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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(7): 2667-2669

www.thepharmajournal.com
Received: 08-05-2023
Accepted: 16-06-2023

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Optimization threonine requirements for commercial broilers

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Abstract
A study on 250 commercial broilers (Ven Cobb) was conducted to evaluate the graded concentration of digestible threonine (75, 70, 65, and 60% of the digestible lysine) in broiler diets. The chicks were allocated into five treatments, each containing ten replicates and five chicks, owing to a completely random design. During the experiment, the birds were fed a diet made of corn and soy. Throughout the study period, supplementing digestible threonine at graded concentrations (75, 70, 65, and 60% of digestible Lysine) had no impact on growth rate, feed intake and FCR. Supplementing commercial broiler diets with digestible threonine in varied concentrations had no effect on the carcass characteristics, such as the dressing percentage, breast yield and abdominal fat weight. There was no significant difference in the serum biochemical constituents (glucose, uric acid, HDL, and LDL) between treatment groups. The very low density lipoprotein (VLDL) and serum triglycerides contents in Commercial broilers, however, significantly affected by variations in digestible threonine concentrations. In comparison to other treatment groups, the threonine supplemenation at 75% digestible lysine revealed increased VLDL concentration. It is concluded that digestible threonine concentrations during the pre-starter, starter, and finisher phases at 0.708, 0.630, and 0.570% (60% of the digestible lysine), respectively, are sufficient to optimise the production performance in commercial broilers without having a negative impact on the carcass and serum biochemical profile.

Keywords: Broilers, dressing percentage, digestible threonine, growth performance

Introduction

About 70% of the overall cost of producing broilers is attributed to feed alone. Precision nutrition includes optimal and well-balanced nutritional feeding. Protein is an essential component of all animal tissues and significantly affects chicken growth (Kamran *et al*. 2004) [5]. Utilising the digestible amino acids (DAA) idea might be beneficial in lowering the dietary protein concentration while maintaining optimal chicken performance. Diets for broiler chickens frequently contain corn and soybean meal (SBM). Such diets lack enough AA to satisfy the requirements of modern fast-growing broilers and enable them to reach their full genetic potential. For this reason, crystalline AAs are added to diets based on corn-SBM in order to meet the AA needs.

According to Fernando *et al*. (1994) [4], dietary threonine (Thr) is the third limiting amino acid in low-CP poultry diets based on corn-soybean meal. According to Mao *et al*. (2011) [8], this amino acid is crucial for maintaining gut mucosal integrity and barrier function. Intestinal-mucosal proteins, particularly mucins, and digestive enzymes in the lumen are both integrated with significant amounts of dietary Thr to facilitate the digestion and absorption of nutrients (Dozier *et al*., 2001; Wang *et al*., 2009) [2, 13]. The results of studies conducted over the past fifteen years, it has been concluded that Thr should be expressed relative to 0.63 to 0.70% of dietary Lys, with the primary variables being gender, strain, diet and age (Kidd, 2002) [7]. To maximise production performance, AA criteria have become crucial. Setting the right optimum ratios for these potentially limiting essential amino acids needs to be given considerable attention.

In light of this, it is currently unknown how much AA supplementation can substitute dietary protein without negatively affecting grill performance. The current biological investigation was carried out in order to assess the performance, carcass characteristics, and serum biochemical profile of commercial broiler diets with optimised Thru needs for diets containing low levels of dietary protein.

Materials and Methods

A growth trial lasting six weeks was conducted in commercial broilers utilising 250 day-old male broiler chicks (Ven Cobb - 400) using a completely randomised design (CRD), which included five dietary treatments. The chicks were procured, their wings were banded, and they were all weighed. After that, they were randomly divided into five treatments, each of which had ten replicates and a total of five chicks in each replicate. The chicks were raised under ideal brooding conditions in battery brooders that were electrically heated.

Experimental diets

According to Cobb breeder's recommendations, a corn-soya based control diet was formulated and other experimental diets were formulated by reducing crude protein levels by 2, 1, and 2% during pre-starter, starter and finisher phases respectively, with graded concentrations of threonine 75, 70, 65, and 60% of digestible Lys during pre-starter (0-14 d); (0.885, 0.826, 0.767 and 0.708), starter (15-28 d); (0.787, 0.735, 0.682 and 0.630) and finisher period (29-42 d); (0.712, 0.665, 0.617 and 0.570).

Collection of data

Up to six weeks of age, the body weight of each bird was recorded on an individual basis once a week, and once a week, the feed intake was calculated replicate-wise. The feed conversion ratio (FCR) calculated from 0 to 6 weeks of age at weekly intervals, was computed as feed intake per unit body weight gain. The serum biochemical parameters were analysed using diagnostic test kits (Arkray Healthcare Pvt. Limited, Sachin (Surat), India). The blood was collected at the end of the experiment from one bird from each replicate. Ten birds from each dietary group were sacrificed at the end of the experiment in order to evaluate the carcass parameters (Dressing %, Breast weight, and Abdominal fat), which were expressed as grammes per kilogramme of live body weight. The 15th version of the Statistical Package for Social Sciences (SPSS) one-way ANOVA was used to analyse the data. The difference between the treatment means was analysed using Duncan's multiple range test (Duncan, 1955) [3] at $p<0.05$.

