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Effect of Varying Levels of Methionine on, Growth Response, Tissue Fat and Protein of Broiler Chickens Raised in the Cool Seaceson Under Tropical Environment

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Target audience: Animal scientists, Poultry farmers, Feed millers and Researchers

Abstract

A 28-day trial was carried out to determine the effect of varying levels of methionine on growth performance, carcass quality, tissue fat and tissue protein of broiler chickens raised in the cool season under the tropical environment. Two hundred and eighty five 5-week old birds were used for the experiment and were grouped into five equal number on the basis of equal weight and randomly assigned to five isocaloric and isonitrogenous diet treatments replicated three times with graded levels of supplemental methionine (0.14, 0.19, 0.24 0.29 and 0.34%) amounting to total dietary methionine levels of 0.40, 0.45, 0.50, 0.55 and 0.60%, respectively. Birds fed 0.55% total methionine diet had the highest breast and wing weights, while birds fed 0.50% total methionine diet had the highest thigh weights. Birds fed 0.60% methionine diet had significantly (P<0.05) lower abdominal and tissue fats. These results showed that increasing levels of methionine up to (0.60 %) improved carcass quality by the reduction of tissue fat and abdominal fat of chickens, and birds fed 0.55% methionine in the diet had the highest dressing percentage and prime cuts.

Keywords: Methionine, broiler, growth, tissue, carcass and tropical.

Description of Problem

Methionine is an essential amino acid for poultry. It is the first limiting amino acid and must be supplemented in other to meet the nutritional need of the birds. Methionine supplementation in poultry diets has been reported by (12) to alleviate the negative effects of heat stress in the tropical region there by resulting to increased growth performance, increased protein synthesis, improved feed conversion ratio and decreased fat synthesis in broiler chickens. Methionine supplementation in low diets alleviates the negative effects of heat stress, improves the amino acid balance, promotes growth, enhances feed efficiency, increases protein synthesis, decreases fat synthesis and also improves the immune response through direct effects protein synthesis and breakdown, and indirect effects (derivatives of methionine) (1, 2). Poultry require both methionine and cysteine for protein

synthesis, therefore the Total Sulphur Amino Acids requirement should be taken into account. In avian species, it is generally accepted that around 45 to 50% of TSAA can be supplied by cysteine. Methionine toxicity targets the liver as well as the kidney and the pancrease. Harper *et al.* (3) reported that excess ingestion of methionine led to growth depression, and highly toxic acids formed when the nitrogen is in excess and not incorporated with other amino acids or protein led to methionine imbalance. Deficiency in methionine consumption has a significant negative impact on poultry such as growth inhibition, induction of metabolic disorder and the reduction of disease defensive potential.

The quantity of carcass fat is generally considered to be an unfavourable trait in the broiler industry. It is generally expected that as body weight increases, the quantities of body fat and protein increase at different rates. According to a report (4), the addition of methionine to poultry diets has been correlated with the tendency to reduce body fat and improved carcass quality (5, 6) .Increasing dietary methionine increased the mass of breast meat but reduced the size of the abdominal fat pad due to good balance of amino acids (2, 7). The thrust here is not only to increase production of the conventional feed ingredients but there is an urgent need to know the optimum amounts of these amino acids and dietary nutrients needed by birds. This work therefore aimed at determining the requirements of methionine for good carcass quality, tissue fat and tissue protein of broiler chickens reared in the cool season under tropical environment.

Materials and methods

Experimental site

The experiment was carried out at the Teaching and Research Farm, Department of Animal Science, Ahmadu Bello University, Samaru, Zaria located within the northern Guinea Savannah zone on latitude 11^0 and 12^1N, longitude 7^0 33^1E and altitude of 640m above sea level. The mean minimum daily temperature is from 14^0C-24^0C during the cool season while the mean maximum daily temperature is from 19^0C- 36^0C during the cool season (8)

Experimental birds

A total of 5-week old 285 birds from a commercial hatchery were used for this experiment. They were grouped into five on the basis of equal weight and were randomly assigned to 5 dietary treatments. There were 57 birds per dietary treatment with three replicates consisting of nineteen birds per replicate, raised on deep litter. Feed and water were provided *ad libitum*. The experiment was conducted during the cool season between November and January. The maximum temperatures varied from 14^0C-24^0C.

Experimental diets

Five isocaloric and isonitrogenous broiler finisher diets 1,2,3,4 and 5 were formulated, such that they starter diets Contained 0.40, 0.45, 0.50, 0.55 and 0.60% total methionine, respectively and met the requirements for energy, protein,

calcium, phosphorus and lysine (1). Diet 2 (Table1) was formulated to meet the methionine (1) requirement and was used as the control for the experiment.

