Nigerian J. Anim. Sci. 2023, 25 (1): 78-83

Effect of low protein diets supplemented with different levels of synthetic methionine and lysine on performance of broiler chickens in semi-arid environment

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Target Audience: *Nutritionist, Feed millers.*

Abstract

This study was conducted to evaluate the effect of low protein intake supplemented with lysine and methionine on performance of broiler chickens. One hundred and thirty two (132) unsexed day old broiler chicks were randomly allocated into four (4) experimental diet groups in a Completely Randomized Design (CRD) for a period of six (6) weeks. Each treatment consists of thirty three (33) birds and was replicated three (3) times with eleven (11) birds per replicate. The treatments were; T_1 (Control), T_2 (low CP supplemented with 0.40g/100kg lysine and 0.50g/100kg methionine), T_3 (low CP supplemented with 0.60g/100kg lysine and 0.75g/100kg methionine), T_4 (low CP supplemented with 0.80g/100kg lysine and 1.00g/100kg methionine). Feed and water was given ad-libitum. The results showed that chickens on the control diet had significantly ($P<0.05$) higher feed intake and FCR compared to other groups. There was no significant ($P>0.05$) difference in the blood and carcass parameters measured. It was concluded that dietary low protein diets supplemented with amino acids had no adverse effect on performance of broiler chickens.

Keywords: *Protein; Synthetic amino acid levels; broiler chickens.*

Description of problem

Dietary protein level has major effects on growth performance of poultry. This is because, proteins are primary constituents of body tissues, including organs and muscles. Dietary protein (amino acids) deficiency results in reduction or cessation of growth or productivity and mobilization of protein from less vital tissues to maintain the functions of more vital tissues (1). The ingredients used primarily for protein supply during feed formulation are most expensive components. Major concern of modern poultry enterprise is to reduce feed cost for optimal economic returns. (2). The dietary crude protein (CP) level can possibly be reduced with addition of essential amino acid (AA) (3). In addition, the use of low CP diets with balanced AA supplementation can improve performance, decrease feed cost and increase flexibility in feed formulation (2).

Supplementing broiler diets with methionine and lysine is a common practice in the poultry industry (1). This is because methionine and lysine are universally recognized as the two most limiting amino acid in broiler diet based on maize and soya bean (1) Recent research suggest that increase in the level methionine and lysine in the diet of broiler chickens allows for reduction in protein level in the diet and enhance performance especially the meat quality in regard to carcass yield (3,4). The

objective of the study was to evaluate the effect of low protein diets supplemented with varying level of methionine and lysine on the performance characteristics of broiler chickens.

Materials and Methods

Experimental site

This study was conducted at the poultry unit of the Teaching and Research Farm of the Department of Animal Science University of Maiduguri. Maiduguri is located between Latitude 11^0.85 and 12^0N and Longitude 13^0.16 and 14^0E, and at an altitude of 325m above sea level (5). The mean temperature ranges from 33 - 40^0C (April- May) and the lowest (23 - 28^0C) during the months of December to January. The area is characterized by short duration of rainfall (June to September) which varies from minimum of 300mm to maximum of 700mm per annum (5).

Experimental diet and design

A total of one hundred and thirty two (132) Abor acres day old broiler chicks were randomly allotted into four (4) treatment groups of thirty three (33) birds, each treatment consisted of 3 replicate of 11 birds in a completely randomized design (CRD). Four experimental diets were formulated. The control (T_1), contained optimum levels of crude protein and amino acid (24 and 20% cp; 0.20 lysine and 0.25% methionine respectively for the starter and finisher phases. Diets two to four contained low level of crude protein (20 and 17% cp) with increasing levels of lysine (0.5,0.75, 1.0%) and methionine (0.4,0.6,0.8%) respectively for the starter and finisher phases. The birds were vaccinated against the common poultry diseases in the zone. Feed and water were given ad-libitum for the six (6) week experimental period. Ingredients composition and calculated analysis of the diets are presented Table 1.

Data Collection

Productive Performance

Feed intake was measured daily as the difference between the quantity of feed offered and left over. Live weight was measured weekly using electronic balance, while live weight gain was determined by subtracting the live weight of the current week from that of the previous week. Feed conversion ratio was obtained by dividing the feed intake by the live weight gain for each treatment group.

Blood Parameters

At the end of the finisher phase, two chickens were randomly selected from each replicate and fasted overnight. Blood samples were collected during slaughter from the jugular vein using well labelled heparinises bottles. Hematological parameters measured include packed cell volume (PVC), Hemoglobin (Hb) concentration, Red blood cell (RBC) count, white blood cell (WBC) count, lymphocytes, mean corpuscular haemoglobin (MCH), men corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) together with differential counts of Neutrophils, Lymphocytes and Eosinophils were determined according to (6).

