EFFECTS OF STRAIN AND DURATION OF EARLY FEED WITHDRAWAL AND RE-FEEDING ON CARCASS TRAITS OF BROILER CHICKENS

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ABSTRACT

This research was carried out to evaluate the effects of strain and duration of early feed withdrawal and re-feeding on carcass traits of broiler chickens. A total number of 180 day-old broiler chicks (90 chicks of Arbor Acre and 90 chicks of Cobb-500) were purchased from reputable hatcheries and used for the study that lasted for 42 days. In the first 14 days, all birds were fed ad libitum. From 15-28 days, the birds were allotted to three different treatments labeled: T1 (ad libitum feeding), T2 (feeds were withdrawn from 8a.m – 12 noon daily) and T3 (feeds were withdrawn from 8a.m to 4p.m daily), replicated three times for each strain (each replicate had 10 birds) in a completely randomized design (CRD) arranged in a 2×3 factorial. Immediately after the feed withdrawal period, all the birds were placed on ad libitum feeding till the end of the experiment. The data collected was analysed using fit model of JMP Pro 15. Significant means were separated using Tukey HSD Test at 5 % level of probability. The results showed that strain of broilers significantly ($p<0.05$) influenced carcass traits. Arbor Acre strain had superior live weight, bled weight, dressed weight, carcass weight and intestine weight over the Cobb-500 strain while the Cobb-500 was superior for drumstick weight and liver weight. Conversely, duration of feed withdrawal had no significant ($p>0.05$) effect on all the carcass traits measured. Similarly, interaction of strain and feed withdrawal had not significant ($p>0.05$ effect on all the carcass traits measured. In conclusion, Arbor Acre strain appeared to be the most economic to rear with respect to carcass traits. 4 hours and 8 hours Feed withdrawal during the 3rd and 4th week of rearing broiler chickens had a positive result on the carcass traits of broilers chickens.

Keywords: Strain, Feed withdrawal, Carcass Traits, Broiler, Chickens

INTRODUCTION

Broiler chicken production has been identified as a veritable tool for ensuring food security in developing countries including Nigeria owing to their short production cycle, high feed efficiency and growth rate (Olawumi *et al.,* 2019). Other unique attributes of chicken meat is that the price is comparatively low, easy to partition into smaller parts and its consumption has no religious or cultural restrictions (Jaturasitha, 2004).

Olawumi *et al.* (2012) identified Arbor Acres, Marshall, Hubbard, Anak and Aboaca as strains of broilers commonly used for commercial purposes in Nigeria. According to Catolico and Ampode (2019), these strains of broiler chickens have been highly selected for high growth rate, breast meat yield and feed conversion efficiency under intensive production system. This selection for high growth rate, feed conversion efficiency and carcass traits in these strains of broiler chickens has resulted to physiological, immunological, biochemical and anatomical changes in broiler chickens (Schmidt *et al.*, 2009). Consequently, some negative attributes such as body fat deposition, increased mortality and incidence of metabolic diseases and skeletal disorders have been observed when these broiler chicken strains were fed *ad libitum* (David and Subalini, (2015).

In order to minimize these negative attributes, the concept of feed restriction was introduced. Feed restriction has been suggested as a management tool designed to limit birds access to feeds during a definite period of time which could be quantitative or qualitative (Olawumi, 2015). Feed restriction in broilers can help improve feed efficiency, reduce feed cost and mortality in addition to producing chicken meat at affordable price (Zubair and Leeson, 1996). It was documented in literature that feed restriction reduced chances of metabolic disorders like ascities syndrome which are common with broiler production resulting in high mortality thereby making the enterprise unprofitable (Arce-Menocal *et al.*, 1995).

