COMPARATIVE EVALUATION OF GROWTH PERFORMANCE, MORPHOMETRIC AND CARCASS TRAITS OF THREE STRAINS OF BROILER CHICKEN RAISED IN THE TROPICS

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ABSTRACT

A study was conducted to determine the influence of strain on growth performance, morphometric and carcass characteristics of Arbor Acre, Ross 308 and Cobb 500 strains of broiler chicken. A total of 144 birds were used for this study, the birds were divided into three treatment groups according to strain and each group was randomly replicated four times with 12 birds per replicate and was raised for eight weeks. The data obtain were subjected to analysis of variance. The result showed that Cobb 500 had the most superior body weight, feed intake, weight gain and feed conversion ratio (3520.00 ± 187.48 g, 4757.08 ± 38.56 g,3217.50 ± 161.10 g and 1.48 ± 0.06) respectively followed by Arbor Acre and Ross 308 in that order. However, in the finisher phase there was significant difference (p<0.05) observed in body height, Cobb 500 strain of broiler chicken was significantly (p<0.05) superior in body height than Arbor Acre and Ross 308. The result also indicated that strain had significant (p<0.05) influence on dressed weight, breast weight and liver weight with Cobb 500 being superior to the other two strains. Based on the results of this study, it was concluded that Cobb 500 was the most superior in body weight, weight gain, feed conversion ratio, dressed weight, breast weight and liver weight at 8 weeks compared to Arbor Acre and Ross 308. Therefore, Cobb 500 strain of broiler chicken could be recommended to broiler farmers for increase productivity in the study area.

Keywords: Broiler strain, Growth performance, Morphometric traits, Carcass quality

INTRODUCTION

Poultry industry in Nigeria has over the years witnessed the introduction of different broiler strains as ways of meeting the increasing demand for poultry meat and products. Poultry production is one of the most popular options in reducing the problem of protein deficiency in the diet of Nigerians (NABC, 2020). White meat such as chicken meat is superior to red meat because of its comparatively low-fat content and low cholesterol level (Jaturasitha *et al.,* 2008; Sam *et al.,* 2010). To meet the global increasing demand for poultry products, new strains of broiler are developed for faster growth rate and carcass quality (Olawumi *et al.,* 2012). The growth and carcass yield of broiler chicken is of primary concern to the producers and consumers. Growth (body weight, weight gain, and feed intake and feed conversion ratio) and carcass traits performances depend on strain, nutrition, age, sex and management of the birds (Ajayi and Ejiofor, 2009; Akpa *et al*., 2010; Olawumi *et al*., 2012; Sam *et al*., 2019). Poultry farmers have to select broiler strains that will

reach market weight at a reasonable age in order to maximize profit (Sam *et al*., 2019).

However, the success of poultry production has been strongly related to the improvements in growth performance and carcass yield and composition. Broiler producers are now focusing on carcass yield, growth performance especially with the major component parts such as breast, thigh and drumstick (Sam *et al*., 2010; Shafey *et al.,* 2013). This implies that poultry producer needs to select stock which has the genetic potential for fast growth and early attainment of market weight under the existing climatic condition of the given environment. According to Yahaya *et al.* (2012), body weight and a number of conformation traits such as breast girth, shank length, back length, keel length are also a good indicator of body growth and market value in broilers. Significant differences between strains and sexes in body weight, morphometric parameters and carcass traits had been reported by various authors (Razuki, 2002; Ojedapo *et al.,* 2008; Olawumi *et al.,* 2012; Sam *et al.,* 2019). Significant strain effects on weight gain, feed intake, feed conversion as well as feed efficiency of broiler chickens have also been reported (Olawumi and Dudusola, 2011).

It is therefore pertinent to evaluate these traits to provide useful dependable information that serves as a guide to both researchers and farmers on choice of broiler strain to purchase for increased growth, meat production and maximum profit. Therefore, the objective of this study was to evaluate the influence of strain on growth performance, morphometric trait and carcass characteristics of three broiler chicken strains.

