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Full Length Research Paper

An assessment of indigenous Tswana chickens under traditional free range system

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There is limited information on laying performance and egg characteristics of indigenous Tswana chickens (ITC) under traditional free range system. A structured questionnaire was administered to a random sample of 26 farmers in Oodi, Morwa and Bokaa villages in Kgatleng district. The survey data revealed that on average, 81% of the farmers did not know the age at first egg of ITC and that on average ITC laid 7 eggs per week over an average laying period of 2-3 weeks. The average number of eggs incubated by ITC was found to be 15 eggs/hen and more egg production and more chicks are hatched in winter than in summer. This study also evaluated egg quality characteristics of ITC relative to commercial layer chicken (CLC). A total of 100 eggs obtained from 8 ITC farmers and 108 eggs from two CLC farms were analysed for external and internal egg quality traits. Eggs of ITC had significantly higher (P<0.001) values for egg length (5.68±0.04mm versus 5.58±0.04 mm), yolk weight (16.24±0.37g versus 14.61±0.26 g), yolk % (32.60±0.39% versus 26.53±0.37%) and albumin pH (9.27±0.04 versus 9.14±0.04) and significantly lower (P<0.001) values for egg weight (49.95±0.64g vs. 55.01±0.62g), egg shape index (74.74±0.51 vs. 79.51±0.49), albumin weight (26.20±0.44g vs. 31.40±0.42g), albumin % (52.21±0.47 vs. 57.23±0.45) and egg contents weight (42.44±0.60g vs. 46.02±0.57g) compared to eggs of CLC. No significant differences between eggs of ITC and CLC were observed for egg width, shell weight, shell percentage and shell thickness. Eggs of CLC might therefore be healthier than those of ITC because of their higher protein content and their lower yolk content.

Keywords: Egg traits, laying performance, Tswana chickens, traditional management.

INTRODUCTION

Indigenous Tswana chickens (ITC) are native to Botswana and are mostly kept under the traditional free range system in rural areas of Botswana. ITC are generally heterogeneous with no specific colour patterns, phenotypes and genotypes. This variability offers opportunities for selection and other breeding work. ITC thrive on leftover human foods, kitchen wastes, insects or worms and are sometimes supplemented with cereal grains. They do not enjoy compound feeds or conventional poultry housing and thus produce eggs and meat at least possible cost. Taken together, the high diversity and the low maintenance costs of ITC make them a valuable genetic resource that could form the basis for genetic improvement and supply of cheap protein source in the

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form of meat and eggs. This would help diversify the poultry sector in Botswana through development of breeds well adapted to local conditions and changing climatic conditions due to global warming. There is however paucity of information about potential levels of productivity and production characteristics of indigenous chickens managed under extensive rearing systems. Information on egg production and egg quality traits of ITC managed under traditional free range system (most predominant rearing system or ITC) is lacking. The present investigation was thus undertaken to assess laying performance and the various egg quality traits of ITC managed under the traditional free range system in Kgatleng district of Botswana.

MATERIALS AND METHODS

Study Site

The study was conducted in the 3 villages of Oodi, Bokaa and Morwa in Kgatleng district of Botswana from October 2009 to February 2010. A pre-survey was conducted to identify households keeping indigenous Tswana chickens.

Sampling of households

Twenty six households were selected to participate in the study using random sampling. This corresponded to a random sample of 10 farmers from Bokaa, 10 from Morwa and 6 from Oodi. Only farmers who possessed ITC and were keen to participate in the survey and to release eggs for quality analysis participated in the study. Each household was regarded as an experimental unit. Two commercial layer chicken farms (Botswana College of Agriculture Farm and Bokaa Layer Chicken Farm) also participated in the study by supplying eggs of commercial layer chickens (CLC). A total of 100 and 108 eggs were obtained from 8 ITC farmers and 2CLC farmers, respectively, and were subjected to quality analysis in the laboratory. The external egg quality traits measured were, egg weight (g), egg length (cm), egg width (cm), shell colour and egg shape index (%). Egg weight was determined using an electronic scale, while egg length and egg width were determined with electronic vernier callipers. Egg shape index was calculated as a ratio of the width to the egg length as follows: Egg shape index=(egg width*100)/ egg length.

