EFFECTS OF VARYING DIETARY ENERGY AND PROTEIN LEVELS ON GROWTH PERFORMANCE OF PRE-STARTER BROILER CHICKS

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ABSTRACT
This study was aimed at assessing and ascertaining the energy and protein levels needed by broilers reared in the southern rainforest of Nigeria for its optimal performance. Two hundred and eighty-eight (288) day old broiler chicks of Abor Acre strain were used for the experiment. These birds were allocated to sixteen treatment groups of eighteen birds each with three replicate of six birds each. The experiment lasted for three weeks at the pre-starter phase. Sixteen (16) diets were formulated comprising of four (4) Metabolizable Energy(ME) levels (2800, 3000, 3200 and 3400kcalME/kgDM) and four (4) protein levels (18, 20, 22 and 24%CP). The data obtained from the research was subjected to descriptive statistics and Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) of 4x4 factorial arrangement and the means were separated using the Duncan Multiple Range Test (DMRT) of GENSTAT (2005). The result obtained showed that daily feed intake reduced with an increasing dietary energy level. The daily body weight gain increased with an increasing crude protein level and dietary energy level. Feed conversion ratio (FCR) reduced with an increasing crude protein level along with dietary energy level. Daily protein intake increased with an increasing crude protein level while dietary energy intake level increased with an increasing energy level. Protein and energy levels had highly significant ($p<0.05$) effect on body weight gain. Chicks fed diet with 3400kcalME/kgDM and 22%CP (treatment 15) had the least feed conversion ratio and the least cost of feed intake per kg body weight gain and is more economical.
Keywords: Energy, Crude protein, Growth performance, Feed Intake, Body Weight Gain

INTRODUCTION

Nutrient requirement for any ingredient is defined as the amount of that nutrient which must be supplied in the diet to meet the needs of the normal health of an animal in an environment compatible with good health. It can also be said to be the amount of a given nutrient required by the animal to maximize performance. Formulation of a balanced diet is fundamental to economical poultry production, and this process depends on knowledge of nutrient requirements of poultry and the nutritional attributes of nutrients sources (Carre', 2014).According to Olomu (1995), crude protein and the metabolizable energy values were two nutrients base on which, the nutritionists formulated the poultry feed formulae. Gradually, the nutritionists started looking more deeply and included major amino acids like lysine and methionine, major minerals like calcium and phosphorus and major vitamins like A and D. The requirements were recommended by the NRC (National Research Council), which were worked out mostly at varying research stations long ago (NRC,1994). Energy and protein are important nutrients, representing majority of total cost of the diets for animals. There is need to obtain rapid growth in broilers. The growth of broilers depends upon the level of a balanced protein along with other nutrients. Broiler will also eat to satisfy their energy requirements if fed *ad libitum* (Classen, 2013). Therefore, dietary concentrations and nutrient should be increased in proportion to dietary energy to assure ingestion of the required amounts (Gleaves 1991). This study assessed the growth performance of starter broiler chicken fed varying dietary levels of energy and protein for 3 weeks.

Materials and Method

The feed ingredients used were maize, fishmeal, soybean meal, palm kernel cake, wheat offal, palm oil, bone ash, lysine, methionine, vitamin and mineral premix. They were procured from reputable sources in Uyo metropolis. Sixteen (16) diets were formulated. The diet comprised of four (4) energy levels (2800, 3000, 3200 and 3400kcalME/kgDM) and four (4) protein levels (18, 20, 22 and 24%CP). A total of two hundred and eighty-eight (288) day old broiler chicks were purchased from a

certified distributor in Uyo metropolis and raised in deep litter pens. A day to the arrival of the chicks, the floor of the brooding pen was covered with litter (2-3cm of wood shavings) and the brooding pen was provided with sufficient heat for warmth when the birds arrived. Prior to stocking in the brooding pen, the day-old chicks were weighed. Standard health (medication/vaccination) and management practices were observed. Feed and water was administered *ad libitum*. The birds were weighed weekly and data on feed consumption, body weight was recorded for each treatment group as these were used to determine the following parameters; feed intake, weight gain and feed conversion ratio. Cost indices like cost of feed intake per bird, cost of feed intake per kg body weight gain were calculated. Data obtained were subjected to descriptive statistics and Analysis of Variance (ANOVA) in a Completely Randomized Design of 4x4 factorial arrangement and the means were separated using the Duncan Multiple Range Test (DMRT) of GENSTAT (2005).

