OPTIMUM PROTEIN AND ENERGY LEVELS FOR FOUR GENOTYPES OF LOCAL AND EXOTIC GROWER PULLETS IN THE HUMID TROPICS

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ABSTRACT

TWENTY four dietary combinations of metabolisable energy (ME) levels 2.6-3.2 Mcal/kg and protein levels 14-22%, were fed to equal numbers of 4 genotypes of local x exotic chickens in 2 experiments, to identify the optimum diet for growth under tropical conditions. The diet with ME 3.0 Mcal/Kg and 18% protein proved the most adequate in promoting maximum biological and economic efficiency for growing pullets 8.20 weeks old. Feed consumption was depressed by ME values above 3.0 Mcal/kg ($P < 0.005$) but not by 2.6-3.0 Mcal/kg ME values. Body weights at 140 days were significantly correlated with protein levels but negatively with age at first egg. High protein levels accelerated sexual maturity but the correlation was not significant. The local male x exotic female cross exhibited high heterosis and was equal to or better than the exotic, while its reciprocal cross was nearly as poor as the local, in overall performance. Both groups showed slight indications of dietary specificity but not enough evidence of separate dietary requirements.

INTRODUCTION

The optimum levels of protein and energy for egg type replacement pullets in the growth stage has been investigated by many workers (Kim, 1976; Quisenbury *et al* 1962; Waldroup *et al* 1966; Akuland and Fulton, 1973; Douglas *et al*, 1973; Wright *et al*, (1968). Most of these workers had associated high protein diets (15-17%) at grower stage with accelerated sexual maturity, larger eggs and feed efficiency, higher feed consumption and larger body weight at 140 days when compared with low protein diets (9.27%-13%). On the other hand, reports by McNaughton *et al* (1977), Orr *et al* (1958), Sunde and Bird (1959), Hollands and Gowe (1965), Lillie *et al* (1966) have indicted that dietary protein or energy had

no influence on body weight at 20 weeks, egg weight, egg number, hatchability, fertility, feed requirements or egg quality. Turk *et al* (1961) also reported that high energy and low protein diets caused a delay in sexual maturity, but that any differences in body weight as a result of varying energy and protein levels were usually neutralised around 20 weeks of age.

Protein and energy requirements of the egg type grower pullet have not been extensively investigated under tropical conditions or in relation to various breeds and genotypes which are imported into or developed within the tropics. In a review, Olomu (1979) suggested energy levels of 2400 Kcal/kg for pullets in the tropics. An official panel by the Federal Government of Nigeria also suggested 2.65 Mcal/kg and 16-17% as energy and protein levels respectively for 8-16 week old pullets or 2.65 Mcal/kg and 13-15% for 16-20 week old pullets (Olomu, 1979). The requirements of local chickens for protein and energy also have not been widely studied. Oluyemi (1974, 1979) suggested that the Nigerian indigenous chicken might have a different nutrient requirement from adapted exotic breeds although he did not find any significant diet x genotype interaction.

The objectives of these studies were to identify optimum protein and energy levels for egg type grower pullets of 4 genotype involving the Gold Link exotic strains and the Nigerian local fowl, and to verify the view that low energy diets were more efficacious in the tropics than high energy diets.

MATERIALS AND METHODS

Two experiments were conducted with a total of 336 pullets comprising equal numbers of Local Nigerian Stock, Gold Link (B₁ male and B 72 female) stock and their crosses. The Gold Link is an exotic breed from California, U.S.A., which has Rhode Island Red traits. The local chicken pullets were a random F₁ progeny of parent stock which were hatched from fertile egg of local chickens raised in remote villages in Anambra and Benue State of Nigeria.

Experiment 1 involved 48 pullets of each of the 4 genotypes: Gold Link B1 x Gold Link B72 (GL x GL), Gold Link B72 x Local (GL x LC), Local x Gold Link B72 (LX x GL) and local x local (LC x LC). Two pullets from each genotype were housed together in a battery cage and two battery cages of each genotypes were randomly allotted to each of the 12 experimental diets. The trial was a 4 x 3 factorial design in which genotype, protein and energy levels constituted the main factors while their mutual interactions constituted the subsidiary factors. The 3 — way interaction constituted the error term. The analysis of variance was a completely randomised type as described by Steel and Torrie (1960).

