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Effect of dietary energy level on growth performance and morphometric parameters of local barred chickens at the starter phase

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ABSTRACT

An experiment was conducted to determine the influence of dietary energy level on the growth performance and morphometric characteristics of local barred chicks. The experiment lasted for 12 weeks. Three hundred and twenty day-old barred chicks were assigned to four different dietary treatments, having four replicates of 20 chicks each. Treatments consisted of D0, D1, D2 and D3 containing 2700, 2800, 2900 and 3000 kcal/kg of metabolisable energy respectively. The highest BW (868 g) and BWG (830 g) were recorded with treatment D1 and D3 (844 g and 804 g respectively). These values were significantly (P<0.05) higher compared to D0 and D2. The feed conversion ratio were significantly (P < 0.05) higher with treatments D0 and D2 as compared to treatments D1 and D3. Feed cost per kg of body weight was significantly (P<0.05) lower for treatment D1 as compared to other treatments. Thus, metabolisable energy requirement of local barred chicks between 1 to 12 weeks is 2800 kcal/kg.

Keywords: Barred chickens, dietary energy, starter phase.

INTRODUCTION

The productivity of indigenous chickens can be improved by providing appropriate housing, disease control and good nutrition (Mbajiorgu et al., 2011; Mtileni et al., 2012). The nutritional requirements of commercial chickens, turkeys, pheasants and related poultry stock have been estimated (Yamane et al., 1980; NRC, 1994). However, informations on the protein and energy requirements of indigenous chickens are limited and most of the works done on local poultry are based on nutrient requirement of exotic breed (Kreman et al., 2012; Kana et al., 2013; Kana et al., 2014). Energy is one of the most significant components in poultry feed as far as production cost is concerned. The energy sources contribute to about 70% of the total ration of poultry (Tewe et al., 2002). It is therefore imperative that judicious formulation of poultry feed must be carried out to ensure that optimal efficiency is achieved, not only in the utilization of total feed but also in the use of its energy as well. Numerous studies on commercial broilers have demonstrated that on complete balanced

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feeds, improved growth and feed conversion efficiency could be achieved with increased level of dietary energy (Saleh et al., 2004; Ghazalah et al., 2008; Niu et al., 2009). This was also observed with the relatively slow-growing Malaysian kampong crossbred chicken in the finishing phase (Engku, 2007). During the post-hatching or starter phase (1-21 days), some researches have also been conducted on the response of the village chick to dietary energy level (Nguyen and Bunchasak, 2005; Engku et al., 2011; Magala et al., 2012; Alabi et al., 2013). The results obtained have not been consistent. While Alabi et al. (2013) on South Africa Venda chicks showed that high energy diet promoted greater weight gain than the low energy feed, no difference in growth response was observed with increasing energy content from 2500 to 3000 kcal/kg as reported by Engku et al. (2008) on 21 day-old Malaysian Kampung chicks. With the Cameroon local barred chickens, none of such work has been reported. This study was therefore carried out to investigate the effect of various dietary energy levels on the productivity of local barred chickens in their starter phase.

MATERIALS AND METHODS

Study area

The study was carried out between February and April 2012 at the Teaching and Research Farm of the University of Dschang (LN 5 to 7°, LE 8 to 12°). Dschang is located in the Western Sudano-Guinean Savannah of Cameroon at 1500 m above sea level. Wind speed mean is 1.60m/s, mean temperature is 20 °C and relative humidity varies between 60 - 80%. Annual rainfall varies between 1910 and 2010 mm. The raining season runs from mid-March to mid-November and the dry season from mid-November to mid-March.

Experimental animals, diets and data collection

A total of 500 eggs from a stabilized population (F2) of local barred chickens were incubated according to commercial practices in small scale manual incubator. From the above incubation, 320-day-old barred chicks were used in this study. Birds were randomly distributed to 4 dietary groups, with 4 replications of 20 chickens each in a completely randomized design. Artificial heat for the first 14 days was provided by the used of electric bulbs. Chicks were allocated on a littered floor poultry house in an open system under the same management conditions. Water and feed were offered *ad libitum.* The experiment lasted 12 weeks.

Experimental diets consisted of D0, D1, D2 and D3 containing 2700, 2800, 2900 and 3000 kcal/kg of metabolisable energy respectively (Table 1).

