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The Effect of Animal and Plant Protein-Based Diets on the Crude Protein Requirement of Cockerel Starters

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Target audience: Animal scientists, Nutritionists, Poultry farmers, Feedmillers and Extension agents.

Abstract

The effect of dietary protein sources on the crude protein (CP) requirement of the Black Olympian cockerel starters was studied in an experiment that lasted for 5 weeks. Diet dilution technique was employed to formulate summit diets (SD) I and II based on animal and plant protein sources and containing CP of 280.4g/kg and 281g/kg on as-fed basis respectively and a low-protein (25.6g/kgCP) dilution mixture (DM). Both SDs and DM contained 2600kcal ME/kg. Each SD was serially diluted with DM to produce the treatment diets containing 180,200,220,240 and 260g/kg CP. Two commercial dies were also included (for comparison) to make a total of 12 treatment diets. They were fed ad libitum to a total of 192 birds.

Mean daily weight gain and feed conversion ratio were improved ($P<0.05$) as dietary protein level increased, especially with the plant protein-based diets. Birds receiving diet F(18%CP plant protein-diet) had the poorest ($P<0.05$) daily weight gain and feed conversion ratio compared with diets B(animal protein-based) and I (plant protein-based) which satisfied the protein requirement of the birds for optimal performance. Feed cost per unit weight gain on diet B which contained 20%CP and diet I which contained 24%CP were almost the same and cheaper than with any other diets. It is therefore concluded that 20 and 24CP levels in the animal and plant protein-based diets respectively would satisfy the protein requirement of cockerel starters for optimal growth rate at minimal cost of feeding per unit gain. Variation in the recommended requirement values by different authors is partly due to the quality of dietary protein sources as exemplified by fish meal and bloodmeal versus soyabean meal and groundnut cake-based diets used presently. This should be borne in the minds of poultry farmers and feed millers alike.

Keywords: Animal protein, plant protein, crude protein, cockerels, diet dilution technique.

Description of Problem

Results of the crude protein (CP) requirement studies for cockerel starters have been sparse and variable. It has been indicated by (8) that 20%CP diet would meet the need of cockerel and pullet starters for normal growth. while (2 and 5) and Okosun(5) also reported that CP requirement should be 21% (9) reported that 18-20%CP diet also satisfied the requirement of cockerel starters for best feed conversion value. Published studies conducted at Oyo State College Education, Oyo (11,12) also revealed that CP requirement of cockerels should be 22% with diets based on the combination of animal and plant protein sources at dietary metabolisable energy content of 2600Kcal/kg.

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Earlier reports by 3, 4, 5 and 7 among others have indicated deficiencies of lysine and methionine in plant protein sources such as groundnut cake, cottonseed meal and palm kernel cake among others compared with the animal protein sources such as fishmeal. These reports imply higher crude protein requirement values for different classes of the poultry with plant protein-based diets. This is because the requirement for protein is the requirement for the essential amino acids. The results of studies by (7) and (3) among others for broiler finishers and pullet starters respectively demonstrated this nutritional principle empirically for feed formulation practices by poultry farmers and feed millers.

Furthermore, for the reason of feed cost reduction by the poultry farmers and profit maximization by the feed millers, poultry diets are usually based cheaper plant protein sources unsupplemented or supplemented with synthetic amino acids in Nigeria. However, for optimal performance of the stock, the quality of feeds should not be compromised in an effort to minimize cost of feeding. Therefore this study was designed to investigate the effect of animal and plant protein-based diets on the CP requirement of cockerel starters and to recommend accordingly the requirement value of this nutrient for optimal performance at minimal cost of feeding.

Materials and Methods

Experimental Birds and their Management

A total of 192 day-old Black Olympian chicks were bought from the Poultry Investigation Centre, Fasola near Oyo. They were divided on equal weight basis into 12 treatment groups of 16 birds each at a week-old for the experiment which lasted for five weeks. There were two replicates per treatment and each replicate group was fed and watered *ad libitum*. Birds were managed in deep litter pens and each pen was equipped with 100 watt electric bulb, brooding box, drinker, feeder and a lantern (for use when there was power failure).

