

Effects of strain and skip-a-day feed restriction on growth characteristics of broiler chickens

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Abstract

The aim of this study was to compare the growth performance of different broiler strains and to evaluate the suitable skip-a-day feed restriction regime at the starter and finisher phases. A total number of 288 day-old broilers of Arbor Acres, Hubbard and Marshall were randomly allocated to four treatments of 96 chicks per strain, with each treatment having three replicates of eight birds. The four treatments are full-fed (control), second, third and fourth week skip-a-day feed restriction. Data on body weight and body linear measurements were recorded on weekly basis to the 8th week. Results showed that there was significant ($p < 0.01$) effect of strain on body weight, body length, breast girth at the starter and finisher phases. This indicates that there were differences in genetic make-up of the three strains. Arbor Acre strain appeared tolerant to feed restriction and had superior body weight at the starter and finisher phases. Regarding the effect of skip-a-day feed restriction on birds, there was significant ($p < 0.01$) effect on growth characteristics of the birds. Birds full-fed had the highest mean value in body weight, while third week feed restriction recorded intermediate value but better than other feed restriction regimes. It is suggested that for profitable broiler production under tropical conditions, Arbor Acre and third week skip-a-day feed restriction be considered.

Keywords: Effect, strains, skip-a-day feed restriction, broiler and performance

Des Effets de la contrainte et de la restriction alimentaire par jour sur les caractéristiques de croissance des poulets de gril



Résumé

L'objectif de cette étude était de comparer les performances de croissance de différentes souches de poulets de gril et d'évaluer le régime approprié de restriction des aliments pour animaux par jour aux phases de démarrage et de finition. Un nombre total de poulets de grillage de 288 jours d'Arbor Acres, Hubbard et Marshall ont été attribués au hasard à quatre traitements de 96 poussins par souche, chaque traitement ayant trois répliques de huit oiseaux. Les quatre traitements sont complets – nourris (contrôle), deuxième, troisième et quatrième semaine skip-a-day restriction de l'alimentation. Les données sur le poids corporel et les mesures linéaires du corps ont été enregistrées sur une base hebdomadaire jusqu'à la 8^e semaine. Les résultats ont montré qu'il y avait un effet significatif ($p < 0,01$) de la tension sur le poids corporel, la longueur du corps, la circonférence du sein aux phases de démarrage et de finition. Cela indique qu'il y avait des différences dans la constitution génétique des trois souches. La souche Arbor Acre semblait tolérante à la restriction de l'alimentation et avait un poids corporel supérieur aux phases de démarrage et de finition. En ce qui concerne l'effet de la restriction d'alimentation par jour sur les oiseaux, il y a eu un effet significatif ($p < 0,01$) sur les caractéristiques de croissance des oiseaux. Les oiseaux nourris à part entière avaient la valeur moyenne la plus élevée en poids corporel, tandis que

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la restriction de l'alimentation de la troisième semaine enregistre une valeur intermédiaire, mais mieux que les autres régimes de restriction des aliments pour animaux. Il est suggéré d'envisager une production rentable de poulets de grillage dans des conditions tropicales, arbor acre et restriction d'alimentation de troisième semaine par jour.

Mots-clés: Effet, souches, restriction d'alimentation skip-a-day, poulet à griller et performance

Introduction

Growth characteristics of broiler chickens has improved over the last 30 years mainly because of the genetic progress, improvement of nutrition and controlled environment so that it takes only 33 days to meet finishing final body weight of about two kilogrammes (Wilson, 2005). Unfortunately, this increase in growth rate is accompanied by high body fat deposition, high mortality rate and high incidence of metabolic diseases and skeletal disorders (Zubair and Leeson, 1996), and these are most common in broilers that are fed *ad libitum* (Pasternak and Shalev, 1983; Nir *et al.*, 1996). Thus, feed restriction has been proposed to ameliorate these problems. Feed restriction programme which could be quantitative or qualitative is used to manipulate the feeding strategies of poultry in order to decrease growth and metabolic rate to some extent and to reduce the incidence of ascites, lameness, mortality, sudden death syndrome and reduced production cost. Feed restriction is a method of feeding whereby time, duration and quantity of feed are limited, and it has an impact on whether a bird has the ability of achieving the same body weight as unrestricted birds or birds fed *ad libitum* (Ballay *et al.*, 1992; Yu and Robinson, 1992). The success of poultry production has been strongly related to the improvements in growth performance and carcass yield and composition. Current commercial broiler chickens strains like Arbor Acre, Anak Titan, Ross, Lohmann, Pawl, Hubbard and Kucbor (Idahor *et al.*, 2013) are the result of successful selection programme for rapid growth and body

