Original Research

Effect of L-Threonine Supplementation in Diets on Immune Response and Carcass Traits in Broiler Chickens

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Abstract

Three hundred straight-run 'Cobb 400' day-old broiler chicks were randomly distributed into five treatment groups having three replicates containing 20 chicks in each and reared up to 6 weeks of age. The dietary treatment groups were the threonine deficient diet-Negative Control (A), Control diet containing threonine level as per NRC (B), diet containing L- threonine 10% (C), 20% (D), 30% (E) above NRC, (1994) recommendation. At the end of 3rd week, antibody titres against New Castle Disease (ND) were significantly (P<0.05) higher in treatment group C as compared to other treatment groups, whereas, there was non-significant difference in 6th week of age. At the end of 3rd and 6th week of age the Infectious Bursal Disease (IBD) antibody titers were numerically higher in L-threonine supplemented groups but, differences were non-significant among all treatment groups. The edible carcass yield was slightly higher in l-threonine supplemented groups. The abdominal fat percentage in L-threonine supplemented group C at 10% above NRC level was numerically lower than control and other treatment groups. The results of the present trial suggested that the dietary supplementation of L-threonine at 10% above NRC were found to be beneficial in term of improved immune response and carcass traits in broiler chickens.

Key words: Broiler Chickens, Carcass Traits, Diets, Immune Response, L-Threonine

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Introduction

Feed is the major input accounting 70-75% of the cost of broiler production and feed cost is the major constraint but a major mean for manipulating production cost and making poultry enterprise profitable.

Broilers have high dietary CP needs. Dietary protein level, therefore, has major effect on growth performance and overall cost of finished product. Dietary CP level could possibly be reduced if there were adequate of the minimum levels of amino acids needed to support growth and muscle of broilers (Firman and Boling, 1998). An important objective of the least cost formulation of broiler diets is to provide sufficient amounts of most limiting amino acids to support the needs of tissue maintenance and growth (Kidd, 2000). Marginal dietary deficiencies of threonine may result in economic losses from increased feed conversion and reduced breast meat accretion. It is therefore, important to meet the minimum level of threonine in a broiler diet. As threonine has its role in optimal growth, therefore, meeting the threonine requirement in least cost formulation with the supplementation of crystalline L-threonine (L-Thr.) may reduce dietary crude protein, which ultimately can reduce the feed cost (Khan *et al.*, 2006). In poultry nutrition, the essential amino acids are of great concern and of which threonine is the third limiting amino acid after methionine and lysine in diets of broiler chickens (Han *et al.*, 1992). Adequate digestible Threonine levels are needed to support optimum growth (Kidd *et al*., 1999) because it serves as important component of body protein and plays an important role as precursor of lysine and serine (Ojano and Waldroup, 2002). Threonine improves the livability of heat stressed broilers (Kidd, 2000). 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 (Dozier *et al*., 2001). Broilers fed inadequate threonine had decreased live performance but no effects were apparent on carcass fat. Therefore, it is necessary to balance threonine in broiler diet by adding L-Threonine supplementation or use of soybean meal and meat meal as most important ingredients which supply threonine in the chick diets (Rezaeipour and Gazani, 2014). The threonine requirement of broiler chicken at various ages is variable and factors such as dietary crude protein breed, sex, age and main bird forming diet can affect the threonine requirements (Ciftci and Ceylan, 2004). Keeping above facts in view, the present study was conducted to investigate the effect of L-threonine supplementation in diets on immune response and carcass traits in broiler chickens.

Materials and Methods

Experimental Site

The experiment was carried out on 300 day-old Cobb-400 straight run commercial broiler chicks for a period of 42 days (from 7th May, 2016 to 17th June, 2016) at Poultry Research Centre, Department of poultry Science, Post Graduate Institute of Veterinary and Animal Sciences, Akola, Maharashtra Animal and Fishery science University Nagpur (MS), India.

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Experimental Design and Management of Birds

Three hundred straight run 'Cobb 400' day-old broiler chicks were randomly distributed into five treatment groups having three replicates containing 20 chicks in each and reared up to 6 weeks of age. The diets were formulated as per BIS (2007), while threonine level was maintained as per NRC (1994). The dietary treatment groups were the threonine deficient diet-Negative Control (A), Control diet containing threonine level as per NRC (B), diet containing L- threonine 10% (C), 20% (D), 30% (E) above NRC recommendation. All the diets were isocaloric and isonitrogeneous. The experimental design used for housing the broilers is presented in Table 1.

Table 1: Experimental design used for housing of broilers

Treatment groups	Treatment group details	No. of birds/ replicate	No. of replicates /treatment	Number of birds
A	Threonine deficient diet (Negative Control)	20	3	60
B	Diet with threonine level as per NRC (Control)	20	3	60
C	Diet with L-threonine level 10% above NRC	20	3	60
D	Diet with L-threonine level 20% above NRC	20	3	60
E	Diet with L-threonine level 30% above NRC	20	3	60
Total number of birds				**300**

The standard and uniform managemental practices were followed for all treatment groups throughout the experimental period. The birds were offered *ad-lib* fresh and clean drinking water throughout the experiment. The immunization against Ranikhet disease (B1 strain) and Infectious Bursal Disease (IBD Intermediate Strain) vaccination was carried out on 7th and 14th day, respectively, followed by booster doses on 21st day and 28th day through drinking water.