Feed intake (FI) and life body weight (BW) for individual chicks were recorded weekly; body weight gain (BWG) was obtained by the difference in BW of two consecutive weeks according to the procedures of McDonald et al. (2011). Feed conversion ratio (FCR) was obtained by dividing weekly FI by weekly BWG. The price of kg of feed was given starting from the price of the raw materials available on the local market. Feed cost per kg of body weight (FC) was obtained by multiplying the price of kg of feed by the FCR over the same period. The data on body measurement were taken at the end of the experiment. This measurement included: body length, wing length, comb length, comb height, beak length, head length, body girth, tarsus diameter, tarsus length and wattle height. These parameters were measured and recorded according to Yarubu and Salako (2009) and Ajayi et al. (2012) using a tape rule (cm). Body length was measured from the tip of the beak through the body trunk to the tail. Body girth was measured as the circumference of the breast region, while the wing length was the distance from the scapula joints to the last digits of the wing and tarsus length was measured from the hock joint to the metatarsal pad.

Statistical analysis

Data collected were subjected to one way analysis of variance (ANOVA) to compare treatment means at probabilities of 5%. When differences were declared significant among means, they were separated using the Duncan Multiple Range Test (Steel and Torrie, 1980).

RESULTS

The effect of energy level on feed intake, body weight, weight gain, feed efficiency and cost of feed necessary to produce a kg of body weight is summarized in Table 2.

Feed intake was not significantly (P > 0.05) affected by the energy level of the diet. However, increasing dietary energy level tends to reduce feed intake. Thus, chicks in the group D0 receiving the lowest energy level (2700 kcal/kg) recorded the highest but non-significant feed intake as compared to birds fed D1, D2 and D3.

Dietary energy level had a significant effect (P <0.05) on BW and BWG of chickens. Animals in groups D1 and D3 recorded significantly highest (P <0.05) BW and BWG as compared to birds in groups D0 and D2. The growth curves or BW were similar in all groups. However, the growth curves of animals subjected to diets D1 and D3 were above those subjected to diet D0 containing 2700 kcal and D2 containing 2900 kcal (Figure 1).

Increasing the energy level of the diets tend to lower feed efficiency of the local barred chicks at starter phase. Feed conversion ratio (FCR) and feed cost per kg of body weight (FC) were significantly (P<0.05) higher for birds fed diets D0 and D2 compared to treatments D1 and D3.

Morphometric parameters

Except for the height and length of the comb and the height of the wattles, dietary energy level significantly affected (P < 0.05) all body measurements (Table 3). Increasing dietary energy level tends to increase the values of body measurements. However, the highest (P < 0.05) head length was obtained with the chicks in group D0 (2700 Kcal) as compared to other groups.

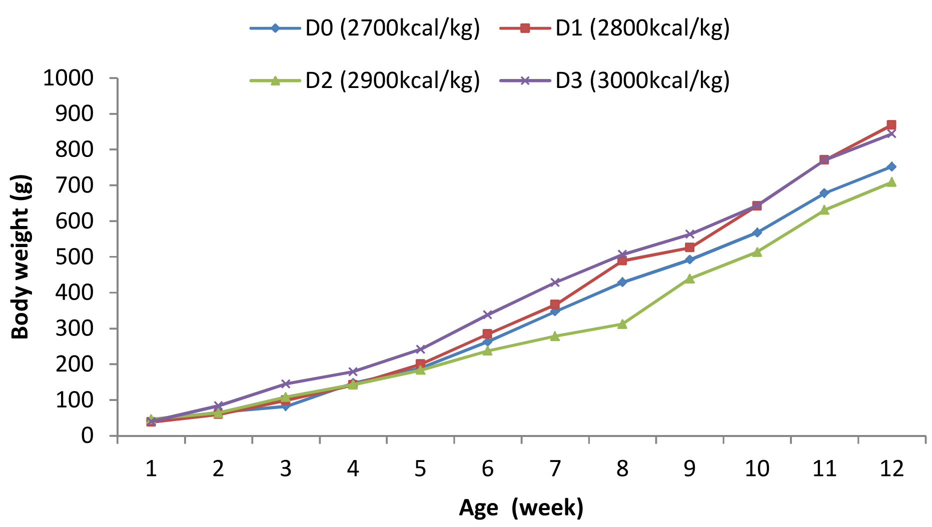

Figure 1: Growth curve of local barred chicks fed graded energy levels.

