Freeland and Cousins 1973; Azza El-Sebai *et al.,* 1994 and Abaza and Azza El-Sebai, (1996).

The present study was conducted to achieve more knowledge about the effects of cadmium on reproductive ability, blood hematological and biochemical parameters and liver and kidney functions of different cockerel strains. Furthermore, the phenotypic correlations between different traits were studied.

MATERIALS AND METHODS

Seventy-eight one-year-old males of three different strains, 23-Hungarian White (WH), 27-Rhode Island Red (RIR) and 28-Hungarian NHx chickens, were randomly divided into three groups (8, 9, 10), (8, 10, 10), (7, 8, 8) respectively and housed in individual cages. Birds were offered for five weeks, a basal diet (1), basal diet supplemented with 50 ppm cadmium (2) and basal

diet supplemented with 75 ppm cadmium (3), cadmium (Cd) provided to the diet as cadmium chloride. Semen samples were collected twice weekly by the massage method from all birds to determine their semen characteristics. Semen volume was measured in graduated tubes. Relative sperm density was estimated in diluted samples (1:200) by spectrophotometer (Eclipse, Merck) at a wavelength of 546 nm. To determine the percent of morphologically abnormal sperm cells Eosin-Nigrosin stain was used (Lake and Stewart 1978).

At the end of the experimental period, birds were individually weighed and blood samples were taken from the *v. ulnaris* to determine the different hematological and biochemical parameters of blood by using Hitachi 717 Automatic Analyzer and PHA1 (Programmable Hematology Analyzer). Serum was submitted for enzyme and electrolyte determinations that included AST (aspartate Aminotransferase EC 2.6.1.1, UV-method) and γGT (L-γ-Glutamyl transferase EC 2.3.2.2) activities, total protein was determined by Biuret method, albumin by Bromocresol green method and creatinine by Jaffé method. The previous parameters were determined according to guidelines and recommendations (Kaneko, 1980; Bogin and Keller, 1987). Serum concentrations of iron, calcium, phosphorus, sodium and potassium were determined by Inductively Coupled Plasma Atomic Emission System (ICP-AES). Chemicals were purchased from Boehringer and Merck Companies. Samples from the testis and liver were taken and prepared for the histological examination. Tissue sections were cut, fixed with 10% buffered formalin and stained with hematoxylin-eosin.

Storage of data and statistical analyses were performed using an IBM AT (compatible) personal computer and Statgraphics; STSC Rockville, MD, USA, copyright, 1991. Multifactor analysis of variance was used to estimate the significant differences and interactions between treatments and strains. Also phenotypic correlations among different traits (for only treated groups) were carried out. Duncan's multiple range test was used for comparison between means (Duncan, 1955).

RESULTS AND DISCUSSION

1. Body weight:

The results of the effects of feeding cockerels contaminated diets with cadmium on body weight are presented in Table (1). They indicated significant differences between treatments and among strains for body weight and percent of body weight change at the end of the experimental period. The adverse effects of cadmium supplementation on body weight was more pronounced in birds fed 75 ppm of cadmium (-25.08%) than those birds fed 50 ppm (-16.62%), while a slight increase occurred in the control birds (0.14%). The present study showed that cadmium supplementation led to a remarkable

Table 1. Effect of cadmium treatments on body weight and some semen quality traits of different cockerels strains

Treatment Basal diets+	N	Body Weight (g) X±S.E	Changes in Body Weight(%)	Semen Volume ml3	Sperm Concentration (109) X±S.E	Sperm Abnormality (%)
0 ppm Cd	23	3109± 44.7[a]	0.14± 1.11[a]	0.864± 0.033[a]	1.161± 0.024[a]	31.12± 1.22[a]
50 ppm Cd	27	2477± 42.0[b]	-16.62± 1.05[b]	0.563± 0.031[b]	0.790± 0.022[b]	35.52± 1.15[b]
75 ppm Cd	28	2129± 40.1[c]	-25.08 ±1.01[c]	0.648± 0.029[b]	0.726± 0.024[c]	37.16± 1.09[b]
Strains:						
RIR	27	2479± 41.3[a]	-16.44± 1.03[a]	0.613± 0.031[a]	0.911± 0.022[a]	31.48± 1.13[a]
NHx	28	2651± 40.8[ab]	-11.78± 1.02[b]	0.739± 0.030[b]	0.894± 0.022[a]	34.87± 1.12[b]
WH	23	2585± 44.7[b]	-13.61± 1.12[ab]	0.723± 0.033[b]	0.873± 0.024[a]	37.45± 1.22[b]