The experimental birds had been raised on deep litter on a 20% protein 2.8 Mcal/kg metabolisable energy diet for 8 weeks. Prior to the experiment, the birds were dewormed and their individual weights taken. Data collection started one week after the birds had been housed in cages and allowed to adjust to the experimental diets.

Feed and water were provided *ad libitum*; the excess water was measured at the beginning of each day which excess feed was measured at the end of every week. Experiment 1 lasted until the birds were 140 days, after which they were weighed and then thinned to one per cage

for total fecal plus urine collection which lasted five days.

The diets used in experiment 1 were compounded by varying the proportions of maize, groundnut cake; rice bran, brewers dry grains and fish meal such that there were four levels of protein viz, 14, 16, 18 and 20% and three ME levels, 2.6, 2.8, and 3.0 Mcal/kg within each protein level, thus producing twelve different diets. The proportions of oyster shell, bone ash, common salt and vitamin-mineral premix were the same in each diet. The composition of experiment 1 is shown in table 1a.

The materials and procedure used in experiment 2 were similar to those described in experiment 1 with these exceptions that:

1. The diets of experiment 2 had different ranges of energy and protein: 2.8 — 3.2 Mcal/kg and 16 — 22%, respectively. The composition of the diet was also different from experiment 1 diets.
2. The genotypes were of a common parent stock but represented a separate hatch.
3. No fecal collection was undertaken in experiment 2 and so no digestibility or nitrogen retention was calculated.
4. The duration of experiment 2 was extended to measure age at first egg (point of lay).
5. Experiment 2 birds were raised on their respective diets (table 1b) from hatch, through 8 weeks and until point of lay.

RESULTS

The performance of pullets in experiment 1 is shown in table 2 while that of experiment 2 is shown in table 3.

Of the nine production parameters evaluated in table 2, six, namely, average daily feed intake, average daily gain, feed-gain efficiency, average daily water consumption, nitrogen retention and body weight at 140 days, were optimised in the diet containing 18% protein and

3.0MCal/kg ME. ($E_{3.0}P_{18}$). The other parameters, protein efficiency ratio (P.E.R.), dry matter digestibility and feed cost per kg gain, optimised at diets $E_{3.0}P_{14}$, $E_{2.6}P_{20}$ and $E_{2.6}P_{14}$, respectively, although the latter 2 comparisons were not significant ($p \leq 0.05$). The values observed in diet $E_{3.0}P_{18}$ were significantly superior to the corresponding values of

the 16% or 14% protein levels with each of the 3 energy levels 2.6, 2.8 or 3.0 MCal/kg ME. In particular, the 14% protein diets with the 2.6 or 2.8 MCal/kg levels were conspicuously poorer than the 14% protein diet with the 3.0 MCal/kg energy level. At the other extreme and 20% diets were also generally inferior to

TABLE 1a
Percentage Composition of Experimental Diets. (Experiment 1)

Ingredients %	DIETS													
	$E_{2.6}P_{14}$	$E_{2.8}P_{14}$	$E_{3.0}P_{14}$	$E_{2.6}P_{16}$	$E_{2.8}P_{16}$	$E_{3.0}P_{16}$	$E_{2.6}P_{18}$	$E_{2.8}P_{18}$	$E_{3.0}P_{18}$	$E_{2.6}P_{20}$	$E_{2.8}P_{20}$	$E_{3.0}P_{20}$	$E_{2.6}P_{20}$	$E_{3.0}P_{20}$
Maize	50	60	64	50	50	55	50	55	56	50	50	50	50	52
G'nut Cake	10	10	12	14	15	16	18	20	22	20	22	22	—	24
Rice Bran	12	8	—	11	7	4	6	—	—	—	—	—	—	—
Brewers Grains	14	8	6	10	10	5	10	5	—	11	7	7	—	—
Fish Meal	3	3	3	4	4	4	5	5	6	8	8	8	8	8
Oyster Shell	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Bone Ash	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Palm Oil	—	—	4	—	3	5	—	4	5	—	2	2	—	5
Common Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vit/Mineral	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Premix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Analysed C.P.%	14.60	14.30	14.00	17.00	16.80	16.20	18.55	18.21	18.85	20.18	20.90	20.90	20.30	20.30
Calculated M.E. (MCal/kg)	2.686	2.796	2.998	2.712	2.835	2.988	2.704	2.938	3.025	2.690	2.804	2.804	2.998	2.998
Cal-Protein Ratio (KCal/g)	18.39	19.55	21.41	15.95	16.87	18.44	14.57	16.13	16.05	13.33	13.41	13.41	14.76	14.76