Birds had been given intra-occular vaccination against Marek's disease at day-old from the Hatchery. Vitalyte and Neoceryl plus were administered to chicks against stress and bacterial diseases through drinking water from day-old to seven days of age. Embazin forte and Esb2 30% were also included in drinking water against coccidiosis at 2-3 weeks and 5-6 weeks respectively. First and second doses of Gumboro vaccine were administered via drinking water containing powdered milk at second and fourth weeks of age. New castle disease vaccine (Lasota) was also administered at fifth week of age.

Treatment Diets

Two summit diets, SDI and SDII based on animal and plant protein sources respectively were formulated to contain 280.4 and 281g/kg crude protein (CP) in greater excess of the recommended protein requirement of the starter chicks. A low-protein (25.6g/kgCP) dilution mixture (DM) was also formulated according to the principles of diet dilution technique as described by Salami and Boorman(10) (see Table 1). Both summit diets (SDI and SDII) and dilution mixture (DM) contained same level of metabolisable energy (ME) of 2600kcal/kg. Pearson square method was used to serially dilute both SDS with DM (on the basis of their calculated CP contents) to produce a total of 10 treatment diets (A-J) of graded CP levels of 180, 200, 220, 240 and 260g/kg for each summit diet. Two commercial diets K and L based on both animal and plant **protein** sources (and whose ME and CP contents were not specified by the manufacturers) were also included to make up twelve treatment diets.

Measurements

Birds and feeds were measured on weekly basis to determine feed intake, weight gain and feed conversion ratio for the entire five weeks of the experiment.

Chemical and Statistical Analyses

Samples of both summit diets (SDI & SDII) and Dilution Mixture (DM) were analysed for their proximate composition according the standard methods of AOAC (1). Live performance data were subjected to analysis of variance and Duncan's multiple range test was also used to compare the treatment means (13).

Feeds Cost Analysis

The cost of both SDs and DM used to produce the treatment diets and the cost of treatment diets was computed using the ruling prices of the feed-stuffs at the time of experiment (Tables 1&2).

Table 1: Composition of Summit Diets and Dilution Mixture (g/kg).

FEED INGREDIENTS	N/Kg	SDI	SDII	DM
Maize	34.00	385.00	250.00	-
Cassava root meal (Lafun)	30.00	-	-	620.00
Groundnut cake	33.00	-	310.00	-
Soyabean meal	53.00	-	270.00	-
Rice offal	3.00	255.00	140.00	330.00
Blood meal	26.00	140.00	-	-
Fish meal	135.00	190.00	-	-
Palm oil	82.50	-	-	20.00
Bone meal	19.00	15.00	15.00	15.00
Oyster shell	15.00	10.00	10.00	10.00
Premix	350.00	2.50	2.50	2.50
Salt	17.50	2.50	2.50	2.50
TOTAL	-	1000.00	1000.00	1000.00
N/kg	-	44.50	34.81	22.56
CALCULATED FRACTIONS:				
Crude protein (g/kg)		280.40	281.00	25.60
Crude fibre (g/kg)		42.88	55.62	62.99
Ether extract (g/kg)		57.37	55.75	44.35
Metabolisable energy 2606-00 (Kcal/kg)		2607.49	2601.60	2601.60
DETERMINED FRACTIONS:				
Crude protein (g/kg)		290.40	295.70	29.50
Crude fibre (g/kg)		134.60	148.80	194.20
Ether extract (g/kg)		40.30	6.46	65.00
Moisture content (g/kg)		87.60	96.50	91.60
Ash (g/kg)		162.20	98.80	107.00

Table 2: Composition of Treatment Diets Produced from SD1, SDII and DM by Pearson square method (g/kg)

Protein Sources	Treatment Code	Dietary Level CP (g/kg)	ME(kcal/kg)	Proportion of: SD (g/kg)	DM(g/kg)	Price (N/kg)
ANIMAL PROTEIN-BASED DIETS	A	180	2606.39	606.20	398.80	35.87
	B	200	2606.61	684.72	315.28	37.59
	C	220	2606.83	763.24	236.76	39.31
	D	240	2606.05	841.76	158.24	41.03
	E	260	2607	920.28	79.72	42.75
PLANT PROTEIN BASE DIETS	F	180	2603.00	606.63	393.32	30.00
	G	200	2602.78	685.28	314.72	30.97
	H	220	2602.56	762.84	236.16	31.94
	I	240	2602.34	842.44	157.56	32.88
	J	260	2602.12	921.00	76.00	33.85
COMMERCIAL STARTER DIETS	K	NS	NS	NA	NA	32.00
	L	NS	NS	NA	NA	35.00

NS = Not specified by manufacturers
NA = Not applicable.

