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Threonine Requirement of Female Broilers from 22 to 42 days of Age†

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Abstract: Threonine is considered to be the third limiting amino acid for broilers. The aim of this study was to determine the threonine requirement of female broilers from 22 to 42 days of age. Seventy five, one-day of age female broiler chicks (Ross 308) were divided into five dietary treatment groups of similar mean weight, comprising 15 birds each, individually. They were fed a basal starter diet containing 23% CP, 3200 ME kcal/kg, 0.91% threonine and 1.10% lysine (Lys) during the first 3 weeks. At the end of the first feeding period, the broilers were randomly assigned to five dietary treatment groups receiving 0.70 (control diet), 0.75, 0.80, 0.85 and 0.90% of threonine. During the feeding period, growth performance parameters, body weight gain, feed intake and feed conversion ratio were determined.
The results obtained in the experiment showed that the group receiving 0.75% threonine attained the best performance. The results of our investigation also showed that the highest body weight gain occurred at 0.75% threonine; the tendency in better feed conversion ratio in the group receiving 0.80% threonine for female broilers. Our results suggest that the current NRC (1994), recommendation of 0.74% threonine for 21 to 42 days old broilers is adequate to support relative growth performance.

Key words: Female broiler, grower period, performance, threonine

22-42 Günlük Yaştaki Dişi Etlik Piliçlerin Treonin Gereksinmesi

Özet: Treonin, düşük proteinli mısır-soya küspesine dayalı yemlerle beslenen broilerlerde 3. sınırlayıcı aminoasit olarak düşünülmektedir. Bu çalışmanın amacı 22-42 günlük yaştaki dişi etlik piliçlerin treonin ihtiyacını tespit etmektir. 1 günlük yaştaki 75 dişi civciv, ortalama canlı ağırlıkları birbirine benzer olacak şekilde her birinde 15 civciv (bireysel kafeslerde) olan 5 muamele grubuna ayrılmıştır. Etlik civcivler ilk 3 hafta yapısında %23 ham protein, 3200 kcal/kg ME, %0.91 treonin ve %1.10 lysin içeren başlangıç yemiyle beslenmişlerdir. Birinci besleme periyodu sonunda broilerler %0.70 (kontrol yemi), %0.75, 0.80, 0.85 ve %0.90 treonin içeren karma yem gruplarına ayrılmıştır. Deneme periyodu boyunca canlı ağırlık kazancı, yem tüketimi ve yemden yararlanma oranı gibi büyüme performans parametreleri tespit edilmiştir.
Denemede %0.75 treonin içeren grup en iyi performansı gösterdiği saptanmıştır. Denemede ayrıca en yüksek canlı ağırlık kazancının %0.75 treonin içeren grupta olduğu, yemden yararlanma oranının ise %0.80 treonin içeren yemle beslenen gruptan elde edildiği görülmüştür. Denemede NRC (1994)'ün 21-42 günlük yaştaki etlik piliçler için önerdiği %0.74 treonin ihtiyacının, büyüme performansını sağlamada yeterli olacağı da tespit edilmiştir.

Anahtar kelimeler: Dişi etlik piliç, büyütme dönemi, performans, treonin

Introduction

Amino acid requirements in growing animals depend on several factors like genotype, age and sex (Muhl and Liebert, 2007; Samadi and Liebert, 2007; Kirscherman *et al.*, 2008; Ayasan *et al*., 2009). Furthermore, procedure for assessing

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the requirement, dietary protein supply (Rangel-Lugo *et al.* 1994; Everett *et al.*, 2008), level of protein deposition and the predicted feed intake (Samadi and Liebert, 2006) are important factors. Additionally, environmental conditions (Quentin *et al.*, 2005; Dozier *et al.*, 2008) and graded stimulation of the immune system may also affect requirement studies (Kidd *et al.*, 2003).