Parameters measured

At the beginning of the experiment, the birds were randomly alloted to the five dietary treatments on the basis of equal weights and thereafter weighed weekly. Weights obtained were subtracted from the previous ones to get weekly weight gain. The cumulative weight gain and feed consumption were computed and used to calculate the feed efficiency and feed cost per kilogram weight gain. Mortality was monitored and recorded as they occoured.

Carcass analysis

At the end of finisher phase two birds per replicates with weights closest to the mean body weight of the replicate were used for the carcass study. The birds were slaughtered after being kept off-feed for twenty four hours. The birds were weighed, slaughtered, bled, de-feathered and eviscerated. Weights of the conventional cut up parts as well as the giblets and the abdominal fats were taken and expressed as percent of the live weight.

Tissue fat and tissue protein analyses

The two birds per replicate used for the carcass analysis were also used for tissue fat and crude protein analyses. Parts of the tissues (breast, thigh, drumstick, wings and back) from each bird from all the treatments were chopped and minced together and taken to the Department of Animal Science, Ahmadu Bello University, Zaria, Biochemical laboratory for tissue fat and tissue protein analyses.

Statistical analysis

Data obtained from the experiment were subjected to the analysis of variance, using the General Linear Model procedure (9). Significant differences among treatment means were separated using the Duncan's Multiple Range Test. (9).

General linear model

$Y_{ij} = \mu + K_{i+} e_{ij}$

Y_{ij}= Observation of the i^{th} level of methionine as shown by broilers performance

μ= Overall mean

K_i =i^{th} effect of methionine

e_{ij} = Random error

Table1: Composition of broiler finisher diets containing graded levels of supplemer methionine fed in the cool season.

	Treatments				
Ingredients	1 Met 0.40%	2 Met 0.45%	3 Met 0.50%	4 Met 0.55%	5 Met 0.60%
Maize	46.76	46.80	46.80	47.00	47.00
Maize offal	4.50	4.50	4.50	4.50	4.50
BDG	5.00	5.00	5.00	5.00	5.00
PKC	5.00	5.00	5.00	5.00	5.00
GNC	30.96	30.90	30.80	30.60	30.50
Palm oil	3.00	3.00	3.00	3.00	3.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Common Salt	0.30	0.30	0.30	0.30	0.30
Premix**	0.30	0.30	0.30	0.30	0.30
Lysine	0.46	0.46	0.46	0.46	0.46
Methionine	0.09	0.14	0.19	0.24	0.29
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
ME Kcal/kg	2932	2932	2929	2931	2929
Crude protein %	21.10	21.10	21.20	21.10	21.20
Ether extract%	7.28	7.28	7.28	7.27	7.27
Crude fibre%	4.56	4.56	4.55	4.54	4.54
Calcium%	1.10	1.10	1.10	1.10	1.10
Lysine%	1.12	1.12	1.12	1.12	1.12
Methionine%	0.40	0.45	0.50	0.55	0.60
Avail P%	0.54	0.54	0.54	0.54	0.54
Met + Cys%	0.70	0.75	0.80	0.85	0.90
Feed cost/kg (₦)	57.60	58.25	59.90	60.60	61.40

Met = Methionine; P= Phosphorus; ME= Metabolizable Energy; Cys= Cysteine ** Biomix premix supplied per kg of diet: Vit. A, 10,000 iu; Vit. D_3, 2000 iu; Vit E, 23 mg; Vit. K, 2mg: Vit. B_1, 1.8; Vit B_2, 5.5mg; Ni 27.5mg; pantothenic acid, 7.5mg; Vit. B_{12}, 0.015mg: Folic acid, 0.75mg; Biotin, 0.06mg; Choline Chloride, 300mg; Co 0.2mg; Copper, 3mg; Iodine 1 mg; Iron, 20 mg; Manganese, 40 mg; Selenium, 0.2 mg; Zinc, 30mg; Antioxidant, 1.25mg.

Results and Discussion

Table 2 shows the performance of broiler chickens fed graded levels of methionine during the cool season. There were significant improvements for final weight, weight gain, feed conversion ratio and feed cost per kg gain with increasing methionine levels from 0.40% to 0.60% of the diets. This result agreed with the findings of (10). Chattopadhyay *et al*. (11) also reported that methionine inclusion in the diet led to increase in body weight and weight gains of birds with lower feed cost per kg gain. The best

performance in terms of body weight gain was treatment 5. Body weight gain and feed conversion ratio generally improved with increasing methionine levels. This result was in agreement with the report of Chattopadhyay *et al* (11). There was no significant (P>0.05) difference in feed intake across treatments. This result is similar to the findings of (12) but contrary to the reports of (13) who reported increased difference (P<0.05) in feed intake for control diet that had no supplemental DL-methionine. The best feed conversion ratio was observed in treatment 5. This is similar to the report of (14) that reported increase in body weight gain and feed conversion ratio with increasing levels of methionine.