conformation. These strains have been studied to acclimatize so well that they can attain table size of 1.6 – 2.0kilogram live weight in 8 – 12weeks old with minimal death rate (Idahor *et al.*, 2013). Broiler breeders and producers are always interested in evaluating the performance of the commercially available strain, considering weight and yield of the breast meat as the most important variables (Scheuermann *et al.*, 2003). This improvement in growth performance and carcass characteristics have resulted to physiological, immunological, biochemical and anatomical changes in broiler (Havenstein *et al.*, 2003; Schmidt *et al.*, 2009). In addition, Julian (2005) reported that rapid growth rate of modern broiler chickens was associated with series of physiological disorders resulting to increase in the rate of mortality during grow-out. Poultry enterprise keeps advancing by improvement of genetic potential of new broiler strains (Kemp and Kenny, 2003). In a bid to reduce this cost, feed restriction has been suggested as a management tool designed to limit bird's access to feeds during a definite period of time which could be quantitative or qualitative (Olawumi, 2015). The aim of this study therefore, was to compare the growth performance of different broiler strains and to evaluate the suitable broiler strains.

Materials and methods

Location of the study

The study was carried out at the poultry unit of the Teaching and Research Farm, Faculty of Agricultural Sciences, Ekiti State

University, Ado-Ekiti, Nigeria. Ado-State is situated entirely within the tropics. It is located between longitudes 40° 51" and 50° 451" East of the Greenwich meridian and latitudes 70° 151" and 80° 511" North of the Equator. It lies South of Ikere Ekiti, East of Ilawe and bounded by Iyin Ekiti in the East and the South. The town enjoys a tropical climate with two distinct seasons. These are the rainy season (April - October) and the dry season (November - March). Temperature ranges between 21°C and 28°C with high humidity of above 5090%. The South-Westerly winds and the North East Trade winds blow in the raining and dry (Harmattan) seasons, respectively.

Site preparation

The site was properly cleaned, washed with soap, Lysol and Izal and fumigated adequately with 40% formaldehyde in water solution and allowed to rest for one week. The house was properly covered and pre-heated before the arrival of the birds so as to ensure that the birds were not predisposed to any disease causing microorganisms present in the site and to raise the temperature of the brooding environment to keep the chicks warm.

Experimental birds and management

A total number of 288 day-old broilers of Arbor Acre, Hubbard and Marshall commercial broiler hybrids were purchased from reputable hatcheries and were randomly allocated to four treatments of 96 chicks each, with each treatment having three replicates of eight birds comprising the sexes per replicate. The four treatments are full – fed (control), second, third and fourth week skip-a-day feed restriction. Thereafter, the birds were given full feed until the end (56 days). The chicks were brooded using coal pot to supply heat for the first three weeks of life. Antibiotics and vitamins were administered as at when due. Also, vaccines against Infectious Bursae and Newcastle diseases were given at specified age intervals. Their beddings are

made up of dry wood shavings to prevent coccidiosis outbreak and high level of hygiene was maintained throughout the experimental period to ensure appropriate environment for growth, and reduction in mortality.

Feed and feeding

The birds were introduced to skip-a-day feed restriction with starter mash (1-4 weeks) containing 3000 Kcal/KgME, 22% CP and finisher feed (5-8 weeks) containing 3100 Kcal//KgME, 21% CP and water was available *ad libitum*.

Data collection

Data on body weight and body linear measurements were recorded on weekly basis during the period of the experiment.

