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Crossbreeding and Reciprocal Effect on Egg Weight, Hatch Weight and Growth Pattern and the Interrelationships Between These Traits in Three Genetic Groups of Native Chickens of Nigeria

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ABSTRACT

The effects of crossbreeding and reciprocal crossing on egg weight, hatch weight and growth pattern was studied in various crossing in three genetic groups (normal feathered, frizzle and naked neck) of the native chickens of Nigeria. The interrelationships between these traits were also determined. There was no significant difference ($p<0.05$) between the main cross and reciprocal crosses in the genetic groups for egg weight and hatch weight of chicks. Similarly, using either the normal feathered or frizzle feather as males in a normal x frizzle feathered cross has no significant variation ($p<0.05$) on post hatch weight gain to 20 weeks of age. However, post hatch weight gain taken 4 weekly to 20 weeks of age varied significantly between pairs of crosses (main and reciprocal) respectively in the normal feathered x naked neck and frizzle feather x naked neck genetic groups. In these genetic groups, using frizzled feathered and naked neck males recorded a significant ($p<0.05$) advantage in post hatch weight gain to 20 weeks of age in the respective breeding groups. Egg weight had a high and significant ($p<0.01$) coefficient of correlation with hatch weight and body weight at 4 weeks of age. Similarly, there was a high and significant coefficient of correlation ($p<0.01$) between body weight at 8 weeks of age and body weights at 12, 16 and 20 weeks of age. Selection for higher body weight birds meant for breeding could therefore be done at 8 weeks to reduce the cost of raising the native birds to sexual maturity before selection.

Key words: Combining ability, growth pattern, sexual maturity, Nigerian chicks

INTRODUCTION

The native chickens of Nigeria have been a focal point for researchers in modern times. Apart from its inherent ability to supply the needed animal protein to Nigerians, it has been shown that the genome of the native fowl is a natural reservoir of some advantageous tropically relevant major genes (Horst, 1988) which are known to have productive and adaptive qualities. These native chickens predominate the Nigerian rural environment where they meet the local protein demand in addition to being a ready source of income to the keepers.

Genetically, the Nigerian local chicken is said to possess a good nicking or specific combining ability which can be used to exploit heterosis (Mohammed *et al.*, 2005). These native birds express diversity in adult body weight, conformation, plumage colour, egg weight, reproductive performance and immune responses to various antigens (Gwakisa *et al.*,1994; Msoffe *et al.*, 2001). The extensive free ranging management system under which they are kept has also exposed them to predators and high incidence of diseases. Survival under the local production system is dependent on the availability of scavengeable feed resources. In addition to these, the native chickens of Nigeria have not been selected along egg or growth lines. The overall cumulative effect of these is the observed low productivity in terms of egg number, egg size, growth and survivability of chicks under the rural production system. Thus, they have not been widely accepted at the commercial level because they have not been improved through purposive selection or breeding programme (Ige *et al*., 2007). One major effort towards improving the productivity of the native chicken has been the importation and distribution of exotic cocks to be used in upgrading the local stock. However, Momoh (2005) noted that the importation of exotic breeds has a downturn on the economy of most developing countries and thus has not favoured livestock and poultry production due to high input requirements, drain on foreign exchange reserve and probably introduction of "*exotic*" diseases which may later become endemic. Thus, the genetically unimproved local chickens have remained predominantly in Nigerian villages (despite the introduction of exotics) where they provide protein for the rural population, create employment and generate family income.

This scenario leaves no other option than to look inwards at the local stock as a means of tackling the endemic animal protein deficiency in the country. Genetic information and careful planning are required to achieve this. The current study is aimed at providing these valuable tools which could be utilized in selection and improvement of the native chickens of Nigeria.

MATERIALS AND METHODS

The study was carried out in Makurdi within the guinea savanna agro ecology of Nigeria. The experimental birds were generated from 180 parent stock hens and 18 cocks obtained from the study environment, stabilized and arranged in a mating ratio of 1:10 cock to hen respectively as shown in Table 1. Eggs were collected daily, weighed and identified based along sire line and breeding group. All eggs were incubated within a maximum period of 7 days post oviposition. Standard incubation management was adapted in the cabinet type electric incubator used. Egg hatching was staggered depending on the batch of incubation. All F_1 pedigreed chicks were identified along sire lines and genetic group and brooded under standard conditions. Brooded chicks were reared to 20 weeks of age during which growth rate was monitored 4-weekly. Routine health management practices typical of the study environment were adapted.

