Effects of varying protein levels on broiler performance when dietary energy levels remain constant

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SUMMARY

In a 9- week long study, three hundred 5-day-old Cobb-100 commercial broiler chicks were fed five isocaloric diets containing 19, 20, 21, 22 and 23 per cent crude protein respectively. Feed and water were supplied *ad libitum*. Feed intake, final body weight and body weight gain significantly ($P<0.05$) increased with increases in dietary crude protein. Feed-conversion efficiency was not significantly influenced by protein level, although birds receiving the 23 per cent protein diet were numerically superior. In addition, protein level did not significantly influence chick mortality and carcass characteristics including dressing percentage, liver, viscera and feathers. Birds on the 21 per cent protein diet gave the best profit over cost of production.

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RÉSUMÉ

OSEI, S.A. & EFFAH-BAAH, K.: *Effets de différents niveaux de la protéine sur la performance du poulet dans des conditions de niveau de l'energie constant*. Dans une étude de neuf semaines de durée, trois cents oisillons du type Cobb-100 ont été données des nourritures pour volaille de même teneurs en energie mais avec des teneurs en protéine brut différents: 19, 20, 21, 22 et 23 %. Les nourritures et de l'eau etaient données librement. La quantité de la nourriture mangé, le poids final et le gain du poids ont significativement augmenté avec l'augmentation de la protéine brut ($P<0.05$). L'efficience de la conversion de la nourriture n'était pas significativement influencé par le niveau de la protéine, bien que les oisillons qui ont reçu la nourriture de 23 % de la protéine étaient numeriquement supérieur. En plus, le niveau de la protéine n'a pas significativement influencé la mortalité d'oisillon et les caractères de carcasse, y compris le pourcentage de la présentation, le foie, les viscères, et les plumes. Les oisillons données la nourriture de 21% protéine ont donnée le plus haut rentabilité par rapport au coût du production.

Introduction

The lack of adequate knowledge of the nutrient requirements of poultry has been a major setback to the efficient development of the industry in tropical countries. In the West Africa subregion, attempts have been made to rectify the situation. Olomu (1976) recommended a dietary protein level of 23 per cent combined with a metabolizable energy of between 2800 and 3000 kcal/kg for starting broilers. Babatunde & Fetuga (1976) concluded from their work that the respective protein requirements of broiler starters and finishers should be 24 and 18 per cent but they did not report the effects of energy on protein requirements. Olomu & Offiong (1980), however, recommended a protein level of 23 per cent and an energy level of 2800-3000 kcal ME/kg for finishers. In Ghana, feed manufacturers generally formulate a combined starter-finisher diet containing 21-22 per cent protein and 2800-2900 kcal/kg ME.

In the light of this, it was felt that a determination of the protein requirements of broilers under isocaloric dietary conditions would contribute to a clearer definition of protein requirements. This study was, therefore, undertaken to study the requirement of the broiler fowl for protein when

dietary energy levels are constant.

Materials and methods

The experiment was conducted at the Poultry Section of the University of Science and Technology, Kumasi. This location lies within latitude 06° 43'N and longitude 01° 36' W (Jollans, 1960), and is generally described as being a hot, humid forest zone. Rainfall averages 1510 mm/annum. Temperatures generally fluctuate between 22 (minimum) and 35 °C (maximum) on a daily basis.

Three hundred 5-day-old unsexed Cobb-100 commercial broiler chicks (obtained from the University Hatchery) were individually weighed and then randomly distributed in equal numbers over five dietary treatments containing 19, 20, 21, 22 or 23 per cent crude protein. Each treatment was replicated twice (30 chicks per replicate). The composition and calculated analysis of the diets is presented in Table 1. Each diet contained approximately 2900 kcal/kg ME (12.15 MJ/kg) and was formulated as a combined starter-finisher diet. Feed and water were supplied *ad libitum*.

The birds were housed in 10 deep litter pens with a floor space of approximately 0.14 m^2/bird. The following parameters were studied: feed consumption, growth rate, feed conversion efficiency and carcass parameters. In addition, cost of feed and profit per broiler were calculated. Feed consumption, growth rate and feed conversion efficiency were calculated at weekly intervals and also at the end of the experiment. After the last weighing, two birds were randomly selected per treatment replicate, reweighed and used for carcass parameter studies. These birds were killed by cutting the throat with a sharp knife. They were

TABLE 1

Composition and Calculated Analysis of Experimental Diets

Ingredients (kg)	*Crude protein levels (%)*				
	19	*20*	*21*	*22*	*23*
Maize	59.5	58.4	57.2	56.4	54.3
Fishmeal	17.0	19.0	20.6	22.4	24.4
Rice bran	10.0	9.5	9.0	8.3	8.4
Wheat bran	12.0	11.0	12.3	12.0	12.0
Oyster shell	0.7	0.5	0.1	0.1	0.1
Salt	0.5	0.5	0.5	0.5	0.5
Premix[1]	0.3	0.3	0.3	0.3	0.3
Calculated nutrient composition[2] (DM basis)					
Crude protein (%)	19.0	20.0	21.0	22.0	23.0
Fibre (%)	4.0	3.9	3.8	3.7	3.7
Ether extract (%)	5.2	5.2	5.3	5.3	5.4
Calcium (%)	1.2	1.2	1.1	1.2	1.3
Available phosphorus (%)	0.63	0.69	0.73	0.78	0.83
Lysine (%)	1.06	1.15	1.29	1.29	1.37
Methionine (%)	0.46	0.50	0.51	0.54	0.57
Cystine (%)	0.29	0.30	0.31	0.31	0.33
Metabolizable energy (kcal/kg)	2902	2904	2914	2910	2905

[1]Provided per kg vitamins A (2,000,000 IU), D (400,000 IU), E (2000 IU) and Se. (20 mg), Mo. (200 mg) and Cu (900 mg).