Body weight

Body weight was determined using a weighing scale in grams. The body weights of the chicken were measured on arrival before they were distributed into the experimental pens. They were thereafter, weighed on weekly basis throughout the experimental period.

Body linear measurements

The under listed linear body traits were measured on each strain at 2, 3, 4, 5, 6, 7 and 8 weeks of age. The linear body traits were estimated with measuring tape in centimeters.

Breast girth was taken at the region of breast expansion when positioned ventrally. Leg length was measured as the length of the torso-metatarsus from the hock joint to the metatarsal pad. Thigh length was measured as the length of the femur bone. Wing length was measured as the distance between the tip of the phalanges and the coracoids-humerus joint. Body length was measured as the distance between the base of the neck and pygostyle.

Statistical analysis

Data collected from the completely randomized design (factorial experiment) was subjected to analysis of variance using

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(SAS, 2003) and the differences between means were separated by Duncan's New Multiple Range test (1955).

The analytical statistical model used was:

$$Y_{ijk} = \mu + S_i + F_j + \epsilon_{ijk}$$

Y_{ijk} = observation of the k^{th} population, of the i^{th} strain and j^{th} feed restriction

μ = overall mean

S_i = fixed effect of i^{th} strain ($i=3$)

F_j = fixed effect of j^{th} feed restriction regimes ($j=4$)

ϵ_{ijk} = random error.

Results

Effect of strain on growth traits at starter phase (1 – 4weeks)

Table 1 shows the effect of strain of broiler chickens on body weight and body linear measurements during the starter phase of production. There was significant ($p<0.01$) effect of strain on body weight at week 1, 3 and 4. However, at week 2, the mean values for the different strains were similar ($p>0.05$). At week 1, 3 and 4, Arbor Acre strain showed superiority in terms of body weight, followed by Hubbard and Marshall strain recorded the lowest values. There was significant ($p<0.01$) effect of strain of body length at week 1 and 3. At week 1, Marshall strain had the highest mean value, while the other strains recorded similar mean values. At week 3, Hubbard strain had superior followed by Marshall which had intermediate mean value. The present study also showed that breast girth was significantly ($P<0.01$) affected by the strain of broiler chickens. Arbor Acre and Hubbard were superior in breast girth when compared to Marshall. This implies that the former had broader chest than the later. In addition, there was significant ($p<0.01$) difference among the strains on wing length at week 3 and 4, while week 1 and 2

recorded similar ($p>0.05$) mean values. In all, Hubbard had higher mean values in wing length than Arbor Acre and Marshall. Furthermore, there was no significant ($p>0.05$) effect of strain on thigh length at starter phase. All strains had similar mean values. On leg length, there was significant ($p<0.01$) difference among the strains at week 1 during the starter phase. But in week 2, 3 and 4, the strains recorded similar ($p>0.05$) mean values. However, at week 1, Arbor Acre recorded superior mean values when compared to Hubbard and Marshall. The latter two strains had similar ($p>0.05$) mean values.

Effect of strain on growth traits at finisher phase (5 – 8weeks)

Table 2 shows the effect of strain of broiler chickens on the body weight and body linear measurements at the finisher phase production. The result showed that there was significant ($p<0.01$) effect of strain on body weight in all the weeks (5-8). At week 5, 6, 7 and 8, Arbor Acre strain recorded the superior mean values for body weight, while Hubbard and Marshall showed similar ($p>0.05$) mean values. There was no significant ($p>0.05$) effect of strain on body length at finisher phase. All strains had similar mean values. As regards breast girth, there was significant ($p<0.01$) effect of strain at week 7 and 8. Arbor Acre recorded the superior values of breast girth while Hubbard and Marshall showed similar ($p>0.05$) values. For wing length, there was significant ($p<0.01$) effect among strains at week 6 and 7. Hubbard and Marshall recorded superior values in wing length compared to Arbor Acre. The Table also showed the effect of strain on thigh length and leg length. There was no significant ($p>0.05$) effect of strain on thigh length at finisher phase. All the strains had similar ($p>0.05$) mean values.

