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Fertility and Hatchability Potentials of Shikabrown® Chickens and Effect of Body Weight and Age of Chicken on Egg Quality Traits in Southwestern, Nigeria

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Target audience: Poultry breeders, Poultry farmers.

Abstract

The study was conducted to assess the reproductive performance and the effect of body weight and age on external egg quality traits of ShikaBrown® (SS-98, SG-98 and SB-98) chickens. Six hundred ShikaBrown® chickens fertile eggs were sourced, incubated and 21 weeks old ShikaBrown® layers were used for studying some external egg quality traits. Data collected were subjected to Analysis of Variance (SAS 9); Univariate was applied to test the effects of age and body weight on external egg quality traits of the birds; where significant differences occurred, the means were separated by Duncan Multiple Range test. The dam (SS-98) parent stock had higher fertility (95.9%) while ShikaBrown® (SB-98) commercial layers had highest hatchability (89.9%). There was significant effect of age and body weight on all the external egg quality traits ($p<0.05$) considered in this study except egg shape index, which was not significantly affected ($p>0.05$) by body weight. The external egg quality traits progressed with corresponding increase in the age and body weight of the ShikaBrown® (SB-98) layers. On the basis of the recorded high values for both reproduction and egg quality traits, the ShikaBrown® parent lines and commercial layers should be made readily available to the commercial poultry farms.

Keywords: Egg, Hatchability, Fertility, External quality traits, ShikaBrown® chicken genotypes (SS-98, SG-98, SB-98).

Description of Problem

In developing countries like Nigeria, where poultry production is experiencing gradual development, genetic improvement of well adapted strains of avian and livestock species is of great importance and should also contribute to their conservation (1). The ShikaBrown® commercial layers (SB-98) is the first chicken strain developed and registered in Nigeria (2) to boost poultry production in the country. It is a

layer line developed to save the country the cost of importing laying birds from foreign countries (3). The layer strain was bred selectively to cope with harsh tropical environment. It is hardy and resistant to many diseases of economic importance. The ShikaBrown® (SB-98) commercial layer however underwent multi-locational production and adaptability trials in all the agro-ecological zones of Nigeria (3,4) before it was released for the commercial use (5). The birds are well adapted to the tropical climate and give the best economic returns. They are excellent layers with a quiet temperament able to produce between 300-350 eggs per hen in the first year of laying. (6) referred to ShikaBrown® (SB-98) commercial as the future backbone of the poultry industry in Nigeria. Numerous authors have conducted various studies on fertility and hatchability of poultry stock and came up with different inferences; such as mating ratio, strain/breed difference, age of breeders (7), sire effects (8,9), major genes (10) to have effect on fertility and hatchability of poultry eggs, among others.

Poultry production is totally dependent on the supply of day old chicks and commercial operations depend mainly on the hatcheries for the supply of day old chicks. Fertility and hatchability are however the major parameters that influence the supply of day old chicks; the economic success of a laying flock solely depends on the total number of quality eggs produced and that the characteristic of egg quality have genetic basis with continuous variability. (11) described egg quality as the characteristics of an egg that affects its acceptability by the consumers. Egg external and internal quality traits are of major importance to egg industries (12); they are significant in the poultry breeding for quality chicks and consumer preferences for better quality eggs (13). The external egg quality traits include egg weight, length, width, volume, shape index and shell thickness which are quantitative traits and may be influenced by many factors such as breed, age of the bird (14, 15), egg size (16) rearing temperature, relative humidity and season (17), genetics (18), rearing environment (19), nutrition and water quality (20), among others.

This study evaluated the reproductive performance of ShikaBrown® chicken genotypes and the effects of body weight and age on external egg quality traits of ShikaBrown® (SB-98) commercial layers in the Southwest agro-ecological zone of Nigeria after 17 years of registration and release for public uses.

