Effects of Genotype and Housing on Reproductive Performance of Two Strains of Commercial Layers in the Derived Savannah Zone of Nigeria

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Abstract
This study was conducted to determine the more efficient and highly productive strain of commercial layers and the more suitable housing (cage or floor) type to adopt for increased production in the Derived Savannah zone. Data on Isa Brown (IB) and Dominant Black (DB) layer strains were used for this study and traits considered are egg production, mortality rate and feed efficiency. Breed had highly significant (P<0.01) effect on egg production. IB genotype recorded 5.14±0.09 eggs/bird/week and was superior to DB which had 4.61±0.09 eggs/bird/week. Housing had no significant (P>0.05) effect on egg production. As regards mortality rate, both breed and housing had no significant (P>0.05) effect on this trait. Pertaining to feed efficiency, there was highly significant (P<0.01) effect of breed on this important productive trait. IB genotype recorded 0.006±1.0x10^{-4}/bird/week and was superior to DB which had 0.005±1.0x10^{-4}/bird/week. However, no significant (P>0.05) effect of housing on feed efficiency was indicated in this study. There was also no significant (P>0.05) breed x housing interaction effect on all these traits. The result indicated that IB was better, feed efficient and more productive than DB and that given a favourable environment and good management, any housing type adopted will give a satisfactory result. It is concluded from this study that proper management of birds will ensure improved performance regardless of housing type used for laying birds. In addition, it is suggested that for egg production in the Derived Savannah zone, IB genotype could be used.

Keywords: Breed, feed, egg, mortality, trait

Introduction
Poultry meat and eggs are sources of high quality animal proteins which when consumed regularly can mitigate the deficiency symptoms associated with starchy foods commonly taken by the majority of the citizens in the developing world. In addition, Otchere et al. (1990) posited that poultry production serves as a means of income generation and employment opportunities. An improvement in poultry production therefore, would bring about remarkable development of the poor impoverished segment of the society (Permin et al., 2000, Gueye, 1998). There are genetic and non-genetic factors affecting the productivity of laying birds. On breed effect, Duduyemi (2005) found no significant effect of breed on egg production while Yakubu et al.
(2007) and Majaro (2001) reported significant effect of breed on egg production and mortality rate. Moreover, Gwaza and Egahi (2009) reported significant effect of breed and age at peak production on egg production in a farm consisting of four strains of layers. Differences in production among breeds reported in literature were as a result of differences in genetic make-up of these birds. Abdel-Rahman (2000) reported that naked neck genotype was superior to full feathered mates in egg production, sexual maturity, mortality rate and feed efficiency. On housing effect, Abdel-Rahman (2000) reported that caged birds produced more (P<0.05) eggs than the floor hens and that the mortality rate was significantly lower in the cage system than the floor. There are three basic types of housing or confinement for chickens and they are deep litter, slatted floor and battery cages (Bogart and Taylor, 1983) and these provide protection from physical hazards, rain and extremes of heat and cold (Penda, 1985). The advantages of cage system over others include optimum use of land and labour, lesser incidence of feed wastages, reduced rate of egg eating and feather pecking and production of clean eggs. Yakubu et al. (2007) reported significant breed differences in egg production and mortality rate and that caged birds performed better (P<0.05) in hen-housed egg production, egg weight and mortality rate than floor birds. Similarly, Ayorinde et al. (1999) and Muthusamy and Viswariathan (1998) reported the superiority of cage birds in terms of egg production while Ayorinde et al. (1999) found out that cage birds had significantly higher feed efficiency, egg weight and lower mortality rate when compared to deep litter system. In contrast, Akinokun and Benyi (1985) did not find any significant effect of housing on egg production, egg weight, feed efficiency, shell thickness and livability but that housing affected the body weight of the birds. In addition, Yakubu et al. (2007) reported significant genotype x housing, genotype x season and housing x season interaction effects on egg production and mortality rate. Confinement or space restriction is now a contentious issue in advanced nations but in the developing world, the demand for battery cage is on the increase due majorly to the aforementioned advantages of cage system over others. Floor eggs when in contact with the faeces according to Souza et al. (2002) are contaminated by the bacterial which entered through egg pores thereby lowering the quality of floor eggs. The present study was undertaken to determine the effects of genotype and housing system on egg production, feed efficiency and mortality rate of exotic commercial layers under tropical conditions of Southwest, Nigeria.