Table 1: Least Squares Means showing the effect of strain of broiler chickens on body weight and body linear measurements at the starter phase

	WEEK ONE			WEEK TWO			WEEK THREE			WEEK FOUR		
	HUBBARD ARBOR ACRE	MARSHALL ARBOR ACRE	HUBBARD ARBOR ACRE	HUBBARD ARBOR ACRE	MARSHALL ARBOR ACRE	HUBBARD ARBOR ACRE	MARSHALL ARBOR ACRE	HUBBARD ARBOR ACRE	MARSHALL ARBOR ACRE	HUBBARD ARBOR ACRE	MARSHALL ARBOR ACRE	HUBBARD ARBOR ACRE
Body Weight (g)	112.03 ^a ± 1.45	104.67 ^b ± 1.45	107.50 ^b ± 1.45	230.48 ± 4.31	221.68 ± 4.31	229.80 ± 4.31	412.33 ^a ± 6.46	404.88 ^{ab} ± 6.46	412.33 ^a ± 6.46	701.33 ^a ± 10.56	686.97 ^a ± 10.56	652.37 ^b ± 10.56
Body Length (cm)	12.69 ^b ± 0.14	13.29 ^a ± 0.14	12.81 ^b ± 0.14	16.20 ± 1.44	16.25 ± 1.44	18.52 ± 1.44	19.75 ^b ± 0.17	20.45 ^a ± 0.17	19.75 ^b ± 0.17	23.28 ± 1.02	23.11 ± 1.02	24.17 ± 1.02
Breast Girth (cm)	6.53 ^c ± 0.07	6.78 ^b ± 0.07	7.06 ^a ± 0.07	9.98 ^a ± 1.44	9.70 ^b ± 1.44	9.67 ^b ± 1.44	12.14 ^a ± 0.18	11.53 ^b ± 0.18	12.14 ^a ± 0.18	13.26 ^a ± 0.21	12.97 ^{ab} ± 0.21	12.57 ^b ± 0.21
Wing Length (cm)	6.52 ± 0.08	6.47 ± 0.08	6.72 ± 0.08	9.47 ± 0.12	9.69 ± 0.12	9.67 ± 0.12	11.04 ^b ± 0.11	11.56 ^a ± 0.11	11.04 ^b ± 0.11	13.08 ^b ± 0.12	13.55 ^a ± 0.12	13.08 ^b ± 0.12
Thigh Length (cm)	3.65 ± 0.29	3.34 ± 0.29	3.89 ± 0.29	5.80 ± 0.09	5.79 ± 0.09	5.74 ± 0.09	9.17 ± 0.15	9.47 ± 0.15	9.17 ± 0.15	11.09 ± 0.14	11.38 ± 0.14	10.96 ± 0.14
Leg Length (cm)	2.84 ^a ± 0.06	2.55 ^b ± 0.06	2.44 ^b ± 0.06	3.49 ± 0.05	3.49 ± 0.05	3.40 ± 0.05	4.86 ± 0.05	4.84 ± 0.05	4.86 ± 0.05	5.40 ± 0.08	5.37 ± 0.08	5.19 ± 0.08

^{a,b,c} Means with different superscripts along rows are significantly different (p<0.01).

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Table 2: Least Squares Means showing the effect of strain of broiler chickens on body weight and body linear measurements at the finishers phase (5 – 8 week)

