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BODY WEIGHT AND MORPHOMETRICS OF FRIZZLE FEATHERED AND PLYMOUTH ROCK BREEDS AND THEIR F1 AND F2 CROSBRED

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ABSTRACT

The study was conducted at the Poultry Research Center (PRC) of the Faculty of Agriculture, DSUST, Ozoro, to evaluate body weight (BWT) and body morphometrics (BM) of Frizzle feathered (FF) chicken and Plymouth Rock (PR) breed and their F1 and F2 crossbred. One hundred and sixty-eight (165) sexually matured FF chickens were reared on deep litter system. It comprises of one 150 FF chicken and 15 PR cock and was bred (natural). The first cross was between FF and PR cock produced 50 % indigenous (I) and 50 % exotic (E) in first filial generation. The second cross was an inter se mating of the heterozygous FF from the F1 generation. The second cross produced offspring that were 25 % I and 75 % E. The pure breed was used to bred F1 and F2 generations. The BM include: body weight (BWT), comb length (CL), Beak length (BKL), Head length (HL), Neck length (NL), Wing length (WL), Keel length (KL), Breast Girth (BG), Thigh length (THL), Shank length (SL), and Toe length (TOL). The results revealed that generation had significant ($P<0.05$) effect on all variables. Results showed that Pure FF of F1 was higher than the parent value. It was concluded that crossbred offspring of F1 and F2 generations were observed to be superior in all the traits of BM than the purebred lines. Therefore, the mating system of crossbreeding and selection should be adopted to enhance genetic improvement strategies of the crossbred lines over many generations.

KEYWORDS

Frizzle feathered, crossbred, body weight, purebred, morphometrics, generations

INTRODUCTION

The domestic fowl plays a major role in supplying the population with egg and meat, which are highly nutritious and popularly consumed. The Nigeria poultry population is estimated at 140 – 160 million with about 72.4 million being the chicken population (FAO, 2006). The rural local chicken accounts ranging from 80% - 85 % of the total chicken population (Sonaiya *et al.,* 1999). Despite their economic importance and high population, the Nigerian ICs has not been fully exploited for the purpose of genetic improvement.
Commercial production of ICs has not been effective because the stocks have been termed a 'poor producer'.(FAO, 2006). They constitute a significant contribution to human livelihood and contribute significantly to food security. Most importantly, they are known for their adaptive hardiness and superiority in terms of their resistance to endemic diseases and other harsh environmental conditions (Malago and Baitilwake, 2009).

The Nigerian ICs are characterized by poor growth, small body size, and low egg production of 30-80 small eggs per hen per year (Akbas *et al*., 2002); Sonaiya, 2003, Adebambo *et al.,* 2006, Momoh and Nwosu, 2008 and Adedeji *et al.,* 2008). However, various researchers have revealed that under good management the IC expresses the potentials of a good producer (Olawoyin, 2006; Adeolu *et al* , 2008 and Adeleke *et al.*,2011).

Cahaner *et al.* (2003) observed that crossing the frizzled resulted in a progeny of ten mature birds of which six were frizzled, while four had a normal plumage. Assuming that all four Frizzles used for the cross were heterozygous, He concluded that the differences between frizzled and non- frizzled are determined by a single pair of factors, frizzling being the dominant allelomorph. He refers to frizzling as a "positive character added to the perfect feather," and he thinks that this is a 'progressive variation as compared with the 'primitive condition of the NF or the 'retrograde type of the Silky feather. This appears to be all the available experimental evidence concerning the inheritance of frizzling, Cahaner *et al.,* (2003) also stated that the Frizzle character acts as a lethal in homozygous condition. They further stated that in the case of the fowl lethal are to be found in the Frizzle, for it would seem that the homozygous FF bird does not appear. These statements are probably founded on the experience of poultry breeders that Frizzle fowls do not breed true but always produce some normal progeny.

The FF chicken is a known heavy bird (Oluyemi and Roberts, 2003) that converts feed efficiently (Liu *et al.,* 2006) and appears to be well adapted to tropical environment (Akbas, 2002). Fayeye *et al.* (2006) reported that body weight of matured FF was 1.3 kg. Ige *et al.* (2012) also reported that BWT of matured FF chicken was 1.44 kg; while the average SL of 2.0 ± 0.11 cm was obtained for FF chicken.