Data on growth were subjected to analysis of variance to test for significant differences between the genetic groups using the SPSS (2004) statistical package. The model fitted was:

$$Y_{ijk} = \mu+g_j+b_i+s_k+e_{ijk}$$

Where:

Y_{ijk} = Observed measure (growth) on an individual bird
μ = Overall mean common to all birds observed
g_j = Random effect of genetic group
b_i = Fixed effect of batch of hatch
s_k = Fixed effect of sex
e_{ijk} = Residual random error

Means were compared using Duncan's New Multiple Range Test (Duncan, 1955).

Table 1: Mating arrangement for generating crossbred chicks

Breeding group	No. of males	No.of females	No.of pens (replicates)	Mating ratio	Genetic group
NF X FF	1	10	3	1:10	Main cross breed (1,2)
FF X NF	1	10	3	1:10	Reciprocal cross breed (2,1)
NF X NN	1	10	3	1:10	Main cross breed (1,3)
NN X NF	1	10	3	1:10	Reciprocal cross breed (3,1)
FF X NN	1	10	3	1:10	Main cross breed (2,3)
NN X FF	1	10	3	1:10	Reciprocal cross breed (3,2)

RESULTS AND DISCUSSION

Table 2 presents the least squares means of egg weights (g) and hatch weights (g) in the genetic groups of the Nigerian local chicken studied. Egg weights and hatch weights were statistically similar ($p>0.05$) between the main and reciprocal crosses in the three genetic groups of the native chickens studied. This presupposes a maternal effect of body weight of dams used on the egg weight and consequently on chick hatch weight. Thus, egg weight is not significantly ($p>0.05$) affected by the genotype of the dam but by its body weight. Peters *et al.* (2007) also in a similar study conducted in Abeokuta-Nigeria reported that there was no significant difference in mean values of egg weight between the frizzle and naked neck chickens. Correspondingly, chick hatch weight observed in the current study is dependent on egg weight.

Table 3 shows the least square means+sem of body weight (g) 4 weekly to 20 weeks of age in the genetic groups of the Nigerian local chicken. Body weight varied significantly ($p<0.05$) between the main cross and reciprocal cross bred between the normal feathered and naked neck and between the naked neck and frizzled genetic groups. Using the normal feathered genetic group either as sires or dams in the mating with the frizzled feathered genotype has no overall significant variation ($p<0.05$) in body weight gain at 20 weeks of age. The significant ($p<0.05$) difference observed in this mating group at the 12th week of age was transient and fizzles out at the 16th and 20th week of age.

There was a significant ($p<0.05$) difference in body weights at all ages evaluated between the main and reciprocal crosses of the normal x frizzled and the frizzled x naked neck genetic groups. Consequently, the normal feathered and naked neck sires should be used in crosses with the frizzled and naked neck genotypes respectively to maximize weights at all ages to 20 weeks of age. This is indicative that these genetic combinations could be developed into meat type chickens.

The interrelationship between egg weight, hatch weight and body weights from 4 to 20 weeks of age is shown in Table 4. There was a high positive significant ($p<0.01$) correlation between egg weight, hatch weight and body weight at 4 weeks of age. The significantly ($p<0.01$) high coefficient of correlation between egg weight and hatch weight and between hatch weight and body weight at 4 weeks of age could be attributed to the maternal effect of egg size. Ajayi *et al.* (2008) in a similar study observed a positive relationship between egg size and chick weight. These authors reported that chick hatch weight as a ratio of egg weight was 74%. This maternal advantage transcends to the fourth week of age and becomes less pronounced at subsequent ages during which the true additive genetic effect on growth comes into play. Thus, subsequent weight gain can be said to be dependent on the genetic potential of the chick and management factors.

