Growth Performance and Economy of Isa-Brown Grower Cockerels (7– 12 weeks) fed Varying Dietary Energy and Protein Levels in the Southern Rainforest Zone of Nigeria

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Abstract
This study was carried out at the University of Uyo Teaching and Research Poultry Farm unit, a southern rainforest zone of Nigeria to ascertain the optimal dietary energy and protein requirements of Isa-brown grower cockerels (7 - 12 weeks). Three metabolizable energy (ME) levels (2800, 2900, 3000 kcal/kg DM) and four crude protein (CP) levels (16, 18, 20, 22%) were assessed across 12 diets using a 3 × 4 factorial experiment arrangement in a completely randomized design (CRD). A total of 360 six-week-old Isa-brown cockerels were randomly assigned to 12 treatment groups. Each group was replicated three times with 10 birds per replicate. Growth performance, Feed conversion ratio, Energy and protein intakes as well as Economic parameters were evaluated. Result showed that birds fed with 2800 kcal/kg ME and 22% CP diet had the highest final body weight and weight gain while those on 2900 kcal/kg ME and 20% CP was the diet with the least cost of feed intake per kg body weight gain. Variations in energy levels did not significantly affect Feed Intake (FI), Body Weight Gain (BWG), Protein Intake (PI) and Metabolizable Energy Intake (MEI) ($P > 0.05$), but differences in Crude protein levels had a significant effect on FI, PI and MEI. In conclusion, for Isa - brown grower cockerels (7 -12 weeks) optimal performance in southern rainforest zone of Nigeria at a least cost feed, it is recommended to use diet containing 2900 kcal/kg ME and 20% Protein.

Keywords: Grower cockerel, Energy, Protein, Growth performance, Economic analysis

Description of Problem

There is no commercial feed for cockerels in the market as cockerel production and management become the neglected sector of animal production. Few farmers that keep cockerels use layer diets meant for pullets as their feed (6). This accrues higher production costs, inadequate growth, and poor feed to meat conversion ratio (2). The non-availability of data on prevailing environmental conditions or local climate for grower cockerels' metabolizable energy (ME) and crude protein (CP) requirements worsens the problem (8). To fill this knowledge gap and promote the production of poultry meat through cockerel production, this study examines how different levels of ME and CP affect grower cockerels (7 – 12 weeks) performance and economic efficiency.

Materials and Methods

The study was conducted at the University of Uyo Teaching and Research Poultry Farm, which is situated in the southern rainforest zone of Nigeria (4°57'N, 7°53'E) and has an average annual temperature of 27.5°C and 2000 mm of rainfall in each year (7). Twelve experimental diets that had three ME levels (2800, 2900, and 3000 kcal/kg) and four CP levels (16%, 18%, 20%, and 22%) in a 3 × 4 factorial arrangement in a Completely Randomized Design (CRD) were used throughout the duration of the trial. White maize, full-fat soybean meal, palm kernel cake, wheat offal, imported fishmeal, bone ash, lysine, methionine, and a premix were the diet ingredients (Table 1 shows the percentage composition of the experimental diets used in the study). 360-day-old cockerels were managed on a deep litter system and fed commercial starter diet to 6 weeks after which they were randomly assigned to 12 cubicles to

receive the experimental diets for six weeks (grower phase). Data on feed consumption and mortality per treatment were collected daily while that of body weight was recorded on a weekly basis. Metabolizable energy intake (MEI), Protein Intake (PI), Feed Intake (FI), Body weight gain (BWG) and Feed Conversion Ratio (FCR) were the parameters calculated. Economic indices measured were the cost of feed intake per bird and the cost of feed intake per kilogram of body weight gain. Duncan Multiple Range Test (DMRT) was used to differentiate treatment means at 5% significance after data were analysed using Analysis of Variance (ANOVA) in GENSTAT (2008).

Results and Discussion

At the end of the trial, it was observed that differences in protein levels and interaction of ME × CP had a significant effect ($P < 0.05$) on the FI, MEI and PI of the birds. Birds on diet 8 (2900 kcal/kg ME, 22% CP) had the highest intake while the least feed intake was from birds fed with diet 3 (2800 kcal/kg ME, 20% CP). This agrees with the findings of (9) who reported that protein levels significantly influenced the feed intake of mamourah cockerels from 6 – 14 weeks. Variations in the energy levels did not have any significant impact on any of the parameters measured. Grower cockerels' final body weight (FBW) varied from 582.73 to 980 g, which was significantly higher than 187.38–197.75 g that (1) recorded for Japanese quails under comparable nutritional replacements. According to (4), dietary energy levels, protein levels, or their interactions did not significantly affect FBW at 12 weeks of age in native hilly hens which aligns with what was obtained from this study. Birds fed diet 7 (2900 kcal ME/kg DM, 20% CP) had the most efficient feed conversion ratio (FCR), though there were no significant differences across the treatment groups. (8) and (2) found no significant effect of energy or protein level variations on FCR in poultry, which is consistent with this observation. Diet 7 (2900 kcal/kg ME, 20% CP) had the least cost per kg weight gain (₦1,094.40), with no significant difference from diets 3, 4, 5, 6 and 9. Variations in energy and protein levels had no significant effect on the cost of feed intake per Kg body weight gain (refer to Table 2 and 3 for results).