TRAIT	WEEK FIVE			WEEK SIX			WEEK SEVEN			WEEK EIGHT		
	ARBOR ACRE	HUBBARD	MARSHALL	ARBOR ACRE	HUBBARD	MARSHALL	ARBOR ACRE	HUBBARD	MARSHALL	ARBOR ACRE	HUBBARD	MARSHALL
Body Weight (g)	1203.60 ^a ± 15.67	1131.40 ^b ± 15.67	1123.93 ^b ± 15.67	1669.43 ^a ± 21.44	1554.33 ^b ± 21.44	1578.30 ^b ± 21.44	2106.40 ^a ± 34.15	1940.68 ^b ± 34.15	1947.83 ^b ± 34.15	2454.33 ^a ± 40.36	2270.90 ^b ± 40.36	2262.78 ^b ± 40.36
Body Length (cm)	25.36 ± 0.18	25.44 ± 0.18	24.92 ± 0.18	27.66 ± 0.60	28.55 ± 0.60	27.58 ± 0.60	31.82 ± 0.30	31.81 ± 0.30	32.27 ± 0.30	31.93 ± 0.34	31.64 ± 0.34	32.08 ± 0.34
Breast Girth (cm)	16.67 ± 0.31	15.84 ± 0.31	15.98 ± 0.31	17.90 ± 0.39	16.91 ± 0.39	17.81 ± 0.39	22.54 ^a ± 0.22	21.74 ^b ± 0.22	21.48 ^b ± 0.22	22.42 ^a ± 20.99 ^b 0.25 ± 0.25	20.99 ^b ± 0.25	21.13 ^b ± 0.25
Wing Length (cm)	15.41 ± 0.22	15.69 ± 0.22	15.51 ± 0.22	16.85 ^b ± 0.18	17.46 ^a ± 0.18	17.45 ^a ± 0.18	19.16 ^b ± 0.25	20.13 ^a ± 0.25	20.04 ^a ± 0.25	20.47 ± 0.18	20.82 ± 0.18	20.63 ± 0.18
Thigh Length (cm)	13.52 ± 0.18	13.90 ± 0.18	13.44 ± 0.18	15.01 ± 0.13	15.24 ± 0.13	15.23 ± 0.13	17.44 ± 0.21	8.05 ± 0.21	7.62 ± 0.21	18.63 ± 0.16	18.80 ± 0.16	18.7 2 ± 0.16
Leg Length (cm)	6.67 ± 0.06	6.66 ± 0.06	6.51 ± 0.06	6.91 ± 0.06	7.04 ± 0.06	7.04 ± 0.06	8.06 ± 0.07	8.14 ± 0.07	8.06 ± 0.07	8.45 ± 0.09	8.34 ± 0.09	8.60 ± 0.09

^{abc} means with different superscripts along rows are significantly different (p<0.01)

Effect of skip-a-day feed restriction on growth traits of broiler chickens at starter phase

Table 3 shows the effect of feed restriction on body weight and body linear measurements of broiler chickens at 8th week. The result showed significant (p<0.01) effect of feed restriction on body weight at week 2, 3 and 4 while at week 1, the strains had similar (p>0.05) mean values for the different feeding regimes. At week 2, birds on full feed, third and fourth week feed restriction showed superiority in terms of body weight while second week feed restriction recorded the lowest mean values of body weight. At week 3, birds on full feed (*ad libitum*) and fourth week feed restriction recorded superior values of body weight while second week feed restriction recorded the intermediate value. But birds on third week feed restriction showed the lowest mean value of body weight.

However, at week 4, full fed broiler chickens showed superiority in terms of

body weight, while second and third week feed restriction recorded the similar (p>0.05) mean values while birds on fourth week feed restriction showed the lowest value of body weight at starter phase.

Effect of feed restriction on broiler chickens body weight and body linear measurements at finisher phase (5 – 8 weeks)

Table 4 shows the effect of feed restriction regimes on body weight and body linear measurements of broiler chickens at finisher phase. The result showed significant (p<0.01) effect of feed restriction regimes on body weight at the finisher phase. At week 5, birds on full feed (*ad libitum*) recorded the superior mean values of body weight, while second week feed restriction showed the intermediate. At week 6, full feed (*ad libitum*) showed superiority in terms of body weight and was significantly (p<0.01) different from second, third and fourth week feed restriction which recorded similar (p>0.05)

Table 3: Effect of skip-a-day feed restriction on the growth performance of broiler chicken strains