The genetic diversity of Nigerian ICs, when compared with exotic breeds, was found to be greater, and such a phenomenon provides opportunity for poultry breeders to develop a relatively high producing breed of chicken adapted to the rural environment of Nigeria (Sonaiya, 2002). That chickens are mostly raised in a low input — low output system where birds are given limited amounts of feed to supplement what they scavenge (McAinsh *et al.,*2004). The objective of the study is to evaluate the BWT and BM of FF pure bred lines and their crossbred performance.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the PRC of the Faculty of Agriculture, DSUST Ozoro. It falls within the rain forest vegetation zone of mid-western Nigeria on Latitude 5^0 32^I N and Longitude 6^0 15^I E of the Greenwich meridian. The climatic condition is humid with a mean annual rainfall of between 2500 and 3000 mm. The mean temperature and RH are 27.4°C and 85 % respectively (DSUST Meteorological Station Ozoro, 2021).

Experimental Birds and their Management

A total of 168 sexually matured birds of FF were purchased and raised on a deep litter system. The deep litter house was made of wooden material and floored with wood shavings for ease of cleaning. The house was open-sided roofed with corrugated iron sheet. It had a total of 12 pens. Each pen measured 2.5 m x 1.5 m. Each pen accommodates 14 ICs. Nest boxes of 2- tier measuring 0.8 m in height and 0.8 m in length were provided for the

layers. A total of 12 nest boxes per tier per pen. A total of 24 hanging tubes were used as drinkers and feeders (12 drinkers and 12 feeders).
Cleaning operation was carried out daily. Disinfectant was used weekly on both feeders and drinkers to prevent contamination of micro organism. Mass selections were used to selected birds at 8 and 12 weeks of age for higher body weight. Servicing was done by keeping 2 mature cocks in each group for natural pen mating. The birds were wing tags with Arabic numbers inscribed on them.

All groups of birds were treated and medicated similarly throughout the study period under the same management conditions. The study lasted for 3 years. Routine preventive hygiene was encouraged by provision of clean water, provision of dry feed and regular cleaning of the pen. They were also dewormed and given Pen Strip, which is a source of antibiotic and vitamins. Sick birds were culled and dead birds were also removed and buried and visits to the poultry unit were kept at minimum outside the normal feeding and cleaning periods.

The birds were fed with compounded breeder diets composed of (15.10 % CP and 2650 kcal ME/kg) and grower diets (16.20 % CP and 2654 kcal ME/kg). Feed and water were given *ad-libitum* throughout the experiments. The birds were raised on deep litter under intensive system of management. The sampled naked neck hens were bred (natural) with PR cock. The collected eggs incubated and hatched. Secondary sexual characteristics which include comb size and tail feather shape were used to sex the birds at 10 weeks of age.

Incubation

The eggs were selected for artificial incubation by discarding very small eggs, broken shells, blood stained or dirty eggs. The eggs were incubated and hatched at the hatchery of Winne Bounty Farms, a commercial hatchery based in Agbarho, Delta State. The incubation was done fortnightly for 12 consecutive months.

Chick Rearing

After hatching, each hatch of chicks was brooded in one unit of the brooder house. .Coal pot and stove were used to provide light and the required heat for the chicks. The chicks were wing- tagged and weighed individually. Glucose was administered via the drinking water. Commercial chick mash (19.5 % CP and 2800 kcal ME/kg) and fresh drinking water were given *ad libitum* . The chicks were vaccinated against Newcastle and Gumboro diseases. Coccidiostat, antibiotic and vitamins were given through their drinking water during the first month. The BWT of chicks was recorded fortnightly up to 44 weeks of age.

First generation

At 8th to 12^{th} weeks, 6 PR cocks and 45 FF female birds were selected to be mated *inter se* to produce the F_2. The males were kept together with the females. The birds were fed with compounded grower mash (16.20% CP and 2654 Kcal ME/Kg) at 6 week of age. The nutrient composition of the diet could ensure adequate availability for growing and breeding poultry according to the standard of NRC (1984). Ingredients were milled and prepared as described by Olomu (2011). Feed and fresh water were given *ad libitum*. They were vaccinated against Fowl pox and Newcastle (Newcavac) diseases. Deworming took place after every 3 months via their drinking water. Birds were sometimes stressed due to weighing and transfers, therefore vitamins were administered intermittently. Four weeks after the first egg has been laid, the males were introduced to the females in a ratio of 2:15 and collection, selecting eggs for incubation and chick rearing up to 6 weeks thereafter. After the 6th week, these F_1 birds were transferred to the deep litter. F_2 was also generated using the same procedure.