There are different methods of feed restriction employed in broiler production to improve efficiency of feed utilization and weight gain, and these include intermittent feeding, skip-a-day feeding (Benyi *et al.*, 2009), appetite suppression with glycolic acid (Pinchasov and Jensen, 1989), time of restriction (Samara *et al.*, 1996), diet dilution (Sahraei and Shariatmadari, 2007) and quantitative feed restriction (Lee and Leeson, 2001). Quantitative feed restriction occurs when the time birds have access to feed in a day is limited, while qualitative feed restriction is the denial of birds to certain nutrients by mixing the compounded feed with inert fibres such as wheat offals (Fanooci and Torki, 2010). Quantitative feed restriction includes intermittent feeding, skip-a-day feeding, appetite suppression with glycolic acid, time of restriction and diet dilution (Benyi *et al*., 2011).

Previous studies have used the concept of feed restriction in broilers to reduce the incidence of metabolic disorders and high mortality (Balog *et al*., 2000). Shafei *et al.* (2018) reported that broilers subjected to feed withdrawal for 8-10 hours daily can compensate for performance losses in the early stage of growth and maximize the relative weights of carcass, breast muscle and thigh, but withdrawal lengths of 6 and 12 hours daily might be too short and too long, respectively, to improve performance losses after resumption of full feeding. Olawumi *et al*. (2019) observed that strain had no significant effect on live weight, carcass and non-carcass traits regardless of feed restriction employed.

However, duration of feed withdrawal significantly affected dressed weight, eviscerated weight, carcass weight and back weights. The authors further stated that birds on *ad libitum* and afternoon feeding groups had higher and superior mean values to morning group. Strain had no significant effect on live weight, carcass and non-carcass traits regardless of feed restriction employed.

Akinsola and Olawumi (2017) observed that strain had no significant effect on live weight of birds subjected to feed restriction but, strain significantly influenced carcass traits of broilers. In addition, there was no significant effect of feed restriction regime on carcass traits except for live weight and dressed weights of broiler chickens regardless of strain of broilers in the same experiment. David and Subalini (2015) recorded that the growth performance and carcass characteristics of broiler chickens were not affected by feed restriction for 3, 5 and 7 hours while significantly higher liver weight was observed in the birds fed *ad libitum.*

While separate effects of strain and non-genetic factors on production performance of boilers were given considerable attention in literature, there is dearth of information in literature regarding interaction effects between strain and feed restriction on carcass traits and meat quality of broiler chickens. In an attempt to further explore the merits of feed restriction, the study was carried out to investigate the effect of strain and duration of early feed withdrawal during the day and re-feeding on carcass traits of broiler chickens.

MATERIALS AND METHOD

Experimental Location

This 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 420m 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 (Ifatimehin *et al*., 2006).

Experimental Design

A total of 180 day-old broiler chicks of two strains comprising of Arbor Acre and Cobb-500 (90 chicks each) were procured from reputable hatcheries and used for the study that lasted for 42 days. In the first 14 days, all birds were fed *ad libitum.* From 15-28 days, the birds were allotted to three different treatments having three replicates for each strain (10 chicks/replicate) such as; T1- both strains in this category were fed *ad libitum* as control treatment, (T2) - both strains under this category had feeds withdrawn from 8-12 noon daily, and (T3) - both strains in this category had feed withdrawn from 8-4pm daily. The experimental design was a completely randomized design arranged in a 2×3 factorial.

All the chicks were placed on a*d-libitum* feeding immediately after the withdrawal period. Fresh and clean water was available *ad libitum.* The chicks were fed using starter feeds having 3000 Kcal kg-1 Metabolizable energy, 22% CP and finisher feeds having 3000 Kcal kg-1 Metabolizable energy, 19.5% CP. Vaccination and other routine medications were carried out as and when due.

At 49th day of age, three birds per replicate, that is, nine birds per treatment on strain basis were randomly selected after starving them overnight for carcass evaluation. The birds were numbered and weighed individually to obtain live body weight and thereafter, slaughtered, bled, scalded and plucked. After de-feathering, the carcasses were eviscerated manually. Data collected for carcass traits included live body weight, bled weight, dressed weight, carcass weight, breast weight, back muscle weight, drumstick weight, thigh weight, wing, intestinal weight, liver and gizzard.

