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Genotype impact on body weight and linear body measurements of main and reciprocal crosses of Isa Brown and local chickens

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Abstract

The indigenous chickens of Nigeria are known for low productivity due to their unimproved genetic condition. However, the chickens are well adapted to hash environmental conditions and resistant to many endemic diseases. A lot of research works have been carried out with the aim of improving the local chickens, but little or no sustainable results are yet to be achieved. The present study seeks to improve growth traits of frizzle feathered, naked neck and normal feathered chickens through main and reciprocal crossbreeding with exotic Isa Brown chicken. Genotype impact on body weight (BWT), shank length (SL), drumstick length (DL), body girth (BG), body width (BW), keel length (KL), body length (BL) and wing length (WL) of 531 crossbred chickens was studied at 2, 10 and 20 weeks of age. The chickens were produced in 12 hatches at day-old. They comprised 123 Isa Brown x frizzle feathered, 49 Isa Brown x naked neck, 116 Isa Brown x normal feathered, 137 frizzle feathered x Isa Brown, 42 naked neck x Isa Brown and 64 normal feathered x Isa Brown genotypes. Data were subjected to two-way analysis of variance. The NxIB, IBxN and IBxNa genotypes recorded higher significant (P<0.05) mean BWT at 2 (59.12±1.07 g), 10 (451.92±6.10 g) and 20 (1133.66±12.00 g) weeks of age. Higher significant (P<0.05) mean SL (2.61 ±0.05cm), BW (10.06±0.12 cm), KL (3.44±0.06 cm), BL (11.26± 0.18cm) and WL (5.69 ±0.07cm) were obtained from IBxN while DL (4.74± 0.07cm) and BG (8.38± 0.08 cm) were obtained from NaxIB genotype at 2 weeks. At 10 weeks of age, higher significant (P<0.05) mean SL (5.24± 0.06 cm) and DL (10.44± 6.92 cm) from IBxNa; BG (16.74 ± 0.20 cm) and BW (20.59± 0.18 cm) from IBxN; KL (7.01± 0.07 cm) from NxIB; BL (26.78±1.42 cm) from FxIB and WL (13.72± 0.09 cm) from IBxF genotypes were recorded. The SL, DL, KL of IBxNa; BW of FxIB and BL of NaxIB genotypes had higher significant means at 20 weeks. The NxIB and IBxN genotypes which depicted outstanding growth performace at 2-10 weeks should be selected for improvement of fast growing chcikens while IBxNa, FxIB, NaxIB genotypes which recorded better performance at 20 weeks may be considered for development of egg-type chickens.

Keywords: Chicken, genotype, body weight, linear body measurements, crossbreeding.
Running Title: Growth traits of chciken genotypes

Impact de génotype sur le poids corporel et les mesures corporelles linéaires des croix principales et réciproques d'Isa Brown et des poulets locaux