Each egg was later carefully opened to allow passage of both egg yolk and albumen. The egg yolk and albumen were then carefully separated and placed in separate petri dishes, which had initially been weighed. The difference in the weight of each petri dish after and before introduction of the egg yolk and albumen were taken as the weight of the egg yolk and albumen, respectively. Shell weight (shell membrane inclusive) was determined by weighing. Egg shell thickness was determined by using a micrometer screw gauge. Accuracy of shell thickness was ensured by measuring shell thickness at the broad end, middle portion and narrow end of the shell and taking the average of the three. Albumin pH and yolk pH were both determined using a pH meter.

Statistical analysis

Survey data were analyzed using Statistical Package for Social Sciences(SPSS) software version 11.5 and descriptive statistics were used to obtain frequencies and percentages. External and internal egg traits were analyzed by General Linear Models of SAS (SAS Institute Inc., 2002) and the model included fixed effect of breed (ITC and CLC). Results on various internal and external egg traits are presented as least squares means ± SE, and means separation was by paired t-test with Sc adjustment to account for differences in the number of eggs between ITC and CLC. Differences between means were declared significant at $P<0.05$.

RESULTS

Household characteristics

Of the 26 farmers interviewed, 68.75% were female and 31.25% were male. The owners of the chickens were mostly illiterate (42.31%), followed by primary education (34.62%), secondary education (19.23) and only 3.85% of the owners had tertiary education. Fifty percentage of the ITC owners were between 41 and 60 years of age, 37.5% were between 21 and 40 years of age and 12.5% of the owners were over 60 years of age. In most of the households, ITC were acquired through purchase (73%), inheritance (23%) and given as gifts or in exchange for labour (4%).

Management of ITC

All the respondents provided feed supplementation of some form to their indigenous Tswana chickens. Most of the respondents supplemented with maize only (42%), 19% with sorghum only, 8% with commercial feeds, an additional 8% with sorghum bran and 23% supplemented with a mixture of sorghum, bran, maize and sunflower. The most popular feeding method was scattering feed on the ground (81%) and only 19% of the respondents used feed containers. Most of the ITC farmers (62%) indicated that they feed their chickens only once a day in the morning,

Table1. External egg characteristics of Indigenous Tswana Chickens (ITC) and Commercial Layer Chickens (CLC)

Traits	ITC	CLC	P-value
Shell colour	Cream white, light brown	Light brown, dark brown	
Egg weight (g)	49.95^{a} ±0.64	55.01^{b} ±0.62	***
Egg length (cm)	5.68^{a} ±0.04	5.58^{b} ±0.04	NS
Egg width (cm)	4.23±0.03	4.43±0.03	***
Egg shape index	74.74^{a} ±0.51	79.51^{b} ±0.49	***

*NS = not significant; *** P < 0.001

31% fed twice a day in the morning and evening and 7% fed three times a day in the morning, afternoon and in the evening. Water was provided *ad libitum* by all farmers and only 19.23% of the farmers vaccinated their chickens against some diseases. All the farmers had no contact at all with extension personnel.

Indigenous knowledge on laying performance of Tswana chickens

Majority of respondents (81%) did not know the age at first egg of ITC (Figure 1). About 8% of respondents thought it was at 4 months of age, 4% thought it was 5 months of age, an additional 4% thought it was 6-7month of age and another 4% of the respondents thought it was more than 7 months of age. According to the respondents, ITC lay between 5 and 20 eggs *per* clutch over a 2-3 weeks period with an average clutch size of 15 eggs *per* clutch. Majority of the respondents (69%) indicated that on average, ITC laid 7eggs/week and 19% of the respondents reported an average of 5eggs/week while 4% of the respondents did not know the number of eggs laid by ITC *per* week. Majority of the farmers (60%) indicated that the average clutch size which also translates to the average number of eggs incubated by ITC was between 11-15 eggs (Figure 2) and 31% of the farmers reported an average clutch size of 16-20 eggs. Only 8% of the farmers reported a clutch size of more than 20 eggs. About 42% of the respondents reported a range of 11-15 chicks hatching *per* clutch of eggs while 38% of the respondents reported 5-10 chicks hatching *per* clutch of eggs. Approximately 20% of the farmers reported 16-20 chicks hatching *per* clutch of eggs. From the pooled data, on average 12 chicks are hatched *per* clutch of eggs by ITC. Majority of respondents (73%) reported winter as the season of most egg production and of large litter sizes in ITC.

