Influence of Varying Energy and Protein Levels on the Performance and Feed Cost of Broiler Chickens

G. O. Adeyemo, M. T. Madamidola and [1]T.I. Ademulegun
Department of Animal Science, Faculty of Agriculture, University of Ibadan, Nigeria
[1]Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria
Email: gbemiadeyemo7@gmail.com

ABSTRACT

The influence of varying energy and protein levels on performance, carcass evaluation and gut morphology of broiler chickens were investigated in a 56-day feeding trial. A total of 192 one-day old Arbor acre broiler chickens were fed 6 diets at the starter and finisher phases. The diets were Recommended Energy-Recommended Protein (RERP, control), Recommended Energy-Lower Protein (RELP), Lower Energy-Recommended Protein (LERP), Lower Energy-Lower Protein (LELP),Higher Energy-Recommended Protein (HERP) and Higher Energy-Lower Protein (HELP). Birds were fed ad-libitum for 8 weeks and weighed weekly to determine their performance. Final body weight, average body weight gain and feed intake were recorded while the feed conversion ratios were determined. Feed cost in Naira (₦) per kilogramme/diet for the six diets were determined. No significant (P>0.05) differences were recorded in the final body weight, average body weight gain and feed intake. Although, HERP and HELP diets enhanced these parameters. Feed conversion ratio were significantly (P<0.05) lowest in birds fed HERP and HELP diets. Birds on these treatments utilized their feed efficiently. Feed cost were significantly (P<0.05) influenced by varying energy and protein in diets. Feed cost increased with increased energy level. Diets with LELP had the least feed cost. In conclusion, feeding broilers with HERP and/or HELPgave better performance with an increased feed cost. However, lowering energy and protein in broiler diets will reduce feed cost at the expense of the bird's performance.

Keywords: Metabolisable energy, Crude protein, Broiler performance and Cost benefit

INTRODUCTION

Longe in 2006 reported that the cost of feed ingredients could be as high as 80% of the total cost of production of finished feed while 60-80% estimation was reported by Durunna *et al.* (2005). In poultry production, the regimes of dietary protein and energy ratios both in the tropics and temperate climates are important though dynamism have been found due to improvement in breeds of chickens as the years go by. Energy is required for body functioning and protein is an essential constituent of all animal tissues. Hunton (1995) found that nutrient intake can be influenced by different levels of energy in diet. It is generally assumed that when birds eat more, they have higher body weights at market age. Improvement in body weight has been attained due to an increase in feed consumption, which is related to genetics (Havenstein *et al.*, 1993) and supported by nutrition.Feed cost can be reduced by decreasing the energy and/or amino acid content in the diet, but this must be counterbalanced by potential losses in broiler performance such as Body Weight (BW) gain, Feed Efficiency (FE) and meat yield (Corzo *et al.*, 2005; Kidd *et al.*, 2005). Protein, having major effect on growth performance of the bird, is the most expensive nutrient in broiler diets (Kamran *et al.*, 2004).

While formulating a broiler diet, the main emphasis is placed on the Crude Protein (CP), because the protein level in broiler diet strongly affects performance and feed cost, and thereby, profitability of a broiler production enterprise (Eits *et al.*, 2004).On the other hand, if high dietary energy and amino acid are provided to the birds, it may not affect broiler performance but will increase the feed cost. Hence, it is important to consider feed cost and broiler's performance to amino acid and energy in the diet to maximize margin. To maximize profit and margin, it is also important to understand feed cost and broiler performance when various energy and amino acid contents are provided to the birds. This study was carried out to further provide information on the impart of various levels of energy and protein on broiler performance and feed cost

MATERIALS AND METHODS

A total of 192 one-day old Abor acre broiler chickens were randomly alloted to six dietary treatments with each group having 32 broilers. The experiment lasted for 8 weeks. Combination of various levels of energy and protein were used. Recommended Energy-Recommended Protein (control), Recommended Energy-Lower Protein, Lower Energy-Recommended Protein, Lower Energy-Lower Protein, Higher Energy-Recommended Protein, Higher Energy-Lower Protein as presented in Tables 1 and 2.

