

EFFECTS OF STRAIN AND FEED WITHDRAWAL DURATIONS ON GROWTH PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

The aim of this study was to investigate the effects of strain and feed withdrawal durations on growth performance of broiler chickens. A total number of 180 day-old broiler chicks of two strains comprising 90 Arbor Acre and 90 Ross 308 were used for the study. In the first 14 days, all birds were fed ad libitum. From 15-28 days, the birds were randomly allotted to 6 treatments in a completely randomized design arranged in 2×3 factorial such that each strain was allotted to three feed withdrawal durations: T₁ (control), T₂- 4 hours feed withdrawal daily, and T₃- 8 hours feed withdrawal daily. The data collected were analyzed using Fit Model of JMP Pro 15. Results showed that treatments affected initial body weight, with higher value in Ross 308 (355.89 g), but final weight, average daily weight gain, average daily feed intake and feed conversion ratio were not affected. Feed withdrawal durations influenced final body weight where the 4 hours feed withdrawal group (2089.83) was similar to the control group (2181.00) and the 8 hours feed withdrawal group (2055.00), but the 8 hours feed withdrawal group (2055.00) had lower final body weight compared to the control group (2181.00). There was no significant ($p>0.05$) strain×feed withdrawal interaction for all the growth parameters measured. It was suggested that farmers can use 4 hours feed withdrawal duration during the day on either Arbor Acre or Ross 308 strain of broiler chickens with a positive result in growth performance.

Keywords: Strain, Feed withdrawal, Growth, Broilers, Chickens

INTRODUCTION

Modern strains of broiler chickens have been specifically bred for rapid growth rate (Paclard, 2014) to attain mature body size within 7-10 weeks (Alzenbarakji, 2011 and Abdollahi *et al.*, 2017). This rapid growth rate of broilers in modern times requires that feed and water be offered to the birds at all times. Incidentally, feed is the most expensive aspect of broiler chicken production and accounts for about 70% of the total cost of producing broiler chickens (Aggrey *et al.*, 2010). Apart from high feed cost, feeding broilers *ad libitum* is often associated with negative attributes such as high incidence of metabolic diseases including ascites, sudden death syndrome and leg abnormalities as well as economic losses (Olkowski *et al.*, 2008). Thus, feed restriction has been suggested to solve these problems.

Feed restriction can be an effective method to reduce economic losses by reducing the incidence of metabolic disorders and mortality in fast growing broiler chickens (Mohammadalipour *et al.*, 2017 and Tumova *et al.*, 2019). Strain of bird, level of feed restriction and period at which feed restriction is applied are factors that may affect the production indices of broiler chickens (Summers and Robinson, 1995).

Adewole *et al.* (2018) observed significant decrease in final live weight and weight gain of pullet chicks with increasing levels of feed restriction. Conversely, Ghanem (2012) recorded insignificant effect of feed restriction on body weight gain and feed efficiency in two breeds of broiler chickens.

Significant effect of strain on final body weight and daily weight gain of restricted Bovans Nera and Isa Brown pullet chicks was observed by Adewole *et al.* (2018). The Bovans Nera pullet was significantly higher in final weight and daily weight gain when compared with the Isa Brown birds of the same age. Similarly, Olawumi *et al.* (2019) also observed significant effect of strain on final body weight of Ross 308 and Arbor Acre broiler chickens.

While there are several published works in literature on the separate effects of strain and feed restriction on production performance of broiler chickens, there is paucity of information in literature regarding the interaction effects of strain and feed withdrawal on the growth performance of broiler chickens in Anyigba. In an attempt to fill this research gap, this study was designed to investigate the effects of strain and feed withdrawal durations on the growth performance of broiler chickens.

MATERIALS AND METHOD

Experimental Location

The study was carried out at the Livestock Teaching and Research Farm, Prince Abubakar Audu University, Anyigba. Anyigba is located in the derived savannah zone of Nigeria on latitude 7°15' and 7°29' N of the equator and longitude 7°11' and 7°32' E of the Greenwich meridian with an average altitude of 420 m above sea level. The zone is characterized by 6-7 months of annual rainfall ranging from 1400-1500mm and daily temperature range of 25-35°C with highest temperature being in June-July (World atlas, 2015).

