Nigerian J. Anim. Sci. 2026, 28 (1): 1-15

Comparative growth and carcass characteristics of progenies from local x exotic chicken crosses

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***Target audience:** Animal breeders, Producers, Farmers, Students*

Abstract

This study investigated the growth performance, body weight, linear body traits, carcass and organ characteristics of crossbred progenies of exotic and indigenous chickens. A composite mating pattern was used to generate 315 progenies from crosses involving a base population of 30 birds consisting of 3 brown normal feathered and 3 black normal feathered local cocks, female exotic breeder layers (parent stock) consisting of 12 Cobb and 12 Arbor Acres at about 20 to 22 weeks of age in the ratio of 1: 4. Data obtained were subjected to analysis of variance in a randomized complete block design. Results on growth performance indices showed that the final body weight, average weight gain and average daily weight gain was significantly (P<0.05) higher in NaCOB progeny with mean values of 1383.33±16.67 g, 1347.66±18.00 g and 24.070.01 g, respectively. Feed conversion ratio (FCR) was significantly lower (P<0.05) in NaCOB (1.08±0.02) indicating the best feed utilization efficiency. Significant differences (P<0.05) were found in the body weights and linear body measurements of the birds in various weeks, with NaCOB having significantly higher (P<0.05) body weights with the mean values of 188.80±5.91 g, 389.20±3.18 g, 615.00±3.56 g, 900.00±22.36 g, 1030.00±30.00 g, 1230.00±20.00 g and 1430.00±20.00 g, respectively from weeks 2 to 8. Live weight (1416.67±16.67 g), defeathered weight (1350.00±28.87g), dressed weight (1250.00±28.87g) and dressing percentage (89.10±0.59%) were significantly higher (P<0.05) in NaCOB. NaCOB had significantly (P<0.05) higher kidneys (0.71±0.01%), large intestine (1.05±0.01%), small intestine (4.97±0.01%) and crop (0.79±0.01%). From the findings of this study, NaCOB progeny showed superior performance over the other genotypes across the growth traits measured and therefore is best suited for improving the local stock in the study area.

***Keywords:** growth performance, body weight, linear body traits, carcass characteristics, crossbred progeny*

Description of Problem

Chickens are recognized as a valuable component of global genetic resources (1), and the most widely distributed avian species in the Nigerian poultry production industry with a total population size of 180 million birds (2). The Nigerian indigenous chickens have been reported to exhibit higher fertility and hatchability under natural incubation, and better adaptation to the prevailing diseases, physical conditions and local management practices than exotic chickens (3). It is however less productive (meat and eggs) than its exotic counterparts (3). Research has shown that the indigenous fowl possesses great potentials for genetic improvement through breeding programme such as selection and/or cross breeding (4).

It is worthwhile considering crossbreeding/ composite breeding as a means of improving the productivity of the indigenous chickens, which would contribute to increased availability and affordability, especially by communities vulnerable to food insecurity.

Crossbreeding has been a pivotal strategy in developing modern commercial chicken breeds (5) and also holds potential for improving rural chickens. Crossbred chickens generally demonstrate higher feed efficiency and lower mortality rates than purebreds, which are crucial for enhancing profitability in poultry production (6). Upgrading the native chicken using high producing European breeds was seen as the quickest way of achieving genetic improvement, thus increasing egg and meat production (7). (8) noted that the rate of growth of an individual influence its body size.

Growth rate is an important tool in assessing the growth performance and potential productivity of animal livestock (9). Animal growth encompasses the increase in size and enhancement of functional capabilities of various tissues and organs from conception to maturity (10). Linear body measurements help in the comparison of growth in different parts of the body. It has been severally used to characterize strains, evaluate carcass yield, sex effect on performance and predict live weight gain in livestock (11). The live body weight and linear body measurements contribute significantly to the lifetime performance of the animal (12). Carcass is an important parameter for determining the relationship for the wholesale or further process bases of birds (13). The objective of this study is to evaluate the growth and carcass characteristics of progenies from local x exotic chicken crosses.

Materials and Methods

Experimental Site

This experiment was carried out at the Poultry Unit, Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike Umuahia, Abia State. The farm is located at latitude 05^0 29^1 North and longitude 07^0 33^1 East. The farm lies in the altitude of 122 m above sea level and within the rainforest zone of south-east Nigeria, which has bimodal rainfall pattern and total annual rainfall range of 1700-2100 mm, maximum ambient temperature of 27 to 36^0C during the hot dry season of the year (November – March) and minimum ambient temperature range of 20^0C-26^0C during the cold rainy season (April-October). The relative humidity ranges from 57-91%. The farm is located in warm humid tropics (14).