Materials and Methods

Six hundred (600) fertile eggs - 150 each from sire (SG-98) and dam (SS-98) stocks of ShikaBrown® chicken parents, and 300 from (SB-98) commercial layers were sourced from the Breeding Unit of Poultry Research Programme of National Animal Production Research Institute (NAPRI, Shika), Zaria, Kaduna state. The mating ratio for the parent stocks was one cock to nine hens raised on deep litter housing system with trap nesting for egg collection and individual bird records. The eggs were arranged and transported in air-conditioned car from Zaria to Ibadan, Oyo State. The eggs were sorted to

remove the cracked/soiled ones and cleaned prior to incubation at the Hatchery Unit of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. All eggs were fumigated with 17g Potassium Permanganate and 100ml of 20% Formalin prior to setting and incubation. On the 18th day of incubation, candling of eggs was done to identify the fertile eggs, remove the dead germs (infertile) and transfer the fertile eggs to the hatching component of the incubator. On hatching of the chicks on the 21st day, egg fertility and hatchability parameters were calculated as follows:

Percent (%) fertility = [Total number of fertile eggs/Total number of eggs set] ×100

Percent (%) hatchability = [Total number of chicks hatched/Total number of fertile eggs set] × 100

Thereafter, the study on the egg external quality traits was conducted at the Live Genebank of Animal Genetic Resources Unit (AnGRs) of National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan. The experiment was conducted during the "early wet season of May to September late wet season" (21) and lasted for sixteen weeks. One hundred and two (102) ShikaBrown® commercial layers (SB-98), intensively reared were used for the study. Three birds of the same or close body weights were allotted in a cell of a battery cage and their eggs were collected two times daily. The birds were weighed weekly to determine the body weight of the birds. A total number of 783 eggs were used for this study such that in each cell, a minimum of 3 and maximum of 5 eggs were sampled. The age of these birds were considered from the age they started laying eggs, which was at the 21st week of age. The birds were fed recommended diets (3), both the feed and water were given *ad libitum* throughout the experimental period. Data were collected on egg weight, egg length, egg width, shell thickness, egg volume, egg shape index, body weight and age of the birds. The weight of the eggs was determined by using electronic balance with capacity of 0.01 to 200g (Kem model. No. 440 – 33N, Germany). The length and width of the eggs were measured using Vernier caliper. The broader end of the shell was measured using micrometer screw-guage to determine the egg shell thickness. The body weight of chicken was measured using an electronic digital balance. The egg shape index is estimated as:

Egg Shape Index = [Egg width/Egg length] × 100%

Data collected were subjected to Analysis of Variance (ANOVA) of the Statistics Analytical System (22), Univariate and frequency procedures were applied to test the effects of age and body weight on external egg quality traits of the birds; where significant differences occurred, the means were separated by Duncan's multiple range (23) test.

Results and Discussion

The results of eggs candling, fertility and hatchability of ShikaBrown® parent stocks (SG-98, SS-98) and commercial layers (SB-98) are shown in Tables I and II. The eggs candling results showed 96.5%, 95.9% and 91.2% of fertile eggs for ShikaBrown® parent (SG-98, SS-98) and commercial layers (SB-98)

respectively, with the overall mean of 93.7%. However, the percent hatched eggs of 87.8%, 89.4% and 89.9% for the ShikaBrown® parent stock (SG-98, SS-98) and commercial layers (SB-98) were recorded respectively. (24) reported percent fertility of 86.0%, 83.1% and 68.2 % in pure native chicken, Alpha and Isa Brown, while percent hatchability of 77.3%, 73.6% and 61.2% in improved native chicken (Alpha), native chicken and Isa Brown, respectively. The percent overall egg set was 84.7% (SG-98), 85.7% (SS-98) and 82.0% (SB-98) as shown below. The total number of 474 chicks (82.6%) hatched from the 600 eggs collected of which commercial chicks were automatically (auto-sexing) identified by their colours. The pullets appeared brownish and cockerels are white/silvery in colour. The results of the study revealed higher fertility (95.9%) in the dam line (SS-98) stock while ShikaBrown® (SB-98) commercial layer had the highest hatchability (89.9%). The study conducted by (25) on fertility and hatchability of ShikaBrown® (SG-98, SB-98 and SB-98) chicken showed that percentage egg fertility and hatchability of commercial (SB-98) stock increased more as the year progressed in the egg production than that of the parent (SG-98 and SS-98) with an average hatchability of 73.7%. On the contrary, (26) reported higher fertility and hatchability rates for ShikaBrown® commercial layer (SB-98) in their studies. The present finding however is in agreement with (27), which inferred that the dam strain had an obvious effect on fertility and hatchability of eggs. (28) noted that, the performance of a given population of birds is a function of their parents and that heterosis is the measure of better performance exhibited by the offspring over their parents. The high fertility (95.9%) and hatchability (89.9%) rates obtained for both parents and the commercial stocks in this study could be traced to the effects of breed/strain, mating ratio of the stocks and continuous selection in the ShikaBrown® chicken population. In as much, hatchability and fertility are two major parameters that highly influence the demand for day-old chicks and ShikaBrown® chicken stocks possess these attributes; (26) corroborated further that the NAPRI provides its customers with good chicken stock required for profitable business.