The total feed given to birds and feed consumed were recorded weekly to estimate the total feed intake per week. The average daily feed intake were also estimated by dividing the feed intake by number of birds.

Birds were weighed weekly to record their body weight while the body weight gain was calculated as the difference in the final weight and initial weight of birds. The average weight gain was calculated by dividing the body weight gain by the number of days.

$$\text{Feed Conversion Ratio} = \frac{\text{Average feed intake (g)}}{\text{Average weight gain (g)}}$$

The total feed cost incured per bird were estimated by dividing the sum of the cost feed ingredient, bagging, milling, and transport by kilogramme of feed produced.

All data collected from each treatment for all the parameters considered were subjected to Analyses of Variance (ANOVA) The means were separated using Duncan's multiple range test.

Table 1
Percentage composition of experimental starter diets

Ingredients (g/100g)	Diets 1	2	3	4	5	6
Maize	49.00	52.00	55.00	56.00	52.15	54.35
Wheat offal	5.00	5.00	4.65	5.00	0.00	0.00
Groundnut Cake	25.00	23.00	25.00	22.00	23.50	22.00
Fullfat Soya	8.65	8.00	5.00	7.12	9.50	9.50
Fishmeal	4.00	3.55	5.00	4.50	5.00	4.50
Palm Oil	3.00	3.00	0.00	0.00	4.50	4.50
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster Shell	1.50	1.50	1.50	1.50	1.50	1.50
Broiler Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.11	0.10	0.10	0.10	0.10
Lysine	0.25	0.34	0.25	0.28	0.20	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Calculated values						
ME	3083	3087	2939	2938	3241	3244
CP (%)	23.06	21.52	23.73	21.81	23.46	21.80
CF (%)	3.17	3.09	3.07	3.08	2.79	2.75
Met (%)	0.45	0.45	0.46	0.45	0.46	0.45
Lys (%)	1.20	1.21	1.20	1.20	1.20	1.20

ME- Metabolizable Energy, CP- Crude Protein, CF- Crude Fibre, Met- Methionine, Lys- Lysine, W/O – Wheat Offal, FM- Fish meal, P/O – Palm oil, GNC- Groundnut Cake, BP- Broiler Premix, FFSB- Full fat Soybean, O/S- Oyster shell, Imgr. – Ingredients

1- Recommended Energy and Recommended Protein
2- Recommended Energy and Low Protein
3- Low Energy and Recommended Protein, 4- Low Energy and Low Protein
5- High Energy and Recommended Protein, 6- High Energy and Low Protein

Table 2
Percentage Composition of Experimental Finisher Diets

Ingredients (g/100g)	Diets 1	2	3	4	5	6
Maize	58.00	59.00	58.00	59.00	59.74	60.69
Wheat Offal	2.00	3.30	5.04	6.00	0.00	0.00
Groundnut Cake	15.00	12.51	17.50	16.02	12.00	11.00
Fullfat Soya	15.40	16.07	12.00	12.00	18.00	18.00
Palm Oil	3.81	3.80	1.60	1.60	5.00	5.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster Shell	1.50	1.50	1.50	1.50	1.50	1.50
Broiler Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.11	0.13	0.11	0.13	0.11	0.12
Lysine	0.18	0.20	0.25	0.25	0.15	0.20
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Calculated values						
ME	3217	3212	3052	3048	3342	3348
CP (%)	19.92	18.77	19.78	19.48	20.44	19.12
CF (%)	2.94	3.00	3.13	3.15	2.78	2.75
Met (%)	0.40	0.41	0.40	0.41	0.40	0.41
Lys (%)	1.04	1.01	1.03	1.02	1.00	1.02

ME- Metabolizable Energy, CP- Crude Protein, CF- Crude Fibre, Met- Methionine, Lys- Lysine, W/O – Wheat Offal, FM- Fish meal, P/O – Palm oil, GNC- Groundnut Cake, BP- Broiler Premix, FFSB- Full fat Soybean, O/S- Oyster shell,
1- Recommended Energy and Recommended Protein
2- Recommended Energy and Low Protein
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RESULTS AND DISCUSIION