Breeding Stock and Management

A base population of 30 birds consisting of 3 brown normal feathered, 3 black normal feathered local cocks and 24 female exotic breeder layers (parent stock consisting of 12 Cobb and 12 Arbor Acres of about 20 to 22 weeks of age) were selected for the generation of the progenies. The Nigerian indigenous cocks were sourced from the three senatorial zones in Umuahia, Abia State, while the exotic strains were purchased from reputable farms in Ibadan, Oyo state. The brown Normal feathered local cocks were mated to the Cobb exotic females, while the black Normal feathered cocks were mated to the Arbor Acres exotic females. The birds were randomly allocated to pens in the ratio of 1 cock: 4 hens.

Progenies generated from the base population which formed two genetic groups (that is, BrownNormalCobb-NaCOB and BlackNormalArbor Acres-NaAA) were 105 each replicated thrice with 35 birds per replicate. The sire line from the first genetic group (BrownNormalCobb-NaCOB) were mated to the dam line from the second genetic group (BlackNormalArbor Acres- NaAA) to produce 105 (BrownNormalCobb x BlackNormalArbor Acres- NaCOB x NaAA) progenies according to a composite mating system, which were also replicated thrice with 35 birds per replicate. The birds were kept in a deep litter house. A total of 315 birds were generated in all, with 105 each for the NaAA, NaCOB and NaCOB x NaAA genotypes, replicated thrice with 35 birds per replicate.

Egg setting, incubation and hatching
Collection of eggs was carried out and marked for six days, kept in a crate in a ventilated room to enable collection of large number of eggs before incubation. The eggs were candled on the 18th day of incubation, and eggs with live embryo were transferred to the hatchery. In the incubator/hatchery, the temperature was maintained at 37.5^{0}C for incubation and 37^{0}C for hatching, with a relative humidity of 60-65%. All chickens were tagged with number for identification and individual records. Feed and water were given *ad libitum*. The birds were fed starter (2800 kcal/kg and 21.50 %CP), grower (2613.5 kcal/kg and 16 %CP) and breeder layer (2700 kcal/kg and 18 %CP) diets.

Data collection
The growth performance parameters measured include:
Initial body weight (g): Birds were weighed at the start of the experiment using a 20,000 g CAMRY brand scale with 50 g sensitivity, while the young chicks were weighed with a digital scale of 0.001 g sensitivity.

Final body weight (g): At the end of the experiment, the birds were weighed to obtain the final body weight.

Total feed consumed (g): This was gotten by subtracting left over from the quantity of feed given (after 24 hours)

Weight gain (g): This was gotten by subtracting the initial body weight from the final body weight

Average daily weight gain (g): This was calculated by the total weight gain divided by the number of experimental days

Average feed intake (g): This was calculated by the total feed consumed divided by the number of birds
Average daily feed intake (g): This was calculated by the total feed consumed divided by the number of birds and multiplied by the number of experimental days
Feed Conversion Ratio (FCR): This was calculated by the total feed consumed divided by the total weight gain
Conformation traits
Body weights and different morphometric parts were measured using a weighing scale and measuring tape and were read in grams (g) and centimeters (cm). These parts are:

Body weight (g): This was measured using a 20,000 g CAMRY brand scale with 50 g sensitivity, while the young chicks were weighed with a digital scale of 0.001 g sensitivity.

Shank length (cm): This was taken as the length of the tarso-metatarsus from the end of the femur bone to the tip of the hock joint to the metatarsal pad.
Thigh length (cm): This is the length of the femur bone.
Thigh circumference (cm): The circumference of the thigh was measured with a tape.

Breast girth (cm): This was determined using a measuring tape at the region of breast expansion when positioned ventrally.
Body length (cm): This is the distance between the base of the neck and pygostyle.
Wing length (cm): This is the distance from the shoulder joint to the extremity of the terminal phalanges.
Keel length (cm): This is measured as the length of the cartilaginous keel bone from the V-joint to the end of the sternum.
All the linear body traits were measured with a tailor's tape.
Carcass evaluation
The carcass weight was taken by randomly selecting five (5) birds per replicate at eight

(8) weeks of age. The birds were starved for 12 hours, weighed and slaughtered by severing the jugular vein. The following carcass were recorded:

Live body weight: The live body weight (LBW) was determined by weighing in kilograms of the live bird using a top loading 20 kg CAMRY brand scale with 50 g sensitivity.

Defeathered weight: The defeathered weight was determined after removing all the feathers and weighed in grams using digital scale with 50 g sensitivity.