TABLE 1b

Percentage Composition of Experimental Diets (Experiment 2)

Ingredients %	E _{2.8}	P ₁₆	E _{3.0}	P ₁₆	E _{3.2}	P ₁₆	E _{2.8}	P ₁₈	E _{3.0}	P ₁₈	E _{3.2}	P ₁₈	E _{2.8}	P ₂₀	E _{3.0}	P ₂₀	E _{3.2}	P ₂₀	E _{2.8}	P ₂₂	E _{3.0}	P ₂₂	E _{3.2}	P ₂₂
Maize	55		60		58		55		60		61		55		60		58.67		55		60		59.25	
Rice Bran	13		11		11		11		10		4		7		6		3		3		1		—	
Brewers Grain	11		5		5		10		4		5		8		2		5		6		1		1	
Groundnut cake	15		16		16		18.4		20.4		20.88		23		25		24.83		27		29		28.75	
Fish Meal	1		1.5		2		1.6		1.6		2		3		3		3		5		5		6	
Palm Oil	1		2.5		4		1		1		3.5		4		1		3.5		1		1		3	
Oyster shell	2		2		2		2		2		2		2		2		2		2		2		2	
Vitamin/Mineral																			1		1		1	
Premix	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
Common Salt	0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5		0.5	
Analysed C.P. %	16.08		17.50		19.50		21.66		15.85		18.35		20.35		22.31		16.38		17.94		20.50		22.42	
Calculated M.E.																								
(MCal/kg)	2.772		3.110		3.164		2.802		3.079		3.185		2.809		3.086		3.185		2.818		3.086		3.214	
Calculated Protein Ratio (kcal)	17.29		17.77		16.23		12.94		19.42		17.33		13.80		13.83		19.44		15.71		15.05		14.33	

TABLE 2

The Response of Grower Chickens to Varying Protein and Energy Levels (Experiment 1)

Parameters:	Protein Levels										Mean	S.E.
	14	16	18	20	2.6	3.0	3.0	3.0	3.0	3.0		
Average Daily Feed (g)	69.73	65.01	69.57	75.75	68.66	69.06	67.48	68.86	75.95	65.59	70.09	3.0
Average Daily Gain (g)	8.27 ^{bc}	7.75 ^c	9.38 ^{bc}	9.80 ^{bc}	9.22 ^{bc}	9.51 ^{bc}	9.36 ^{bc}	10.43 ^{abc}	12.55 ^a	9.90 ^{bc}	11.06 ^{ab}	0.84**
Feed-Gain Ratio	8.43 ^a	8.39 ^a	7.42 ^{ab}	7.73 ^{ab}	7.45 ^{ab}	7.26 ^{ab}	7.21 ^{ab}	6.60 ^{ab}	6.05 ^b	6.93 ^{ab}	6.34 ^b	0.57*
Average Daily Water Consumption (ml)	130.33	115.52	114.12	120.07	117.63	111.61	124.06	115.11	157.39	134.79	144.44	126.56
Dry Matter Digestibility (%)	74.17	74.14	69.45	71.63	74.56	71.59	72.92	76.50	77.57	78.04	69.69	73.45
Nitrogen Retention (g/day)	1.55 ^b	1.49 ^b	1.88 ^{ab}	2.01 ^{ab}	1.86 ^{ab}	2.04 ^{ab}	1.90 ^{ab}	2.17 ^{ab}	2.61 ^a	2.12 ^{ab}	2.48 ^a	2.03
Protein Efficiency Ratio	0.81 ^{ab}	0.85 ^{ab}	0.97 ^a	0.77 ^{ab}	0.80 ^{ab}	0.86 ^{ab}	0.76 ^{ab}	0.83 ^{ab}	0.87 ^{ab}	0.72 ^b	0.76 ^{ab}	0.81
Body weight at 140 days (g)	1102.04 ^d	1058.36 ^d	1195.28 ^c	1230.56 ^c	1181.84 ^c	1206.20 ^c	1193.60 ^c	1283.48 ^{bc}	1461.56 ^a	1238.96 ^c	1336.40 ^c	1229.95
Feed cost per kg gain (¢)	1.86	2.01	1.96	1.89	1.90	1.98	1.93	1.94	1.90	2.07	1.98	1.96

TABLE 3

The Response of Grower Chickens to Varying Protein and Energy Levels (Experiment 2)