Table1: Percentage Composition of grower diets with varying dietary energy and protein levels fed to Isa-brown grower cockerel (7 – 12 weeks)

	Experimental Diets											
Diets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Ingredients (%)												
Maize	57.00	54.10	52.05	50.20	64.00	61.00	60.40	57.20	67.00	63.00	60.05	56.85
Palm Oil	0.50	0.50	0.50	0.50	0.50	0.50	0.20	0.50	2.00	2.00	1.90	2.10
FFSBM	13.60	20.10	26.60	33.70	17.20	22.00	27.30	33.40	16.00	22.00	28.10	34.30
IFM	1.00	1.00	1.00	0.50	0.50	1.00	1.90	2.00	1.90	1.90	1.90	2.00
PKC	9.00	8.70	7.00	4.00	7.00	5.00	1.65	1.30	0.35	0.30	1.80	0.10
Wheat offal	14.35	11.05	8.30	6.05	6.25	5.95	4.00	1.05	8.20	6.25	1.70	0.10
Bone Ash	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
Table Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L- Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
* Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100	100	100
Calculated composition:												
ME	2808	2805	2806	2803	2905	2907	2901	2909	3007	3008	3009	3001
CP	16.05	18.07	20.04	22.09	16.02	18.01	20.04	22.01	16.03	18.04	20.01	22.01
EE	3.98	3.82	3.56	3.20	3.70	3.85	3.32	3.11	3.38	3.34	3.21	2.96
CF	6.45	5.41	4.86	4.17	4.20	4.10	3.38	3.00	3.42	3.35	3.04	2.65
Ca	1.12	1.13	1.14	1.12	1.10	1.12	1.16	1.18	1.12	1.14	1.16	1.17
TP	0.85	0.86	0.87	0.87	0.79	0.81	0.83	0.84	0.80	0.81	0.82	0.83
Lysine	1.20	1.16	1.32	1.29	1.05	1.18	1.36	1.51	1.10	1.21	1.36	1.52
Methionine	0.38	0.43	0.42	0.39	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.40

FFSBM= Full Fat Soya Bean Meal; PKC= Palm kernel cake; ME=Metabolizable Energy; CP= Crude Protein; EE= Ether Extract; Ca= Calcium; TP=Total phosphorus; IFM = Imported fishmeal. *Supplied per Kg diet: Vit. A 4×106 I.U, Tocopherols 4×103 I.U, Vit. K3 800mg, Folacin 200mg, Thiamine 600mg, Cyanocobalamin 4mg, Biotin 8mg, Manganese 3kg, Zinc 20g, iron 3g, choline chloride 80g, copper 2g, iodine 480mg, Cobalt 80mg Selenium 40mg BHT 25g and Anti – caking agent 6g

Table 2: Growth Performance of grower cockerels (7 - 12 Weeks) fed varying dietary metabolizable energy and Crude protein levels

DIET	ME	CP	Initial Body Weight (g)	Daily Feed Intake (g)	Daily Body Weight Gain(g)	Final Body Weight (g)	Feed Conversion Ratio	Daily Protein Intake (g/bird/day)	Daily ME Intake (KcalME/ KgDM)	Cost of Feed Intake Per Bird (₦)	Cost of Feed intake per Kg body weight gain (₦)
1	2800	16	278.93	49.35^{ab}	7.23^{g}	582.73^{f}	6.82^{a}	7.90^{d}	138.19^{b}	782.16^{de}	2563.32^{b}
2	2800	18	277.53	44.26^{de}	9.40^{efg}	672.20^{def}	4.77^{b}	7.97^{d}	123.94^{c}	744.40^{e}	1911.24^{cd}
3	2800	20	280.53	29.67^{i}	10.91^{de}	738.67^{cd}	2.92^{cde}	5.93^{f}	83.08^{f}	530.73^{g}	1242.09^{e}
4	2800	22	275.27	43.89^{de}	16.78^{a}	980.00^{a}	2.62^{de}	9.66^{b}	122.89^{cd}	831.71^{cd}	1180.64^{e}
5	2900	16	278.67	30.20^{i}	12.97^{cd}	823.33^{bc}	2.69^{de}	4.83^{g}	87.57^{f}	515.96^{g}	1094.31^{e}
6	2900	18	287.13	47.43^{bc}	15.51^{ab}	938.67^{a}	3.06^{cde}	8.54^{c}	137.54^{b}	854.25^{bc}	1312.25^{e}
7	2900	20	288	33.12^{h}	14.16^{bc}	882.80^{ab}	2.36^{e}	6.62^{e}	96.05^{e}	645.08^{f}	1094.40^{e}
8	2900	22	276.33	51.48^{a}	8.32^{fg}	625.87^{ef}	6.15^{a}	11.31^{a}	149.29^{a}	1056.28^{a}	3001.09^{a}
9	3000	16	278.07	42.69^{ef}	14.65^{abc}	893.33^{ab}	2.92^{cde}	6.83^{e}	128.07^{c}	790.91^{de}	1288.04^{e}
10	3000	18	268.4	45.77^{cd}	10.09^{ef}	692.13^{de}	4.54^{b}	8.21^{cd}	137.09^{b}	879.99^{b}	2082.54^{c}
11	3000	20	283.07	40.34^{fg}	11.26^{de}	755.93^{cd}	3.59^{c}	8.07^{cd}	121.03^{cd}	811.65^{cd}	1719.61^{d}
12	3000	22	274.67	38.62^{g}	11.40^{de}	753.33^{cd}	3.39^{cd}	8.49^{c}	115.82^{d}	815.18^{cd}	1702.61^{d}
SEM			1.68	1.19	0.51	21.97	0.24	0.28	3.46	24.55	102.34
P value			0.627^{ns}	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**

