PROTEIN AND ENERGY IN BROILER STARTER DIETS: EFFECTS ON GROWTH PERFORMANCE AND NUTRIENT UTILIZATION

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ABSTRACT

The effect of varying energy and protein concentration on performance and nutrient utilization of broiler chicks in the humid tropics was investigated in a 3 × 3 factorially designed experiment with three levels of energy (10.46 , 12.13 and 13.81 MJME/kg diet) and three levels of crude protein (12, 24 and 27%) giving a total of 9 diets. A total of 180 seven-dy old Hubbard chicks into nine equal treatments of 20 birds, replicated twice, were used in the study which lasted 21 days . Percent nitrogen retained and fat and crude fibre 'digested' differed significantly (P< 0.05) among treatments. Birds fed 10.46 MJME / kg and 21% CP had the lowest (62.07) Percent fat digested increased as the percent dietary protein increased in each of the groups of diets, while percent fibre digested ranged between 48.12 and 59.89. Birds fed 10.46 and 12.13 MJME/Kg had their mean weights improved, though not significantly (P>0.05) as the percent dietary protein increased from 21- 27% while birds fed 13.81MJME diet had depressed body weight. Feed consumed also decreased , though not significantly (P>0.05) with increased dietary protein in the first 2 groups of diets but birds on 13.81MJME diet followed no definite trend.

Birds fed 12.13 MJME/Kg and 24% or 27%CP gave the best feed/gain ratios, though the 2 values were not different (P>0.05) from each other. Feeding up to 27% protein had no further advantage over 24% protein, hance 12.13MJME / Kg and 24%CP with Calorie: Protein ratio of 118.46 seem the best combination for optimal performance of broiler chicks in the tropics.

Key words: Protein ,Energy Utilization, Broiler Starter, Humid tropics

INTRODUCTION

The level and efficiency of production of any animal depends on the provision in the diet of adequate energy, protein , minerals and vitamins in certain proportions found to be most suitable for the production desired. In this broad classification of dietary essentials, energy and protein are probably the ones of greatest significance both in a nutritional sense and economically. It is to our advantage, therefore, to make the best possible use of both energy and protein by ensuring that the amounts required for maximum production are optimum in the diet (Davidson, 1961) . This is because the worth of a diet is its potentiality for providing the birds with nutrients for maintenance and production. Therefore, the diet must be fed at levels which will ensure maximum economic returns.

Information on the requirements for energy, protein and limiting amino acids in broiler is richly available from temperate countries and National Research Council (NRC) recommendations are based on these reports. The levels of protein recommended for broilers during the starter phase is 23-24 percent with the

same energy base of 3200KCal ME/Kg diet (NRC , 1971; 1984) . Various studies have also been carried out determining the nutrient requirements of birds reared in the tropics with particular reference to Nigeria; and various levels of protein and energy have been recommended. In 1979, Oluyemi and Roberts recommended 23% and 20% protein with same 3,200KcalME/Kg diet for broilers of ages 0-6 weeks and 7-10 weeks respectively. Apart from this, they further stated that diets should be formulated to meet the various requirements as indicated by the age and the physiological state of the fowl. Njike and Ndife (1980) using unsexed Ross broiler -type chicks, recommended 23 -24% protein with energy level of 2800 - 3000Kcal ME/Kg for the finishing phase. In another experiment, Olomu and Offiong (1980) tested the performance of Ross-type broiler chicks on a two-phase feeding regime. Four protein levels (17,20,23 and 26%) and three energy levels (2800, 3000 and 3200Kcal/Kg diet) were used for the starting phase and similar protein and energy levels for the finishing phase. The data showed the protein requirment of broiler chicks to be 23% or 26% with the energy level of 2800 or 3000 Kcal/Kg diet; a confirmation of the earlier findings of Olomu (1976).Onwudike (1983) indicated that a protein level of 22% and energy content of 2900Kcal ME /Kg should be recommended for starting broilers while Fetuga (1984) found the energy and protein requirements of broilers in the wet tropics to be 2800-3000Kcal/Kg diets (0-5; 5-9 weeks) and 23 - 24% / 19-21% (0-5;5-9 weeks) respectively . The narrow ranges of 22-24% CP and 2800-3100 Kcal ME /Kg diet for broiler starter and 18 - 20 %CP and 2800-3100 KcalME/Kg diet for broiler finisher recommended by various workers (Oluyemi and Roberts, 1979; Njike and Ndife , 1980; Olomu and Offiong. 1980; Onwudike, 1983,Fetuga , 1984) are now about two decades old. Within these two decades there has been introduction of new and improved breeds and strains of chicks.This would, of course, mean existence of strain with different requirements. This therefore, calls for re-evaluation of existing feeding standards, more especially as it relates to energy and protein .It is on this premise that this study was undertaken to re-evaluate the effect of varying energy and protein concentrations on performance and nutrient utilization of broiler chicks in humid tropics.

