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Comparative Growth Performance of Cross-Bred (50% Orpington: 25% Australorp: 25% Tswana) and Pure-Bred Tswana Chickens under an Intensive Management System

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Abstract: Indigenous Tswana chickens are well-adapted to local environmental conditions but exhibit slow growth rate. Exotic chickens are not well-adapted to local environmental conditions but exhibit rapid growth rate and high egg production. Crossbreeding of Tswana chickens with exotic breeds can therefore be used as a strategy to improve growth performance of Tswana chickens. The objective of this study was to evaluate growth performance of 75% Exotic x 25% Tswana chickens under an intensive management system. A total of 56 Crossbred chickens and 60 purebred Tswana chickens were evaluated for growth performance (body weight) fortnightly from 4 weeks to 20 weeks of age. The chickens were raised under a deep litter house system and provided with water and commercial feeds *ad libitum*. Males of both crossbred and purebred chickens were generally heavier than their female counterparts at different ages. Body weight was significantly higher in crossbred males and females than purebred Tswana chickens at 20 weeks of age. Introducing the Orpington breed to the Australorp x Tswana crosses however did not further boost growth performance of the resulting three-breed cross.

Key words: Growth performance, crossbred tswana chickens, purebred tswana chickens, intensive system

INTRODUCTION

Indigenous Tswana chicken production is an important agricultural activity of almost all rural communities in Botswana and provides animal protein in the form of meat and eggs. FAO (1998) consider poultry production as an excellent tool in poverty alleviation due to its quick turn over and low investment. Improving the productivity of indigenous chicken would improve protein nutrition and increase income levels of the rural population (Alewi and Melesse, 2012) through the provision of meat and eggs and occasional sales of live chickens and eggs. Indigenous Tswana chickens are characterized by slow growth rate and lower mature body weight compared to their exotic counterparts (Kgwatalala and Segokgo, 2013). Two methods that can be employed to improve growth performance of indigenous chickens are within breed selection and cross breeding. Within breed selection is deliberate choice of fast growing individuals and subsequent breeding of those selected individuals among themselves. The major drawback with this method is that it is very slow and selection limit is reached faster. Cross breeding is an alternative method of improving growth performance in poultry aimed at producing superior crosses for growth traits under the influence of various genetic and non-genetic factors (Mahmoud and El-Full, 2014). In crossbreeding two different but complimentary breeds are mated together in order to benefit from heterosis and breed complementary and improvements in economic traits are realized within a relatively short period of time.

Tswana chickens are hardy, well adapted to prevailing environmental conditions (physical environment and production environment); are resistant/tolerant to diseases and parasites but exhibit slow growth rate and low egg production (Kgwatalala and Segokgo, 2013). Exotic breeds are not well adapted to local environmental conditions, have poor resistance to parasites and diseases but exhibit rapid growth rate and high egg production (Alemu, 1995; Gueye, 1998). Cross breeding of Indigenous chickens with exotic chicken breeds is expected to result in a hybrid/cross that is better adapted to local environmental conditions than exotic breeds and at the same time produce a reasonable amount of eggs and meat (Mekki *et al*., 2005). The purpose of this study was therefore to produce crossbred chickens (3-breed crosses) and evaluate their growth performance under an intensive management system.

MATERIALS AND METHODS

Study area: The study was conducted at Botswana College of Agriculture, Content Farm, Sebele, Gaborone, in the Southern part of Botswana from September 2013 to the end of February 2014.

Experimental animals: Two Blue Orpington cocks were housed together with 30 cross-bred females (50% Blue Australorp x 50% Tswana chicken) described by Kgwatalala and Segokgo (2013) in one deep litter house to produce fertile eggs. Another two Indigenous Tswana

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cocks were housed together with 30 pure-bred Tswana females in another deep litter house to produce fertile eggs. 150 eggs were collected from each of the Poultry houses within a week and incubated in an automatic egg incubator at 37.5°C and 65% relative humidity for 21 days to produce cross-bred and pure-bred chicks. Upon hatching pure-bred and cross-bred chicks were housed separately in brooding units until 4 weeks of age. At four weeks of age, the birds were individually identified using leg bands. 20 pure-bred Tswana chickens and 20 cross-bred chickens were then housed together in one deep litter house for a total of 3 deep litter houses resulting in 3 replications. The number of chickens of each breed and sex under each replication at the end of the study are shown in Table 1.

Table 1: Distribution of chickens according to breed and sex under each replication

	Replication		
Breed	1	2	3
Crossbred males	12	10	8
Crossbred females	8	8	10
Tswana males	9	10	8
Tswana females	11	10	12

Feeding and management: Pure-bred and cross-bred chickens were fed with chick starter crumbs *ad libitum* from day old to 4 weeks of age. From 4 to 20 weeks of age, chickens were fed commercial broiler grower pellets. Water was provided *ad libitum* during the brooding and growth phases.

