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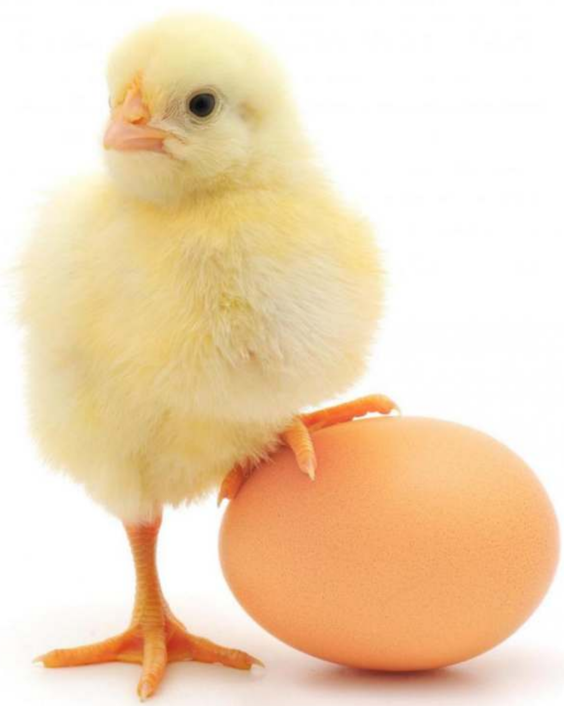

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Dietary Threonine Supplementation for Improving Growth Performance and Edible Carcass Parts in Japanese Quails, *Coturnix coturnix Japonica*

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Abstract: The present study was conducted to evaluate the effects of dietary threonine amino acid supplementation on growth performance and carcass characteristics of Japanese quails. Day old, two hundred and seventy quail chicks were divided into six dietary treatment groups comprising 45 birds each, which consisted of 3 subgroups containing 15 birds for each replicate. Experimental diets were prepared and contained 0.81, 0.86, 0.91, 0.96, 1.01 and 1.06 % threonine amino acid, respective to groups 1-6, on fresh matter basis. Birds were fed these experimental diets respective to treatment for 35 days. Total feed intakes and the changes in body weights were determined on weekly basis. At the end of experiment 35-d, birds were killed humanly to determine their edible carcass parts. Results showed that threonine supplementation to the diet did not affect growth performance and edible carcass parts ($p>0.05$), assuming that birds can make metabolic adaptation to current dietary threonine supplementations.

Key words: Threonine, growth, edible carcass parts, quail

Introduction

Threonine (2-amino-3-hydroxy butanoic acid) has a molecular mass 119.12 g mol^{-1} and contains 11.76% nitrogen (Kidd and Kerr, 1996; Ayasan, 2004). Threonine is considered to be the third limiting amino acid for broiler chicks fed low protein corn-soybean meal diets (Kidd *et al.*, 1999). L-threonine is added to the diet of pigs and poultry in order to exactly match the dietary amino acid balance with the unique nutritional requirements of the animal. As a result of this balancing process, the animal may utilize feed more efficiency with reduced amounts of protein.

Up to now, many studies have been conducted to test the efficacy of threonine on animal growth and performance. Several studies have been conducted to asses whether dietary supplemented threonine can improve performance of broilers, layers, pigs and rabbits. Threonine requirements for broilers have been evaluated from 0 to 8 wk of age (Webel *et al.*, 1996; Kidd and Kerr, 1997; Kidd *et al.*, 1997; Kidd *et al.*, 1998; Kidd *et al.*, 1999; Dozier *et al.*, 2000; Dozier *et al.*, 2001; Rosa *et al.*, 2001). Kidd *et al.* (2003) did two experiments in which Ross 308 male broiler chicks received diets containing 0.6, 0.7, and 0.8% total dietary threonine with and without E. acervuline infection. Positive and negative main effect growth responses occurred for increasing dietary threonine and administration of E. acervuline inoculum, respectively. Treatment interactions, however, did not occur. These results indicate that broiler chick threonine needs are not increased by a mild E. acervuline infection.

As seen in above studies, dietary supplementation of threonine has mostly been used in different animal species in poultry, pig and rabbits. However, there has not been rare or no information regarding the effect of dietary supplementation of threonine on growth performance and carcass characteristics of Japanese quail. Therefore, the present experiment was conducted to test the effects of dietary threonine supplementation on growth performance and carcass characteristics of Japanese quails.