Table 1: Composition and calculated analysis of experimental broiler starter and finisher diets

	Level of Lysine and Methionine							
		Starter				Finisher		
Ingredients	Control	Low	Medium	High	Control	Low	Medium	High
Maize	45	53	55.10	54.7	54	58	58	58
Soyabean meal	35	26	24	25	26	21.6	21.15	20
Wheat offal	10	12.6	12	11	10	12	12	14
Fish meal	6	4	4	4	4	2	2	2
Bone meal	3	3	3	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00
Methionine	0.20	0.40	0.60	0.80	0.20	0.40	0.60	0.80
Palm oil					2.0	2.0	2.0	2.0
Total	100	100	100	100	100	100	100	100
Calculated analysis (%)								
Cp	23.92	20.28	20.16	20.23	19.88	17.12	17.02	17.01
Me	2809.4	2817.47	283.05	2832.61	3068.63	2981.16	2984.16	2984.16
Lysine	1.22	1.31	1.56	1.81	1.06	1.31	1.56	1.81
Methionine	0.56	0.71	0.91	1.11	0.53	0.71	0.91	1.11

The Vitamins premix in this study has the following composition, vitamin A, 12000.00IU, Vitamin E 1500mg, Folic acid 1000mg, Pantothenic acid 1500mg, Vitamin B12, 15000mg, Vitamin B6, 2500mg, Vitamin K, 2000mg, Choline 500,000mg Mn 100mg, Vitamin B2 6000mg, Vitamin B1, 2000mg, Biotin 60000mg, Vitamin C, 30000mg Copper 15000mg, Cobalt 250mg and Selenium 100mg.

Carcass Parameters

At the end of the finisher phase, two birds were randomly selected from each replicate. The chickens were weighted, slaughtered and plucked after steeping in hot water at 80^0 C for 2-5 minutes. Each carcass was divided into the following anatomical parts: shanks, drumsticks, thigh, back, thorax, wings, breast, neck and head. The visceral components which include heart, crop, gizzard, proventriculus, liver, spleen, intestines and abdominal fat were removed from individual carcasses. The Cut-up parts and visceral organs were individually weighed using electronic sensitive balance and expressed as a percent of live weight.

Cost per gain analysis

Feed cost per kilogram was calculated from the cost of ingredients used in the feed preparation. Feed cost per kilogram live weight gain was determined using prevailing market prices of each ingredient at the time of the study.

Statistical analysis

All data obtained from the study were subjected to analysis of variances (ANOVA) of the completely randomized design (CRD). Significant differences obtained, were separated using least significant differences (LSD).

Result and Discussion

Productive Performance

Result for the productive performance is presented in Table 2. There was significant ($P<0.05$) difference among the treatments for

weekly feed consumption. Chickens on the control diet consumed significantly (P<0.05) more feed than other groups throughout the experimental period. This is followed by birds on high, medium and low methionine and lysine diets. The trend showed a decreasing tendency with decreasing methionine and lysine level. Weekly live weight gain also showed significant (P<0.05) difference among the treatment groups. The birds on the control and high lysine and methionine diets had similar and better weight gain compared to their counterparts on low and medium levels of methionine and lysine The result of this study also revealed significant (P<0.05) difference feed conversion ratio (FCR). Chickens on the control and high lysine and methionine diets had similar and higher FCR compared to other groups. Feed cost per kilogram and cost per kilogram gain were higher in chickens on high methionine and lysine diets. Those on the control had the least feed cost and cost per kilogram gain followed by those on medium and low lysine and methionine supplementation.

Table 2: Effect of low protein diets supplemented with varying levels of lysine and methionine on productive performance of broiler chickens

	Lysine/Methionine level				
	T1	T2	T3	T4	
Parameters	Control	Low	Medium	High	SEM
Weekly feed intake (g)					
	90.12^{a}	78.03^{b}	75.18^{b}	89.33^{a}	2,09
	128.22^{a}	107.98^{b}	112.89^{bc}	121.73^{ab}	2.91
	174.08^{a}	145.47^{b}	144.00+	161.12^{b}	4.16
	229.27^{a}	185.97^{b}	187.19^{b}	199.66^{b}	6.35
	294.44^{a}	235.39^{b}	238.41^{b}	251.91^{b}	8.57
	328.25^{a}	276.74^{b}	281.25^{b}	290.82^{ab}	2.30
Weekly body weight (g)					
	70.57^{a}	64.02^{b}	66.98^{b}	78.85^{a}	1.51
	86.83^{ab}	80.02^{a}	81.42^{b}	87.54^{ab}	3.31
	113.45^{a}	98.47^{b}	104.68^{ab}	101.13^{ab}	5.62
	128.52^{a}	109.21^{b}	112.81^{b}	107.70^{b}	4.77
	139.70^{a}	120.79^{b}	123.55^{b}	131.99^{ab}	7.03
	147.78	144.48	141.38	146.91	8.22
Weekly feed conversion ratio					
	1.28^{b}	1.22^{a}	1.23^{a}	1.33^{b}	0.02
	1.48^{a}	1.35^{b}	1.23^{b}	1.40^{ab}	0.03
	1.56^{a}	1.49^{ab}	1.38^{b}	1.60^{a}	0.04
	1.79^{ab}	1.71^{bc}	1.66^{c}	1.85^{a}	0.03
	2.11	1.95	1.95	1.91	0.12
	2.23^{a}	1.96^{b}	1.99^{b}	1.99^{b}	0.07
Feed cost (₦/kg)					
	113.17	117.76	121.24	123.12	
Feed cost per kg gain					
	110.46	197.47	196.55	209.80	

a, b, c = Means bearing different superscripts within the rows differ significantly (P<0.05)
SEM = Standard Error

