ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 8 (9): 862-865, 2009
ISSN 1682-8356

Threonine Requirement of Broiler from 22-42 Days

Tugay Ayasan[1], Ferda Okan[2] and Hatice Hizli[1]
[1]Cukurova Agricultural Research Institute, Adana, Turkey
[2]Department of Animal Science, Faculty of Agriculture, University of Cukurova, Adana, Turkey

Abstract: Threonine is considered to be the third limiting amino acid for broiler chicks fed low protein corn-soybean meal diets. Very limited information is available on the requirement of the threonine for broilers. The aim of this study was to determine the threonine requirements of broiler chickens from 22-42 days of age. Seventy five Ross 308 one-day-old male broiler chicks were divided into five dietary treatment groups of similar mean weight, comprising 15 birds each. They were fed a basal starting diet containing 23% CP, 3200 ME kcal/kg, 0.81% threonine and 1.24% lysine for first 3 weeks. Chicks were randomly assigned to five treatments involving 0.70, 0.75, 0.80, 0.85 and 0.90% of total threonine for 21 days (between 22-42 days). Results indicated that a linear response to dietary threonine for final body weight, body weight gain and threonine intake occurred in experiment but other live performance parameters were not impacted by dietary threonine. Our results suggest that the current NRC recommendation of 0.74% threonine for 3-6 week old broilers is adequate to support comparable growth performance.

Key words: Threonine, male broiler, requirement, performance

INTRODUCTION

Amino acid requirements in growing animals depend on several factors like genotype, age and sex (Samadi and Liebert, 2007; Muhl and Liebert, 2008). Furthermore, procedure for assessing the requirement (Ishibashi *et al*., 1998), dietary protein supply (Rangel-Lugo *et al*., 1994), level of protein deposition and the predicted feed intake (Samadi and Liebert, 2006;2007) are important factors. Additionally, environmental conditions and graded stimulation of the immune system may also affect requirement studies (Kidd *et al*., 2003).

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. But there are considerable studies, concerning dietary needs of the most limiting essential amino acids (i.e., total sulfur amino acids and threonine) in growing broilers.

Threonine is considered to be the third limiting amino acid for broiler chicks fed low protein corn-soybean meal diets (Kidd *et al*., 1999; Ayasan and Okan, 2006; Baylan *et al*., 2006). Threonine participates in protein synthesis, and its catabolism generates many products important in metabolism (i.e., glycine, acetyl-Coa and pyruvate). Threonine serves as a component of body protein and precursor of glysine and serine, is involved in immune responses, needed in gastrointestinal mucin production (Lemme, 2003). Poultry are not capable of synthesizing threonine de novo which makes it a nutritionally essential amino acid. Threonine (2-amino-3-hydroxybutiric acid, $C_4H_9NO_3$) has a molecular weight of 119.12 and contains 11.76 nitrogen (Kidd and Kerr, 1996; Ayasan, 2004). Other report suggested that the nutritional and metabolic status of glycine and serine in relation to that of threonine need to be understood, because the metabolic degradation of threonine produces glycine and serine whereas nitrogen excretion through the uric acid pathway requires the availability of the glycine, glutamate and aspartate (Barbour *et al*., 2008).

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 utilizes feed more efficiency with reduced amounts of protein. This is better for the animal and better for the environment (Anonymous, 2001b).

The NRC (1994) suggest that 21-42 day-old broilers fed diets containing 3200 kcal/kg of diet should receive a total dietary threonine level of 0.74% of diet. Anonymous (1995) and Garnsworthy and Wiseman (1999) suggested that broilers fed diets containing 3200 kcal/kg of diet from 22-42 days of age should receive diets containing a total dietary threonine level of 0.63%. Lemme (2001) concluded that the total dietary threonine requirement of growing broilers does not exceed 0.66% of diet. Ojano-Dirain and Waldroup (2002) suggested that the modern rapidly growing broiler may have threonine requirements greater (0.78%) than those generally recommended (0.74%) by NRC (1994). As seen, reported threonine requirement values for broilers vary greatly.

The objective of this study was to evaluate the response of broilers between 22-42 days of age to dietary threonine.