Mating involving FF chickens and PR cock

The first cross was between FF layers and PR cock produced (50 % I and 50 % E) in the F_1. The second cross was an *inter se* mating of the heterozygous Nn birds from the F_1 generation. The second cross produced offspring that were 25 % I and 75 % E. The two crosses are schematically shown below:

First mating

First Parents (F_1) Female: Male

IC X PR

↓

(50 % I: 50 % E)

Second mating

Second Parents (F_2) Female: Male

IC (*inter se*) X PR

↓

(25 % I: 75 % E) F_2

Experimental Design

The experimental design was CRD. There were 3 treatments at two levels, 15 birds per treatment and 2 replicates of 15 birds per replicate. Below is the schematic upgrading procedure of IC by E for two generation.

Generation	Mating Types		
	(100% I)	x	(100% E)
	↓		
F_1	(50% I: 50% E)	x	(100% E)
	↓		
F_2	(25% I: 75% E)	x	(100% E)

Data Collection

Body Morphometrics

Data obtained were BM that were taken fortnightly from each bird. The BM include: BWT, CL, BKL, HL, NL, WL, KL, BG, THL, SL, and TL). BWT was taken using scout 11 electronic weighing balance 600 g capacity from day - old to 20 weeks of age while 10 kg simple table scale from 20th week. BM was taken, using fibre tape calibrated in centimeters (cm). FI and FE were also noted. Descriptions of how BM was taken are as follows:

CL: length of part of the head that the comb covered.

BKL: Measured from the tip of the beak (*Rostrurn maxillae*) to the base.

HL: Measured as the distance between the base of beak and the *axis vertebrae*.

NL: This is the length of the axial skeleton from the first to the last *cervical vertebrae*.

WL: The length between the scapula and the tip (*second digits phalanges*) of the wing.

WS: Measured as the distance between the left wing tip to the right wing tip across the back of the chicken.

KL: Taken as the length of the sternum or breast plate.

BG: Taken as the distance between the left scapula and the right scapula taken at the deepest region of the breast.

THL: Measured as the distance between *the hock joint* and *pelvic joint.*

SL: Measured as the distance between the mid region of the *Genus* and that of the *Regio tarsalis,*

TOL: The length between the hind region of *Regio tarsalis* and the outside of the *Digital Pedis* (mid digit).

BWT: The weight of the live bird.(Molenaar*et al.*,2008)

Statistical analysis

Data obtained were subjected to ANOVA using the Student Newman Keule test as described by Alika (2011) for the procedure of SAS (2005) to determine BWT and BM phenotypic gain. The model for the ANOVA was represented as:

Model: $Yijk = \mu+ai+eijk$ ……..(1)

Yijk = body weight measurements.

μ. = overall mean

ai = effect of the ith genotype (i = 1,2,3 and 4).

eijk = random error residual error normally distributed.

Results

The mean value of CL, BKL, HL and NL as influenced by generation are presented in Table 1. Generation had significant (P<0.05) effect on all variables. The CL of F_2 crossbred had higher mean value than the parent line and F_1crossbred. There was a significant generation effect on the BKL; HL and NL with F_2 crossbred birds generally having higher mean values for all traits. Within the F_1 and F_2, the crossbred had higher values.

Mean values for WL and WS of FF and their crossbred with the exotic as influenced by generation are presented in Table 2. F_2 crossbred had significantly (P<0.01) longer WL and WS than F_1 and parent birds. The higher mean values of 23.60 cm was observed in FF x PR cock for F_2 crossbred for WL, while 47.30 cm was respectively obtained for WS which was also significant (P<0.05). These values was significantly (P<0.05) higher than those obtain in F_1

The mean values for KL and BG as influenced by generation are presented in Table 3. KL and BRG were significantly (P<0.05) longer in the F_2 crossbred progenies of FF x PR (15.43 cm) compared to those of pure FF (11.58 cm). The F_2 values were also higher than those of F_1. The mean BG value of F_2 crossbreds FF x PR cock (14.38 cm) were higher than values reported in F_1.

The mean THL, SL and TOL of FF chicken and their crosses with PR cock as influenced by generation are presented in Table 4. THL, SL and TOL were also significantly (P<0.05) longer in the F_2 compared to the F_1 and pure lines. The crossbred were also longer than the pure lines. Pure FF of F_1 was higher than the parent value.

