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EFFECT OF HIGH LEVELS OF FOUR AMINO ACIDS ON GROWTH PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

The aim of this study was to find the effect of four amino acids (tryptophan (Trp), arginine (Arg), methionine (Met) and threonine (Ther)) supplementation higher than the NRC recommendation on growth performance. A total of 250 day-old male broiler chickens were assigned to five groups in a completely randomized design. Five dietary treatments included one control group (A) and four experimental groups (B: 2 times NRC level of Ther, C: 2 times NRC level of Trp, D: 2 times NRC level of Met, E: 2 Times NRC level of Arg). Growth performance parameters (Body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR)) were measured. Body weight gain, feed intake and feed conversion ratio were significantly influenced by the dietary treatments. Supplementation of arginine, methionine, tryptophan and threonine had the best results respectively. In conclusion, our data suggest that the amino acids requirement of male broiler chicks is higher for growth performance than was suggested by the last NRC committee and the amino acids higher than NRC requirements might have positive effects on health status of broiler chickens.

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Introduction

Improvement in genetic potentials and management practice and also increase in poultry production is required to adjust the valuable formulation strategy. Nutrient requirement standard have been reported by the National Research Council [1] are usually based on the needs of healthy birds under ideal management, but birds in commercial systems are normally exposed to different kinds of stresses, diseases and also the combination of environmental condition. So, such changes may involve replacement of specific ingredients and/or alternation to nutrient levels in the diet. There is some evidence that essential amino acid level in the feed higher than of NRC specifications needed to achieve optimal growth performance [2].

Tryptophan is an essential amino acid in poultry and is required for a wide variety of metabolic activities. Because its concentration in organisms is among the lowest of amino acids, it can be easily play a rate-limiting role in protein synthesis. Apart from being a structural component of all proteins it is a precursor for synthesis of two hormones, serotonin and melatonin [3]. In addition to all aforementioned, Trp has also been linked with niacin biosynthesis in chickens [4]. There is little information in the literature about Trp requirements for broilers and some of the results are controversial. Ureotelic species (i.e., birds) cannot synthesize Arg because they have an in complete urea cycle. Past research has clearly demonstrated that importance of providing chickens adequate dietary Arg to support growth responses. Arginine like most amino acids is traditionally noted for its role in protein synthesis. Many studies recognized the importance of Arg on growth, immunity, wound healing and greater muscle mass and rapid healing from injury [5]. Arginine is a potent scavetagogue for growth hormone, insulin and insulin-like growth factor-1. Methionine, lysine and threonine are regarded as to be the first, second and third limiting amino acids in broilers fed practical corn-soybean meal diets [6]. Methionine is an important amino acid in protein synthesis in broilers and Met supplementation can alter the immune response and is beneficial in reducing the immunologic stress. Methionine is metabolically linked with cystine and choline and is necessary for producing keratins used in feather growth [7]. Adequate digestible threonine levels are needed to support optimum growth because it serves as important component of body protein and plays an important role as precursor of lysine and serine [6]. Threonine is needed

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for optimal immune response and gastrointestinal mucine production. It has been reported to improve the livability of heat stressed broilers. Increased dietary threonine concentration is known to improve nitrogen retention in broiler chicks; therefore, changing level of threonine concentration is an important tool to improve nitrogen utilization [7]. Unfortunately, research into the high levels of amino acids requirements of broilers is lacking. Therefore, the aim of this study was to evaluate the effects of four amino acid supplementation higher than NRC level on growth performance of broiler chickens.

Materials and Methods

The experiment was conducted in an experimental house, where average minimum and maximum temperatures were 20 and 31 ºC, respectively. A total of 250 one-day-old male chicks of Cobb 500, with 44 g of initial weight, were reared in 25 pens (10 birds/ pen) at a density of 11 birds/m^2. Chicks derived from broiler breeder of similar age. Mash feed and water were offered ad libitum, and chicks were submitted to continuous light regimen during the entire experimental period. The experiment was divided into two phases, including a starter (d 0-21) and grower (d 22-42). Five dietary treatments included one control group (A) and four experimental groups (B: 2 times NRC (Ther), C: 2 times NRC (Trp), D: 2 times NRC (Met), E: 2 Times NRC (Arg). The basal diets were formulated to meet or exceed requirements by the NRC (1994) for broiler chickens (Table 1). Body weight gain and feed intake were recorded weekly and adjusted for the two periods (starter and grower). The ratio between feed intake and weight gain was calculated to offer the feed conversion efficiency. Data were analyzed as a randomized complete design using the GLM procedure of SAS [8]. If the difference among the five treatments was significant, then Duncan's Multiple Comparison test was used for multiple comparisons. A level of $p \leq 0.05$ was set as the criterion for statistical significance.

Results and Discussion

In starter period the values of FI and BWG among treatments were not significantly different but FCR significantly improved ($p<0.05$). Compared to control, in grower period the values of FI and BWG have significantly increased and FCR has gradually decreased ($p<0.05$) (Tables 2-4). There was no abnormal behavior observed in birds receiving different levels of supplementation.

The results showed that the amino acids supplementation higher than NRC recommendation hade positive effect on growth performance and the best growth performance results belong to arginine, methionine, tryptophan and threonine respectively.

