L-THREONINE SUPPLEMENTATION IN LOW CRUDE PROTEIN DIET OF BROILER STARTER CHICKEN

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ABSTRACT

This study was conducted to determine the effect of threonine (Thr) supplementation to low protein diet (LPD) on performance and nitrogen utilization of growing broilers (1 to 21 old). A total of 200, one-day-old unsex broiler chicks were randomly allocated to five treatments with four replicates of 10 birds each. Five isocaloric diets were formulated; diet 1 served as a positive control with 23% CP level, diet 2 served as the low protein diet (LPD, negative control) with 20% CP level while diet 2, 3 and 4 contained Thr supplementation to diet 2 at 0.2, 0.4 and 0.6%, respectively. The result showed that average daily feed intake, average daily gain, feed conversion ratio and all the nitrogen utilization parameters except nitrogen intake were significantly (P < 0.05) influenced by Thr supplementation. Daily feed intake was lower (P<0.05) in birds fed control and 0.6% Thr diet compared to other treatment diets. Improved (P<0.05) daily weight gain and feed conversion ratio was observed in birds fed the control diet and did differ from those fed 0.4 and 0.6% Thr diets compared with those on LPD and 0.2% Thr diets. A significant (P < 0.05) increase in nitrogen retention with corresponding decrease in nitrogen excretion was observed in birds fed 0.4% and 0.6% Thr diets. In conclusion, this study demonstrates that with a minimum level of 0.4% Thr supplementation, feeding a low CP diet of 20% in broiler starter chickens is possible without any adverse effect on performance and nitrogen utilization efficiency.

Keywords: broilers, low protein diet, nitrogen utilization, performance, threonine.

INTRODUCTION

Globally, there is great interest in the use of low crude protein (CP) diets in poultry nutrition for economic and environmental advantages especially for improved nitrogen efficiency utilization, reduction in feed cost and reduced total nitrogen output to the environment. However, this reduction in dietary CP has been reported to cause decreased performance probably because of inadequate provision in essential amino acids (AA) in order of their limitations (Belloir *et al.*, 2019). Poultry nutritionists have decreased the use of protein-rich feed ingredients by supplementing critical amino acids such as DL-methionine and L-lysine which are the first 2 limiting amino acids in most vegetable protein sources in order to support optimal performance and ensure maximum economic return. Further decrease in CP requirements of birds will only be possible with the consideration of the next limiting amino acid especially during the starting phase of bird's development. In corn -soya based feedstuff for poultry, Thr is the third limiting amino acid for broilers, and it becomes more limiting as crude protein decreases (Kidd and Kerr, 1996; Rasheed *et al.*, 2018). Adequate Thr levels are needed to help optimum growth because it serves as an essential component of body protein and plays a vital role in excellent immune response and gastrointestinal mucin production (Corzo *et al.*, 2007; Ospina-Rojas *et al.*, 2013; Qaisrani *et al.*, 2018; Helal *et al.*, 2020). This study was conducted to evaluate the response of broiler chicks fed low protein diets containing graded levels of L-Thr supplementation on growth performance and efficiency of nitrogen utilization.

MATERIALS AND METHODS

This experiment was conducted at the Poultry Unit of Teaching and Research Farm of the Department of Animal Production Technology, Federal College of Wildlife Management New Bussa, Niger State is located on longitude 9° 81' 95"N and 9° 49' 10" N and latitude 4° 58' 05" N and 4° 34' 49" N (Aguihe *et al*., 2020). A total of 200, day old broiler chicks were used for this study. Completely Randomized Design (CRD) was adopted and birds were randomly allotted to five treatments with each treatment having 4 replicates comprising of 10 birds each. The chicks were housed in an open - sided and well - ventilated pens and wood shavings was used as litter materials. A continuous lighting system was used to ensure that experimental feed and water were provided *ad-libitum*. Five isocaloric diets that meets the standard nutrient requirement for broilers at 1 - 21 days old as recommended by NRC (1994) were formulated. Diet 1 (positive control) contained standard protein diet of 23% CP level, Diet 2 contained a low protein diet (LPD) of 20% CP level while diet 3, 4 and 5 were contained LPD with L-Thr supplementation at 0.2, 0.4 and 0.6%, respectively (Table 1). Birds and feed were weighed at placement on day 1 and at the end of the experimental phase (21 d) for the determination of body weight gain, feed intake, and feed:gain. On replicate basis, total nitrogen intake, nitrogen retention, nitrogen efficiency and total excretion of nitrogen were computed using the procedures as described by Belloir *et al.* (2019). All data were analyzed using one-way ANOVA, means were compared using Turkey test (SPSS 16.0 for Windows, SPSS Inc., Chicago, IL, USA.). A P-value of 0.05 or less was declared significant.