Table 1: Percentage Composition of Experimental Diets fed to pre-starter broiler chicks

Diets	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Feed Ingredients:																
Maize	47.50	41.90	36.80	31.80	58.50	53.35	48.00	44.90	61.80	63.05	52.00	52.00	59.5	54.05	49.15	46.20
FFSBM	20.00	26.50	33.00	39.50	20.00	26.40	33.00	39.65	22.00	29.00	35.00	38.00	23.45	30.00	36.60	39.60
Fishmeal	0.10	0.10	0.10	0.10	2.00	2.00	2.00	2.00	2.00	2.00	2.00	4.00	2.00	2.00	2.00	4.00
PKC	10.20	10.00	10.00	10.00	0	0	0	0	0	0	0	0	0	0	0	0
WO	17.60	16.90	15.50	14.00	14.05	12.80	11.55	8.50	7.10	0.70	4.00	0	4.60	3.50	1.80	0
Palm oil	0	0	0	0	1.00	1.00	1.00	0.50	2.65	0.80	2.55	1.55	6.00	6.00	6.00	5.75
Bone meal	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
NaCl	0.25	0.25	0.25	0.25	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	0.25	0.25	0.25	0.25
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	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Calculated Composition																
ME	2808	2801	2803	2807	3008	3008	3008	3014	3202	3200	3208	3207	3404	3401	3408	3406
CP	18.04	20.06	22.04	24.02	18.06	20.02	22.04	24.01	18.04	20.02	22.00	24.00	18.00	20.02	22.01	24.09
EE	3.94	3.77	3.58	3.40	3.51	3.33	3.41	2.96	3.32	3.16	2.96	2.91	3.13	2.94	2.76	2.70
CF	6.93	7.01	7.02	7.02	4.73	4.76	4.8	4.58	3.73	3.05	3.71	3.21	3.33	3.39	3.36	3.17
Ca	1.45	1.47	1.49	1.50	1.47	1.49	1.50	1.52	1.47	1.48	1.50	1.61	1.47	1.49	1.50	1.61
Tp	0.97	1.00	1.03	1.06	0.91	0.94	0.97	0.99	0.87	0.86	0.92	0.95	0.86	0.89	0.92	0.96
Lysine	1.16	1.33	1.49	1.65	1.18	1.34	1.00	1.67	1.20	1.36	1.52	1.71	1.21	1.38	1.54	1.74
Methionine	0.54	0.57	0.61	0.64	0.54	0.57	0.60	0.64	0.54	0.57	0.61	0.66	0.54	0.57	0.61	0.66

ME = Metabolizable Energy; CP = Crude Protein; EE = Ether Extract; CF = Crude Fibre; Ca = Calcium; FFSBM = full fat soybean meal; , PKC = Palm Kernel Cake; WO = Wheat Offal

*Supplied per kg diet: Vit. A, 4 x 10^6 I.U.; Tocopherols 4 x 10^3 I.U; Vit. K_3 800mg; Folacin, 200mg; Thiamine, 600mg; Cyanocobalamin, 4mg; Biotion, 8mg; Manganese, 3g; Zinc 20g; Iron, 3g; Choline chloride, 80g; Copper, 2g; Iodine, 480mg; Cobalt, 80mg; Selenium, 40mg; BHT, 25g and Anti-caking agent, 6g.

