

## Performance of F1 Generation of Nigerian Indigenous Chicken and Plymouth Rock

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**Target Audience:** Indigenous chicken farmers, Poultry breeders, Researchers, Monogastric nutritionist and Students

### Abstract

Indigenous chickens in Nigeria are identified by low egg production (EP), small egg size, stunted growth, and light body weight (LBW). The research was conducted to evaluate body weight (BW), feed intake (FI), feed cost (FC) per kg gain of F<sub>1</sub> generation of indigenous chicken (IC), growth rate, hematological parameters and carcass traits and their crosses. Total of 168 matured ICs of different types [normal feathered (NF), frizzle feathered (FF) and naked neck (Nn)] were purchased and managed intensively. The birds were selected at 8–12th week for higher body weight and crossbred with Plymouth rock (PR) cock. The fertile eggs were hatched to form F<sub>1</sub>. Mating was with inter se and crossbreeding between IC x PR. The first cross was between NF x NF, FF x FF, and Nn x Nn. NF x PR, FF x PR, and Nn x PR cock, respectively, produced 50% IC and 50% PR in F<sub>1</sub>. The result revealed that there was a substantial difference in weight gain (WG) and FC/kg/gain in all genotypes. All growth indices studied (weight gain, growth rate, specific growth rate and growth efficiency) declined with age. Crossbred group had higher packed cell volume (PCV) value NF x PR (29.15%), Nn x PR (28.23%), and FF x PR (28.35%) and low PCV values in indigenous genotypes. Carcass weight was significantly higher in crossbred birds than indigenous genotypes. In conclusion, further studies to upgrade schematically to F<sub>2</sub> generations would be very viable for future selection and improvement programmes of these crossbreds.

**Key words:** Crossbreeding; genotype; exotic cock; crossbred; progenies; purebred; weight gain; Indigenous; generation; body weight

### Description of Problem

Domestic chicken performs a significant function through production of eggs and meat, which are very nutritious and popularly acceptable by human population (1). Rural

people consume a reasonable percentage of animal protein originating from IC meats and eggs (2), and it is mainly employment for rural farmers (3). Despite the Nigerian indigenous chicken (NIC) contributions, it

has yet to fully take advantage of the genetic improvement.

The birds are categorized by slow growth, small size of their body, and low EP ranging from 30-80 small eggs/hen/year (4,5,6). Many researchers reported that with good management practices, IC would exhibit the potential of good meat and egg producers (7,8,9).

The (10) considered indigenous chicken production are of 'poor producer' because the stocks have yet to be effective for commercial enterprise. Despite this fact, they contribute significantly to human income and food availability and safety. They also possess high resistance to harsh environmental conditions and endemic diseases (11).

Available information on IC resources in Nigeria has been documented (12,13,4). These authors consider Nigerian Indigenous chicken as a light breed, characterized by light body weight and egg size, slow in attaining market weight but hardy and well adapted to the tropical climate, and shows resistance to some prevailing diseases endemic to Africa. The NIC is, however, reported to be adaptive for the improvement layer strain for tropical environments due to its heat tolerance and adaptation in the rainforest zone (4). At the rural level, indigenous chickens are kept mainly for consumption and income. Women with flocks own these birds, ranging from 15 to 20 per household (14).

They are managed on a free-range system (FRS) where they mostly scavenge on kitchen waste, worms, insects, grasses and vegetables for feed. There is little or no controlled breeding in FRS. (15) stated that ICs are not grouped into specific breeds. Instead, they are heterogenous in their

phenotypic and genotypic outlook.

The ICs face harsh weather, diseases, and parasites, which partly account for their poor productive performance. However, they can be made more productive by improving their production environment. A plausible approach to genetic improvement of NIC selection is based on genotypic and phenotypic characteristics. The current challenge is to evaluate BW, FI and FC per kg gain of F<sub>1</sub> of IC and their crosses.

## **Materials and Methods**

### **Experimental Site**

The research was conducted at the Departmental Research Center (DRC), Faculty of Agriculture, Southern Delta University, Ozoro. Latitude 5° 32' N and Longitude 6° 15' E of Greenwich Meridian place the center in Mid-western Nigeria's rainforest. Humidity averages 2500-3000 mm per year, and 27.4 °C and 85 percent are the mean temperature and RH (16).

### **Experimental Birds and Management**

Total 168 matured birds of the different strains (NF, Nn and FF) were procured and reared on a deep litter system in an open-sided house roofed with corrugated sheet. The rearing house was made of wood, comprising of 12 pens with wood shavings on the floor, and each pen measuring 2.5 m x 1.5 m. Each pen was made to accommodate 14 ICs with 12 hens and two cocks for mating purpose. 2-tier nest boxes measuring 0.8m high and 0.8m long were supplied for the layers. 12 nest boxes/tier/pen and 24 feeders and drinkers comprised of (12 drinkers and 12 feeders) were used in this experiment. Routine cleaning was carried out with the removal of debris and litter materials. Droppings were discarded from the poultry

unit regularly and Disinfectant was used weekly in all equipment used to avoid contamination of microorganisms. Mass selection was used to select birds at 8 - 12 week of age for higher BW. Birds were tagged with Arabic numbers on their left wing. The birds were routinely offered medication and vaccination during the period of the study for the three years.

The compounded breeder and grower diets and their composition are shown in Table 1. Feed and water were given *ad libitum* throughout the experiment. Birds were fed for 36 months, and eggs were collected two times daily, branded, and stored not more than 7 days at room temperature (25 °C) before incubation. The birds were raised under an intensive system. The sampled IC were cross bred (natural) with indigenous (I) cock and exotic (E) cock. The collected eggs were hatched to form F<sub>1</sub>. Secondary sexual features, such as the size of their comb and the shape of their tail feather, were used in the sexing the birds at 10 WOA.