Phenotypic gain in BWT of NF and PR cock at F_1 and F_2 generations are presented in Table 5. The results revealed that the pure line genotypes had phenotypic increase in BWT that increased with generation. The crossbred decreased in phenotypic gain with increase in generation. Pure FF birds that increased from 54.95 % to 58.03 % from F_1 to F_2 had a similar case when crossed with the exotic where it had an increase of 55.44 % to 57.60 %.

Discussion

The head morphometrics for both parent and crossbred birds used in the study (Table 1) were observed to differ in length in favour of the crossbred progenies. The $F_1$and F_2 generations were found to be superior in all the traits (CL, BKL, HL and NL respectively) than the purebred lines. These results are in agreement with the study of Msoffe *et al*., (2002) and Adeleke *et al*., (2011) carried out in Tanzania and Nigeria respectively. In general, ICs in Botswana appear to be smaller in CL, BKL, HL and NL (Badubi *et al*., 2013) than the crossbred progenies in the current study. However, the results obtained for purebred lines indicated lower performance compared to values obtained by Essien and Adeyemi (1999) and Nwagu *et al*., (2009). However, combination of genes could have contributed to such differences. The superiority of the F_2 over the F_1 and parent birds, and F_1 birds over the parent birds could be attributed to the fact that dominant gene carrier in crossbred were higher in BKL, HL and NL than their respective recessive gene carrier in purebred of the FF chickens.

The influence of generation on WL and WS reported by Nwagu *et al*., (2009) for crossbred progenies of FF chicken was markedly higher than those obtained in this present study (Table 2). This contradiction may be due to strain and environmental differences. According to Okon *et al*., (1997), exotic breed is more superior to both purebred and crossbred progenies of chicken because the dominant gene carriers of exotic breed were higher in WL and WS than their respective recessive gene carriers in purebred lines. The observed superiorities in this current study are consistent with the reports of Adeleke *et al*., (2011).

The F_1 and F_2 crossbred of FF x PR cock were superior to the parent stock in terms of KL and BG (Table 3). This finding may be attributed to the good combining ability on these two measured traits. These traits showed rapid increase in growth and development which is in agreement with the report of Essien and Adeyemi (1999).

They suggested that the effect of genotype enhanced growth and physiological development. This finding also agrees with the observation of Fayeye and Ayorinde (2006) on ICs relating to BWT and body size parameters.

The higher values observed in F_1 generation for THL, SL and TOL were however statistically significant ($p<0.05$) (Table 4).The result revealed that the genetic influence of these three traits were about the same in the parent and F_1 generation except those of F_2 generation which were higher. It could be concluded that for subsequent increase in generation these traits will proved its potential for meatiness. The present report tended to support the work of Van Marle-Koste r*ets al*., (2008) in native chickens that the observed traits may phenotypically improve for further crossbreeding. Similarly, Okpeku *et al*; (2003) also reported that the observed traits were higher in F_2 generation than both parent birds and F_1 generation. Kabir (2006) reported that the above measured traits of purebred birds were relatively lower than those observed in his research work of IC strains. The reasons for the differences in this present study and other related literature reports could be due to differences in strain used, experimental setting location and management system. The superiorities of the F_2 crossbred chickens to purebred lines in the traits measured are as a result of genetic influenced.

The BWT of both purebred and crossbred chickens used in this present study indicates higher performances compared to the result of Essien and Adeyemi (1999) who reported average body weight of 1.08 kg and 1.28 kg for hen and cock at 24 weeks of age, and 1.00 kg reported for Adene (2001) as average adult birds. The BWT of purebred lines in this current study was in agreement with earlier reports (Nwosu and Asuquo, 1985; Nwosu and Omeje 1985; Oluyemi and Robert, 2003 and Adebambo *et al.,* 2009) that ICs are relatively small in BWT. The present work supported the earlier submission of Shoffner *et al*., (1993) that the parent stocks with reported gene for FF, was significantly smaller in the BWT when compared to crossbred progenies of both F_1 and F_2 generation. Heterosis may have accounted for the superiority. Similar observation was made by Oluyemi and Roberts (2003). They crossed local female hens and exotic broilers starter. They concluded that heterosis produced offspring that were heavier in live weight than the local parents. The increasing trends BWT of crossbred bird in this present study showed that crossbreeding could significantly improve the performance of the FF chicken for meat production.

