

Effect of Dietary DL-Methionine Supplementation on Growth Performance, Serum Biochemical Indices, and Carcass Characteristics of Broiler Chicken

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Abstract

An experiment was conducted to evaluate the effect of dietary supplementation of DL-methionine (DLM) on growth performance, serum biochemical indices, and carcass characteristics of broiler chickens. One hundred and twenty (120) day-old, commercial run broiler chicks were randomly distributed into 4 groups with 6 replicates of 5 chicks in each replicate. A basal diet was prepared to meet the nutrient requirements of broilers during different phases of life (Pre-starter, 0-14 d; Starter, 15-28 d; Finisher, 29-42 d) except DLM (0.4%), which served as a control. Subsequently, three experimental diets were formulated to contain DLM at 0.45, 0.50, and 0.55%. Each diet was fed at random to 6 replicates of 5 chicks each throughout the experimental period of 6 weeks. The birds were maintained in a deep litter system of housing with standard managerial practices. The body weight gains increased, and the feed conversion ratio improved significantly ($P < 0.05$) by increasing the level of DLM from 0.40 to 0.45% in the diet. No further advantage on BWG or FCR could be observed by further increasing the dietary levels of DLM to 0.50 or 0.55%. The BWG and FCR of broilers during 4-6 weeks and 0-6 weeks were not influenced due to the levels of dietary DLM in the present study. The serum concentrations of calcium, phosphorus, uric acid, triglycerides, and cholesterol were not influenced by the levels of dietary DLM. However, the concentration of protein in the serum increased by increasing the level of DLM increased from 0.40 to 0.45%. The levels of dietary DLM (0.40-0.55%) did not influence dressed yield, liver, heart, gizzard, giblet, and abdominal fat content of broiler chickens. From the findings of the present study, it is concluded that a 0.45% level of DLM in the diet is adequate for eliciting optimum performance in broiler chickens during 0 to 6 weeks of age.

Keywords: Broiler Chicken, Carcass Characteristics,, DL-Methionine, Growth Performance, Serum Biochemical Indices.

Introduction

One of the most crucial nutrients for the bird is protein, which has a significant impact on growth, feed utilisation, and production performance (NRC, 1994). The requirements of protein and critical amino acids predominantly depend on the genetic makeup, growth, and production potential of the bird (Wijtten *et al.*, 2004; Panda *et al.*, 2007). Protein is one of the most expensive components of feed, and the maximum amount is lost in the digestive process. Supplementation of direct amino acids in the diet is the most probable way to decrease the nitrogen excretion in faeces. It makes sense to cut back on the amount of protein in the diet, as chickens can only use around 40-50 % of the food protein (Lopez and Leeson, 1995).

Poultry uses amino acids from dietary protein to carry out a variety of tasks. Methionine and lysine are the two most important essential amino acids for poultry diet (Harms, 1992). Formulation of the diet with the required level of nutrients is essential for obtaining optimum performance and reducing nitrogen excretion to minimize pollution. Therefore, the study was performed to evaluate the effect of supplemental DL-methionine on growth performance, serum biochemical indices, and carcass characteristics of broiler chickens.

Materials and Methods

Birds and Management

One hundred and twenty (120) day-old, commercial run broiler chicks were randomly distributed into 4 groups with 6 replicates of 5 chicks in each replicate. The brooder temperature was maintained at $34 \pm 1^{\circ}\text{C}$ up to 7 days of age and gradually reduced to $26 \pm 1^{\circ}\text{C}$ by 21 days of age, after which chicks were maintained at room temperature. The birds were maintained in a deep litter system of housing with standard managerial practices. The experiment was conducted following the guidelines of the Institute Animal Ethics Committee. A uniform management schedule was followed for all the birds.

Diets

A basal diet was prepared to meet the nutrient requirement of broilers during different phases of life (Pre -starter, 0-14 d; Starter, 15-28 d; Finisher, 29-42 d) except DLM (0.4%) which served as control (ICAR 2013, Table 1). Subsequently three experimental diets were formulated to contain DLM at 0.45, 0.50 and 0.55%. Each diet was fed at random to 6 replicates of 5 chicks each throughout the experimental period of 6 weeks.

Parameters Studied

Individual body weight of chicks and replicate-wise feed intake were recorded at a weekly interval. Feed conversion ratio was calculated as the ratio between feed consumed and weight gained.

On 38th day, around 3 ml blood was collected from brachial vein of two birds per replicate (12 per treatment), serum was separated and stored at -20°C until further analysis. The serum was subsequently analyzed for the concentration of total protein, albumen, triglycerides, total cholesterol, calcium and phosphorus using reagent kits (Coral Clinical Systems, Goa, India).