Egg traits of indigenous Tswana chickens under traditional management

There were significant differences (P<0.001) in egg weight, egg length and egg shape index between ITC and their commercial counterparts (see Table 1).The eggs of commercial layer chickens (CLC) were heavier than those of their indigenous counterparts. There was however no significant difference in egg width between ITC and CLC. The egg shell colour of indigenous Tswana chickens ranged from cream white to light brown while those of commercial layers ranged from light brown to dark brown in colour.

There were significant differences in albumin weight, albumin percentage, yolk weight, yolk percentage; yolk+ albumin weight and yolk colour between ITC and CLC (Table 2).

Generally, commercial layers had significantly higher albumin weight and albumin percentage and yolk plus albumin (edible portion) than their indigenous counterparts (see p-values in table 2). However, ITC had significantly higher yolk weight, yolk percentage and albumin pH than their commercial counterparts. There were no significant differences in shell weight, shell thickness, shell percentage and yolk + albumin % between ITC and CLC. The egg yolk of ITC was however darker or deep yellow in colour in to the light yellow egg yolk of CLC.

DISCUSSION

The survey results show that ITC are mostly owned by women, the elderly and people with low levels of education. Low levels of education observed in the current study may explain poor management practices of ITC and heavy reliance on indigenous knowledge and practices in

Table 2. Internal egg characteristics of indigenous Tswana chickens under traditional management and commercial layer chickens under intensive management

Traits	ITC	CLC	P-value
	Average	Average	
Albumin weight (g)	26.20[a] ±0.44	31.40[b] ±0.42	<0.0001
Albumin %	52.21[a] ±0.47	57.23[b] ±0.45	<0.0001
Yolk weight (g)	16.24[a] ±0.37	14.61[b] ±0.26	<0.0001
Yolk %	32.60[a] ±0.39	26.53[b] ±0.37	<0.0001
Yolk+Albumin weight (g)	42.44[a] ±0.60	46.02[b] ±0.57	<0.0001
Yolk+Albumin %	84.81±0.46	83.75±0.45	0.1025
Shell weight (g)	7.51±0.27	9.00±0.26	<0.0001
Shell %	15.36±0.47	16.25±0.45	0.1688
Shell thickness (mm)	0.429±0.008	0.438±0.007	0.3920
Albumin pH	9.27[a] ±0.04	9.14[b] ±0.04	0.0263
Yolk pH	6.50±0.04	6.37±0.04	0.0508
Yolk Colour	Dark Yellow	Yellow	

the management of ITC. ITC farmers also keep no production records of their chicken flocks as indicated by lack of knowledge of the age at first egg of their indigenous Tswana chickens by the majority of the farmers. This implies that there will be no culling strategy as any unproductive bird can easily go unnoticed (McAinsh *et al.,* 2004). Even though some farmers did not know the number of eggs laid by ITC per week, majority of the farmers reported an average of 7 eggs per bird per week. Majority of the farmers reported an average clutch size of 11-15 eggs per clutch of eggs with the pooled average clutch size of about 15 eggs and these results are consistent with Badubi *et al.,* (2006) who also reported an average clutch size of 11-15 eggs per clutch. Tadelle and Ogle (2001) reported a clutch size of 15-20 eggs in indigenous chickens of Ethiopia and some of the factors influencing clutch size are nutrition, size of the bird and the season of laying. The average number of chicks hatched per clutch of eggs by ITC averaged 12 chicks per clutch and this is consistent with the average of 11 chicks/clutch reported by Moreki and Masupu (2006) in ITC.

