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Response of Broilers to Alternative Dietary Crude Protein Regimen

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Abstract: An experiment was conducted to evaluate the use of a single diet containing 18% crude protein (CP) and 3000kcal/kgME as an alternative feeding regimen to 3 other conventional feeding standards for broiler production. Three hundred and twenty (320) Anak broilers were randomly divided into four treatment groups. The first three groups served as control while the 4th was the tested treatment. Broilers in group 1(G_1) representing control 1 were fed diet with 23% CP 0-3 weeks, 20% CP 3-6 weeks and 16% CP 6-8 weeks. While those in group 2 (G_2) representing control 2 were fed diet with 23% CP 0-6 weeks and 14% CP 6-8 weeks. Also broilers in group 3 (G_3) representing control 3 were fed diet with 20% CP 0-4 weeks and 16% CP 4-8 weeks, while those in group 4 were fed 18% CP 0-8 weeks. All diets contained 3000kcal/kg of metabolizable energy. The birds were kept in battery brooder cage for 8 weeks. Feed and water were supplied ad libitum. At the 8th week, 10 birds were randomly selected from each of the four treatment groups and starved for 18 hours. They were killed by cervical dislocation and used to determine the carcass parameters. Performance results at 8 weeks showed that broilers fed on 18% CP and 3000kcal/kg ME had the lowest feed intake ($P<0.05$). Although the weight gain was significantly reduced, broiler in the group had comparable feed gain ratio with those on two of the control groups($p>0.05$) and better feed to gain ratio than the third control group ($p<0.05$). Mortality was not significantly influenced by any of the dietary treatments ($P>0.05$). Dietary crude protein CP 18% and 3000kcal/kgME for broilers resulted in better carcass weight, breast meat yield and gizzard weight when compared with the controls ($P<0.05$). It also reduced abdominal fat content ($p<0.05$). Economically, feeding broiler on diet of 18% CP and 3000kcal/kg of energy for 0-8 weeks also recorded a significantly reduced cost benefit ratio a factor that determines how best the production cost is utilized ($P<0.05$). It was then concluded that using dietary CP 18% and 3000kcal/kgME for feeding broilers from 0-8 weeks, could be an alternative to the conventional feeding methods currently used for broilers where they are fed 2 or 3 different diets in a space of 0-8 weeks where they are expected to be marketed. It was also noted that such feeding method would be suitable for poultry farmers who practice on-farm feed production.

Key words: Broiler, crude protein, alternative feeding, performance cost / benefit

Introduction

Poultry production in the tropics is adversely affected by high cost and inadequate feed supply (Raviundran *et al*., 1982). Feed constitute substantially to the cost of poultry production representing about 60% of the total cost of production. Protein is a vital nutrient to both animal and man, for proper muscular development and growth. Meeting protein requirements, represents one of the major cost of feeding broilers (Oyedeji and Atteh, 2003). Moran (1979) reported that protein is one of the most expensive items in the cost of a complete feed, hence it is to be expected that every effort will be made to reduce its use without lowering performance. Reports on the use of low protein diets for feeding broilers in relation to energy have not been consistent.

Hill and Dansky (1950) reported that growth of broilers was reduced when a high energy and low protein was fed but the growth was restored when the energy level was lowered. On the other hand, Sunde (1956) found that a ration high in protein and low in energy reduced growth and efficiency of feed utilization.

Twining *et al*. (1974) reported that broilers chicks receiving a low protein starter has poorer body weight and feed conversion at 4 weeks of age compared to those receiving the required level. However, when they subsequently consumed an adequate finisher diet, compensatory growth led to near equivalent final performance.

The National Research Council (NRC, 1994) recommended feeding standard for broilers under temperate conditions has not been totally practicable in the tropics for the obvious reasons of environmental differences and type and quality of available feed ingredients.

