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# Short Term Egg Production and Egg Quality Characteristics of Main and Reciprocal Crossbred Normal Local, Naked Neck and Frizzle Chicken X Exotic Broiler Breeder Stock in a Humid Tropical Environment

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**Abstract:** This study was designed to evaluate the effect of main and reciprocal crossbreeding on short term egg production and egg quality characteristics of crossbred Normal Local (NL), naked neck (Na) and frizzle chicken X exotic broiler breeder stock. Result showed that the main crossbreds (ExNL, ExNa and ExF) were significantly ($p<0.05$) lighter in body weight at sexual maturity (960.00, 812.50 and 1030.00 g), respecting than their reciprocal crossbred (NLxE, NaxE and FxE) counterparts with body weights of 1891.67, 1576.50 and 2072.00 g, respectively. The reciprocal crossbreds also had significantly heavier egg weight at first egg and greater egg number (90 days of lay). Shell thickness and yolk weight were not significantly different ($p>0.05$) in all genetic groups while egg length, yolk index, albumen weight and Haugh unit were significantly ($p<0.05$) higher for the reciprocal crossbreds. The frizzled individual in both crosses outperformed their normal feather and naked neck counterparts in body weight and most of the egg traits evaluated thus, indicating that the frizzling gene may be advantageous in poultry production in the humid tropics. Generally, reciprocal crossbreeding resulted in a more rapid improvement of the local chicken body weight, egg production and the egg quality traits studied.

**Key words:** Crossbreeding, local chicken genotypes, major genes, egg traits, maternal effect

## INTRODUCTION

A number of major genes or gene complexes have been identified in the genome of the native fowl of the tropics[1,2]. Prominent among these are the naked neck frizzle and silky genes. These genes are propagated naturally in the Nigerian local chicken population. They have been found to reduce or ameliorate tropical heat stress in individuals possessing them. This characteristic has led to their being referred to as tropically relevant major genes. The thermoregulatory effects of the naked neck and the frizzle genes have been investigated in broiler chicken[3,4] and in egg-type chicken[5-7]. In Nigeria, a study by Ibe[8] showed that randombred naked neck and frizzle local chickens were superior to their normal feathered counterparts with respect to growth performance.

The use of naked neck males in the improvement of body weight, egg production and egg size at ambient temperature of 30°C in some Asian countries has been reported by Yushimura *et al.*[9]. In Bangladesh, Zaman *et al.*[10] mated naked neck (NN) x Rhode Island Red (RIR), NN x Fayoumi, RR x Fayoumi and Fayoumi and reported significant breed effects on most of the egg production traits (age at sexual maturity, egg weight, egg number and rate of lay) and some egg quality parameters (shell thickness, albumen height, yolk colour and Haugh unit). Apart from age at sexual maturity which was significantly better for the naked-neck carrying genotypes, all the other egg production as well as egg quality traits reported were better for either the RIR x Fayoumi or the Fayoumi breed. Conflicting results of this kind demands that more studies be carried out in most parts of the tropics to establish the beneficial effects or otherwise of these genes.

The mating system that results in most rapid improvement of economic (body weight and egg production) traits in crossbred chicken has also suffered similar conflicting reports. For instance, Nwosu and Omeje[11] reported positive and significant heterosis in hen-day egg production in a cross between exotic cocks and the local hens but not in the reciprocal (native cock x exotic hen) crossbreds, while Ude and Omeje[12] reported significant improvement in the same trait in the reciprocal crossbreds.

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The present study was therefore designed to elucidate the effect of main and reciprocal crossbreeding as well as influence of some major genes on short term egg production and egg quality characteristics of $F_1$ crossbred normal, naked neck and frizzle chicken in a humid tropical environment.

## MATERIALS AND METHODS

**Study area:** The research was conducted at the poultry unit of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The study area falls within the rainforest zone of South East Nigeria. It has a bimodal rainfall pattern and total annual rainfall range of 1700-2100 mm. The maximum ambient temperature for the area ranged between 27°C to 36°C during the hot dry period of the year (November-April) and minimum ambient temperature range of 20 to 26°C during the cold rainy season (May-September). The climatic condition of this area has been aptly described as warm-wet or hot-humid tropics.

**Management of foundation stock:** The parent stock utilized in the study were males and females of Normal Local (NL) naked Neck (Na) and Frizzle (F) local chickens maintained at the poultry unit of the University Teaching and Research Farm Umudiike. The exotic broiler (E) breeder stock was acquired from a reportable poultry breeder farm at Owerri in Imo state, Nigeria. The birds were given standard poultry husbandry attention as was available at the University farm.

**Mating system:** The main cross progenies (ExNL, ExNa and ExF) were produced by mating exotic broiler (E) males to Normal Local (NL), naked neck (Na) and Frizzle (F) females while the reciprocal crossbreds (NLxE, NaxE and FxE) were produced by a reverse order mating. There were thus six genetic groups. Artificial insemination was used because of obvious difference in body size between the exotic broiler breeder stock and their local chicken mates. Fertile eggs were collected, identified appropriately and set in the incubator on a weekly basis.

