GROWTH PERFORMANCE, LINEAR MEASUREMENT AND COST-BENEFIT OF TWO STRAINS OF BROILER CHICKENS IN A HUMID TROPICAL ENVIRONMENT

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ABSTRACT

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The study was conducted to evaluate strain effect on growth performance, body conformation, carcass and cost-benefit parameters of two broiler chickens – Arbor Acre and Anak. A total number of 100 each of Arbor Acre and Anak Titan were used for the experiment which lasted for 56 days (8 weeks). The experiment was carried out at the Poultry Unit of the Teaching and Research farm of Michael Okpara University of Agriculture, Umudike, where the birds were raised in separate deep litter pens. Each strain was replicated 5 times with 20 birds per replicate. Data collected include body weight and linear body traits (body girth, shank length, thigh length, wing length and body length) at 2 weeks interval beginning from 2nd week, growth performance traits, carcass and organ characteristics as well as cost-benefit indices. Data were analyzed using independent student’s t-test statistic. Analyzed results showed that strain had significant (p<0.05) effect on the traits measured except organ characteristics. Arbor Acre had significantly (p<0.05) higher daily feed intake (136.26 vs 111.82 g per day per bird), daily weight gain (32.31 vs 28.22) and better feed conversion ratio (3.47 vs 4.06) than Anak. Arbor Acre strain also had significantly (p<0.05) heavier body weight, longer body length and shank length in weeks 4, 6 and 8, longer thigh length in weeks 4 and 6 as well as longer wing length in week 8 compared to the Anak strain. A similar trend was observed with the carcass characteristics. Arbor Acre showed superiority (p<0.05) over Anak in dressed weight (1403.87 vs 1333.28 g), shank (6.50 vs 4.81 % live weight) and thigh (14.81 vs 13.10 % live weight). At similar cost of production, the Arbor Acre strain had significantly (p < 0.05) lower feed cost/bird and feed cost/weight gain and generated higher revenue (₦846.20 vs 695.90) and gross margin (₦556.10 vs 405.80) than its counterpart strain. From this study, it is concluded that broiler chicken’s growth responses are affected by their genetic potential and Arbor Acre strain appeared more adaptable and profitable in our study area.

Keywords: Growth performance, conformation, carcass, cost-benefit, strain

INTRODUCTION

The expansion and improvement of the Nigerian poultry industry has been one of the major focuses of the federal government in order to improve the animal protein consumption of her citizenry (CBN, 2004). As a result, the Nigerian poultry industry has over the years been flooded with different exotic broiler strains. Ude et al. (2015) observed that many strains of broilers have been imported into Nigeria. The performance of these birds is affected by their genotype as well as the rearing environment. Genotype x environment interaction may cause loss of fitness traits for those strains that are not suited in a particular environment. Thus, broiler producers’ needs to select those strains that are best suited in a particular environment for rearing. Apart from strain, body weight and conformation traits such as breast width, keel length, shank length, thigh length etc are known to be good estimators of body growth and market value of broilers (Yahaya et al., 2012). Edward (2000) reported that selection programmes is mainly focused on these economic traits. In corrobororation, Owojori et al. (2011) reported that studies on conformation traits had found application in selection and breeding. Amao et al. (2012) also stated that animal linear body measurements had been used to predict live gain, examine relationship among economic characteristics, reproduction, and performance and to study the relationship between heredity and environment. There are also evidences that there are differences in body weight among strains of broilers (Leeson et al., 1997; Musa et al., 2006). Razuki et al. (2011) reported significant strain differences in body weight and linear body traits at various ages among broiler chickens.

In the past, broilers were mainly sold whole but now many customers demand for chicken parts to reduce burden on family finances (Olawumi, 2013). According to Ewart (1993), there was a dramatic increase in the proportion of birds being grown for portioning and that this is the situation in all countries where broilers are raised for human consumption. It then implies that producers’ needs strains of broilers with fast growth rate and more meat yield for maximum economic returns in their peculiar environment. The aim of this study was to evaluate growth

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performance, body conformation, carcass characteristics and cost-benefits of two strains of broilers (Arbor Acre and Anak) in a humid tropical environment of Nigeria.