	Protein Levels (%)												Mean	S.E.
	16			18			20			22				
Energy (Mcal/kg)	2.8	3.0	3.2	2.8	3.0	3.2	2.8	3.0	3.2	2.8	3.0	3.2	Mean	S%E
Average Daily Feed (g)	55.73 ^{de}	55.85 ^{de}	53.60 ^d	61.73 ^{bc}	63.45 ^{abc}	59.65 ^{cd}	67.05 ^a	65.43 ^{ab}	61.93 ^{bc}	61.33 ^{bc}	61.65 ^{bc}	62.25 ^{bc}	60.80	1.40 ^{**}
Average Daily Gain (g)	10.3 ^f	11.69 ^e	11.61 ^f	11.79 ^e	14.30 ^{ab}	13.02 ^{cd}	12.61 ^d	14.71 ^a	13.80 ^{abc}	11.71 ^f	13.80 ^{abc}	13.62 ^{bc}	12.75	0.27 ^{***}
Feed:Gain Ratio	5.48 ^b	4.85 ^a	4.68 ^a	5.30 ^b	4.56 ^a	4.84 ^a	5.37 ^b	4.48 ^a	4.79 ^a	5.28 ^b	4.52 ^a	4.81 ^a	4.91	0.122 ^{***}
Protein Efficiency Ratio	1.15 ^c	1.30 ^a	1.34 ^a	1.05 ^d	1.23 ^b	1.20 ^b	0.94 ^f	1.12 ^c	1.16 ^c	0.86 ^g	1.01 ^{de}	0.99 ^c	1.11	0.016 ^{***}
Point of lay (days)	169.75	177.25	176.00	188.25	167.00	186.50	176.75	158.25	171.50	173.75	169.00	177.00	174.25	7.46 ^{**}
Body weight at 140 days (g)	1272.56 ^d	1389.32 ^c	1382.60 ^c	1397.72 ^c	1608.56 ^a	1501.04 ^b	1465.76 ^b	1643.00 ^a	1566.56 ^{ab}	1391.00 ^c	1545.56 ^{ab}	1551.44 ^{ab}	1476.26	11.82 ^{**}
Cost of Feed @ (N/ton)	236.9	257.9	261.6	255.5	272.8	284.5	284.5	301.8	305.2	315.9	333.2	344.7	287.88	—
Feed Cost per kg Gain (N)	1.30	1.25	1.22	1.35	1.24	1.38	1.53	1.35	1.46	1.67	1.51	1.66	1.41	—

the 18% diets, although there were generally no significant differences between the two sets of values.

There were significant differences between the 12 diets in experiment 1 in average daily gain ($P \leq 0.01$), feed-gain ratio ($P \leq 0.05$), nitrogen retention ($P \leq 0.01$), protein efficiency ratio ($P \leq 0.01$) and body weight at 140 days ($P \leq 0.05$). Significant protein effects were observed in average daily gain, feed-gain ratio, nitrogen retention and body weight at 140 days. There were no significant energy or interaction effects in any of the parameters; significant genotype effects were observed in nitrogen retention, protein efficiency ratio (PER) and body weight at 140 days. The remaining parameters — average daily feed consumption, water consumption, dry matter digestibility and feed cost per kg gain — did not vary significantly among the 12 diets ($P \geq 0.05$).

In experiment 2 (table 3) 4 parameters out of 7, namely, average daily gain, feed-gain efficiency, point of lay and body weight at 140 days, optimised at diet E_{3.0} P₂₀. The other parameters, average daily feed, PER and feed cost per kg gain, op-

timised in diet E_{2.8} P₂₀, E_{3.2} P₁₆, and E₃ P₁₆, respectively. There were however no significant differences between the optimum values recorded in diet E_{3.0} P₂₀ and the corresponding values of diet E_{3.0} P₁₈, which gave the best results in experiment 1. But there were wide significant differences between the observed optimum diet E_{3.0} P₂₀ and all the 16% protein diets. The 22% protein diets on the other hand were generally close or inferior to the optimum diet.

Significant differences were observed in experiment 2 among the 12 diets in average daily feed intake, average daily gain, feed-gain ratio, P.E.R. ($P \leq 0.05$) and body weight at 140 days ($P \leq 0.01$). These differences were due to significant energy, protein and genotype effects in every case except in average daily feed intake where energy effect was not significant ($P \geq 0.05$). Energy $\times$ genotype effect was not significant ($P \geq 0.05$). Significant energy $\times$ genotype interactions were observed in PER and average daily gain ($P \leq 0.05$). Two parameters which did not show any significant differences among the diets were age at point of lay and feed cost per kg gain.