$^{a-i}$Means along same Column with different superscript are significantly (P ≤ 0.05) different. ME - Metabolizable energy (Kcal/kgDM); CP - Crude Protein, SEM - Standard error of the mean. * - significant (P ≤ 0.05), ** - highly significant (P ≤ 0.01), ns – non significant (P > 0.05)

Table 3: Interaction of metabolizable energy and crude protein on growth Performance of grower cockerels (6 - 12 Weeks) fed varying dietary metabolizable energy and crude protein levels

DIET	ME	CP	Initial Body Weight (g)	Daily Feed Intake (g)	Daily Body Weight Gain(g)	Final Body Weight (g)	Feed Conversion Ratio	Daily Protein Intake (g/bird/day)	Daily ME Intake (KcalME/ KgDM)	Cost of Feed Intake Per Bird (N)	Cost of Feed intake per Kg body weight gain (N)
Effect of metabolizable energy levels											
	2800		278.07	41.79	11.08	743.4	4.28	7.86	117.03	722.25	1724.32
	2900		282.53	40.56	12.74	817.67	3.57	7.82	117.61	767.89	1625.52
	3000		276.05	41.86	11.85	773.68	3.61	7.9	125.5	824.43	1698.2
SEM			1.68	1.19	0.51	21.97	0.24	0.28	3.49	24.55	102.34
P value			0.279^{ns}	0.887^{ns}	0.423^{ns}	0.393^{ns}	0.410^{ns}	0.994^{ns}	0.549^{ns}	0.240^{ns}	0.924^{ns}
E*ffect of protein levels*											
		16	278.56	40.75^{a}	11.62	766.47	4.14	6.52^{c}	1147.95^{a}	696.34^{b}	1648.56
		18	277.69	45.82^{a}	11.67	767.67	4.12	8.24^{b}	132.68^{a}	826.21^{a}	1768.68
		20	283.87	34.38^{b}	12.11	792.47	2.96	6.87^{c}	100.06^{b}	662.49^{b}	1352.03
		22	275.42	44.66^{a}	12.17	786.4	4.05	9.82^{a}	129.33^{a}	901.06^{a}	1961.45
SEM			1.68	1.19	0.51	21.97	0.24	0.28	3.49	24.55	102.34
P Value			0.344^{ns}	0.001**	0.974^{ns}	0.969^{ns}	0.237^{ns}	0.001**	0.001**	0.001**	0.199^{ns}
Interaction, ME × P			0.968^{ns}	0.91^{ns}	0.209^{ns}	0.164^{ns}	0.533^{ns}	0.033*	0.054*	0.063^{ns}	0.154^{ns}

$^{a-c}$Means along same Column with different superscript are significantly (P ≤ 0.05) different. ME - Metabolizable energy (Kcal/kgDM); CP - Crude Protein, SEM - Standard error of the mean. * - significant (P ≤ 0.05), ** - highly significant (P ≤ 0.01), ns - nonsignificant (P > 0.05)

Conclusion and Application

Diet with 2900 kcal/kg ME and 20% CP demonstrated to be optimal with least cost. This combination is hereby recommended for profitable cockerel production in southern rainforest zone of Nigeria. The results of this study offer scientifically supported nutritional recommendations to animal nutritionists, poultry farmers, and feed millers for designing grower diets tailored to cockerels in Southern Rainforest Zone of Nigeria. The ideal nutritional mix of 2900 kcal ME/kg DM and 20% CP allows formulators to maximize weight gain and profitability while also drastically lowering production costs, nutrient waste and improving feed efficiency. Finally, adopting the above recommendations can support national food security initiatives by improving local

meat production via optimal cockerel feeding/nutrition and combating malnutrition.

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