Means in the same column with different superscripts are significantly different ($P \leq 0.05$)

Table 2. Effect of cadmium treatments on some blood parameters of different cockerels strains

Treatment Basal diet +	N	WBC 10^3 /mm^3	RBC 10^6 /mm^3	Hb (g/100ml)	PCV (%)
0 ppm Cd	23	42.87± 5.51[a]	4.07± 0.05[a]	14.68± 0.29[a]	50.7± 1.01[a]
50 ppm Cd	27	25.88± 5.18[b]	3.45± 0.05[b]	12.24± 0.28[b]	42.1± 1.04[b]
75 ppm Cd	28	25.33± 4.94[b]	3.09± 0.04[c]	9.67± 0.26[c]	36.9± 1.05[c]
Strains:					
RIR	27	29.88± 5.09[a]	3.67± 0.04[a]	12.51± 0.27[a]	45.6± 1.02[a]
NHx	28	32.03± 5.03[b]	3.45± 0.04[b]	11.82± 0.27[a]	41.5± 1.04[b]
WH	23	32.17± 5.51[b]	3.49± 0.05[b]	12.25± 0.29[a]	42.6± 1.01[b]

Means in the same column with different superscripts are significantly different ($P \leq 0.05$)

decrease in broiler body weight. This is in accordance with the results of *Hill et al.* (1980); Azza El-Sebai (1987) and Szilagyi *et al.* (1994). Body weight of broiler chickens fed diets supplemented with 20, 40 and 60 ppm cadmium was reduced at six week of age by about 22.0, 33.6 and 51.3%, respectively, (Abaza, 1996). Also, Bokori *et al.* (1996) found that the change in broiler cockerels body weight was proportional to the dose of cadmium. Body weight of RIR was more adversely affected by cadmium treatments than NHx or WH strains, while the differences between RIR and NHx strains were insignificant (Table 6).

2. Semen quality:

Semen characteristics are presented in Table (1). Cadmium addition caused a significant reduction in semen volume and sperm concentration and significant increase in sperm abnormalit. No significant effect was noticed between 75 and 50 ppm cadmium except in sperm concentration, which was adversely proportional to the dose of cadmium. These results indicated an obvious adverse effect for cadmium on the reproductive ability of cockerels as manifested in a noticeable decrease in semen volume and sperm concentration, as well as an increase in sperm abnormality. The obtained results of semen traits as affected by cadmium treatment in the present study are confirmed by a histological examination. This effect appears mainly due to a toxic effect on spermatogenesis and Leding cells. Similar results were reported by Abaza *et al.* (1996) on Gödöllõ New Hampshire cockerels at one year of age fed 100 ppm cadmium. In rats, cadmium induces injurious effects on vasculature of tests and subsequently influences spermatogenesis and androgen production (Saksena and Lau, 1979).

In respect to strain differences, significant differences were found among strains for semen volume and percentages of abnormalities, while the differences in sperm concentration were insignificant (Tables 1 and 6). RIR strain had highest tolerance (better values) against cadmium pollution for semen traits. Kamar *et al.* (1984) and Machal *et al.* (1996) found strain differences for semen traits. However, Osman (1991), Nayak *et al.* (1992), Segura Correa and Aguayo Arceo (1996) and Attia and Neamat Badawy (1996) found insignificant differences among tested breeds.

Repeatability estimates (Becker, 1968) of semen volume, concentration and abnormalities were 0.1673, 0.1670 and 0.4131, respectively. These results mean that the sperm abnormality trait is a repeatable character or in other words, the effect of cadmium on the semen volume and concentration had variable values as compared with sperm abnormality values. *Segura* Correa and Aguayo Arceo (1996) found that repeatability of ejaculate volume and sperm concentration were 0.32 and 0.20 respectively, for Rhode Island Red males vs. 0.37 and 0.34 for naked neck indigenous Mexican cocks.

However, Bongalhardo *et al.* (1995) reported higher values for repeatability of ejaculate volume of White Leghorn cocks (ranged from 0.73 to 0.99).