Dressed weight: The dressed carcass weight (DCW) was determined after bleeding, defeathering and removal of head, shank and non-edible viscera, and was weighed in grams using digital scale.

The cut parts: Namely, breast, thigh, drumstick, wings, neck and back cut were weighed in grams using digital scale. The visceral organs, lungs, liver, kidney and heart were also weighed in grams, respectively.

Data Management and Analysis

Data were collected weekly (for body weights and linear body traits) from the 2nd week first thing in the morning prior to time for feeding the animals. Data were analyzed using Analysis of Variance. For the quantitative traits, the general linear model GLM, SAS Package – v.9.4 (15) appropriate for a randomized complete block design (RCBD) was used to test the effect of these strains on growth performance and carcass evaluations. The statistical model for the design is shown below.

$Y_{ijk} = \mu + G_i + H_j + e_{ijk}$

Where,

Y_{ijk}= individual observation on the strains

μ = population mean

G_i = effect of the i^{th} genetic group (strain)

H_j = hatch effect (block)

e_{ijk} = random error, assumed to be independently, identically and normally distributed with zero mean and constant variance (iiNd $(0, \sigma^2)$).

Significant means were separated using Duncan Multiple Range Test (16) at 0.05 level of probability.

Results and Discussion

Growth Performance of the Progenies of Crossbred Chickens

Table 1 shows the results on the growth performance of the progenies of crossbred chickens for a period of 8 weeks. There were significant (P<0.05) differences among the genetic groups for final body weight, average weight gain, average daily weight gain and FCR. The final weight, average weight gain and average daily weight gain was significantly (P<0.05) higher in NaCOB progeny with a mean value of 1383.33±16.67 g, 1347.66±18.00 g and 24.07±0.01 g, respectively. Feed conversion ratio (FCR) were significantly influenced (P<0.05) by genotype with the significant (P<0.05) least FCR found in NaCOB (1.08±0.02). No significant difference (P>0.05) was found in the percent mortality of the birds. FCR of NaCOB (1.08±0.02) was better when compared to the NaAA and NaCOB x NaAA. This could be as a result of superior growth performance of NaCOB, hence showing better efficiency of the birds to convert feed to meat, thus resulting in the most efficient value of the feed conversion ratio (17). Among the genetic groups, NaCOB became the genotype of choice in terms of feed conversion ratio since the lower the numerical value for FCR, the more superior the birds in utilizing feed (18). (18) reported that feed conversion ratio (1.48 ± 0.06) was significantly lower (P<0.05) in Cobb 500 than Arbor Acres (1.71 ± 0.04). Feed conversion ratio is one of the major criteria used in defining the performance of broilers (19). (20) described feed efficiency as feed intake per weight gain which measures how efficiently the feed is being utilized, and this is obviously of economic importance because feed represent about 75

% of the total cost of production in poultry (21). Other researchers reported that there was no significant difference due to breed or strain in average daily feed intake, average daily weight gain and efficiency of feed utilization (22; 23). This discrepancy could be attributed to the genetic makeup of the birds used for the study. (24) and (25) reported mean initial weight of 27.02 g from Nigerian local chickens consisting of heavy and light ecotypes and their crossbred, and 30.11+0.12 g from a normal feather female line of Nigerian local chicken respectively, which were lower that the values obtained in this study. (8) noted that the rate of growth of an individual influence its body size. (18) reported that the final body weight was significantly higher (P<0.05) in Cobb 500 (3520.00 ± 187.48 g) than in Arbor Acres (3010.00 ± 47.08 g) at 8 weeks. (26) and (27) also reported significant differences in feed conversion ratio of different strains of broiler. (21) reported no significant differences (P>0.05) in feed intake of Anak and Marshall strains of broiler. (28) also reported no significant difference (P>0.05) in the feed intake of Ross 308 sire x Brown dam, Ross 308 x Black dam, Arbor Acres sire x Brown dam and Arbor Acres sire x Black dam, which was in contrast to the findings of this present study.