Result and Discussion

The result obtained from the experiment showed that Energy levels, Crude Protein levels and the interaction of ME and CP levels had significant ($p<0.05$) effect on feed intake (32.86 – 44.52g). Birds that received the least energy intake and the highest protein intake (2800kcalME/kgDM and 24%CP) had the highest daily feed intake. Daily body weight gain was highest in birds fed diet containing the highest ME and crude protein levels (3400kcalME/kgDM, 24% CP) as 29.30g and lowest in birds fed diet containing the least ME and crude protein levels (2800kcalME/kgDM, 18% CP) as 22.20g, therefore, ME levels, CP levels had significant ($p<0.05$) effect on the birds daily body weight gain. Highest final body weight was obtained for birds receiving 2400 kcal ME/kg and 24%CP diet, while the lowest final body weight was obtained from birds receiving 2800kal ME/kg and 18%C. Increased energy levels and increased protein levels resulted in a lowered Feed Conversion Ratio (FCR): Feed conversion ratio was highest in birds fed diet containing 2800kcalME/kgDM and 18%CP (1.87) and lowest in birds fed diet containing 3400kcalME/kgDM and 22%CP (1.22). This therefore means that birds of treatment 15 (3400kcalME/kgDM and 22%CP) made more body weight gain per kg of feed consumed. ME levels, CP levels and their interaction had significant ($p<0.05$) effect on the energy intake of the broiler birds. Cost of Feed Intake / Bird was highest in birds fed 3400kcalME/kgDM, 24% CP as ((₦)214.03) and lowest in birds fed 2800kcalME/kgDM and 18%CP as ((₦)148.44).

Table 2: Growth performance and economy of pre-starter broiler chicks (0-3weeks) fed varying dietary levels of energy and protein level

TRT	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	Daily Energy intake	Cost of feed Intake per bird (₦)	Cost of FI / Kg body weight gain(₦)
1	2800	18	38.47	41.59^{ab}	22.20^{e}	504.67^{e}	1.87^{a}	7.48^{h}	116.45^{ef}	148.44^{f}	317.21^{cd}
2	2800	20	38.00	43.28^{ab}	24.11^{cde}	557.07^{bcde}	1.78^{abc}	8.65^{def}	121.19^{cdef}	161.78^{ef}	317.04^{cd}
3	2800	22	38.52	41.78^{ab}	25.05^{bcd}	564.47^{bcd}	1.68^{bcdef}	9.23^{cd}	116.97^{def}	164.73^{def}	313.30^{d}
4	2800	24	38.95	44.52^{a}	25.75^{bcd}	579.67^{bcd}	1.74^{abcd}	10.68^{a}	124.66^{cde}	182.24^{bcde}	340.41^{abcd}
5	3000	18	38.95	43.16^{ab}	24.47^{cde}	552.80^{bce}	1.76^{abcd}	7.77^{gh}	129.47^{abcd}	169.73^{cde}	328.85^{bcd}
6	3000	20	38.58	42.17^{ab}	24.38^{cde}	550.30^{cde}	1.73^{bce}	8.38^{efg}	126.50^{bcde}	173.06^{cde}	358.11^{abc}
7	3000	22	39.04	43.03^{ab}	25.64^{bcd}	577.07^{bcd}	1.68^{bcdef}	9.46^{bc}	129.09^{abcde}	189.29^{bc}	352.04^{abcd}
8	3000	24	39.57	43.36^{ab}	26.54^{bc}	596.80^{bc}	1.64^{defg}	10.40^{a}	130.08^{abc}	196.76^{ab}	355.18^{abcd}
9	3200	18	39.04	41.12^{ab}	23.26^{de}	527.47^{de}	1.78^{abcd}	7.40^{h}	131.61^{abc}	174.94^{cde}	360.02^{ab}
10	3200	20	39.17	40.06^{b}	22.30^{e}	507.50^{e}	1.80^{ab}	8.02^{fgh}	128.18^{bcde}	173.71^{cde}	372.63^{a}
11	3200	22	39.04	40.81^{ab}	25.87^{bc}	582.40^{bcd}	1.58^{fg}	8.97^{cde}	130.58^{abc}	188.45^{bc}	347.57^{abcd}
12	3200	24	39.39	43.41^{ab}	26.43^{bc}	607.67^{ab}	1.65^{cdefg}	10.42^{a}	138.90^{ab}	211.56^{a}	382.21^{a}
13	3400	18	39.69	41.70^{ab}	25.98^{bc}	585.30^{bc}	1.60^{efg}	7.51^{h}	141.80^{a}	185.77^{bcd}	347.16^{abcd}
14	3400	20	38.86	39.19^{b}	25.48^{bcd}	574.00^{bcd}	1.53^{gh}	7.83^{gh}	133.24^{abc}	183.48^{bcd}	343.10^{abcd}
15	3400	22	38.71	32.86^{c}	27.05^{d}	606.80^{abc}	1.22^{i}	7.23^{h}	111.72^{f}	172.26^{bcd}	314.25^{d}
16	3400	24	38.91	41.73^{ab}	29.30^{a}	654.27^{a}	1.43^{h}	10.01^{ab}	141.89^{a}	214.03^{a}	349.63^{abcd}
Mean			38.90	41.49	25.07	566.99	1.68	8.72	128.36	180.64	343.67
SEM			0.10	0.46	0.30	6.43	0.02	0.18	1.47	2.73	3.91
P Value			0.363^{ns}	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.008**