3. Blood hematological and biochemical parameters

3. 1. Hematological parameters

Results of cadmium treatments on some hematological parameters are presented in Table (2). They showed a significant ($P \leq 0.05$) reduction in red blood cells (RBC), hemoglobin concentration (Hb) and hematocrit value (PCV), as well as a significant decrease in white blood cells (WBC) regardless of cadmium dose, indicating an anemic effect of cadmium. Similar indication was reported by Freeland and Cousins (1973), Azza El-Sebai (1987) and Abaza and Azza El-Sebai (1996). Hill *et al.* (1980) stated that anemia is one of the most sensitive early symptoms of oral cadmium intoxication. Iron deficiency anemia may be due to the competition between iron and cadmium at the binding sites of the iron transport system in the intestine (Schafer and Forth, 1985). The decrease of hemoglobin and hematocrit values obtained in the present study supported that intestinal Fe absorption was reduced due to cadmium treatments. With respect to strain differences, data showed significant differences for WBC, RBC and PCV (Table 6). RIR strain had highest tolerance against cadmium pollution for hematological parameters. While, the differences among strains were insignificant for Hb values.

3. 2. Biochemical parameters

Data of serum concentrations of total protein, albumin, as well as the activities of AST and γGT are presented in Table (3). It could be noticed that the treatment with 75 ppm cadmium led to a significant decrease in the serum concentrations of total protein and albumin while insignificant reduction in total protein concentration occurred when 50 ppm cadmium was supplemented. It is known that most of the serum proteins including albumin are synthesized in the liver and then secreted in the blood stream. Therefore, the achieved decrease indicated that cadmium inhibited the protein s synthesis in the liver and/or depressed their secretions. Similarly, Abaza and Azza El-Sebai (1996) using broilers found significant decrease in serum total protein and albumin levels due to cadmium treatment.

The decrease of serum total protein and albumin is concomitant with an increase in the activities of AST and γGT (Table 3) indicating the occurrence of liver damage. Also, changes in enzyme activities may provide an indirect evidence for cellular damage and indicate the toxic mechanism involved. The increase of AST and γGT activities due to cadmium, were also found by Szaro *et al.* (1981); Abaza and Azza El-Sebai (1996). In respect to strain differences, the data showed significant differences for γGT activity (Table 6).

Serum creatinine (Table 3) showed significant increase due to cadmium treatments, with highest values for 75 ppm level. This significant increase

Table 3. Effect of cadmium treatments on some blood biochemical parameters of different cockerels' strains

Treatment Basal diet+	N	AST (IU/l)	γGT (IU/l)	Total Protein (g/l)	Albumin (g/l)	Creatinine (μmol/l)
0 ppm Cd	23	227.53± 34.12^{a}	16.19± 0.88^{a}	52.16± 0.95^{a}	20.25± 0.35^{a}	28.42± 0.74^{a}
50 ppm Cd	27	406.13± 32.08^{b}	17.81± 0.82^{a}	49.83± 1.01^{ab}	18.43± 0.37^{b}	34.74± 0.69^{b}
75 ppm Cd	28	522.32± 30.60^{c}	26.93± 0.79^{b}	47.38± 0.91^{b}	18.26± 0.34^{b}	37.17± 0.66^{c}
Strains						
RIR	27	374.79± 31.57^{a}	14.66± 0.81^{a}	50.78± 0.93^{a}	18.30± 0.35^{a}	30.43± 0.68^{a}
NHx	28	388.79± 31.14^{a}	20.96± 0.79^{b}	49.79± 0.92^{a}	19.72± 0.34^{b}	34.64± 0.67^{b}
WH	23	399.45± 34.13^{a}	25.32± 0.87^{c}	48.74± 1.00^{a}	18.93± 0.38^{ab}	35.25± 0.74^{b}

Means in the same column with different superscripts are significantly different (P ≤ 0.05).

Table 4. Effect of cadmium treatments on some serum mineral concentration of different cockerels' strains

Treatment Basal diet+	N	Calcium (mmol/l)	Phosphorus (mmol/l)	Sodium (mmol/l)	Potassium (mmol/l)	Iron (μmol/l)
0 ppm Cd	23	11.50± 0.15^{a}	4.97±0.16^{a}	170.85± 1.99^{a}	6.42± 0.19^{a}	29.61± 0.69a 29.21± 0.74a
50 ppm Cd	27	10.7± 0.14^{b}	4.81± 0.16^{a}	158.43 ±1.87^{b}	5.46 ±0.18^{b}	25.65± 0.66b
75 ppm Cd	28	10.30± 0.13^{c}	3.75± 0.75^{b}	144.09± 1.78^{c}	5.72 ±0.15^{b}	
Strains						
RIR	27	11.47± 0.14^{a}	4.23± 0.16^{a}	166.03± 1.84^{a}	6.58± 0.15^{a}	28.61±0.68^{a} 28.35± 0.67^{a}
NHx	28	10.38 ±0.14^{b}	4.71±0.16^{a}	156.69±1.81^{b}	5.89 ±0.17^{b}	27.51± 0.74^{a}
WH	23	10.66± 0.15^{b}	4.59± 0.18^{a}	145.64± 1.99^{c}	5.14 ±0.20^{c}	