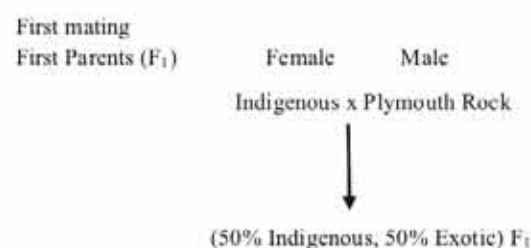
Normal eggs were identified and separated for artificial incubation while the abnormal comprising the deformed, undersized, cracked, blood-stained or dirty eggs were rejected. The incubation was carried out every 2 weeks for a period of 12 repeated months.

The hatched chicks were brooded with coal pots and stoves as heat sources for the chicks. The initial individual weight of the chicks was taken, and oral administration of glucose was done. Commercially compounded chick mash containing 19.5 percent CP and 2800 kcal ME/kg was used for feeding with a regular clean water supply. The BW of chicks was documented in every two weeks up to 44<sup>th</sup> week.

At 8 - 12 weeks, 6 PR cocks and 30 NF, 12 Nn

and 18 FF making a total of 30 females ICs were selected with a mating ratio of PR to ICs to be 1:10 for the F<sub>1</sub> to be mated *inter se* to produce the F<sub>2</sub>. The cocks and the hens were in proximity to one another. A formulated grower mash (16.20% CP and 2654 Kcal/Kg ME) was fed at 6 WOA. Suitable nutrient composition as recommended by (17) for growing and breeding poultry was followed. Feedstuff was crushed and prepared by (18). Feed and clean water were administered. Newcastle and Fowl pox vaccines were also given. Deworming was done every three months orally. At every week, vitamin and mineral nutrient were given to the birds to reduce stressed. After the 4th week of the first egg laid, cocks were introduced to the hens in a ratio of 2:14. Sorted eggs were incubated, and the chicks were reared for another 6 weeks before F<sub>1</sub> birds were moved to the deep litter.

Mating with *inter se* and crossbreeding between IC x PR. The first cross was between NF x NF, FF x FF and Nn x Nn. NF x PR, FF x PR and Nn x PR cock, which produced 50% IC and 50% PR in F<sub>1</sub>. The cross is diagrammatically shown below:



### Experimental Design

RCBD was used consisting of three (3) treatments and 1 generation, 14 birds/treatment for 2 replicates. A schematic upgrading procedure of indigenous stock (I) by exotic stock (E) for 1 generation is shown below:

### Generation Mating Types.

(100% I) x (100% E)



F<sub>1</sub> (50% I: 50% E x (100% E)

### Sample and Data Collection

Feed intake and live weight was recorded. The growth of the birds in response to the experimental diets was monitored by taking their body weights, followed by weighing on a weekly basis prior to feeding. Feed offered on daily per bird was recorded and residues was weighed and recorded to compute feed intake on daily basis. At the completion of the experiment, ten (10) genotypes chickens (5 males and 5 females) were randomly selected from each replicate. The birds were starved 12 hours. Blood samples were collected in heparinized bottles from each bird from the jugular vein after slaughter. Hematological parameters measured include packed cell volume (PCV), Hemoglobin (Hb) concentration, Red blood cell (RBC) count, white blood cell (WBC) count, mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) together with differential counts of Neutrophils, Lymphocytes, Eosinophils and Basophils were determined according to (19)

### Slaughtering and Dressing

Birds were slaughtered by the exsanguination method through manual cutting of the carotid arteries. Subsequently, scalding was carried out at 54°C for 4 minutes and de-feathering was carried out by keeping the skin intact. The inspection of the meat was performed after the evisceration process. The weight of each dressed carcass, heart, gizzard, liver, lungs and other non-edible

parts (head, shank/feet, and abdominal fat) was noted. After overnight chilling (6.0±1.0°C), the dressed carcass was cut into main parts and the weight of each part was documented. The yield of the carcass, organs and all the cut-up parts including non-edible parts was expressed as the proportion of live bodyweight.

### Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) using statistics model procedure (21). Means were separated using Duncan's Multiple Range Test of the same statistical package. Carcass performance traits were analyzed using the model

$$Y + A + B + (AB) + e_{ijk}$$

where:

Y = observed performance of the j individual of the i genotype (j = 1 - 5);

μ = overall mean;

A = effect of i genotype (1, 2, ..., 5);

B = effect of j sex (1, 2,);

AB = effect of interaction of i genotype and j sex (j = male, female);

e = residual error

### Results

The BW, FI and cost analysis of parent line and F<sub>1</sub> generations are presented in Tables 2 and 3, respectively. There was a remarkable difference (p < 0.05) in WG and FC per kg per gain in all genotypes. Mortality was the highest value (5.50%) for NF birds, followed by FF (5.20%) and the least Nn (3.65%). The BW, FI and cost analysis of F<sub>1</sub> and crossbred are shown in Table 3. There was no principal difference in BW among the purebred birds, but significant (p < 0.05) variation existed among the crossbred progenies. The differences in final BW between the purebred and their crossbred were 158.87 g, 263.58 g, and 320.58 g for FF Vs FF x PR, NF Vs NF x PR, and Nn Vs Nn x PR, respectively.