Materials and Methods

Two hundred and seventy quail chicks were divided into six dietary treatment groups of similar mean weight (8.24 ± 0.050 g/bird) comprising 45 birds each, which consisted of 3 subgroups containing 15 birds for each replicate. Basal diet was formulated with linear programming. Diets were composed of corn, soybean, corn gluten meal, wheat middling, fat, limestone, salt, and supplements of vitamins, minerals (Table 1). Experimental treatments consisted of six concentrations of total threonine using diets that ranged from 0.81 to 1.06 % in progressive increments of 0.05 %.

During the experimental procedure, body weights and feed intakes of grouped chicks were weighted by electronic balance with 0.1 g sensitivity in order to determine growth performance body weight gain and feed conversion ratio (FCR, g feed: g gain) on weekly basis. At the end of the experimental period, 12 birds from each dietary treatment were slaughtered humanly to determine to carcass characteristics. Processing criteria obtained were live body weight, hot carcass weight, breast weight (skinless and boneless,

Table 1: Ingredients and chemical composition of experimental diet

Ingredients	g/kg	Nutrient contents	%
Corn	475.72	Dry matter	88.68
Corn gluten meal	144.02	ME, Kcal kg^{-1}	3000
Wheat middling	120.00	Crude protein	23.00
Soybean meal	156.56	Ether extract	7.49
Limestone	12.89	Crude fiber	3.15
Fish meal	14.90	Crude ash	3.47
Vegetable oil	50.00	Lysine	1.10
Vitamin premix*	2.00	Threonine	0.81
Mineral premix**	1.50	Arginine	1.14
Salt	3.94	Methionine	0.52
Dicalcium phosphate	15.81	Methionine + cystine	0.92
Lysine	2.66	Tryptophan	0.20
		Ca	1.00
		Available P	0.45
		Na	0.20
		K	0.47*

Each 2 kg of vitamin premix contains 12000000 IU Vitamin A, 3500000 IU Vitamin D_3, 100 g Vitamin E, 3 g Vitamin K_3, 2.5 g Vitamin B_1, 6 g Vitamin B_2, 40 g Niacin, 12 g Pantothenic acid, 4 g Vitamin B_6, 15 mg Vitamin B_{12}, 1500 mg Folic acid, 150 mg Biotin, 100 g Vitamin C. **Each 1.5 kg of mineral premix contains 100g Mn, 2.5 mg Fe, 65 g Zn, 15 g Cu, 250 mg Co, 1g I, 200 mg Se, 450 g Choline chloride.

Table 2: Effects of dietary threonine supplementation on growth performance of quails

	Dietary Threonine, %						SED
Days	0.81	0.86	0.91	0.96	1.01	1.06	
Cumulative feed intakes (g per bird)							
1-7	42.32	47.11	45.62	48.15	45.60	47.20	0.455
1-14	168.01	178.99	173.82	176.80	179.40	172.75	0.959
1-21	326.64	331.45	325.70	326.79	330.19	335.25	2.458
1-28	517.14	521.41	513.86	516.40	532.99	528.52	3.457
1-35	740.68	734.04	741.93	738.64	761.61	759.87	3.972
Cumulative body gains (g per bird)							
1-7	22.62	25.62	23.90	25.88	22.85	25.41	0.320
1-14	68.27	73.37	71.07	74.86	66.99	70.34	0.658
1-21	116.96^{c}	119.83^{bc}	124.70^{ab}	127.70^{a}	118.36^{bc}	128.65^{a}	1.318
1-28	176.30^{b}	189.19^{a}	184.40^{ab}	191.36^{a}	180.79^{ab}	191.95^{a}	1.848
1-35	230.22	231.12	234.29	230.71	228.46	235.87	1.520
Feed conversion ratios (g feed: g gain)							
1-7	1.87	1.83	1.90	1.86	1.99	1.85	0.012
1-14	2.46	2.43	2.44	2.36	2.67	2.45	0.023
1-21	2.79^{b}	2.76^{ab}	2.61^{ab}	2.55^{a}	2.79^{b}	2.60^{ab}	0.032
1-28	2.93^{bc}	2.75^{ab}	2.78^{abc}	2.69^{a}	2.94^{c}	2.75^{ab}	0.030
1-35	3.21	3.17	3.16	3.20	3.30	3.22	0.022

Pectoralis major and Pectoralis minor) and thigh weight. The obtained data regarding growth performance and carcass characteristics were subjected to analysis of variance using GLM procedure of SPSS (Windows version of SPSS, release 13.0). The significant means were ranked using Duncan's Multiple Range Test.