One bird representing the mean body weight of each replicate (six birds per dietary treatment) was selected and sacrificed by cervical dislocation at 43 days of age. The data on the weight of edible carcass, liver, gizzard, abdominal fat, and breast meat were recorded, and all the data were expressed as a percentage of the pre-slaughter weight of the same bird.

Statistical Analysis

The data were subjected to statistical analysis under a completely randomized design employing one-way analysis of variance (Snedecor and Cochran, 1989). The means of different treatments were compared with Duncan's multiple range tests (Duncan, 1955). Significance was considered at $P < 0.05$ levels.

Results and Discussion

Growth Performance

The body weight gain (BWG), feed consumption, and feed conversion ratio (FCR) of broiler chickens during 0-3, 4-6, and 0-6 weeks are given in Table 2. The body weight gain of broiler chicks during 0-3 weeks was lowest in the control group (0.40% DLM). Dietary supplementation of DLM at 0.45% significantly increased the BWG compared to the control. However, no differences in BWG could be observed among 0.45, 0.50, and 0.55% DLM dietary groups. The BWG of broilers during 4-6 weeks and 0-6 weeks was not influenced due to the levels of dietary DLM in the present study. The cumulative feed consumption of broilers during 0-3, 4-6, and 0-6 weeks' period was not influenced due to dietary supplementation of methionine at various levels (0.40, 0.45, 0.50, and 0.55%). The FCR was highest in the control group during the 0-3 week of age, containing the lowest level of DLM in the diet. Increasing the level of dietary DLM to 0.45% significantly improved the FCR of the broiler chickens during 0-3 week of age. However, no significant difference could be observed amongst 0.45, 0.50, and 0.55% DLM dietary groups. The FCR during 4-6 and 0-6 weeks of age was not influenced by dietary levels of methionine in the present study.

Table 1: Ingredient and nutrient composition of basal pre-starter, starter and finisher diet (% as such basis)

Ingredients	Pre-starter (0-10 d)	Starter (11-21 d)	Finisher (22-42 d)
Maize	54.21	57.29	61.59
Soybean meal	39.29	35.38	31.25
Salt	0.45	0.45	0.45
Di-calcium phosphate	1.89	1.81	1.66
Shell grit	0.72	0.67	0.67
DL - methionine	0.07	0.09	0.11
AB2D3K ¹	0.015	0.015	0.015
B complex ¹	0.015	0.015	0.015
Choline chloride 50%	0.06	0.06	0.06
Mineral Mixture ²	0.12	0.12	0.12
Toxin binder	0.20	0.20	0.20
Antibiotic	0.05	0.05	0.05
Coccidiostat	0.05	0.05	0.05
Vegetable oil	2.71	3.68	3.68
Nutrient Composition			
Metabolizable energy (kcal/kg)	2950	3050	3100
Crude protein (%)	22.5	21.0	19.5
Lysine (%)	1.25	1.14	1.04
Methionine (%)	0.40	0.40	0.40
Calcium (%)	0.90	0.85	0.80
Non-phytate phosphorus (%)	0.45	0.43	0.40

¹Supplies per kg diet: Vitamin A, 16,500 IU; vitamin D3, 3200 ICU; vitamin E, 12 mg; vitamin K, 2 mg; vitamin B1, 1.2 mg; vitamin B2 10 mg; vitamin B6, 2.4 mg; vitamin B12, 12 µg; niacin, 18 mg; pantothenic acid, 12 mg;

²Mn, 90 mg; Zn, 72 mg; Fe, 60 mg; Cu, 10 mg; I, 1.2 mg.

Similar to the findings of the present study, Aikin *et al.* (2021) reported higher body weight gain due to DLM supplementation in broiler chickens. Supplemental methionine in broiler diets has been shown to improve body weight gain, feed conversion ratio, and average daily gain (Zhang *et al.*, 2019). Methionine is the first limiting amino acid in the poultry fed maize soyabean meal-based diets. It is required for building the immune system and improving life performance, i.e., feed efficiency, muscle development, and meat yield. (Hickling *et al.*, 1990; Agostini *et al.*, 2016). In our study, higher weight gain of broiler chickens was observed in the diet containing 0.45% methionine compared to 0.40% methionine. Increasing the levels of dietary methionine beyond 0.45% did not have any additional advantage on the body weight gain of broilers. The NRC (1994) suggested the methionine

requirement of broiler for maximum growth during 0-3 weeks of age is 0.50%. However, in the current study a lower level of methionine was found to be adequate for optimum body weight gain during 0-3 weeks of age.