Table 1: Composition of experimental diets

Feed ingredients	**Control**	**LPD**	**LPD +0.2% Thr**	**LPD +0.4% Thr**	**LPD +0.6% Thr**
Maize	50.05	59.55	59.55	59.50	59.30
Soybean meal	39.55	29.35	29.15	29.00	29.00
Soya-oil	3.00	2.00	2.00	2.00	2.00
Fish meal	3.00	4.00	4.00	4.00	4.00
DCP	2.00	2.30	2.30	2.30	2.30
Limestone	1.50	1.40	1.40	1.40	1.40
Salt	0.30	0.30	0.30	0.30	0.30
Vitamin-Premix	0.30	0.40	0.40	0.40	0.40
DL-Methionine	0.20	0.30	0.30	0.30	0.30
L-Lysine	0.10	0.40	0.40	0.40	0.40
L-Thr	0.00	0.00	0.20	0.40	0.60
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude protein %	23.12	20.45	20.37	20.30	20.29
Methionine	0.55	0.60	0.60	0.60	0.60
Lysine	1.38	1.34	1.33	1.33	1.32
Threonine	0.83	0.64	0.69	0.74	0.78
Energy (Kcal/kg)	3028.16	3057.73	3052.85	3047.45	3040.51
Calcium %	1.08	1.09	1.85	1.84	1.09

RESULT AND DISCUSSION

The results of performance and nitrogen utilization of broiler chicks fed LPD with Thr supplementation is presented in Table 2. Birds fed control diet had lower ($P < 0.05$) ADI followed by the group fed 0.6% Thr diet compared to those fed other treatment diets. The ADG of birds fed control, 0.4% Thr and 0.6% Thr supplemented LPD diets were significantly ($P<0.05$) higher than those offered LPD and 0.2% Thr diets. A higher ($P<0.05$) feed:gain was recorded in birds fed LPD and 0.2% Thr diets but decreased as Thr supplementation increased up to 0.6%, compared to those on the control diet having the lowest ($P<0.05$)

feed:gain. Increasing Thr supplementation to LPD of growing broiler chicks produced significant improvements in feed:gain and ADG, which underscores the important role of this amino acid in promoting growth (Taghinejad-Roudbaneh *et al*., 2013; Helal *et al*., 2020). Similar results were observed by Horn *et al*. (2009), Zhang *et al*. (2014), Jiang *et al*. (2017) who reported that the growth performance was enhanced with increased dietary Thr supplementation in ducks. Similarly, Xie *et al*. (2014) reported that the weight and feed intake of Pekin ducks increased and feed:gain of ducks decreased linearly as the dietary Thr level increased. One possible explanation for improved growth performance could be that Thr is a major component of mucin, a glycoprotein, which filters nutrients inside the gut lumen and helps in digestion and absorption (Smirnov *et al*., 2006; Star *et al.,* 2012). Nitrogen retention was similar among the birds fed control and Thr supplemented LPD diets but higher ($P < 0.05$) than the group fed LPD diets. Birds fed control, 0.4% Thr and 0.6% Thr supplemented Thr diet recorded a higher ($P < 0.05$) nitrogen efficiency compared to the group fed LPD and 0.2% Thr diets. A higher ($P < 0.05$) nitrogen excretion was recorded in birds fed LPD and similar to the control diet and 0.2% Thr diet compared to those in group fed 0.4 and 0.6% Thr diet. A decreasing trend was observed in nitrogen excretion as the level of Thr supplementation increases in the LPD. Earlier studies showed that increasing the amount of dietary Thr increases nitrogen retention and reduces nitrogen loss in chickens (Kidd and Kerr, 1996; Qaisrani *et al*., 2018). The decrease in nitrogen excretion leads to strong and synergistic decrease of nitrogen amounts lost through volatilization, thus, lowering the rate of ammonia emission in the poultry house (Belloir *et al*., 2017). Improved nitrogen retention observed as level of Thr supplementation increased may be linked to improved feed efficiency of the birds. Similarly, Dozier *et al*. (2001) stated that nitrogen retention was higher in broilers fed higher total dietary Thr level compared with diet containing lower Thr concentration. The extensive involvement of Thr with the intestinal mucosa and digestive enzymes may be linked to its influence on performance and nitrogen utilization (Dozier *et al*., 2001; Najafir *et al.,* 2017).

Table 2: Performance and nitrogen utilization of broiler chicks fed low protein diets with threonine supplementation.

Parameters	**Control**	**LPD**	**LPD+0.2% Thr**	**LPD+0.4% Thr**	**LPD+0.6% Thr**	**SEM**	**P-values**
ADI, g/bird	67.90^{b}	73.19^{a}	72.31^{a}	74.07^{a}	70.55^{ab}	1.84	0.119
ADG, g/bird	43.28^{a}	28.38^{c}	35.96^{b}	41.96^{a}	40.55^{a}	1.50	0.001
Feed:gain	1.57^{b}	2.60^{a}	2.01^{a}	1.77^{b}	1.74^{b}	0.10	0.001
N_{intake}, g	47.48	45.27	44.54	45.48	43.28	0.54	0.140
$N_{retention}$, g	26.36^{a}	17.28^{b}	21.9^{a}	25.55^{a}	24.69^{a}	0.92	0.001
$N_{efficiency}$, %	55.65^{a}	38.15^{b}	49.25^{b}	56.18^{a}	57.07^{a}	2.01	0.001
$N_{excretion}$, g	21.12^{a}	27.99^{a}	22.64^{a}	19.93^{b}	18.58^{ab}	0.97	0.001

^{abc}Means with no common superscripts differ significantly ($p < 0.05$).
LPD: Low protein diet; ADI: Average daily intake; ADG: Average daily gain; N: Nitrogen

CONCLUSION AND RECOMMENDATION

Feeding low protein diets with a minimum of 0.4% Thr supplementation resulted in improved performance and nitrogen utilization of growing broiler chicks. Moreover, if low CP diets with supplemental methionine and lysine are desired, careful evaluation of the minimum dietary Thr may be necessary for optimal growth response in birds.

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