Résumé

Les poulets indigènes du Nigéria sont connus pour une faible productivité en raison de leur état génétique non amélioré. Cependant, les poulets sont bien adaptés aux conditions environnementales de hachage et résistantes à de nombreuses maladies endémiques. Beaucoup de travaux de recherche ont été réalisés dans le but d'améliorer les poulets locaux, mais peu ou pas de résultats durables ne doivent pas encore être atteints. L'étude actuelle cherche à améliorer les traits de croissance de frisée à plumes, au cou nu et à des poulets à plumes normaux à travers une traversée principale et réciproque avec du poulet exotique Isa Brown. Impact de génotype sur le poids corporel (PC), la longueur de la tige (LT), la longueur de la batterie (LB), la girthe corporelle (GC), la largeur du corps (LC), la longueur de la quille (LQ), la longueur du corps (LC) et la longueur de l'aile (LA) de 531 poulets *croisés ont été étudiés à 2, 10 et 20 semaines. Les poulets ont été produits dans 12 trappes à la journée. Ils comprenaient 123 Isa Brown X Frizzle à partir de 49 Isa Brown X nu au cou Col, 116 Isa Brown X Normal Pumelure, 137 Frizzle X Marron, 42 Nue X Isa Brown et 64 Génotypes de X Isa Brown. Les données ont été soumises à une analyse bidirectionnelle de la variance. Les génotypes NxIB, IBxN et IBxNa ont enregistré des PC significatifs plus importants (P <0,05) à 2 (59,12 ± 1,07 g), 10 (451,92 ± 6,10 g) et 20 (1133,66 ± 12,00 g)semaines d'âge. Plus important signifiant (p <0,05) SL (2.61 ± 0,05 cm), LC (10,06 ± 0,12 cm), LQ (3,44 ± 0,06 cm), LC (11,26 ± 0,18 cm) et WL (5,69 ± 0,07cm) ont été obtenus à partir de IBXN tandis que LB (4,74 ± 0,07 cm) et GC (8,38 ± 0,08 cm) ont été obtenus au génotype NaxIB à 2 semaines. À 10 semaines d'âge, plus important significatif (p <0,05) SL (5,24 ± 0,06 cm) et DL (10,44 ± 6,92 cm) de Ibxna; BG (16,74 ± 0,20 cm) et BW (20,59 ± 0,18 cm) d'IBxN; Kl (7,01 ± 0,07 cm) de NxIB; BL (26,78 ± 1,42 cm) de FxIB et LA (13,72 ± 0,09 cm)des génotypes IBXF ont été enregistrés. Le LT, LB, LQ d'Ibxna; LC des génotypes de FxIB etBL de NaxIB avaient des moyens importants plus importants à 20 semaines. Les génotypes NxIB et IBxN qui représentent une croissance exceptionnelle de performance à 2 à 10 semaines doivent être sélectionnés pour améliorer les poules à croissance rapide, tandis que Ibxn, FxIB, des génotypes NaxIB qui ont enregistré de meilleures performances à 20 semaines peuvent être envisagées pour le développement de poulets de type œuf.*

Mots-clés: poulet, génotype, poids corporel, mesures corporelles linéaires, croisement croisé.

Introduction

Local chickens play a vital role in conservation of genetic resources for poultry breeding and improvement. These chickens consist of different individuals and strains with high genetic and phenotypic variability (Mwacharo *et al.,* 2007; Halima *et al.,* 2009). Such strains include frizzle feathered, naked neck and normal feathered chickens which carry frizzle (F), naked neck (Na) and normal (N) single major genes, respectively. The Na and F genes are regarded as feather restriction and structure genes, respectively. The Na gene reduces the number of neck feathers and restricts their distribution while the F gene modifies the feather shape (Yunis and Cahaner, 1999) by curling, and hence reduces the feather size (Horst, 1998). Horst and Mathur (1992) reported that the presence of naked neck gene results in 20-30% total reduction of feather coverage with the lower neck of the bird appearing almost naked while frizzle gene reduces the insulating properties of the feather cover and makes it easier for the bird to radiate heat from the body. These major genes are reported to ameliorate tropical heat stress and enhance the performance of chickens under hot humid environments (Hernandez et al., 2002; Cahaner *et al.,* 2008) as a result of their thermoregulatory functions in local chickens (Ibe, 1993). The genes impact productive adaptability (Horst, 1988) on individuals carrying them. Productive adaptability is defined as a phenomenon whereby an animal gives an acceptable level of production in a stressed environment (Ibe, 1998).

The frizzle feathered and naked neck individuals contribute much to the gene pool of the indigenous chickens as well as advances in poultry breeding in Nigeria. Whereas Nwaogwugwu *et al.* (2009) reported that these chickens have potential to be used in developing breeds of different types, Nwachukwu *et al.* (2009) noted that they could be used to develop light and heavy broiler lines. Despite these potentialities, the chickens are scarce within the locality and facing possibility of becoming extinct in the near future. There is need, therefore, to multiply and conserve the frizzle and the naked neck chickens through crossbreeding and other breeding methods.