Table 1: Means±SE of growth performance of the progenies of crossbred chickens

Parameters	NaAA	NaCOB	NaCOB x NaAA
Initial body weight (g)	32.67±1.45	35.67±0.67	30.67±0.67
Final body weight (g)	1183.33 ± 16.67^{b}	1383.33 ± 16.67^{a}	1133.33 ± 33.00^{c}
Average feed intake (g)	1493.33 ± 31.80^{b}	1460.00 ± 30.55^{b}	1977.78 ± 40.06^{a}
Average daily feed intake (g)	26.67 ± 0.57^{b}	26.07 ± 0.55^{b}	35.32 ± 0.01^{a}
Average weight gain (g)	1150.67 ± 15.34^{b}	1347.66 ± 18.00^{a}	1102.67 ± 10.01^{c}
Average daily weight gain (g)	20.55 ± 0.08^{b}	24.07 ± 0.01^{a}	19.69 ± 0.03^{c}
FCR	1.30 ± 0.02^{b}	1.08 ± 0.02^{a}	1.79 ± 0.01^{c}
Mortality (%)	3.00±0.03	2.00±0.02	3.33±0.03

^{a,b,c} Means with different superscripts in the same row are significantly different (P<0.05), S.E: Standard Error.
NaAA = Normal feathered local cock x Abor acre, NaCOB = Normal feathered local cock x Cobb

Body Weight and Linear Body Measurements of the Progenies of Crossbred Chickens

Table 2 shows the least square means (±SE) of body weight and body linear measurement from 2 to 8 weeks of age for NaAA, NaCOB and NaCOB x NaAA. Significant differences (P<0.05) were found in the body weights and linear body measurements of the birds in various weeks. The BWT of the birds significantly differ (P<0.05) throughout the weeks. In weeks 2, 3, 4, 5,6, 7 and 8, NaCOB had significant higher (P<0.05) body weights with the mean values of 188.80±5.91 g, 389.20±3.18 g, 615.00±3.56 g, 900.00±22.36 g, 1030.00±30.00 g, 1230.00±20.00 g and 1430.00±20.00 g, respectively, followed by NaAA which was significantly higher (P<0.05) than NaCOB x NaAA. For BL, NACOB had significant (P<0.05) longer body in weeks 2 (18.20±0.12 cm), 3 (20.50±0.16 cm), 4 (24.20±0.12 cm), 5 (27.50±0.22 cm), 6 (28.80±0.20 cm), 7 (31.40±0.24 cm) and 8 (33.40±0.24 cm), respectively. For SL, NaCOB had significant (P<0.05) longer shank in weeks 2, 3,4, 5, 6 and 7 with mean values of 8.50±0.14 cm, 9.40±0.24 cm, 12.20±0.12 cm, 13.30±0.12 cm, 13.80±0.12 cm and 14.20±0.12 cm respectively.

Table 2: Means±SE of body weight and linear body measurements of the progenies of crossbred chickens at 2 to 8 weeks

