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The effect of a low-protein diet on Japanese quail rearing, egg quality and hatchability

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ABSTRACT

Three groups of Japanese quails were reared on diets differing in protein content, which was 28, 24 and 20% in successive rearing stages in group I, whereas in group II it was lowered, to 25, 22 and 19%, respectively, and in group III, to 22, 20 and 18%. It was found that the protein level did not affect the morphological traits of eggs or the protein percentage in their content; however, fat and ash quantities increased. Yolk cholesterol and chemical composition of egg yolk and white were at similar levels in all groups. Improvement of fertilization rate, but lowering of hatchability, was found in groups fed low-protein diets.

KEY WORDS: quail, low-protein diet, egg quality, hatchability

INTRODUCTION

The results of a few investigations point to the possibility of lowering the feed protein level in quail rearing without negatively affecting survival rate, slaughter value or meat quality (Pudyszak and Mikulski, 1997). Moderate lowering of the protein level with simultaneous balancing of amino acids did not negatively affect production or dissection indices, or meat chemical composition in chicken broilers, either (Jamroz et al., 1984); on the other hand, considerable lowering of protein worsens slaughter traits, without influencing meat chemical composition (Świerczewska et al., 2000).

The aim of the experiment was to assess diets with different protein levels used during quail rearing on egg quality and hatchability in the first stage of reproduction.

MATERIAL AND METHODS

During rearing and reproduction, Japanese quails of the variety Pharaoh were kept in cages under optimum microclimatic and light regime conditions. Control quails were

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fed according to the recommendations of Rutkowski (1996), i.e. with diets containing 28, 24 and 20% crude protein. In group II, the protein level in three successive rearing stages was lowered to 25, 22 and 19%, respectively, whereas in group III, to 22, 20 and 18%. After completing rearing, 24 females and 8 males with body weights approximating the sex and group means were selected from each group and kept in three groups as continuations of previous rearing groups. All groups were fed with a complete feed mix with 11.7 MJ/ME/kg and protein level of 21.0%. In the 12th week of life, 45 eggs (15 from each group) underwent quality assessment in two repetitions. Selected physical traits as well as basic chemical composition were assessed in the eggs with standard methods, and egg yolk cholesterol according to Krause et al. (1966). The mineral contents egg yolk and white were determined by inductively coupled argon plasma emission spectrometry. Egg hatchability was assessed in the 14th week of life. Eggs for hatching were collected during 7 successive days.

The obtained results were analysed statistically by one-way analysis of variance and Duncan's test.

RESULTS

Egg weight was similar in all groups and averaged 11 g. No significant differences were found either in the absolute or relative weights of egg white and yolk (Table 1). The most favourable proportions between egg white and yolk

Table 1. Selected morphological traits and chemical composition of quail eggs

Specification	Yolk				Egg white			
	I	II	III	SEM	I	II	III	SEM
Weight, %	29.38	29.83	29.66	0.36	59.11	59.18	57.95	0.38
Index	0.37^{a}	0.40^{ab}	0.41^{b}	0.006	0.15	0.15	0.14	0.004
pH	5.93	5.79	5.67	0.03	8.65	8.59	8.58	0.04
Chemical composition								
protein, %	14.94	15.10	15.01	0.10	9.52	10.01	9.94	0.10
crude fat, %	31.65^{a}	32.32^{a}	33.51^{b}	0.24	-	-	-	-
crude ash, %	1.10^{a}	1.45^{b}	1.52^{b}	0.05	0.68^{a}	0.66^{ab}	0.64^{b}	0.01
cholesterol, mg/g	15.80	15.92	16.33	0.14	-	-	-	-
Ca, mg/g	1.65	1.72	1.53	0.035	0.158	0.17	0.19	0.010
Na, mg/g	0.37	0.37	0.36	0.007	1.80	1.79	1.75	0.043
K, mg/g	0.75	0.74	0.78	0.016	1.48	1.54	1.46	0.026
Mg, mg/g	0.13	0.13	0.12	0.002	0.13	0.14	0.14	0.004
P, mg/g	5.87	5.85	5.79	0.06	0.23	0.26	0.26	0.010
Fe, µg/g	51.9	49.9	48.2	1.68	1.29	1.35	1.02	0.158
Zn, µg/g	23.9	24.1	24.2	0.87	0.99	1.35	0.94	0.088
Cu, µg/g	1.09	1.10	1.07	0.022	0.51	0.56	0.47	0.024
Se, µg/g	0.58	0.61	0.60	0.033	0.20	0.21	0.18	0.006
Mn, µg/g	0.59	0.62	0.68	0.035	0.03	0.04	0.03	0.003