WEEKS	Body weight	Body length	Breast girth	Wing length	Thigh length	Leg length
WEEK ONE						
Full feed	106.40± 1.67	12.71 ± 0.16	6.75 ± 0.08	6.54 ± 0.09	3.40 ± 0.34	2.58 ± 0.07
2 nd week feed restriction	110.53± 1.67	13.15 ± 0.16	6.88 ± 0.08	6.60 ± 0.09	3.47 ± 0.34	2.65 ± 0.07
3 rd week feed restriction	108.36±1.67	13.01 ± 0.16	6.76 ± 0.08	6.63 ± 0.09	3.46 ± 0.34	2.68 ± 0.07
4 th week feed restriction	106.91± 1.67	12.84 ±0.16	6.77 ± 0.08	6.50 ± 0.09	4.18 ± 0.34	2.51 ± 0.07
WEEK TWO						
Full feed	244.22±4.98	16.60 ± 1.66	10.12 ^a ± 0.09	9.74 ^a ± 0.14	5.89 ^a ± 0.10	3.59 ^a ± 0.05
2 nd week feed restriction	165.60 ^b ± 4.98	14.94 ± 1.66	8.91 ^b ± 0.09	9.02 ^b ± 0.14	5.24 ^b ± 0.10	3.27 ^b ± 0.05
3 rd week feed restriction	251.42 ^a ±4.98	16.68 ± 1.66	10.01 ^a ± 0.09	9.92 ^a ± 0.14	6.04 ^a ± 0.10	3.47 ^a ± 0.05
4 th week feed restriction	248.04 ^a ± 4.98	19.72 ± 1.66	10.09 ^a ± 0.09	9.76 ^a ± 0.14	5.95 ^a ± 0.10	3.58 ^a ± 0.05
WEEK THREE						
Full feed	447.31 ^a ± 7.45	20.52 ^a ± 0.20	12.18 ^a ± 0.20	11.51 ^{ab} ± 0.13	9.37 ^{ab} ± 0.17	4.92 ^a ± 0.06
2 nd week feed restriction	364.58 ^b ± 7.45	19.56 ^b ± 0.20	11.39 ^b ± 0.20	10.95 ^c ± 0.13	9.12 ^b ± 0.17	4.72 ^b ± 0.06
3 rd week feed restriction	335.07 ^c ±7.45	19.25 ^b ±0.20	11.09 ^b ± 0.20	11.19 ^{bc} ±0.13	8.89 ^b ± 0.17	4.65 ^b ± 0.06
4 th week feed restriction	406.91 ^a ± 1.67	21.84 ^a ±0.16	11.77 ^a ± 0.08	6.50 ± 0.09	4.18 ± 0.34	2.51 ± 0.07
WEEK FOUR						
Full feed	761.40 ^a ±12.20	23.68 ± 1.18	13.56 ^a ± 0.25	13.62 ^a ± 0.14	11.37 ± 0.16	5.51 ^a ± 0.09
2 nd week feed restriction	707.51 ^b ± 12.20	23.15 ± 1.18	12.94 ^{ab} ± 0.25	13.28 ^{ab} ± 0.14	11.20 ± 0.16	5.26 ^{ab} ± 0.09
3 rd week feed restriction	680.07 ^b ±12.20	22.64 ± 1.18	12.66 ^b ± 0.25	13.02 ^b ± 0.14	11.08 ± 0.16	5.30 ^{ab} ± 0.09
4 th week feed restriction	571.91 ^c ± 12.20	24.61± 1.18	12.56 ^b ± 0.25	13.03 ^b ± 0.14	10.92± 0.16	5.22 ^b ± 0.09

mean values. At week 8, full feed (*ad libitum*) recorded superior mean value of body weight, while third and fourth week feed restriction showed intermediate mean values. The results showed significant ($p < 0.01$) effect of feed restriction regimes on body length at week 5 and 8. Birds on full feed (*ad libitum*) and second week feed restriction recorded superior value, while third and fourth week feed restriction recorded similar ($p > 0.05$) values. At week 8, full feed (*ad libitum*) recorded the highest mean value of body length and was statistically similar ($p > 0.05$) to birds on third and fourth week feed restriction. However, birds on second week feed restriction showed the lowest mean value and was similar ($p > 0.05$) to third and fourth week feed restriction. As regards breast girth, there was significant ($p < 0.01$) effect