Age (weeks)	Progeny	BWT (g)	BL (cm)	SL (cm)	KL (cm)	WL (cm)	BRG (cm)	TL (cm)	TG (cm)
2	NaAA	115.20±2.13^{b}	16.60±0.24^{b}	6.80±0.20^{b}	5.80±0.20	8.80±0.20	13.60±0.40^{b}	6.80±0.20^{a}	5.40±0.19^{b}
	NaCOB	188.80±5.91^{a}	18.20±0.12^{a}	8.50±0.00^{a}	6.40±0.24	9.80±0.20	15.60±0.24^{a}	7.40±0.24^{a}	6.10±0.19^{a}
	NaCOB x NaAA	68.36±3.30^{c}	9.18±0.08^{c}	6.18±0.01^{b}	4.45±0.33	8.58±0.33	11.45±0.33^{c}	5.44±0.33^{b}	4.41±0.29^{c}
3	NaAA	196.60±6.12^{b}	18.70±0.25^{b}	9.40±0.24^{a}	7.80±0.25^{a}	9.00±0.00	16.40±0.24^{b}	8.40±0.24^{b}	6.40±0.24^{a}
	NaCOB	389.20±3.18^{a}	20.50±0.16^{a}	9.40±0.19^{a}	7.70±0.12^{a}	11.40±0.19	20.30±0.20^{a}	9.20±0.12^{a}	6.40±0.19^{a}
	NaCOB x NaAA	104.12±0.07^{b}	10.27±0.08^{c}	6.84±0.14^{b}	5.60±0.13^{b}	10.08±1.00	15.95±0.08^{c}	7.28±0.09^{c}	4.57±0.15^{b}
4	NaAA	342.29±0.47^{b}	12.21±0.67^{c}	9.85±0.08^{b}	7.45±0.04^{c}	11.08±0.14^{b}	20.61±0.75^{b}	9.11±0.34^{b}	6.91±0.13^{c}
	NaCOB	615.00±3.56^{a}	24.20±0.12^{a}	12.20±0.12^{a}	9.40±0.24^{a}	12.30±0.20^{a}	24.00±0.40^{a}	10.40±0.24^{a}	8.60±0.29^{a}
	NaCOB x NaAA	253.60±3.56^{c}	20.20±0.12^{b}	9.70±0.20^{b}	8.70±0.25^{b}	10.40±0.24^{c}	20.00±0.00^{b}	10.40±0.24^{a}	7.20±0.12^{b}
5	NaAA	505.63±0.47^{b}	13.73±0.34^{c}	10.85±0.67^{b}	8.79±0.50^{b}	12.08±0.67	24.11±0.67^{b}	10.28±0.82	8.08±0.50
	NaCOB	900.00±22.36^{a}	27.50±0.22^{a}	13.30±0.12^{a}	10.80±0.12^{a}	13.30±0.12	28.80±0.34^{a}	12.30±0.12	9.80±0.12
	NaCOB x NaAA	430.00±5.58^{c}	21.90±0.37^{b}	10.80±0.12^{b}	9.30±0.12^{ab}	11.90±0.19	22.90±0.29^{b}	10.90±0.19	8.80±0.25
6	NaAA	716.67±0.75^{b}	14.48±0.22^{c}	11.51±0.34^{b}	9.79±0.75	12.74±0.67	26.45±0.35^{b}	10.61±0.35^{b}	9.66±0.36
	NaCOB	1030.00±30.00^{a}	28.80±0.20^{a}	13.80±0.12^{a}	11.80±0.20	13.80±0.12	30.60±0.24^{a}	12.20±0.19^{a}	10.40±0.24
	NaCOB x NaAA	557.40±19.18^{c}	24.30±0.12^{b}	11.63±0.34^{b}	10.40±0.19	12.20±0.12	26.90±0.19^{b}	12.60±0.29^{a}	10.40±0.24
7	NaAA	950.00±0.58^{b}	15.99±0.68^{c}	12.01±0.48^{b}	10.45±1.00	13.24±0.12^{b}	29.45±0.64^{b}	11.43±1.06	10.08±0.44
	NaCOB	1230.00±20.00^{a}	31.40±0.24^{a}	14.20±0.12^{a}	12.20±0.12	14.20±0.12^{a}	33.40±0.24^{a}	13.20±0.12	11.40±0.24
	NaCOB x NaAA	910.00±29.15^{c}	27.30±0.20^{b}	12.40±0.19^{b}	10.40±0.19	12.44±0.12^{c}	28.30±0.20^{b}	12.70±0.25	10.60±0.24
8	NaAA	1190.00±24.49^{b}	29.60±0.19^{b}	13.30±0.29	11.70±0.20	15.30±0.20	30.80±0.49^{c}	13.40±0.24^{b}	11.60±0.24^{ab}
	NaCOB	1430.00±20.00^{a}	33.40±0.24^{a}	14.28±0.12	12.70±0.12	14.70±0.12	35.40±0.24^{a}	13.70±0.12^{a}	12.40±0.24^{a}
	NaCOB x NaAA	1140.14±0.46^{c}	17.00±0.69^{c}	12.51±0.70	10.95±0.67	14.74±0.67	31.33±0.14^{b}	11.94±0.08^{c}	11.04±0.34^{b}

^{a,b,c} Means with different superscripts in the same column are significantly different (P<0.05), S.E: Standard Error. BWT= Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRG= Breast girth, TL= Thigh length, TG= Thigh girth. NaAA = Normal feathered local cock x Abor acre, NaCOB = Normal feathered local cock x Cobb