The results of the means, standard deviations and covariances of external egg quality traits of the birds are presented in Table III. The eggs were 5.35 ± 0.30cm long, 4.06 ± 0.25cm wide, weighing 58.36 ± 6.07g, the shell of the eggs were 37.37 ± 4.48cm thick, the egg volume and shape index obtained were 46.47 ± 7.20cm^3 and 75.99 ± 5.48% respectively. These values were however consistent in trend and higher than the values obtained for IsaBrown by (15); Harco breed and indigenous chickens by (27); YaffaBrown by (29); White Leghorn by (30); Dominant Black by (28); unclassified Nigerian local chickens by (31) and Fulani ecotypes chicken by (32) in their various studies. (24) recorded mean egg weight of 59.02, 53.10 and 41.00 g for Isa Brown, improved native Alpha and native chicken respectively. The present findings suggest superiority of ShikaBrown® chicken with respect to the

Table I: Egg candling results of ShikaBrown® chicken genotypes.

Chicken genotype	No. of eggs transferred	No. of infertile eggs	No. of broken eggs	Fertile %	No. of eggs set
SG-98	139	4	1	96.5	144
SS-98	141	5	1	95.9	147
Subtotal	**280**	**9**	**2**	**96.2**	**291**
SB-98	258	24	1	91.2	283
Total	**538**	**33**	**3**	**93.7**	**574**

Sire line - SG-98, Dam line - SS-98, Commercial Pullet - SB-98.

Table II: Eggs hatched results of ShikaBrown® chicken genotypes.

Chicken genotype	No. of good chicks	% Hatched	% Overall egg set	No. of rejected eggs	No. of unhatched eggs	No of broken eggs	No. of fertile eggs	No. of eggs set
SG-98	119	87.8	84.7	3	16	1	139	144
SS-98	125	89.4	85.7	1	14	3	141	147
Subtotal	**242**					**4**	**280**	**291**
SB-98	112	89.9	82.0	2	24	2	258	283
Cockerels	118							
Total	**474**			**6**		**6**		**574**

Sire line - SG-98, Dam line - SS-98, Commercial Pullet - SB-98.

Table III: The means, standard deviations and covariances of external egg quality traits of ShikaBrown® (SB-98) commercial layers. N = 783

Trait	Mean	Standard deviation	Covariance [%]
Egg length [cm]	5.35	0.30	20.06
Egg weight [g]	58.36	6.07	36.85
Egg width [cm]	4.06	0.25	9.16
Shell thickness [cm]	37.37	4.48	20.07
Egg volume [cm^3]	46.47	7.20	51.75
Egg shape index (%)	75.99	5.48	30.02

external egg traits which they have been carefully selected and bred for that purpose with good adaptation to the prevailing environment.

The result of the effects of age and body weight on external egg quality traits of ShikaBrown® (SB-98) commercial layers is presented in Tables IV and V. The age of the birds significantly ($p < 0.05$) affected all the external egg quality traits considered in this study. (25) reported significant decrease in most of the internal and egg quality traits with the age of the layer chicken. Egg length and egg width increased with the age of birds while the egg shape index varied as the hen progressed in age. (33) reported egg shape index value of 0.72. The corresponding increase in the egg weight with hen's age is expected. Egg weight is the most important quality trait not only to the consumers but also to the egg producers (34). The heaviest eggs were obtained at the last week of the experiment. Significant increase observed in egg weight with age of the birds (SB-98) is consistent with the reports of (35) and (36) who reported egg weight increased with the hen's age. Poor egg shell quality results in loss. The egg shell thickness in the present study increased with the age of the birds; the thickest shell of the eggs was obtained at 34-37 weeks. This is consistent with the reports of (37) who observed heavier egg shell in older IsaBrown birds;

Table IV: Effect of age on external egg quality traits of Sh ikaBrown® (SB-98) commercial layers.