of feed restriction regimes on breast girth at week 7 and 8. At week 7 and 8, Full feed (*ad libitum*) showed superiority in terms of breast girth to second, third and fourth week feed restriction which recorded similar ($p > 0.05$) mean values. For wing length, there was significant ($p < 0.01$) effect of feed restriction regimes on wing length at week 6, 7 and 8. At week 6, full feed (*ad libitum*) recorded highest mean value of wing length compared to birds on second and third week feed restriction. At week 7, full feed (*ad libitum*) showed superiority in terms of wing length to second, third and fourth week feed restriction. At week 8, birds on full feed (*ad libitum*) had the highest mean value of wing length, while third and fourth week feed restriction recorded the intermediate mean values, and second week feed restriction showed the lowest mean value.

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Table 4: Effect of skip-a-day feed restriction on the growth performance of broiler chicken strains at finisher phase

	Body weight	Body length	Breast girth	Wing length	Thigh length	Leg length
WEEK FIVE						
Full feed	1250.18 ^a ±18.09	25.71 ^a ± 0.21	16.76 ± 0.36	15.92 ±0.25	14.05 ^a ± 0.20	6.86 ^a ± 0.07
2 nd week feed restriction	1168.07 ^b ±18.09	25.40 ^{ab} ± 0.21	16.26 ± 0.36	15.38 ± 0.25	14.03 ^a ± 0.20	6.59 ^b ± 0.07
3 rd week feed restriction	1113.82 ^c ±18.09	24.91 ^b ± 0.21	15.93 ± 0.36	15.57± 0.25	13.19 ^b ± 0.20	6.53 ^b ± 0.07
4 th week feed restriction	1079.84 ^c ±18.09	24.93 ^b ± 0.21	16.70 ± 0.36	15.28 ± 0.25	13.20 ^b ± 0.20	6.47 ^b ± 0.07
WEEK SIX						
Full feed	1688.69 ^a ± 24.76	28.49 ± 0.69	18.38 ± 0.45	17.72 ^a ± 0.21	15.36 ± 0.15	7.15 ^a ± 0.07
2 nd week feed restriction	1573.84 ^b ± 24.76	27.89 ± 0.69	17.21± 0.45	17.24 ^{ab} ± 0.21	15.13 ± 0.15	7.03 ^{ab} ± 0.07
3 rd week feed restriction	1563.20 ^b ± 24.76	27.78 ± 0.69	17.34 ± 0.45	17.11 ^{ab} ± 0.21	14.93 ± 0.15	6.92 ^b ± 0.07
4 th week feed restriction	1577.02 ^b ±24.76	27.56 ± 0.69	17.24 ± 0.45	16.94 ^b ± 0.21	15.22± 0.15	6.89 ^b ± 0.07
WEEK SEVEN						
Full feed	2171.07 ^a ± 39.44	32.30 ± 0.35	22.61 ^a ± 0.26	20.55 ^a ± 0.29	18.12 ^a ± 0.25	8.44 ^a ± 0.07
2 nd week feed restriction	1911.49 ^b ± 39.44	31.52 ± 0.35	21.66 ^b ± 0.26	19.64 ^b ± 0.29	17.17 ^b ± 0.25	7.88 ^c ± 0.07
3 rd week feed restriction	1985.36 ^b ± 39.44	31.91 ± 0.35	21.79 ^b ± 0.26	19.58 ^b ± 0.29	17.88 ^{ab} ± 0.25	7.88 ^c ± 0.07
4 th week feed restriction	1925.31 ^b ±39.44	32.14 ± 0.35	21.62 ^b ± 0.26	19.33 ^b ± 0.29	17.64 ^{ab} ± 0.25	8.14 ^b ± 0.07
WEEK EIGHT						
Full feed	2564.18 ^a ± 46.60	32.90 ^a ± 0.39	22.55 ^a ±0.29	21.49 ^a ± 0.20	19.37 ^a ± 0.19	8.87 ^a ± 0.11
2 nd week feed restriction	2137.98 ^c ± 46.60	30.81 ^b ± 0.39	20.77 ^b ± 0.29	20.11 ^c ± 0.20	18.32 ^b ± 0.19	8.15 ^b ± 0.11
3 rd week feed restriction	2324.76 ^b ± 46.60	31.83 ^{ab} ± 0.39	21.51 ^b ± 0.29	20.19 ^{bc} ± 0.20	18.89 ^a ± 0.19	8.48 ^b ± 0.11
4 th week feed restriction	2290.44 ^b ±46.60	31.98 ^{ab} ± 0.39	21.23 ^b ± 0.29	20.76 ^b ± 0.20	18.28 ^b ± 0.19	8.37 ^b ± 0.11

