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Effect of Supplementation of Synthetic Lysine and Methionine on Serum Biochemical Profile, Carcass Characteristics and Meat Composition in Broiler Chicken

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ABSTRACT

A total of 144 day old broiler chicks of Vencobb strain 400 randomly distributed into four groups (3 replicates of 12 chicks) using randomized block design *viz.* T_0 - basal diet (control), T_1, T_2 and T_3 were offered the basal diet supplemented with synthetic L-lysine at 20, 30 and 40% and DL-methionine at 30, 40 and 50% in excess of the total BIS (2007) recommendations upto 42 days of age. Non-significant effect of supplementation of synthetic lysine and methionine were observed on feed intake. However, total gain in body weight and FCR were significantly ($P<0.01$) influenced by supplementation. Significant increase ($P<0.001$) in serum total protein was observed in the birds of T_2 group whereas serum cholesterol and triglyceride level decreased ($P<0.01$) with increased level of synthetic amino acids. Statistically non-significant effect of supplementation was observed on dressing percentage, yield of prime cuts, percent weight of visceral organs and chemical composition of meat except that the abdominal fat pad was lower in groups T_2 and T_3. The study revealed that supplementation of 30% synthetic L-lysine and 40% DL-methionine higher than BIS (2007) recommendation in broiler rations reduced serum cholesterol and triglyceride levels.

Key words: Blood biochemical parameters, Broiler chicken, Carcass characterstics, DL-methionine, L-lysine

INTRODUCTION

India is the 5th largest producer of poultry meat in the world producing about 2.337 million tonnes of chicken meat annually (Prabakaran, 2012). Broiler farming is fast growing and profitable meat industry in the country. It can supply readily available source of animal protein to fight against protein malnutrition in Indian population. The major objective of commercial broiler farming is to produce protein rich and fat free meat for the consumers. The change in market scenario and consumer preference have forced the producers to produce high quality carcass with low price by using different feed additives.

Lysine is essential for mobilization of fatty acid into the mitochondria and also helps in enhancing growth performance, breast meat yield, carcass protein retention and reduces fat deposition. Lysine has also been shown to exhibit specific effects on carcass composition and breast meat yield (Schutte and Pack, 1995). Increasing lysine over and above of NRC (1994) recommendations improved weight gain, feed efficiency and breast meat yield (Si *et al.,* 2004) and reduced deposition of extra fat in the carcass (Moran and Bilgili, 1990). The blood biochemical profile may monitor the quality of nutrition and health of birds (Etim *et al.,* 2014). Blood glucose, cholesterol, triglyceride and total protein level indicate changes in carbohydrate, fat and protein metabolism in the body affecting growth, meat production and quality of meat. Lysine and methionine in excess of NRC (1994) recommendations improved plasma triglyceride and cholesterol and also enhanced economical performance (Bouyeh, 2013). Therefore, the present study was conducted to evaluate the effect of synthetic L-lysine and DL-methionine on blood biochemical profile and carcass characterstics of the commercial broiler chicken.

MATERIALS AND METHODS

The experiment was conducted in the experimental poultry shed, Department of Animal Nutrition, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam. A total of 144 day old broiler chicks (Vencobb strain 400) randomly distributed into 4 groups (3 replicates of 12 chicks)

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using randomization block design *viz.* T_0-basal diet (control), T_1, T_2 and T_3 were offered the basal diet supplemented with synthetic L- lysine at 20, 30 and 40% and DL- methionine at 30, 40 and 50% in excess of the total BIS (2007) recommendation. The basal diet was prepared as per BIS (2007) without supplementation of L-lysine and DL-methionine (Table 1). DL-methionine (MetAMINO®) and L- lysine (Biolys®) were procured from Evonik India, Mumbai.

All the chicks were reared in deep litter system under similar environmental conditions (temperature 20-27°C and humidity 78-88%) and had access to *ad lib.* feed and water during entire experimental period. The chicks were offered *ad lib.* pre starter ration containing 23% crude protein and 3000 kcal ME per kg (BIS, 2007) for the first 7 days of age. The experimental diets were offered *ad lib.* to the starter and finisher chicken. The chicks were vaccinated against Ranikhet disease with Lasota strain (F1) and Infectious Bursal Disease (IBD) vaccine on 7th and 14th of age, respectively. Daily feed offered and residue left was weighed and recorded to monitor daily feed intake. The body weight of the individual birds was recorded weekly in the morning prior to feeding during the entire experimental period of 42 days to calculate average body weight change, gain in weight and feed conversion ratio (FCR).