MATERIAL AND METHODS

Experimental site
The research was carried out at the Poultry unit of the Teaching and Research farm of Michael Okpara University of Agriculture, Umudike, Abia State. Umudike located on latitude 05° 29' N and longitude 07° 33' E on an elevation of 122 m above sea level within the tropical rainforest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22°C - 36°C and relative humidity of 50-95% depending on the season and location.

Management of experimental birds and data collection
A total of two hundred (200) broiler day old chicks comprising 100 each of Arbor Acre and Anak strains were purchased from a reputable hatchery in Ibadan, Nigeria. The chicks were brooded for two weeks and reared on deep litter pens for 56 days (8 weeks) by conforming to standard management procedures. The chicks were offered clean water and fed **ad libitum** with a commercial feed starter diet from day old to 2 weeks of age. After brooding for 2 weeks, each strain which was housed separately in deep litter rearing pens was randomly allotted to five replicates of 20 birds each. Then, compounded broiler starter (23.00 % CP, 2808 kcal per kgME) and finisher (20 % CP, 3000 kcal per kgME) diets were fed **ad libitum** and fresh clean water also offered to the birds. Proper sanitation and routine medication were maintained to forestall any outbreak of disease.

Data were collected on the following parameters on each strain.

### Growth performance traits

- **Average feed intake (g/bird/day) =** Quantity of feed consumed (g) – Leftover (g)
  
  \[
  \text{Average feed intake (g/bird/day) = } \frac{\text{Number of birds x 42 days} - \text{Leftover (g)}}{42} 
  \]

- **Average daily weight gain (g/bird/day) =** Final live weight (g) – Initial live weight (g)
  
  \[
  \text{Average daily weight gain (g/bird/day) = } \frac{\text{Number of birds x 42 days} - \text{Initial stock}}{42} 
  \]

- **Feed conversion ratio =** Average daily feed intake (g)/Average daily weight gain (g)

- **Mortality (%) =** \( \frac{\text{Number of dead birds}}{\text{Initial stock}} \times 100 \)

### Conformation traits

Body weight and the under listed linear body traits were measured on each strain at 2, 4, 6 and 8 weeks of age.

- **Body girth:** This was taken at the region of breast expansion when positioned ventrally.
- **Shank length:** It was taken as the length of the tarso-metatarsus from the hock joint to the metatarsal pad.
- **Wing length:** This was measured as the distance between the tip of the phalanges and the coracoids-humerus joint.
- **Body length:** The distance between the base of the neck and pygostyle.
- **Thigh length:** length of the femur bone.
- **Wing length:** This was measured using a weighing scale while the linear body traits were estimated with a measuring tape.

### Carcass characteristics

After measuring the final body weights at 8 weeks, 20 birds (2 per replicate) each of the strain were randomly selected for carcass evaluation. The birds were starved of feed overnight and were slaughtered by severing the jugular vein. The birds were de-feathered after immersing them in hot water, plucked and eviscerated. The dressed birds were weighed to obtain dressed weight before cutting into parts: thigh, drum stick, breast, wing and back cut which were weighed separately according to Scott et al. (1969). Dressed weight, cut parts and internal organs were expressed as percentage of live weight to obtain their relative weights.

### Cost-benefit analysis

Cost analysis was carried out at the end of the finisher phase to compare the profitability of the strains. Cost-benefit parameters measured included Cost per kg feed = proportion of each ingredient in the diet × cost per kg of ingredients ÷ 100. Feed cost per bird = feed consumed × cost per kg feed. Feed cost per weight gain = cost per kg feed × feed conversion ratio. Cost of production = cost per kg weight gain × mean weight gain. Revenue = price of 1 kg meat × mean weight gain. Gross margin = Revenue – cost of production.

### Statistical Analysis

Data collected on these traits were subjected to statistical analysis using SPSS (2011) software package. The independent student’s t-test (Gusset, 1957) was used to compare means of the growth performance, linear body, carcass and cost variables between Arbor Acre and Anak strains and statistical differences were established at \( P \leq 0.05 \) level of significance.