Crossbreeding not only ensures multiplication of chickens, but also results in individuals with different genetic constitutions, which have effects on quantitative characters. Crossbreeding has been reported to improve live weights and body weight of chickens at 12 weeks of age (Asiedu and Weaver, 1993;

Nwachukwu *et al.,* 2006). Nwachukwu *et al.* (2006) reported superiority of Frizzle x Exotic reciprocal cross over all other genetic groups studied with respect to body weight and linear body parameters at 18 weeks of age. These linear body parts allow comparisons of growth in different parts of the body (Abdullah *et al.,* 2018). They are useful in quantifying size and shape which have direct relationship with the economic values of animals (Ibe, 1993). They serve as phenotypic index of selection for meat and egg-type chickens. Moreover, the linear body measurements are reported to have positive correlation with body weight in chickens (Gambo *et al.,* 2014). Such correlation is reported to be useful in early and indirect selection, which has advantages in reducing cost and improving annual genetic gain (Nwaogwugwu *et al.,* 2018).The linear body measurements are also efficient and unbiased predictors of body weight of poultry as they are not adversely affected by the animal's gut fill (Olowofeso, 2009). Demands for chicken cut-parts have increased in our society in the past few decades. Prominent among these are the drumstick, the back and the breast, which have linear measurements. Conscious and consolidated efforts should be made by animal breeders through crossbreeding and other methods to improve the body weight and linear body measurements of chickens. The objective of this study was to determine the impact of genotype on body weight and linear body measurements of main and reciprocal crosses of Isa Brown and local chickens.

Materials and methods

Management of parent stock and production of first filial generation progeny

A total of 69 parent stocks consisting of 36 exotic Isa Brown (9 cocks and 27 hens), 11 frizzle feathered (3 cocks and 8 hens), 10 naked neck (3 cocks and 7 hens) and 12 normal feathered (3 cocks and 9 hens) chickens were used in the experiment. The chickens were naturally mated in main and reciprocal order for Isa Brown cocks and the local cocks, respectively. The birds were fed layer mash containing 2,650 metabolisable energy per kilogram weight (ME/kg) and 16.5 % crude protein (CP) ad libitum. A vitamin supplement was administered to the birds through drinking water. Eggs were collected and their pedigree identified with permanent markers. They were stored in cool, dry place. A total of 531 first filial generation (F_1) of unsexed chickens were produced in 12 consecutive hatches. These consisted of 123 Isa Brown x frizzle feathered main cross, 49 Isa Brown x naked neck main cross, 116 Isa Brown x normal feathered main cross, 137 frizzle feathered x Isa Brown reciprocal cross, 42 naked neck x Isa Brown reciprocal cross and 64 normal feathered x Isa Brown reciprocal cross. The chicks were vaccinated at day-old against Newcastle Disease and brooded together in cages of 79 x 67 x 61 cm^3 dimension each, constructed on deep litter pens of 2.65 x 1.67 m^2 dimension each. Brooding lasted for 4 weeks per hatch.

The birds were fed and provided cool, clean water ad libitum. During brooding, they were fed using round plastic feeders adequately spaced out. After brooding, they were fed with conical and rectangular iron feeders hung approximately 25 cm above the litre level. Four-litre plastic drinkers were used to provide water to the birds. Feeding was done in starter and grower phases. At starter phase (day1 to 6 weeks), the birds were fed starter mash containing 2800 kcal ME/kg and 20% crude protein (CP) and at grower phase (6-20 week) they were fed grower mash containing 2550 kcal ME/kg and 15% CP. Appropriate antibiotics were administered to the birds to control bacterial diseases.

Data collection and measurement of parameters

Data used for the analysis were collected on body weight and linear body measurements of individual chickens on both sexes at 2, 10 and 20 weeks of age. Body weight was measured in grams (g), using Ohaus electronic sensitive weighing scale (Model CS5, 000) with sensitivity of 2.00 g. The linear body measurements were taken in centimetre (cm) using measuring tape. Shank length was measured as the length of the leg from the hock joint to the tarso- metatarsus pad. Drumstick length was measured as the length of the femur bone. Body width was measured as the circumference of the widest part of the body. Body girth was measured as the circumference of the breast around the deepest region. Body length was measured as the distance between the comb and pygostyle towards the tail. Keel length was measured as the length of the keel bone from the V-joint to the end of the sternum. Wing length was measured as the length of the wing from the scapular joint to the last digit of the wing.