At the end of the experiment, six birds from each group were selected for collection of blood sample from the wing vein. The blood samples were brought to the laboratory without disturbing the clots and centrifuged at 3000 rpm for 15 min. to collect serum and stored at -20°C till further analysis. After thawing, serum samples were analyzed for concentration of glucose, total protein, cholesterol, triglyceride and alanine amino transferase (ALT) by spectrometric method (dual beam UV-Spectrometer) using commercial kits (Coral Clinical System, Uttrakhand, India).

Table 1. Ingredient (%) and nutrient composition (% DM basis) of the basal diet

Attribute	Starter	Finisher
Ingredient composition		
Maize	51	54.3
De-oiled rice polish	5.5	7.2
De-oiled ground nut cake	15	10
Soybean meal	23.5	22.5
Vegetable oil	3	4
Mineral mixture	1.5	1.5
Common salt	0.5	0.5
Nutrient composition on DM basis		
Dry matter	92.23	92.09
Crude protein	22.08	20.01
Crude fibre	5.78	5.10
Ether extract	4.20	4.30
NFE	54.79	57.59
Total ash	13.15	13.00
*ME (Kcal/kg)	3130	3202
*Lysine	1.20	1.00
*Methionine	0.50	0.45

*Calculated values (Vitamin premix (Vitablend vit A, B_2, D_3, K) was added @ 20 g per quintal of diet in both starter and finisher diet. Mineral mixture contained calcium 25%, Phosphorus 5%, Sodium chloride 23%, Iodine 10 ppm, Copper 100 ppm, Manganese 2000 ppm and Cobalt 10 ppm.

Birds were slaughtered for the carcass parameters and composition of meat at the end of the experimental trial. The birds were fasted overnight and pre-slaughter weights were recorded. The dressed weight of each group was obtained separately after complete bleeding and removal of feathers, viscera, head and legs by keeping the skin intact with the carcass and calculated as percent of pre-slaughter weight. The neck, wing, back, drumstick, thigh and breast meat were weighed seperately and divided by pre-slaughter weight to determine relative weight and expressed as percentage. Fat around the abdominal wall was removed and weighed and calculated as percentage pre-slaughter weight.

The edible visceral organs (heart, liver and gizzard) and lymphoid organs were weighed individually after separating from viscera. The total weight of small intestine along with caecal content was taken and calculated as percent of pre-slaughter weight. The representative meat samples (100 g) were collected from breast and thigh portion after slaughter of the birds. Samples were mixed together and thoroughly chopped with the help of chopper and kept at -20°C for further analysis. The proximate constituents of diets and meat were analysed (AOAC, 2005). Data were analyzed by using IBM-SPSS version 20. One way ANOVA was used for comparison of means according to Duncans multiple range test at 5% level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

Gain in weight (g/bird) showed significant ($P<0.001$) effect due to supplementation of synthetic L- lysine and DL-methionine in the diet (Table 2). The present findings are in accordance with the report of Kalbande *et al.* (2009) in broilers fed on different levels of synthetic methionine supplemented diets. It might be due to the effect of balance of both lysine and methionine and their combined effect in improving feed and nutrient utilization and more availability of lysine and methionine for protein synthesis. However, the feed intake was similar in different groups. Contrary to the present findings, Pillai *et al.* (2006) reported higher ($P<0.05$) feed intake with addition of high level of methionine in the broiler ration. Significant difference ($P<0.001$) was observed in FCR due to supplementation, which might be due to better effect of lysine and methionine in nutrient utilization resulting in higher body weight gain. Similar pattern was reported by Osti and Pandey (2004).

Blood glucose level of broilers in different groups varied from 180.9 to 182.2 mg/dL (Table 3) and the values were similar in all groups. The blood glucose values were comparable to the findings of Sonowal (2008) in broiler chicken. The serum protein values in different groups varied from 4.30 to 6.11 g/dL. Significantly ($P<0.001$) higher serum total protein values were obtained in the higher supplementation groups as compared to control (T_0) and T_1 groups. However, the highest value was found in group T_2 where 30 and 40% synthetic L-lysine and DL-methionine were supplemented. Similar trend of serum protein values of broiler chicken were reported by Hosseintabar *et al.*

Table 2. Effect of dietary supplementation of synthetic L-lysine and DL-methionine on growth performance of commercial broiler chicken

Parameter	Group				SEM	P value
	T_0	T_1	T_2	T_3		
Total gain in weight (g/bird)	1713.15^{a}±23.90	1799.96^{b}±26.80	1923.35^{c}±27.00	1882.60^{c}±23.50	14.20	<0.001
Total feed intake (g/bird)	3291±21.00	3214±25.10	3353±37.80	3408±14.10	73.17	0.881
Overall FCR	1.92^{b}±0.05	1.79^{b}±0.03	1.75^{a}±0.01	1.81^{b}±0.11	0.13	0.042