MATERIALS AND METHODS

Location of the Experiment: This study was carried out at the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University Obio Akpa. Obio Akpa is located between latitudes 4º30ºN and 5º00N and longitudes 70º30ºE and 80º00E. The area is characterized with an annual rainfall ranging from 3500 – 5000 mm and average monthly temperature of 25^0C, and relative humidity between 60 – 90 %. It is in the tropical rainforest zone of Nigeria. The people in the study areas depend on livestock and crop production (Wikipedia, 2022).

Experimental Birds and Management: Arbor Acre, Cobb 500 and Ross 308, commercial broiler strains were purchased from Zactech, Goldsmind and Agrited hatcheries respectively in Oyo State, Nigeria. A total of 144 unsexed day-old broiler chicks comprising 48 each of Arbor Acre, Cobb 500 and Ross 308 commercial strains were allocated into three treatments (according to strain) with four replications (12 chicks per replicate) in a completely randomized design (CRD). Each strain was identified by wing tag and assigned to pen in a brooder house. Chicks were brooded for two weeks in the restricted brooding section of the Teaching and Research Farm of Department of Animal Science, Akwa Ibom State University. Electric bulb and charcoal stoves were used as source of heat. After brooding birds were transferred to the rearing house for another six weeks. All necessary routine management practices and the recommended vaccination schedule were strictly observed throughout the period of the study.

All chicks were fed *ad-libitum* with a commercial broiler starter diet (Top Feeds Super Starter, Premiere Feed Mills Company Limited, Nigeria) containing 24 % crude protein and 300 kcal/kg metabolizable energy up to four weeks of age. Thereafter the birds were given broiler finisher ration (Top Feeds Broiler Finisher, Premiere Feed Mills Company Limited, Nigeria) containing 21 % crude protein and 2800 kcal/kg metabolizable energy up to eight weeks. Fresh drinking water was given *ad-libitum* to the birds throughout the experimental period.

Data Collection

Growth Traits: The birds were weighed at the beginning of the experiment and weekly thereafter. Data were collected on the initial body weight, final body weight, daily feed intake and feed conversion ratio as follows: Feed intake (FI) was obtained as the difference between the quantity offered the previous day

and the quantity left over, The daily weight gain (WG) was calculated by dividing the total weight gain by the number of days the experiment lasted. Feed conversion ratio (FCR) was calculated by dividing the feed intake by weight gain. Daily weight gain was calculated by dividing the body weight gain by the number of days the feeding trial lasted.

Morphometric Traits: The linear body measurements were taken in cm using tailors' tape as described by Sam *et al.* (2019) as follows: Breast girth: this was taken as the circumference of the breast around the deepest region of the breast using measuring tape in cm. Keel length: This was taken as the length of the sternum. Shank length: this was measured as the length of the tars-metarsus from the hock joint to the metatarsal pads. Thigh length: this was measured as the distance between hock joint and pelvic joint. Wing length was measured between the tip of the phalanges and coracoids - humorous joint. Body Length The distance between the base of the neck to the tip of the tail.

Carcass Traits: Cut-up parts and organ weight were determined as describe by Ojewole and Longe (1999). Two birds from each replicate that is eight birds per treatment and 24 birds all together (birds closest in mean weight per replicate) were chosen. The selected birds were fasted overnight and weighed to obtained the live weight thereafter bleed by severing the jugular vein. They were then dipped in hot water and defeathered. The head, neck and shank were removed to have the dressed weight and percentage dressed weight which is based on the relationship between the dressed weight and the live weight after the internal organs have been removed and was calculated as shown below: Dressed weight = live weight - (weight of the head + shank + feather + intestine). % dressed weight = dressed weight ÷ live weight × 100 and Live weight = weight of the bird after fasting.

Carcass Traits Measurement: After slaughtering, data were also collected on carcass characteristics as follows: Carcass weight: It was taken as the hot eviscerated carcass without feet, head and abdominal fat using digital weighing scale. Breast Weight: measured as the weight of the breast. Drum Stick: measured as weight of the drumstick. Thigh: measured as weight of the thigh. Wing: measured as weight of the wing. Back: measured as weight of the back using sensitive weighing balance (S. Miller Digital Scientific Scale) and were expressed in grammes.