The responses of the four genotypes to varying protein and energy levels are shown in table 4 for experiment 1 and in table 5 for experiment 2. In table 4 there were three parameters which showed significant differences due to genotype. These were nitrogen retention, PER and body weight at 140 days. The GL x GL crosses had the highest gains, feed efficiency, dry matter digestibility, and significantly the highest nitrogen retention ($P \leq 0.01$), PER ($P \leq 0.01$) and body weight at 140 days ($P \leq 0.05$). The LCxGL crosses had the highest feed and water intake, but these comparisons were not significant ($P > 0.05$). The LC x LC crosses trailed in feed intake and average daily gains and in nitrogen retention, PER and body weight at 140 days but these values were only significantly lower than the GLxGL values not with the other crosses. The GL x LC crosses showed relatively poor performance when compared with their reciprocal counterparts in most parameters.

The diets in which each genotype manifested its best performance are also shown in Table 4, alongside the mean diet which gave the best overall value in each parameter. It will be seen that there was no consistency in genotype specificity for optimum diets, except that the mean optimum diets appeared to agree in a majority of cases with the optimum diets of the highest performing genotypes, namely GL x GL and LC x GL.

In experiment 2 (Table 5), the 4 genotypes showed significant differences in feed intake, gains, P.E.R., feed-gain ratio and body weight at 140 days ($P \leq 0.005$), but not in age at point of lay ($P > 0.05$). The GL x GL genotype had the highest feed efficiency, P.E.R., body weight at 140 ($P \leq 0.05$) but the latest initiation of lay ($P \leq 0.05$). The LC x GL genotype had the highest feed intake and average daily gains ($P \leq 0.05$) than its reciprocal cross or the LC x LC. The GL x LC and LC x LC genotypes had the

poorest performances which were generally significantly lower than either of the GL x GL or LC x GL genotypes.

The diets of optimum performance differed across genotypes and across parameters such that there was no consistency. However, the growth parameters appeared to optimise in diet E_{3.0} P₁₈ for the GL x GL and LC x GL genotypes and in diet E_{3.0} P₂₀ for the LC x LC and GL x LC genotypes. This segregation is also apparent in the levels of significance between the two groups. No genotype specificity for optimum diets was observed.

DISCUSSION

Examination of Table 2 will show that diet E_{3.0} P₁₈ supported the best response in 6 out of the 9 parameters measured in experiment 1. In two of those parameters, namely, average daily gain and body weight at 140 days, the values obtained from this diet was significantly higher than any of the other 11 diets. In the three cases where maximum values were observed in diets other than E_{3.0} P₁₈, the values were not significantly different from the observed value in E_{3.0} P₁₈. It is therefore clear that diet E_{3.0} P₁₈ is the optimum diet under the conditions of experiment 1. In experiment 2, although diet E_{3.0} P₂₀ appeared to top the list in a different range of protein and energy levels, its values were not significantly different from those of diet E_{3.0} P₁₈ of experiment 2. It is concluded therefore that in the two experiments, diet E_{3.0} P₁₈ gave the best overall results; and is recommended as the optimal diet, under the conditions of the two experiments, for growing pullets 8-20 weeks.

The protein level of 18% is higher than the levels of 15-16% recommended in literature for replacement pullets 8-16 weeks or the 12-13% for 16-20 week old pullets (Lillie *et al* 1966; Sunde and Bird, 1959; Turk *et al* 1961, Olomum 1979). Judging from the average daily gains of

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TABLE 4

The Response of Four Genotypes of Exotic and Local Grower Chickens to Varying Protein and Energy Levels
(Experiment 1)