^{abc}Mean values with different superscripts within row differ significantly

Table 3. Effect of dietary supplementation of synthetic L-lysine and DL-methionine on blood biochemical profile of commercial broiler chicken

Parameter	Group				SEM	P value
	T_0	T_1	T_2	T_3		
Glucose (mg/dL)	181.10±10.60	182.20±15.10	181.90±16.00	180.90±14.60	6.37	1.000
Protein (g/dL)	4.30^{a}±0.45	5.02^{ab}±0.76	6.11^{c}±0.88	5.52^{bc}±0.12	0.20	0.001
Cholesterol (mg/dL)	166.50^{c}±2.83	150.50^{b}±4.78	112.30^{a}±2.26	107.50^{a}±1.43	6.59	<0.001
Triglycerides (mg/dL)	102.00^{c}±3.05	83.00^{b}±2.37	55.86^{a}±2.28	52.74^{a}±2.69	5.37	<0.001
ALT (U/mL)	26.79±0.69	25.86±0.49	25.17±0.36	25.15±0.34	0.28	0.105

[a,b,c]Mean values with different superscripts within a row differ significantly (P<0.001)

(2015) when broilers were supplemented with lysine and methionine in excess of NRC (1994) recommendation. The higher values of serum protein in T_2 and T_3 group might be attributed to higher metabolizability of crude protein with higher nitrogen retention due to proper balance of amino acids in diet leading to increased absorption of amino acid into the blood.

The values of serum cholesterol decreased (P<0.001) with increased level of supplementation. The values were lower in groups T_2 and T_3 compared to groups T_0 and T_1 which might be attributed to the hypocholesterolemic activity of methionine. The findings of current experiment corroborated with those of Kalbande *et al.* (2009). Serum triglycerides levels were influenced (P<0.001) by supplementation of synthetic amino acids. Lower values were observed in groups given high level of supplementation (T_2 and T_3 group) as compared to the unsupplemented group (T_0) and low supplemented group (T_1). The lower level of serum triglyceride in supplemented group might be attributed to the lipolytic action of both lysine and metionine since higher concentration of lysine and methionine stimulate pancrease for secretion of insulin into blood. Insulin in poultry can exert glucagon effect on release of fatty acids and amino acids from body store and leading to protein synthesis lowering triglyceride levels (Sturkie, 1986). Similar finding were reported by Bouyeh and Gevorgytan (2011) when basal diet was supplemented with Lys and Met (as TSAA) in 0, 10, 20, 30 or 40% more than NRC (1994) recommendations. The serum ALT activity was found to be similar in all the groups. These findings were in

Table 4. Effect of dietary supplementation of synthetic L-lysine and DL-methionine on dressing percentage and prime cuts of commercial broiler chicken

Parameter	Group				SEM	P value
	T_0	T_1	T_2	T_3		
Slaughter wt. (g)	1774^{a}±57.8	1874^{ab}±61.2	2079^{b}±43.6	1944^{ab}±87.4	40.6	0.036
Dressed wt. (g)	1244^{a}±40.1	1348^{a}±69.4	1558^{b}±38.9	1420^{ab}±43.1	31.9	0.028
Dressing percentage	70.12±0.88	71.95±1.40	74.95±0.50	73.19±1.31	0.568	0.271
Prime cuts						
Neck	6.17±0.25	6.12±0.47	6.19±0.27	6.27±0.08	0.14	0.989
Wing	10.56±0.52	10.73±0.96	10.04±0.38	10.62±0.25	0.27	0.846
Back	17.43±0.49	17.57±1.09	17.64±1.09	15.91±1.67	0.55	0.690
Breast	32.74±1.34	32.61±1.12	35.20±0.67	35.38±0.43	0.55	0.110
Thigh	13.97±1.19	13.97±0.82	14.71±0.46	15.77±0.37	0.40	0.354
Drumstick	12.63±0.61	13.18±0.91	13.53±0.38	12.83±0.27	0.28	0.723

[a,b,c]Mean values with different superscripts within a row differ significantly (P<0.05)

accordance with those of Kalbande *et al.* (2009) and Halder and Roy (2007).

Dressing percentage was similar in all the groups (Table 4). Bouyeh (2013) observed dressing percentage of 71-78 in broilers fed with the rations supplemented with lysine and methionine @ 1.1, 1.2, 1.3 and 1.4 times in excess of NRC (1994) recommendations. Similar dressing percentage were reported in broiler chicken due to feeding of excess lysine and methionine (Tang *et al.,*2007; Ahmed and Abbas, 2015). Highest dressing percentage in group T_2 might be due to proper balance of amino acids in diet leading to more protein synthesis and deposition in body causing muscle development especially in breast muscle. Si *et al.* (2004) showed that increasing lysine over and above NRC (1994) recommendation improved weight gain, feed efficiency and breast muscle yield in broilers.