Statistical model and analysis

The following fixed effect model was used in randomized complete block design. Hatch served as block.

$\mathbf{Y_{ijk} = \mu + H_i + G_j + \epsilon_{ijk}}$,

where:

Y_{ijk} = Body weight/linear body measurements of the kth progeny of jth genotype in ith hatch

μ = Population mean

H_i = Fixed effect of hatch (i = 1,…, 12)

G_j = Fixed effect of genotype (j = 1,…, 6)

ϵ_{ijk} = Random error, assumed to be independently and identically normally distributed with zero mean and constant variance [iind $(0,\sigma^2)$].

Data were analysed by two-way analysis of variance using IBM SPSS (2011). Means of significant genotype effects were separated using Duncan's (1955) New Multiple Range Test.

Results and Discussion

Mean BWT and LBMs of main and reciprocal crosses of Isa Brown and local chickens at 2 weeks of age are presented in Table1. Genotypes differed significantly ($P<0.05$) in all the traits studied. The BWT of the chickens ranged from 48.01±0.81g – 59.12±1.07 g. Normal feathered main and reciprocal crosses had heavier BWT. Isa Brown x normal main cross genotype was significantly ($P<0.05$) higher for shank length (2.61±0.05 cm), body width (10.06±0.12 cm), keel length (3.44±0.06 cm) and wing length (5.69 ±0.07cm). NaxIB genotype showed superiority in drumstick length (4.74±0.07 cm), body girth (8.38±0.08 cm) and body length (11.27±0.08 cm) compared to other genotypes. However, the drumstick length of NxIB and IBxN genotypes was high and did not differ significantly ($P>0.05$) from that of NaxIB genotype. Furthermore, the body girth of FxIB and NaxIB genotypes were similar but wider than those of the other genotypes. Similarly, the body length of IBxN, NxIB and FxIB genotypes on the one hand and the wing length of IBxN and NxIB genotypes on the other hand, though numerically smaller, did not differ significantly ($P>0.05$) from those of NaxIB genotype.

Table 1: Mean (± se) body weight and linear body measurements of main and reciprocal crosses of Isa Brown and local chickens at 2 weeks of age

	Main cross			Reciprocal cross		
Trait	IBxF	IBxNa	IBxN	FxIB	NaxIB	NxIB
BWT (g)	$49.60^{b}\pm0.74$	$48.01^{b}\pm0.81$	$58.49^{a}\pm1.12$	$58.09^{a}\pm0.85$	$56.57^{ab}\pm0.95$	$59.12^{a}\pm1.07$
SL (cm)	$2.40^{cd}\pm0.04$	$2.31^{b}\pm0.04$	$2.61^{a}\pm0.05$	$2.57^{ab}\pm0.04$	$2.58^{ab}\pm0.04$	$2.48^{bc}\pm0.04$
DL (cm)	$4.13^{c}\pm0.05$	$4.10^{c}\pm0.05$	$4.59^{a}\pm0.08$	$4.34^{b}\pm0.05$	$4.74^{a}\pm0.07$	$4.63^{a}\pm0.08$
BG (cm)	$7.55^{c}\pm0.06$	$7.7^{d}\pm0.04$	$7.92^{b}\pm0.10$	$8.26^{a}\pm0.10$	$8.38^{a}\pm0.08$	$7.85^{b}\pm0.11$
BW (cm)	$9.12^{d}\pm0.07$	$9.01^{d}\pm0.05$	$10.06^{a}\pm0.12$	$9.73^{c}\pm0.08$	$9.82^{ab}\pm0.10$	$9.82^{ab}\pm0.11$
KL (cm)	$2.96^{d}\pm0.02$	$3.01^{cd}\pm0.03$	$3.44^{a}\pm0.06$	$3.10^{c}\pm0.04$	$3.29^{b}\pm0.04$	$3.31^{b}\pm0.06$
BL (cm)	$10.30^{b}\pm0.07$	$10.31^{b}\pm0.07$	$11.26^{a}\pm0.18$	$11.09^{a}\pm0.08$	$11.27^{a}\pm0.08$	$11.13^{a}\pm0.15$
WL (cm)	$5.65^{b}\pm0.09$	$5.07^{c}\pm0.07$	$5.69^{a}\pm0.07$	$5.35^{b}\pm0.06$	$5.64^{a}\pm0.07$	$5.65^{a}\pm0.07$