Discussion

Effect of strain on growth traits

Body weight has an important role in the development of the broiler chicken and the emphasis should be on accelerated growth rate during the rearing weeks of a broiler's

life (Rodriquez *et al.*, 2005). From the study, Arbor Acre strain possessed superior genetic make-up and was able to withstand the stress induced by the treatment applied on them at the early age. This is in agreement with the findings of Smith and

Pesti (1998) and Gonzales *et al.* (1998a), Benyi *et al.* (2009) who reported significant strain differences in body weights in different strains of broiler chickens. Abdullah *et al.* (2010) also reported significantly strain effect on the weight gain of broilers at 7-21 and 28-42 days of age. In addition, Gonzales *et al.* (1998) observed that weight gain in broiler chickens was significantly affected by strain. In this study, all the birds across strains increased in body weight and body parts with advancing age. Sun *et al.* (2006) posited that body weight increased with age in both *ad libitum* and feed-restricted chickens. This is a normal natural phenomenon. However, in contrast, Olawumi (2015) reported that strains did not differ in body weight and body linear measurements at the starter phase. Yakubu *et al.* (2010) studied the effects of genotype on growth performance of broiler chickens in North-central Nigeria, and found that final body weight, average weekly body weight and weekly feed intake were affected by strain, with higher means recorded for Arbor Acres. Udeh *et al.* (2015) reported that Arbor Acre gained significantly more weight at 3 weeks of age and Marshal at weeks 4-5 and 6-7.

Effect of skip-a-day feed restriction on growth traits of broiler chickens

In the study, feed restriction had impact on body weight and body linear measurements. Full fed birds recorded the highest mean values, followed by 2nd and 3rd week feed restriction, while 4th week feed restriction had the lowest values in terms of body weight and body linear measurements regardless of strain of broiler chickens. This scenario suggest that younger birds were least affected than older birds when exposed to feed restriction programmes. The body weights of all chickens across the three treatments at the end of the finisher phase (8th week) were, however, lower than full fed birds. This implies the inability of

birds under restriction feeding to catch-up with full fed birds. These results are in agreement with those of Sandilands *et al.* (2006) who reported that the mean body weight of the control treatment in starter period was higher than that of the restricted feeding treatments. Also, in agreement, Benyi and Habi (1998) reported that chicks fed *ad libitum* grew faster and were found to be heavier than those on restricted feeding regimes, and consistent with the findings of Roth *et al.* (1993), Santoso *et al.* (1993a) and Khantaprab *et al.* (1997). On the contrary, Scheideler and Baughman (1993) and Deaton (1995) reported that restricting feed supply had no significant effect on broiler performance during growing period. Crouch *et al.* (2002c) and (Ukachukwu and Akpan, 2007) reported that the restricted fed chickens performed better than full-fed chickens in breast muscle weight in terms of body weight percentage. The result of this study contradicted the findings of early researchers who reported that broiler chickens subjected to a short period of severe early feed restriction showed a complete catch-up in body weight following re-feeding (Plavnik *et al.*, 1986; Plavnik and Hurwitz, 1990) and Olawumi (2015). However, Khetani *et al.* (2009) observed no significant effect of feed restriction on body weight and body linear measurements in broilers.

Conclusion

From this study, Arbor Acre broilers had highest values of body weight, body length and breast girth. Also, birds on third week skip-a-day feed restriction recorded highest values of body weight, breast girth, thigh length than other feed restriction regimes. In view of the results obtained in this study, it is recommended that Arbor Acres and third week skip-a-day feed restriction should be adopted for profitable production in the tropics.

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