Conclusion

The crossbred progenies of both F_1 and F_2 generations were found to be superior in all the traits of BM than the purebred lines. The low BWT and BM produced by purebred birds in this study may indicate less genetic variability relative to purebred lines. Therefore, crossbreeding and selection should be practice to bring about genetic improvement of the crossbred lines over many generations.

TABLE 1: MEAN (±SD) OF HEAD MORPHOMETRICS OF FF CHICKEN AND PR COCK BREEDS AND THEIR F_1 AND F_2 CROSSBRED

VARIABLE (cm)	STRAIN	PARENT	F_1	F_2
CL	FF	4.10 ± 0.29^{c}	4.25 ± 0.15^{b}	4.80 ± 0.20^{a}
	Exotic (PR cock)	6.98 ± 0.04	-	-
	FF x PR cock	-	5.20 ± 0.06^{b}	6.40 ± 0.46^{a}
BKL	FF	3.48 ± 0.14^{c}	4.20 ± 0.10^{b}	5.05 ± 0.22^{a}
	Exotic (PR cock)	4.40 ± 0.04	-	-
	FF x PR cock	-	6.30 ± 0.15^{b}	7.20 ± 0.12^{a}
HL	FF	6.73 ± 0.29^{c}	7.05 ± 0.15^{b}	8.45 ± 0.29^{a}
	Exotic (PR cock)	8.18 ± 0.65	-	-
	FF x PR cock	-	8.47 ± 0.05^{a}	8.53 ± 0.16^{a}
NL	FF	7.00 ± 0.20^{c}	8.45 ± 0.05^{b}	10.08 ± 0.19^{a}
	Exotic (PR cock)	13.94 ± 0.03	-	-
	FF x PR cock	-	12.37 ± 0.03^{b}	14.33 ± 0.45^{a}

Means with different superscript on the row are significantly different ($p< 0.05$)

TABLE 2: MEAN (±SD) OF WING MORPHOMETRICS OF FF CHICKEN AND PR COCK BREEDS AND THEIR F_1 AND F_2 CROSSBRED

VARIABLE (cm)	STRAIN	PARENT	F_1	F_2
WL	FF	11.23 ± 0.25^{c}	13.85 ± 0.05^{b}	20.00 ± 0.27^{a}
	Exotic (PR cock)	27.45±0.03	-	-
	FF x PR cock	-	16.27 ± 0.09^{b}	23.60 ± 0.29^{a}
WS	FF	22.55 ± 0.51^{c}	27.80 ± 0.10^{b}	30.10 ± 0.55^{a}
	Exotic (PR cock)	55.00 ± 0.06	-	-
	FF x PR cock	-	32.63 ± 0.18^{b}	47.30 ± 0.58^{a}

Means with different superscript on a row are significantly different (P< 0.05)

TABLE 3: MEAN (±SD) OF BM OF FF CHICKEN AND PR COCK BREEDS AND THEIR F_1 AND F_2 CROSSBRED

VARIABLE (cm)	STRAIN	PARENT	F_1	F_2
KL	FF	4.10 ± 0.29^{c}	6.55 ± 0.05^{b}	11.58 ± 0.36^{a}
	Exotic (PR cock)	36.87 ± 0.71	-	-
	FF x PR cock	-	11.93 ± 0.32^{b}	15.43 ± 0.45^{a}
BG	FF	4.15 ± 0.16^{c}	$6.85. \pm 0.05^{b}$	10.10 ± 0.27^{b}
	Exotic (PR cock)	20.91 ± 0.05	-	-
	FF x PR cock	-	10.63 ± 0.03^{b}	14.38 ± 0.48^{a}

Means with different superscript on a row are significantly different (p< 0.05)

TABLE 4: MEAN (±SD) OF LIMB MORPHOMETRICS OF FF AND PR COCK BREEDS AND THEIR F_1 AND F_2 CROSSBRED

VARIABLE (cm)	STRAIN	PARENT	F_1	F_2
THL	FF	8.58 ± 0.03^{c}	10.90 ± 0.10^{b}	15.82 ± 0.13^{a}
	Exotic (PR cock)	32.78±0.16	-	-
	FF x PR cock	-	12.60 ± 0.25^{b}	20.98 ± 0.31^{a}
SL	FF	6.13 ± 0.02^{c}	7.90 ± 0.00^{b}	9.85 ± 0.35^{a}
	Exotic (PR cock)	17.27 ± 0.47	-	-
	FF x PR cock	-	9.40 ± 0.06^{b}	11.73 ± 0.28^{a}
TOL	FF	4.20 ± 0.02^{c}	6.15 ± 0.05^{b}	6.38 ± 0.10^{a}
	Exotic (PR cock)	9.38 ± 0.31	-	-
	FF x PR cock	-	6.53 ± 0.03^{a}	7.00 ± 0.12^{b}

Means with different superscript on a row are significantly different (p< 0.05)

Table 5: Phenotypic gain in BWT of FF between F_1, and F_2 generation.