For KL, no significant differences ($P>0.05$) were seen in weeks 2, 6, 7 and 8, while in week 3, the KL value of NaAA (7.80±0.25 cm) and NaCOB (7.70±0.12 cm) were statistically the same ($P>0.05$) but were significantly ($P<0.05$) longer than the value of NaCOB x NaAA (5.60±0.13 cm). In weeks 4 and 5, NaCOB had significantly ($P<0.05$) longer keel with the mean keel length of 9.40±0.24 cm and 10.80±0.12 cm, respectively. However, the keel length of NaCOB (8.79±0.50 cm) at week 5 was not significantly different ($P>0.05$) from that of NaCOB x NaAA (9.30±0.12 cm). The WL in weeks 2, 3, 5, 6 and 8 showed similarity among the three genotypic groups. However, in weeks 4 and 7, NaCOB had significant ($P<0.05$) longer wing spans of 12.30±0.20 cm and 14.20±0.12 cm, respectively. For BRG, significant differences ($P<0.05$) were seen in the three genotypic groups in all the weeks studied with NaCOB having higher ($P<0.05$) breast circumference of 15.60±0.24 cm, 20.30±0.20 cm, 24.00±0.40 cm, 28.80±0.34 cm, 30.60±0.24 cm, 33.40±0.24 cm and 35.40±0.24 cm, respectively, followed by NaAA, which was significantly higher ($P<0.05$) than NaCOB x NaAA in weeks 2 and 3 but statistically similar to NaCOB x NaAA in weeks 4, 5, 6 and 7, while in week 8, NaCOB x NaAA was significantly higher ($P<0.05$) than NaAA. The TL of the birds were not significantly ($P>0.05$) different in weeks 5 and 7. In week 2, NaAA (6.80±0.20 cm) and NaCOB (7.40±0.24 cm) had significant higher ($P<0.05$) TL than NaCOB x NaAA (5.44±0.33 cm). In week 3 and 8, NaCOB was significantly higher ($P<0.05$) with mean length of 9.20±0.12 cm and 13.70±0.12 cm, while in weeks 4 and 6, TL was significantly higher ($P<0.05$) in NaCOB and NaCOB x NaAA with the mean thigh length of 10.40±0.24 cm (week 4) and 12.60±0.29 cm (week 6). TG showed no significant differences ($P>0.05$) in weeks 5, 6 and 7. NaCOB had significant higher ($P<0.05$) TG in weeks 2 (6.10±0.19 cm) and 4 (8.60±0.29 cm). In week 3, NaAA (6.40±0.24 cm) and NaCOB (6.40±0.19 cm) had higher ($P<0.05$) mean TG while in week 8, the mean TG was significantly higher ($P<0.05$) in NaCOB (12.40±0.24 cm) but not significantly different ($P>0.05$) from NaAA (11.60±0.24 cm).

The results of the current study that revealed significant genotype effect of body weight and other linear body measurements of birds is expected because of variations in the genetic constitutions of the birds which is a major determinant of growth and physiological development. This is consistent with the reports of (29). The significant difference in body weight is in line with the reports of (30), (31), (32) and (33). These authors in their various findings reported that growth traits of chickens varied based on the genotype of the chickens. In his report, (32) affirmed variations in early growth traits of chicken progenies produced from chicken sires crossed with Fulani ecotype dams. In line with this, (34) reported differences in growth traits of two commercial broiler chickens. Similarly, (33) reported variations in the growth traits of pure and crossbred chicken progenies under derived savannah area of Nigeria. The significant differences observed in growth traits of the crossbred progenies in this study implied that the genotype have different genetic potentials for growth. In this study, the body weight ranged from 115.20±2.13 g – 1190±24.49 g, 188.80±5.91 g –1430±20.00 g and 68.36±3.30 g – 1140.14±0.46 g for NaAA, NaCOB and NaCOB x NaAA respectively. This affirms the report of (35) that broiler chickens attain market weight of 1300 to 2000g at 8 weeks of age as seen in NaCOB. As reported by (36), body weights for Cobb and Arbor Acres ranged from 266.67 g – 1920 g and 276.33 g –1973 g, respectively in weeks 3-8. This range was higher than what was obtained in this study. It may be attributed to the fact that this present study used local crossbreds as against exotic purebreds used by (36). (37) reported significant (P<0.05) differences in body weights and morphometric traits in different broiler strains at weeks 4 and 8, with the Ross strain showing superiority over the Abor Acres and Cobb strains in body weight (3100 g, 2833 g, 2466 g), breast girth (48 cm, 46 cm, 45 cm), wing length (19 cm, 18 cm, 17 cm), shank length (7 cm, 7 cm, 6 cm), and keel length (18 cm, 17 cm, 17 cm), respectively at week 8. These ranges were also higher than what was obtained in this study. This could be attributed to the fact that this present study used both local and exotic crossbreds as against exotic purebreds used by (37). (28) reported that Ross 308 sire x Brown dam showed superiority over other genetic groups in terms of body weights in weeks 2,4,6,8 and 12 (76 g, 198 g, 245 g, 541 g, and 1240 g) respectively. However, these values were lower than the values obtained in this present study. This could also be associated with the fact that the dam line used by (28) was Nigerian indigenous chicken as against the exotic chicken dam line used in the current study. (38) reported higher values for body weight and body length in indigenous normal feathered hen crossed with exotic to be 353.00 g and 33.43 cm at week 4, respectively. The difference in values could be attributed to differences of genotype, environment and management (28). The significant variation in body weight and linear body measurements of the resulting progenies of the crosses are consistent with the reports of (39) and (40) in which breed differences had significant effect on growth performance of different strains of birds.