Table 2: Performance of broiler finisher chickens fed graded levels of methionine in the cool season.

Parameters	Treatments					
	1	2	3	4	5	SEM
	0.40Met%	0.45Met%	0.50%Met	0.55Met%	0.60Met%	
Initial weight(g)	572.00	572.35	572.18	572.13	572.44	0.09
Final weight(g)	1406.33^{e}	1611.67^{d}	1730.67^{c}	1971.00^{b}	2073.00^{a}	19.29
Weight Gain(g)	834.33^{e}	1039.31^{d}	1158.48^{c}	1389.87^{b}	1500.56^{a}	19.33
Ave daily gain(g)	29.50^{d}	37.12^{c}	41.37^{b}	41.96^{b}	53.59^{a}	0.65
Feed Intake(g)	3225.60^{a}	3236.50^{a}	3039.60^{b}	2981.10^{b}	3242.70^{a}	100.64
Feed Intake(g/d)	115.20^{a}	115.29^{a}	108.56^{b}	106.47^{b}	115.81^{a}	3.59
FCR	3.86^{c}	3.12^{bc}	2.62^{b}	2.13^{a}	2.18^{a}	0.09
Feedcost/kg gain(#)	208.48^{c}	170.11^{bc}	144.74^{b}	118.59^{a}	123.23^{a}	5.06
Mortality (%)	7.07	10.53	7.02	7.02	7.02	1.49

a, b, c, d, e=Means with different superscripts on the same row differ significantly (p<0.05)
SEM = Standard Error of Means Met= Methionine FCR= Feed conversion ratio

Table 3 shows the carcass characteristics of broiler finisher. The live weights , carcass weights and dressing percentage as well as breast weights and wings, thighs, drumsticks, liver, abdominal fat, spleen, and back expressed as percent of live weights were significantly (P<0.05) affected by dietary treatments. Birds fed diet containing 0.55% methionine had the best result for most of the carcass yield indices such as dressing percentage, breast, wings and thighs. This result is similar to the findings (15) who reported that feeding methionine levels above (1) recommendation enhanced breast yield. They observed that higher methionine levels increased carcass yield and reduced abdominal fat as it was in this study. The observed increase in dressing percentage in this study was similar to the findings of (11) who reported significant improvement in dressing percentages of birds fed synthetic methionine. Abdominal fat decreased as the dietary

level of methionine increased in the diet. This is similar to the findings of (6). Increased proportions of breast and thigh weights observed in treatment 4 containing 0.55% methionine may be attributed to the role of methionine in the synthesis of creatine, which is a nitrogenous organic acid that occurs naturally in animals and helps to supply energy to all cells in the body, primarily those of the muscle.

The effect of graded levels of methionine on tissue fat and tissue protein of broiler birds is presented in Table4. Treatment 5 with 0.60% methionine had the lowest tissue fat as shown in Figure 1. This observation was in consonance with earlier reports (6, 16), that the higher the levels of methionine and lysine in the diets, the lower the body fat which may be attributed to increase in protein intake thereby inducing a decrease in the protein calorie ratio. This reduction in the energy intake relative to the protein, results in decreasing body fat percentage.

Table 3: Carcass characteristics of broiler finisher chickens fed graded levels of methionine in the cool season.

Parameters	Treatments					SEM
	1 0.40%Met	2 0.45%Met	3 0.50%Met	4 0.55%Met	5 0.60%Met	
Live weight (g)	1410^{e}	1617^{d}	1760^{c}	1920^{b}	2030^{a}	0.01
Carcass weight (g)	800^{d}	1100^{c}	1260^{b}	1530^{a}	1540^{a}	0.02
Dressing (%)	57.19^{d}	68.19^{c}	71.63^{bc}	79.77^{a}	75.71^{ab}	0.92
Prime cut and organ weight expressed as % of live weight						
Breast	12.94^{a}	14.61^{bc}	16.24^{ab}	18.36^{a}	17.77^{a}	0.30
Wings	7.35^{c}	8.21^{bc}	9.67^{ab}	11.19^{a}	10.36^{a}	0.23
Thigh	13.45^{b}	15.04^{b}	18.72^{a}	18.19^{a}	17.11^{a}	0.24
Drumsticks	8.12^{c}	9.76^{b}	10.31^{ab}	11.15^{b}	11.05^{a}	0.18
Liver	2.42^{a}	2.43^{a}	1.90^{ab}	2.28^{a}	1.67^{b}	0.07
Heart	0.67	0.71	0.64	0.50	0.51	0.03
Kidney	0.28	0.23	0.21	0.24	0.25	0.02
Gizzard	3.11	2.68	2.27	2.37	2.26	0.08
Abdominal fat	2.30^{e}	1.96^{d}	1.63^{c}	1.28^{b}	0.84^{a}	0.03
Spleen	0.14^{a}	0.12^{b}	0.10^{c}	0.10^{c}	0.09^{c}	0.002
Lung	0.81	0.77	0.74	0.73	0.61	0.04
Back	13.64^{b}	15.22^{a}	14.60^{ab}	13.41^{b}	13.26^{b}	0.20