Table 2: Effect of DL methionine supplementation of growth performance of broiler chickens

DLM (%)	Body weight gain (g)			Feed consumption (g)			Feed conversion ratio		
	0-3 wk	4-6 wk	0-6 wk	0-3 wk	4-6 wk	0-6 wk	0-3 wk	4-6 wk	0-6 wk
0.40	646.23 ^a	1343.1	1989.4	928	2777	3705	1.44 ^b	2.07	1.86
0.45	730.50 ^b	1225.9	1956.4	930	2768	3699	1.27 ^a	2.27	1.89
0.50	713.53 ^b	1289.9	2003.5	923	2789	3713	1.29 ^a	2.16	1.85
0.55	727.80 ^b	1292.7	2020.5	924	2771	3695	1.26 ^a	2.14	1.83
SEM	12.66	26.69	25.20	2.31	5.17	6.37	0.027	0.045	0.022
P value	0.026	0.549	0.873	0.721	0.541	0.819	0.044	0.506	0.809

Means bearing different superscripts within a column differ significantly ($p < 0.05$); SEM: Standard Error of Mean

Table 3: Effect of dietary supplementation of DL- methionine on serum biochemical profile of broiler chickens

Diets	Protein (g/dl)	Calcium (mg/dl)	Phosphorus (mg/dl)	Uric acid (mg/dl)	Triglycerides (mg/dl)	Cholesterol (mg/dl)
T ₁ (0.40% Met)	5.38 ^a	11.48	5.84	4.82	184.42	178.24
T ₂ (0.45% Met)	5.72 ^b	11.32	5.64	4.86	180.46	174.56
T ₃ (0.50% Met)	5.82 ^b	11.40	5.72	4.75	178.84	184.62
T ₄ (0.55% Met)	5.74 ^b	11.44	5.76	4.90	182.54	172.88
SEM	0.06	0.12	0.06	0.04	2.18	3.24
P value	0.049	0.642	0.424	0.688	0.764	0.654

Means bearing different superscripts within a column differ significantly ($p < 0.05$); SEM: Standard Error of Mean

Table 4: Effect of dietary DL- methionine supplementation on carcass characteristic of broiler chickens

DLM (%)	Dressed wt.	Heart	Liver	Gizzard	Giblet	Abdominal Fat
0.40	79.30	0.47	1.97	1.61	4.06	1.80
0.45	78.69	0.41	2.08	1.34	3.84	1.84
0.50	77.72	0.45	2.26	1.56	4.29	1.76
0.55	79.19	0.43	2.09	1.56	4.09	1.82
SEM	0.64	0.02	0.05	0.06	0.11	0.04
P value	0.860	0.626	0.302	0.424	0.577	0.341

Serum Biochemical Parameters

The effect of dietary supplementation of DLM on serum biochemical profiles of broiler chickens is presented in Table 3. The serum concentrations of calcium, phosphorus, uric acid, triglycerides and cholesterol were not influenced by the levels of dietary DLM in the present study. However, concentration of protein in the serum varied

significantly ($P < 0.05$) due to dietary DLM levels. Lowest concentration of protein in the serum of broilers was observed in the control diet containing lowest level of DLM (0.40%). Increasing the level of methionine from 0.40 to 0.45% significantly ($P < 0.05$) increased the serum protein concentration. However, no further increase in serum concentration of protein was observed by enhancing the dietary DLM levels beyond 0.45%. Adejumo (2021) did not observe any difference in levels of serum triglyceride, total protein, uric acid, and non-esterified fatty acid in the plasma due to various levels of dietary DLM (0.42-0.61 %) in broilers. The non-significance difference in various serum biochemical parameters indicated that broilers could harmonize their blood metabolism to normal metabolic status during the finisher period.

Carcass Characteristics

The effect of dietary supplementation with methionine on carcass characteristics of broiler chickens is given in Table 4. The dressed wt percentage varied between 77.72-79.3% and was comparable among the dietary groups. The levels of dietary methionine (0.40-0.55%) had no influence on dressed yield. Similarly, the other carcass parameters like liver, heart, gizzard, giblet, and abdominal fat content were not influenced by the present study. Concomitant to the findings of the present study Linh *et al.* (2020) also did not observe any influence of dietary methionine on carcass weight, liver, heart, and gizzard weight. In another study, Aikins *et al.* (2021), however, reported higher dressed yield in broiler chickens due to dietary supplementation of methionine at 0.20% to the basal diet containing 0.37% methionine. In our study, the lowest level of methionine employed was 0.40%, and the carcass traits of broilers in this dietary group were comparable to the other dietary groups' higher levels of methionine (0.45, 0.50, and 0.55%). Thus, it is suggested that 0.40% methionine in the diet of commercial broilers is adequate for optimum carcass yield.

Conclusion

From the findings of the present study, it is concluded that a 0.45% level of DLM in the diet is adequate for eliciting optimum performance in broiler chickens during 0 to 6 weeks of age.

Contribution by Authors

Equal contribution. All authors declared that 'written informed' consent was obtained from the approved parties for the publication of this article and accompanying images.

Conflict of Interests

There is no conflict of interest.

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