MATERIALS AND METHODS

Experimental Design and Diets:

The design of this experiment was a 3 × 3 factorial type with 3 levels of energy (10.46 , 12.13 and 13.81MJME/Kg) superimposed with three levels of crude protein (21 ,24, and 27%) giving a total of nine diets. The rations were supplemented with synthetic lysine and methionine. The composition of the diets is presented in Table 1

Experimental Birds.

One hundred and eighty (180) day-old Hubbard broiler chicks obtained from a commercial hatchery were fed a common diet containing 24% CP and 12.13 MJME/Kg for the first 7 days of life.They were thereafter randomly allotted to each of the 9 dietary treatments of 20 birds each. Each group was sub-divided into 2 replicate having 10 birds each. They were raised in electrically heated battery brooders for the entire period of the experiment which lasted 28dys. All the birds were fed *ad-libitum* and allowed free access to water throughout the duration of

the trial. During the feeding trial Terramycin, Furazolidone and Narcox (Coccidoiostat) were applied to their water as recommended .Biovit (mulitvitamin) was also added to their water as anti-stress whenever any antibiotic was used. The chicks were given Lasota and Gomboro vaccines respectively on the 14th and 23rd days of the experiment.

Nutient Utilization Trials

A nutrient balance diet using the total collection method for the excreta , was conducted during the last 4 days of Week 3 . Feed intake during the period was noted. The dietary and excreta samples were analysed for proximate components using AOAC (1990) methods . The gross energy of samples was determined using a ballistic bomb calorimeter. Apparent metabolizable energy of diets corrected to zero nitrogen balance was calculated.

Performance Characteristics

A weekly record of feed consumption and birds' liveweights were collected and the feed/gain ratio was calculated from the data obtained.

Statistical Analysis

Data obtained were subjected to analysis of variance(ANOVA) in a 3 × 3 factorial design while means were separated using Duncan's multiple range test (Gomez and Gomez, 1985) . The criterion for significance was a

TABLE 1: PERCENTAGE COMPOSITION OF EXPERIMENTAL DIETS FED BROILER CHICKS FROM 7-28DAYS OF AGE.

	METABOLIZABLE ENERGY (10.46MJ/Kg)			METABOLIZABLE ENERGY (12.13MJ/Kg)			METABOLIZABLE ENERGY (13.8MJ/Kg)		
	DIET 1	DIET2	DIET3	DIET4	DIET5	DIET6	DIET7	DIET8	DIET9
INGREDIENT	21%CP	24%CP	27%CP	21%CP	24%CP	27%CP	21%CP	24%CP	27%CP
Yellow Miaze	28.70	24.20	21.70	58.61	56.40	47.01	55.05	43.05	33.00
Maize Offal	39.04	35.55	29.05	8.25	1.50	-	-	-	-
Palm Oil	-	-	-	-	-	1.80	8.58	10.60	12.70
Groundnut Cake	19.60	27.65	36.60	20.34	29.30	38.50	23.60	33.60	41.60
Fish Meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Blood Meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oyster Shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bone Meal	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.16	0.11	0.15	0.30	0.20	0.05	0.27	0.25	0.10
D-Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis									
ME (MJ/KG)	10.46	10.46	10.46	12.13	12.13	12.13	13.81	13.81	13.81
Crude Protein(%)	21.09	23.92	27.05	21.34	24.48	27.33	21.42	24.43	27.32
Protein:Calorie ratio	128.51	112.88	99.82	135.90	118.46	106.11	144.72	126.89	113.32
Lysine(%)	1.20	1.25	1.29	1.24	1.24	1.20	1.20	1.21	1.27
Methionine(%)	0.65	0.61	0.65	0.56	0.56	0.58	0.53	0.55	0.56
Calcium (%)	1.51	1.53	1.54	1.52	1.53	1.54	1.52	.1.54	1.55
Phosphorus(%)	0.68	0.71	0.75	0.76	0.80	0.83	0.76	0.79	0.81
Determined Composition									
Crude Protein(%)	21.63	24.56	27.44	21.75	24.88	27.81	20.88	25.00	27.31
Crude Fibre(%)	8.76	8.54	7.45	6.18	6.18	6.18	6.09	5.75	5.46
Ether extract(%)	1.01	1.55	1.97	1.87	1.86	2.00	9.37	9.58	11.46
ME(MJ/KG)	10.68	10.73	10.48	12.03	12.19	12.16	13.94	13.99	13.97