^{ab}- means values within yolks and whites in rows marked with different letters differ significantly ($P<0.05$)

were found in group II (1.82:1). Small differences were observed in yolk index and egg shell percentage in the egg, with those between group II (11%) and group III (12.4%) being statistically significant. Total protein content in egg white and yolk did not depend on feeding in the rearing period. On the other hand, a significant increase of yolk fat content, amounting to 1.86%, was found in eggs of group III, and in ash, by 0.35 and 0.42% in groups II and III, respectively, when compared with the control group. The increase of yolk fat content was accompanied by a small increase of cholesterol content in experimental groups, in particular in group III (by 0.53 mg/g). No significant effect of feeding on the percentage of selected minerals in the egg content was found (Table 1).

The best fertilization rate was found in group III (Table 2). However, this group presented the largest hatching losses (22.3%). The highest hatching indices from fertilized eggs were found in the control group (89.3%), whereas the lowest, in group III.

Table 2. Hatching results

Parameter	Group		
	I	II	III
Number of set eggs	90	90	90
Rate of fertile eggs, %	93.3	90.0	96.7
Dead embryos and crippled hatchlings, %	10.0	16.7	23.3
Hatchability from set eggs, %	83.3	73.3	73.3
Hatchability from fertile eggs, %	89.3	81.5	75.9

DISCUSSION

In this study, egg weight was similar to that found in our previous investigations (Tarasewicz et al., 2000) and larger than that given by Panda and Singh (1990) for quail eggs, whereas yolk percentage was smaller, that of egg shell, larger when compared with the results of the cited authors. In all groups,slightly less total protein was found in egg yolks and whites when compared with the data of Shanawany (1994). Total lipid and ash levels in egg yolk increased significantly in group III, the last being by 1.26% more when compared with the results presented by Shanawany (1994). The cholesterol level in egg yolk was in the range given by other authors. The levels of minerals in egg yolk and white, after calculating them into egg content, were similar to the data of Shanawany (1994). Significant improvement of the fertilization rate was found in group III, which points to better preparation for reproduction of males fed with a protein-sparing diet. On the other hand, this group showed the lowest hatchability rate, which was nonetheless comparable with the results of Baumgartner et al. (1997). Considering that the chemical composition of quail eggs from the experimental groups did not change

significantly, it is difficult to explain the worsening of reproduction results in these groups.

CONCLUSIONS

Lowering the protein content in rearing diets of Japanese quail affected neither the morphological traits nor chemical composition of eggs.

Lower dietary protein contents may improve the fertilization rate, however the hatchability rate may be lower in groups fed with reduced-protein diets.

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STRESZCZENIE

Wpływ niskobiałkowej diety w wychowie japońskich przepiórek na jakość i wylęgowość jaj

Celem pracy była ocena niskobiałkowej diety stosowanej w wychowie na jakość i wylęgowość jaj przepiórek. W grupie I młode przepiórki żywiono zgodnie z normą, tj. podawano paszę zawierającą 28, 24 i 20% białka ogólnego. W grupie II poziom białka w paszy obniżono odpowiednio do 25, 22 i 19%, a w grupie III do 22, 20 i 18%. Stwierdzono, że rodzaj diety nie wpłynął na cechy morfologiczne jaja oraz zawartość w nim białka, zwiększyła się natomiast ilość tłuszczu i popiołu w jego treści. Zawartość cholesterolu w żółtku i pierwiastków mineralnych w treści jaja były podobne. Stwierdzono poprawę zapłodnienia, ale obniżenie wylęgowości w grupach żywionych mieszankami niskobiałkowymi.