	GENOTYPES					
	GL × GL	LC × GL	GL × LC	LC × LC	Mean	P
<i>Parameters:</i>						
Average Daily Feed Intake (g)	67.84 (11.59) [@]	74.25 (4.88)	69.58 (3.81)	67.08 (6.31)	69.69	n.s.
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{2.6} P ₂₀	E _{3.0} P ₂₀	E _{3.0} P ₁₈	
Average Daily Gain (g)	10.87 (2.87)	9.66 (1.52)	9.61 (1.22)	9.07 (1.35)	9.80	n.s.
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{2.8} P ₁₆	E _{2.8} P ₂₀	E _{3.0} P ₁₈	
Feed per Unit of Gain	6.48 (1.45)	7.83 (0.98)	7.35 (0.98)	7.53 (1.19)	7.30	n.s.
Optimum Diet	E _{3.0} P ₁₆	E _{3.0} P ₂₀	E _{2.8} P ₁₆	E _{3.0} P ₁₈	E _{3.0} P ₁₈	
Average Daily Water Intake (ml)	134.22 (35.62)	140.44 (25.04)	112.63 (10.92)	119.54 (19.54)	126.71	n.s.
Optimum Diet	E _{2.6} P ₂₀	E _{2.6} P ₁₄	E _{2.6} P ₂₀	E _{2.8} P ₂₀	E _{3.0} P ₁₈	
Dry Matter Digestibility (%)	75.47 (5.45)	72.02 (7.26)	73.06 (5.47)	73.26 (3.76)	73.45	n.s.
Optimum Diet	E _{2.6} P ₂₀	E _{2.8} P ₁₄	E _{2.6} P ₂₀	E _{3.0} P ₁₄	E _{2.6} P ₂₀	
Nitrogen Retention (g/day)	2.47 ^a (0.73)	2.05 ^b (0.52)	1.89 ^b (0.32)	1.71 ^b (0.35)	2.03	P/0.01
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{2.8} P ₁₆	E _{2.8} P ₂₀	E _{3.0} P ₁₈	
Protein Efficiency Ratio	0.93 ^a (0.17)	0.75 ^b (0.09)	0.80 ^b (0.12)	0.78 ^b (0.08)	0.82	P/0.01
Optimum Diet	E _{3.0} P ₁₆	E _{2.6} P ₁₄	E _{3.0} P ₁₄	E _{3.0} P ₁₈	E _{3.0} P ₁₄	P/0.01
Body weight at 140 days (g)	1320.44 ^a	1218.80 ^b	1214.60 ^b	1169.24 ^b	1230.77	P/0.05
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{2.8} P ₁₆	E _{2.8} P ₂₀	E _{3.0} P ₁₈	

[@] Standard deviation in parenthesis

the 14% protein diets in Table 2, or the 16% diets in Tables 2 and 3, it would appear that these two levels were about 33%-24% respectively, inferior to the optimum diet E_{3.0} P₁₈ in each case. Energy did not affect feed intake in experiment 1

where the highest energy level was 3.0 Mcal/kg, but did so in experiment 2 (P/0.005) where the highest level was 3.2 Mcal/kg. This indicates that energy levels of 3.0 or below does not depress intake under tropical conditions. also within

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TABLE 5

The Response of Four Genotypes of Exotic and Local Grower Pullets to Varying Protein and Energy Levels (Experiment 2)

	Genotypes					
	GL × GL	LC × GL	GL × LC	LC × LC		Mean
Parameters:						
Average Daily Feed						
Intake (g)	66.00 ^a (4.66)	68.60 ^a (5.82)	55.38 ^b (4.07)	53.2 (3.57) ^b	60.80	P/0.005
Optimum Diet	E _{2.8} P ₂₀	E _{2.8} P ₁₈	E _{2.8} P ₂₀	E _{3.0} P ₂₀	E _{2.8} P ₂₀	
Average Daily Gain						
(g)	14.78 (1.66)	14.90 (1.62)	11.02 (1.18)	10.17 (1.15)	12.72	P/0.005
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{3.0} P ₂₀	E _{3.0} P ₂₀	E _{3.0} P ₂₀	
Feed-Gain Ratio	4.52 ^a (0.36)	4.62 ^a (0.36)	5.03 (0.43)	5.26 ^b (0.39)	4.86	P/0.005
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{3.0} P ₂₀	E _{3.0} P ₂₀	E _{3.0} P ₂₀	
Feed-Gain Ratio	4.52 ^a (0.36)	4.62 ^a (0.36)	5.03 (0.43)	5.26 ^b (0.39)	4.86	P/0.005
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{3.0} P ₂₀	E _{3.0} P ₂₀	E _{3.0} P ₂₀	
Protein Efficiency						
Ratio	1.19 ^a (0.15)	1.16 ^a (0.16)	1.06 ^b (0.14)	1.02 ^b (0.12)	1.11	P/0.005
Optimum Diet	E _{3.2} P ₁₆	E _{3.2} P ₁₆	E _{3.2} P ₁₆	E _{3.0} P ₁₆	E _{3.2} P ₁₆	
Point of Lay (Days)	179.83 (12.48)	171.67 (14.00)	169.42 (17.98)	176.08 (16.99)	174.25	n.s.
Optimum Diet	E _{3.0} P ₂₀	E _{2.8} P ₂₀	E _{3.2} P ₂₂	E _{3.0} P ₂₀	E _{3.0} P ₂₀	
Body weight at 140						
days	1584.23 ^a	1462.16 ^b	1455.42 ^b	1403.09 ^b	1476.22	P/0.005
Optimum Diet	E _{3.0} P ₁₈	E _{3.0} P ₁₈	E _{3.0} P ₂₀	E _{3.0} P ₂₀	E _{3.0} P ₂₀	