Pesti (1982) indicated that better estimates of the co-efficients for the effects of protein and energy contents of diets on growth, feed utilization and carcass composition, need to be determined for starting chicks and finishing broilers under field conditions before they can be added to the diet formulation model for maximum profitability. Little research emphasis has been placed on the response of broilers to different dietary protein

Table 1: Composition and Proximate Analysis of Diets used in the experiment

	3000 kcal/kg ME (Crude Protein)				
	23%	20%	18%	16%	14%
Yellow corn	42.03	53.02	40.00	53.99	50.00
Soybeans meal	29.81	24.03	17.47	13.81	12.00
Brewers Dry Grain	10.00	5.00	15.00	14.00	15.00
Maize Offal	8.00	7.54	12.45	8.67	12.45
Blood Meal	3.03	3.00	2.94	1.38	0.52
Palm Oil	3.58	3.00	6.85	4.92	5.46
Bone meal	2.69	2.55	2.16	2.17	2.17
Oyster shell	0.26	0.28	0.10	0.15	0.15
Salt	0.25	0.25	0.25	0.25	0.25
*Vit. Min. Premix	0.25	0.25	2.25	0.25	0.25
DL - Methionine	0.10	0.10	0.10	0.10	0.10
Grit	--	0.98	2.43	0.31	1.65
Total	100.00	100.00	100.00	100.00	100.00
Proximate Analysis					
Dry matter%	95.62	96.10	95.49	95.82	95.89
Crude Protein%	22.93	19.87	17.85	15.92	13.88
Ether extract%	4.78	4.35	7.34	5.63	6.85
Crude Fibre%	3.87	4.71	5.83	4.26	4.98

*Provided per kg of diet, Vitamin A (8000IU); Vitamin D_3 (1, 200IU), Vitamin E (31IU), Vitamin K_3 - KASTAB (2mg), Vitamin B_2 - Riboflavin (8mg), Vitamin B_3 - Nicotonic acid (10mg), Vitamin B_5 - Panthothanic acid (150mg), manganese (mn) (180mg), Zinc (ZN) (50mg); Copper (CU) 2mg), Iodine (I) (1.2mg), Cobalt (Co) (0.2mg), Selenium (Se) (0.1mg)

regimens as to determine an acceptable feeding standard for broilers in the tropics. Presently, the conventional feeding of broilers involves two or three diets (Broiler starter, growers and finisher feeds) with varied dietary protein and probably energy levels in a space of only 8 to 10 weeks when they are expected to reach market weight. This often makes broiler feeding to be cumbersome especially for poultry farmers who are practicing on- farm feed production. The objective of this study was therefore to determine the use of a single dietary crude protein regimen as an alternative to the conventional systems of feeding broilers, the parameters of interest being the performance and carcass characteristics as well as economics of broiler production.

Materials and Methods

Three hundred and twenty (320) Anak broiler chicks were randomly divided into four treatment groups of average equal body weights. The broilers were fed either one, two, or three of the experimental diets in Table 1. The experimental diets were formulated to be isocaloric each containing 3,000 kcal/kg of metabolizable energy. Thus the treatments were variations of dietary crude protein levels and the time of feeding. Each of the four groups consisted of 4 replicates of twenty birds per replicate, all housed in electrically heated battery brooders. Three groups of broilers were placed on three conventional feeding regimens therefore served as controls for broilers in the fourth group.

Broilers in group 1(G_1) were fed diets containing 23% CP 0 - 3 weeks, 20% CP 3 - 6 weeks and 16% CP 6 - 8 weeks, while those in group 2 (G_2) were fed diets containing 23% CP 0 - 6 weeks and 14% CP 6 - 8 weeks. Also broilers in group 3 (G_3) were fed 20% CP 0 - 4 weeks and 16% CP 4 - 8 weeks; while those in group 4 (G_4) were fed 18% CP 0 - 8 weeks. Feed and water were supplied *ad libitum* throughout the duration of the study which lasted for 8 weeks. Weekly data of feed intake and weight gain were collected. A metabolic study was conducted during the 3rd week of the experiment. Weighed quantities of feed were supplied and faecal samples collected over a 72 hour period using the total collection method. The faecal samples collected were oven dried at 60°C for 24 hours, weighed, ground and stored in refrigerator prior to chemical analysis. The proximate compositions of nutrients in the feed and faecal samples were determined, using methods of AOAC (1980).