Results and Discussion

The results of this trial show that the treatment diets had significant ($P<0.05$) influence on the birds. Performance of birds fed animal protein were significantly ($P<0.05$) better than those fed on plant protein diets (Tables 3 & 5). This is in line with several reports (3.4.7) that animal protein-based diets promoted better performance than plant protein-based diets. This shows that animal protein-based diets are superior in quality to plant protein-based diets since the latter are mildly deficient in lysine and methionine as indicated in the earlier reports (3,4,5,7).

Table 4 shows the responses of the birds fed different levels of CP regardless of the source of protein and those fed the two commercial diets (control). Daily weight gain and feed conversion ratio (FCR) were improved as the level of CP increased with both protein sources up to 22% CP beyond which there was no significant improvement. Similar results had earlier been obtained for cockerel starters with diets based on the combination of animal and plant protein sources in this institution (11,12).

The mean daily weight gain and mean feed conversion ratio of birds were significantly ($P\leq0.05$) improved as the CP levels increased from 18 to 20%CP with both protein sources (Table 5). This supported the submission of (8) among others who reported that protein is an essential nutrient in poultry diets. However, there were no significant ($P>0.05$) difference in the performance of birds fed diets B to E. Birds fed diets A and F consumed more feed while those fed diets B to E and G to J consumed less. This is in accordance with the observations of (6) and (11 & 12) among others who reported respectively that broilers and cockerel starters fed low-protein diets increased their feed intake presumably in an effort to overcome the deficiency of protein in the diets.

It is evident from Table 5, that as the dietary CP level increased cost per gramme of the diets were also increased as previously reported (10,11,12). However, feed cost per unit of weight gain (kobo) was reduced with diets B, I, K and L which was about 12 kobo, indicating that the diets satisfied the protein needs of the recipient stock. It was lowest on these diets than diets F and H (plant protein-based diets) which were about 18 and 14 kobo respectively. The relatively higher cost of feeding per unit of gain as recorded for diets F, G and H was attributed to over consumption of the diets in a bid to satisfying the CP needs of the birds (10,11,12). Thus poor quality feed especially in respect of dietary crude protein content would increase the cost per unit of output while good quality diet would decrease cost of feed per unit gain.

The result of this study shows that protein requirement of cockerel starters during 1 to 6 weeks of age would be satisfied with 20%CP with animal protein-based diet in accordance with Njike (3) and in contrast to 21%CP level indicated for starter chicks by MC Donald *et al.* (2) and Okosun (5).

The recommendation of 24%CP with plant protein-based diet is also in agreement with Njike (3) who reported that 24%CP with plant protein-based diet without supplementation of fish meal and lysine or methionine satisfied the requirement of starter chicks.

Table 3: Performance characteristics of cockerel starters fed animal and plant protein-based diets during 1 to 6 weeks of age.

Performance Parameters	Protein sources: Animal protein -based diets	Protein sources: Plant protein -based diets	±SEM
[1]IMBW(g/b)	74.56[a]	74.68[a]	0.25
[2]MDWG(g/bd)	16.44[a]	14.23[b]	0.47
[3]MDFI(g/bd)	54.83[b]	59.37[a]	0.29
[4]MFCR	3.21[a]	4.29[b]	0.07
[5]FMBW(g/b)	649.63[a]	572.58[b]	7.26

[1,2,3,4,5]Refers to initial mean body weight, mean daily weight gain, mean daily feed intake, mean feed conversion ratio and final mean body weight respectively.

[a,b]Means bearing identical superscripts are similar (P>0.05) while those with unidentical superscripts differ (P<0.05).