Corresponding Author: Tugay AyasanCukurova Agricultural Research Institute, PK:45, Karatas Road, 17 Km Yuregir-Adana,Turkey

Table 1: Experimental design

Groups	Starting (Week 1-3)	Growing (Week 4-6)
A		0.70% Threonine, 1.24% Lysine
B	Basal Diet	0.75% Threonine, 1.24% Lysine
C	0.91% Threonine, 1.24% Lysine	0.80% Threonine, 1.24% Lysine
D		0.85% Threonine, 1.24% Lysine
E		0.90% Threonine, 1.24% Lysine

MATERIALS AND METHODS

In the study, 75 Ross 308 one-day-old male broiler chicks were divided into five dietary treatment groups of similar mean weight, comprising 15 birds each. For the first 3 weeks, the birds were fed a common starting diet from 1-21 d containing 23% CP, 3200 ME kcal/kg, 0.81% threonine and 1.24% lysine. Chicks were randomly assigned to five treatments involving 0.70, 0.75, 0.80, 0.85 and 0.90 % of total threonine for 21 days (between 22-42 days) (Table 1).

Diets were isoenergetic and isonitrogenous and formulated to satisfy the nutrient requirement standards for broilers (Table 2), NRC (1994). Diets were composed of corn, soybean meal, corn gluten meal, fat, limestone, salt and supplements of vitamins, minerals. Feed ingredients (corn, soybean meal, corn gluten meal) were analyzed for all amino acids prior to formulation. Analyzed amino acid values were used in least-cost formulation. Basal diet was formulated with linear programming.

During the experiment, growth performance; body weight gain, feed intake and feed conversion rate were recorded weekly. Individual body weight was recorded at the beginning of the experiment and weekly Feed intake was recorded 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. This experiment was conducted over a 6 wk period.

All data were subjected to the General Linear Models Procedure of SAS (1998). Mean separation procedure was performed by orthogonal polynomial techniques.

Table 2: Ingredients and chemical composition of the experimental diet

	Diets	
Ingredients (kg/1000 kg)	Starting (1-21 Days)	Growing (22-42 Days)
Maize	473.31	489.20
Soybean Meal	156.56	149.51
Corn Gluten Meal	144.02	113.83
Wheat Middlings	121.00	140.02
Fish Meal	14.92	2.53
Vegetable Oil	50.00	60.00
Vitamin Premix*	2.00	2.00
Mineral Premix**	1.50	1.50
Salt	3.94	4.54
Dicalcium Phosphate	15.81	18.27
Limestone	12.89	12.52
Lysine	4.05	4.90
Methionine	-	1.18
Calculated composition (g/kg)		
Crude Protein	230.0	202.1
Ether Extract	74.9	86.1
Crude Fiber	31.5	25.0
Crude Ash	34.7	34.5
Threonine	9.1	7.0
Lysine	12.4	12.4
Arginine	11.4	10.7
Methionine	5.2	5.5
Methionine + Cystine	9.2	9.0
Tryptopan	2.0	2.0
Calcium	10.0	10.0
Available P	4.5	4.5
Sodium	2.0	2.0
Potasium	4.7	6.1
ME (MJ/kg)	13.40	13.40

*Provided per kg of diet: Vitamin A 12000 IU; vitamin D_3 3500 IU; vitamin E 100 mg; vitamin K_3 3 mg; vitamin B_1 2.5 mg; vitamin B_2 6 mg; niacin 40 mg; pantothenic acid 12 mg; vitamin B_6 4 mg; vitamin B12 0.015 mg; folic acid 1.5 mg; biotin 0.15 mg; vitamin C 100 mg. **Provided per kg of diet: mangan 100 mg; iron 2.5 mg; zinc 65 mg; copper 15 mg; cobalt 0.25mg; iod 1 mg; selenium 0.2mg; cholin chlorite 450mg

RESULTS AND DISCUSSION

The results obtained in the experiment are summarized in Table 3. Regression analyses for variables measured in 22-42 d broilers are given in Table 4.