Dietary treatments had no significant (p>0.05) influence on the average daily feed intake. Treatment 3 recorded the highest feed intake (82.74g/bird) while birds on treatment 4 had the lowest feed intake of (76.66 g/bird) as compared to treatments 1, 2, 5 and 6 which had mean values of 83.04, 80.37, 82.34 and 80.73 g/bird respectively. Thelevel of crude protein and metabolizable energy in diets did not influence the birds feed intake. This agrees with the report of Ferguson *et al.* (1998) who noted no effect on feed intake by decreasing crude protein from 20.4 to 18.8% during the starter phase. Han *et al.*(1992) also found no difference in feed intake of broilers when the crude protein contentof their diet was decreased from 23 to 20%. Kamran *et al.*(2004) also reported a non-significant effect of energy and protein dilution on feed intake. Birds fed low energy and crude protein diets had the lowest feed intake in this study. This is in agreement with the report of Dairo *et al.*(2010) who found a lowered feed intake for birds fed diets with low energy and low protein. Our observation however was contrary to some other studies.Kamran *et al.*(2008) found feed intake to linearly increase with decreasing crude protein and metabolizable energy. Bregendahl *et al.* (2002) and Nawaz *et al.*(2006) also reported increased feed intake inbroilers fed diets having decreased metabolizable energy and crude protein contents. Birds fed recommended energy and low protein had a lower feed intake as compared to the control diet with recommended energy and protein. This is contrary to what Fatufe and Rodehutscord (2005) reported that there were no effect or even increased feed intake when birds were fed low protein and normal energy diets.

The average body weight gain (g/bird) had no significant (p>0.05) variation across treatments. However, the highest mean value was recorded in treatment 5 (41.41g/bird) as compared to treatments 1, 2, 3, 4 and 6 with average body weight gain 39.94, 37.31, 38.96, 37.96 and 40.64 g/bird respectively.This study showed that birds fed high energy-recommended protein and high energy-low protein diets had the highest final body weight and body weight gain when compared to the control diet having recommended energy and protein levels. This could be attributed to the high energy level in the diet which was sufficient to meet the bird's energy requirement and convert the excess to carcass and also allowing the available protein to be used up in gaining body weight. This result agree with the work ofReginatto *et al.*(2010) who reported an improved performance with higher levels of dietary energy. Growth rate was improved by increasing dietary energy concentration (Sizemore and Siegal, 1993). These reports are contrary to that of Leeson *et al.*(1996) who found that dietary metabolizable energy had less effect on growth performance. Similar responses in final body weights and body weight gains were observed in birds fed recommended energy-low protein and low energy-low protein. This showed that lowering the protein level of broiler diets influenced the bird's overall body weight gain. Aletor *et al.*(2000) also reported that the performance in terms of growth is adversely affected by low protein diets. Ferguson *et al.*(1998) and Jacob *et al.*(1994) also reported that feeding low crude protein diets to broiler reduced growth performance. Dean *et al.*(2006); Fatufe and Rodehutscord (2005) also said broiler performance was not compromised even when low crude protein diets were formulated to contain 22.2 and 22.9%. Reduction in the final body weight of birds fed low energy-low protein in this study is in agreement with the research of Leeson *et al.*(1996) who reported that dilution of dietary energy and protein significantly reduced growth rate. Kamran *et al.*(2008) also reported that weight gain was linearly decreased as dietary crude protein and energy decreased.