Means in the same column with different superscripts are significantly different (P ≤ 0.05)

might reflect the kidney damage caused by the toxicity effect of cadmium. Similar findings were noted by Abaza *et al.* (1996). Also, Bokori *et al.* (1996) found that the highest cadmium content (724 mg/Kg) was in the kidney of broiler cockerels after prolonged dietary exposure to cadmium. With respect to strain differences, it was highly significant for creatinine level (Table 6).

The results of feeding diet contaminated with cadmium on serum concentration of calcium, phosphorous, sodium, potassium and iron are presented in Table (4). Data clearly showed that cadmium caused a significant ($P \leq 0.05$) depression in the concentrations of calcium, phosphorous, sodium, potassium and iron. The effect was positive and proportional with the level of cadmium. Positive and negative effects were observed in broilers regarding to the metabolism of iron, zinc, copper and manganese as affected by cadmium (Bokori *et al.*, 1995). Iron absorption in chickens decreased due to lead or cadmium treatment, as found by Freeland and Cousins (1973), Schafer and Forth (1985), Azza El-Sebai (1987) and Abaza *et al.* (1996). Moreover, Hristic, (1996) showed that supplementary cadmium to broiler decreased bone manganese, zinc and iron contents and the decrease was dose-related.

In general, the differences between NHx and WH strains for most traits under study, except for γGT activity, Na and K concentrations were insignificant, since both of two strains were the same genetic constitution.

4. Histological examination

The histological examination of testes showed damage in the semeniferous tubules, necrosis, disrupted spermatogenesis and degenerating Ledyig cells (Legends 2). After treatment with cadmium the histological examination of liver showed degeneration of the hepatocytes and disorganization of hepatic cords occurred at some places. Furthermore, compensatory hypertrophy of some hepatocytes was also observed (Legends 4 and 5). In some cases there are focal inflammatory changes, especially around the central veins. The histopathological changes in testes and liver of birds fed diets polluted with high level of cadmium (75 ppm) support the previous results obtained in the present study.

5. Phenotypic correlations

Phenotypic correlations presented in Table (5). There were significantly positive correlations between body weight and sperm concentration, calcium, and phosphorous and iron concentrations. The values were 0.473, 0.64, 0.478 and 0.547, respectively. On the other hand, the same trait had negative significant correlations with sperm abnormalities, creatinine concentration and γGT activities. The values were -0.585, -0.454 and -0.305, respectively. Significant negative correlation values were found also for percentage of change in body weight with RBC (-0.335), Hb (-0.300), sperm concentration

Table 5. Phenotypic correlations among different traits studied

Traits	Body weight	B.W. Change	RBC	Hb	Sperm Conc.	Ejaculate volume	Sperm abnorm.	Creatinine conc.	AST	GGT	T.P.	Ca	P	Fe
B.W.	1.000	0.097	0.024	0.036	0.473**	0.130	-0.585**	-0.454**	-0.241	-0.305*	0.002	0.636**	0.478**	0.547**
B.W change		1.000	-0.335*	-0.30*	-0.342**	-0.128	0.208	0.330*	0.671**	0.173	-0.292*	-0.34**	-0.187	0.139
RBC			1.000	0.403**	0.375**	0.149	-0.242	-0.143	-0.132	-0.108	0.162	0.024	0.016	0.215
Hb				1.000	0.005	0.188	-0.111	-0.220	-0.170	-0.132	0.193	0.100	0.040	0.242
Sperm conc.					1.000	-0.192	0.548**	-0.166	-0.185	-0.08	0.326	0.032	0.038	0.165
Ejaculate volume						1.000	0.137	-0.205	-0.077	-0.038	0.071	0.106	0.105	0.186
Sperm abnorm.							1.000	0.054	0.125	0.049	-0.068	-0.35**	-0.278*	-0.339**
Creatinine Conc.								1.000	0.406**	0.225	-0.266	-0.296*	-0.186	-0.253
AST									1.000	0.123	-0.047	-0.117	-0.120	-0.46**
GGT										1.000	-0.22	-0.142	-0.119	-0.168
T. P.											1.000	0.520**	.406**	0.049
Ca												1.000	0.617**	0.424**
P													1.000	0.243
Fe														1.000