Table 1: Composition and chemical characteristics of experimental diets.

Composition (kg)	Experimental diets			
	D0 (2700kcal/kg)	**D1 (2800kcal/kg)**	**D2 (2900kcal/kg)**	**D3 (3000kcal/kg)**
Corn meal	40.0	45.0	43.0	45.0
Wheat bran	25.0	19.0	20.0	19.0
Cotton seed cake	8.0	8.0	8.0	3.5
Soybean cake	15.5	15.5	15.0	15.9
Fish meal	5.0	6.0	6.0	8.0
Shellfish powder	1.5	1.5	1.5	1.0
Premix 5% *	5.0	5.0	5.0	5.0
Palm oil	0.0	0.0	1.5	3.0
Total	100.0	100.0	100.0	100.0
Calculated chemical composition				
Crude protein (%)	23.0	23.2	23.4	23.0
Metabolisable Energy (kcal/kg)	2715	2813	2906	3010
Calcium (%)	1.49	1.48	1.49	1.42
Phosphorus (%)	0.76	0.69	0.71	0.75
Lysine (%)	1.31	1.29	1.49	1.34
Methionine (%)	0.43	0.43	0.43	0.45
Price** (Fcfa/kg)	242	236	243	247

*premix 5%: crude protein = 40%; metabolisable Energy = 2078 kcal/kg; Calcium = 8%; Phosphor = 2.05% ; Lysine = 3.30% ; Methionine = 2.40%. **1 USD = 485.43 Fcfa.

Table 2: Effect of energy level on growth performances and the cost of feed per kg body weight of local barred chicks at started phase (1 – 12 week of age).

Parameters	**Experimental diets**				**P**
	D0 (2700kcal/kg)	**D1 (2800kcal/kg)**	**D2 (2900kcal/kg)**	**D3 (3000kcal/kg)**	
Feed intake (g)	3624.42±211.48[a]	3198.94±179.38[a]	3169.75±165.69[a]	3338.00±169.11[a]	0.297
Body weight (g)	752.09±88.10[a]	868.81±34.47[b]	708.63±14.83[a]	844.08±55.95[b]	0.003
Body weight gain (g)	710.78±84.47[a]	830.78±35.53[b]	662.20±14.90[a]	804.33±59.78[b]	0.003
Feed conversion ratio (g/g)	5.07±0.34[b]	3.82±0.26[a]	4.79±0.07[b]	4.16±0.32[a]	0.000
FC (Fcfa)	1228.36±81.52[c]	901.86±62.00[a]	1161.54 ± 17.00[c]	1027.55± 78.09[b]	0.000

a,b and c: Means within the same row with a different superscript are different ($P < 0.05$).

Table 3: Effect of energy level on body morphometric parameters of local barred chicks at started phase (1–12 weeks of age).

Morphometric parameters (cm)	Experimental Diets				P
	D0 (2700 kcal/kg)	D1 (2800 kcal/kg)	D2 (2900 kcal/kg)	D3 (3000 kcal/kg)	
Wing Length	20.45±1.75[a]	19.90±1.74[a]	18.26±0.78[b]	20.20±1.35[a]	0.002
Foot length	23.66±1.52[b]	26.10±3.3[a]	26.94±1.97[a]	24.62±1.46[b]	0.000
Tarsus length	7.27±0.64[bc]	7.48±0.69[ab]	6.93±0.58[c]	7.78±0.48[a]	0.000
Tarsus diameter	1.03±0.17[a]	1.05±0.13[a]	0.90±0.07[b]	1.07±0.10[a]	0.005
Body length	29.71±1.91[bc]	31.09±2.92[ab]	28.74±2.79[c]	32.12±1.92[a]	0.000
Head length	5.84±0.57[a]	4.38±0.28[b]	4.00±0.22[c]	4.30±0.28[b]	0.000
Beak length	3.29±0.41[a]	3.25±0.26[a]	3.07±0.11[b]	3.26±0.18[a]	0.193
Body girth	23.08±1.52[b]	24.56±1.94[a]	23.93±1.04[ab]	24.08±1.64[ab]	0.009
Comb Height	1.03±0.69[a]	1.11±0.67[a]	0.80±0.35[a]	1.12±0.64[a]	0.538
Comb length	2.52±0.78[a]	2.69±1.00[a]	2.23±0.48[a]	2.81±1.02[a]	0.283
Wattle height	1.23±0.60[a]	1.26±0.35[a]	1.02±0.33[a]	1.31±0.42[a]	0.341

a, b, c : Means within the same row with a different superscript are different ($P < 0.05$).