Measurement of parameters: Body weight of individual chickens (both purebreds and crossbreds) was measured fortnightly from 4 to 20 weeks of age using an electronic balance.

Statistical analysis: Growth data were analyzed using General Linear Model procedures of statistical analysis system SAS (2009) version 9.2.1 and the model include fixed effects of breed (Pure-bred Tswana and 75% exotic x 25% Tswana cross-bred chicken) and sex (male and female) and the interaction between breed and sex. The results are presented as least square means±SD error and means separation were by paired t-test with Scheffe's adjustment to account for unequal number of sampling units in the replications. Differences between means were declared significantly different at $p \leq 0.05$.

RESULTS AND DISCUSSION

Body weights at different ages of both males and females of crossbred and purebred Tswana chickens are presented in Table 2. There were no significant sex differences in body weights of crossbred chickens at 4 and 6 weeks of age. However, crossbred males were significantly heavier ($p<0.05$) than their age-matched female counterparts from 8 to 20 weeks of age. Significant sex differences in body weight in purebred Tswana chickens were only observed from 14 to 20 weeks of age. The early attainment of sexual dimorphism in crossbred chickens than in pure-bred Tswana chickens is consistent with Kgwatalala and Segokgo (2013) who reported sex differences in body weight in crossbred chickens (50% Australorp x 50% Tswana) and pure-bred Tswana chickens from 10-18 and 14-18 weeks of age, respectively. Higher body weight in crossbred males than females at 20 weeks of age found in the current study is consistent with Adedokun and Sonaiya (2002) and Momoh *et al*. (2010). Adedokun and Sonaiya (2002) reported body weights of 1360±60.2 and 1275±79.6 g in Dahlem Red x Fulani crossbred males and females, respectively and body weights of 1336±60.2 and 1143±46.0 g in Dahlem Red x Yoruba crossbred males and females, respectively, at 20 weeks of age. The body weights of crossbred males and females (3-breed cross) at 18 weeks of age found in the current study are however similar to body weights of crossbred (Australorp x Tswana) males and females at the same age reported by Kgwatalala and Segokgo (2013). Breeding Australorp x Tswana crossbred females with Orpington males did not make any significant improvement in growth performance in the resulting 3-breed cross probably because of the genetic similarities between the Orpington and the Australorp breeds (less heterosis effects) and the breakdown of favorable gene combinations in the F1 (Australorp x Tswana) cross during gametogenesis. It however changed the physical appearance of the 3-breed cross away from that of pure Tswana breed and more towards that of the Orpington breed which might actually boost sales of the 3-breed cross. Higher body weights in pure-bred Tswana males than females from 14 to 20 weeks of age are consistent with Kgwatalala *et al*. (2012). Adedokun and Sonaiya (2002) also reported significantly higher body weight in Nigerian indigenous chicken males than females at 15 weeks of age (862±56.5 and 721±72.8 g, respectively) and at 20 weeks of age (1191±40.5 and 970±32.3 g, respectively). The body weight of male and female Tswana chickens at 20 weeks of age are however higher than that of Nigerian indigenous chicken at 20 weeks of age reported by Adedokun and Sonaiya (2002) and Momoh *et al*. (2010). Higher body weights in crossbred and purebred males than their female counterpart is consistent with Mohammed *et al*. (2005) and Pahdi *et al*. (2012) who reported the presence of early sexual dimorphisms in chicken. According to Adedeji *et al.* (2006) significantly higher body weights in both crossbred and purebred males than females during the post-brooding phase might be attributed to the differences in hormonal profile, aggressiveness and dominance of males when feeding especially when males and females are housed together.

Table 2: Body weights of males and females of crossbred and tswana chickens under an intensive management system

	---------- Weight of crossbred chickens (g) ----------		---------- Weight of tswana chickens (g) ----------	
Age in weeks	Males	Females	Males	Females
4	258.73±14.25	236.87±16.47	278.85±15.24	283.79±13.96
6	446.25±19.58	399.38±22.62	473.56±20.94	449.87±19.19
8	815.09±31.09[a]	674.71±36.64[b]	698.78±33.92	646.27±31.73
10	1241.60±39.97[a]	938.13±47.11[b]	928.35±43.62	813.24±40.81
12	1541.91±41.53[a]	1104.41±48.94[b]	1215.20±45.31	1052.45±42.38
14	1720.42±51.02[a]	1325.74±60.12[b]	1473.95±55.66[a]	1241.82±52.07[b]
16	2002.22±52.51[a]	1674.71±61.88[b]	1571.95±57.29[a]	1339.82±53.59[b]
18	2251.34±65.10[a]	1744.86±76.73[b]	1981.38±71.04[a]	1573.43±66.45[b]
20	2458.57±66.82[a]	1930.08±78.75[b]	2064.17±74.71[a]	1692.10±68.20[b]