Site Preparation

The poultry pen was properly cleaned, washed with soap, Lysol and Izal and fumigated adequately with 40% formaldehyde in water solution and allowed to stay 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 and to raise the temperature of the brooding environment to keep the chicks warm.

Experimental Design

A total number of 180 day-old broiler chicks of two strains comprising of 90 Arbor Acre and 90 Ross 308 were procured from reputable hatcheries and assigned to six treatments in a completely randomized design arranged in a 2×3 factorial. In the first 14 days, all birds were fed *ad libitum*. From 15-28 days, each strain of broiler chicken was allotted to three different treatments having three replicates each, and 10 birds per replicate such that; T1-Both strains were placed on *ad libitum* feeding (control), T2-both strains were placed on 4 hours feed withdrawal from 8-12 noon daily, and T3-both strains were subjected to 8 hours feed withdrawal from 8-4pm daily. Thereafter, all the birds were subjected to full feeding until the end of the experiment (42 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 Bursa and Newcastle diseases were given at specific age intervals. The beddings were 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 feed withdrawal durations with starter mash (1-4 weeks) containing 3000 Kcal/Kg ME, 22% CP and Finisher feed 3100 Kcal/Kg ME, 21% Cp and water was available *ad libitum*.

Data Collection

Data were collected on final body weight, feed intake, average daily gain, and feed conversion ratio.

Statistical Analysis

The data collected were subjected to analysis of variance using Fit Model of JMP Pro 15 to determine the main effects of strain, levels of feed withdrawal and their interaction (strain × feed withdrawal). Significant means were separated using Tukey HSD Test at 5 % level of probability. The appropriate statistical model used was:

$$Y_{ijk} = \mu + S_i + W_j + S_i \times W_j + \varepsilon_{ijk}$$

Where,

Y_{ijk} = Dependent variables;

μ = Population mean;

S_i = Fixed effect of strain (i= 1 to 2);

R_j = Fixed effect of feed withdrawal (j= 1 to 3);

$S_i \times W_j$ = Overall interaction effect;

ε_{ijk} = Residual error

RESULTS

Effect of strain on growth performance of broiler chickens subjected to feed withdrawal durations

Table 1 shows the effect of strain on growth performance of broiler chickens subjected to feed withdrawal durations. The initial body weight was significantly ($p < 0.05$) different across the two strains of broiler chickens. Ross 308 birds had a superior ($p < 0.05$) initial body weight of 355.89g compared to 304.44g obtained for Arbor Acre birds. The results of the growth performance revealed that the effect of strain was insignificant ($p > 0.05$) on final body weight, average daily weight gain, average daily feed intake and feed conversion ratio.

Table 1: Effect of strain on growth performance of broiler chickens subjected to feed withdrawal durations

Parameters	Ross 308	Arbor Acre	SEM	P-value
Initial body weight (g)	355.89 ^a	304.44 ^b	2.81	0.000
Final body weight (g)	2124.89	2092.33	26.37	0.399
ADWG (g/bird/day)	63.92	63.85	0.93	0.964
ADFI (g/bird/day)	111.96	108.99	5.49	0.709
FCR	1.70	1.75	0.07	0.653

^{ab} = Means in the same row with different superscripts are significantly different ($p < 0.05$) from each other, ADWG: Average daily weight gain, ADFI: Average daily feed intake, FCR: Feed conversion ratio, SEM: Standard error of mean

Effect of feed withdrawal durations on growth performance of broiler chickens

The effect of feed withdrawal durations on growth performance of broiler chickens is presented in Table 2. There was no significant ($p > 0.05$) difference in initial weight, average daily weight gain, average daily feed intake and feed conversion ratio except final weight. Final weight (2151.00g) in the control group was similar ($p > 0.05$) to 4 hours feed withdrawal group (2089.83g), but significantly ($p < 0.05$) higher than the 8 hours feed withdrawal group (2055.00g). The 4 hours feed withdrawal group had similar final weight (2089.83g) to the 8 hours feed withdrawal group (2055.00g).