The dietary inclusion of L-threonine, similar to that of lysine, results in a further decrease in crude protein because most of the threonine in broiler diets comes from soybean meal and meat meals. Thus, adequate knowledge of the requirement of the next limiting amino acid beyond threonine or adequate knowledge of the crude protein level needed to maximize bird productivity is needed to take advantage of feed-grade amino acids at affordable prices (Kidd *et al.*, 2002).

Increasing levels of dietary threonine and lysine levels resulted in responses in the experiments (Kidd and Kerr, 1997; Ayasan and Okan, 2006; Baylan *et al.*, 2006; Sriperm *et al.*, 2008). Kidd and Kerr (1997) estimated total threonine requirements of 0.70%, 0.74% and 0.78% of the diet, respectively, for body weight gain, feed conversion ratio and breast meat in broilers. Research into requirements for the maximum performance of growing broilers is sparse and, until recently, that addressing the threonine requirements for breast meat development was unknown (Kidd, 2000). The NRC (1994) suggests that fed diets containing 3200 kcal/kg of diet should receive a total dietary threonine level of 0.74 % of diet.

Studies on threonine in poultry revealed contradictory results. Threonine requirements for body weight gain and feed conversion efficiency were estimated to be 0.66 and 0.68% of the diet, respectively (Penz *et al.*, 1991). This experiment suggests that NRC (1994) 21 to 42 day requirement of 0.74% of diet is too high. Similarly, Muhl and Liebert (2007) found that observations for age period are the below the NRC (1994) recommendations (0.74%) and observations from Webel *et al.*, (1996).

Garnsworthy and Wiseman (1999) suggested that broilers fed diets containing 3200 kcal/kg of diet from 22 to 42 days of age should receive diets containing a total dietary threonine level of 0.70% and 0.63%. Kidd *et al.*, (2000) conducted that threonine needs of growing broilers to optimize feed conversion efficiency may be affected by the starter level of dietary lysine. Lemme (2001) concluded that the total dietary threonine requirement of growing broilers does not exceed 0.66% of diet. Corzo *et al.*, (2003) found that additional research is warranted to determine if the threonine requirement of females for this specific age (30 to 42 days) differ under diverse environmental conditions.

Samadi and Liebert (2008) were to establish the requirements and optimal dietary ratio of lysine to threonine for fast growing chickens (genotype Ross 308) depending on age, daily protein deposition and of dietary amino acid efficiency. Researches found that for the commercial growth period of fast growing chickens, the derived optimal lysine to threonine ratio was constant (1:0.69).The applied modelling procedure gave conclusions for quantitative requirements and optimal dietary lysine: threonine ratios in line with actual recommendations.

Waldroup *et al.*, (2002) found that threonine supplementation of turkey diet can increase weight gain. Lehman *et al.*, (1997) reported that weight gain and feed conversion efficiency were not affected by an increase in threonine level from 0.69% to 0.91% in a wheat-corn-soybean diet fed to Turkey.

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 and quails. But there are considerable studies, concerning dietary requirements of the most limiting essential amino acids (i.e., total sulfur amino acids and threonine) in growing diets for females. Thus, this study was conducted to evaluate the threonine requirements of female broilers in between 22-42 days period.

Materials and Methods

Animals and experimental diets

Seventy five, one days of age female broiler chicks (Ross 308) were divided into five dietary treatment groups of similar mean weight, comprising 15 birds each, individually. They were fed a basal starter diet containing 23 %CP, 3200 ME kcal/kg, 0.91% threonine and 1.10% lysine for the first 3 weeks period. Then the broilers were randomly assigned to five treatment groups involving 0.70, 0.75, 0.80, 0.85 and 0.90% of total threonine for the second 21 days (between 22-42 days period). Thus, the experiment was started from the 22nd day. During the experimental periods, the diets used were isoenergetic and isonitrogenous and formulated to satisfy the nutrient requirement standards for broilers (Table 1) for the second phase (between 22-42 days) NRC (1994).

