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Repeatability estimates of growth and egg production traits in the Fulani ecotype chicken

*SOLA-OJO, FOLUKE E.¹, ADEDIBU, YETUNDE I.² & AYORINDE, K.L.¹

¹Department of Animal Production, University of Ilorin, Ilorin, Nigeria

²Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria

*corresponding author: mofesola1@yahoo.com +234-803-821-7248.

Abstract

One hundred and eighty three Fulani Ecotype (FE) chicks hatched from FE eggs were used to estimate Repeatability (R) for growth and Egg production traits. Growth traits measured were Body weight (BW), Body length (BL), Body girth (BG), Wing length (WL), Drumstick length (DL), Keel length (KL), Thigh length (TL), Shank length (SL), Shank diameter (SD). Repeatability estimated was moderate for BW (0.50) from day old to 10 weeks age and high for BG (0.67) and DL (0.65). From 11 to 20 weeks age, high R of 0.91 was estimated for BW, TL (0.69) and BG (0.68) while moderate repeatability estimates of 0.58 and 0.52 were obtained for shank length and shank diameter respectively. At the onset of lay, seventy two adult FE hens were randomly distributed into battery cage, and labelled per unit for egg production records. R was estimated for Egg weight (EW), Egg shell quality (ESQ), Yolk index (YI) and Haugh Unit (HU) at 30, 40, 50 and 60% Hen Housed Production (HHP). R was moderate for HU and ESQ (0.43) at 30% HHP. At 40% HHP, ESQ had the highest R estimate (0.60), while EW and HU had 0.41. At 50% HHP, EW had R of 0.42, ESQ had 0.43, HU had 0.26. R estimate was highest for ESQ at 60% HHP (0.48) followed by HU and EW (0.32). R estimated for YI were consistently low (0.01-0.16) throughout the HHP. R estimated in this study indicated the potential of FE chicken for genetic improvement.

Keywords: Indigenous chicken, Growth traits, Egg quality traits, Repeatability Estimates.

Introduction.

In the ancient times, domestication of poultry was meant for religious, cultural and recreational purposes, particularly where cock fighting provided a major recreation, especially in Europe and America. Lately, in the 20th century and today poultry farming has been on commercial scale. Genetic improvement of poultry has made commercialization of poultry possible and this has led to improved varieties of exotic breeds with good performance, high egg production rate and ability to convert low quality feed into high quality protein within a shorter period. In the developing world, most genetic change take place through change of breeds via crossbreeding, a programme aimed at upgrading indigenous breeds (Nimbkar *et al.* 2008).

Genetic improvement is the systematic exploitation of genetic variation in important traits among individuals within or between breeds and has been considered a high priority in poultry development projects (Branckaert *et al.*, 2000). Genetic improvement of livestock has made and

will continue to impact on agricultural development, food security and sustainability. Genetic improvement can take many forms, but generally and logically follows an ordered hierarchy of events. This starts with understanding the production and marketing systems, choice of appropriate breeds or strains which can sometimes lead to replacement of existing breeds, establishment of an effective pure breeding or crossbreeding system and further improvement through selection of superior genotypes within populations that best suit the production and market conditions.

Genetic improvement in the developed world is now primarily based on few breeds and it is usually a within-breed-improvement programme. Improvement in body weight of meat type poultry is usually through genetic improvement for body weight since it is a highly heritable trait. Ayorinde (1995) stated that in most cases the resultant changes brought about by such efforts, are not measured despite the fact that there is an agreement that selection for increased

body weight in various farm animals should normally be accompanied by changes in morphological and physiological status of the animals. In poultry, it should be in the form of bigger size, fleshing, body condition and general conformation. Geneticists worldwide have various tools that they use in improvement of plant and animal, notable among them is the repeatability estimates (Falconer, 1989). Repeatability or correlation between measurements made on the same animal or plant over time or space is a concept closely related to heritability (Falconer, 1989). It refers to the expression of the same traits in the life of the same animal at different times. This portion of variance will include additive genetic, dominance and epistatic portions, since the genes or gene combinations do not change when they influence the successive expressions of the same trait in the same individuals. It may also include some of the permanent environmental influences which are common.