Carcass Characteristics of the Progenies of Crossbred Chickens at 8 weeks

The carcass characteristics of the different genetic groups are shown in Table 3. Significant differences (P<0.05) were observed in the carcass characteristics of the birds, implying that genotype has significant effect on the carcass traits. This variation may be attributed to the genetic makeup of these chicken genotypes. This agrees with the findings of (41). Live weight (1416.67 g), defeathered weight (1350.00 g), dressed weight (1250.00 g) and dressing percentage (89.10%) were significantly higher (P<0.05) in NaCOB than in NaAA and NaCOB x NaAA. Different meat portions also differed significantly (P<0.05) in different genetic groups, with NaCOB having higher significant (P<0.05) values for breast cut (24.16%) and back cut (17.69%). The mean wing percentage showed no significant difference (P>0.05) between NaAA (9.91%) and NaCOB (11.27%) but were significantly higher (P<0.05) than NaCOB x NaAA (7.00%). This result revealed no significant differences (P>0.05) in the mean thigh, shank, head and drumstick percentages. Numerically, the mean percentages of thigh, shank, head and drumstick were higher in NaCOB.

According to (13), the output quality of the system is fixed by a predetermined amount of kilogram carcass of final product of broiler**.** The average dressing percentages of the birds in this study were higher than the value obtained by (42) who reported average range value of 53.33 to 66.67% for the indigenous cocks, and average range value of 67.33 to 73.33% for the indigenous hens reared in North western Ethiopia.

This variation might be due to differences in the age of the chickens when slaughtered and carcass components that were included in the dressed carcass during the calculation of the dressing percentage. In a study by (43), kuroiler chickens had heavier weights for live weight, bled weight, pluck weight, eviscerated weight, wing weight, shank weight, drumstick and back weight breasts than naked neck, normal feather, kuroiler normal feather crossbred and kuroiler naked neck crossbred chickens. These differences are probably due to variations in the genetic constitution of the bird genotypes. The findings of present study are in agreement with previous studies by (44) who reported varied carcass characteristics in Naked neck, Normal feathered, Frizzle feathered and Noiler as influenced by breed and sex. Similarly, (45) reported varied carcass characteristics in different chickens of normal feathered, frizzled feathered and naked neck chickens in the semi-arid zone of Nigeria. These authors claimed that variations in the carcass components were due to variation in the genetic makeup of chickens used in the studies.

However, (28) reported Ross 308 sire x Brown dam had the highest significant (P<0.05) live weight (1240.83 g) and dressed weight (1160.67 g) in their study, which was lower than the values obtained for NaCOB in this present study. The authors also reported that the dressing percentage of Ross 308 sire x Brown dam progenies (54.73 %) was statistically similar to those of Arbor Acres sire x Brown dam (53.45%). Similar observations were made by (28) who attributed the differences in values to genetic variations as well as the researches being carried out in different locations. According to (46), diet, age, sex, genotype and environment as factors that affect carcass composition. (47) also reported a significant variation of dressing weight due to breed effect, and stated that Cobb chicken had higher dressing weight (2664.00 g) than the Marshall counterparts (1854.15 g). This is attributed to the fact that this present study used crossbreds as against exotic purebreds used by (47).

Table 3: Means±SE of carcass characteristics of the progenies of crossbred chickens at 8 weeks

Parameters	NaAA	NaCOB	NaCOB x NaAA
Live weight (g)	1203.3±3.33^{b}	1416.67±16.67^{a}	1166.67±0.33^{b}
Defeathered weight (g)	1083.33±44.10^{b}	1350.00±28.87^{a}	1133.33±33.33^{c}
Dressed weight (g)	1016.67±16.67^{b}	1250.00±28.87^{a}	850.00±28.87^{c}
Dressing percentage (%)	83.58±0.99^{b}	89.10±0.59^{a}	77.21±5.45^{b}
Breast (% of dressed weight)	20.16±0.45^{b}	24.16±0.56^{a}	18.03±0.58^{c}
Thigh (% of dressed weight)	12.23±0.62	13.40±1.27	10.00±1.15
Wings (% of dressed weight)	9.91±0.11^{a}	11.27±0.64^{a}	7.00±1.15^{b}
Neck (% of dressed weight)	5.52±0.29	5.77±0.40	5.35±0.58
Back (% of dressed weight)	14.21±0.31^{b}	17.69±0.89^{a}	12.01±1.20^{b}
Shank (% of dressed weight)	4.57±0.30	4.76±0.39	4.37±0.01
Head (% of dressed weight)	3.61±0.31	3.83±0.44	3.41±0.01
Drumstick (% of dressed weight)	11.48±0.29	11.79±0.41	11.18±0.01

^{a,b,c} Means with different superscripts in the same row are significantly different (P<0.05), S.E: Standard Error. NaAA = Normal feathered local cock x Abor acre, NaCOB = Normal feathered local cock x Cobb

According to (48), live weight of 1937.50 g, 2048.88 g and 2215.00 g were reported for Arbor Acres, Cobb and Marshall strains, respectively. The authors also reported the wing, breast weight, thigh weight, head and neck weight of Marshall strain to be 179.70±5.29 g, 325.40±9.15 g, 420.00±8.51 g, 74.50±3.10 g and 67.90±0.68 g, respectively. These values were higher than the values obtained in this work, which may be attributed to the fact that these strains were purebred exotic raised mainly as meat type.