### RESULTS AND DISCUSSION

Growth performance traits

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**Growth performance traits**

**RESULTS AND DISCUSSION**

**carcass and cost variables**

**Independent student's t**
The means and standard errors of growth performance traits of Arbor Acre and Anak strains are presented in Table 1. The result showed significant difference (p < 0.05) between the two strains. Arbor Acre was significantly (p<0.05) superior to Anak in daily weight gain (32.31), daily feed intake (136.26) and feed conversion ratio (3.47). No significant difference (p > 0.05) was observed between the two strains for mortality. Strain differences in production traits of broilers have been reported. Yakubu et al. (2010) studied the effects of genotype on growth performance of broiler chickens in north central Nigeria and found that final body weight, average weekly body weight and weekly feed intake were affected (p<0.05) by strain, with higher means recorded for Arbor Acre than Anak Titan. Udeh et al. (2015) reported that Arbor Acre gained significantly (p<0.05) more weight than Ross at 3 weeks of age and Marshal at weeks 4-5 and 6-7. Abdullah et al. (2010) also reported significantly (p<0.01) strain effect on the weight gain of broilers at 7-21 and 28-42 days of age. Earlier, Gonzales et al. (1998) concluded that weight gain in broiler chickens is significantly affected by strain.

Table 1: Growth performance traits of Arbor Acre and Anak broiler chickens

<table>
<thead>
<tr>
<th>Trait</th>
<th>Strain</th>
<th>Arbor Acre</th>
<th>Anak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial body weight (g)</td>
<td></td>
<td>374.33 ± 3.76</td>
<td>367.88 ± 4.94</td>
</tr>
<tr>
<td>Final body weight (g)</td>
<td></td>
<td>1687.00 ± 36.48a</td>
<td>1537.67 ± 52.85b</td>
</tr>
<tr>
<td>Daily feed intake (g/bird/day)</td>
<td></td>
<td>136.26 ± 2.86b</td>
<td>111.82 ± 3.65b</td>
</tr>
<tr>
<td>Daily weight gain (g)</td>
<td></td>
<td>32.31 ± 0.95ab</td>
<td>28.22 ± 1.11b</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td></td>
<td>3.47 ± 0.13b</td>
<td>4.06 ± 0.15a</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td></td>
<td>1.50 ± 0.22</td>
<td>1.60 ± 0.10</td>
</tr>
</tbody>
</table>

*Means with different superscripts across the rows are significantly different (p<0.05).

On the average, Arbor Acre consumed more feed when compared to Anak Titan. This is in agreement with earlier reports of significant differences in feed intake among strains of broiler chickens (Rondelli et al., 2003; Taha et al., 2010; Udeh et al., 2015). Significant variations among broiler strains on feed conversion ratio have also been observed. Similar to our finding, Olawumi et al. (2012) found superior (p<0.05) FCR for Arbor Acre over Hubbard and Marshal broiler strains from 1st to 7th week of age. Yakubu et al. (2010) also found better feed conversion efficiency in Arbor Acre broilers in relation to Anak Titan. The result of our study suggests that Arbor Acre is a better converter of feed to flesh and at maturity could generate good returns compared to Anak.

Body weight and linear body traits
The means and standard errors of body weight and linear body traits at 2, 4, 6 and 8 weeks of age of Arbor Acre and Anak broiler strain are given in Table 2. Significant strain differences (p<0.05) were also noted in body weight, body length, shank length, thigh length and wing length. The values obtained for body weight and linear body traits for each of the strains increased progressively from day old to 8 weeks of age. Olawumi et al. (2012) recorded significantly (p<0.01) higher body weight for Arbor Acre compared to Marshal. In other investigations, Arbor Acre broilers showed superiority in body weight from day old to 8 weeks of age in comparison with other strains (Udeh et al., 2011; 2015). On the contrary, Yahaya et al. (2012) reported higher (p<0.05) body weight for Hubbard over Arbor Acre at age 2, 4, 6 and 8 weeks. These results indicate that differences in genetic makeup of broilers set a ceiling on body weight capacity.