Statistical Analysis

The data collected were analyzed using fit model of JMP Pro 15. 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 carcass traits of broiler chickens

Table 1 shows the effect of strain on carcass traits of broiler chickens. The results showed that strain significantly ($p<0.05$) influenced live weight, bled weight, dressed weight, carcass weight, drumstick weight, liver weight and intestine weight. Arbor Acre was superior ($p<0.05$) to Cobb-500 for live weight (2142.00 versus 2.24.61), bled weight (2076.15 versus 1974.94), dressed weight (1587.59 versus 1468.56), carcass weight (1462.44 versus 1351.01) and intestine weight (138.15 versus 91.49) respectively. Conversely, Cobb-500 had a significantly ($p<0.05$) better drumstick weight (9.98) than Arbor Acre (9.45). Liver weight was also higher ($p<0.05$) for Cobb-500 (80.12) than Arbor Acre (42.30). Breast weight, back weight, thigh weight, wing weight and gizzard weight were not significantly ($p>0.05$) influenced by strain of broiler chickens.

Table 1: Effect of strain on carcass traits and organ weight of broiler chickens

Traits	Strains		SEM	p-value
	Arbor Acre	**Cobb-500**		
Live weight (g)	2142.00[a]	2031.15[b]	31.14	0.015*
Bled weight (g)	2076.15[a]	1980.85[b]	31.05	0.035*
Dressed weight (g)	1587.59[a]	1477.07[b]	26.42	0.004*
Carcass weight (g)	1462.44[a]	1358.30[b]	24.97	0.004*
Breast weight (%)	25.01	24.14	0.46	0.193
Back weight (%)	14.61	13.83	0.42	0.203
Thigh weight (%)	11.35	10.77	0.22	0.071
Drumstick weight (%)	9.45[b]	10.01[a]	0.16	0.016
Wing weight (%)	7.70	7.85	0.13	0.411
Gizzard weight (g)	65.89	64.00	1.71	0.439
Liver weight (g)	42.30	78.30[a]	8.54	0.005*
Intestine weight (g)	138.15[a]	91.37[b]	7.80	0.000*

[ab] = Means along rows with different superscripts are significantly different (p<0.05)

Effect of duration of early feed withdrawal and re-feeding on carcass traits of broiler chickens

Table 2 below shows the effect of duration of early feed withdrawal and re-feeding on carcass traits of broiler chickens. The result showed that there was no significant (p>0.05) effect of feed withdrawal on all the carcass traits (live weight, bled weight, dressed weight, carcass weight, breast weight, back weight, thigh weight, drumstick weight and wing weight) and organ weight (gizzard weight, liver weight and intestine weight) measured.

Table 2: Effect of duration of early feed withdrawal and re-feeding on carcass traits and organ weights of broiler chickens

Traits	*Ad-libitum* (T_1)	4hrs feed withdrawal (T_2)	8hrs feed withdrawal (T_3)	SEM	P-value
Live weight (g)	2072.28	2072.56	2114.89	38.14	0.663
Bled weight (g)	2028.78	2014.56	2042.17	38.03	0.877
Dressed weight (g)	1527.89	1517.06	1552.06	32.36	0.737
Carcass weight (g)	1408.95	1401.39	1420.78	30.58	0.903
Breast weight (%)	24.70	24.19	24.85	0.57	0.691
Back weight (%)	14.48	14.90	13.29	0.52	0.087
Thigh weight (%)	11.12	10.86	11.21	0.27	0.652
Drumstick weight (%)	9.88	9.63	9.69	0.20	0.638
Wing weight (%)	7.88	7.59	7.86	0.16	0.387
Gizzard weight (g)	66.11	65.72	63.00	2.10	0.525
Liver weight (g)	59.61	61.17	60.11	10.46	0.994
Intestine weight (g)	113.67	116.50	114.11	9.55	0.973