There were significant (p<0.05) difference in the Feed Conversion Ratio (FCR) among treatments. Birds on treatments 5 and 6 responded similarly to the diets and had the lowest feed conversion ratio of 1.99. There were no significant (p>0.05) difference among treatments 1, 3 and 4 with mean values 2.08, 2.12 and 2.03 respectively while birds on treatment 2 had the highest feed conversion ratio.There were no significant variations (p>0.05) among the final body weight (g/bird) of birds fed the different diets, although birds on treatment 5 recorded the weight of 2358.20 g/bird compared to the other treatments 1, 3 and 6 with mean value 2275.50, 2220.50 and 2314.90 g/bird respectively. However, birds on treatment 2 and 4 had the lowest values (2127.60 and 2164.90 g/bird respectively) when compared to other treatments.This study showed that birds fed high energy-recommended protein and high energy-low protein diet had the best feed to gain ratio with low feed conversion ratio of 1.99 irrespective of the low protein or recommended protein levels fed to the birds. This could indicate that birds were able to adequately utilize the excess energy for growth even when protein levels were loweror equal to the recommended levels. It could also be attributed to better dietary digestibility since energy plays a major role in the digestion and absorption of nutrients. Sizemore and Siegel (1993) reported an improved feed conversion ratio by increasing the dietary energy concentration. Sadeghi and Tabiedian (2005) also found a decreased feed conversion ratio in birds fed high energy diets in a period of 7 – 21 days. This is contrary to the report of Jafarnejad and Sadeghi (2011) who reported that there were no differences in the feed conversion ratio of birds fed high energy-normal protein diets. This study also showed that birds fed low energy-recommended protein diet and recommended energy-low protein diet had an increased feed conversion ratio while those on low energy-low protein diets had a relatively reduced feed conversion ratio when compared to the control. This is contrary to the report of Kamran *et al.* (2008) who reported an increased feed conversion ratio as dietary protein and enrgy decreased. There were also an increased feed conversion ratios when birds were fed diets with recommended energy-low protein. This could mean that birds were consuming more feed and growing more slowly.

There were significant ($P<0.05$) difference in the feed cost among dietary treatments. There were no significant ($P>0.05$) difference in the feed cost of treatments 5 and 6. However, treatment 5 had the highest feed cost of ₦521.42/kg. There were significant ($P<0.05$) difference in the feed cost of the control diet (₦490.45/kg) as compared to other treatments while treatments 2 and 3 had no significant ($P>0.05$) difference with mean values ₦471.42/kg and ₦470.00/kg respectively. The feed cost of diet 4 had the least value (₦444.83/kg) and significantly ($P<0.05$) varied from other diets.

The calculated cost analysis in naira per kilogramme of feed showed that feeding broiler chickens with high energy-recommended protein or high energy-low protein diets increased the cost of feed while feeding birds with a low energy-low protein diets reduced the cost of feed. This is in agreement with the report of Corzo *et al.*(2005) who said that feed cost can be reduced by decreasing the energy level of diets although this must be counterbalanced by potential losses in broiler performance such as body weight gain, feed efficiency and meat yield (Kidd *et al.*,2005).

Table 3
Performance traits of broilers fed varying energy and protein levels in a 56-days feeding trial

Parameters Measured	Diets 1	2	3	4	5	6
Final Body Weight	2275.50	2127.60	220.50	2164.90	2358.20	2314.90
Body Weight Gain	39.94	37.31	38.96	37.96	41.41	40.64
Average Feed Intake	83.04	80.37	82.74	76.66	82.34	80.73
Feed Conversion Ratio	2.08^{ab}	2.16^{a}	2.12^{ab}	2.03^{ab}	1.99^{b}	1.99^{b}
Feed Cost (N/Kg)	490.45^{ab}	471.42^{bc}	470.00^{bc}	444.83^{c}	521.42^{a}	509.60^{a}

a, b, c, Treatment means with different superscript in the same row are significantly ($p<0.05$) different.
FCR – Feed Conversion Ratio, BW-Body Weight (g/bird), BWG-Body Weight Gain (g/bird/day), FI-Feed Intake (g/bird/day), DW- Dressed Weight (%).
1- Recommended Energy and Recommended Protein
2- Recommended Energy and Low Protein
3- Low Energy and Recommended Protein
4- Low Energy and Low Protein
5- High Energy and Recommended Protein
6- High Energy and Low Protein

CONCLUSION

Feeding broilers with High Energy Recommended Protein and/or High Energy Low Protein gave better performance with an increased feed cost. However, lowering energy and protein in broiler diets will reduce feed cost at the expense of the bird's performance.

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