A linear response to dietary threonine for final body weight, body weight gain and threonine intake occurred in experiment but other live performance parameters were not impacted by dietary threonine. The body weight gain response indicated that 0.75% dietary threonine supported good growth of 22-42 d old broilers. Birds fed the control diet containing 0.70% threonine had body weight gain (61.4 g/bird d) and feed: gain (1.96) responses that were poorer than responses of body weight gain (64.49 g/bird/day) and feed: gain (1.93) of birds receiving 0.75% dietary threonine from the experimental diet as determined by regression equations. This result is in agreement with previous studies in broilers. Kidd and Kerr (1997) reported that the 21-42 day NRC threonine requirement of 0.74% of diet is too high. In contrary, Dozier *et al.* (2001) indicated that threonine supplementation of the diet did not affect body weight gain, while Lehmann *et al.* (1997) indicated that different threonine levels (0.82-0.88-0.94-1.00-1.06-1.12%) improved body weight gain. Lemme (2001)

Table 3: The effects of live performance of male broilers given progressive supplements of l-threonine to the diets fed from 22-42 days of age

Contrast		Orthogonal	Polynomial	Techniques	
Linear	*	*	NS	*	NS
Quadratic	NS**	NS	NS	NS	NS
Threonine	Final Body Weight	Body Weight Gain	Feed Intake,	Threonine Intake	Feed:gain
%	g	g/bird d		mg/bird d	g:g
0.70	1988	61.4	121	840	1.96
0.75	2026	64.5	124	930	1.93
0.80	1992	62.7	125	990	1.98
0.85	1988	62.6	118	1000	1.89
0.90	1953	62.1	121	1090	1.96
SEM	11.56	6.17	2.7	3.0	0.004

*p<0.01; **NS: Not significant

Table 4: Regression analysis for variables measured in 22-42 day old broilers

	Constant term	S.E.	P	b1	S.E.	P	b2	S.E.	P
Feed Conversion Ratio	3.097	3.230	0.439	-2.823	8.122	0.761	1.714	5.073	0.768
BWG (g/bird/day)	-34.937	84.499	0.719	247.286	212.463	0.365	-155.429	132.699	0.362
Feed intake (g/bird/day)	-7.97	224.457	0.975	335.134	564.371	0.613	-214.571	352.491	0.605

reported that the optimum dietary threonine levels for 20-42 d old broilers for body weight gain was 0.66%, compared to the 0.74% suggested by NRC (1994) for 21-42 d old broilers.

Our experiment shown that the threonine requirement to maximize growth for males 0.75% of the diet. Robins (1987) concluded that the threonine requirement of broiler should be expressed as 3.7% of dietary crude protein. From the calculated crude protein level in the current study (20.21%), we can estimate a threonine requirement of 0.75% of diet (20.21% crude protein x 0.037).

A linear, quadratic to dietary threonine for feed intake not occurred in experiment. Broilers fed a diet containing 0.80% threonine attained greater cumulative feed intake than the others. This numerical increase in feed intake can be explained that threonine may have appetitive effect on feed intake. This result is in agreement with those reported in birds (Anonymous, 2001a). In contrast to our results Shan *et al.* (2002) reported that the feed intake was significantly different between groups.

Threonine intake increased as dietary threonine increased (linear effect p<0.01). Feed conversion ratio were not significantly (linear, quadratic) in groups. Broilers fed diets with 0.85% threonine had numerically higher feed conversion ratio (1.89) but was not significantly different others. The feed conversion rates were 1.96 for control group, 1.89 for 0.85% threonine supplemented group. These results are consisted with previous experiment of Anonymous (2001a); Ojano-Dirain and Waldroup (2002) and Kidd *et al.* (2003) who observed not to improve feed conversion ratio with the supplementation of threonine to the diet. In contrast to our results, Anonymous (2001a); Ojano-Dirain and (Waldroup, 2002; Kidd *et al*., 2003) reported that the feed conversion ratio was found different between groups. Lemme (2003) reported that feed conversion ratio of male broilers was optimized as dietary threonine was increased from 0.55-1.05% respectively.

The results of our investigation showed that the highest body weight gain occurred at 0.75% threonine; the tendency in better feed efficiency in 0.85% threonine added group for broilers. Our results suggest that the current NRC (1994) recommendation of 0.74% threonine for 3-6 week old broilers is adequate to support comparable growth performance.

ACKNOWLEDGEMENT

The authors would like to acknowledge the grant support provided by Cukurova University of Research Fund.

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