HERITABILITY AND REPEATABILITY ESTIMATES OF SOME MEASURABLE TRAITS OF SHIKA BROWN® CHICKENS IN ALIERO

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ABSTRACT
A total of 566 chicks hatched from 96 ShikaBrown® chicken were used for this study at the Kebbi State University of Science and Technology, Aliero, Nigeria. Growth performance data were collected from the first week through week 18 and data obtained were analyzed using the Generalized Linear Model Procedure of Statistical Package for Social Sciences (SPSS). Generally, heritability estimates (h^2) for all the traits studied ranged from low to high. The h^2 estimated were 0.06±0.00, 0.57±0.01, 0.77±0.01, 0.27±0.01 and 0.09±0.01 for weekly egg production, egg weight, hatch weight, fertility and hatchability, respectively. The h^2 for body weight of male chicks was lowest h^2 (0.06±0.00) at week 2 and highest (0.53±0.01) at week 8, while that of female chicks was 0.40±0.01 at week 2 and 0.91±0.02 at week 18. The repeatability estimates for body weight of male chicks were high, and ranged from 0.52±0.02 at week 2 to 0.66±0.02 at week 8.
Key words: estimates; heritability; repeatability; ShikaBrown®; chicken

INTRODUCTION
In Nigeria, genetic parameters such as repeatability and heritability are given prominence in determining the appropriate animal evaluation (Wolc *et al.*, 2007, Toye *et al.*, 2012). Repeatability has been described as a term to estimate the extent of the consistency of the performance or behaviour of an individual over time (Dohm, 2002). On the other hand, the heritability of a trait, in the narrow sense, is the proportion of the total phenotypic variation that is due to additive genetic effect, which can be passed from the parents to the progeny.
There have been previous attempts at determining the repeatability and heritability estimates of production traits in layers in Nigeria. Olowofeso and Adeleke (2012) estimated repeatability for numbers of eggs laid by Bovans Nera and Harco Black layer strains in phases I and II of production. Yakubu *et al.* (2017) reported a moderate heritability estimate (0.326±0.011) and low repeatability estimate (0.082±0.011) in Sasso chicken breed. The objective of this research was to determine the heritability and repeatability estimates of some measurable traits of ShikaBrown chicken and the first generation of their progenies.

MATERIALS AND METHODS
Location of experiment
The research was conducted at the Animal Science Laboratory, University campus at Aliero (Lat. 12° 18'18" N, Long. 4° 29'52"E and Alt. 266.2m above sea level) in the dry sub-humid zone of Nigeria.
Management of breeding stock
During the onset of lay, the birds were fed diet containing 2,600 ME Kcal/kg and 16-18% crude protein. Egg production of the parent stock was observed before selection and setting up of mating pens. A total of 96 ShikaBrown® chickens of age 48 weeks were used as parents for the study. The birds which consisted of 84 pullets and 12 cocks were selected and allowed to mate in separate pens labelled according to the cocks (sire). The pullets with brown plumage were mated to white- brown cocks at a ratio of 1:7. Fertile eggs were collected three times daily (7:00am, 2:00pm, and 5:00pm). The eggs were sorted to remove cracked eggs, soiled eggs, small-sized or oversized eggs.
Estimates of genetic parameters
Genetic parameters were estimated using the sire model, whereby the total variance was partitioned into those components that are due to sire or environment. In this design, the statistical model is shown below:
$Y_{ij}=\mu + a_i+ e_{ij}$.
Where
Y_{ij}= the record of the j^{th} progeny of i^{th} sire; μ = the common mean; a_i= effect of the i^{th} sire;

e_{ij}= the uncontrolled environmental and non-genetic deviations attributable to the individuals.
Repeatability was estimated using the formula: $R = \sigma^2_G / \sigma^2_G+\sigma^2_E$
Where σ^2_G and σ^2_E are components of the variance respectively between birds and repeated observations.
The standard error (S.E.) of repeatability (R) was calculated using the formulae given by Becker (1984).

$$\text{S.E.} = \sqrt{\frac{2(1-R)^2[1+K-1)R]^2}{K(K-1)(N-1)}}$$

Where:
K = number of records per age of bird; R = repeatability coefficient; N = total number of observations.
Heritability was defined as the ratio of additive genetic variance to phenotypic variance as follows:
Heritability $(h^2) = \sigma^2_A/ \sigma^2_P$
Where:
σ^2_A = additive genetic variance
σ^2_P= phenotypic variance which is variance due to genotype (σ^2_G) and environment (σ^2_E).
The estimate of the narrow-sense heritability (h^2) for the traits studied was calculated as indicated below following the method of Becker (1984):
$h^2 = 4\sigma^2S/(\sigma^2S+\sigma^2 W)$
Where:
h^2 = narrow sense heritability based on paternal half-sib correlation; $\sigma\ ^2S$ = sire (bird) variance component;
$\sigma\ ^2W$ = error variance component.
The standard error (S.E) of heritability (h^2) was calculated according to Swiger *et al*. (1964).

$$\text{S.E.} = \sqrt{\frac{2(1-t)^2[1+K-1)t]^2}{K(K-1)(N-1)}}$$

Where:
t = intraclass correlation ($t = 1/4\ h^2$); K = number of records per age of bird; N = total number of observations.