Statistical Analysis: The data obtained from growth performance traits (body weight, feed intake, weight gain and feed conversion ratio), morphometric traits (breast girth, keel length, shank length, thigh length and wing length) and carcass traits (Live weight, dressed weight, dressing percentage, carcass weight, breast weight, drum stick, thigh, wings and back weight) were subjected to analysis of variance (ANOVA) using General Linear Model Procedure of SPSS (2008) version 23. Means with significant differences were separated using Duncan's Multiple Range Test of the same package. The correlation coefficient was used to estimate the association between growth traits, morphometric traits and carcass trait from each of the strains using PROC CORR procedure of the same statistical package. The statistical model used is as shown below: $Y_{ik} = \mu + Ai + e_{ik,}$ Where; Y_{ik} = Record of measurable traits, μ = population mean, A = effect of strain (A = 1, 2, 3) and e_i = random error.

RESULTS AND DISCUSSION

Growth Performance Traits: The influence of strain on growth performance of three strains of birds Arbor Acre, Ross 308 and Cobb 500 indicated significant differences ($p<0.05$) in all the growth performance parameters measured (Table 1). Cobb 500 had significantly higher ($p<0.05$) values in all the parameters though statistically similar with Arbor Acre in total feed intake and daily feed intake.

The result showed that the final body weights were significantly higher ($p<0.05$) in Cobb 500 (3520.00 ± 187.48 g) than in Arbor Acre (3010.00 ± 47.08 g) and Ross 308 (3005.00 ± 105.00 g) which were similar at week 8 of age.

Table 1: Growth performance of three strains of broiler chicken

Parameters	Arbor Acre	Ross 308	Cobb 500
Initial body weight (g)	342.50 ± 20.16	385.00 ± 22.17	302.50 ± 41.30
Final body weight (g)	3010.00 ± 47.08[a]	3005.00 ± 105.00[a]	3520.00 ± 187.48[b]
Weight gain (g)	2667.50 ± 47.67[a]	2620.00 ± 91.46[a]	3217.50 ± 161.10[b]
Daily weight gain (g)	63.51 ± 1.13[a]	62.38 ± 2.17[a]	76.61 ± 3.83[b]
Total feed intake (g/bird)	4550.73 ± 103.63[ab]	4477.98 ± 61.79[a]	4757.08 ± 38.56[b]
Daily feed intake (g/bird)	108.32 ± 2.44[ab]	106.62 ± 1.47[a]	113.45 ± 0.90[b]
Feed conversion ratio	1.71 ± 0.04[b]	1.71 ± 0.06[b]	1.48 ± 0.06[a]

[ab] means on the same row with different superscripts are significantly Different (p<0.05)

This result was similar to reports of Udeh *et al.* (2015) who reported that Arbor Acre and Ross 308 were similar in weight, but superior to Marshal at eight weeks of age. However, Amao *et al.* (2011) reported that Ross 308 had superior weight to other strains of birds used in their experiment at eight weeks of age. This result agreed with the findings of Ajayi and Ejiofor (2009) and Razuki *et al*. (2011) who reported significant strain differences in live body weight of broiler chicken at 8 weeks. The weights of the strains of birds used in this study were similar to weights reported by Sam *et al.* (2010; 2019). These authors reported that broiler chicken attain market weight of 1.2 – 3.500 kg at 8 – 10 weeks. Final weight gains were similar among Arbor Acre (2667.50 ± 47.67 g) and Ross 308 (2620 ± 91.46 g) strains but significantly lower (p<0.05) than the value for Cobb 500 (3217.50 ± 161.10 g). This result indicated that Cobb 500 had a greater genetic potential for weight gain than the other two strains. Not much literature is found on performance of Cobb 500. However, the results obtain from this study in body weight was higher than that which was obtain by Sam *et al.* (2010) in Arbor Acre strain of broiler. This may be probably due to differences in environmental and management practices used. Feed intake was observed to follow the same trend.

The result indicated that feed conversion ratio (1.48 ± 0.06) was significantly lower (p<0.05) in Cobb 500 than the other two strain; Arbor Acre (1.71 ± 0.04) and Ross 308 (1.71 ± 0.06). Cobb 500 had significantly better (p<0.05) feed conversion than the other two strains. This result was contrary to the reports of Amao *et al*. (2011) that Ross 308 broilers had better feed conversion ratio than other strains of birds used in their study.

