Evaluation of growth and reproductive traits of Nigerian local chicken and exotic chicken

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ABSTRACT
An experiment was carried out to evaluate some reproductive and growth traits of Nigerian indigenous light ecotype and exotic chicken for possible egg and meat-type chicken development. This study was undertaken to contribute to the genetic improvement of the Nigerian indigenous chicken by crossing with an exotic egg type strain Isa Brown. The birds were arranged in 3 breeding groups: BG₁ (Local cocks (EC) X Exotic females (EF)), BG₂ (exotic cocks (EC) X local females (LF)) and BG₃ (local cocks (LC) X local females (LF)). The hens were subjected to natural mating and eggs laid were collected according to breeding groups and hatched. The offsprings that were generated were used for growth performance studies. Data collected were subjected to analysis of variance. Results indicated significant (P<0.05) effect of genotype on fertility and hatchability of eggs. Percentage fertility across the genotypes were 70.00, 72.60 and 82.00, while hatchability was 69.70, 84.00, and 60.97%, for BG₁, BG₂ and BG₃ respectively. The cross bred (BG₁ and BG₂) had higher egg weight (60.42g, 51.40g), than BG₁ (38.64g). There was significant effect (p<0.05) in all the weekly body weights studied. The findings showed that breeding local pullets with local cocks, improved fertility while hatchability were improved by breeding local pullets with exotic cock. Body weights of chicks hatched from eggs of the exotic pullets with local cock were better than the other groups. Exotic chickens are recommended for the improvement body weight of the light ecotype chicken in Nigeria.

Key words: Body weight, Exotic, Fertility, Hatchability, Indigenous.

INTRODUCTION
Poultry eggs constitute one of the most valuable sources of animal protein recommended for human consumption, and offer means of solving the problems of animal protein shortage especially in the rural areas in many African countries (Olawoyin, 2006). Fertility, hatchability, egg production and growth are economically important traits in local poultry production systems, since the developed chickens are kept for both meat and egg production. Breeders usually aim at conserving and increasing the productive efficiency of native chickens genetically for economic traits (R.Sh., 2014). High fertility and hatchability of eggs of breeder stock and survivability of the chicks is necessary to produce large numbers of birds. This would augment the grossly inadequate protein supply of developing countries like Nigeria (Nse Abasi et al., 2014). The supply of day-old chicks is very important for the success of the poultry production chain (King’ori, 2011). Fertility and hatchability are two major parameters that highly influence the demand for day-old chicks. Fertility refers to the percentage of incubated eggs that become fertile while hatchability is the percentage of fertile eggs that hatch (Wondmeneh et al., 2006; King’ori, 2011).

In Nigeria, the local chickens are widely distributed in the rural areas, where they are kept by the natives, principally as a source of protein and income. Egahi et al. (2010) noted that the local chicken has unique adaptive features predispose it to adapt to the local environment better than their exotic contemporaries. Olawoyin (2006) suggested that genetic improvement of Nigerian indigenous chickens can help to alleviate the problems of animal protein shortage especially in the rural areas. The Nigerian indigenous chickens are suitable for the development of layer strains for the tropical environment (Adekunle, 2012). This can be attributed to their possession of inherent advantages which include better flavour of meat and egg, high degree of adaptability to
prevailing condition, high genetic variance in their performance, hardness, disease tolerance, ease of rearing and ability to breed naturally (Ige, 2013).

Reports have also shown that the indigenous chicken possesses great potentials for genetic improvement through breeding programmes such as selection and/or cross breeding (Nwosu et al., 1983; Nwosu and Omeje, 1985; Ikeobi et al., 1996; Adebambo et al., 1999; Peters et al., 2004; Adeleke et al., 2004, Adebambo et al., 2009). Cross breeding of the local stock with an exotic commercial stock could take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds (Adebambo et al., 2009).