Table 1: Percentage Composition of Chicken Breeder and Grower Diets

Ingredients	Grower Diet	Breeder Diets
Maize	57.00	60.05
Soyabean meal	15.25	15.40
Wheat bran	24.30	15.25
Bone meal	1.75	1.75
Limestone	1.25	7.00
Common salt	0.35	0.35
Premix	0.10	0.10
<b>Total</b>	<b>100.00</b>	<b>100.00</b>
Calculated composition		
CP (%)	16.20	15.10
ME, Kcal/kg	2654	2650
Lys (%)	0.93	0.63
Meth. + cyst. (%)	0.55	0.46
Ca (%)	1.02	1.04
Total phosphorus (%)	0.74	0.73
Available phosphorus (%)	0.46	0.44

Premix included are: vitamin A, 7500 I.U; Vitamin D, 2500 I. C.U; vitamin. 2.3 mg; Vit amin K, 1.5; thiamine, 1mg; riboflavin, 2.75 mg; niacin, 12.5 mg, calcium pantothenate, 5 mg. Choline, chloride, 60 mg; vitamin B 0.005 mg; manganese oxide, 16.13 mg; zinc oxide, 12.5 mg; copper oxide, 1.28 mg; carbonate, 20.3 mg; cobalt sulphate, 286 mg; potassium iodide, 35 mg.

Table 2: Body weight, FI and Cost per kg Gain of Parental Stock from 14-22 weeks of age

Parameters	FF	NF	Nn
IWT (g/bird)	658.60 ± 8.04 <sup>a</sup>	695.43 ± 1.67 <sup>a</sup>	688.50 ± 9.70 <sup>a</sup>
FWT (g/bird)	1709.25 ± 5.39 <sup>a</sup>	1741.00 ± 4.84 <sup>a</sup>	1700.01 ± 4.15 <sup>a</sup>
WG (@22 weeks)	1050.65 ± 6.71 <sup>a</sup>	1045.57 ± 4.60 <sup>b</sup>	1011.51 ± 3.54 <sup>c</sup>
DWG (g/bird)	18.76 ± 0.06 <sup>a</sup>	18.67 ± 0.05 <sup>a</sup>	18.06 ± 0.06 <sup>b</sup>
DFI (g/bird)	156.83 ± 4.32	149.79 ± 6.07	137.48 ± 1.65
TFI (g/bird)	161419.44 ± 9.26	117000.24 ± 10.89	171680.88 ± 11.80
FCR	153.64 ± 0.63	111.90 ± 0.05	169.73 ± 0.06
FC per kg (N)	960.50 ± 1.98 <sup>a</sup>	696.43 ± 0.45 <sup>b</sup>	1021.91 ± 0.52 <sup>a</sup>
TCF consumed (N)	5181.66 ± 1.98 <sup>a</sup>	3958.95 ± 1.75 <sup>c</sup>	4799.43 ± 1.84 <sup>b</sup>
FC per kg/gain (N)	276.21 ± 3.42 <sup>a</sup>	212.05 ± 2.00 <sup>b</sup>	265.75 ± 2.41 <sup>a</sup>
FE	6.70 ± 0.02	6.98 ± 0.03	7.36 ± 0.02
Mort. (%)	5.02 ± 0.09 <sup>a</sup>	5.50 ± 0.08 <sup>a</sup>	3.65 ± 0.06 <sup>b</sup>

abc means in the same row with different superscript differ substantially (p<0.05)

FF= Frizzle feathered; NF= Normal feathered; Nn = Naked neck; IWT = Initial weight; FWT = Final weight; WG = Weight gain; DWG = Daily weight gain; DFI = Daily feed intake; TFI = Total feed intake; FCR = Feed conversion ratio; TCF = Total cost of feed; FC = Feed Cost; FE = Feed efficiency

Table 3: Body weight, FI and Cost per kg Gain of F<sub>1</sub> of IC and PR from Day - old - 22 weeks of age

Parameters	FF	NF	Nn	FF X PR	NF X PR	Nn X PR
IWT (g/bird)	21.80±0.29 <sup>c</sup>	24.20±0.71 <sup>c</sup>	31.89±0.11 <sup>b</sup>	35.80±0.15 <sup>ab</sup>	38.70±0.15 <sup>a</sup>	43.63±0.32 <sup>a</sup>
FWT (g/bird)	782.00±2.09 <sup>b</sup>	892.60±1.18 <sup>b</sup>	996.20±1.16 <sup>b</sup>	940.33±1.15 <sup>ab</sup>	1254.00±4.18 <sup>a</sup>	1333.80±3.23 <sup>a</sup>
WG (@ 22 weeks)	760.20±4.52 <sup>c</sup>	868.40±3.08 <sup>bc</sup>	964.31±6.81 <sup>b</sup>	904.53±5.06 <sup>b</sup>	1215.30±11.2 <sup>a</sup>	1290.17±8.26 <sup>a</sup>
DWG (g/bird)	4.94±0.30 <sup>c</sup>	5.64±0.37 <sup>b</sup>	4.96±0.20 <sup>b</sup>	5.87±0.10 <sup>ab</sup>	7.89±0.12 <sup>a</sup>	8.38±0.15 <sup>a</sup>
DFI (g/bird)	148.96±0.13	152.37±0.25	145.52±0.26	138.68±0.42	141.76±0.35	139.51±0.51
TFI (g/bird)	22939.84±7.48	23464.98±9.26	22410.08±8.31	21356.72±6.27	21831.04±5.24	21484.54±8.42
FCR	30.18±0.15	27.02±0.17	29.32±0.21	23.61±0.14	17.96±0.12	16.65±0.26
FC/kg (N)	32.50 ± 2.03	30.00 ± 0.63	31.45 ± 0.81	35.45 ± 0.46	26.00 ± 0.38	33.62 ± 1.02
TCF consumed (N)	745.55±3.02	709.20±3.41	704.74±3.16	757.21±3.62	567.58±3.14	722.16±2.18
FC per kg/gain (N)	150.92±2.51 <sup>a</sup>	125.74±2.68 <sup>a</sup>	142.09±2.14 <sup>a</sup>	129.00±2.01 <sup>a</sup>	71.94±1.25 <sup>b</sup>	86.18±1.41 <sup>b</sup>
FE	5.10±0.15	5.70±1.17	5.25±0.71	6.25±0.70	8.57±0.64	9.25±1.03
Mort. (%)	2.27±0.08 <sup>c</sup>	2.15±0.05 <sup>c</sup>	1.92±0.17 <sup>d</sup>	4.65±0.10 <sup>a</sup>	3.42±0.06 <sup>b</sup>	5.12±0.25 <sup>a</sup>