Results and Discussion

The results obtained in this study are presented in Table 2. The results of the experiment showed that threonine supplementation to the diet affected feed intake and feed conversion ratio, significantly ($p<0.05$) without affecting body weight gain. However, evidently, the increased dietary threonine from 0.81 % to 1.06 % resulted in a 2.41 % increase in body weight gain. The highest body weight gain occurred at 1.06 % threonine supplemented group. This can be explained that 1.06 % threonine level in diet was optimal. Japanese quails chicks aged 1-42 day-old should be fed a diet containing 1.02 % threonine level (NRC, 1994). This result is in reasonable agreement with previous studies conducted with quails of this weight range. Shim and Vohra (1980) determined that the threonine requirement of quail chicks was 1.20 % of diet in their early age. Dozier *et al.* (2001) reported that threonine supplementation of the diet did not affect body weight gain; while Lehman *et al.* (1997) indicated that different threonine levels (0.82-0.88-0.94-1.00-1.06-1.12 %) improved body weight gain.

Quail chicks given diet containing 1.01 % threonine attained greater cumulative feed intake than the others

Table 3: The edible carcass parts of 35–d old Japanese quail chicks subjected to dietary threonine supplementation

Parameters	Threonine content of diet, %						
	0.81	0.86	0.91	0.96	1.01	1.06	SED
Body weight, g per bird	239.0	242.8	240.4	246.5	242.8	249.9	1.43
Carcass yield, %	74.8	75.5	75.2	74.5	74.7	75.0	0.96
Breast meat, %	36.1	34.8	34.5	34.8	35.5	35.0	0.23
Thighs, %	33.9	34.7	34.3	34.6	34.1	34.0	0.15

groups but not statistically significant (p>0.05). This result is in agreement with those reported in birds (Shan *et al.*, 2002; Kidd *et al.*, 2004). This numerical increase in feed intake can be explained that threonine may have appetitive effect on feed intake. In the present experiment, feed intake data were obtained in group level. If feed intake data had been collected individually for each bird, appetitive effect of threonine would have been appeared.

The average feed conversion efficiency was 3.21 for control group, 3.16 for 0.91 % threonine supplemented group. This feed conversion efficiency on 1.01 % threonine group than the control group was mainly due to better utilization of feed as a result of threonine supplementation. These results are consisted with previous experiments of Rangel-Lugo *et al.* (1994) and Kidd *et al.* (2001) who observed to improve feed conversion ratio with the supplementation of threonine to the diet. In contrast to our results, Ojano-Dirain and Waldroup (2002) reported that the feed conversion ratio was not different between groups.

Supplemental L-threonine did not affect carcass parameters (p>0.05) in the current experiment. This response has been in line with the studies of Kerr *et al.* (1999) and Dozier *et al.* (2000) where carcass yield (%) was not affected by threonine supplementation of the diet. The greatest increase in carcass yield (%) was achieved by 0.86 % threonine supplemented group, while the lowest carcass yield (%) was observed 0.96 % threonine supplemented group, but these are not statistically significant.

Breast is the most valuable part in the carcass of birds. Knowing the optimal level of dietary threonine required to maximize breast meat yield is important because threonine's degree of dietary limitation may decrease breast yield responses from dietary lysine and/or methionine. Marginal dietary deficiencies of threonine may result in economic losses from increased feed conversion ratio and reduced breast meat accretion (Kidd *et al.*, 1999). It is important, therefore, to meet the minimum dietary threonine level needed in animal diet. In the current experiment, increasing dietary threonine did not increase breast yield. Kidd and Kerr (1997) indicated that suboptimal levels of dietary threonine in broilers have profound effects on edible meat, in addition to limiting performance criteria. Ojano-Dirain and Waldroup (2002) indicate that feeding diets with threonine levels of 0.78 and 0.87 % had no significant effects on breast meat yield.

As breast meat yield, thighs were not affected by dietary threonine supplementation. Kerr *et al.* (1999) found that increasing dietary threonine had no effect thigh weight but decreased thigh yield. Furthermore, Dozier *et al.* (2000) obtained similar results after supplementation of L-threonine of diet. Surprisingly, increasing dietary threonine increased thigh weight and yield. This effect is inconsistent with the previous findings (Kidd *et al.*, 1996; Kidd and Kerr, 1997).

In conclusion, dietary threonine supplementation did not affect growth performance and edible carcass parts (P>0.05), assuming that birds can make metabolic adaptation to current dietary threonine supplementations.

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