At 8 weeks, 10 birds were randomly selected from each of the four treatment groups, weighed and after being starved for 18 hours, were killed by cervical dislocation. Each bird was plugged, to determine the weight of the feathers. The carcasses were eviscerated to determine the carcass weight, liver and clean gizzard weights. The adipose tissue surrounding the gizzard and intestine, extending within the ischium and surrounding the cloaca, bursal of fabricius and adjacent abdominal muscles was collected and weighed as the abdominal fat. Carcasses were carefully cut and breast meat

Table 2: Performance and nutrient utilization of broilers fed different dietary crude protein (CP) regimens (0-8 weeks)

Parameter	G_1	G_2	G_3	G_4	SEM
Feed intake (g)	4462[a]	4485[a]	4226[b]	4133[b]	25870
Body weight gain (g)	1699[a]	1656[a]	1510[b]	1562[b]	13917
Feed gain ratio	2.63[b]	2.71[ab]	2.80[a]	2.65[b]	0.15
% Mortality	3.62	0.00	3.62	0.00	4.65
Nutrient Utilization					
Protein retention	72.35	71.82	69.56	70.28	1.86
Fat Utilization	76.94	75.68	72.89	75.82	0.81
Fibre (Available)	39.28	38.91	40.26	38.62	0.42

SEM – Standard Error of Mean. ab: Within rows, means carrying different superscripts differ significantly (P<0.05)

Table 3: Economics of Broilers subjected to different dietary crude protein (CP) regimens (0-8 weeks)

Parameter	G_1	G_2	G_3	G_4	SEM
Average cost /kg of feed (N)	49.68[a]	45.67[ab]	46.30[ab]	42.11[b]	3.10
Cost of feed intake / N / bird	221.67[a]	204.60[ab]	195.66[b]	174.04[c]	19.82
Revenue at N350 /kg of bird	594.65[a]	579.60[a]	528.5[b]	546.7[b]	30.17
Benefit (N) / bird	372.98[a]	375.00[a]	332.84[b]	372.66[a]	20.38
Cost / benefit ratio	0.59[a]	0.55[b]	0.59[a]	0.47[b]	0.07

SEM – Standard Error of Mean. a,b,c: Within rows, means bearing different superscripts differ significantly (P<0.05)

weights determined. The economic parameters were calculated using the prevailing market prices of ingredient used in the diet and that of broilers on live-weight basis. Data collected were statistically analyzed by analysis of variance (Steel and Torrie, 1980). The Duncan's Multiple Range Test (Duncans, 1955) was used to detect difference among means.

Results

The results of broiler performances and nutrient utilization are shown in Table 2. Feed intake, weight gain and feed to gain ratios were significantly influenced among treatments (p< 0.05). The lowest feed intake was recorded among broilers subjected to dietary CP of 18% from day old to 8 weeks. While the highest body weight gain was recorded among broilers subjected to 23% CP (0-3 weeks) 20%, CP (3-6 weeks) and 16% CP (6-8 weeks). However, the poorest feed to gain ratio was recorded for broilers subjected to 20% CP (0-4 weeks) and finished with 16% CP (4-8 weeks). Mortality percentage was not significantly influenced among treatments (P>0.05), among broilers (P70.05). Nutrient utilization was comparable among treatments (P>0.05). The economics of broiler production as affected by dietary CP regimens is as shown in Table 3. All the economic parameters considered were significantly affected among treatment groups (P<0.05). Average cost/kg of feed and cost of total feed intake per bird were lowest among broilers subjected to 18% CP from 0-8 weeks of age, while the lowest revenue and marginal benefit were recorded for broilers subjected to 20% CP 0-4 weeks and 16% CP 4-8 weeks (P<0.05). However, the best cost/benefit ratio of 0.47 was incured in groups of broilers subjected to 18% CP from 0 - 8 weeks of age (P<0.05).

Data presented in table 4 are the effects of dietary CP regimens on carcass characteristics of broilers. All the parameters examined were significantly influenced (P<0.05).

Carcass weight was lowest in broilers subjected to 20% CP 0 - 4 weeks finished with 16% CP 4 - 8 weeks while the best breast meat yield (333 g) and lowest feather weight (105g) were recorded among broilers fed on 18% CP from 0 - 8 weeks of age (P<0.05).

Also, the highest gizzard weight and one of the lowest abdominal fat pad (% carcass weight) were recorded among broilers started and finished with 18% CP 0-8 weeks (P<0.05).