Vit. Premix provided (per tonne feed): Vit. A 5,000,000 I.U; Vit D3 1,000,000 I.U; Vit E: 16.00g; Vit. K3 1.00g; Vit.B1:0.80g; VitB2:2.40g; Nicotinic acid:0.40g, 14.00g,calcium D-Panthothenate: 4.00g; VitB6:1.40g; Vit.B12 :10.00mg; Folic acid: 0.40g; Biotin, 0.02g;Choline Chloride: 120g; Zinc Bacitracin:16.00g;Lasalocid(Avatec)36.00g; Mn 4000g;Fe:20g,Zinc 18.00g;Cu:0.80g;Iodine 0.62g. Cobalt: 0.09g; Selenium: 0.04g

* Data are means of three determinations

probability of 0.05.

RESULTS

Apparent Nutrient Utilization

Table 3 show that percent nitrogen retained and fat and crude fibre utilized differed significantly ($P<0.05$) among treatments. The percent nitrogen retained ranged from 62.07 to 76.03 with birds fed 10.46MJME/Kg and 21% CP having the lowest value. The percent fat digested

TABLE 2: PERFORMANCE CHARACTERISTICS OF BROILER CHICKS FED VARYING LEVELS OF DIETARY ENERGY AND PROTEIN FROM 7-28 DAYS OF AGE

	Metabolizable energy (MJME/Kg)									
	10.46			12.13			13.81			
	Dietary			Crude			Protein	(%)		
Response criteria	21	24	27	21	24	27	21	24	27	SEM
Mean Intial Weight, g(at 7 days of age)	108.64^{a}	100.00^{a}	96.50^{a}	102.50^{a}	99.06^{a}	94.00^{a}	95.96^{a}	105.22^{a}	94.44^{a}	2.82
Mean Final Weight, g(at 28 days of age)	482.00^{c}	494.50^{bc}	502.50^{bc}	507.50^{bc}	528.00^{ab}	542.00^{a}	488.00^{c}	486.00	367.50^{d}	10.04
Mean Feed Consumed, g(7-28days)	830.89^{a}	809.00^{ab}	789.00^{ab}	768.45^{b}	723.11^{c}	717.92^{c}	665.35^{d}	684.60^{cd}	579.68^{e}	12.98
Mean Metabolizable energy Consumed. MJ/Bird	0.41^{b}	0.40^{a}	0.38^{a}	0.44^{a}	0.42^{a}	0.41^{a}	0.44^{a}	0.45^{a}	0.38^{a}	0.2681
Mean Protein Intake g / Bird	8.60^{a}	9.50^{a}	10.00^{a}	8.00^{a}	8.60^{a}	9.50^{a}	6.62^{a}	8.15^{a}	7.54^{a}	0.2681
Mean Daily Gain, g (7-28 days)	17.78^{c}	18.79^{bc}	19.33^{b}	19.29^{b}	20.43^{a}	21.33^{a}	18.67^{b}	18.13^{c}	13.00^{d}	0.3337
Mean Daily Feed Intake, g(7- 28 days)	39.56^{a}	38.52^{ab}	37.57^{ab}	36.59^{b}	34.43^{c}	34.19^{c}	31.68^{d}	32.60^{cd}	27.60^{e}	0.763
Feed/Gain Ratio (7-28days)	2.2^{a}	2.06^{ab}	1.90^{bc}	1.90^{c}	1.69^{d}	1.61^{d}	1.71^{d}	1.80^{cd}	2.12^{ab}	0.007

Means within a horizontal line followed by different supersripts are significantly different ($P<0.05$)

TABLE 3: APPARENT NUTRIENT UTILIZATION OF BROILER CHICKS FED VARYING DIETARY ENERGY AND PROTEIN LEVELS FROM 7 TO 28 DAYS OF AGE.

	METABOLIZABLE ENERGY (MJMEK/Kg)									
	10.46			12.13			13.81			
RESPONSE CRITERIA	21	24	27	21	24	27	21	24	27	SEM
Nitrogen retention (%)	76.03^{a}	72.45^{b}	75.00^{a}	67.56^{bcd}	62.07^{d}	64.89^{cd}	68.81^{bc}	64.33^{cd}	66.00^{cd}	1.20
Fat utilization (%)	86.21^{c}	91.38^{c}	92.84^{b}	87.07^{d}	90.79^{c}	91.06^{c}	98.25^{a}	98.32^{a}	98.54^{a}	0.82
Crude fibre utilization (%)	59.36^{a}	58.51^{ab}	60.80^{a}	48.76^{d}	50.79^{cd}	54.26^{bc}	59.89^{a}	51.36^{cd}	48.12^{d}	1.06

Mean without common superscripts in horizontal rows are significantly different ($P<0.05$).

seemed to increase gradually as the percent dietary protein increased for each of the 3 groups of diets containing 10.46 , 12.13 or 13.81 MJME/Kg . The percent fibre utilized ranged between 48.12 and 59.89%.