N= 55
$P \leq 0.05 = 0.262$
$P \leq 0.01 = 0.339$

Table 6. Analysis of variance for all traits studied

S.O.V	d.f.	M.S.									
		Body weight	Body weight change	Semen volume	Sperm concentration	Sperm abnormality	WBC	RBC	Hb	PCV	
Treatments	2	6156722.5***	4009.63***	0.5754***	1.3484***	241.05***	240947.8***	6.048***	160.75***	0.122***	
Strains	2	202603.1*	148.85***	0.1234**	0.0088	223.42***	4295.2**	0.376**	3.32	0.012***	
Interaction	4	114800.5	150.54***	0.0777*	0.0238	57.86	2932.1**	0.128	6.82*	0.005**	
Error	69	45771.9	28.59	0.0251	0.0129	34.34	696.3	0.053	1.99	0.001	
S.O.V	d.f.	M.S.									
		AST	γGT	T. protein	Albumin	Creatinine	Calcium	Phosph.	Sodium	Potassium	Iron
Treatments	2	553738.72***	893.99***	152.67**	31.59***	505.14***	9.275***	10.480***	4595.43***	5.929***	128.965***
Strains	2	3924.69	717.43***	25.72	13.65*	178.22***	8.627***	1.660	1506.73***	12.839***	8.009
Interaction	4	42048.55	170.16**	125.291***	16.58**	95.19***	7.134***	0.429	812.02***	6.351***	17.590
Error	69	26683.29	17.59	23.38	3.23	12.58	0.519	0.710	91.05	0.878	12.491

***P < 0.001 **P < 0.01 *P < 0.05

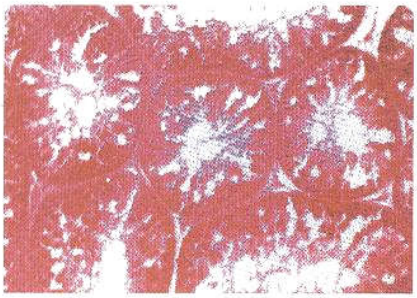

Fig.1. Tests of a control bird showing normal structure of semeniferous tubules and interstitial tissue.

Fig.2. Tests of birds treated with cadmium showing disrupted spermatogenesis and degenerating Ledig cells

Fig.3.A part of the liver of a control bird showing normal appearance The hepatocytes running parallel with the sinuses.

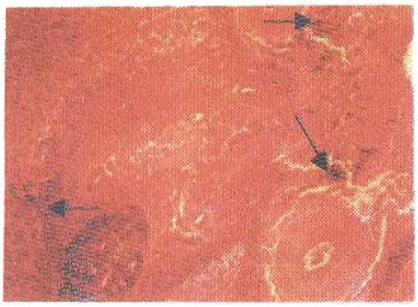

Fig. 4. A part of the liver after cadmium treatment. Arrow points the inflammatory reactions with lymphocytes infiltration.

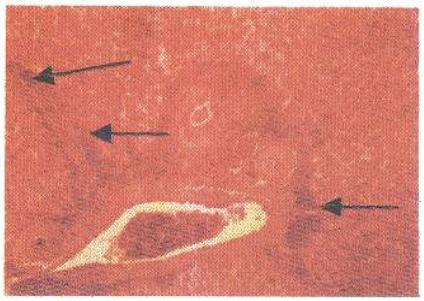

Fig.5. A central part of the hepatic lobule. Arrows shows The lymphoctes infiltration around the central vein after cadmium treatment.

(-0.342), total protein (-0.292) and calcium concentration (-0.340). However, significant positive correlation values were observed for percentage of change in body weight with creatinine concentration (0.33) and AST activity (0.671).

The correlations between blood and semen traits except between RBC and sperm concentration (0.375), were non-significant, which are in line wthe findings of Machal *et al.* (1996) on Rhode Island Red and Barred Plymouth Rock cocks. Highly significant positive correlation was found between sperm concentration and percent of sperm abnormality (0.548). This result is in agreement with those reported by Kamar *et al.* (1979), Kamar *et al.* (1984), Osman (1991) and Attia and Neamat Badawy (1996).