Percent yield of different prime cuts was similar in all groups (Table 4). While Hesabi *et al.* (2006) and Bouyeh (2013) reported that breast muscle yield, thigh and leg percentage was significantly higher with increased level of methionine and lysine in excess of NRC (1994) recommendations. The relative percent weight of visceral organs except that of abdominal fat did not differ significantly among the groups (Table 5). Onu *et al.* (2010) also reported similar results on supplementation of different levels of synthetic lysine and methionine in excess of NRC (1994) recommendations in the ration of broiler chicken. The mean relative percent weight of abdominal fat was lower ($P<0.01$) in groups T_2 and T_3 compared to groups T_1 and T_0. Similarly, Melaku *et al.* (2014) also obtained lower abdominal fat in broilers by feeding of rations supplemented with different levels of lysine. Lower percentage of abdominal fat in groups T_2 and T_3 indicated that high level of lysine and methionine reduced fat accumulation which might be due to the effect of lysine and methionine as precursor of L-carnitine and augment its supply for use in metabolism thereby facilitating fatty acid oxidation and

Table 5. Effect of dietary supplementation of synthetic L-lysine and DL-methionine on visceral and lymphoid organs of commercial broiler chicken

Attribute	Group				SEM	P value
	T_0	T_1	T_2	T_3		
Visceral organ weight						
Liver	3.63±0.02	3.61±0.03	3.59±0.03	3.64±0.02	0.01	0.410
Heart	0.59±0.03	0.53±0.03	0.57±0.02	0.55±0.03	0.01	0.400
Gizzard	3.29±0.15	3.28±0.12	3.29±0.10	3.27±0.12	0.06	0.999
Intestine	4.79±0.16	4.80±0.49	4.62±0.29	4.90±0.38	0.16	0.950
Kidney	0.26±0.05	0.24±0.04	0.28±0.06	0.26±0.04	0.02	0.970
Abdominal fat	1.32^{c}±0.05	1.14^{b}±0.06	0.71^{a}±0.02	0.66^{a}±0.02	0.08	<0.01
Lymphoid organ weight						
Spleen	0.14±0.02	0.13±0.01	0.15±0.02	0.13±0.03	0.01	0.898
Thymus	0.39±0.03	0.37±0.03	0.38±0.04	0.36±0.06	0.02	0.938
Bursa	0.07±0.00	0.07±0.00	0.07±0.00	0.07±0.00	0.01	0.174
Percent chemical composition of meat (DM basis)						
Moisture	74.33±0.20	74.23±0.93	74.14±1.99	74.30±0.90	0.45	0.999
Crude protein	18.16±0.95	18.19±0.60	18.90±1.38	18.26±1.06	0.39	0.940
Ether extract	6.52±0.09	6.46±0.48	6.03±0.07	6.32±0.92	0.21	0.908
Total ash	0.74±0.06	0.70±0.12	0.72±0.07	0.74±0.02	0.03	0.977

[a,b,c]Mean values with different superscripts within a row differ significantly ($P<0.01$)

reducing the amount of long chain fatty acids available for storage of fat as abdominal fat pad. Relative percent yield of lymphoid organs (spleen, bursa and thymus) was similar in different groups. The relative percent yields of spleen, thymus and bursa of fabricius observed in the present experiment were similar to the finding of Cengiz *et al.* (2008) in broiler chicken fed rations in excess of lysine and methionine of NRC requirements. Other workers (Konashi *et al.,* 2000; Kidd and Fancher, 2001) reported non-significant effect of dietary amino acid concentration on immune organs.

The moisture, crude protein, ether extract and total ash contents in breast and thigh muscle were similar in different groups (Table 5). However, higher protein (18.90±1.38%) and lower fat (6.03±0.07%) content was observed in group T_2 where ration was supplemented with 30% lysine and 40% methionine in excess of BIS (2007) recommendations which might be due to proper ratio of essential and non-essential amino acids in the diet. Bedford and Summers (1985) also observed that the increase in the ratio of essential and non-essential amino acids in broiler diet increased the carcass protein with decrease in carcass fat. Reduction in the amount of fat in the carcass might be due to higher level of lysine in diet which increased energy expenditure for protein deposition and maintained greater muscle mass providing a lower amount of energy for fat deposition (Lesson, 1995).

CONCLUSION

Dietary supplementation of synthetic L-lysine and DL-methionine @ 30 and 40% higher than BIS (2007) reduced the accumulation of abdominal fat pad and decreased serum cholesterol and triglycerides level in the commercial broilers, however, further studies are required to ascertain the findings of the present study.

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