Furthermore, birds with better production performance can result from the combined ability of best performing exotic lines and the indigenous chicken. Exploring the potentials of the Nigerian indigenous light chicken ecotype through cross breeding will not only lead to improvement of the local chicken but also reduction of the cost of importation of day-old chicks and breeder stock which are costly to manage, especially in Nigeria. This work was designed to evaluate growth and some reproductive traits of crosses of the exotic Isa Brown strain and the Nigerian local light ecotype chicken reared in the derived savannah zone of Nigeria.

MATERIALS AND METHOD
Location of the study: The experimental birds were housed in the Poultry unit of Department of Animal Science Farm, University of Nigeria, Nsukka (UNN). Nsukka is located on latitude 05°22' North and longitude 07°24' East with annual rainfall ranging from 986 to 2098mm. The natural day length for Nsukka is 12-13 hours and average annual maximum and minimum temperatures are 29.7°C and 21.0°C, respectively. The relative humidity ranges from 34 to 78% (Momo et al., 2010).

Breeding design and management of experimental birds: Seventy Nigerian indigenous light chickens ecotype (10 males and 60 females) and thirty five exotic Isa Brown chickens (5 males and 30 females) at point of lay, were randomly selected from existing populations and allowed to mate naturally in separate pens at a mating ratio of 1 male to 10 females. The birds were randomly allotted into three breeding groups identified as: BG1 (LCB♂ X EF♀), BG2 (EC♂ X LF♀) and BG3 (LC♂ X LF♀). The birds were fed commercial layers diet (18% crude protein and 2750ME Kcal/Kg daily on an ad libitum feeding regime. Clean drinking water was also provided. Necessary medications and vaccinations were administered to ensure good health and improve egg production, fertility and hatchability. Cocks were allowed to run with the hens for two weeks before egg collection commenced.

Hatchable eggs were collected daily; they were identified according to breeding group and stored in a cool room for 7days at temperature of 10-14°C and relative humidity of 75-80%. The eggs were fumigated and set in different trays (with respect to the breeding groups) in the incubator. Eggs were candled to check on 18th day of incubation. On hatching, the chicks were weighed, wing banded, brooded for 4 weeks and, thereafter, transferred to rearing pens where they were raised for 12 weeks. The birds had free access to feed (starter and grower’s mash) and water. Necessary medications and vaccinations were administered in addition to proper management practices.

Data collection and Statistical analysis: Weight of the eggs laid was measured on daily basis using a sensitive electronic balance (600g capacity). The percentage fertility was calculated by expressing the total number of fertile eggs as a percentage of the total number of eggs set while the percentage hatchability was determined by expressing the total number of hatched chicks as a percentage of total number of fertile eggs. Weight of each chick was taken at day-old and subsequently monthly.

Data collected were analysed for the effect of genotype using analysis of variance procedure and significant means separated by Duncan’s New Multiple Range Test procedure (SPSS, 2013).

Experimental design: The experiment was carried out using completely randomized design (CRD). The model was as follows: \[ X_{ij} = \mu + T_i + e_{ij} \]

where \( X_{ij} \) is the overall observation (egg weight, fertility, hatchability, and body weight), \( T_i \) = effect of the \( i \)th genotype (i=1, 2, 3) \( \mu \) = population mean \( e_{ij} \) = Random error

RESULTS AND DISCUSSION
Mean egg weight: The mean egg weight of BG1 (60.00g), BG2 (51.40g) cross bred hens laid significantly (P<0.05) heavier eggs than the pure line BG3 (38.64g) (Table 1). The mean egg weight reported in this study ranged between 38.64 to 60.00g. The egg weight (38.64g) obtained for BG3 genotype was lower than the average egg weight of 52.81g for indigenous Venda chicken of Mbajorgu (2011) and 54.60g of egg weight for broiler chicken eggs reported by Ramaphala and Mbajorgu (2013). The lowest egg weight recorded by the light ecotype chicken might have been due to their small body size which affected the egg size and to non genetic and
Fertility and hatchability: Effect of genotypes on percentage fertility in progenies of Nigerian indigenous light ecotype and Isa Brown chicken are shown on table 1. Fertility was significantly (P<0.05) influenced by genotypes. Higher percent fertility was observed in BG1 (82.00 %) compared to those of cross bred BG2 (72.60 %) and BG3 (70.00 %). This could be due to the fact that the local cock and local pullets were well adapted to the environment as a result of inherent advantage that they posses. These results were in agreement with report by (El-Gendy, 2000; Hanafi and Iraqi, 2001), who recorded fertility ranging from 63.6 to 96.7% in Native breeds. Similar result was obtained by Dessie and Ogle (2001) Ethiopian local purebred. The implication of this result is that, higher percent fertility is achieved in local stocks more than the exotic in this study area. This result disagrees with that of Sola-Ojo and Ayonide (2011), who reported lower fertility for local Fulani ecotype x local Fulani ecotype and attributed it to some non-genetic factors imposed on the birds during the experimental period.