For the linear body traits, Arbor Acre also had longer (p<0.05) body length and shank length at 4, 6 and 8 weeks, thigh length at 8 weeks and wing length at 2 and 8 weeks, whereas thigh length was higher (p<0.05) in Anak in week 2 and 4. The longer body length, shank length, thigh length and wing length of Arbor Acre at maturity could be used to differentiate between the two strains at matured weight. Significant strain differences in linear body traits have also been reported (Olawumi et al., 2012; Yahaya et al., 2012). These two groups of researchers found Arbor Acre less superior to Marshal and Hubbard in terms of shank length and breast girth and shank length, neck length and thigh length, respectively. Ajayi and Ejiotor (2009) found significant effect of genotype on breast girth and shank length. The observed differences between this present study and these other reports might be attributed to differences in strains used, environmental condition and management system.

Carcass characteristics and cost-benefit analysis
Table 3 indicates the means and standard errors of carcass and organ characteristics of the two strains – Arbor Acre and Anak. Significant (p<0.05) differences were observed only for dressed weight, dressing percent, shank and thigh, in which Arbor Acre chickens were superior to Anak. Yakubu et al. (2010) reported that Arbor Acre had significantly (p<0.05) higher relative (%) fasted body, carcass, back, neck and wing weights compared to Anak Titan. Earlier, Mendes et al. (1994) studied four broiler strains and observed that strain had a significant effect on carcass yield and percentage of breast meat. In our study, back, neck, breast, wing and drumstick and all the organ characteristics did not differ significantly (p>0.05) between the two strains. Similar results have been observed among Arbor Acre, Hubbard, Hybro, Lohman and Pilch (Lambio et al., 1987), Arbor, Acre, Ross and...
Table 2: Body weight and linear body traits at 2, 4, 6 and 8 weeks of age for Arbor Acre and Anak strains

<table>
<thead>
<tr>
<th>Age (week)</th>
<th>Strain</th>
<th>N</th>
<th>BW (g)</th>
<th>BL (cm)</th>
<th>BG (cm)</th>
<th>SL (cm)</th>
<th>TL (cm)</th>
<th>WL (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>AA</td>
<td>82</td>
<td>374.33 ± 3.76</td>
<td>22.64 ± 0.43</td>
<td>18.03 ± 0.43</td>
<td>9.83 ± 0.20</td>
<td>8.28 ± 0.27</td>
<td>12.21 ± 0.37</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>82</td>
<td>367.88 ± 4.94</td>
<td>23.61 ± 0.48</td>
<td>18.49 ± 0.23</td>
<td>9.41 ± 0.27</td>
<td>9.10 ± 0.22</td>
<td>11.44 ± 0.36</td>
</tr>
<tr>
<td>4</td>
<td>AA</td>
<td>80</td>
<td>699.24 ± 10.24</td>
<td>27.26 ± 0.43</td>
<td>21.32 ± 0.42</td>
<td>10.78 ± 0.16</td>
<td>9.28 ± 0.17</td>
<td>16.86 ± 0.35</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>78</td>
<td>658.00 ± 8.90</td>
<td>25.43 ± 0.55</td>
<td>21.80 ± 0.32</td>
<td>11.39 ± 0.13</td>
<td>10.94 ± 0.12</td>
<td>16.86 ± 0.74</td>
</tr>
<tr>
<td>6</td>
<td>AA</td>
<td>70</td>
<td>1140.67 ± 18.50</td>
<td>32.22 ± 0.12</td>
<td>25.91 ± 0.16</td>
<td>11.95 ± 0.97</td>
<td>10.74 ± 0.26</td>
<td>18.70 ± 0.15</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>75</td>
<td>1098.64 ± 22.01</td>
<td>29.54 ± 0.25</td>
<td>25.56 ± 0.25</td>
<td>10.91 ± 0.20</td>
<td>10.79 ± 0.10</td>
<td>18.72 ± 0.17</td>
</tr>
<tr>
<td>8</td>
<td>AA</td>
<td>68</td>
<td>1687.00 ± 36.48</td>
<td>36.26 ± 0.67</td>
<td>29.97 ± 0.54</td>
<td>14.20 ± 0.25</td>
<td>12.20 ± 0.16</td>
<td>27.34 ± 0.62</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>67</td>
<td>1537.67 ± 52.85</td>
<td>31.22 ± 0.40</td>
<td>29.58 ± 0.24</td>
<td>13.08 ± 0.54</td>
<td>11.31 ± 0.26</td>
<td>20.10 ± 0.47</td>
</tr>
</tbody>
</table>