<sup>abc</sup> means in the same row with different superscript differ significantly (p < 0.05)

IWT= Initial weight, FWT= final weight, WG= weight gain, DWG= Daily weight gain, DFI= Daily feed intake, TFI= Total feed intake, FCR= Feed conversion ratio, FC= feed cost, TCF= Total cost of feed, FE= Feed efficiency and Mort. = Mortality  
PR = Plymouth rock

The FCR was not much different in purebred lines, but there was a meaningful difference ( $p > 0.05$ ) among the crossbred progenies. Crossbred offspring were most efficient in feed utilization in contrast to the purebred line. Frizzled feathered crossbred progenies tend to be more cost-efficient ( $p < 0.05$ ) than NF and Nn crossbred offspring. There was no substantial difference ( $p < 0.05$ ) in the FE utilization among the purebred birds. The economic analysis revealed that it costs between ₦109.20 and ₦131.16 to feed the pure lines than the crossbred. There was no significant difference ( $p < 0.05$ ) among the purebred groups in FE ( $p < 0.05$ ), but there was a notable ( $p < 0.05$ ) difference among the

crossbred group. The mortality was not more than 5% in all the genotypes.

#### Growth Indices

The weight gain, growth rate, specific growth rate and growth efficiency of  $F_1$  crossbred of indigenous chicken are presented in Table 4. All growth indices studied (weight gain, growth rate, specific growth rate and growth efficiency) declined with age. Highest weight gain and growth rate were obtained between 8–22 weeks of age, but the highest decrease in weight gain and growth rate were observed between 22 to 44 weeks of age. Specific growth rate and growth efficiency followed the same trend as growth rate.

**Table 4: Growth Indices of  $F_1$  Crossbred of Indigenous Chicken**

Growth indices				
$F_1$ Generation				
Growth Phase	Weight gain (g)	Growth rate (%)	Specific Growth Rate (%)	Growth Efficiency
0 - 8 weeks	18.83	99.56	7.83	0.330
8 - 22 weeks	53.57	137.61	5.24	0.315
22 - 44 weeks	34.36	58.24	1.21	0.037

#### Hematological Parameters

The effect of genotype on hematological characteristics of  $F_1$  crossbred of indigenous chicken is presented in Table 5. The effect of genotype was significant ( $P < 0.05$ ) on hematological parameters measured. Crossbred group had higher PCV value NF x PR (29.15%), Nn x PR (28.23%), and FF x PR (28.35%) and low PCV values in indigenous genotypes. Hemoglobin (Hb) also have similarity trend with PCV, where indigenous genotype had lower ( $P \leq 0.05$ ) values ( $P < 0.05$ ) than crossbred groups.

Higher ( $P < 0.05$ ) red blood cell (RBC) (2.84) count were recorded in crossbreds' birds compared to 1.87 – 2.43 observed in indigenous genotypes. It was also noted that the values followed the trend of PCV and Hb. Crossbred chicken group had highest (122.67fl) mean corpuscular volume (MCV) value. The lowest value (110.62fl) was recorded in the frizzle feathered birds. Mean corpuscular hemoglobin (MCH) value was highest (44.47 pg) in crossbred group. While indigenous genotypes group had lower value (39.33 pg) for Naked neck birds.

Lymphocytes were higher ( $P \leq 0.05$ ) value chicken group compared to crossbred group ranges from (70 – 71%) in indigenous values (60–61%).