Peters et al. (2004) stated that the local hens can favourably compete with their exotic counterparts in the tropics in terms of fertility and egg production. The authors suggested that genotype-environment interaction could play a major role in the potency of the sperm of the local chicken sire. Also, the higher performance of the local chicken over the exotic chickens in terms of fertility is said to be environmentally influenced. The findings of Malago and Baitilwake (2009) revealed a non significant variation in fertility between the local chicken, Rhode Island Red and their crossbred (92, 91.1 and 94.5%, respectively).

Data reveals that hatchability (Table 1) were significantly (P<0.05) different among the genetic groups. BG1 had the highest percentage hatchability (84.00) while BG3 had the lowest (60.97%). These results are within the range that reported by Zaky (2005) and R.Sh (2014), who found that hatchability percentages ranged from 61.2 to 86.7 %. Malago and Baitilwake (2009) obtained a significantly (p<0.05) lower hatchability in the local chicken (52.2%) when compared to their exotic and crossbred counterparts. The result of the present study is close to 69.30% hatchability obtained by Daikwo et al. (2011) in a population of Dekina local chickens. Perhaps, this could be attributed to the relationship between egg weight and hatchability. Gonzales et al. (1999) reported that, it is preferable to have egg of average weight to achieve good hatchability as far as chicken is concerned. This is probably because breed has little effect on hatchability of poultry eggs. Nwosu and Omeje (1985) reported that the local chicken is seen as a genetic raw material for layers breeding in Nigeria if appropriate genes can be transferred from exotic strains into local chicken population.

Although hatchability is a function of fertility in this report, the percentage fertility which was highest for BG1 (LC X LF) turned around to record the lowest percentage hatchability. The result is not surprising since investigations had established the relationship between egg weight and hatchability. Gonzales et al. (1999) reported that, it is preferable to have egg of average weight to achieve good hatchability as far as chicken is concerned. This is probably because breed has little effect on hatchability of poultry eggs. Peters et al. (2004) reported that hatchability has been found to be influenced by physiology, egg size, nutrition, genotype and possession of major genes. Hatchability for small eggs

<table>
<thead>
<tr>
<th>Traits</th>
<th>Genotype</th>
<th>BG1 (Local female line)</th>
<th>BG2 (Local female line)</th>
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</thead>
<tbody>
<tr>
<td>Egg weight</td>
<td>60.42 ± 0.32 ‚</td>
<td>51.40 ± 2.26 ‚</td>
<td>38.64 ± 1.41 ‚</td>
</tr>
<tr>
<td>Fertility %</td>
<td>70b</td>
<td>72.60 b</td>
<td>82.00</td>
</tr>
<tr>
<td>Hatchability</td>
<td>69.70 b</td>
<td>84.00</td>
<td>60.97 b</td>
</tr>
<tr>
<td>W0</td>
<td>38.60 ± 0.32 b</td>
<td>36.58 ± 0.22 b</td>
<td>30.11 ± 0.12 *</td>
</tr>
<tr>
<td>W 4</td>
<td>350 ± 0.12 c</td>
<td>240 ± 0.10 b</td>
<td>215±0.56 *</td>
</tr>
<tr>
<td>W 8</td>
<td>702 ± 0.42 c</td>
<td>559 ± 0.26 b</td>
<td>404 ± 0.11</td>
</tr>
<tr>
<td>W12</td>
<td>1000.00 ± 0.26 c</td>
<td>920 ± 0.16 b</td>
<td>889 ± 0.45</td>
</tr>
</tbody>
</table>