Table 1. Ingredients and chemical composition of the experimental diet

Ingredients (kg/1000 kg)	Periods	
	Starting (Between 1-21 days)	Growing (Between 22-42 days)
Corn	475.7	489.3
Soybean Meal	156.6	153.4
Corn Gluten Meal	144.0	112.1
Wheat Middlings	120.0	140.0
Fish Meal	14.9	1.4
Vegetable Oil	50.0	60.0
Vitamin premix (Rovimix Vitamin 1)*	2.0	2.0
Mineral premix (Remineral-1)**	1.5	1.5
Salt	3.9	4.6
Dicalcium Phosphate-18	15.8	18.4
Limestone	12.9	12.5
Lysine	2.7	3.5
Methionine	-	1.2
Analyzed Composition	1000	1000
Dry Matter, %	89.8	89.0
Crude Protein, %	22.0	20.0
Ether Extract, %	6.5	7.3
Crude Fiber, %	3.0	2.5
Crude Ash, %	6.5	5.0
Threonine, %	0.7	0.7
Lysine, %	0.9	1.1
Arginine, %	0.9	1.1
Methionine, %	0.4	0.6
Methionine + Cystine, %	0.9	0.9
Tryptopan, %	0.2	0.2
Calcium, %***	1.0	1.0
Available P, %***	0.4	0.5
Sodium, %***	0.2	0.2
Potasium, %***	0.5	0.6
ME (kcal/kg)	3200	3200

*Each 2 kg of vitamin premix contains 12000000 IU Vitamin A; 3500000 IU Vitamin D_3; 100000 mg Vitamin E; 3000 mg Vitamin K_3; 2500 mg Vitamin B_1; 6000 mg Vitamin B_2; 40000 mg Niacin; 12000 mg Pantothenic Acid; 4000 mg Vitamin B_6; 15 mg Vitamin B12; 1500 mg Folic Acid; 150 mg Biotin; 100000 mg Vitamin C. ** Each 1.5 kg of mineral premix contains 100000 mg Manganese; 2500 mg Iron; 65000 mg Zinc; 15000 mg Copper; 250 mg Cobalt; 1000 mg Iod; 200 mg Selenium; 450000 mg Chlorite. *** Calculated composition

Diets were composed of corn, soybean meal, corn gluten meal, wheat middlings, fat, limestone, salt, and supplements of vitamins, minerals. Feed ingredients (corn, soybean meal, corn gluten meal) were analyzed for all amino acids (AOAC, 1995) prior to formulation then those values of the feed ingredients were used in at least-cost formulation by linear programming.

Feed ingredients, experimental diets were analysed for CP by the Kjeldahl method (AOAC, 1984) and AAs by ion-exchange chromatography after oxidation and hydrolysis (Llames and Fontaine, 1994).

Growth performance

During the experiment, growth performance, body weight gain, feed intake and feed conversion ratio were recorded weekly. Individual body weight was recorded at the beginning of the experiment and weekly. Feed conversion ratio was calculated weekly as the amount of feed consumed per unit of body weight gain. This experiment was conducted at the Animal Facility Research Centre of the University of Cukurova, Agricultural Faculty, and Department of Animal Science

Statistical analysis

Body weight of the groups at the beginning of the second period was taken co-variant for body growth during the second period. The data were analyzed statistically using the GLM (General Linear Model) procedure of SAS (1998) and treatment means were separated using Duncan's New Multiple Range Test.

Results

The effects of threonine supplementation on female broiler's performance are shown in Table 2. The results showed that threonine supplementation to the diet had no significant (P>0.05) effects on body weight gain, feed intake and feed conversion ratio.

A quadratic response to dietary threonine for final body weight occurred in experiment but other live performance parameters were not impacted by dietary threonine(Table 3).

The average feed conversion ratio values for the treatment groups receiving 70, 75, 80, 85 and 90% threonine supplemented groups were 2.0, 1.9, 1.9, 1.9 and 1.9, respectively.