Table 2: Effect of feed withdrawal durations on growth performance of broiler chickens

Parameters	T ₁ (Control)	T ₂ (4HFW)	T ₃ (8HFW)	SEM	P-value
Initial weight (g)	323.17	321.50	315.83	3.44	0.321
Final weight (g)	2181.00 ^a	2089.83 ^{ab}	2055.00 ^b	32.29	0.045
ADWG (g/bird/day)	66.35	63.16	62.14	1.14	0.056
ADFI (g/bird/day)	121.08	107.72	102.63	6.72	0.177
FCR	1.82	1.71	1.66	0.09	0.438

^{abc} = Means in the same row with different superscripts are significantly different ($p < 0.05$) from each other, ADWG: Average daily weight gain, ADFI: Average daily feed intake, FCR: Feed conversion ratio, SEM: Standard error of mean, 4HFW: 4 Hours feed withdrawal daily, 8HFW: 8 Hours feed withdrawal daily

Interaction between strain and feed withdrawal durations on growth performance of broiler chickens

Interaction effects between strain and feed withdrawal durations on growth performance of broiler chickens are presented in Table 3. All the parameters measured (initial body weight, final body weight, average daily weight gain, average daily feed intake and feed conversion ratio) were not significantly ($p>0.05$) influenced.

Table 3: Interaction between strain and feed withdrawal durations on growth performance of broiler chickens

Parameters	T ₁ S ₁	T ₂ S ₁	T ₃ S ₁	T ₁ S ₂	T ₂ S ₂	T ₃ S ₂	SEM	p-value
Initial body weight (g)	340.00	340.00	327.67	306.33	303.00	304.00	4.86	0.391
Final body weight (g)	2179.00	2117.33	2078.33	2183.00	2062.33	2031.67	45.67	0.787
ADWG (g/bird/day)	65.68	63.48	62.59	67.03	62.83	61.70	1.61	0.753
ADFI (g/bird/day)	127.76	102.57	96.65	114.39	112.88	108.62	9.50	0.360
FCR	1.94	1.62	1.55	1.70	1.79	1.76	0.13	0.186

ADWG: Average daily weight gain, ADFI: Average daily feed intake, FCR: Feed conversion ratio, SEM: Standard error of mean, T₁: *Ad libitum* feeding, T₂: 4 Hours feed withdrawal daily, T₃: 8 Hours feed withdrawal daily, S₁: Strain 1 (Ross 308), S₂: Strain 2 (Arbor Acre)

DISCUSSION

The present study revealed that Ross 308 strain of broiler chickens had superior initial weight than the Arbor Acre strain, but at the end of the experiment, all growth parameters (final body weight, average daily weight gain, average daily feed intake and feed conversion ratio) evaluated were not affected by treatments for both strains of broiler chickens. This implies that although the two strains of broiler chickens differed in their initial body weights, there was absence of genetic variation which manifested in their comparable growth performance traits at the end of the experiment. A possible explanation for the similarity in the genetic makeup in Ross 308 and Arbor Acre broiler strains is that modern day broiler chickens were developed from a common origin of ancestors by breeders (Sarker *et al.*, 2002; Moro *et al.*, 2005; Abdullah *et al.*, 2010; Hossain *et al.*, 2011; Thutwa *et al.*, 2012; Udeh *et al.*, 2015 and Ikusika *et al.*, 2020).

The findings of this study agree with Sudik *et al.* (2020) who reported insignificant differences in live weight, total weight gain, daily weight gain, total feed intake, feed conversion ratio and mortality in Arbor Acre and Marshall Grinphield broiler chickens. Similar findings were reported by Kareem-Ibrahim *et al.* (2021) where Arbor, Cobb and Ross strains of broiler chickens did not differ in their final weight and total weight gain although significantly lower values were obtained for Marshall strain of broiler chickens in the same study.

Adedokun *et al.* (2022) also observed insignificant differences for final weight, weight gained, average daily weight gained, total feed intake and average daily feed intake in Cobb and Ross strains of chicken but they were significantly different from Arbor Acre chickens for the same growth parameters measured. Contrasting results were observed by Okusanya and Akindlade (2019), where Cobb and Arbor Acre broiler chickens differed in their growth performance traits. Amao *et al.* (2011) also observed superior growth performance traits for Ross over Anak and Marshall strains of broiler chickens in terms of body weight, daily weight gain, average daily feed intake and feed conversion ratio. Similarly, the report of Ghanem (2012) revealed higher live body weight, weight gain and better feed efficiency in Cobb-500 than that of Hubbard strain.