$^{a-d}$Means in the same row with different superscripts are significantly different ($P<0.05$)

IBxF= Isa Brown x Frizzle feathered main cross, IBxNa = Isa Brown x Naked neck main cross, IBxN = Isa Brown x Normal feathered main cross, FxIB= Frizzle feathered x Isa Brown reciprocal cross, NaxIB = Naked neck x Isa Brown reciprocal cross,

NxIB= Normal feathered x Isa Brown reciprocal cross, BWT=Body weight; SL=shank length; DL=Drumstick length; BG=body girth; BW=Body width; KL=Keel length; BL=Body length; WL=Wing length, se=standard error

The mean BWT and LBMs of main and reciprocal crosses of Isa Brown and local chickens at 10 weeks of age are presented in Table 2. The genotypes differed significantly (P<0.05) in all traits studied. The heaviest BWT (451.92±6.10 g) was obtained from IBxN. This was significantly similar to the BWT (444.32±6.09g) of FxIB. The IBxNa genotype had the longest significant (P<0.05) shank length (5.24±0.06 cm) and drumstick length (10.44±6.92 cm) which did not differ significantly (P>0.05) from the drumstick length of IBxN and FxIB genotypes. The broadest body girth (17.05±0.15cm) and body width (20.59±0.18 cm) were obtained from IBxN genotype, which did not differ significantly from those of the FxIB genotype. Higher significant (P<0.05) mean for keel length (7.01±0.07 cm), body length (26.78±1.42 cm) and wing length (13.72 ±0.09 cm) were obtained from NxIB, FxIB and IBxF genotypes, respectively.

Table 2: Mean (± se) body weight and linear body measurements of main and reciprocal crosses of Isa Brown and local chickens at 10 weeks of age

	Main cross			Reciprocal cross		
Trait	IBxF	IBxNa	IbxN	FxIB	NaxIB	NxIB
BWT (g)	406.75^{c}±4.80	439.68^{ab}±4.68	451.92^{a}±6.10	444.32^{a}±6.09	377.64^{d}±7.10	422.77^{bc}±8.72
SL (cm)	4.96^{bc}±0.04	5.24^{a}±0.06	5.07^{b}±0.06	4.97^{bc}±0.05	4.63^{d}±0.05	4.82^{c}±0.06
DL(cm)	10.26^{a}±0.07	10.44^{a}±6.92	10.44^{a}±0.10	10.25^{a}±0.07	9.79^{b}±0.08	9.88^{a}±0.11
BG (cm)	17.05^{a}±0.15	15.99^{b}±0.15	16.74^{a}±0.20	16.61^{a}±0.15	15.88^{b}±0.13	16.15^{b}±0.16
BW (cm)	19.94^{b}±0.16	18.88^{c}±0.18	20.59^{a}±0.18	20.47^{b}±0.15	18.97^{c}±0.17	19.60^{b}±0.21
KL (cm)	6.67^{c}±0.06	6.96^{d}±0.07	6.87^{ab}±0.08	6.81^{bc}±0.06	6.66^{c}±0.05	7.01^{a}±0.07
BL (cm)	24.19^{bc}±0.19	23.10^{c}±0.21	26.46^{ab}±1.18	26.78^{a}±1.42	22.99^{c}±0.25	25.67^{ab}±0.26
WL (cm)	13.72^{a}±0.09	13.14^{ab}±0.12	13.17^{b}±0.05	13.15^{b}±0.10	12.79^{b}±0.11	13.00^{ab}±0.15