Table 2. The effect of threonine on performance characteristics of female broilers

CONTRAST	ORTHOGONAL		POLYNOMIAL	TECHNIQUES
Linear	NS**	NS	NS	NS
Quadratic	*	NS	NS	NS
THREONINE	FINAL BODY WEIGHT	BODY WEIGHT GAIN	FEED INTAKE	FEED CONVERSION RATIO
%	g		g/bird/day	
0.70	1726.36	54.59	107.32	2.0
0.75	1924.36	61.83	119.49	1.9
0.80	1906.33	60.46	112.35	1.9
0.85	1796.50	57.18	110.73	1.9
0.90	1870.31	59.02	112.98	1.9

*P<0.05; ** NS: Not significant (P>0.05).

Table 3. Regression analysis for variables measured between 22-42 days old female broilers

	Constant term	S.E.	P	b1	S.E.	P	b2	S.E.	P
Feed conversion ratio	0.387	2.523	0.880	0.221	1.352	0.880	0.589	1.273	0.675
Final Body Weight (g)	-57.311	9.852	0.028	0.063	0.011	0.028	-0.001	0.000	0.028
Body Weight Gain (g/bird/day)	-33.471	6.815	0.039	1.165	0.232	0.038	-0.010	0.002	0.038
Feed Intake (g/bird/day)	-34.627	13.600	0.126	0.641	0.248	0.122	-0.003	0.010	0.124

Discussion

The results obtained in the experiment summarized in Table 2. The results of the experiment showed that threonine level of the diet did not affect body weight gain, feed intake and feed conversion ratio. Evidently, the increased dietary threonine from 0.70% to 0.90% resulted in 8.13% increase in body weight gain. The highest body weight gain occurred at 0.75% threonine receiving group. Threonine level in diet was supra level.

Most likely, animals can spend metabolic fuel to get rid of excessive threonine intake as given in table values of NRC (1994) that broiler chicks aged 21-42 day-old should be fed a diet containing 0.80% threonine level.

Lemme (2001) reported that the optimum dietary threonine levels for body weight gain were 0.66%, compared to the 0.74% suggested by NRC (1994). Kerr *et al.,* (1999) found that regardless of dietary lysine concentration, increasing dietary threonine from 85% to 92.5% of the NRC (1994) recommendation appeared to be adequate for broiler body weight gain. The results of current study are in line with the results of Dozier *et al.,* (2001) who reported that the broilers fed on rations containing different threonine did not significantly affect feed intake of birds receiving 0.74% threonine.

Dietary threonine levels had no significant effect (P>0.05) on feed intake and feed conversion ratio in this study. Increasing dietary level from 0.70 to 0.90% did not affect feed intake and feed conversion ratio. Broilers fed a diet containing 0.75% threonine attained greater cumulative feed intake than the others. This result is in agreement with a previous study (Shan *et al*., 2002).

Feedings diets with threonine levels of 0.70-0.90% had no significant effects on feed conversion ratio of female broilers. Broilers fed diets with 0.80% threonine had numerically the best feed conversion ratio (1.86) but it was not significantly higher (P>0.05). This feed conversion ratio was mainly due to better utilization of feed as a result of threonine supplementation. A similar relationship concerning the changes in feed conversion ratio in response to dietary threonine could not be detected in broilers (Ojano-Dirain and Waldroup, 2002) and quails (Canogullari *et al.,* 2009). In contrast to our results, Kerr *et al.,* (1999); Anonymous (2001) reported that the feed conversion ratio was different between the groups.

Conclusion

The results of our investigation showed that the highest body weight gain occurred at 0.75% dietary threonine level; the tendency in better feed conversion ratio in 0.80% threonine added group for broilers. Our results suggest that the current NRC (1994) recommendation of 0.74% threonine for 21 to 42 days old broilers is adequate to support comparable growth performance.

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