W0 = body weight at hatch.
W4 = body weight at 4 weeks of age,
W8 = body weight at 8 weeks of age.
W12 = body weight at 12 weeks of age.
is lower compared to that of medium and large eggs. Sola-Ojo and Ayorinde (2011) reported many factors contributing to the failure of a fertile eggs to hatch which include insufficient nutrients in the egg, egg storage duration and conditions. King’Ori (2011) reported other factors that might have caused significant differences in hatchability include health, nutrition and age of the flock and egg size.

Contrary to the present findings, very high hatchability percentage value ranging from 90.89 - 92.43% was observed in the COBB 500 broilers chicken study of Ramaphala and Mbajorgy (2014). The improved percentage hatchability value associated with COBB 500 broilers chicken could be attributed to their genetic make up for better reproductive ability than the light ecotype local chicken which according to Momoh and Nwosu (2008) has not been described, nor selected and termed it a “neglected child”. Higher percentage hatchability has been reported for local chicken by Momoh et al. (2004) in basket incubation in the light ecotype Local chickens in Nigeria.

Body weight: The mean growth performance of the offspring of the breeding groups is shown in Table 1. Day-old body weight of BG, progenies (38.60g) was significantly (p<0.05) heavier than those of BG (36.58g) and BG (30.11 g). The superiority in weight could be traced to the egg size (weight) of BG. Woaanski et al. (2006). reported that heavier eggs contain more nutrients than small or medium seized eggs and as a result, chickens from heavier eggs tend to have more yolk attachment at hatching. This yolk is utilized by the chick after hatching and the chicks depend on the quantity and quality of this yolk. Generally, there was significant difference (P<0.05) in genotype effect on all the body weight traits studied with birds from genotype BG, having the heaviest (p<0.05) weight at 4, 8, and 12weeks. This observation is not unexpected since it is known that a strong and positive correlation exists between egg weight and chick hatch-weight in chickens. The superiority exhibited by the BG suggests that it has better growth potentials than the others. This is probably due to the fact that the exotic has gone through selection for growth rate while the Nigerian local chickens have not gone through selection for the traits studied. This could also be attributed to additive genetic merit and non-additive heterosis effects from crossbreeding local and exotic stock.

The genotype effect observed in this experiment corresponds with findings of Nwagu et al. (2001); Sola-Ojo and Ayorinde (2011) where the genotype of the crossbred was superior to that of purebred local chickens. Momoh et al. (2010) attributed the significant inferior weight of the light ecotype chicks when compared with the heavy crossbred mainly to the maternal influence due to egg size. The heavier eggs, from which the exotic chicks were hatched, were larger than those of the light ecotypes, from which the light ecotype and the main cross chicks were hatched. It has been reported (Omeje, 1983; Asuquo and Okon, 1993; Adedokun and Sonayia, 2001) that hatching weights as well as body weight at 4 weeks and 8 weeks are influenced by mature egg weight. Furthermore, these body weight differences at different ages and in different genetic groups could form basis for selection for higher body weights in the local chicken.

Mortality: There were no significant (p>0.05) genotype effect on mortality. The mortality rate was very low. Low mortality in all the genotype showed that management of the birds were good and secondly the purebred and the cross bred adapted favourable to the environmental condition of Nsukka.

CONCLUSION

The results of this study revealed that, crossing with the indigenous stock as males and the exotic dams, yielded better results especially in egg weight, hatchability and body weight, while crossing the purebred local chickens improved led to higher fertility. The conclusion from this study is that sorting eggs according to weight and genotype before incubation might be advantageous in obtaining higher day-old chick weight in pure and crossbred chickens. Therefore, this study recommends crossbreeding of the Nigerian indigenous light ecotype chicken with Isa brown to improve the productive efficiency of the Nigerian indigenous light ecotype chicken.

REFERENCES