Results and Discussion

According to data on body weight gains (Table 1), the treatment group T5 supplemented with digestible threonine had an increase in body weight gain that was relatively higher than the control group T1 supplemented with digestible threonine during the pre-starter, starter, and finisher phases as well as throughout the experimental period, at 0.708, 0.630, and 0.570% (60% of the digestible lysine). In contradiction to the findings of the current study, Mehri *et al*. (2012) [9], Corzo *et al.* (2009) [7] and Kidd *et al.* (1999) [6] found that dThr (%) values of 0.78, 0.73 and 0.66 respectively, significantly ($p<0.05$) increased body weight gain in commercial broilers.

The findings on cumulative feed intake (Table 1) indicate a non-significant ($p>0.05$) relationship with threonine concentration in commercial broilers fed diets based on corn-soybean meal. In contrary to the results of the present investigation, Star *et al.* (2010) [12] observed that broilers with a Thr: Lys ratio of 0.65 had considerably higher feed intake than broilers with a Thr: Lys ratio of 0.70.

For the entire period of the investigation, the FCR (Table 1) did not show any significant ($p>0.05$) differences between the treatment groups with varied concentration of digestible threonine in commercial broilers.

Table 1: Effect of supplemental digestible threonine on growth performance on commercial broilers (0–42 days).

Treatment	Body weight gain (gram/bird)	Feed Intake (gram/bird)	Feed conversion ratio (FCR)
T_1	1870	3133	1.677
T_2	1887	3111	1.650
T_3	1835	3038	1.657
T_4	1874	3159	1.688
T_5	1912	3189	1.668
SEM	14.87	22.35	0.005
p-value	0.595	0.264	0.165

In this present investigation, the addition of varied levels of digestible threonine supplementation had no effect on the slaughter parameters, including dressing percentage and abdominal fat weight (Table 2). Contrary to these results, Ospina-Rojas *et al.* (2014) [11] found that feeding Cobb 500 male commercial broilers diets supplemented with Thr:Lys ratios of 57.0, 60.5, 64.0, and 67.5 percent did not alter carcass and meat yields. However, broilers fed various concentrations of digestible threonine in this investigation had significantly ($p<0.05$) recorded higher breast weight. This is in accordance with Kidd *et al.* (1999) [6] findings, which indicated that 0.67% threonine was necessary for breast meat yield to be optimise in terms of body weight, feed conversion ratio, dressing percentage and relative breast weight in 42 to 56-day-old broilers.

Table 2: Effect of supplemental digestible threonine on carcass characteristics (g/kg slaughter live weight) of commercial broilers.

Treatment	Dressing (%)	Breast weight	Abdominal fat weight
T_1	72.19	196.7^{b}	13.04
T_2	73.35	216.3^{a}	15.07
T_3	72.00	216.7^{a}	12.63
T_4	73.49	216.2^{a}	12.93
T_5	73.89	218.5^{a}	14.90
SEM	0.292	2.420	0.555
p-Value	0.499	0.018	0.481

^{ab}Means with different superscripts in a column differ significantly ($p<0.05$).

The results of the present investigation on serum biochemical indicators *viz.*, high density lipoprotein (HDL), low density lipoprotein (LDL), glucose, cholesterol and uric acid did not differ between treatment groups (Table 3). In contrary to the present investigation, Min *et al*. (2017) [10] reported that as dietary Thr levels increased the plasma uric acid (UA). However, the present study analysis of serum triglyceride levels and very low density lipoprotein (VLDL) levels revealed a significant difference ($p<0.05$) between treatment groups when digestible threonine was added to commercial broilers.

Table 3: Effect of digestible threonine supplementation on serum biochemical Constituents of male commercial broilers.

Treatment	(mg / dL)						
	Uric acid	Cholesterol	Triglycerides	Glucose	HDL	LDL	VLDL
T_1	5.357	126.8	128.3^{b}	103.3	22.20	78.97	25.66^{b}
T_2	5.506	139.2	146.8^{a}	101.0	22.20	87.64	29.36^{a}
T_3	5.387	136.9	122.4^{b}	103.9	22.92	89.50	24.48^{b}
T_4	5.232	154.2	130.6^{ab}	102.4	22.46	105.61	26.13^{ab}
T_5	5.506	141.0	131.4^{ab}	99.3	22.42	92.34	26.27^{ab}
SEM	0.056	5.179	2.640	1.258	0.159	5.071	0.528
p-Value	0.524	0.596	0.045	0.803	0.620	0.590	0.045

^{ab}Means with different superscripts in a column differ significantly (p<0.05).

Thus, the results of the present investigation showed that incorporating dietary threonine to commercial broiler diets, even at 60% of the digestible Lys Cobb recommendation, had no effect on the growth performance, feed intake, FCR, dressing percentage, breast yield, or weight of abdominal fat. Therefore, by providing digestible threonine at 60% of the digestible Lys Cobb recommendations, the dietary CP level in commercial broiler diets can be lowered to 2, 1, and 2% during the pre-starter, starter, and finisher periods, respectively.

Conclusions

Commercial broilers need to be supplemented with 0.708, 0.630, and 0.570% (60 percent of the digestible lysine) of digestible threonine during the pre-starter, starter and finisher phases respectively, to maximise their productive performance.

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