**Table 5: Genotypic Effects on Hematological Characteristics of F<sub>1</sub> Crossbred of Indigenous Chicken**

Parameters /Genotype	FF	NF	Nn	FF X PR	NF X PR	Nn X PR
PCV (%)	26.34±1.43 <sup>b</sup>	24.08±0.63 <sup>b</sup>	25.66±0.65 <sup>b</sup>	28.35±1.04 <sup>a</sup>	29.15±1.54 <sup>a</sup>	28.23±1.32 <sup>a</sup>
HB (g/100ml)	8.50±0.47 <sup>b</sup>	8.15±0.21 <sup>b</sup>	8.87±0.22 <sup>b</sup>	10.19±0.35 <sup>a</sup>	10.21±0.52 <sup>a</sup>	11.50±0.45 <sup>a</sup>
RBC (10 <sup>9</sup> /mm <sup>3</sup> )	2.43±0.24 <sup>b</sup>	1.87±0.12 <sup>b</sup>	2.24±0.13 <sup>b</sup>	2.62±0.20 <sup>a</sup>	2.78±0.03 <sup>a</sup>	2.84±0.06 <sup>a</sup>
WBC (10 <sup>3</sup> /mm <sup>3</sup> )	14.60±1.05 <sup>c</sup>	16.48±0.35 <sup>b</sup>	16.50±0.42 <sup>b</sup>	19.91±0.82 <sup>a</sup>	20.05±1.03 <sup>a</sup>	20.45±0.62 <sup>a</sup>
MCV (fl)	110.61±8.20 <sup>b</sup>	116.59±5.69 <sup>b</sup>	117.02±5.15 <sup>b</sup>	119.93±7.34 <sup>a</sup>	121.21±6.05 <sup>a</sup>	122.67±5.26 <sup>a</sup>
MCH (pg)	41.86±2.77 <sup>b</sup>	40.76±1.90 <sup>b</sup>	39.33±1.71 <sup>c</sup>	43.81±2.42 <sup>a</sup>	42.95±1.56 <sup>a</sup>	44.47±1.69 <sup>a</sup>
MCHC (g/dL)	33.24±0.03	33.12±0.04	33.39±0.03	33.97±0.04	34.30±0.05	34.50±0.03
Neutrophils (%)	21.94±0.85 <sup>b</sup>	21.70±0.93 <sup>b</sup>	22.60±0.91 <sup>b</sup>	20.90±0.82 <sup>b</sup>	21.85±0.89 <sup>b</sup>	23.36±0.93 <sup>a</sup>
Eosinophils (%)	1.70±0.13 <sup>b</sup>	1.78±0.10 <sup>b</sup>	1.86±0.13 <sup>b</sup>	2.25±0.04 <sup>a</sup>	2.15±0.08 <sup>a</sup>	2.57±0.14 <sup>a</sup>
Lymphocytes (%)	70.87±0.77 <sup>a</sup>	71.88±0.92 <sup>a</sup>	70.96±0.71 <sup>a</sup>	61.50±1.55 <sup>b</sup>	60.85±0.88 <sup>b</sup>	61.58±0.80 <sup>b</sup>
Monocytes (%)	12.79±0.92 <sup>a</sup>	12.60±0.73 <sup>a</sup>	13.20±1.00 <sup>a</sup>	12.80±1.04 <sup>a</sup>	12.97±0.68 <sup>a</sup>	13.64±0.92 <sup>a</sup>
Basophil (%)	3.08±0.15 <sup>a</sup>	2.86±0.10 <sup>a</sup>	2.79±0.15 <sup>a</sup>	3.08±0.41 <sup>a</sup>	2.89±0.10 <sup>a</sup>	2.98±0.12 <sup>a</sup>

*a, b, and c, means within the same row bearing different superscript differs significantly (P < 0.05). \*Significant (P=0.05). PCV = Packed Cell Volume, Hb = Hemoglobin Concentration, RBC = Red Blood Cell count, WBC = White Blood Cell count, MCH = Mean Corpuscular Hemoglobin, MCV = Mean Corpuscular Volume, MCHC = Mean Corpuscular Hemoglobin Concentration.*

### Carcass Characteristics

Live body weight of both indigenous genotypes and crossbred chickens were significantly different. However, carcass weight was significantly higher in crossbred birds (Table 6). In cut-up parts, the weight of the breast was significantly ( $p < 0.0001$ ) higher in crossbred while weights of the legs, back and neck were significantly ( $p < 0.05$ ) lower in the indigenous genotypes. Therefore, the yield of carcass (dressing percentage) and breast was significantly ( $p < 0.01$ ) higher in crossbred chickens. Absolute weights of organs such as lungs, liver, heart

and gizzard (giblets) and their yield were significantly ( $p < 0.001$ ) lesser in the indigenous genotypes when compared to those of crossbred chicken at 22nd weeks of age.

### Discussion

The WG obtained (Table 2) revealed that the DWG of the parent stock of 5.56 and 6.26 g/bird conform with the report of [22], who reported a DWG of 6.17 g/bird for starter pullets, with more than 4.11 g/bird/day for chickens' egg layers conveyed by (23). The average DFI of IC in this study (137.48 g to