Performance Characteristics of the Broiler

Table 2 shows the performance of the birds. The group of birds fed 12.13MJME/Kg diet gave the highest mean daily body weight. As the percent protein in each of the diets increased from 21 to 27 , the mean daily body weight gain were also improved . The same trends was also noticed in birds fed 10.46MJME/Kg while the mean daily body weights gain decreased as the percent dietary protein increased from 21-27% in birds fed 13.81MJME/Kg . The mean daily body weight gain and final weight at 28 days of age were significantly ($P<0.05$) influenced by the treatment diets.

Feed consumed decreased significantly ($P<.0.5$) as the percent protein in diets increased except the group offered the 13.81MJME/Kg diet for which there was no definite trend. The birds fed13.81MJME/Kg and 27%CP had the lowest total feed intake (579.68g) while birds fed 10.46MJME/Kg and 21%CP gave the highest total feed intake (830.89g) Birds fed 12.13MJME/Kg and 27% CP gave best feed /gain ratio, which was closely followed by birds fed 12.13MJME/Kg and 24% CP. The two values were , however , not significantly different ($P>0.05$) from one another. Birds fed 10.46MJME/Kg and 21%CP gave the poorest (2.23) feed/gain ratio.

DISCUSSION

Nutrient Utilization

The nitrogen retention values obtained were generally high for all the treatment diets, this would be expected since at week four, most of the tissues being laid down by the birds are proteinaceous tissues compared to the finisher phase when most of the tissues laid down are fat tissues(Amubode, 1981; Kroydahl and Dalsgard, 1981) .The pattern of fat utilization showed generally high coefficients in all the treatment. The uniformly superior indices recorded in Diets 7, 8, and 9 can be attributed to fat supplementation. Similar values have been reported for chicks (Degroote, 1969). The high crude fibre digestibility, perhaps, is a reflection of the degradation of dietary fibre by the chicken fed lower ME in an attempt to satisfy energy requirement. Birds have been shown to be capable of 'digesting' dietary fibre (Longstaff and McNab, 1989) although the extent of utilization varies between animals, species and fibre source(Bell, 1960).Similarly, dietary fibre is said to be most digestible in diets with lowest dietary energy concentration (Lansen and oldfield, 1961) , this probably explains the significantly superior values for birds fed diets 3, 6 and 7.

Growth Performance

Protein and energy undergo different metabolic processes in the fowl. They however fulfill a number of physiological purpose in common and these are body maintenance , growth and production. Among these, rapid growth rate is the primary criterion of nutrient adequacy for the growing chick. Values obtained from birds fed 10.46MJME/Kg and 12.13MJME/Kg slightly agreed with earlier reports (Farrel 1974;Farrel *et al.*, 1977).Growth depression observed in birds fed 13.81MJME/Kg could be due to the fact that, at high ambient temperature as obtained in the tropics, stress exerted due tothe metabolism of excess protein and fat in the diet when coupled with thermal stress may reduce efficiency of feed utilization . Birds fed low energy , low protein in this trial consumed more feed than others. Keshavarz anf.Fuller (1980) observed that birds fed low protein or low energy diets increased their feed consumption presumably in an effort to overcome the protein and energy deficiences. The formulation of diets 1 to 3 with lower energy (when compared with diets 4-9) concentrations required the inclusion of substantial amount of maize offal (29.05 - 39.04) which is fibrous and low in energy . The birds started on 10.46MJME/Kg and 21%CP and 10.4MJME/Kg and 24%CP gave poor gain and feed/gain ratio. This is in agreement with the work of Dumansky *et al.*,

(1977) who observed that decreasing protein in the starting diet gave similar gain and slightly poorer feed efficiency. The low energy also contributed to the small weights. The lowest body gain observed in birds fed 13.81MJME/Kg and 27%CP might not be unconnected with the inability of the birds to consume substantial amount of feed because; (i) its minimum requirement for protein and energy were easily met, hence the birds could not consume enough mineral and vitamins required for body weight; (ii) the heat stress caused by the hot environmental condition also hindered adequate feed intake resulting in the poor daily gain of the birds fed this diet. However birds fed 12.13MJME/Kg and 24 or 27%CP with Calorie: Protein ratio of 118.46 and 106.11 respectively had the best daily gain because the protein and energy were in adequate proportion and this enhanced adequate consumption of feed components thus promoting efficient utilization of such feed components by the birds.

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