Therefore, it is not advisable to select local chicken for growth performance based on hatch weight or weights at 4 weeks of age. A high and positive coefficient of correlation was observed between body weight at 4 weeks of age and at 8 weeks of age. This relationship was however not sustained after 8 weeks of age probably due to different genes or set of genes affecting body

Table 2: Least squares means of egg weights (g) and hatch weights (g) in the genetic groups of the Nigerian local chicken

	Egg weight				Hatch weight			
Genotype	Minimum	Maximum	Mean±SE	CV	Minimum	Maximum	Mean±SE	CV
NF×FF	25.72	44.39	35.13±0.59	4.40	19.06	31.87	25.48±0.40	2.98
FF×NF	29.11	44.39	36.52±0.53	4.05	21.44	32.63	26.51±0.38	2.86
NF×Na	30.52	29.82	35.87±0.25	2.00	22.38	29.39	26.10±0.19	1.51
Na×NF	25.72	47.02	35.51±0.61	4.43	19.06	33.95	25.76±0.43	6.37
FF×Na	34.72	49.28	39.50±0.44	3.47	24.30	36.02	28.61±0.34	2.67
Na×FF	33.38	49.28	39.70±0.59	4.42	24.17	36.02	28.95±0.45	3.37

NF: Normal feathered genotype, FF: Frizzle feathered genotype, Na: Naked neck genotype

Table 3: Least square means±sem of body weight (g) at various ages of the genetic groups of the Nigerian local chicken

Genotype	4 weeks wt.	8 weeks wt.	12 weeks wt.	16 weeks wt.	20 weeks wt.
NF x FF	86.31±0.54^{c}	267.78±3.68^{cb}	620.22±9.99^{b}	819.14±9.39^{b}	1040.52±12.34^{c}
FF x NF	87.18±0.51^{cb}	268.57±3.52^{cb}	608.15±10.13^{c}	821.59±8.83^{b}	1047.45±13.47^{c}
NF x Na	83.57±0.69^{d}	264.11±3.19^{d}	639.49±7.94^{a}	842.29±5.88^{a}	1088.20±12.21^{b}
Na x NF	80.91±0.87^{e}	257.16±3.01^{e}	500.53±7.11^{e}	793.95±5.84^{c}	1017.63±10.79^{d}
FF x Na	91.87±0.78^{a}	283.50±2.41^{a}	526.81±7.84^{d}	734.41±7.38^{d}	1040.49±13.06^{c}
Na x FF	88.29±0.91^{b}	270.13±1.92^{b}	623.18±7.10^{b}	817.42±6.71^{b}	1121.78±9.94^{a}

NF: Normal feathered genotype., FF: Frizzle feathered genotype, Na: Naked neck genotype

Table 4: Correlation coefficient between egg weights (g), hatch weight and weights (g) at different ages in the genetic groups of the Nigerian local chicken

	Egg wt.	Hatch wt.	4 week wt.	8 week wt.	12 week wt.	16 week wt.	20 week wt.
Egg wt.	1	0.983**	0.198**	0.048	0.004	-0.12	0.107
Hatch wt.		1	0.181**	0.33	-0.009	0.087	-0.015
4 weeks wt.			1	0.427**	0.067	0.002	0.053
8 weeks wt.				1	0.405**	0.449**	0.436**
12 weeks wt.					1	0.812	0.487
16 weeks wt.						1	0.622
20 weeks wt.							1

**Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level

weights after 8 weeks of age. A high and positive coefficient ($p<0.01$) of correlation was also noticed between weights at 8 weeks of age and weights at 12, 16 and 20 weeks of age. This is indicative of a strong genetic relationship between genes affecting body weights at these ages. It is therefore possible to predict body weights at subsequent ages from the body weights at 8 weeks of age. The implication to the Animal breeder here is that for purposes of selective breeding, birds could be selected at 8 weeks of age to reduce the cost of raising all birds to sexual maturity before selection.

CONCLUSION

The effects of crossbreeding and reciprocal crossing on egg weight, hatch weight and growth pattern was studied in the normal feathered, frizzle and naked neck native chickens of Nigeria. The interrelationships between these traits were also determined. Both straight cross and reciprocal crossing has no significant effect ($p<0.05$) on egg weight and hatch weight of chicks in the genetic groups of the native chickens studied. However, using frizzled feathered and naked neck males recorded a significant ($p<0.05$) advantage in post hatch weight gain to 20 weeks of age in the respective breeding groups. Egg weight had a high and significant ($p<0.01$) coefficient of correlation with hatch weight and body weight at 4 weeks of age. Similarly, there was a high and significant coefficient of correlation ($p<0.01$) between body weight at 8 weeks of age and body weights at 12, 16 and 20 weeks of age. Selection for higher body weight birds meant for breeding could therefore be done at 8 weeks to reduce the cost of raising the native birds to sexual maturity before selection.

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