Table 4: Performance characteristics of cockerel starters fed different protein levels during 1 – 6 weeks of age.

Parameters	Protein Levels (%): 18	20	22	24	26	Control Diet	±SEM
[1]IMBW(g/b)	74.64[a]	74.27[a]	75.00[a]	74.64[a]	74.27[a]	74.89[a]	0.44
[2]MDWG(g/bd)	13.12[b]	14.83[ab]	15.19[ab]	16.39[a]	16.80[a]	15.68[ab]	0.82
[3]MDFI(g/bd)	61.59[a]	56.75[b]	57.24[b]	55.94[b]	57.18[b]	53.92[c]	0.50
[4]MFCR	4.82[c]	3.76[bc]	3.84[bc]	3.41[ab]	3.43[ab]	3.45[ab]	0.11
[5]FMBW(g/b)	533.66[c]	593.15[b]	605.48[b]	647.94[a]	661.92[a]	623.51[ab]	12.57

[1,2,3,4,5]See footnote to Table 3
[a,b,c]See footnote to Table 3

Table 5: Interaction effect of different protein sources and levels of protein on live performance characteristics of cockerel starters during 1 to 6 weeks of age.

Performance Parameter	Animal Protein-Based Diets Protein Levels (%)					Plant Protein-Based Diets Protein Levels (%)					CONTROL DIETS		
	A 18	B 20	C 22	D 24	E 26	F 18	G 20	H 22	I 24	J 26	K CP not Specified	L	±SEM
[1]IMBW(g/b)	75.00^{a}	74.27^{a}	76.27^{a}	74.27^{a}	74.27^{a}	74.27^{d}	74.27^{a}	75.00^{a}	75.00^{a}	74.21^{a}	74.52^{a}	75.25^{a}	0.62
[2]MDWG(g/bd)	15.38^{ab}	25.83^{ab}	16.59^{ab}	16.82^{ab}	17.60^{ab}	10.88^{c}	13.58^{bc}	13.49^{bc}	15.95^{ab}	15.99^{ab}	16.41^{ab}	14.95^{ab}	1.16
[3]MDFI(g/bd)	56.78^{d}	54.99^{df}	54.87^{df}	52.80^{f}	53.94^{f}	66.40^{a}	56.50^{de}	59.61^{bc}	59.08^{bc}	60.41^{b}	53.61^{f}	54.27^{ef}	0.70
[4]MFCR	3.53^{bc}	3.30^{abc}	3.34^{bc}	3.10^{ab}	3.01^{ab}	6.10^{f}	4.19^{d}	4.33^{cd}	3.17^{cd}	3.78^{cd}	3.40^{abc}	3.70^{bc}	0.16
[5]FMBW(g/b)	612.43^{bcde}	628.32^{abc}	656.48^{ab}	662.79^{abc}	690.09^{a}	454.89^{f}	547.57^{de}	547.45^{c}	666.08^{abc}	633.74^{abc}	648.69^{abc}	598.33^{cde}	17.78
<u>Cost of Production</u>:													
[6]Cost/g feed (kobo)	3.59	3.79	3.93	4.0	4.28	3.0	3.10	3.11	3.29	3.39	3.50	3.20	-
[7]Feed cost/g live weight gain (kobo)	12.66	12.41	13.13	12.12	13.12	18.30	12.97	13.47	12.20	12.79	11.90	11.84	-

[1,2,3,4,5]See footnote to Table 3
[6]Computed from Table 2
[7]Obtained as the product of FCR and cost per gramme diet
[a,b,c......f]See footnote to Table 3

Conclusions and Applications

1. Weight gain and feed conversion ratio were optimized minimal cost of feeding (about 12 kobo) in birds fed with diets B and I beyond which there was no significant benefit for increasing dietary CP level with the two types of diets.
2. It is evident that feeding of cockerel starterS with CP level higher than 20%CP with animal protein-based diet and 24%CP with plant protein-based diet may not be profitable and is also a waste of the costly protein fraction of the diet.
3. Feed millers and poultry farmers should therefore mind the variation in the recommended crude protein requirement of monogastric stock such as the cockerel starters with respect to dietary protein source(s) used in feed formulations.

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