$^{a-d}$Means in the same row with different superscripts are significantly different (P<0.05)

IBxF= Isa Brown x Frizzle feathered main cross, IBxNa = Isa Brown x Naked neck main cross, IBxN = Isa Brown x Normal feathered main cross, FxIB= Frizzle feathered x Isa Brown reciprocal cross, NaxIB = Naked neck x Isa Brown reciprocal cross, NxIB= Normal feathered x Isa Brown reciprocal cross, BWT=Body weight; SL=shank length; DL=Drumstick length; BG=body girth; BW=Body width; KL=Keel length; BL=Body length; WL=Wing length, se=standard error

Mean BWT and LBMs of main and reciprocal crosses of Isa Brown and local chickens at 20 weeks of age are presented in Table 3. The genotypes differed significantly (P<0.05) in all traits except for body girth and wing length. At this age, IBxF, IBxNa, FxIB and NaxIB genotypes performed significantly better than IBxN and NxIB genotypes in many traits studied. The BWT of the chickens were significantly (P<0.05) higher for IBxNa and FxIB. Among the LBMs evaluated, IBxNa genotype had higher significant (P<0.05) means for shank length (10.49±0.10cm), keel length (12.86±0.12 cm) and drumstick length (18.77±0.15 cm). Body width (33.47±0.24 cm) and body length (40.44± 0.32 cm) were significantly (P<0.05) higher for FxIB and NaxIB genotypes, respectively.

The BWT means of the chickens (Table 1) in the present study were generally greater than those reported for unimproved Nigerian local chickens (Omeje and Nwosu, 1984; Fayeye *et al.,* 2005), but fell within the range reported for main crossbred exotic and local chickens (Nwachukwu *et al.,* 2006). The observed greater performance of these crossbreds arises from positive heterosis advantage of crossbreeding, which is the mean performance of the hybrid above the mean of the two parents (Verma and Agawal, 2009). The BWT of the main crosses was greater than that of the reciprocal crosses. Nwachukwu *et al.* (2006)

conducted similar experiment in the same environment and reported that the reciprocal crossbred local and exotic chickens performed better than the main cross at 18 weeks of age as a result of maternal effect. The observed difference may be due to differences in age and strains of chickens used. Age and strain have been reported to influence the performance of poultry (Adeleke *et al.,* 2004). The superior performance arising from the main cross in the present study is therefore, attributed to sire effect. Sire effect is preferable in animal breeding since maternal effect is non-additive and cannot be used to estimate heritability or determine the breeding values of animals (Mulder and Hill, 2007).

Table 3: Mean (± se) body weight and linear body measurements of main and reciprocal crosses of Isa Brown and local chickens at 20 weeks of age

	Main cross			Reciprocal cross		
Trait	**IBxF**	**IBxNa**	**IBxN**	**FxIB**	**NaxIB**	**NxIB**
BWT(g)	1081.41^{c} ±13.90	1133.66^{a} ±12.00	1109.43^{abc} ±14.53	1119.95^{ab} ±15.28	1021.50^{d} ±16.27	1089.76^{bc} ±20.06
SL(cm)	9.49^{b}±0.11	10.49^{a}±0.10	8.14^{d}±0.08	8.64^{c}±0.06	8.12^{d}±0.09	8.25^{d}±0.10
DL(cm)	18.50^{a}±0.20	18.77^{a}±0.15	16.00^{c}±0.13	16.85^{b}±0.11	15.69^{c}±0.21	17.04^{b}±0.19
BG cm)	28.29±1.76	26.58±0.19	26.75±0.21	27.10±0.24	25.85±0.25	27.72±0.23
BW(cm)	30.67^{d}±0.26	30.91^{d}±0.28	31.44^{c}±0.20	33.47^{a}±0.24	30.50^{d}±0.30	31.96^{b}±10.24
KL(cm)	10.56^{b}±0.10	12.86^{a}±0.12	10.14^{c}±0.11	10.50^{b}±0.09	10.56^{b}±0.11	10.25^{c}±0.10
BL(cm)	39.37^{b}±0.33	36.62^{c}±0.26	36.73^{c}±0.23	38.49^{b}±0.43	40.44^{a}±0.32	39.29^{b}±0.24
WL(cm)	24.40±0.20	23.52±0.16	23.68±1.08	22.74±0.13	22.75±0.32	24.44±0.23

$^{a-d}$Means in the same row bearing different superscripts are significantly different ($P<0.05$).