Materials and Methods
Study location: The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, University of Ado-Ekiti between February 2008 – August 2008. Ado-Ekiti is situated along latitude 7°31’ and 7°49’ North of the Equator and longitude
The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

Management and Experimental birds: The two breeds raised are Isa Brown (IB) and Dominant Black (DB). One hundred (100) day-old chicks of each breed were purchased from local hatcheries and reared under the same housing and management conditions. Each breed was housed in standard, well constructed open-sided but separate pens (deep litter) from day-old till the commencement of laying. Cleanliness and other sanitary measures such as removal of caked or wet litters were carried out at regular intervals. The birds were vaccinated against Newcastle, Fowl pox and other viral diseases while antibiotics were administered on regular basis. They were dewormed and given vitamins at regular intervals. At 5% production, layers mash was introduced and given ad libitum containing 2650Kcal ME/kg and 16.5% CP fortified with micronutrients. Fresh, clean water was given everyday. Debeaking was carried out at the commencement of egg production in order to reduce the incidence of egg cannibalism and pecking. At 47th week of age, the experimental birds were divided, randomly selected and those for the cage (two-tier cage) were transferred there while their mates remained on the floor for comparison of their performance. The ones transferred to the cage were given some days to acclimatize and adapt to the new housing environment before we began our data collection on them. The experimental birds housed in the cage and on the floor were subjected to same treatments and their production cycle covered both dry and wet seasons and were carefully monitored so as to obtain an unbiased data. The data collected lasted to 76 weeks of age from 48th week inclusive (29 weeks). Daily records of eggs produced, feeds consumed and mortality from 48th week till the end of the experiment, that is, 76th week (29 weeks) were registered and used for this study. Feed efficiency refers to the ratio of hen-day egg production to feed (gm) consumed, that is,

Feed efficiency (FE) = hen-day eggs/bird/week / Feeds (gm)/bird/week

The higher the FE value, the higher the efficiency of the birds in converting feeds to eggs or meat, that is, the better the performance of the birds.

The appropriate statistical model used was:

\[ Y_{ijk} = \mu + G_i + H_j + \varepsilon_{ijk} \]

\[ Y_{ijk} = \text{observation of the } k^{th} \text{ population, of the } j^{th} \text{ housing and } i^{th} \text{ genotype} \]

\[ \mu = \text{common mean} \]

\[ G_i = \text{fixed effect of } i^{th} \text{ genotype (i=2)} \]

\[ H_j = \text{fixed effect of } j^{th} \text{ housing (j=2)} \]

\[ \varepsilon_{ijk} = \text{random error normally and independently distributed with zero mean and common variance}. \]
**Data analysis:** The data were subjected to analysis of variance (ANOVA) and Duncan New Multiple Range Test (DMRT) to determine the differences between means of breed, feed efficiency and mortality rate using SAS (2001) computer package.

**Results and Discussion**

**Effect on Egg Production**

The least square means showing the effect of genotype on egg production was presented in Table 1. There was highly significant (P<0.001) effect of breed on egg production of commercial layers. Isa Brown (IB) recorded 5.14±0.09 eggs/bird/week and was superior to Dominant Black (DB) with 4.61±0.09 eggs/bird/week regardless of the housing system. That is, IB birds in the cage and on the floor produced at least 5 eggs/bird/week while DB hens in the two housing systems had at least 4 eggs/bird/week. This implies that IB genotype was more productive and efficient converters of feed to eggs than DB genotype. The obtained result agrees with the findings of Yakubu *et al.* (2007) and Majaro (2001) who reported significant effect of breed on egg production. In contrast, Olawumi *et al.* (2008) reported no significant effect of breed on egg production of White Plymouth Rock and Barred Plymouth Rock layer breeders. Between naked neck and full feathered birds, Abdel-Rahman (2000) also reported significant breed effect on egg production and his findings are in conformity with the present study. Genetic variation in egg production as revealed in this study could be attributed to differences in genetic make-up of the two breeds and not due to any environmental factors because the birds were of the same age, reared under the same housing environments and subjected to the same feeding and management practices. This obtained result also confirmed the findings of Olawumi and Adeoti (2009) who reported that brown feathered birds are more productive than black feathered birds.

The least square means showing the effect of housing on egg production was shown in Table 1. There was no significant (P>0.05) effect of housing on egg production regardless of individual breed performance. That is, both IB and DB genotypes on the floor and in the cages performed equally well and no housing system is superior to the other. Birds in the cage produced 4.89±0.09 eggs/bird/week while the ones on the floor had 4.85±0.09 eggs/bird/week and were similar. The result was consistent with the findings of Akinokun and Benyi (1985) but contradicted those of Abdel-Rahman (2000) and Yakubu *et al.* (2007) who reported significant housing effect on egg production of commercial layers. It is observed that improved management practices coupled with well balanced feeds will produce good results in whatever housing system we employ to raise the laying birds. It is concluded that both cage and deep litter systems are good
and profitable provided a favourable environment and optimum management practices are put in place. There was no significant (P>0.05) genotype x housing interaction effect on egg production and this contradicted the report of Yakubu et al. (2007) who reported significant genotype x housing interaction effect on egg production.