Genotype	P	F_1	H %	F_2	H %
FF	709.25	839.33	54.95	782.00	58.03
Exotic (PR cock)	3017.17				
FF x PR cock		998.20	55.44	940.33	57.60

References

Adebambo, O.A, Ilceobi, C.O.N., Ozoje, M O, Adenowo, J.A, and Osinowo, O.A (1999) Colour Variation and Performance Characteristics of the Indigenous Chickens of Southwest, Nigeria .*Nigerian Journal of Animal Production 26: 15 -22.*

Adebambo, A.O., Ozoje, M.O., Abiola, S.S and Funmi Adebambo,(2006).Analysis of the growth curves of Indian and Nigerian chicken ecotypes in the humid tropics. *Asset Series* 6(1):103-110.

Adedeji, T.A., Adejoh, I.O., Ige, A.O., Ameen, S.A., Akinwumi, A.O., and Amao S.R. (2008).Genetic evaluation of growth performance of pure and crossbred chicken progenies in a derived savannah environment. In *Proceedings of the 13th Annual Conference of Animal Science Association of Nigeria, September 15-19, Ahmadu Bello University, Zaria, Kaduna State*. Pp 8-12

Adeleke,M.A.,Peters,S.O.,Ozoje,M.O.,Ikeobi,C.O.N.,Bamgbose, A.M. and Olufunmilayo, A. Adebambo (2011).Genetic parameter estimates for body weight and linear body measurements in pure and crossbred progenies fo Nigerian indigenous chickens. *Livestock Research for Rural Development* 23(1): 1-8

Adeolu, A.I, O Okoleh, V. U and Ofurna, M.O. (2008). Estimate of Genetic Parameters for Egg Production Traits of the Local chicken in Southeastern Nigeria. *Proceedings of the 11th Annual Conference of the ASAN, ABU, Zaria.* Pp 9 – 12.

Akbas, Y., Altan,O and Kocok, C.(2002).Effects of hen's age on external and internal egg quality characteristics .*Turk. Journal Veterinary of Animal Science*.20:455 – 465.

Alika, J.E.(2011). *Statistics and Research Methods*. AMBIK Press, Benin - City, Nigeria. Pp 363.

Cahaner, A., Duyan, S. and Debb, N.,(2003).Improving the broiler meat production especially in hot climates, by genes that reduce or eliminate feather coverage. *British Poultry Science*, 31(19):18-22.

Delta State University of Science and Technology Meteorological Station Report Zonal Office Ozoro, 2021.

Essien, A.I., and Adeyemi, J.A., (1999). Comparative Growth Characteristics of two Broiler Strains raised in the wet Humid Tropics. *Tropical Journal of Animal Science* 1(2):1-8

FAO (2006).High bird flu in Africa after Outbreak in Nigeria htto://www.fao.org.newsroom/enlnews/200611 000226; index.hteml.

Fayeye, T.R., Ayorinde, K.I., Ojo, V., and Adesina, O.M. (2006).Frequency and influence of some major genes on body weight and body size parameters of Nigerian local chickens. *Livestock Research for Rural Development.*18 :(3):http//www.Irrd org/Irrd18/3/faye18037.htm [Accessed 3 May, 2007.

Ige,A.O.,Salako,A.E.,Yakubu,A.Ojedapo,L.O.,Adedeji,T.A.,andAdeoti,T.M.(2012). Comparison and prediction of morphological characteristics of frizzled feather and Naked neck chicken in derived savannah zone.PAT December, 2012,8(2):68 -75.