Organ Proportion of the Progenies of Crossbred Chickens at 8 weeks

The results of organ proportions of NaAA, NaCOB and NaCOB x NaAA chicken genotypes are presented in Table 4. With the exception of liver, gizzard, spleen and heart, genetic group had significant ($P<0.05$) effect on the proventriculus, lungs, kidney, pancreas, small intestine, crop and large intestine. NaCOB had significantly ($P<0.05$) higher kidney (0.71±0.01%), large intestine (1.05±0.01%), small intestine (4.97±0.01%) and crop (0.79±0.01%). The mean percent pancreas was significantly higher in NaCOB x NaAA (0.22±0.01%) but was not significantly different ($P>0.05$) from NaAA (0.21±0.01%). From these findings, it was discovered that the value of organs of NaCOB were greater than that of NaAA and NaCOB x NaAA.

Table 4: Means±SE of organ proportions of the progenies of crossbred chickens at 8 weeks

Parameters (% of LW)	NaAA	NaCOB	NaCOB x NaAA
Liver	2.34±0.17	2.40±0.02	2.40±0.20
Gizzard	2.13±0.07	2.16±0.01	2.14±0.07
Spleen	0.26±0.01	0.24±0.02	0.24±0.01
Proventriculus	0.41±0.01^{a}	0.40±0.01^{a}	0.35±0.01^{b}
Lungs	0.63±0.01^{b}	0.62±0.01^{b}	0.70±0.01^{a}
Kidney	0.64±0.02^{b}	0.71±0.01^{a}	0.63±0.02^{b}
Pancreas	0.21±0.01^{ab}	0.19±0.01^{b}	0.22±0.01^{a}
Heart	0.45±0.03	0.50±0.01	0.51±0.01
Crop	0.78±0.01^{a}	0.79±0.01^{a}	0.63±0.02^{b}
Large intestine	1.05±0.03^{a}	1.05±0.01^{a}	0.89±0.01^{b}
Small intestine	4.29±0.15^{b}	4.97±0.01^{a}	4.18±0.16^{b}

^{a,b,} Means with different superscripts in the same row are significantly different ($P<0.05$), S.E: Standard Error.
NaAA = Normal feathered local cock x Abor acre, NaCOB = Normal feathered local cock x Cobb.

This could suggest that there may be a higher digestive metabolic activity that took place in the organs of this genotype. It could also be attributed to existence of genetic variability among the progenies as was also reported by (28) in a study with local x exotic chicken crosses. Edible offal which includes gizzard, heart, kidney and liver are important components of chicken meat. The findings of the current study also revealed that the percentage of lungs of NaCOB x NaAA was greater than that of NaAA and NaCOB. This could suggest that there was a higher digestive metabolic activity that took place in the organ of this genotype. In line with this, (49) and (50) had earlier reported a substantial effect of the genotype on abdominal fat as was observed in this study.

The report of (51) for the percentage organ weights of heart, lungs, liver, gizzard, spleen and intestine in Ross 308 broiler chickens (0.4%, 0.69%, 2.51%, 2.12%, 0.09%, and 3.89%, respectively) are similar to the values recorded in this present study, except the spleen which was lower than the value recorded in this present study. This could be as a result of the genetic makeup of the broiler strain used. However (52) reported higher values for liver, heart, proventriculus, gizzard and spleen in 42 days old Ross 308 broilers (43.6, 9.6, 8.3, 24.7, and 2.7, respectively). This could be as a result of the ages of broiler birds used for the study.

Conclusions and Applications

1. Based on the results from this study, genotype had significant effect on the parameters measured.
2. The results revealed that the NaCOB genotype showed superior performance in the growth performance indices as seen in the final body weight, average weight gain, average daily weight gain and FCR, body weight and linear body traits, carcass traits and organ proportions.
3. The NaCOB genotype could be utilised or exploited for meat production purposes as seen in their superior performance in the final body weight, average weight gain, FCR, linear body traits and carcass traits when compared to the other genotypes. This will result in increased meat yield for farmers in the humid tropical environment.

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