**Management of $F_1$ crossbred chicks:** A total of 216 day-old chicks hatched weekly for seven weeks were utilized in the study. The birds were fed *ad libitum* during the brooding and growing phases while regulated quantities of feed were offered to the birds according to their body weights during lay. Commercial feed (Top feeds brand) were given to the birds during brooding (0-6weeks), rearing (7-20weeks) and laying period (21-36 weeks). Broiler starter mash containing 23% CP, pullet grower mash containing 16% CP and layers mash containing 20% CP were fed, respectively during the above phases of growth.

**Parameters measured:** Body weight of birds at first egg, average age at first egg and short term (90 days) egg production as well as egg quality parameters (egg weight, egg length, shell thickness, yolk weight, albumen weight, yolk index and Haugh Unit) were measured in all genetic groups. Body weight of birds were taken with a sensitive 5000 g coltina-Japanese made top loading scale. Egg weight was determined using mettler electronic balance of 0.01 g sensitivity. Egg length was taken as distance between the broad and the narrow ends of the egg using venier calipers while shell thickness was determined with Ames micrometer screw gauge (Ames 25 M5). Evaluation of yolk and albumen heights was done after the eggs were neatly broken at the middle and the content poured on a petri-dish. The yolk and albumen heights were measured using Ames tripod thickness measure (Ames 5-6418, 0.1 mm). Yolk index was calculated as ratio of yolk height to yolk width while Haugh unit was determined based on albumen height and egg weight using and interior quality calculator for eggs (USDA chart for scoring broken-out egg). All egg quality parameters were determined when the birds had attained at least 60 days in –lay.

**Statistical design and analysis:** The experiment was designed as a Randomized Complete Block (RCB) with genetic group as single factor of interest and hatches as blocks. Means and their standard errors for measured parameters were computed. Data were analysed using Analysis of Variance appropriate for randomised complete block design. Differences in means were detected using Duncan's Multiple Range Test[13].

## RESULTS AND DISCUSSION

The egg production characteristics of the main and reciprocal $F_1$ crosses are presented in Table 1. The main cross hybrids (ExNL, ExNa and ExF) with body weight of 960.00, 812.50 and 1030.00 g, respectively at sexual maturity were significantly ($p<0.05$) lighter than their reciprocal cross counterparts (NLxE, NaxE and ExE) which had body weights of 1891.67, 1576.50 and 2072.00 g, respectively. The body weights of the main cross hybrids fall within the range of body weights reported by Nwosu and Asuquo[14] for normal feather local chickens and Ibe[8] for randombred normal, naked neck and frizzle local chickens. The reciprocal crossbreds on the other hand had heavier body weights tending towards the weight for their exotic dam. This indicates evidence of maternal influence on body weights of these crossbred chickens. The implication of this observation is that the main cross individuals could be used to develop potential egg-laying lines or strains while the reciprocal crossbreds which were

Table 1: Egg production characteristics of main and reciprocal crossbred normal, naked neck and frizzle chickens

| | Main crosses | | | Reciprocal crosses | | |
|---|---|---|---|---|---|---|
| Parameters | ExNL | ExNa | ExF | NLxE | NaxE | FxE |
| Av. body wt. at | 960.00$^{e}$ | 812.50$^{e}$ | 1030.00$^{d}$ | 1891.67$^{b}$ | 1576.50$^{c}$ | 2072.00$^{a}$ |
| sexual maturity (g) | (29.15) | (55.43) | (39.97) | (76.59) | (43.3) | (49.50) |
| Av. age at sexual | 170.00$^{b}$ | 162.00$^{b}$ | 186.18$^{a}$ | 158.33$^{c}$ | 157.00$^{c}$ | 182.75$^{a}$ |
| maturity (days) | (2.30) | (8.82) | (2.01) | (1.20) | (1.73) | (20.21) |
| Av. egg wt. at | 26.44$^{bc}$ | 27.15$^{b}$ | 28.12$^{b}$ | 32.33$^{a}$ | 34.33$^{a}$ | 33.88$^{a}$ |
| 1st Egg (g) | (0.53) | (0.50) | (0.71) | (0.28) | (0.88) | (0.50) |
| Short-term | 25.40$^{c}$ | 29.05b$^{c}$ | 31.50$^{b}$ | 39.15$^{a}$ | 41.00$^{a}$ | 32.83$^{b}$ |
| egg No. | (1.10) | (0.55) | (0.35) | (2.77) | (1.52) | (0.90) |

$^{a-e}$Means in the same row with different superscripts are significantly different ($p<0.05$). Standard error of means (S.E.M) in parentheses