Procurement of Ingredients and Feed Formulation

The good quality feed ingredients were procured from local market for preparation of experimental diets. The L-threonine was supplied by Evonik India Pvt. Ltd. Andheri East, Mumbai, Maharashtra, India. The feeding of broilers was done in three phases as pre-starter (300 g/bird), starter (700 g/bird) and then finisher for all treatment groups. As per the plan of experiment, the composition of broiler feed for pre-starter, starter and finisher have been presented in Table 2.

Data Collection

Two birds from each replicate and a total of six birds from each treatment group were randomly selected for the blood collection at the end of 3rd and 6th week of age. The serum samples were used for Haemagglutination Inhibition (HI) test to detect the antibody titer against New Castle Disease Virus by Beta procedure (Allan *et al.*, 1978). The ND antibody titer @ 8 HAU and specific antibody titer against IBD as quantified by enzyme-linked immunosorbent assay (ELISA). The total six birds from each

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treatment i.e. two birds from each replicate were randomly selected at the end of 6th week of age and slaughtered to study carcass traits.

Table 2: Ingredient (%) and nutrient composition of treatment Groups A (negative control group) and B (control group)

Ingredient (%)	Pre-starter		Starter		Finisher	
	Group A	Group B	Group A	Group B	Group A	Group B
Maize	57.98	57.56	56.36	56.00	59.970	59.200
Soybean meal	18.60	23.90	23.30	29.00	19.380	25.570
Maize gluten meal (60%)	7.00	6.00	3.50	3.00	3.000	2.000
Groundnut Meal	7.00	3.00	5.50	1.00	5.000	1.000
Meat cum bone meal (MBM)	5.00	5.00	4.50	4.00	4.500	3.700
Vegetable oil	1.60	1.80	4.00	4.13	5.200	5.500
Dicalcium phosphate (DCP)	0.70	0.70	0.75	0.85	0.850	1.000
Limestone powder (LSP)	0.80	0.80	0.90	0.90	0.900	0.900
Salt	0.25	0.25	0.25	0.25	0.250	0.250
Trace mineral premix*	0.15	0.15	0.15	0.15	0.150	0.150
Vitamin premix**	0.10	0.10	0.10	0.10	0.100	0.100
DL-Methionine	0.12	0.12	0.15	0.15	0.130	0.130
L-Lysine	0.34	0.26	0.18	0.11	0.120	0.050
Choline chloride	0.06	0.06	0.06	0.06	0.150	0.150
Toxin binder	0.10	0.10	0.10	0.10	0.100	0.100
Coccidiostat	0.05	0.05	0.05	0.05	0.050	0.050
Sodium bicarbonate	0.15	0.15	0.15	0.15	0.150	0.150
Total	100.00	100.00	100.00	100.00	100.00	100.00
Nutrient Composition on dry matter basis						
Metabolizable energy (kcal/kg)	3007.14	3002.93	3102.34	3100.36	3204.70	3203.87
Crude protein (%)	23.02	23.01	22.01	22.05	20.05	20.06
Ether extract (%)	4.69	4.85	6.91	6.97	8.20	8.38
Calcium (%)	1.01	1.03	1.02	1.02	1.03	1.01
Total phosphorus (%)	0.73	0.73	0.70	0.70	0.70	0.69
Available phosphorus (%)	0.47	0.47	0.46	0.45	0.47	0.46
Crude fiber (%)	4.03	3.92	3.99	3.87	3.77	3.70
Total lysine (%)	1.30	1.30	1.20	1.20	1.03	1.04
Total methionine (%)	0.50	0.50	0.50	0.50	0.45	0.45
Total Threonine (%)	0.76	0.80	0.76	0.80	0.69	0.72

*The diets C, D and E were formulated by adding L-threonine at 10, 20 and 30% above NRC (1994) recommendation to control diet group B; *Trace Mineral Mixture: - Each kg contains: Copper-15g, Iodine-2g, Iron-90g, Manganese-100g, Selenium-0.3g and Zinc-80g; ** Vitamin Premix: -Each 500g contains: Vit. A12.50MIU, Vit. D3-2.50 MIU, Vit. E-12g, Vit. K-1.50g, Thiamine (B1)-1.50g, Riboflavin (B2)-5g, Pyridoxine (B6)-2g, Cyanocobalamin (B12)- 0.015g, Niacin-15g, Cal D Pantothenate-10g and Folic acid-0.50g.*

Statistical Analysis

Data was subjected to statistical analysis by using Complete Randomized Design as described by Snedecor and Cochran, (1994).

