EFFECT OF FEEDING LOW PROTEIN DIETS SUPPLEMENTED WITH SYNTHETIC AMINO ACIDS ON BROILER BIRDS

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ABSTRACT
An eight-week study was conducted to determine the effect of feeding low protein diets supplemented with synthetic amino acids to broiler birds. Ninety six unsexed day-old chicks (Hubbard strain) were used for the study. The birds were randomly divided into 6 groups of 16 birds each. The groups were randomly assigned to 6 diets in a 2x3 factorial arrangement involving 3 levels (18, 20 and 22) of crude protein and two levels (0.25 and 0.5% levels of lysine in the starter phase and 3 levels (18, 19 and 20) of crude protein and two levels (0.25 and 0.5%) level of lysine in the finisher phase. Each treatment was replicated 2 times with 8 birds per replicate. Results showed that in the starter phase, final body weight (FBW), total weight gain, daily feed intake, total feed intake, average daily weight gain, feed conversion ratio, protein efficiency ratio and cost of feed per kg gain were all significantly ($p < 0.05$) affected by dietary treatments. Birds on treatment 3 had similar final body weight value, total weight gain, average daily weight gain (ADWG) and FCR with those on treatment 1 (control). Birds on treatment 3 had the least cost per kg gain. In the finisher phase, final body weight (FBW), total weight gain, daily feed intake, total feed intake, average daily weight gain and cost of feed per kg gain were all significantly ($p < 0.05$) affected by dietary treatments. Birds on treatments 1 and 3 had similar FBW, ADWG and cost of feed per kg gain. Birds on treatment 3 had the highest total weight gain. It was concluded that in order to achieve substantial economic savings without affecting the growth performance of broilers, 20% CP diet supplemented with 0.25% lysine and 19% CP diet supplemented with 0.25% lysine should be fed to broiler starters and finishers, respectively.
Keywords Amino Acids, low protein, broiler birds, growth performance.

INTRODUCTION
As human population continues to grow, with the greatest growth expected in countries that are already suffering from chronic hunger and malnutrition, there will be need to ensure food safety for all and especially the more susceptible sector of human population (Adeola and Olukori, 2009). It is a well known fact that the growth rate of human population far exceeds that of animal protein production and this great disparity creates a problem for food security. Consequently, the demand for animal protein exceeds the supply (Ikani and Dewfang, 2004). Broiler meat is one of the principal sources to fill the genuine gaps of the animal protein and can play leading role in providing balanced diet (Alam and Khan, 2000). Commercial Poultry breeding programmes have been imposing high selection pressure for achieving rapid genetic gain per unit time at the earliest possible ages. Today, the broiler chickens weigh around 2.2 to 2.4 kg at 40 days of age. The magnitude of the growth indicates that each day in the life of broiler chicken is important to achieve the targeted body weight. Considering the high magnitude of growth, there has been considerable research directing towards defining the minimum intake of dietary protein (CP) and amino acids (AA) to reduce the nitrogen in the excreta, thus reducing the nitrogen loss to the environment (Aletor *et al.*, 2000; Plumstead *et al.*, 2007; Waguespack *et al.*, 2009). Amino acids are critical for muscle development (Tessseraud *et al.*, 1996) and lysine (Lys) content in the breast muscle is relatively higher than other AA (Munks *et al.*, 1945). Lysine

represents approximately 7% of the protein in breast meat (Munks *et al.*, 1945). Lysine, one the key AA for protein synthesis and muscle deposition has also been demonstrated to be involved in the synthesis of cytokines, proliferation of lymphocytes and thus in the optimal functioning of immune system in response to infection. Inadequate Lysine supply reduces antibody response and cell-mediated immunity in chickens (Geraert and Mercier, 2010). Therefore the objective of this study was to evaluate the effects of low protein diets supplemented with lysine on growth performance of broiler birds.

MATERIALS AND METHODS

Location of the experiment

The experiment was carried out at the poultry Unit of the Teaching and Research Farm, Department of Animal Science, University of Nigeria, Nsukka in Enugu State, Nigeria. The study lasted for a period of eight weeks.