Table 2: Egg quality characteristics of main and reciprocal crossbred normal, naked neck and frizzle chickens

| | Main crosses | | | Reciprocal crosses | | |
|---|---|---|---|---|---|---|
| Parameters | ExNL | ExNa | ExF | NLxE | NaxE | FxE |
| Av. egg wt. (g) | 36.26$^{cd}$ | 38.13$^{d}$ | 35.33$^{d}$ | 41.89 $^{b}$ | 42.53$^{b}$ | 44.00$^{a}$ |
| | (0.85) | (1.04) | (0.93) | (0.88) | (2.68) | (1.38) |
| Egg length (mm) | 48.76$^{b}$ | 51.88$^{a}$ | 48.73$^{b}$ | 50.62$^{a}$ | 50.52$^{a}$ | 52.41$^{a}$ |
| | (0.68) | (0.25) | (0.48) | (0.38) | (3.57) | (0.58) |
| Shell thickness (mm) | 0.31 | 0.30 | 0.33 | 0.31 | 0.34 | 0.30 |
| | (7.30) | (7.07) | (4.90) | (4.60) | (7.50) | (3.05) |
| Yolk weight (g) | 10.22 | 10.75 | 10.54 | 10.79 | 10.78 | 11.90 |
| | (0.48) | (0.91) | (0.46) | (0.66) | (0.78) | (0.47) |
| Yolk index | 0.52$^{b}$ | 0.52$^{b}$ | 0.54$^{ab}$ | 0.52$^{b}$ | 0.59$^{a}$ | 0.54$^{ab}$ |
| | (1.01) | (3.60) | (1.28) | (2.21) | (2.52) | (5.63) |
| Albumen wt. (g) | 18.30$^{c}$ | 21.45$^{b}$ | 18.72$^{c}$ | 25.12$^{a}$ | 26.17$^{a}$ | 27.21$^{a}$ |
| | (1.14) | (0.64) | (0.79) | (0.70) | (1.88) | (1.29) |
| Haugh unit | 101.72$^{bc}$ | 105.22$^{a}$ | 100.25$^{c}$ | 104.00$^{ab}$ | 103.00$^{b}$ | 106.29$^{a}$ |
| | (0.81) | (1.86) | (0.46) | (1.98) | (1.78) | (0.62) |

$^{a-d}$Means in the same row with different superscripts are significantly different ($p<0.05$). Standard error of means (SEM) in parentheses

heavy could be used to develop dual purpose or meat-type chickens. In poultry, reciprocal effects in crosses have been detected for egg production, egg quality, sexual maturity and viability traits[15]. This phenomenon in poultry are thought to originate form sex-linked genes and/or material effects[16]. This depicts that the dam line is very important in practical poultry breeding.

Table 1 also shows age at sexual maturity for the various genetic groups. The frizzled individuals in main and reciprocal crosses which had the highest body weight in their respective groups also had delayed age at sexual maturity (186.18 and 182.75 days), respectively. This observation is consistent with the reports of Ramappa *et al.*[17,18] that within the same level of management, genetically heavier birds attain sexual maturity later than light bodied ones. It was also found that average egg weight at first egg for the reciprocal crosses were significantly ($p<0.05$) higher when compared with their main cross counterparts. This observation corroborates the heavier body weights recorded for reciprocal crosses and therefore supports the reports of Duplessis and Erasmus[19] which showed that bigger birds normally laid larger eggs than those with smaller body weights.

Reciprocally crossed neck (NaxE) individuals showed some outstanding egg production characteristics as seen Table 1. They had earliest age to sexual maturity (157.00±1.73 days), highest average egg weight at first egg (34.33±8.00) and highest short term egg number (41.0±1.52 eggs) within 90 days of lay. This observation, coupled with their lighter body weight at on-set of lay present this genetic group as a potential egg-laying line. This improve egg production performance for the naked neck genotype notwithstanding, effort should be made to improve on their reported poor disease resistance and liveability problems[20,21].

Table 2 presents egg quality characteristics of the main and reciprocal $F_1$ crosses. The egg weights taken at 60 days of lay were significantly ($p<0.05$) bigger for the reciprocal crossbreds. Among the reciprocal crosses, FxE genetic group had average egg weight of 44.00±1.38 g, which was significantly higher than average egg weights of 42.53±2.68 g and 41.89±0.88 g, for NaxE and NLxE, respectively. This further confirms the superiority of the frizzle genotypes over the naked neck and normal feather individuals for body weight as seen in Table 1. This observation agrees with the view that a high positive correlation exists between body weight and egg weight in chicken as reported by Ayorinde *et al.*[22].

Apart from shell thickness and yolk weight which were not significantly different ($p>0.05$) in all genetic groups, the reciprocal crossbreds generally had significantly ($p<0.05$) higher values of the egg quality parameters studied. This observation is in line with the reports of Richlefs[23] that larger body sized birds had larger egg length, egg width and better internal egg qualities than lighter body sized ones. The Haugh unit values obtained for the various genetic groups were all high, indicating that the eggs produced by these crossbreds were of good quality.

## CONCLUSION

It is evident from the present study that maternal environment (body size and egg size of dams) influenced body weights attained by these $F_1$ crossbred chicken. Main and reciprocal crossbreeding influenced the egg-laying and egg quality characteristics of the birds with the reciprocal crossbreds performing better in most parameters evaluated. Among the genetic groups, the frizzled individuals (ExF and FxE) within their respective breeding groups showed superiority in body weight and in most egg production parameters studied. This seems to suggest that the frizzled chickens were better adapted to their humid tropical environment. In general, reciprocal crossbreeding resulted in progenies which had rapid improvement in body weight and in those egg production and egg quality characteristics associated with body weight in the chicken.

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