Table 3: Effect of energy, protein and their interaction on growth performance of pre-starter broiler chicks (0-3weeks) fed varying dietary energy and protein levels

TRT	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	Daily Energy intake	Cost of feed intake/ Bird (₦)	Cost of fl/Kg Body weight gain(₦)
Effect of metabolizable energy levels											
	2800		38.48	42.79^{a}	24.27^{b}	551.46^{b}	1.77^{a}	9.01	119.81^{b}	164.30^{b}	321.99^{c}
	3000		39.03	42.93^{a}	25.25^{b}	569.24^{b}	1.70^{a}	9.00	128.78^{a}	182.21^{a}	348.54^{ab}
	3200		39.15	41.34^{a}	24.46^{b}	556.25^{b}	1.70^{a}	8.70	132.31^{a}	187.16^{a}	365.60^{a}
	3400		39.04	38.87^{b}	26.95^{a}	605.09^{a}	1.44^{b}	8.14	132.16^{a}	188.88^{a}	338.53^{bc}
Mean			38.93	41.48	25.23	570.51	1.65	8.71	128.27	180.64	343.67
SEM			0.10	0.45	0.29	6.43	0.24	0.17	1.47	2.77	3.91
P value			0.079^{ns}	0.003**	0.003**	0.010**	0.001**	0.268^{ns}	0.005**	0.004**	0.001**
Effect of protein levels											
		18	39.03	41.89^{ab}	23.97^{b}	542.55^{b}	1.75^{a}	7.54^{c}	129.83^{ab}	169.72^{b}	338.31^{ab}
		20	38.65	41.17^{ab}	24.06^{b}	547.21^{b}	1.71^{ab}	8.22^{b}	127.27^{ab}	173.00^{b}	347.72^{ab}
		22	38.82	39.61^{b}	25.90^{a}	582.68^{a}	1.53^{c}	8.72^{b}	122.08^{b}	178.68^{b}	331.79^{b}
		24	39.20	43.25^{a}	27.00^{a}	609.60^{a}	1.61^{bc}	10.37^{a}	133.88^{a}	201.14^{a}	356.85^{a}
Mean			38.93	41.48	25.23	570.51	1.65	8.71	128.27	180.64	343.66
SEM			0.10	0.45	0.29	6.43	0.02	0.17	1.47	2.77	3.91
P value			0.243^{ns}	0.035*	0.001**	0.001**	0.006**	0.001**	0.032*	0.001**	0.114^{ns}
Interaction, ME x P			0.3801^{ns}	0.2031*	0.0015**	0.0010**	0.010**	0.163^{ns}	0.3621*	0.0001**	0.0202*

$^{a-i}$Means along the same column with different superscript are significantly (P≤0.05) different. TRT = Treatment; 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)

CONCLUSION

Chicks fed diet with 3400kcalME/kgDM and 22%CP (treatment 15) had the least feed conversion ratio and the least cost of feed intake per kg body weight gain and is more economical. Pre-starter broiler chicks required 3400kcalME/kgDM and 22%CP for optimal performance.

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