RESULTS AND DISCUSSION

Coefficients of heritability

The heritability estimates for traits studied ranged from low to high. The heritability estimates for number of eggs produced (at age 38 to 51 weeks) was low (0.06±0.00). High h^2 was estimated for egg weight (0.57±0.01) and hatch weight (0.77±0.01). Fertility had moderate heritability estimate (0.27±0.01), while percent hatchability had low heritability (0.09±0.01). Heritability estimates for male body weight were 0.06±0.00, 0.53±0.01, 0.46±0.01, 0.41±0.01, and 0.40±0.01 for age 2, 8, 10, 12, and 18 weeks respectively. Similarly, heritability estimates for female body weight were 0.40±0.01, 0.75±0.01, 0.85±0.01, 0.84±0.01, and 0.91±0.02 for age 2, 8, 10, 12, and 18 weeks respectively.
The low heritability estimate (0.06±0.002) for egg production observed at 48th week of age in the present study partially agrees with and fall within the range observed by Nurgiartiningsih *et al.* (2005) who reported a range between 0.01 and 0.45 for heritability of egg production of hen-housed and survivor production. The high heritability value for egg weight (0.57±0.01) at 48th week in the present study was in agreement with the findings of Wei and van der Werf (2014) who reported high heritability value (0.63) for purebred and moderate value (0.27) for crossbred laying chickens.
The heritability estimates for male body weight in the present study range from positively low (0.06±0.00 at week 2) to positively high (0.53±0.01 at week 8). The observation agrees with the findings of Banerjee (2011) who reported low heritability value (0.01 to 0.05) for male body weight at week 2, as well as high heritability value (0.54) at week 10. The reason for low heritability estimates at week 2 could be as a result of non-genetic influence such as maternal effect associated with dam and egg size which could mask the likely superiority occasioned by sire additive gene effect observed at later ages. The maternal influence wanes with advancement in age allowing for expression of true genetic potentials of the birds.

However, the heritability estimates for female body weight was positively high and almost increased with age (0.40±0.01 at week 2 to 0.91±0.02 at week 18). The observation also partially agrees with the findings of Kabir *et al.* (2006), who reported high heritability values (0.892, 0.677, 0.559 and 0.700, 0.562, 0.420) for strains A and B of Rhode Island breeder hens aged 20, 30 and 40 weeks, respectively. The observation of the present study does not follow the trend of decreasing heritability values with age as observed by Kabir *et al.* (2006).

Coefficients of Repeatability

The repeatability estimates for traits studied ranged from moderate to high, the repeatability estimates for egg weight (0.67±0.01) and hatch weight (0.70±0.01) were high. Similarly, fertility had high repeatability estimate (0.81±0.03), while percent hatchability had moderate repeatability (0.32±0.04). Repeatability estimates for male body weight were 0.52±0.02, 0.66±0.02, 0.65±0.02, 0.63±0.02, and 0.63±0.02 for age 2, 8, 10, 12, and 18 weeks, respectively. Similarly, repeatability estimates for female body weight were 0.63±0.02, 0.70±0.02, 0.72±0.02, 0.72±0.02, and 0.73±0.02 for age 2, 8, 10, 12, and 18 weeks respectively. Traits with high repeatability indicates greater potentials of the birds to repeat their performance on those traits. High repeatability values on body weight observed agree with the findings of Sanda *et al*. (2014). Moderate value of repeatability estimated in the present study in the case of egg production is not in line with the findings of Yakubu *et al.*, (2017), who reported low repeatability value (0.082±0.011) in Sasso chicken breed.

Table 1: Heritability and Repeatability Coefficients of Some Traits of ShikaBrowns

S/No	**Trait**	**Heritability (h^2)**	**Repeatability (R)**
1	MWEP (38-51)	0.06±0.00	0.37±0.03
2	Egg weight (g)	0.57±0.01	0.67±0.01
3	Hatch weight (g)	0.77±0.01	0.70±0.01
4	Fertility (%)	0.27±0.01	0.81±0.03
5	Hatchability (%)	0.09±0.01	0.32±0.04
6	MBW 2 (g)	0.06±0.00	0.52±0.02
7	FBW 2	0.40±0.01	0.63±0.02
8	MBW 8	0.53±0.01	0.66±0.02
9	FBW 8	0.75±0.01	0.70±0.02
10	MBW 10	0.46±0.01	0.65±0.02
11	FBW 10	0.85±0.01	0.72±0.02
12	MBW 12	0.41±0.01	0.63±0.02
13	FBW 12	0.84±0.01	0.72±0.02
14	MBW 18	0.40±0.01	0.63±0.02
15	FBW 18	0.91±0.02	0.73±0.02

MWEP=Mean weekly egg production; MBW2= Male body weight at week 2, 8, 10, 12 and 18; FBW= Female body weight at week 2, 8, 10, 12 and 18.

Conclusion and recommendation

The moderate to high heritability estimates obtained in the present study indicate that selection of birds could be done for the traits at the phase studied in this experiment to improve the traits. Low estimate was however observed in the case of heritability. However, both genetic parameters could be improved upon by incorporating more records and increasing the sample size in addition to better rearing environment.

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