**Table 6: Carcass Characteristics of F1 Crossbred of Indigenous Chicken**

Traits	Genotypes						p Value
	FF	NF	Nn	FF X PR	NF X PR	Nn X PR	
Live weight (g)	782.00±2.09 <sup>a</sup>	892.60±1.18 <sup>a</sup>	996.20±1.16 <sup>a</sup>	940.33±1.15 <sup>a</sup>	1254.00±4.18 <sup>b</sup>	1333.80±3.23 <sup>a</sup>	0.0006
Plucked weight (g)	414.93±1.07	485.86±1.06	525.82±1.07	565.15±1.05	794.32±1.08	868.23±1.10	0.0021
Plucked weight (%)	53.06±0.24 <sup>d</sup>	54.43±0.28 <sup>d</sup>	52.78±0.34 <sup>d</sup>	60.10±0.55 <sup>e</sup>	63.34±0.36 <sup>b</sup>	65.09±0.63 <sup>a</sup>	0.0001
<b>Carcass composition (g)</b>							
Carcass weight (g)	596.00±5.06 <sup>c</sup>	712.23±3.14 <sup>d</sup>	717.30±2.35 <sup>d</sup>	761.33±1.46 <sup>c</sup>	1065±1.12 <sup>b</sup>	1142.80±1.10 <sup>b</sup>	0.0045
Dressing (%)	76.21±1.23 <sup>d</sup>	79.79±1.31 <sup>c</sup>	71.97±1.26 <sup>e</sup>	80.96±1.42 <sup>b</sup>	84.93±1.33 <sup>c</sup>	85.68±1.37 <sup>c</sup>	0.0154
<b>Cut-up parts (g)</b>							
Head weight	30.02±0.12 <sup>c</sup>	27.13±1.01 <sup>c</sup>	29.95±0.15 <sup>c</sup>	39.65±0.24 <sup>b</sup>	57.98±0.10 <sup>a</sup>	59.33±0.38 <sup>a</sup>	0.0147
Neck weight	45.41±1.06 <sup>c</sup>	52.78±1.22 <sup>d</sup>	53.49±1.04 <sup>d</sup>	62.09±0.38 <sup>e</sup>	82.87±0.37 <sup>b</sup>	85.23±0.46 <sup>b</sup>	0.0042
Wings weight	52.07±1.03 <sup>c</sup>	57.95±1.04 <sup>d</sup>	58.49±1.04 <sup>d</sup>	67.17±1.03 <sup>d</sup>	88.74±1.00 <sup>b</sup>	96.64±0.52 <sup>c</sup>	0.0061
Breast weight	117.57±2.04 <sup>d</sup>	139.38±2.03 <sup>d</sup>	151.08±2.26 <sup>d</sup>	176.26±2.04 <sup>d</sup>	229.40±2.05 <sup>b</sup>	244.47±1.28 <sup>a</sup>	0.0001
Thigh weight	68.58±1.06 <sup>f</sup>	87.82±1.23 <sup>d</sup>	79.84±1.43 <sup>e</sup>	99.78±1.27 <sup>e</sup>	132.29±1.47 <sup>b</sup>	147.22±1.05 <sup>c</sup>	0.004
Drumstick weight	78.69±1.04 <sup>e</sup>	96.30±1.34 <sup>d</sup>	99.23±1.11 <sup>d</sup>	114.48±1.48 <sup>e</sup>	159.21±1.38 <sup>b</sup>	164.14±1.08 <sup>b</sup>	0.036
Back weight	81.02±1.05 <sup>e</sup>	95.72±1.23 <sup>d</sup>	97.90±1.10 <sup>d</sup>	108.62±1.27 <sup>e</sup>	147.60±1.12 <sup>b</sup>	155.37±1.04 <sup>b</sup>	0.0001
Shanks/feet weight	42.17±1.08 <sup>e</sup>	45.82±1.04 <sup>d</sup>	51.76±0.13 <sup>e</sup>	59.12±1.10 <sup>b</sup>	81.32±0.32 <sup>c</sup>	84.36±0.46 <sup>c</sup>	0.0483
Head (%LW)	3.84±0.01 <sup>b</sup>	3.04±0.01 <sup>b</sup>	3.01±0.02 <sup>b</sup>	4.22±0.02 <sup>c</sup>	4.62±0.01 <sup>c</sup>	4.45±0.03 <sup>b</sup>	0.0001
Neck (%LW)	5.81±0.03 <sup>b</sup>	5.91±0.03 <sup>b</sup>	5.37±0.02 <sup>b</sup>	6.60±0.04 <sup>a</sup>	6.61±0.03 <sup>a</sup>	6.39±0.02 <sup>a</sup>	0.0001
Wings (%LW)	6.66±0.04 <sup>b</sup>	6.49±0.02 <sup>b</sup>	5.87±0.01 <sup>c</sup>	7.14±0.02 <sup>c</sup>	7.08±0.02 <sup>c</sup>	7.24±0.02 <sup>c</sup>	0.0003
Breast (%LW)	15.03±0.04 <sup>b</sup>	15.63±0.04 <sup>b</sup>	15.17±0.03 <sup>b</sup>	18.75±0.06 <sup>a</sup>	18.29±0.05 <sup>a</sup>	18.33±0.04 <sup>a</sup>	0.0132
Thigh (%LW)	8.77±0.06 <sup>d</sup>	9.84±0.03 <sup>c</sup>	8.01±0.03 <sup>d</sup>	10.61±0.02 <sup>d</sup>	10.55±0.04 <sup>d</sup>	10.89±0.03 <sup>d</sup>	0.0006
Drumstick (%LW)	10.06±0.05 <sup>b</sup>	10.80±0.03 <sup>b</sup>	9.96±0.02 <sup>b</sup>	12.18±0.03 <sup>a</sup>	12.70±0.04 <sup>a</sup>	12.31±0.02 <sup>a</sup>	0.0002
Back (%LW)	10.36±0.04 <sup>b</sup>	10.72±0.10 <sup>b</sup>	9.82±0.08 <sup>b</sup>	11.55±0.13 <sup>a</sup>	11.77±0.08 <sup>a</sup>	11.65±0.11 <sup>a</sup>	0.0376
Shanks/feet (%LW)	5.39±0.02 <sup>b</sup>	5.13±0.02 <sup>b</sup>	5.20±0.01 <sup>b</sup>	6.29±0.03 <sup>c</sup>	6.48±0.02 <sup>c</sup>	6.32±0.01 <sup>a</sup>	0.0002
<b>Organ weight (g)</b>							
Crop	4.62±0.01 <sup>d</sup>	4.93±0.01 <sup>d</sup>	5.08±0.02 <sup>c</sup>	6.63±0.01 <sup>b</sup>	8.99±0.01 <sup>b</sup>	9.71±0.01 <sup>a</sup>	0.0001
Lungs	5.25±0.02 <sup>d</sup>	6.13±0.02 <sup>e</sup>	6.49±0.01 <sup>e</sup>	7.89±0.02 <sup>b</sup>	10.65±0.02 <sup>a</sup>	11.49±0.02 <sup>a</sup>	0.0364