Table 1: Least square means showing the effect of breed and housing on egg production

<table>
<thead>
<tr>
<th>Factors</th>
<th>N.(weeks)</th>
<th>LSQ</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isa Brown</td>
<td>58</td>
<td>5.14</td>
<td>0.09a</td>
</tr>
<tr>
<td>Dominant Black</td>
<td>58</td>
<td>4.61</td>
<td>0.09b</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cage</td>
<td>58</td>
<td>4.89</td>
<td>0.09a</td>
</tr>
<tr>
<td>Floor</td>
<td>58</td>
<td>4.85</td>
<td>0.09a</td>
</tr>
</tbody>
</table>

a,b- means in columns with different superscripts are significantly different

Table 2: Least square means showing the effect of breed and housing on mortality rate

<table>
<thead>
<tr>
<th>Factors</th>
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<th>LSQ</th>
<th>SE</th>
</tr>
</thead>
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<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isa Brown</td>
<td>58</td>
<td>0.069</td>
<td>0.05a</td>
</tr>
<tr>
<td>Dominant Black</td>
<td>58</td>
<td>0.103</td>
<td>0.05a</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cage</td>
<td>58</td>
<td>0.052</td>
<td>0.05a</td>
</tr>
<tr>
<td>Floor</td>
<td>58</td>
<td>0.121</td>
<td>0.05a</td>
</tr>
</tbody>
</table>

a,b- means in columns with common superscripts are not significantly different

Table 3: Least square means showing the effect of breed and housing on feed efficiency

<table>
<thead>
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<th>Factors</th>
<th>N.(weeks)</th>
<th>LSQ</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isa Brown</td>
<td>58</td>
<td>0.006</td>
<td>1.1 x 10^{-4a}</td>
</tr>
<tr>
<td>Dominant Black</td>
<td>58</td>
<td>0.005</td>
<td>1.1 x 10^{-4b}</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cage</td>
<td>58</td>
<td>0.006</td>
<td>1.1 x 10^{-4a}</td>
</tr>
<tr>
<td>Floor</td>
<td>58</td>
<td>0.006</td>
<td>1.1 x 10^{-4a}</td>
</tr>
</tbody>
</table>

a,b- means in columns with different superscripts are significantly different

Effect on Mortality Rate

The least square means showing the effect of genotype on mortality rate was presented in Table 2. There was no significant (P>0.05) effect of breed on mortality rate. IB
recorded 0.069±0.05/breed/week while DB had 0.103±0.05/breed/week regardless of the housing type. It could be said that the two breeds are adaptable and good for rearing in this zone judging by their lower mortalities during both wet and dry seasons of the observed period. The result was inconsistent with the findings of Abdel-Rahman (2000) and Yakubu et al. (2007) who reported significant breed differences on mortality rate. Mortality rate or survivability of a breed is a measure of its hardiness or disease resistance, having low heritability value and influenced largely by the environment.

Furthermore, the least square means showing the effect of housing on mortality rate was presented in Table 2. There was no significant (P>0.05) effect of housing on mortality rate regardless of the breeds’ performance. That is, cage birds recorded 0.052±0.05/week and floor hens had 0.121±0.05/week and were similar. The result in this study agrees with that of Akinokun and Benyi (1985) but contradicted Abdel-Rahman (2000) and Yakubu et al. (2007) who both reported significant housing effect on mortality rate. The result indicates that improved management practices and good feeding coupled with optimum health care will ensure top performance of layers irrespective of housing system used. There was no significant (P>0.05) breed x housing interaction effect on mortality rate and this was not in agreement with Yakubu et al. (2007).

**Effect on Feed Efficiency**

The least square means showing the effect of genotype on feed efficiency was presented in Table 3. There was highly significant (P<0.001) effect of breed on feed efficiency. IB recorded 0.006±1.0x10^-4/week and DB had 0.005±1.0x10^-4/week. IB genotype was superior to DB in terms of feed efficiency regardless of housing system. This implies that the former was more efficient in feed conversion to eggs than the latter. The obtained result corroborates the previous reports (Abdel-Rahman, 2000) that there existed significant breed differences in feed efficiency. In agreement with these findings, Benyi et al. (2006) also reported that Hyline Brown layers utilized feed more efficiently than White Hyline layers. This result indicates a strong association between egg production and feed efficiency since the breed with higher egg numbers also gave superior feed efficiency values. IB genotype was better and superior in both egg production and feed efficiency and is recommended to farmers in order to achieve maximum productivity and profit.

Also, Table 3 shows the effect of housing on feed efficiency of two strains of commercial layers regardless of the breeds’ performance. There was no significant (P>0.05) housing effect on feed efficiency. Cage birds recorded 0.006±1.0x10^-4/week
while floor birds had 0.006±1.0x10⁻⁴/week and were similar. This implies that birds in both housing systems are not significantly different in the rate of feed conversion to eggs and that they both utilized feeds given efficiently. The result was in conformity with the findings of Akinokun and Benyi (1985) who found no significant differences in feed efficiency between cage and deep litter hens. It is therefore, inferred from this study that proper management of birds will ensure improved performance regardless of housing type used for laying birds. There was no significant (P>0.05) breed x housing interaction effect on feed efficiency.

**Conclusion:** The result of this study showed that Isa Brown (IB) was superior to Dominant Black (DB) in egg production and feed efficiency but recorded similar values in mortality rate. This implies that IB genotype utilized feeds given more efficiently, produced more eggs and appeared more profitable than DB genotype. There was no significant housing effect on egg production, mortality rate and feed efficiency. There were also no significant genotype x housing interaction effects on egg production, mortality rate and feed efficiency.

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**References**