However, Abdullah *et al.* (2010) and Udeh and Ogbu (2011) also observed significant differences in feed conversion ratio of different strains of broiler. Feed conversion ratio is one of the major criteria used in defining the performance of broilers (Sam *et al.,* 2010). Skinner-Noble and Teeter (2003) described feed efficiency as feed intake per weight gain which measures how efficiently the feed is being utilized, and this is obviously of economical importance because feed represent about 75 % of the total cost of production in poultry (Amao *et al.,* 2011). Feed conversion ratio obtained in this study for the three strains were within the range reported for broilers (Amao *et al*., 2011; Udeh *et al.,* 2015). Earlier reports by Sam *et al.* (2010) indicated that the lower the feed conversion ratio the better the performance of birds. However, this results disagree with the reports of Amao *et al*. (2011) who observed no significant differences (p>0.05) in feed intake, weight gain and feed conversion of Anak and Marshall strains of birds. The observed differences between the present study and those of earlier authors might be as a result of differences in genetic constitution of birds and management practices

Morphometric Traits: The effect of strain on morphometric traits of Arbor Acre, Ross 308 and Cobb 500 broiler strains at starter indicated that no significant differences (p>0.05) were observed in the started phase (Table 2), whereas in the finisher phase significant differences (p<0.05) were observed (Table 3). Cobb 500 had significantly higher (p>0.05) value for body height and body girth than Arbor Acre and Ross 308. Cobb 500 recorded 28.77 ± 0.40, 32.41 ± 0.69, 38.62 ± 0.90 and 39.95 ± 0.72 cm for weeks 5, 6, 7 and 8 respectively in

Table 2: Morphometric traits of three strains of broiler chicken at starter phase

Ages (Weeks)	Strain	Body Girth (cm)	WL (cm)	KL (cm)	ThL (cm)	SL (cm)	BH (cm)	BL (cm)
2	Arbor Acre	16.10 ± 1.79	12.83 ± 1.78	7.96 ± 0.14	9.25 ± 0.30	6.12 ± 1.00	18.21 ± 0.64	18.16 ± 0.53
	Ross 308	17.92 ± 0.12	10.71 ± 0.28	7.81 ± 0.15	9.76 ± 0.19	4.79 ± 0.14	18.75 ± 0.14	18.64 ± 0.34
	Cobb 500	16.63 ± 0.59	10.09 ± 0.33	7.43 ± 0.16	9.59 ± 0.48	4.79 ± 0.24	17.29 ± 1.00	17.35 ± 0.25
3	Arbor Acre	21.05 ± 0.43	13.11 ± 0.30	9.62 ± 0.24	11.62 ± 0.43	5.30 ± 0.34	21.36 ± 0.29	21.55 ± 0.31
	Ross 308	20.21 ± 0.43	12.53 ± 0.18	8.79 ± 0.46	12.02 ± 0.40	4.87 ± 0.16	21.04 ± 0.44	21.56 ± 0.49
	Cobb 500	21.62 ± 0.53	12.97 ± 0.18	9.87 ± 0.10	11.61 ± 0.53	4.94 ± 0.28	20.96 ± 0.38	21.46 ± 0.57
4	Arbor Acre	24.34 ± 0.29	14.95 ± 0.38	11.28 ± 0.16	14.14 ± 0.35	6.98 ± 0.07	24.57 ± 0.17	26.16 ± 0.51
	Ross 308	24.11 ± 0.14	15.44 ± 0.21	11.10 ± 0.13	13.70 ± 0.34	7.06 ± 0.29	24.26 ± 0.18	25.73 ± 0.31
	Cobb 500	24.83 ± 0.72	15.23 ± 0.43	11.76 ± 0.30	13.79 ± 0.58	7.13 ± 0.31	24.50 ± 0.49	26.34 ± 0.38

WL= Wing length, KL= Keel length, THL= Thigh length, SL=Shank length, BH= Body height, BL= Body length

Table 3: Morphometric traits of three strains of broiler chicken at finisher phase