Trait	Age (Weeks)			
	(22-25)	(26-29)	(30-33)	(34-37)
Egg length [cm]	5.31±0.03^{b}	5.35±0.02^{ab}	5.35±0.02^{ab}	5.39±0.02^{a}
Egg weight [g]	57.03±0.38^{b}	58.52±0.50^{b}	58.66±0.46^{b}	59.60±0.37^{a}
Egg width [cm]	4.03±0.01^{a}	4.04±0.16^{a}	4.04±0.02^{b}	4.12±0.02^{a}
Shell thickness [cm]	37.35±0.23^{b}	37.97±0.19^{b}	35.91±0.54^{b}	38.26±0.11^{a}
Egg volume [cm^3]	45.40±0.37^{b}	46.00±0.45^{b}	46.25±0.61^{b}	48.22±0.57^{a}
Egg shape index (%)	76.33±0.41	75.60±0.35	75.62±0.41	76.43±0.39

^{a,b,c} *Means with different superscripts along the same row are significantly different [p<0.05].*

Table V: Effect of body weight on external egg quality traits of ShikaBrown ® (SB-98) commercial layers.

Trait	Body weight (kg)				
	1.0 – 1.4	1.41 – 1.90	1.91 – 2.30	2.31 – 2.70	2.71 – 3.10
EL (cm)	5.28 ± 0.03^{b}	5.33 ± 0.02^{ab}	5.39 ± 0.03^{a}	5.33 ± 0.02^{ab}	5.39 ± 0.02^{a}
EWt (g)	58.90 ± 0.47^{b}	58.00 ± 0.53^{b}	59.44 ± 0.57^{ab}	57.08 ± 0.59^{b}	58.35 ± 0.34^{a}
EW (cm)	4.02 ± 0.01^{b}	4.03 ± 0.02^{ab}	4.07 ± 0.02^{b}	4.02 ± 0.02^{b}	4.10 ± 0.02^{a}
SHT (cm)	36.96 ± 0.30^{b}	37.65 ± 0.20^{ab}	38.42 ± 0.21^{a}	36.69 ± 0.50^{bc}	37.23 ± 0.37^{ab}
EV (cm^3)	44.79 ± 0.47^{c}	45.61 ± 0.45^{bc}	47.09 ± 0.56^{ab}	45.51 ± 0.58^{bc}	48.12 ± 0.59^{a}
ESI	76.48 ± 0.56	75.80 ± 0.34	75.69 ± 0.44	75.42 ± 0.43	76.32 ± 0.38

^{a,b,c} *means with different superscripts along the same row are significantly (P < 0.05) different EL-Egg length (cm), EWt-Egg weight (g), EW-Egg width (cm), SHT-Shell thickness (cm)EV-Egg volume (cm^3), ESI-Egg shape index*

likewise (16) corroborated the report. Our results however exceeded the average egg shell thickness values of 0.30 and 0.35 mm for Nigerian local breeds and IsaBrown respectively as reported by (38), (39) for Nera black and (40). The egg volume also increased with the hen's age. Furthermore, all the external egg quality traits considered in this study was also significantly (p< 0.05) increased with the body weight of the hen with the exception of egg shape index which was less significant. The egg length was significantly affected when the birds weighed between 1.0 and 1.4kg, likewise the egg weight when the birds weighed between 1.9 and 2.3kg. However, the egg width, egg volume and shell thickness followed similar trends of significantly affected with the birds' weight of 2.7 and 3.1kg.

Conclusions and applications

1. Since, hatchability and fertility are two major parameters that highly influence the demand for day-old chicks and good attributes of reproductive performance of any breeding stock; ShikaBrown® (SS-98) chicken dam line possesses these attributes and ShikaBrown® (SB-98) commercial layers is desirable for the external egg traits.
2. It is therefore recommended that the ShikaBrown® layers and parents should be promoted and made available to the commercial poultry farmers'

farms.

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