The average egg weight of ITC in the current study was found to be 49.95±0.64 and ranged from 37.07g-66.62g which is significantly higher than that of indigenous chickens of Sudan which ranged from 37.95-39.89g in weight (Mahammed *et al.,* 2005) and that of the Fulani– ecotype chicken of Nigeria which averaged 40.73±4.07g (Fayeye et al., 2005). Yousief (1987) and Sulieman (1996) reported average egg weight of 42.2 and 40.6g, respectively, for the large Baladi Sudanese indigenous chickens. Egg weight is largely affected by environmental factors, food restriction and parental average body weight (Mohammed *et al,* 2005) and the variation in egg weight within and between indigenous chickens in different countries could be attributed to these factors. Moreover, genetic involvement including breed or strain within breed could also explain the observed variations. The average egg length of ITC reported in the current study (5.68 cm) is very close to that of the naked-neck strain (5.15 cm) but much higher than that of the normal feathered (4.36 cm) strain of indigenous chickens of Nigeria (Yakubu *et al.,* 2008). Yousif and Eltayeb (2011) reported egg lengths of 5.02 and 5.09 in dwarf Bitwel and naked neck Sudanese native chicken breeds. Likewise the egg width or egg diameter of ITC (4.23 cm) is much higher than that of the naked neck (3.84 cm) and normal feathered (3.54) strains of indigenous chickens of Nigeria (Yakubu *et al.,* 2008). The egg width of ITC is however consistent with that of the naked neck Sudanese native chicken breed which averaged 4.0 cm (Yousif and Eltayeb, 2011). The higher egg shape index for ITC (74.74%) relative to that of the normal-feathered strain of Nigeria native chicken (68.29%) as reported by Yakubu *et al.* (2008) is indicative of better external egg quality of ITC since egg shape index is a good indicator of external egg quality, and the higher the index the better the external quality.

Shell quality, particularly shell thickness is an important trait that breeders of layers incorporate into their breeding programs to reduce egg breakage. The egg shell thickness of ITC (0.429±0.007 mm) is slightly higher than those of

naked-necked (0.38mm) and normal feathered (0.34mm) strains of indigenous chickens of Nigeria (Yakubu *et al.,* 2008), Fayoumi indigenous chickens of Pakistan with an egg shell thickness of 0.37±0.023 (Akhtar *et al.*, 2007) and the dwarf Bitwel and naked neck Sudanese native chicken breeds with average shell thickness of 0.386±0.003 and 0.395±0.003mm, respectively. The egg shell thickness of ITC is however slightly less than the egg shell thickness of Fulani-ecotype chickens of Nigeria with average shell thickness of 0.58mm (Fayeye *et al*., 2005). The shell weight of ITC (7.51±0.27g) is higher than that of the Fulani-ecotype chickens of Nigeria which averaged 5.04g (Fayeye *et al.,* 2005), the Fayoumi of Pakistan with egg shell weight of 6.29g (Akhtar *et al.,* 2007), the indigenous chickens of India which averaged 4.63g (Iqbal and Pampori, 2008) and the dwarf Betwel and naked neck Sudanese native chicken breeds with egg shell weights of 5.48±0.05 and 5.97±0.06g, respectively (Yousif and Eltayeb, 2011).

The albumin weight of ITC (26.20±0.44g) reported in the current study is higher than that of the Fulani-ecotype chicken (20.33g) and similar to those of dwarf Bitwel and naked neck Sudanese native chicken breeds which averaged 22.09±0.22 and 24.41±0.22g, respectively (Fayeye *et al.*, 2005; Yousif and Eltayeb, 2011). The egg yolk weight of ITC (16.24±0.27g) is however consistent with that of the Fayoumi breed of Pakistan (Akhtar*et al.,* 2007) and thedwarf Bitwel and naked neck Sudanese native chicken breeds which averaged 14.13±0.14g and 15.02±0.14g, respectively (Yousif and Eltayeb, 2011). The egg yolk of ITCs kept under traditional management system is acidic with average pH of 6.61±0.06 and the albumin is alkaline with average pH of 9.33±0.05.

CONCLUSIONS

The average clutch size or average number of eggs incubated by Tswana chickens is 15 eggs and the average number of chicks hatched per clutch of eggs is 12 chicks. Eggs of ITC are lighter than those of their CLC counterparts. Eggs of ITC have more egg yolk and less egg white relative to those of their CLC counterparts. However there is no difference in the egg shell thickness between ITC and CLC. Eggs of CLC might therefore be healthier than those of ITC because of their higher protein content and their lower yolk content.

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