*Means on the same column with different superscripts are significantly (p < 0.05) different. AA = Arbor Acre, AT = Anak, BW = body weight, BL = body length, BG = body girth, SL = shank length, TL = thigh length, WL = wing length, N = Number of observations.

Table 3: Carcass and organ characteristics of Arbor Acre and Anak broiler strains

<table>
<thead>
<tr>
<th>Trait</th>
<th>Arbor Acre</th>
<th>Anak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight (lwt) g</td>
<td>1687.00</td>
<td>1537.67</td>
</tr>
<tr>
<td>Dressed weight (g)</td>
<td>1403.87</td>
<td>1333.28</td>
</tr>
<tr>
<td>Dressing percent</td>
<td>91.30</td>
<td>84.01</td>
</tr>
<tr>
<td>Back % lwt</td>
<td>16.60</td>
<td>16.20</td>
</tr>
<tr>
<td>Breast % lwt</td>
<td>27.70</td>
<td>27.90</td>
</tr>
<tr>
<td>Neck % lwt</td>
<td>5.15</td>
<td>6.00</td>
</tr>
<tr>
<td>Shank % lwt</td>
<td>6.50</td>
<td>4.81</td>
</tr>
<tr>
<td>Wing % lwt</td>
<td>12.90</td>
<td>11.60</td>
</tr>
<tr>
<td>Drumstick % lwt</td>
<td>13.50</td>
<td>13.90</td>
</tr>
<tr>
<td>Thigh % lwt</td>
<td>14.81</td>
<td>13.10</td>
</tr>
<tr>
<td>Liver % lwt</td>
<td>2.35</td>
<td>2.72</td>
</tr>
<tr>
<td>Heart % lwt</td>
<td>0.49</td>
<td>0.58</td>
</tr>
<tr>
<td>Kidney % lwt</td>
<td>0.67</td>
<td>0.75</td>
</tr>
<tr>
<td>Spleen % lwt</td>
<td>0.13</td>
<td>0.14</td>
</tr>
<tr>
<td>Gizzard % lwt</td>
<td>2.19</td>
<td>2.42</td>
</tr>
</tbody>
</table>

*Means on the same row with different superscripts are significantly (p < 0.05) different. \% lwt = percent live weight, SEM = standard error of mean.

Cost-benefit indices of Arbor Acre and Anak production are shown in Table 4. A significant difference (p < 0.05) was noted between the strains in feed cost/bird, feed cost/weight gain, revenue/bird and gross margin. Arbor Acre chickens incurred less cost per bird as well as cost for a unit weight gain and generated more revenue (846.20) and gross profit (556.10) when compared to Anak. In their study, Yakubu et al. (2010) obtained higher (p < 0.05) gross margin for Arbor Acre compared to Anak Titans (€2.76 versus €2.19, respectively). Obike et al. (2015) reported differences (p < 0.05) in revenue/bird and gross margin between Marshal and Anak strains. At similar cost of production, therefore, our result suggests that rearing Arbor Acre broilers could be more profitable than Anak.

**CONCLUSION**

From this study, it was concluded that strain of broilers had significant effect on growth performance, body weight, conformation traits, carcass and economics of production traits. Arbor Acre genotype exhibited superiority in almost all the traits studied. The strain, therefore, is recommended to researchers and poultry producers in our study zone for increased productivity and maximum profit.

**REFERENCES**