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Results and Discussion

ND Antibody Titers

The statistical analysis of data pertaining to ND antibody titer and IBD antibody titer at the end of 3rd and 6th weeks of age was presented in Table 4. At the end of 3rd week, antibody titers against ND were significantly (P<0.05) higher in treatment group C as compared to other treatment groups (Table 3).

Table 3: Immune response and carcass traits in broilers fed different levels of L-threonine

Parameters	Treatment Groups					CD
	A (Thr. deficient diet)	B(Control)	C (10% L-thr. above NRC)	D (20% L-thr. above NRC)	E (30% L-thr. above NRC)	
	(Thr. as per NRC)					
ND antibody titer- 3rd week	4.0±1.3^{b}	4.6±0.9^{b}	10.3±2.6^{a}	5.3±0.4^{b}	5.6±1.1^{b}	4.320*
ND antibody titer- 6th week	4.3±0.8	5.3±0.8	5.0±0.8	5.6±1.1	5.0±0.4	NS
IBD antibody titer-3rd week	225.5±152.08	226±88.04	304.8±33.96	282.8±34.42	297.5±74.61	NS
IBD antibody titer-6th week	1886.5±441.04	2136.8±287.36	2324.1±159.41	2287.5±211.50	2156.6±196.91	NS
Edible carcass yield (%)	76.89±0.95	76.61±0.62	75.39±0.49	76.80±0.28	77.03±0.58	-
Abdominal fat (%)	1.70±0.10	1.47±0.06	1.21±0.15	1.26±0.15	1.36±0.10	-

*Means bearing similar superscript within a row do not differ significantly from each other. * P<0.05, NS - Non-Significant, CD – Critical Difference.*

Table 4: Analysis of variance for immune response in broilers fed different levels of L-threonine

Source	DF	ND antibody titer- 3rd week			ND antibody titer- 6th week		
		SS	MSS	F ratio	SS	MSS	F ratio
Treatments	4	182.666	45.666	3.455*	25.866	6.466	1.565
Error	25	330	13.2	-	103.333	4.133	-
Total	29	-	-	-	-	-	-
	IBD antibody titer-3rd week				IBD antibody titer-6th week		
Treatments	4	757159.533	189289.883	4.061	1745374.133	436343.53	0.943
Error	25	1163535.833	46541.433	-	11588420.67	463536.83	-
Total	29	-	-	-	-	-	-

DF- Degrees of freedom, SS- Sum of squares, MSS- Mean sum of squares

The L-threonine supplemented groups C, D and E above NRC levels were numerically higher ND antibody titers as compared to control group B and threonine deficient group A, but the difference was non-significant in all treatment groups. At the end of 6th week of age the data revealed that ND antibody titers were non-significant in all treatment groups, whereas, ND antibody titers were improved in L-threonine supplemented groups and control group as compared to threonine deficient group. The results are in agreement with Abbasi *et al*. (2014) who reported that supplementation of dietary L-threonine upto 110% in Ross strain improved antibody titers. Similarly, Maroufyan *et al*. (2010) observed that ND antibody titers of broilers receiving the highest level of methionine and threonine were significantly higher than that of other treatment groups.

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IBD Antibody Titers

At the end of 3rd and 6th weeks of age the IBD antibody titers were non-significantly higher in treatment group C (Table 3). L-threonine supplemented groups showed numerically higher IBD antibody titres as compared to control group B and threonine deficient group A. These finding are in agreement with Mehdi *et al*. (2013) reported that the threonine supplementation has great effect on antibody titers against IBD., the broilers receiving threonine levels of higher than NRC recommendations have a numerically higher IBD antibody titer than those received lower level of threonine. The best level of threonine was 0.81% which supported immune function. In contrast, Maroufyan *et al*. (2010) reported that IBD antibody titers of broilers receiving highest level of methionine and threonine were significantly higher than that of other treatment groups.

Carcass Traits

The edible carcass yield was slightly higher in threonine supplemented groups (Table 3). The present findings are in accordance with Corzo *et al*. (2003) reported carcass as well as breast meat improved in linear manner with increasing dietary threonine. However, Mazraeh *et al*. (2013) also reported that positive beneficial effect of L-threonine on development of carcass of broiler chicken. Similarly Dozier *et al*. (2000) also reported that increasing dietary threonine did not alter carcass yield.

It was observed that the abdominal fat percentage in L-threonine supplemented group C at 10% above NRC level was numerically lower than control and other treatment groups. The present finding is in comparable with Estalkhzir *et al.* (2013) reported that the highest percentage of abdominal fat related to 115% treatment and the lowest its percentage is related to threonine 105% treatment. Similarly, Nadeem *et al*. (2004) reported that abdominal fat was significantly affected by higher concentration of threonine.

Conclusion

The results of the present experiment suggested that the dietary supplementation of L-threonine at 10% above NRC were found to be beneficial in terms of improved immune response and carcass traits in broiler chickens.

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