DISCUSSION

Within the limits of the experimental conditions imposed, during the twelve-weeks growth period (1 to 12 weeks) feed intake was not significantly affected ($P > 0.05$) by dietary energy level. This finding, while being consistent with that of Nguyen and Bunchasak (2005), on the Thailand Betong native chicken and Magala et al. (2012) on Uganda local chickens, was different from the observations of Niu et al. (2009), Alabi et al. (2013) on commercial broilers and Venda chicks respectively. This may be due to breed differences which have different gene encoding key regulatory factors such as hormones, enzymes and metabolic pathways (Richards and Proszkowiec-Weglarz, 2007; Tang et al., 2007). Emmans and Fisher (1986) and Emmans (1989) indicated that chickens grow based on their genetic potential; thus, they attempt to eat as much of a given feed as would be required to satisfy their growth needs. However, the present result is in agreement with NRC (1994) which reported that it is not always accurate to conclude that poultry feed intake is adjust to achieve a minimum energy intake from diets. On the other hand, it may be assumed that the energy contents between 2700-3000 ME kcal/kg met or exceeded the requirement of the barred chicks, so that subsequent varying energy levels did not affect feed intake.

Life body weight, body weight gain, feed conversion ratio and feed cost / kg of meat were significantly affected ($P < 0.05$) by the different dietary regimes. Diet D1 and D3 with 2813 and 3010 kcal/kg of metabolisable energy respectively exhibited the greatest BW, BWG and the lowest FCR as compared to D0 (2715 kcal) and D2 (2906 kcal). This is consistent with the findings of Saleh et al. (2004), Ghazalah et al. (2008) and Alabi et al. (2013) who obtained improved FCR with increasing energy level. Furthermore, several researches have shown that growth parameters are influenced by changes in dietary energy concentration in two partially dependent pathways. Firstly, as dietary energy increases, feed efficiency is improved as less feed is taken in to satisfy the energy needs of the chickens and secondly, growth rate is promoted by increasing levels of dietary energy as reported by Plavnik et al. (1997), Yalcin et al. (1998) and Dublecz et al. (1999).

In addition, the faster growth rate of chicks fed with high metabolizable energy diet may be due to the use of energy for efficient retention of protein; since protein is the building blocks needed for growth (Moreng and Avens, 1985). The improvement in response to dietary energy during the starter phase were further shown by the reports of Maiorka et al. (2004) who observed improved body weight and FCR with increased dietary energy in the starter period. The present result disagrees the reports of Nguyen and Bunchasak (2005) on the Betong chicken, Hidalgo et al. (2004), Dozier et al. (2008) and Niu et al. (2009) on broiler chicks and Engku et al. (2011) on Kampung chicks.

The economic evaluation shows that the mean feed cost necessary to produce a kg of body weight is significantly ($P<0.05$) lower in D1 as compared to D0, D2 and D3. Variations in energy level from 2700 to 2800 kcal lead to reduction in 270.21Fcfa in cost of production. It can be explained by the fact that consumption index reduce significantly between D0 (2700 kcal), D1 (2800 kcal) and D3 (3000 kcal). This is consistent with the findings of Mafouo et al. (2011) who obtained a reduction in cost of production with reduction in consumption index.

Increasing the energy level of the diet tends to increase the values of body measurements in the starter phase; this is due to the fact that morphometric characteristics have a direct relationship with body weight in poultry (Ige et al., 2006; Ogah, 2011). Hence, increasing in dietary energy level lead to higher body measurements.

Conclusion

Optimal response in feed intake, growth rate, feed conversion ratio in local barred chickens increase with an increased in dietary energy level. Body morphometric parameter tends to increase with an increased dietary energy level. Therefore, 2800 kcal/kg should be adopted as metabolisable energy requirement for local barred chicks at early growth period.

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