Significant positive correlation was found between AST and creatinine concentration (0.406) indicating that the liver and kidney damages were related as a result of cadmium treatment. Highly significant negative correlation was found between AST activity and iron concentration (-0.463), while, highly positive correlations were found between total protein and both of calcium (0.520) and phosphorous (0.406) concentrations.

In general, there were highly significant positive correlation values between the evaluated metal concentrations, ranged between 0.424 and 0.617 except between Fe and P. On the other hand, no significant correlation was found between all metal concentrations studied with sperm volume and concentration, while the correlation between metals and sperm abnormalities were negative and significant. This finding may indicate that the reduction in these metals as a result of cadmium treatment caused the increase in the sperm abnormalities. Moreover, the correlation values for all metals studied with creatinine concentration, AST and γGT activities were negative. These results may indicate that the occurrence of liver and kidney damage as a result of cadmium treatment caused a reduction in the metabolism of these metals. Bokori *et al.* (1995) stated that there were positive and negative effects regarding the metabolism of iron, zinc and copper as reflection of cadmium intake in broiler chicks.

On the basis of the results obtained in this study, it can be concluded that the consumption of diets polluted with cadmium cause dysfunction in the reproductive and physiological systems of cockerels. Also, data indicated that strains differed in their tolerance to polluted diets with cadmium.

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جودة السائل المنوى و المعايير البيوكيميائية و الهيماتولوجية لذكور سلالات الدجاج المختلفة المعرضة للتلوث بالكادميوم

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أستخدم فى الدراسة ٧٨ ذكر عمر عام تنتمى الى ثلاث سلالات مختلفة (٢٧ رود ايلاند–٢٨ مجرى NHx-23 مجرى ابيض) قسمت عشوائيا الى ثلاثة مجاميع وتم تسكينهم فى أقفاص فردية. المجموعة الأولى غذيت على العليقة الأساسية و المجموعة الثانية غذيت على العليقة الأساسية مضافا إليها ٥٠ جزء فى المليون كادميوم بينما المجموعة الثالثة غذيت على العليقة الأساسية مضافا إليها ٧٥ جزء فى المليون كادميوم فى صورة كلوريد كادميوم لمدة ٥ أسابيع لتقيم تأثير تلوث علائق ذكور الدجاج بالكادميوم على وزن الجسم – صفات السائل المنوى – الصفات الهيماتولوجية و البيوكيميائية للدم فى السلالات المختلفة هذا بالإضافة الى الفحص الهستولوجى للخصية والكبد. أظهرت النتائج أن هناك اختلافات معنوية بين المعاملات و كذلك السلالات بالنسبة لصفة وزن الجسم حيث أن الذكور المغذاة على عليقه أساسية ملوثة ب ٧٥ جزء فى المليون كادميوم أظهرت انخفاض عالى فى وزن الجسم (–٢٥,٠٨ ٪) مقارنة بالمجموعة الثانية المغذاة على عليقه بها ٥٠ جزء فى المليون كادميوم (–١٦,٦٢٪).

أيضا أوضحت النتائج أن هناك تأثير مباشر للتلوث بالكادميوم على الصفات التناسلية حيث أنخفض حجم السائل المنوى و تركيز الحيوانات المنوية و زيادة نسبة الإسبيرمات المشوهة و قد كان المعامل التكرارى لهذه الصفات هو ٠,١٦٣٧ – ٠,١٦٧ – ٠,٤١٣١ على الترتيب. كما وجد أن التلوث بالكادميوم يؤدى إلي انخفاض معنوى فى تركيز البروتين و الألبومين فى السيرم و الذى كان مصاحبا بزيادة فى نشاط أنزيمات AST و GGT الدالة على حدوث تلف بالكبد. كذلك أظهرت نتائج الدراسة الحالية حدوث انخفاض معنوى فى تركيز السيرم من المعادن و كذلك فى قيم الهيموجلوبين و نسبه كرات الدم الحمراء و الذى يرجع الى تلوث العليقة بالكادميوم.

بالإضافة الى ذلك فأن نتائج الإرتباطات بين الصفات المدروسة كانت ذات اتجاهات معينة (موجبة أو سالبة) كنتيجة لإستهلاك الكادميوم. كما أظهرت السلالات إختلافاً فيما بينها فى قدرتها على تحمل تلوث العليقة بالكادميوم.