Means with different superscripts within breed at a particular age were significantly different from each other (p<0.05)

Table 3: Body weights of males and females of crossbred and indigenous tswana chickens raised under an intensive management system

	---------- Weight of males (g) ----------		---------- Weight of females (g) ----------	
Age in weeks	Crossbred	Tswana	Crossbred	Tswana
4	258.73±14.25	278.85±15.24	236.87±16.47	283.79±13.96
6	446.25±19.58	473.56±20.94	399.38±22.62	449.87±19.19
8	815.09±31.09	698.78±33.92	674.71±36.64	646.27±31.73
10	1241.60±39.97[a]	928.35±43.62[b]	938.13±47.11	813.24±40.81
12	1541.91±41.53[a]	1215.20±45.31[b]	1104.41±48.94	1052.45±42.38
14	1720.42±51.02[a]	1473.95±55.66[b]	1325.74±60.12	1241.82±52.07
16	2002.22±52.51[a]	1571.95±57.29[b]	1674.71±61.88[a]	1339.82±53.59[b]
18	2251.34±65.10[a]	1981.38±71.04[b]	1744.86±76.73[a]	1573.43±66.45[b]
20	2458.57±66.82[a]	2064.17±74.71[b]	1930.08±78.75[a]	1692.10±68.20[b]

Means with different superscripts within sex at a particular age were significantly different from each other (p<0.05)

There were no significant differences in body weight between crossbred males and pure bred Tswana males from 4 to 8 weeks of age (Table 3). At 4 and 6 weeks of age, Tswana males were heavier than their crossbred counterparts but by 8 weeks of age, crossbred males were heavier than purebred Tswana males. Crossbred males were significantly heavier ($p<0.05$) than their age-matched indigenous counterparts from 10 to 20 weeks of age. The highest body weight gain occurred between 8 and 10 weeks of age in crossbred males and between 16 and 18 weeks of age in purebred Tswana males. Significantly higher body weight in crossbred males than purebred Tswana males from 10 to 20 weeks of age is consistent with Kgwatalala and Segokgo (2013). Significantly higher body weights in crossbred males than their indigenous counterparts at 10-20 weeks of age is consistent with Adedokun and Sonaiya (2002) who found significantly higher body weights in crossbred Dahlem red x Fulani males than Nigerian indigenous chicken males at 20 weeks of age (1360±60.2 and 1191±40.5 g, respectively) and in Dahlem Red x Yoruba crossbred males than Nigerian indigenous chicken males (1336±60.2 and 1191±40.5 g, respectively) also at 20 weeks of age. Alewi and Melesse (2012) reported significantly higher post brooding (9-20 weeks of age) average body weight in Kei x Fayoumi (852 g) and Kei x Rhode Island Red (968 g) crossbred males than purebred indigenous Kei males (762 g) in Ethiopia. Momoh *et al*. (2010) also reported significantly higher body weight in Heavy ecotype x light ecotype crossbred males than pure bred light ecotype males (937±7.32 and 831±5.52 g, respectively) at 20 weeks of age.

In females, there were no significant differences in body weights between Crossbred and purebred Tswana chickens from 4 to 14 weeks of age. Purebred Tswana females were heavier than their crossbred counterparts at 4 and 6 weeks of age but from 8 weeks of age onwards, crossbred females were heavier. Crossbred females were significantly heavier ($p<0.05$) than their age-matched purebred counterparts from 16 to 20 weeks of age. The highest body weight gain occurred between 14 and 16 weeks of age in crossbred females and between 10 and 12 weeks of age in purebred Tswana females. Superiority in growth performance in crossbred females than their purebred indigenous counterparts found in the current study is consistent with Kgwatalala and Segokgo (2013) who also reported significantly higher body weights in the Australop x Tswana crossbred females than purebred Tswana females at 16 weeks (1567.53±48.21 and 1363.14±54.38 g, respectively) and 18 weeks of age (1774.93±48.41 and 1545.14±54.62 g, respectively). Alewi and Melesse (2012) reported significantly higher post brooding (9-20 weeks of age) average body weight in Kei x Fayoumi (704g) and Kei x Rhode Island Red (778 g) crossbred females than purebred indigenous Kei females (641 g) in Ethiopia. Adedokun and Sonaiya (2002) reported significantly higher body weight in crossbred Dahlem Red x Fulani and Dahlem Red x Yoruba females than their purebred Nigerian indigenous chicken counterparts at 20 weeks of age. Momoh *et al*. (2010) also reported significantly higher body weights in Heavy ecotype x Light ecotype crossbred females than Light ecotype females (901±4.43 vs. 787±4.36 g) at 20 weeks of age. Significantly higher body weights in both

crossbred males and females than their indigenous counterparts at the end of the study (20 weeks of age) are probably mainly due to breed complimentarily (favorable breeding value for growth) and to some extent favorable gene combination value or heterosis.

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