Experimental material

The materials used as feed ingredients to formulate the experimental diets for the research include as follows: maize, wheat offal, soya bean meal, groundnut cake, palm kernel cake, fish meal, bone meal, salt, lysine, methionine and vitamin–mineral premix. The feed ingredients were purchased from Nsukka, in Enugu State, Nigeria.

Experimental diets, animals and management

A total of ninety-six day –old unsexed broiler chicks was used for the study. In the starter phase, the birds were randomly divided into 6 groups of 16 birds each. The groups were randomly assigned to 6 caloric (2.63-2.66ME/kg) and nitrogenous diets in a 3x2 factorial arrangement involving three levels of protein (22, 20 and 18%) and two lysine levels (0.25 and 0.5%). Each treatment group were replicated two times with 8 birds per replicate. The birds in each replicate were brooded in a deep litter pen measuring 1.50m x 1.50m in the experimental poultry house. In the finisher phase, birds from the starter phase were randomly assigned to 6 treatment groups with 16 birds per group. Each group were replicated 2 times with eight birds per replicate placed on deep litter of fresh wood shavings in open sided house partitioned into pens measuring 1.50m x 1.50m. The birds were randomly assigned to 6 caloric and nitrogenous diets in a 3x2 factorial arrangement involving three levels of protein (20, 19 and 18%) and two lysine levels (0.25 and 0.5%). water was provided *ad libitum* and other routine management practices such as vaccination, cleaning of drinkers, feeders and the pens were done.

At the end of the experimental period (8th week), in order to evaluate carcass quality, two birds per replicate, with body weights as close as possible to the average body weight of the experimental unit, were slaughtered. Birds were weighed, de-feathered, eviscerated, and weighed again to obtain carcass weight (without head and feet), and breast, thigh, liver and abdominal fat weights. Breast, thigh and carcass yields were determined as carcass weight relative to body weight and expressed as a percentage of body weight (%).

Statistical Analyses

Data collected were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980).). Significant differences found among the treatment means was separated using Duncan's New Multiple Range Test (Duncan, 1955) and accepted at 5% or 1% level of probability.

RESULTS AND DISCUSSION

Growth performance of broiler chicks fed diets containing varying levels of synthetic amino acids in table 1

The result showed that there were significant ($P<0.05$) differences in final body weight (FBW), weight gain, daily weight gain feed intake and feed conversion ratio (FCR) among the treatments. As shown in Table 2, birds in T_3 had the highest FBW and total weight gain (TWG) when compared to those in other treatments irrespective of the decreased crude protein level. This is in line with the reports of Durrani *et al.* (2006) that the decrease in crude

protein level up to 16% with adequate methionine and lysine supplementation had no deleterious effect on body weight gain.

Feed conversion Ratio (FCR) differed significantly ($P<0.05$) among the various treatments. Birds on T_5 and T_6 had the highest FCR value (2.10 and 1.90) respectively and this is in agreement with the findings of Moran *et al.* (1992) which indicated an increase in FCR with a decrease of crude protein (23 to 20% and 20 to 17%) in starter and grower diets supplemented with amino acids. Ferguson *et al.* (1998) noted a significant increase in FCR when the crude protein was reduced from 21.5 to 19.6% at 6 weeks of age. Neto *et al.* (2000) also reported a 13% increase in FCR of birds fed 17% crude protein diets compared to those fed 24% crude protein diet. Similar researches have also been determined to know the effect of dietary lysine on broilers. Broilers have shown to have a greater response to supplemental lysine when 17% CP was fed, but less response to supplemental lysine when 23% CP was fed for both BWG and FCR (Sterling *et al.*, 2006). Considerable research has been found published in different research journals on this aspect. Hussein *et al.* (2001) reported that broiler feed supplementation with essential amino acids or low CP diets (17.3 or 17.7% CP) could improve growth of broilers during weeks 2 and 3.

Table 3 shows the growth performance of broiler finisher birds fed containing varying levels of synthetic amino acids.