each protein level in experiments 1 and 2, energy levels lower than 3.0 Mcal/kg gave significantly poorer responses than the 3.0 Mcal/kg diet. These results therefore disagree with the view that low energy levels give better performance under tropical conditions (Olomu 1979). The general indications are that under high ambient temperatures like Nigeria, protein levels should be stepped up to counteract the depressing effect of temperature on feed and nutrient intake (Oluyemi 1979). It is also observed that low dietary energy results in poor utiliza-

tion of dietary protein, and any reduction in dietary energy at high protein levels would appear to be unnecessary and wasteful (O'Neil *et al*, 1962).

Body weights and protein levels were significantly and positively correlated in experiments 1 and 2 ($r = -0.97$ and 0.89 , respectively, $P/0.05$). This supports the findings of Kim, 1976; Quinsbury *et al*, 1962; Waldrup *et al* 1966; Douglas *et al* 1973; Auckland and Fulton 1973 and Wright *et al* 1968, that high protein levels result in larger body weights at 140 days. The results are also consistent with the

reports of those workers that larger body weights result in earlier initiation of lay ($r = -0.43$; $P/0.05$), and that high protein levels also result in earlier sexual maturity ($r = -0.40$, $P = 0.05$). The absence of a significant correlation between protein level and age at first egg is in support of Turk *et al* 1961, who suggested that differences in dietary regimes tended to converge at the 20th week of growth. The 14% protein diets in this study could not support a body weight of 1225 g at 140 days, which is considered necessary for initiation of lay (McNaughton *et al* 1977).

The cost of diet per kg of body weight gain showed no significant variation in experiments 1 and 2, however, the least cost-gain ratio in experiment 1 was N1.86 in diet E2.6 P14 and N1.90 in diet E3.0 P18. In experiment 2, the least was N1.23 in diet E3.0 P16 and N1.34 in diet E3.0 P18. Thus on the basis of least cost consideration, the E3.0 P18 diet was also economical.

In genotype comparisons, the GL x GL and the LC x GL genotypes showed clear superiority over the GL x LC or LC x LC genotypes in all parameters of experiments 1 and 2. The performance of LC x GL was equal to in many cases and in some cases superior to the GL x GL. Omeje and Nwosu (1982) had reported the highest heterosis in the LC x GL using the same germ plasm and working in the same environment. This is of considerable importance in breeding work involving the local and exotic chickens.

Point of lay was reached earlier in the local chicken and their crosses than the exotic cross (Table 5). Though not significant, this trend was first observed by Obioha (1982) who obtained 10 days earlier sexual maturity in the local chicken than an exotic Starcross strain. Body weight at 140 days was significantly higher in the GL x GL than the other genotypes in both experiments 1 and 2. This is expected considering the small size of the local chicken with reference to the exotic chicken. It is of some interest that

the LC x LC genotype failed to reach the minimum body weight of 1225 g at 140 days which is considered important from point of view of initiation of lay. However, the lack of any significant difference in the ages at which the genotypes initiated lay does not give any importance to this observation.

From Tables 4 and 5, the optimal diets in which the genotypes manifested their highest response shows a division between GL x GL and LC x GL on the one hand, where diet E3.0 P18 was preponderant, and GL x LC and LC x LC on the other, where diet E3.0 P20 was preponderant. This apparent segregation however, could be based on the higher performance of the former group, rather than an indication of separate dietary requirements *per se*.

The different starter dietary programmes were manifested in the higher sensitivity of experiment 2 but did not significantly affect the overall dietary requirement in the grower period.

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