

*Original Research***Effect of Elevated Dietary Amino Acid Levels in Corn-Soya Diet on Growth Performance and Carcass Characteristics of Commercial Broilers**Jyoti M. Mali, A. K. Srivastava^{1*}, M. M. Pawar, H. D. Chauhan and A. K. Jain

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Abstract

This study was conducted to determine the effect of elevated dietary amino acid levels in corn-soya diets on growth performance and carcass characteristics of commercial broilers. A total 200 broiler chicks (Cobb 400) were randomly assigned to four treatments: viz. T₁ (control) was fed with standard diet as per BIS (1992) and the groups T₂, T₃ and T₄ were fed with standard diet + 5, 10 and 20 % additional amino acids (DL-methionine, L-lysine and L-threonine) than BIS (1992) recommendation, respectively. The birds fed diet with 10% additional amino acids (T₃) had higher (P<0.05) final body weight and overall gain in body weight than the control diet (T₁) and 20% additional amino acids supplemented diet (T₄), while comparable to the 5% additional amino acids supplemented group (T₂). The feed intake was higher (P<0.05) in T₃ group followed by T₁ and T₂ groups and lower in T₄ group. The dressing percentage, weights of heart, spleen and gizzard were not affected by the additional supplementation of amino acids. However, liver weight was significantly higher in groups supplemented with 10 and 20% additional amino acids in broiler ration. Return over feed cost (Rs. / bird) was higher in T₂ (48.81) and T₃ (47.33) groups than T₁ (43.32) and T₄ (42.79) groups. It was concluded that 10% additional supplementation of amino acids (DL-methionine, L-lysine and L-threonine) to corn-soya diet resulted in improved final body weight, feed intake and return over feed cost in commercial broilers.

Key words: Broiler, Carcass Characteristics, Growth, Lysine, Methionine, Threonine

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Introduction

Feed represents about 65-70% of the total cost of broiler production. Protein is considered as one of the major cost components in commercial poultry feed. Protein is an essential constituent of all tissues of animal body and has major effect on growth performance of the bird (Kamran *et al.*, 2004). Feeding high amino

acid density diets improves feed conversion and increases weight gain and breast meat yield of broiler chickens (Kidd *et al.*, 2004). Methionine is usually the first limiting amino acid in most of the practical diets for broiler chickens followed by lysine and threonine. Rising prices of maize grains and soybean meal in recent years have resulted in increased feed costs for poultry feeds which form a major concern in the industry. These constraints inhibit the birds to utilize the feeds more efficiently and deprive them from getting full nutritional benefits which result in poor performances. The economic viability of poultry production is dependent upon sourcing high quality feed ingredients, having knowledge of their amino acid composition, and formulating a diet that supports the birds maintenance and productive functions (Kidd and Tillman, 2016). Additionally, economic production, desirable carcass characteristics and composition and protection of the environment through decreased nitrogen excretion are current consideration in poultry production. Many poultry nutritionist have tried synthetic amino acids in broiler ration and found that dietary amino acids are required by birds to achieve optimum performance measured in terms of growth, feed conversion ratio and carcass quality. Most of the research findings revealed that actual requirement of critical amino acids are more than NRC (1994) and BIS (1992; 2007) specifications. Therefore, supplementation of limiting amino acids viz., methionine, lysine and threonine in corn-soya based diet is required to support optimal growth performance and to ensure maximum economic return. Looking to the benefits of amino acids supplementation in broiler diets, the present experiment was designed to evaluate the effect of elevated dietary supplementation of amino acids (DL-methionine, L-lysine and L-threonine) in corn-soya based diet on growth performance and carcass characteristics of commercial broilers.

Materials and Methods

The present study was conducted at Sub-department of Avian Production and Management of Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar which is located in semi-arid region of Banaskantha District of North Gujarat having latitude of 24.35° North and longitude of 72.59° East. The mean temperature (°C) during experimental period were ranged between 12.3 (Min.) and 35.5 (Max.) and the relative humidity (%) ranged between 28 (Min.) and 89 (Max.). The present experiment was carried out after approval for use of chicks and experimental procedures by Institutional Animal Ethics Committee. A total 200 broiler chicks (Cobb 400) purchased from a local hatchery were weighed and randomly assigned to four treatments with five replicates of 10 chicks based on a completely randomized design. The group T₁ (control) was fed with standard diet as per BIS (1992). The groups T₂, T₃ and T₄ were fed with standard diet + 5, 10 and 20 % additional amino acids (DL-methionine, L-lysine and L-threonine) than BIS (1992) recommendation, respectively. The ingredients and chemical composition of basal diets are presented in Table 1. The chemical composition of starter and finisher diets were determined as per the

procedures of AOAC (1995). Broilers were raised in deep-litter housing system. Feed and water were provided *ad libitum* throughout the experiment. Chicks were individually weighed at weekly intervals. Feed consumption and feed conversion ratio (FCR=feed intake/weight gain) were calculated at weekly intervals. Mortality was recorded daily.