The result of the Growth performance of broiler finisher birds fed diets containing varying levels of synthetic amino acids is shown in Table 3. The result showed that there were significant ($p<0.05$) differences in final body weight (FBW), total weight gain (TWG), Daily feed intake (DFI), Total feed intake (TFI) and Average daily weight gain (ADWG) among the treatments. As shown in Table 2, FBW birds in T_3 had the highest FBW value (3143.5g) which differed from those in T_5 (1973g) and T_6 (2093.5g). However there was significant ($P<0.05$) between birds in T_3 and those in T_1 (2981g), T_2 (2487) and T_4 (2414g). In total weight gain (TBW) was also observed to be highest in T_3 (1587.5g) which was statistically similar with those in T_1 (1537g). However TWG differed significantly among the other treatments. Weight gain was low on low dietary protein. Gonzales *et al.* (1998) partly attributed this effect to reductions in thyroxine, IGF and growth hormone. The least FBW and total weight gain was observed in birds on T_5 and T_6, while those on treatment 3 had the highest FBW and TWG. This agrees with the report of Brengendahl *et.al.* (2002) which stated that chicks fed low crude protein diet supplemented with essential amino acid gained less weight than the chicks fed control diet (20% CP). Perhaps the birds need for the essential amino acids were not met. The present study was conducted in a severe hot weather, and besides heat stress may have hindered their feed intake thereby limiting the much needed protein for growth. This is very pronounced in birds on treatment 5.

CONCLUSION

In conclusion, based on the results obtained in this study, broiler starters can be fed 20% CP diet supplemented with 0.25% lysine while broiler finishers can be fed 19% CP diet supplemented with 0.25% lysine in order to achieve substantial economic savings without affecting the growth performance, carcass and organ characteristics of broilers.

REFERENCES

Adekunle, A.O. (1995). Farm management and record keeping in enterprise paper presented at the National Pig Production Workshop held at NCRI Ibadan, pp :84.

Adeola, O. and Olukori, O.A. (2009). Opportunities and challenges in the use of alternative feedstuff in poultry production. Proceedings of the 3rd Nigerian International Poultry Summit: 22-25 Feb, 2009. 45-54 Abeokuta, Ogun state Nigeria.

Alam, S.M and Khan, M.A (2000). Poultry farming in Pakistan. Industry and Economy Magazine. 7thAugust, 2000.

Aletor, V.A, Hamid, I., Neib, E and Pfeffer, E. (2000). Low-protein amino acid supplemented diets in broiler chickens: effects on performance, carcass characteristics, whole body composition and efficiency of nutrient utilization. J. Sci. Food Agric. 80: 547-554.

Duncan, D. B. (1955). Multiple Ranges and Multiple F. test Biometrics. New York: McGraw Hill Higher Education.

Geraert, P.A and Mercier Y. (2010). Amino acids: beyond the building blocks! Antony: ADISSEO France SAS.

Gonzales E., Buyse, J., Loddi, M.M., Takita, T.S., Buyse, N and Decuypere, E. (1998). Performance, incidence of metabolic disturbances and endocrine variables of food-restricted male broiler chickens, Brit. Poult. Sci. 39:671–678

Munks, B., Robinson, A., Beach, E.F.,, Williams, H.H.(1945). Amino acids in the production of chicken egg and muscle. Poultry Science ;24:459–464

Plumstead, P.W., Romero-Sanchez, N.D. Paton, N.D. Spears J.W. and Brake, J. (2007). Effects of dietary metabolizable energy and protein on early growth responses of broilers to dietary lysine. Poult. Sci. 86:2639-2648.

Moran, E.T., Jr., R.D. Bushong and S.F. Bilgili. (1992). Reducing dietary crude protein for broilers while satisfying amino acid requirements by least-cost formulation: Live performance, litter composition, and yield of fast-food carcass cuts at 6 weeks. Poultry Sci. 71:1687-1694

Neto, M.G., Pesti, G.M.and Bakalli, R.I. (2000). Influence of dietary protein level on the broiler chicken's response to methionine and betaine supplements. Poult. Sci. 79:1478-1484.

Hussein, A.S., Cantor, A.H., Pescatore, A.J. (2001). Effect of Low Protein Diets with Amino Acid Supplementation on Broiler Growth J. Appl. Poult. Res. 18(10): 354-362.

Steel, R.G.D. and Torrie, J.H (1980) Principles & Procedures of Statistics. A Biometric Approach (2nd ed.). McGraw-Hill publishers, New York. 633pp.