[abc] = Means along rows with different superscripts are significantly different (p<0.05)

Interaction effect of strain and duration of feed withdrawal on carcass traits and organ weights of broiler chickens

Table 3 below shows the interaction effect of strain and duration of feed withdrawal on carcass traits of broiler chickens. The result showed that there was no significant ($p>0.05$) interaction effect of strain and duration of feed withdrawal on all the carcass traits (live weight, bled weight, dressed weight, carcass weight, breast weight, back weight, thigh weight, drumstick weight and wing weight) and organ weight (gizzard weight, liver weight and intestine weight) measured.

Table 3: Interaction effect of strain and duration of feed withdrawal on carcass traits and organ weights of broiler chickens

Traits	T1S1	T2SI	T3S1	T1S2	T2S2	T3S2	SEM	P-VALUE
Live weight (g)	2094.33	2109.00	2222.67	2050.22	2036.11	2007.11	53.94	0.245
Bled weight (g)	2039.22	2048.00	2141.22	2018.33	1981.11	1943.11	53.78	0.242
Dressed weight (g)	1576.33	1558.44	1628.00	1479.44	1475.67	1476.11	45.76	0.729
Carcass weight (g)	1445.33	1442.56	1499.44	1372.56	1360.22	1342.11	43.24	0.568
Breast weight (%)	25.22	25.20	24.62	24.19	23.18	25.07	0.81	0.312
Back weight (%)	14.89	15.12	13.82	14.07	14.68	12.76	0.74	0.913
Thigh weight (%)	11.57	11.22	11.25	10.66	10.51	11.16	0.38	0.533
Drumstick weight (%)	9.62	9.30	9.44	10.14	9.96	9.93	0.28	0.946
Wing weight (%)	7.78	7.59	7.72	7.97	7.59	7.99	0.23	0.846
Gizzard weight (g)	68.11	65.22	64.33	64.11	66.22	61.67	2.97	0.685
Liver weight (g)	39.89	41.56	45.44	79.33	80.78	74.78	14.80	0.927
Intestine weight (g)	132.00	140.22	142.22	95.33	92.78	86.00	13.51	0.770

^{abc} = Means along rows with different superscripts are significantly different ($p<0.05$)

DISCUSSION

The significant differences observed for live weight, bled weight, dressed weight, carcass weight, drumstick weight, liver weight and intestine weight across the two strains suggests that genetic differences exist within the strains, with Arbor Acre chickens having greater growth potentials than the Cobb-500 broiler strain. The findings of this study are in agreement with Olawumi and Fagbuaro (2011) who assessed the productive performance of Marshall, Arbor Acre and Hubbard strains of commercial broiler chickens and observed that Marshall genotype had superior ($p<0.05$) mean values in dressing out weight, eviscerated weight, carcass weight, carcass percentage, breast muscle weight, back weight, back muscle weight, thigh muscle weight, drumstick weight, neck weight and wing weight when compared to Arbor Acres and Hubbard. Similar research findings was also documented by Ikusika *et al.* (2020) who observed significant differences in carcass yields across strains.

The authors observed within the strains, Aboaca birds had the highest dressed weight and breast weight compared to Anak and Ross strains. It was recorded that Aboaca birds had higher carcass yield and lower visceral weights compared with Ross and Anak chicken. Several researchers including Musa *et al.* (2006), Ojedapo *et al.* (2008), Chukwuka *et al.* (2010), Fernandes *et al.* (2013) and Kamporn *et al.* (2022) also reported significant effect of breed in carcass traits of broiler chickens. In contrast, Olawumi and Omolola (2020) observed insignificant differences for carcass traits in Arbor Acre, Hubbard and Marshall strains of broiler chickens. live weight, bled weight, dressed weight, eviscerated weight, breast weight, back weight, thigh, drumstick, wing weight, head, heart, liver, proventriculus, intestine weight, spleen, lung + trachea, vent and shank were similar among the three genetic groups. The difference between these findings may be due to the type or strain of broiler used, geographical location, treatment applied and age of slaughter of experimental birds.

