EFFECT OF CHROMIUM AND CADMIUM ON EGG QUALITY OF JAPANESE QUAILS

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Introduction

Chromium is an essential nutrient for animals. Chromium is being required for the maintenance of normal glucose tolerance (Baselt, 2000). It was shown decrease of cholesterol level in the muscles, heart, blood plasma and egg yolks following different sources of dietary chromium supplementation (Debski et al., 2000; Koréneková, et al., 2002).

Cadmium is a highly toxic element. It forms a serious hazard to the animal health and a threat to most life forms (Braeckman et al. 1997; Smith et al., 1994; Kleczkowski et al., 1995). Element toxicity upon the biological systems of animals is affected by the route and form of ingestion as well as by the interaction between essential and toxic elements. The amount of an element which accumulates in the organs depends on the interval of exposure, the quantity ingested and the production, as well as their age and breed (Massanyi et al., 2000).

Japanese quail is an interesting domestic economic species for commercial egg and meat production beside chickens. Quail is often used for investigation physiological process in the birds, and well as suitable experimental animal for observation relationship between essential elements and xenobiotics *in vivo* condition (Koréneková et al., 2004). Nutrition is one of the most important factors required to maintain quails in good physical condition and to obtain normal growth and egg production. Further improvement of poultry meat and eggs quality may be achieved by animal diet optimalization (Venglovský et al., 2005). The purpose of our experiment was to determine the effect of chromium on weight of Japanese quail eggs, strength as well as thickness of eggshells.

Material and methods

Forty Japanese quails, (40-days-old) were included in the experiment. Quails were divided into 2 groups. Each group consisted of 20 birds. In the experimental group 2, chromium ($CrCl_3.6H_2O$; Merck, Germany) was administered daily in the form water solution at a dose of 0.12 mg of Cr for one quail. Group 1 was the control group.

Birds were fed complete feed mixture HYD-10, set as full – value feed for the whole experiment. (Table 1). Feed mixture and water were provided *ad libitum.* The composition of the feed was in accordance with Decree of the Ministry of Agriculture of the Slovak Republic No. 149/2, 100, 2003. **Composition of complete feed mixture (HYD-10):**

Feed composition		Minerals		Vitamins	
Crude protein	153.0 g.kg^{-1}	Zn	60 mg.kg^{-1}	A	8 000 IU. kg^{-1}
Metabolizable energy	11.5 MJ.kg^{-1}	Ca	28-45g.kg^{-1}	D_3	1 600 IU. kg^{-1}
Ash	160.0 g.kg^{-1}	P	5 g.kg^{-1}	E	10 mg. kg^{-1}
Fiber	60.0 g.kg^{-1}	Na	2,2-2,5 g.kg^{-1}	B_2	4 mg. kg^{-1}
Lysine	7.0 g.kg^{-1}	Mn	40 mg.kg^{-1}	B_{12}	10 µg.kg^{-1}
Methionine + cystine	6.0 g.kg^{-1}	Fe	40 mg.kg^{-1}		
Methione	3.5 g.kg^{-1}	Cu	4 mg.kg^{-1}		
Linoleic acid	15.0 g.kg^{-1}				

The experimental condition complied with the requirements for ethical standards and under favourable microclimatic conditions for growing of welfare and animal treatment. The Japanese quails were kept in cages. The biological trial lasted 58 days. The weight of eggs, strength and thickness of eggshells were determined on 35 and 58 day of experiment.

Throughout the experiment, the resistance of the eggshell against breaking was observed. The solidity was evaluated as the force or work needed to break the eggshells, expressed in units of force or work. The strength of the eggshell was determined by method established by Marcinka and Gažo (1964). The force needed to break eggshell was developed under the pressure of a spring by means of manual tightening of the screw. The force was read from scale of values. The values characterizing the eggshell were expressed in N/cm^2.

Results were statistically analyzed (ANOVA) using Student's *t*-test at significance levels of P ≤0.05, P≤ 0.01 P≤0.001. Data are presented as means and standard deviations. Coefficient of variation (V %) was calculated by dividing the standard deviations by the mean, multiplied by 100.

Results and discussion

The results of egg weight, eggshell strength and eggshell thickness are presented in Table 1.

Egg weight

As shown in the table, egg weight of Japanese quail was higher in control group G1 (10.79 g) than in experimental group G2 (10.06g) with addition of chromium on 35 day of experiment. At the end of experiment, was observed decrease of egg weight only in control group On the other hand, slight increase of egg weight was observed in experimental group G2 with addition of chromium (10.11g).