Traits	Genotypes						p Value
	FF	NF	Nn	FF X PR	NF X PR	Nn X PR	
Liver	22.00±0.05 <sup>c</sup>	23.30±0.04 <sup>d</sup>	24.98±0.06 <sup>d</sup>	30.99±0.04 <sup>b</sup>	42.20±0.08 <sup>a</sup>	43.95±1.06 <sup>a</sup>	0.0437
Gizzard	24.94±0.06 <sup>d</sup>	30.26±0.03 <sup>c</sup>	31.68±0.06 <sup>c</sup>	40.45±0.05 <sup>b</sup>	32.84±0.07 <sup>c</sup>	57.00±1.05 <sup>a</sup>	0.0003
Heart	5.42±0.03 <sup>c</sup>	5.94±0.02 <sup>c</sup>	5.63±0.01 <sup>c</sup>	11.05±0.02 <sup>b</sup>	14.91±0.02 <sup>a</sup>	15.78±0.01 <sup>a</sup>	0.0004
Spleen	1.19±0.00 <sup>b</sup>	1.09±0.00 <sup>b</sup>	1.25±0.01 <sup>b</sup>	2.19±0.01 <sup>a</sup>	2.99±0.01 <sup>a</sup>	3.26±0.00 <sup>a</sup>	0.0001
Large intestine	19.16±0.04 <sup>d</sup>	26.13±0.13 <sup>d</sup>	28.46±0.65 <sup>d</sup>	49.68±0.47 <sup>c</sup>	66.07±0.38 <sup>b</sup>	69.78±0.38 <sup>a</sup>	0.0002
Small intestine	7.29±0.01 <sup>c</sup>	8.84±0.01 <sup>d</sup>	9.46±0.02 <sup>c</sup>	14.78±0.04 <sup>b</sup>	20.81±0.11 <sup>a</sup>	22.00±0.12 <sup>a</sup>	0.0001
Abdominal fat	Trace	Trace	Trace	9.90±0.02	13.05±0.01	13.98±0.01	-
Crop (%LW)	0.59±0.02 <sup>b</sup>	0.55±0.01 <sup>b</sup>	0.51±0.03 <sup>b</sup>	0.70±0.02 <sup>c</sup>	0.72±0.03 <sup>c</sup>	0.73±0.02 <sup>c</sup>	0.0001
Lungs (%LW)	0.67±0.01 <sup>b</sup>	0.69±0.01 <sup>b</sup>	0.65±0.02 <sup>b</sup>	0.84±0.04 <sup>a</sup>	0.85±0.05 <sup>a</sup>	0.86±0.04 <sup>a</sup>	0.0346
Liver (%LW)	2.81±0.02 <sup>b</sup>	2.61±0.02 <sup>b</sup>	2.51±0.01 <sup>b</sup>	3.30±0.03 <sup>b</sup>	3.36±0.02 <sup>c</sup>	3.29±0.02 <sup>c</sup>	0.0001
Gizzard (%LW)	3.19±0.03 <sup>b</sup>	3.39±0.02 <sup>b</sup>	3.18±0.03 <sup>b</sup>	4.30±0.02 <sup>a</sup>	4.20±0.01 <sup>a</sup>	4.27±0.02 <sup>a</sup>	0.0632
Heart (%LW)	0.69±0.01 <sup>b</sup>	0.66±0.01 <sup>b</sup>	0.56±0.01 <sup>b</sup>	1.17±0.01 <sup>a</sup>	1.19±0.02 <sup>a</sup>	1.18±0.00 <sup>a</sup>	0.0001
Spleen (%LW)	0.15±0.01 <sup>b</sup>	0.12±0.01 <sup>b</sup>	0.12±0.01 <sup>b</sup>	0.23±0.01 <sup>a</sup>	0.24±0.02 <sup>a</sup>	0.24±0.01 <sup>a</sup>	0.0002
Large intestine (%LW)	2.45±0.01 <sup>c</sup>	2.93±0.01 <sup>b</sup>	2.86±0.02 <sup>b</sup>	5.28±0.03 <sup>a</sup>	5.27±0.01 <sup>a</sup>	5.23±0.02 <sup>a</sup>	0.0001
Small intestine (%LW)	0.93±0.00 <sup>b</sup>	0.99±0.01 <sup>b</sup>	0.95±0.01 <sup>b</sup>	1.57±0.01 <sup>a</sup>	1.66±0.02 <sup>a</sup>	1.65±0.01 <sup>a</sup>	0.0001
Abdominal fat (%LW)	Trace	Trace	Trace	1.05±0.00	1.04±0.00	1.05±0.00	-

a, b, c, d, e and f mean within the same row bearing different superscript differs significantly ( $P < 0.05$ ).

156.83 g/bird/day) was more than those stated by (21) for starter pullets (39.61 to 41.58 g/bird /day) and 85 g/day/bird during laying period by (24, 25).

This variation may be occasioned by the season and the differences in location. The outcome of FCR showed that FF birds used their meal more efficiently than NF and Nn chickens. This indicates that NF and Nn might potentially have efficiently utilized their diets. (22) also reported the same observations on FE, signifying that all purebred birds on the same meal with the crossbred eat more quantity of feed than the crossbred indicating a higher FC/kg gain. This discovery is at variance with the review of (24) that IC does not consume as much as the exotic. In agreement with the report of (25) this report also shows that Naked neck and FF birds were the least in marketing cost (Table 2) by gaining 1 kg BW with ₦132.92 and ₦127.46, respectively, while NF birds were the best as (₦ 98.62) was expended to gain the same quantity of BW.

(12) stated that modern productive breeds of hens are identified by high FI and FCR when placed on grain-based commercial rations. The higher level of FI attained by purebreds could not be converted to BW. It can, therefore, not fit into the enormity of specialization, which allows optimum FI and usage for productive purposes.