The results of the present study revealed that final weight of broiler chickens was similar for birds on control group and 4 hours feed withdrawal group. In other words, the birds on 4 hours feed withdrawal group compensated and statistically reached the same final body weight as the unrestricted birds. This implies that the period of restriction did not affect the market body weight. Similar results were observed by Ewa *et al.* (2006), who reported insignificant difference in the final weight of broilers on D1 (*ad libitum*) and D3 (chicks fed 80% of *ad libitum* 28-47 days of age and then re-alimented to *ad libitum* 48 – 70 days of age).

Similarly, Asra *et al.* (2019) observed insignificant differences in body weight and body weight gain of broiler chickens subjected to *Ad libitum* feeding and 5% feed restriction. Contrastingly, a significant effect of feed restriction was observed in body weight and body weight gain of broiler chickens on 10%, 15% and 20% feed restriction. The reason for the insignificant difference in final weight for the *Ad libitum* group and the 4 hours feed withdrawal group could be that following re-alimentation, the 4 hours restricted birds consumed feeds voraciously which translated to a good gain for the later growth performance traits. Feed restriction often results in apparent decrease in maintenance requirement of birds due to depressed metabolic rate. This suggests that birds become more efficient in utilizing reduced feed intake. This is based on the concept of reduced maintenance requirement in animals recovering from periods of feed withdrawal where the carry over effects of lowered metabolic rates allows more feed to be available for growth purposes (Lawrence and Fowler, 1998).

Conversely, feed restriction was lowest in final body weight of birds on 8 hours feed withdrawal duration. The birds on 8 hours feed withdrawal duration were unable to totally compensate for the loss of body weight gain during the restriction period following re-feeding. The lack of compensatory growth in birds on the 8 hours feed withdrawal group might be related to the short re-alimentation period. Yu and Robinson (1992) reported that factors such as severity, timing, duration of feed restriction, feed intake during the periods of re-feeding, sex and strain may affect the

subsequent ability of broiler chickens to recover from a growth deficit state due to feed restrictions. Similar findings by Adewole *et al.* (2018) revealed that final body weight, daily weight gain and feed intake were highest for birds on *ad libitum* feeding compared to birds on one-day and two-days restriction feeding. Omosebi *et al.* (2014) also observed that the control group on full-feeding had significantly higher growth performance (final body weight, total feed intake, daily feed intake, total weight gain and daily weight gain) than the restricted groups.

The results of this study showed that interaction effect between strain and feed restriction did not affect final body weight, average daily weight gain, average daily feed intake and feed conversion ratio. The implication is that the effects of the two factors are mutually exclusive on the growth performance traits of broiler chickens. In other words, the nutritional environment of the three treatment groups (*ad libitum*, 4 hours and 8 hours feed withdrawal durations) similarly affected gene expression and regulation of performance traits in the broiler chickens. Therefore farmers can apply feed withdrawal strategies on any of the two genotypes without expecting any performance variation due to genotypic effect. This result agrees with Dozier *et al.* (2023) who reported strain did not interact with skip-a-day feed removal to influence live performance of broilers. Contrastingly, Adewole *et al.* (2018) observed significant interaction effects between strain and feed restriction for final body weight, weight gain, feed intake, protein intake, protein efficiency ratio, feed conversion ratio and mortality in Isa-Brown and Bovans Nera pullets.

CONCLUSION AND RECOMMENDATIONS

The findings of this research reviewed that Ross 308 and Arbor Acre broiler chickens strains subjected to feed withdrawal durations did not differ significantly in final body weight and other growth performance indices. Therefore, any of the strains is recommended.

Feed withdrawal durations significantly affected final weight of Ross 308 and Arbor Acre broiler chickens beyond 4 hours feed withdrawal duration daily therefore, poultry farmers are advised to use 4 hours daily feed withdrawal to minimise negative consequences and reduce cost of feeding broiler chickens. Finally, the study revealed that there was no effect on strain by feed withdrawal durations on growth performance characteristics of broiler chickens.

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