Table 1: Ingredients and chemical composition of basal diet

Ingredients (%)	Starter Diet	Finisher Diet	Chemical Composition (%)	Starter Diet	Finisher Diet
Yellow Maize	53.9	54.08	Crude protein	23.02	20.21
De-oiled Rice Bran	1.15	9.15	Ether extract	3.81	4.47
Soybean (DOC)	39.76	30.5	Crude fiber	4.62	5.96
Di-calcium phosphate	2	1.39	Total ash	2.89	3.47
Shell Grit	2.2	1.7	Calcium	0.87	0.68
Salt	0.3	0.3	Phosphorus	0.56	0.47
Trace Minerals	0.1	0.1	Lysine*	1.27	1.05
BVzyme	0.05	0.05	Methionine*	0.43	0.38
Neftin	0.03	0.05	Threonine*	0.89	0.76
Lipocare	0.1	0.1	ME (kcal/kg)*	2880.47	3007.05
Toxin binder	0.1	0.1	*calculated values as fed basis		
Madhuramicine	0.05	0.05			
Zigbir	0.03	0.03			
Merivet 100	0.01	0.02			
Vegetable oil	-	2.19			
Groblend	0.24	0.2			

At the end of experimental feeding, two birds from each replicate were randomly selected, starved over night with the provision for *ad libitum* water and sacrificed by cervical dislocation. The dressing percentage was calculated as the per cent of the carcass weight to the body weight after removing the feathers, neck, legs and internal viscera. Weights of different organs *viz.*, heart, liver, gizzard and spleen were recorded. The economics of broiler production in different treatment groups was calculated based on current market price of various particulars. The data were analyzed as per Snedecor and Cochran (1994). The significant differences among the tested means were tested with Duncan's Multiple Range Test (DMRT) and significance was declared at $P < 0.05$.

Result and Discussion

The data on growth performance, feed intake and feed conversion ratio are presented in Table 2. The birds fed diet with 10% additional amino acids mixture of methionine, lysine and threonine (T₃) had higher ($P < 0.05$) final body weight and overall gain in body weight as compared to control diet (T₁) and 20% additional amino acids supplemented diet (T₄), while comparable to diet fed with 5% additional amino

acids supplementation (T₂). Significantly improved body weight in additional (10%) amino acids supplemented group is a clear reflection of significantly higher feed intake of all limiting amino acids, better utilization and efficiency. Moreover, limiting amino acids (methionine, lysine and threonine) are components of muscle protein and their sufficiency in diet might have improved body weight gain in broilers.

Table 2: Effect of dietary supplementation of additional amino acids on the growth performance of broiler chicken (n=200)

Attributes	Treatments				SEM	Significance
	T ₁	T ₂	T ₃	T ₄		
Initial body weight (g)	102.5	103.3	107.4	105.4	2.203	NS
Final body weight (g)	2156.22 ^a	2244.83 ^{ab}	2324.79 ^b	2120.04 ^a	5.767	*
Body weight gain (g)	2053.72 ^a	2141.53 ^{ab}	2217.39 ^b	2014.64 ^a	5.613	*
Feed intake (g)	3898.12 ^{ab}	3903.01 ^{ab}	4146.97 ^b	3766.19 ^a	17.74	*
Feed conversion ratio	1.9	1.82	1.87	1.87	0.037	NS
Mortality (%)	4	6	6	8	-	-

^{abc}Means bearing different superscripts in a row differ significantly (* $P < 0.05$; NS: Not-significant); T₁: Control (standard diet as per BIS, 1992); T₂; T₃ and T₄: Control diet + 5, 10 and 20 % additional amino acids (DL-methionine, L-lysine and L-threonine) than BIS recommendation, respectively.

In line with our findings, Weurding *et al.* (2003) and Toghyani *et al.* (2017) also observed improved body weight gain in broilers on the diet when the levels of essential amino acids were increased. The findings of the present investigation were in agreement with that of Igbasan and Olugosi (2013) who reported that body weights of broilers were significantly increased with the supplementation of amino acids at the rate of 5, 10 and 15% in broiler ration. Similar results were also observed by Nasr *et al.* (2011) in broiler diet supplemented with additional level of lysine (120 % of NRC requirement). The feed intake was higher ($P < 0.05$) in T₃ group followed by T₁ and T₂ groups and lower in T₄ group. The 20% additional amino acids supplementation in the diet of broilers reduced feed intake. Generally, higher supplementation of essential amino acids beyond the requirement causes a depression in feed intake and consequently growth rate (Toghyani *et al.*, 2017). In contrast, some researchers (Darsi *et al.*, 2012; Malomo *et al.*, 2013; Basavanta Kumar *et al.*, 2016) had reported non-significant pattern in feed intakes of broilers supplemented with elevated levels of amino acids in diet. Although, final body weights were improved in 5 and 10% extra amino acids supplemented groups, the feed intake was also higher in these two groups and thus, the feed conversion ratio was similar to that of control group. The similar results were reported by Abudabos and Aljumaah (2012), Igbasan and Olugosi (2013) and Malomo *et al.* (2013) in broilers fed with extra amino acids over the NRC requirements.