a, b, c,d,e= Means with different superscripts on the same row differ significantly ($p<0.05$) SEM = Standard Error of Means Met= Methionine

Table 4: Effect of graded levels of methionine on tissue fat deposit and tissue protein of broiler finisher birds reared during the cool season.

Parameters	Treatments					SEM
	1 0.40%Met	2 0.45%Met	3 0.50%Met	4 0.55%Met	5 0.60%Met	
Tissue fat	25.83^{d}	23.92^{c}	21.59^{cd}	20.46^{b}	19.32^{a}	0.31
Crude protein	42.10	42.96	43.21	43.51	44.55	0.22

a, b, c,d=Means with different superscripts on the same row differ significantly ($p<0.05$)
SEM = Standard Error of Means Met= Methionine

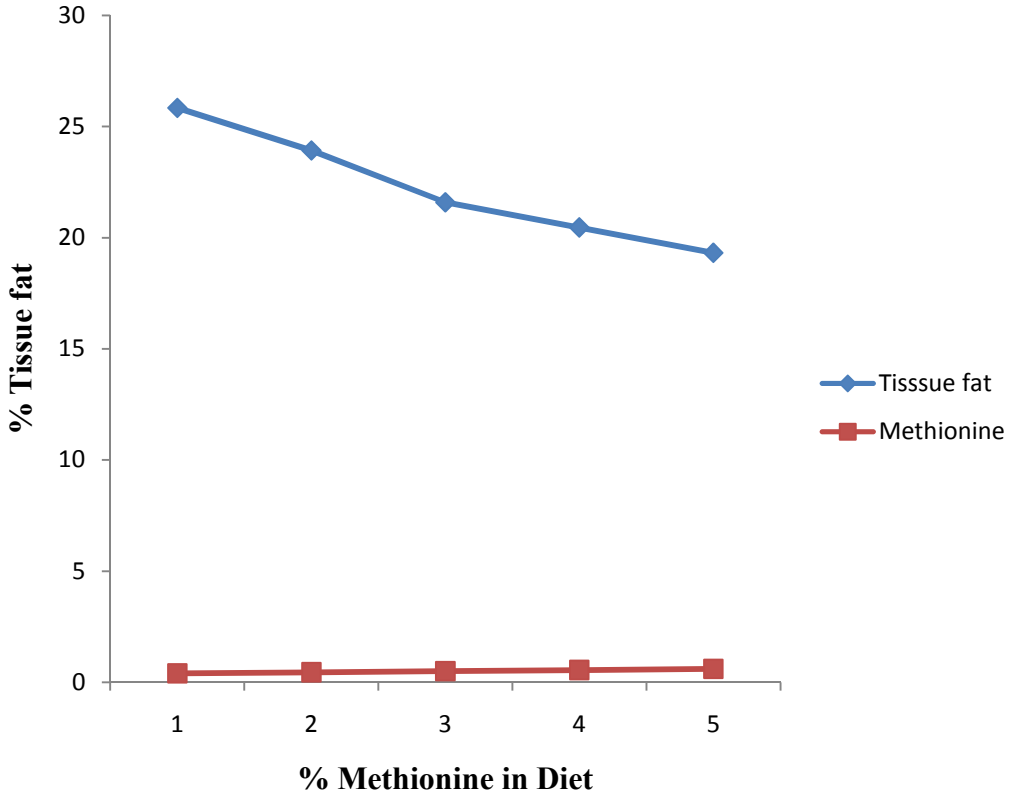

Figure 1: Percentage change in tissue fat of broiler finisher birds fed graded levels of methionine in the cool season (5weeks). 1, 2, 3, 4 and 5 represent 0.40, 0.45, 0.50, 0.55 and 0.60% total methionine in the diet.

Conclusion and Application

It was concluded that:

1. At 0.60% inclusion of methionine broiler finisher chickens had the lowest tissue fat and abdominal fat.
2. Methionine level up to 0.55% in the diet of broiler finisher

chickens raised in the cool season in the tropical environment resulted to improved carcass quality.

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