Ages (Weeks)	Strain	Body Girth (cm)	WL (cm)	KL (cm)	ThL (cm)	SL (cm)	BH (cm)	BL (cm)
5	Arbor Acre	30.78 ± 0.71	17.55 ± 0.26	12.50 ± 0.61	15.73 ± 0.26	7.51 ± 0.57	27.41 ± 0.24^{a}	27.73 ± 0.94
	Ross 308	31.07 ± 0.42	17.32 ± 0.63	12.65 ± 0.57	16.35 ± 0.42	7.65 ± 0.82	27.92 ± 0.41^{a}	28.02 ± 0.72
	Cobb 500	31.39 ± 0.50	17.92 ± 0.35	12.99 ± 0.55	16.26 ± 0.53	7.91 ± 0.72	28.77 ± 0.40^{b}	28.90 ± 1.05
6	Arbor Acre	33.49 ± 0.35	18.23 ± 0.23	14.31 ± 0.37	18.97 ± 0.95	8.37 ± 0.92	31.63 ± 0.62^{a}	31.13 ± 0.60
	Ross 308	33.73 ± 0.58	18.50 ± 0.16	14.23 ± 0.53	19.11 ± 0.87	8.71 ± 0.98	31.09 ± 0.68^{a}	30.54 ± 1.50
	Cobb 500	34.68 ± 0.62	18.81 ± 0.04	14.70 ± 0.44	18.86 ± 0.64	8.38 ± 0.96	32.41 ± 0.69^{b}	31.44 ± 1.27
7	Arbor Acre	35.86 ± 0.61	20.07 ± 0.31	15.54 ± 0.73	19.08 ± 0.39	8.63 ± 0.43	34.37 ± 0.66^{a}	32.55 ± 0.73
	Ross 308	35.02 ± 2.06	19.54 ± 0.23	16.38 ± 0.48	19.44 ± 0.78	8.78 ± 0.16	37.19 ± 0.86^{a}	34.55 ± 0.87
	Cobb 500	38.80 ± 0.49	20.32 ± 0.23	18.17 ± 0.27	19.88 ± 0.47	8.70 ± 0.07	38.62 ± 0.90^{b}	33.04 ± 0.68
8	Arbor Acre	36.00 ± 0.24^{b}	39.00 ± 0.22	21.00 ± 0.33	16.00 ± 0.42	20.00 ± 0.23	38.90 ± 0.64^{a}	35.01 ± 0.31^{b}
	Ross 308	36.00 ± 0.28^{b}	38.52 ± 0.27	20.00 ± 0.25	18.06 ± 0.62	19.52 ± 0.23	38.90 ± 0.61^{a}	32.21 ± 0.44^{b}
	Cobb 500	39.00 ± 0.31	40.00 ± 0.24	21.95 ± 0.32	20.01 ± 0.66	20.05 ± 0.21	39.95 ± 0.72^{b}	38.01 ± 0.37

ab means on the same column within a week with different superscripts are significantly ($p<0.05$) Different. WL= Wing length, KL= Keel length, THL= Thigh length, SL=Shank length, BH= Body height, BL= Body length

body height, while Arbor Acre recorded 27.41 ± 0.24, 31.63 ± 0.62, 34.37 ± 0.66 and 38.90 ± 0.64 cm for week 5, 6, 7 and 8 in body height respectively, whereas Ross 308 305 had 27.92 ± 0.41, 31.09 ± 0.68, 37.19 ± 0.86 and 38.90 ± 0.61 cm respectively in body height. Similar trend was observed for body girth.

The result of this study is in line with the reports of Sam *et al*. (2019) who reported similar body weight in Arbor Acre broiler strain.

The observed results suggest that environment and management influence these morphometric parameters more compared to genetic makeup.

Carcass Composition: The carcass composition of Arbor Acre, Ross 308 and Cobb 500 strains of broiler chicken revealed significant difference ($p<0.05$) in the live weight (3010.00 ± 47.08, 3005.00 ± 105.00 and 3520.00 ± 187.48 g) of Arbor Acre, Ross 308 and Cobb 500 strains respectively (Table 4).