The dressing percentage, organ indices (as percentage of live body weight) of heart, spleen and gizzard were not affected by the additional supplementation of amino acids (Table 3). In line with our findings,

other workers (Ngambi *et al.*, 2009; Shashipal *et al.*, 2010; Khan *et al.*, 2011; Kumari *et al.*, 2012) also reported non-significant effect on dressing percentage of broilers fed elevated levels of amino acids.

Table 3: Effect of dietary supplementation of additional amino acids on carcass characteristics of broiler chickens

Attributes (As Percentage of Live Weight)	Treatments				SEM	Significance
	T ₁	T ₂	T ₃	T ₄		
Dressing (%)	75.22	75.95	76.39	75.1	0.25	NS
Heart (%) [†]	0.44	0.4	0.47	0.46	0.013	NS
Spleen (%) [†]	0.15	0.2	0.17	0.12	0.014	NS
Gizzard (%) [†]	1.49	1.45	1.53	1.58	0.062	NS
Liver (%) [†]	2.11 ^a	2.10 ^a	2.39 ^b	2.45 ^b	0.075	*

[†]expressed as percentage of live body weight; T₁: Control (standard diet as per BIS, 1992); T₂; T₃ and T₄: Control diet + 5, 10 and 20 % additional amino acids (DL-methionine, L-lysine and L-threonine) than BIS recommendation, respectively.

However, liver weight was significantly higher in groups supplemented with 10 and 20% additional amino acids in broiler ration (Table 3). This could be due to the extra load of protein digestion, metabolism and absorption on hepatic system of birds. The present finding on liver index was in agreement with that of Kumari *et al.* (2012) who also observed increased liver weight in broilers supplemented with methiorea and DL-methionine at 1 kg/ton of feed and DL-methionine at 2 kg/ton than the control diet. The organ index of liver was significantly ($P < 0.05$) increased when extra supplementation of lysine (120% NRC) was made (Nasr and Kheiri, 2011). The data on effect of dietary supplementation of additional amino acids on economics of broiler chickens production is given in Table 4.

Table 4: Effect of dietary supplementation of additional synthetic amino acids on economics of broiler chickens production

Particulars	Treatments			
	T ₁	T ₂	T ₃	T ₄
No. of chicks at start	50	50	50	50
Cost of day old chicks (Rs. 25/chick)	1250	1250	1250	1250
No. of birds died	2	3	3	4
No. of birds at end of experiment	48	47	47	46
Avg. live wt. at end of experiment (kg/bird)	2.1562	2.2448	2.3248	2.12
Total live wt. (kg)	103.5	105.51	109.27	97.52
Income through sale of birds (Rs. 68/kg)	7037.9	7174.5	7430	6631.5
Avg. feed consumed (kg/bird)	3.898	3.903	4.147	3.766
Total feed consumed (kg)	187.11	183.44	194.91	173.25
Cost of feed (Rs. 26.5/kg)	4958.41	4861.2	5165.05	4590.99
Cost of supplement (Rs.)	0	19.12	40.52	72.01
Total cost of feeding (Rs.)	4958.41	4880.32	5205.57	4663
Feed cost/kg live wt. production (Rs.)	47.91	46.26	47.64	47.81
Return over feed cost (Rs./bird)	43.32	48.81	47.33	42.79

T₁: Control (standard diet as per BIS, 1992); T₂; T₃ and T₄: Control diet + 5, 10 and 20 % additional synthetic amino acids (DL-methionine, L-lysine and L-threonine) than BIS recommendation, respectively.

The income through sale of birds was the highest in T₃ (Rs. 7430.0) group as compared to T₁ (Rs. 7037.9) and T₂ (Rs. 7174.5) groups and the lowest in T₄ (Rs. 6631.5) group. The total cost of feeding was Rs. 4958.41, 4880.32, 5205.57 and 4663.00 in T₁, T₂, T₃ and T₄ groups, respectively. Return over feed cost (Rs. / bird) was higher in groups T₂ (48.81) and T₃ (47.33) than T₁ (43.32) and T₄ (42.79) groups. The increased economic returns in 5 and 10% extra amino acids supplemented groups could be attributed to their improved body weights. Similar to present finding, Dhumal *et al.* (2017) and Kumari *et al.* (2017) also reported that supplementation of additional amino acids in the ration of broilers lead to higher economic returns.

Conclusion

From the results of this study, it was concluded that 10% additional supplementation of amino acids (DL-methionine, L-lysine and L-threonine) than the BIS (1992) in corn-soya diet resulted in improved final body weight, feed intake and return over feed cost in commercial broilers.

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