Sterling, K.G., D.V. Vedenov, G.M. Pesti and R.I. Bakalli. 2005. Economically optimal dietary crude protein and lysine levels for starting broiler chicks. Poultry Sci. 84: 29-36.

Durrani F.R, Khan, Q., Mian, M.A, Durrani, Z. (2006). Effect of feeding low protein broiler finisher diets supplemented with methionine and lysine on the overall performance of broiler chicks. Int. J. Bio. Biot. pp. 2225.

Tesseraud, S., Peresson, R., Chagneau, A.M.(1996). Dietary lysine deficiency greatly affects muscle and liver protein turnover in growing chickens. British Journal of Nutrition;75:853–865.

Waguspeak, A.M., Powell, S., Bidner, T.D. Payne, R.L and. Southern, L. L. (2009). Effect of incremental levels of L-lysine and determination of the limiting amino acids in low crude protein corn-soybean meal diets for broilers. Poult. Sci. 88:1216-1226.

Table 1 Percentage composition of broiler starter diets

Crude protein levels (%)	22		20		18	
Lysine levels (%)	0.25	0.5	0.25	0.5	0.25	0.5
Ingredients (%)/Diets	1	2	3	4	5	6
Maize	34.90	35.00	39.40	39.40	43.80	43.80
Wheat Offal	13.2	13.2	14.00	13.20	14.00	15.00
Palm kernel meal	16.90	16.90	17.50	18.40	19.00	18.00
Soybean meal	10.50	10.40	8.30	8.10	6.00	6.05
Groundnut cake	17.50	17.25	13.80	13.65	10.20	9.90
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Bone Meal	4.00	4.00	4.00	4.00	4.00	4.00
Vit-Min Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.5	0.25	0.5	0.25	0.5
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated composition:						
Crude protein (%)	22	22	20	20	18	18
Energy(Mcal/kgME)	2.63	2.63	2.64	2.64	2.66	2.65
Crude fibre	5.02	6.02	4.60	6.02	8.05	7.00

* Vit A – 10,000.00 iu., D_3-2,000 iu., B1-0.75g., B2-5g., Nicotinic acid – 25g., K3-2.5g., E-25g., Biotin – 0.05g., Folic acid – 1g., Choline Cholride 250g., Cobalt –0.400g., Copper 8g., Managnese 64g., Iron –32g., Zn – 40g., Iodine – 0.8g., Flavomycin – 100g., Spiramycin 5g 3-Nitro-50g., DL-Methionie –50g., Selenium 0.6g., Lysine 120g., BAT-5g.

Table 2. Percentage composition of broiler finisher diets

Crude protein levels (%)	20		19		18	
Lysine levels (%)	0.25	0.5	0.25	0.5	0.25	0.5
Ingredients (%)/Diets	1	2	3	4	5	6
Maize	39.40	39.40	41.50	41.50	43.80	43.80
Wheat Offal	14.00	13.20	20.00	20.50	14.00	15.00
Palm kernel meal	17.50	18.40	12.30	11.90	19.00	18.00
Soybean meal	8.30	8.10	7.00	7.10	6.00	6.05
Groundnut cake	13.80	13.65	12.20	11.75	10.20	9.90
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Bone Meal	4.00	4.00	4.00	4.00	4.00	4.00
Vit-Min Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.5	0.25	0.5	0.25	0.5
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated composition:						

Crude protein (%)	20	20	19	19	18	18
Energy (Mcal/kgME)	2.88	2.88	2.90	2.88	2.88	2.88

* Vit A – 10,000.00 iu., D_3-2,000 iu., B_1-0.75g., B_2-5g., Nicotinic acid – 25g., Calcium pantothenate 12.5g., B_{12}-0.015g., K_3-2.5g., E-25g., Biotin – 0.050g., Folic acid –1g., Manganese 64g., Choline chloride 250g., Cobalt-0.8g., Copper 8g., Manganese 64g., Iron –32G., Zn-40g., Iodine-0.8g., Flavomycin-100g., Spiramycin 5g., Dl-methionie-50g, Selenium 0.6g., Lysine 120g., BAT-5g.