Eggshell strength

The comparison of the experimental group G2 (11.83; 11.52 N), with control group G1 (12.09; 13.05 N) revealed a decrease of eggshell strength after addition of chromium in the middle and in the end of experiment (35 and 58 day).

Eggshell thickness

The decrease of eggshell thickness was observed in the middle of the study (0.236 mm) as well as in the end of experiment (0.235 mm) in experimental group G2 supplemented with chromium in comparison to control group (0.245;0.255 mm).

Table 1. Effect of chromium supplementation on quality parameters of Japanese quail eggs

Analyzed Parameters		Control group		Experimental group			
		35. days	58. days	35. days		58. days	
		G1	G1	G2	G3	G2	G3
Egg weight (g)	x	10.79	10.00	10.38	8.356	10.110	9.520
	SD	1.297	1.762	0.804	1.883	1.188	1.183
	Max	12.53	12.80	12.08	10.320	12.400	10.900
	V (%)	12.01	17.26	7.75	22.53	11.760	12.430
Eggshell strength (N)	x	12.09	13.05	11.49	10.630	11.50	10.490
	SD	1.997	1.414	1.435	1.095	1.786	1.535
	Max	13.81	14.66	14.10	11.960	14.38	12.820
	V (%)	16.51	10.83	12.49	10.300	15.54	14.630
Eggshell thickness (mm)	x	0.245	0.255	0.240	0.215	0.233	0.215
	SD	0.028	0.016	0.012	0.019	0.011	0.009
	Max	0.293	0.283	0.267	0.243	0.257	0.230
	V (%)	11.660	6.470	4.850	8.710	4.670	4.390

n = 15 eggs, G1= control group, G2= chromium, G3=chromium + cadmium

Egg weight

The weight of Japanese quail was lower in experimental group G3 with addition cadmium and chromium (9.148; 9.321g) than in experimental group G2 (10.06; 10.11g) with addition of chromium on 35 day as well as 58 day of experiment.

Eggshell strength

In the experimental group G3, decrease of eggshell strength was observed (10.32; 10.66 N), after addition Cd +Cr combination in comparison to experimental group G2 (11.83; 11.52 N) in the middle as well as in the end of experiment.

Eggshell thickness

The eggshell thickness was decreased in the middle of the study (0.230 mm) as well as in the end of experiment (0.227 mm) in experimental group G3 (Cd+Cr) in comparison to experimental group G2 (0.236;0.235 mm) with Cr addition.

In our study, the evidence for an interaction between cadmium and chromium was observed after addition of cadmium. The evidence is from data on the qualitative parameters of Japanese quail measured on 35 and 58 day of experiment. This allowed comparison of the parameters for different days in each egg, which is powerful assessment for the effect of the treatments than between experimental groups comparison. The values of egg weight, eggshell strength and eggshell thickness after cadmium and chromium combination (G3) were lower than in control group G1 and experimental group G2.

Addition of cadmium showed a strong negative effect on parameters of Japanese quail quality. The adverse effect of cadmium and other heavy metals has been studied in poultry. According of Sály et al., (2004) lead addition caused a decrease in the egg weight, strength and thickness of eggshell.

Chromium deficiency is caused by a number of factors. One important factor is daily dietary intake of bioavailable and bioactive Cr, either from food or from combination of diet and Cr supplementation. One very important factor could cause Cr deficiency in all species, and that factor is stress. It means, that animals exposed to stress condition need more Cr and that may create a Cr deficiency. Such circumstances exist, when intensely managed poultry are often exposed to periodic stress. (Barceloux, 1999).

Sahin et al., (2002; 2003b) observed that chromium supplementation can alleviate negative effect of heat stress on egg production and egg quality of laying Japanese quail. The best results were obtained with 1 200 microg Cr/kg diet, and chromium supplementation at such a level can be considered to be protective management practice in a quail diet, reducing the negative effects of heat stress. The effect of Cr on egg production and egg quality of laying hens was investigated by Uyanik et al., (2001). They found that supplemental chromium (20 ppm) had no effect on egg weight shell thickness and but increased shell breaking strength

Results of the present study show that supplementing chromium improved weight of eggs, however slight decreased strength as well as thickness of eggshells. The combination of Cd and Cr had negative effect on the quality of Japanese quail eggs. The interaction between chromium and cadmium is not sufficiently known. These problems need further clarification.

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