NRC requirements for amino acids and protein are designed to support maximum growth and production in healthy bird kept under ideal conditions. The recommended levels of amino acids in poultry depend on species, stage, environment condition and level of feed energy. So, the low concentration of amino acids in high protein corn-soybean diets has led to wide use of synthetic amino acids supplementation in poultry feed. The present findings although indicated that there was a significantly increased in BWG and FI and significantly better FCR in birds subjected to the highest level of amino acids.

As expected, dietary Arg increased FI and BWG. This is in agreement with Emadi et al (2010) [9]. Corzo and Kidd (2003) showed that higher level of dietary Arg had no effect on broilers during the total growth period, except for the first 3 weeks of age [8]. Association of available Arg with microbial challenges occurring at younger ages has been shown to have affected growth performance and health status of the bird [5]. Similar Arg observations were reported by Chamruspollert et al (2004), where a higher requirement of Arg was needed for feed conversion than that for the body weight gain [10]. During the present study Arg supplementation had positive effect on feed conversion ratio. More studies showed that in an ambient and stress conditions high levels of dietary Arg improve body weight gain [11]. Emadi et al 2010 reported that use of high levels of Arg may improve the growth performance and health status of broiler chickens. As shown, dietary Trp increased FI and BWG. This is in agreement with Harms and Russel (2000) [12]. Pegonova and Eder (2003) [13] reported that feed consumption was higher in broiler chickens with received high concentration of dietary Trp compared with those which received low concentration of it. This effect could be due to the function of Trp as a precursor of the neurotransmitter serotonin. It is well known that serotonin, which is formed in the brain and influences feed consumption of animals [3]. The present findings indicated that Met and Ther can improved the growth performance. Fasuyi and Aletor (2005) reported that better performance can still be obtained with adequate supplementation of essential amino acids especially methionine which has been identified to be in marginal quantities in most poultry diets [14]. An improve in broiler performance when high levels of Met and Ther to a corn-soybean diet has been reported by Maroufyan et al (2010) [7].

Conclusion

It is concluded that among the four amino acids arginine has beneficial effects on growth performance and these results indicated that supplementation diets with synthetic amino acids more than NRC recommendation could be a nutritional strategy for improvement in broiler chicken's performance and health status

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Table 1: ingredients and nutrient composition of diets

Items	Starter	Grower
Ingredient (%)		
Corn	45.35	50. 95
Soybean meal	43.97	38.22
Vegetable oil	6.22	6.89
Di calcium phosphate	1.91	1.76
Limestone	1.20	1.05
Salt	0.44	0.31
Vitamin and mineral mix[1]	0.60	0.60
DL-Methonine	0.20	0.10
Lysine	0.11	0.12
[2]Calculated composition		
Crude protein (%)	22	20
ME (Kcal kg^{-1})	3050	3150
Available phosphorus (%)	0.45	0.42
Calcium (%)	1.00	0.90
Methionine	0.50	0.38
Lysine	1.10	1.00
Arginine	1.40	1.33
Tryptophan	0.28	0.26
Threonine	0.80	0.74
Na	0.20	0.74
Cl	0.39	0.25
K	1.02	0.92
Crude fiber	4.20	3.92
Ca/P	138	157

1: Provided per kilogram of diet: 12 000 IU Vitamin A., 3 500 IU Vitamin D3, 100 g Vitamin E., 3 mg Vitamin K3, 2.5 mg. Vitamin B1, 6 mg Vitamin B2, 25 mg Niacin, 12 mg Ca-DPantothenate, 4 mg Vitamin B6., 0.015 mg Vitamin B12., 1.5 mg Folic Acid,150mg D-Biotin., 100 mg Vitamin C., 450 mg Colin chloride. 100 mg Mangan., 25 mg Iron., 65 mg Zink., 15 mg Copper., 0.25 mg Cobalt., 1 mg Iodine., 0.2 mg Selenium. 2: Based on NRC (1994) feed composition table.

Table 2: Effect of dietary arginine, methionine, tryptophan and threonine on feed intake (FI) of broiler chickens from 0-42 days of age

	FI (g, days)	
Treatment	0-21	22-42
A	1929.5	2357.1^{a}
B	1950.4	2648.7^{c}
C	1990.5	2575.2^{b}
D	1933.5	2912.5^{d}
E	2003.9	2571.4^{b}
P	0.08	0.001
SE	10	22

Table 3: Effect of dietary arginine, methionine, tryptophan and threonine on body weight gain (BWG) of broiler chickens from 0-42 days of age

	BWG (g, days)	
Treatment	0-21	22-42
A	1135	873^{a}
B	1219	981^{b}
C	1327	1073^{c}
D	1289	1165^{e}
E	1382	1118^{d}
P	0.057	0.001
SE	12	11

Table 4: Effect of dietary arginine, methionine, tryptophan and threonine on feed conversion ratio (FCR) of broiler chickens from 0-42 days of age

	FCR(days)	
Treatment	0-21	22-42
A	1.7^{d}	2.7^{d}
B	1.6^{c}	2.7^{d}
C	1.5^{b}	2.4^{b}
D	1.5^{b}	2.5^{c}
E	1.4^{a}	2.3^{a}
P	0.001	0.001
SE	0.03	0.04

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