Table 4: Carcass composition of Arbor Acre, Ross 308 and Cobb 500 strains of broiler chicken

Parameters	Arbor Acre	Ross 308	Cobb 500
Live weight (g)	3010.00 ± 47.08[a]	3005.00 ± 105.00[a]	3520.00 ± 187.48[b]
Dressed weight (g)	1646.0 ± 131.55[a]	1692.00 ± 75.16[a]	1778.00 ± 180.39[b]
Dressing percent (%)	54.68 ± 4.41	56.31 ± 2.16	50.51 ± 5.22

[a,b] Means in a row with different superscripts are significantly different (p<0.05)

The least value of 3005.00 ± 105.00 grams was recorded for Ross 308 strain, although Ross 308 strain gave the highest mean dressing percentage of 56.31 % than Arbor Acre 54.68 %, and Cobb 500 50.51 % but were not significantly ($p>0.05$) different. Cobb 500 strain had significantly higher ($p<0.05$) dressed weight (1778.00 ± 180.39 g) than Arbor Acre (1646.00 ± 131.55 g) and Ross 308 (1692.00 ± 75.16 g). The superiority of Cobb 500 strain in carcass composition over Arbor Acre and Ross 308 strain was in agreement with the report of Rahman (2014).

Table 5 indicated carcass and organ characteristics of Arbor Acre, Ross 308 and Cobb 500 strains of broiler chicken. The results indicate influence of strains on breast weight and liver. Cobb 500500 had significantly higher ($p<0.05$) values in breast weight (290.00 ± 66.92 g) than Arbor Acre and Ross 308 (284.50 ± 18.71 and 286.00 ± 16.53 g respectively). Liver weights for Ross 308 (105.50 ± 105.00 g) was significantly higher ($p<0.05$) than the other two strains (78.50 ± 47.08 and77.50 ± 187.48 g for Arbor Acre and Cobb 500 respectively).

Table 5: Carcass and organ characteristics of Arbor Acre, Ross 308 and Cobb 500 strains of broiler chicken

Parameters	Arbor Acre	Ross 308	Cobb 500
Drum stick	102.50 ± 11.44	115.25 ± 5.36	126.50 ± 7.08
Thigh	264.50 ± 23.10	262.00 ± 24.93	270.50 ± 23.60
Wing	198.00 ± 26.27	198.50 ± 8.62	213.00 ± 15.18
Breast	284.50 ± 18.71[a]	286.00 ± 16.53[a]	292.00 ± 66.92[b]
Neck	38.50 ± 3.23	52.50 ± 8.21	55.50 ± 6.61
Shank	71.50 ± 3.20	75.00 ± 7.85	80.50 ± 4.86
Head	47.00 ± 2.12	51.75 ± 4.78	56.50 ± 2.33
Liver	78.50 ± 8.06[a]	105.50 ± 8.54[b]	77.50 ± 3.77[a]
Heart	9.00 ± 0.91	10.00 ± 1.87	8.75 ± 1.25
Gizzard	36.50 ± 3.70	43.50 ± 2.60	39.00 ± 2.38
Kidney	10.00 ± 0.00	10.00 ± 0.00	10.00 ± 0.00

[a,b] Means in a row with different superscripts are significantly different (p<0.05)

However, there were no significant differences ($p>0.05$) in drumstick, thigh, wing, breast, neck, shank, heart, head, kidney and gizzard across the three strains. However, the values obtained for carcass traits in this study are higher than what was reported by Akpa *et al*. (2010) for male and female Arbor Acre broiler strain raised to maturity.

The findings of this study indicating higher live body and breast weight in Cobb 500 strain was contrary to the reports of Udeh and Ogbu (2011) who reported higher carcass weights of Arbor Acre and Ross 308. However, the slight difference in values of carcasses traits between the strains maybe attributed to nutrient absorption effects between the strains.

Conclusion: It was concluded from this study that Cobb 500 was the most superior in body weight, weight gain and feed conversion ratio at 8 weeks compared to Arbor Acre and Ross 308 in the study environment. The strains of broiler chicken did not differ in body girth, Wing length, keel length, thigh length, shank length, body height and body length at started phase of the

experiment but showed difference in the finisher phase with Cobb 500 having the highest value in body height compared to Arbor Acre and Ross 308. Cobb 500 also had the heaviest breast weight (292.00 ± 66.92 g) when compared with Arbor Acre (284.50 ± 18.71 g) and Ross 308 (286.00 ± 16.53 g). Other carcass characteristics measured showed no significant difference ($p>0.05$) across the treatments.

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