TABLE 3: Growth performance of broiler chicks fed diets containing varying levels of synthetic amino acids

	Treatments						
CP levels (%)	22	22	20	20	18	18	
Lysine levels (%)	0.25	0.5	0.25	0.5	0.25	0.5	
Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
IBW (g)	393.75	370.65	402.5	390.65	392.55	401.90	6.63
FBW (g)	1440.6^{ab}	1356.2^{ab}	1556.2^{a}	1325.0^{b}	1234.2^{b}	1390.2^{ab}	35.15
TWG (g)	1046.8^{ab}	1168.8^{ab}	1362.5^{a}	934.3^{ab}	841.8^{b}	968.3^{ab}	64.20
DFI (g)	88.98^{ab}	89.79^{a}	89.38^{a}	86.37^{ab}	86.78^{ab}	81.78^{b}	1.02
TFI (g)	14950^{ab}	15086^{a}	15017^{a}	14512^{ab}	14580^{ab}	13740^{b}	1.72
ADWG (g)	49.85^{ab}	46.93^{ab}	54.94^{a}	44.49^{ab}	40.08^{b}	46.11^{ab}	1.64
FCR	1.70^{b}	1.85^{ab}	1.60^{b}	1.75^{b}	2.10^{a}	1.90^{ab}	0.05
PER	2.50^{c}	2.30^{c}	3.05^{ab}	2.55^{bc}	2.50^{c}	3.10^{a}	0.10
CFKG (N)	202^{a}	159^{d}	137^{e}	170^{c}	178^{b}	165^{c}	5.91

^{abcdef} Means on the same row with different superscript are significantly ($p < 0.05$) different.
IBW= Initial body weight, FBW= Final body weight, TWG= Total weight gain, DFI= Daily feed intake, TFI= Total feed intake, ADWG= Average daily weight gain, FCR= Feed conversion ratio, PER= Protein Efficiency ratio, CFKG= Cost of feed per kg, SEM= Standard error of mean.
T_1= 0.25kg lysine & 22% CP, T_2= 0.5kg lysine & 22% CP, T_3= 0.25kg lysine & 20% CP, T_4= 0.5kg lysine & 20% CP, T_5= 0.25kg lysine & 18% CP, T_6= 0.5kg lysine & 18% CP.

Table 4: Growth performance of broiler finisher birds fed diets containing varying levels of synthetic amino acids

	Treatments						
CP levels (%)	20	20	19	19	18	18	
Lysine levels (%)	0.25	0.5	0.25	0.5	0.25	0.5	
Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
FBW (g)	2981^{a}	2487^{ab}	3143.5^{a}	2414^{ab}	1973^{b}	2093.5^{b}	147.78
TWG (g)	1539^{a}	1131^{b}	1587.5^{a}	1001.5^{c}	738.5^{d}	793.5^{c}	99.97
DFI (g)	160^{bc}	175^{ab}	187^{a}	168^{ab}	132^{d}	142^{cd}	5.86
TFI (kg)	3.59^{bc}	3.91^{ab}	4.18^{a}	3.75^{ab}	2.96^{d}	3.19^{cd}	1.31
ADWG (g)	54.98^{a}	40.39^{b}	56.70^{a}	35.78^{b}	26.39^{c}	28.35^{c}	4.38
FCR	2.35	2.45	2.50	3.10	3.25	3.0	0.13
PER	2.15	1.50	2.10	1.45	1.25	1.35	0.15
CFKG (N)	126^{e}	159^{d}	137^{e}	170^{b}	176^{a}	165^{c}	5.43

^{abcdef} Means on the same row with different superscript are significantly ($p < 0.05$) different.
FBW= Final body weight, TWG= Total weight gain, DFI= Daily feed intake, TFI= Total feed intake, ADWG= Average daily weight gain, FCR= Feed conversion ratio, PER= Protein Efficiency ratio, CFKG= Cost of feed per kg, SEM= Standard error of mean.
T_1= 0.25kg lysine & 20% CP, T_2= 0.5kg lysine & 20% CP, T_3= 0.25kg lysine & 19% CP, T_4= 0.5kg lysine & 19% CP, T_5= 0.25kg lysine & 18% CP, T_6= 0.5kg lysine & 18% CP.