Discussion

The reduction in body weight gain among treatments followed the same trend as feed intake. However, it is significant to note that broilers started and finished on a single diet containing 18 %CP and 3000 kcal/kg of metabolizable energy were as efficient in feed conversion as those on different dietary CP presented in either 2 regimens (starter and finisher) or 3 regimens (starter, grower and finisher). In some previous studies feeding low protein diets to broiler decreased growth performance (Ferguson *et al.*, 1998; Jacob *et al.*, 1994). It was shown that reducing CP diets by 2% in starter period did not affect body weight gain (Parr and Summer, 1991; Moran and Stilborn, 1996). Hill and Dansky (1950) reported that growth of broiler was reduced when a high energy and low protein diet was fed but the growth was restored when the energy level was lowered. On the other hand, Sunde (1956) found that a ration high in protein and low in energy reduced growth and efficiency of feed utilization. Twinning *et al.*, 1974) reported that broiler chick receiving a low protein

Table 4: Carcass characteristics of Broilers subjected to different dietary crude protein (CP) regimens (0-8 weeks)

Parameter	G_1	G_2	G_3	G_4	SEM
Carcass wt(g)	1413[a]	1463[a]	1350[b]	1428[a]	88.46
Breast meat yield (g)	314[b]	325[a]	300[c]	333[a]	14.31
Feather wt (g)	145.00[a]	122.50[b]	15720[a]	105.00[c]	23.25
Liver wt (g)	441.10[b]	34.20[b]	58.30[a]	66.70[a]	22.69
Gizzard wt (g)	43.8[b]	42.7[b]	66.70[a]	66.80[a]	13.57
Abdominal fat (%carcass wt)	3.56[b]	1.71[b]	5.74[a]	2.15[b]	1.88

SEM – Standard Error of Mean. a,b,: Within rows, means bearing different superscripts differ significantly (P<0.05)

starter had poorer body weight and feed conversion at 4 weeks of age compared to those receiving the required level. However when they subsequently consumed an adequate finisher diet, compensatory growth led to near equal final performance. It has been suggested that protein levels influence feed intake especially in relation with energy level (Al-Ribdawi and Singh, 1989). This is the case in this study as broilers on 18%CP had the lowest feed intake. Rezaei *et al*. (2004) reported that reducing dietary protein with adding 1.5g lys. Hcl/kg diet in starter and grower period (bases on 12.12 MJ ME/kg diet) could be suitable for improving body weight gain, feed efficiency and breast meat yield for Ross broiler chicken. With comparable carcass weight, the best breast meat yield and lowest feather weight, it would appear that subjecting boiler to 18% dietary CP and 3000kcal/kg of energy would be useful as a single diet for broiler production. Presumably the birds used most of the dietary protein to produce muscle/meat in an attempt to exhibit compensatory growth. Compensatory growth has been defined as growth that is faster than normal after a period of nutrient restriction. (Bohman, 1955), Compensatory growth has been studied in a number of animals as a means of enhancing weight gain or improving utilization of ingested food (Moran, 1979, Plavnik and Hurwitz, 1989). Breast meat represents a large portion of carcass meat. Breast muscle development is also affected by sex, age, breed and genetics (Moran and Bilgili, 1990). Gizzard weight was significantly increased among treatments especially in broilers started and finished on 18% CP, and those on 20% CP at starting period and 16% CP at finishing period. The diet containing 18% CP had the highest inclusion level of girt, which presumably assisted the gizzard the grinding process and hence led to an increase in the size of the gizzard. This may be an economic advantage where there is good market for gizzard as a delicacy. There was a significant reduction in abdominal fat percentage for broiler that received 18% CP from day old to 8 weeks as well as those that received 23%CP 0-6weeks and 14% CP 6-8 weeks. This might be a means of controlling this factor that downgrades carcass quality. The economic factor showed that a single dietary CP of 18%, 3000kcal/kg of energy compared favourably with the various conventional regimens of feeding broilers. More importantly, low cost/benefit ratio an economic factor which is more constant is best achieved with a single dietary 18% CP and 3000Kcal/kg ME as used in this study. Cost per unit of production has been suggested to be the best determinant of what constitutes the best feed for the animal (Atteh, 2002). An excellent but costly feed will enhance good growth but the cost per unit of production of the feed may make it uneconomical.

In conclusion although the use of 18% CP and 3000kcal/kgME regimen did not directly improve body weight gain, it might be speculated that the feed intake reduction, comparable feed gain ratio, best carcass and breast meat yields and reduced abdominal fat pad are enough incentives for the use of such feeding regimen. Also the reduction in cost/benefit ratio of broiler position is an added advantage. Furthermore, the use of a single dietary regimen as applied in this study for broiler production is important for the production setting in Africa where poultry farmers practice on-farm feed production as it would be much easier to produce and apply such feeds on farm than the use of two or even three grades of feed within the space of eight weeks.

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