Kabir, M., Oni, O.O., Akpa, G.N and Adeyinka, I.A.,(2006).Heritability estimates and Inter-relationships of body weights and shank lengths in Rhode Island Red and White chickens. *Pakistan Journal of Biological Science*. 9(15):2892-2896

Liu,Y.P., Wu, G.S., Yao, Y.G., Miao, Y.W., Luikart. G., Baic,M., Beja-pereira, A., Ding ,Z.I.,Palanichamy, M.G., and Zhang,Y.P. (2006). Multiple maternal origins of chickens: Out of the Asian jungles. *Molecular Phylogenetics and Evolution* 38: 112- 119

Malago, J.J and Baitilwake, M.A.(2009). Egg traits, fertility, hatchability and chick survivability of -Rhode Island Red, local and crossbred chickens. T*anzania Vet. Journal* 26(1): 24 -36

McAinsh C.V, Kusina J, Madsen J. and Nyomi, O.(2004).Traditional chicken production in Zimbabwe. *World's poultry Science Journal* 60: 233-246.

Molenaar,R.,Reijrink,I.A.M.,Meijerhof, R and Van Den Brand, H.(2008) Relationship between hatching length and weight on later productive performance in broilers. *World's Poultry Science Journal*.64(4):599-603.

Momoh, O.M., and Nwosu, C.C.,(2008).Genetic evaluation of growth traits in crosses between two ecotypes of Nigerian local chicken. In: *Proceedings of the 13th Annual Conference of Animal Science Association of Nigeria, September 15-19, Ahmadu Bello University, Zaria, Kaduna State*. Pp 59-64.

Msoffe, P.I.M., Minga, U.M., Olsen, J.F.,Yongolo, M.G.S., Juul-Madsen, H.R., Gwakisa, P.S and Mtambo, M.M.A (2001). Phenotypes including immune competence in scravenging local chicken ecotypes in Tanzania. *Tropical Animal Health Production*.33:341- 354

National Research Council, (1984).*Nutrient requirements of poultry*, 8th revised edition, 71 pp .National Academy press, Washington, D, C.

Nwosu, C.C. and Asuquo, B.O. (1984).*Heritability of body weight in local chicken. Proc. of 9th Annual Conf. on Self-sufficiency in Animal Protein Supply Under Changing Economic Fortunes*. University of Nigeria, Nuskka, 41-48.

Nwosu, C.C. and Omeje, S.S.(1985).Improved annual egg production from Nigerian local chicken by Gold link cross progeny. *Nigerian Journal of Animal Production.* 12:161-164.

Okon, B.; Ogar, J.B. and Mgbere, O.O. (1997).Interrelationships of live body measurements of broiler chickens in a humid tropical environment. *Nigerian Journal of Animal Production.* 24(1):7-12.

Okpeku, M.; Orheruata, M.A. and Imumorin, I.(2003). Phenotypic and genetic variation among local chickens in Edo State of Nigeria. *Proceedings of 28th Annual Conference of the Nigerian Society for Animal Production.* (NSAP), 28:119-121.

Olawuyin, O.O. (2006).Evaluation of performance and adaptability of the local Nigerian and exotic Harco cockerels in the humid tropical zone. *Tropical Journal of Animal Science* 9(1): 63-67.

Olomu, J M (2011). *Monogasric Animal Nutrition. .Principles and Practice..*2nd (ed).St. Jackson publication, Benin- City. Pp 427.

Oluyemi, S.O., Roberts, F.A. (2003) *Poultry production in warm wet climates* 2nd edition spectrum Books limited Ibadan, Nigeria. Pp 105-110.

Shoffner,R.N.,Otis,J.S.and Garwood, V.A.(1993).Association of dominant marker traits and metric traits in chickens .*Poultry Science*. 72:1405 – 1410.

Sonaiya, E.B.(2003).Producing local livestock – Improving rural livelihood. In: Taiwo, A.A.,Raji, A.M., Ogbonna, J.U. and Adebowale, E.A. (eds).*Proceedings of 28th Annual Conference Nigerian. Society for Animal Production.* 16-20th March, 2003.Pp. 9 - 11.

Sonaiya, E.B, Branckacrt R.D.S, and Gueye, E.F (1999). Research and Development for Family Poultry Introductory Paper to the first INFPD/FAO Electronic conference.

Sonaiya, E.B.(2002).Rural poultry science – Emerging concepts in theoretical and empirical research. In: *Proceedings of the 11th European Poultry Conference. 6-10sept,*2002, Bremen, Germany. Pp 18- 21

Van Marle – Koster, E.V and Casey, N H.(2001). Phenotypic characterization of native chicken lives in South Africa. *AGRI* 29:71-78.