[2]Based on proximate analysis of respective ingredients performed at the Nutrition Laboratory, Animal Science Department, UST, Kumasi, Ghana.

allowed to bleed for 5 min and then reweighed. The difference in the two weights was taken as the blood weight. Feathers were then removed by hand following a hot water scald. The defeathered carcass was weighed and the loss in weight was taken as feather weight.

Carcasses were eviscerated by hand and the weights of total viscera and liver were recorded. The dressing percentage was then defined as the ratio of eviscerated weight to liveweight multiplied by 100.

Data were subjected to the analysis of variance technique and significant differences among means separated using Duncan's multiple range test (Steel & Torrie, 1960).

broilers. He attributed the polyphagia to the fact that high protein diets induce appetite in chickens. Olomu & Offiong (1980), on the other hand, observed no significant effects of dietary protein levels from 17 to 23 per cent on feed consumption.

The average final liveweights were significantly ($P<0.05$) affected by protein levels with birds receiving the 19 per cent protein diet being the lightest (1.75 kg/bird). This compares with 1.83, 2.05, 1.95 and 2.06 kg/bird for birds fed 20, 21, 22 and 23 per cent protein diets respectively. Similarly, liveweight gains were significantly improved by the high protein diets (1.70, 1.78, 2.00, 1.90 and 2.00 kg/bird for broilers on 19, 20, 21, 22 and 23 per cent crude protein respectively. As stated earlier, birds

TABLE 2

Live Performance, Carcass Characteristics and the Economics of Production of Broilers

Parameter	*Crude protein levels (%)*				
	19	*20*	*21*	*22*	*23*
Average total feed intake (kg/bird)	4.63 ± .50^{b}	4.76 ± .55^{a}	4.96 ± .41^{c}	4.76 ± .48^{a}	5.04 ± .60^{c}
Average initial body weight (g)	54.3	5.36	54.8	52.7	55.7
Average final liveweight (kg/bird)	1.75 ± .10^{a}	1.83 ± .12^{ab}	2.05 ± .20^{b}	1.95 ± .17^{ab}	2.06 ± .19^{b}
Average body weight gain (kg/bird)	1.70 ± .08^{a}	1.78 ± .10^{ab}	2.00 ± .18^{c}	1.90 ± .18^{b}	2.00 ± .20^{c}
Feed conversion efficiency (kg feed/kg gain)	2.74 ± .19	2.68 ± .15	2.49 ± .20	2.5 ± .20	2.52 ± .16
Dressing percentage	67.4 ±2.4	6.2 ±2.9	68.5 ±1.9	67.9 ±3.0	68.5 ±3.0
Viscera weight[1]	12.5	15.7	14.2	14.5	13.9
Liver weight[1]	1.9	1.9	2.1	2.0	2.0
Feather weight[1]	6.5	5.8	5.0	6.3	5.9
Cost/kg feed (US dollars)	.17	.18	.18	.19	.19
Profit/bird (US dollars)	.41	.44	.58	.51	.53

a, b, c - mean in a row with different superscripts significantly different ($P < 0.05$)
1 - percent of liveweight

Results and discussion

Summaries of results are presented in Table 2. Feed consumption was significantly increased ($P<0.05$) by protein levels above 19 per cent and reached a maximum intake of 5.04 kg/bird/9 weeks at the 23 per cent protein level. These results are in agreement with the earlier work of Smith (1967) who observed that an increase in protein from 15 to 23 per cent induced an increased feed intake by

on higher protein levels consumed significantly more feed; at high levels of feed intake, relatively more nutrients will be made available to the birds for growth (Abrams, 1961). In addition, there was a tendency towards improved feed utilization efficiency as protein levels increased above 19 per cent. These two factors may explain the better growth of birds on higher than 19 per cent crude protein. Reddy, Siddique & Reddy (1972) similarly observed better growth rates in birds fed 21 or 23

per cent protein than those on 18 or 19 per cent crude protein.

Feed conversion efficiency progressively improved although non-significantly as protein content of the diets increased above 19 per cent. Babatunde & Fetuga (1976) in Nigeria have reported significantly improved feed conversion efficiency as dietary protein level increased from 14 to 24 per cent. A trend towards better feed conversion efficiency indicates the birds increased ability to convert high protein diets into useful product.

Data on carcass parameters and the economics of production are shown in Table 2. Differences in protein content of diets did not significantly ($P<0.05$) influence carcass characteristics, including dressing percentage and weights of viscera, liver and feathers. These results corroborate earlier observations by Olomu & Offiong (1980) who fed broilers diets containing as high as 26 per cent protein.

The cost per kilogram of feed proportionally increased as protein level was increased, reflecting the cost of fishmeal which is the main protein source for poultry feeding in Ghana. On the other hand, profits/bird (defined as sale price of broiler minus costs of day-old chicks, feed and medication) increased as protein levels were increased. The highest profit was obtained with birds on 21 per cent protein. Feed accounts for up to 80 per cent of the variable costs in the production of poultry in Ghana (Inkumsah, 1971). It is essential, therefore, that the protein level that will optimize profit be used in feed formulation. Based on this criterion and the fact that birds on 21 per cent protein performed as well as those on 22 or 23 per cent protein, it is recommended to include 21 per cent protein where broilers are fed combined starter-finisher diets.

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