IBxF= Isa Brown x Frizzle feathered main cross, IBxNa = Isa Brown x Naked neck main cross, IBxN = Isa Brown x Normal feathered main cross, FxIB= Frizzle feathered x Isa Brown reciprocal cross, NaxIB = Naked neck x Isa Brown reciprocal cross, NxIB= Normal feathered x Isa Brown reciprocal cross, BWT=Body weight; SL=shank length; DL=Drumstick length; BG=body girth; BW=Body width; KL=Keel length; BL=Body length; WL=Wing length, se=standard error

The greatest impact of IBxN genotype on BWT, which did not differ significantly from that of FxIB at week 10 (Table 2) suggests that normal and frizzle genes may be utilized in main and reciprocal crossbreeding to improve fast growing heavy broilers. This is evidently supported by the findings of Nwachukwu *et al.* (2006) who reported that both exotic broiler x normal main cross and frizzle x exotic broiler reciprocal cross outweighed their naked neck cross counterparts at final growth phase. The longest significant shank length and drumstick length obtained from IBxNa genotype suggest that naked neck gene may impact greater height relative to BWT in chickens. Since naked neck chickens generally possess small body weight relative to their normal and frizzle counterparts, it implies that chickens which have longer shank length may be light in size. Light-bodied chickens such as naked neck individuals had been depicted for high rate of egg production because of attainment of early sexual maturity (Nwaogwugwu *et al.,* 2009). From the on-going discussion, it is logical to infer that shank length and drumstick length may serve as indicators of high laying potential in chickens. However, the greater means of shank length, drumstick length, body girth and body width obtained for IBxNa genotype in comparison with its reciprocal counterpart, NaxIB, resulted from sire (Isa Brown cock) effect in the main crossbreeding. Such effect is pertinent to estimation of heritability and breeding value of animals, which are important in improvement of quantitative characters. The largest body girth and body width obtained from IBxF and IBxN genotypes indicate that frizzle and normal feather genes may impact large body size to chickens. Large body size correlates positively with body weight and may serve as important indicator for good broilers. The longest keel length, body length and wing length obtained from NxIB and IBxF further indicate that normal feather and frizzle genes, are capable of improving growth and should be utilized in developing broiler chicken. Long keel length could mean large muscular deposit and consequent heavy body weight.

The significant genotype impact on the measured traits at 20 weeks of age with the exception of body girth and wing length (Table 3) implies that at maturity, the traits are more likely to be used as selection indices for improving size and conformation of crossbred chickens. The superiority of frizzle and naked neck carrying- genotypes both in the main and the reciprocal crosses at this age supports earlier observation that the direct effects of frizzle and naked neck genes on thermoregulatory efficiency in a hot, humid environment maybe evident at point of inflection or even after the growing phase (Ibe, 1993). This informed the reason for introgressing these genes into individuals for improvement of egg production traits in chickens in a similar study (Egahi *et al.,* 2013).

Conclusion

Isa Brown and normal feathered main and reciprocal crossbred chickens exhibited better body weight and linear body measurements between 2 and 10 weeks of age. Naked neck and frizzle feathered main and reciprocal crosses exhibited greater body weight and linear body measurements at 20 weeks of age. Main and reciprocal Isa Brown and normal feathered chickens can be selected between 2 and 10 weeks to develop fast growing broiler chickens. Frizzle feathered and naked neck crosses of Isa Brown chickens can be selected at 20 weeks of age to develop egg-type chickens.

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