The insignificance difference in carcass traits of broiler chickens across *Ad libitum* feeding and feed withdrawal treatment groups may be due to the occurrence of compensatory growth during re-feeding period in feed withdrawn birds. This suggests that there may be gradual physiological adaptation of the birds to the different feeding regimes and probably improving the efficiency of conversion of the feed available to them (Ghanem, 2014). Susbilla *et al*. (1994) clearly demonstrated the occurrence of compensatory growth in strains of broilers following a period of decreased growth rate caused by feed restriction. Similarly, Yu *et al*. (1990) reported little compensatory growth in feed restricted broilers after 3 weeks of age because the there was no sufficient time for recovery until market age. The findings of this study are in agreement with the findings of Gobane *et al.* (2021) who observed no significant effect of feed restriction on the relative weights of heart, liver, gizzard, feet, and heads among the treatment groups except for intestine weight which was lower ($P < 0.05$) in birds fed *ad libitum* than one week feed restriction and two weeks feed restriction. Similarly, Mohammed *et al.* (2020) observed that feed restriction did not affect the result of all carcass characteristics and organ weights except breast percentage. Salih (2012) also observed insignificant effect of feed restriction on slaughter weight, dressed weight and dressing percentage except for carcass weight. The birds on no feed withdrawal had lowest percentage of breast of broiler chickens. In contrast to the findings of this study, Tumova *et al.* (2022) observed that slaughter weight and carcass weight were significantly lower in restricted chickens than in *ad libitum* chickens.

The insignificant strain by feed withdrawal interaction on carcass traits and organ weights implies that there was absence of joint effect of strain and duration of feed withdrawal on birds' carcass performance; that is, the two factors acted independently of each other as explained by Olawumi *et al.* (2012). This result agrees with Akinsola and Olawumi (2017) who observed no significant ($p>0.05$) strain by feed interaction effect on live weight and slaughter weight of Arbor Acre, Hubbard and Marshall broiler chickens.

However, the aforementioned authors observed significant ($p<0.01$) strain by feed restriction interaction effects on dressed, eviscerated, back and breast weight of Arbor Acre, Hubbard and Marshall broiler chickens. The results of the current work contradicts the findings of Toledo *et al*. (2004) who reported significant genotype by diet interaction effect on carcass trait such as breast yield. The absence of genotype x ration interaction in the present study indicates that the nutritional environment of the three rations (*Ad liitum*, 4 hours and 8 hours feed withdrawal during the day) similarly favoured gene expression and regulation of carcass traits. Hence, the two genotypes did not differ in ranking. The implication is that farmers can raise any of the two genotypes on any of the three treatment groups without detrimental effect on carcass yield.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this research, it can be concluded that Arbor Acre strain of broiler chickens recorded superior carcass traits compared to Cobb-500 broiler strains. Conversely, feed withdrawal did not have significant effect on all the carcass traits and giblets measured. Therefore, young broilers subjected to feed withdrawal for 4 and 8 hours daily during the third and fourth weeks (14-28 days) can compensate for performance losses in the early stage of growth and maximize the relative weights of carcass, breast muscle and thigh when subjected to *ad libitum* feeding during the finisher stage. Finally, there was no strain by feed withdrawal interaction effect on all the carcass traits of broilers measured.

Based on the findings of this research, Arbor Acre strain of broilers is also recommended over the Cobb-500 strain. Secondly, it is recommended that 8 hours feed withdrawal be practiced in the raising of fast growing broilers in the third and fourth week as no significant difference is observed in the carcass traits of broilers.

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