Blood and carcass parameters

The result of this study revealed no significant (P>0.05) difference among the treatment groups in haematological and carcass parameters measured Tables 3 and 4.

Table 3: Effect of low protein diet supplemented with lysine and methionine on haematological indices of broiler chickens

	Lysine/ Methionine level				
	T1	T2		T3	T4
Parameters	Control	Low	Medium	High	SEM
PCV (%)	28.00	31.00	30.00	28.00	0.11
Hb (%)	9.40	10.20	10.07	9.43	0.38
RBC ($\times 10^6$/dl)	24.33	25.67	25.22	24.00	1.73
WBC($\times 10^3$/mm^3)	15.33	17.67	17.00	17.67	1.38
MCV	117.00	121.00	120.00	320.0	103.95
MCH	38.33	39.00	39.00	40.00	2.93
MCHC	33.16	33.25	33.18	33.29	0.06
Neutrophil	29.33	36.00	33.00	34.33	3.31
Eosirophil	1.33	1.33	0.67	0.00	0.86
Lymphocyte	69.33	62.33	66.33	65.33	3.32
Monocyte	0.00	0.33	0.00	0.33	0.23
Basophil	0.00	0.00	0.00	0.00	0.00

Table 4: Effect of low protein diets supplemented with lysine and methionine on carcass parameters of broiler chickens

	Level of Lysine/Methionine				
	Control	Low	Medium	High	
Parameters	T1	T2	T3	T4	SEM
Live weight	2278.50	2065.34	1900.56	1909.78	80.18
Dressed weight	1664.17	1482.67	1307.89	1371.67	96.28
Dressing %	75.57	71.64	68.62	71.48	2.46
Cut up parts (%)					
Shanks	4.41	4.74	4.87	4.45	0.89
Head	2.13	2.55	2.40	2.25	0.38
Wing	7.85	8.21	8.25	7.54	0.38
Thigh	11.03	9.91	9.77	10.18	0.86
Drumstick	10.70	35.45	9.71	10.34	19.58
Breast	17.68	17.66	17.42	19.46	1.31
Back	9.19	8.67	9.61	9.43	1.28
Neck	5.20	4.45	5.49	5.71	1.13
Organs weight (%)					
Crop	0.39	0.26	0.44	0.81	0.07
Liver	1.73	1.75	2.26	2.15	0.11
Spleen	.28	0.25	0.23	0.19	0.05
Gizzard	2.71	3.09	2.87	2.88	0.10
Heart	0.55	0.55	0.63	0.58	0.05
Abdominal fat	2.07	2.03	2.79	2.18	0.22
Small intestine	0.77	1.12	0.89	0.95	0.06
Large intestine	3.21	3.41	3.54	3.05	0.11

a, b, c = Means bearing different superscripts within the rows differ significantly (P<0.05) SEM = Standard Error

Discussion

Increased feed intake in the control and high methionine and lysine groups might be related to protein -energy balance of the diet which is an important factor influencing nitrogen balance and utilisation of dietary

protein (7). Thus, the birds might consume more feed to generate more energy for the high protein, and high methionine and lysine metabolism. Better weight gain in birds on the control and high lysine and methionine diets might be related to increased feed intake coupled with increased dietary CP, lysine and methionine levels which were adequate for growth and muscle formation. Decreased CP and medium to low lysine and methionine levels might be responsible for poor performance in the groups fed low lysine and methionine diets The findings of this study is similar to the reports of (8) which revealed that dilution of the CP content of the diet, while increasing the limiting amino acids resulted in a significant ($P<0.05$) increase in weight gain in chicks at various growth stages. This could infer that the increased lysine and methionine were utilised for protein synthesis to complement the low protein in the diet. The observation on FCR could be related to higher feed intake recorded for the groups. Lack of significant difference in blood and carcass parameters observed in this study suggest that decreasing dietary CP with increasing lysine and methionine levels had no adverse effect on the parameters.

Conclusions and Application

1. Broiler chickens fed low protein diet supplemented with the limiting amino acid had similar performance as chickens on high protein diet.
2. Low CP high amino acid supplementation increased feed cost
3. Low CP high amino acid supplementation had no adverse effect on blood and carcass characteristics of broiler chickens
4. Low protein diet can be supplemented with lysine and methionine at the rate of 1.0 and 0.8 g/kg respectively, in the diets of broiler chickens without detrimental effect on performance.

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