The WG of crossbred offspring was superior to the purebred line in the  $F_1$  generation. (Table 3). Nn x PR had the highest WG of 1030.53 g/bird. The crossbred gained more weight/day than the purebred. There were differences of 158.87 g, 263.58 g, and 320.58 g in weight of pure FF Vs FF x PR, NF Vs NF x PR, and Nn Vs Nn x PR, respectively. This report was in agreement with the findings of (27). The DWG obtained corresponds with values in the literature (28, 23,27). Birds that consumed less amongst the purebred gained

less, whereas, amongst the crossbred, those that consumed less gained more. FC per unit WG with  $F_1$  crossbred progenies were lower when compared with the purebred lines. It took ₦84.31, ₦89.68, and ₦99.22 to gain 1 kg of NF, Nn, and FF crossbred progenies as against ₦131.16, ₦139.98 and ₦109.20 Nn, FF and NF purebred, respectively. This showed that producing 1 kg of crossbred is cheaper than their pure line counterparts. Nevertheless, the results revealed that ICs kept under IMS were inferior to exotic birds (cocks) kept under similar conditions in terms of survival and health status (Table 2). PR under IMS looked bright, active, and interested in their On-Station environment. In contrast, weariness in their confinement environment, wing droppings, huddling at the corner, attempting to fly out of the pen, and habit of pecking and cannibalism were frequently observed among the IC layers kept under IMS in this study.

(14), working on the productivity of IC in Botswana, observed a significant increase in the efficiency of feed utilization, BWG and mean BW of crossbred offspring of  $F_1$  generation. This observation was similar to that obtained in this study. The improvement in FI, WG, FCR, and FE in  $F_1$  crossbred may be attributed to better protein absorption and availability of amino acids in the diet. Hence, crossbred progenies utilized nutrients of feed for higher performance of BWG. The result clearly showed that crossbred progenies of both  $F_1$  ICs are more efficient with a lower cost of production than purebred under an IMS. The result also agreed with (27), who reported the virtue of IC for the traditional low input-per-output production system.

Growth rate declined with advancing age with highest growth being at 8 – 22 weeks which is in close agreement with (22), but slightly earlier than the age by (29). Growth rate increased between hatch and 5 weeks of

age before it declined at 6 weeks of life and subsequently increased (30). The results obtained in on – station study revealed that crossbreeding indigenous chicken with exotic improved body weight gain greatly at 12 weeks (22). These results indicate that indigenous chickens have a higher potential for growth than what was found in the field survey. The variation in growth rates might be due to differences in time of survey, age, genotypes and type of management practiced by farmers. The specific growth rate and growth efficiency also declined in  $F_1$  and  $F_2$  as the crossbred aged which indicated that increase in cell mass and efficiency of growth is between 8 – 22 weeks of age. Therefore, any attempt to manipulate the growth of crossbred of indigenous chicken should be targeted at this age bracket.

The lower mean values of Packed Cell Volume, Hemoglobin and MCHC indigenous genotypes fall within normal ranges as reported by (31). These authors reported normal avian Packed Cell Volume as ranging from 25% to 45% and a Packed Cell Volume less than 25% may be detrimental to the individual animal. These significant differences ( $P < 0.05$ ) which may be attributed to strain differences are consistent with (32 and 33), strengthening the argument for inherent genetic differences. The higher values for MCH values in this investigation in indigenous genotypes compared to crossbred group probably reflect inherent genetic differences. This is in agreement with the findings of (34) though their findings disagreed with this study in the values of packed cell volume and hemoglobin which were lower in indigenous genotypes birds. However, (33, 34 and 35) attributed low values of packed cell volume, hemoglobin and MCHC to poor genetic inheritance especially stunted growth syndrome (SGS) whereas (36) attributed low

erythrocyte values to genetic make-up. The above reasons cannot be overemphasized for variations found in our studies where both indigenous and crossbred birds were subjected to common environment of feeding and management. Therefore, the only logical factor implicated is the genotype of the indigenous chickens.

The lesser yield observed in the indigenous genotypes might be due to less muscle mass and higher percentage of non-edible portions such as head, shank, and blood and feathers as a proportion of live bodyweight of these genotypes. Further, high muscle and bone mass of crossbred chickens might have contributed to the higher dressing yield in crossbred. The dressing percentage of indigenous chicken was similar to that of other indigenous chickens such as Frizzle, normal feathered birds (76.21%, 79.79%) (37, 38) and Naked neck (71.97%) (39). However, the dressing percentage recorded in this study is lower than those observed in crossbred chickens' studies for FF x PR (80.96%), NF x PR (84.93%) crossbred birds slaughtered at a younger age of 22 weeks (40) and Nn x PR (85.68%).

Breast yield was higher in crossbred while the yield of head, wings, back and neck were lower in indigenous genotypes. This difference was due to the selection of crossbred for higher breast yield.

Weights of head and breast parts of indigenous chicken were comparable to those of other native chickens such as frizzle feathered (22.7 and 17.1%), Naked neck (23.4 and 16.3%) and Normal feathered (20.51 and 15.91%) breeds (41, 42). Higher yield of liver, heart and gizzard (giblets) observed in crossbred is due to higher feed intake, absorption of nutrients and metabolism that are required for rapid growth in such a long period of time. Indigenous birds are slow in growth and their feed intake

is also very low hence have a lesser percentage of internal organs related to digestion and metabolism as compared to the fast-growing crossbred. The giblet percentage observed for crossbred in the present study was comparable with those reported for F<sub>1</sub> generation (42).

### Conclusion and Applications

1. The findings revealed that FC per unit WG with crossbred offspring was lower and ranged from ₦84.31 - ₦99.22 compared with the purebred lines, which ranged from ₦109.20 - ₦131.16 to achieve 1 kg of pure lines.
2. The crossbred chickens studied were significantly different (P>0.05) in their hematological parameters from the indigenous genotypes, thus indicating that the crossbred chickens have upgraded from a common wild ancestor.
3. Further studies to upgrade schematically to F<sub>2</sub> generations would be very viable for future selection and improvement programmes of these crossbreds.

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