Repeatability gives the upper limit of heritability in its broader sense. The regression of the future performance on past performance can be used to compare repeatability. It can also be derived as an intra class correlation among records of traits on the same individual by analysis of variance (Ibe, 1995). Repeatability estimates tell the fraction of differences between single records of individuals that are likely to occur in future performance. Repeatability estimates also tell how many records should be consulted on an individual before it may be culled. When the repeatability estimate is high, culling on the basis of first time production will be effective in improving the production when the trait is expressed next. Since repeatability is influenced by changes in genetic status of animals involved (Ibe, 1995), it will be appropriate to estimate repeatability in traits associated with growth and egg production in an indigenous Fulani Ecotype Chicken as this can be a source of information for breeder in any improvement programme for this indigenous chicken type.

Materials and Methods

One hundred and eighty three day old chicks hatched from eggs collected from Fulani Kraals in three settlements in Kwara State were used for the experiment. The birds were brooded and reared to 20 weeks of age using a deep litter system. Feed given were chick mash from 0- 8 weeks and

growers mash from 9- 20 weeks formulated according to chicken feed requirement by NRC (1994). Feed and water were supplied *ad libitum*. All the necessary vaccinations were administered as appropriate. Data on growth measurements beginning from first week of age were taken on a weekly basis. Body Weight (BW) was taken using a sensitive weighing scale recorded in grams. Body Length (BL) was measured, with the aid of a tape rule from the nasal opening with the neck carefully stretched and measured along the back to the tip of the pygostyle. Body Girth (BG) was determined by winding a tape rule beneath the wing and around the region of the breast. Shank Length (SL) was measured using a pair of Vernier calliper as the distance from the foot pad to the hock joint. Shank Diameter (SD) was measured using a pair of vernier calliper at the middle of the left shank of each bird. Thigh Length (TL) was taken with the use of a tape rule from the tip of the tarsus to the ball joint. Keel Length (KL) was measured from the cranial to the caudal terminals of the keel bone using a tape rule. Wing Length was measured with aid of a tape rule with the wing stretched and the measurement taken from the humerus-coracoids junction to tip of the digit. Data obtained on growth traits were grouped into two (0-10 weeks and 11-20 weeks) which enabled determination of variances for estimating repeatability over these periods (Ibe, 1995).

At 21 weeks, seventy two adult FE hens were randomly distributed into battery cage (hen per unit cage) and labelled for proper identification and data collection on egg production traits. This was done for a period of 52 weeks, and egg production period were grouped into four using Hen Housed Production (HHP) which was calculated as the ratio of daily number of egg produced to the number of hen housed. Hens were fed diet formulated according to NRC (1994) to meet a laying chicken feed requirement throughout the period.

Repeatability was estimated for egg production and egg quality traits from one thousand, five hundred and sixty five (1565) eggs collected on daily basis for a period of 52 weeks. From the caged FE hens, eggs collected on daily basis were numbered according to the hen number. An egg was taken from each hen on weekly basis and used to evaluate internal and external quality traits. This was done by taking a labelled, freshly

laid egg as a representative of eggs laid by the hen for that week. The egg was weighed, broken and the content poured into a Petri dish for determination of the external and internal egg quality traits on weekly basis for a period of 52 weeks. Albumen and yolk were carefully separated with the aid of a spatula and each weighed. Yolk height and albumen height were measured using spherometer while yolk width was measured with the aid of vernier calipers and Yolk index (YI) was taken as the ratio of yolk height (YH) to yolk width (YWD). Haugh Unit Score was calculated by the use of Haugh unit charts, using the H vs. W. Where H = Height of albumen in (mm), W = weight of egg (g) Nesheim *et al.* (1979). The weight of the shell was determined by washing the shell with warm water to remove any trace of albumen and then air dried before weighing. Egg Shell quality was then calculated using the expression:

Shell weight(g)

Surface area (cm²)

Where the surface area = $4.835 \times 0.602w$ and w is the weight of the egg observed.

Values obtained were grouped and repeatability was estimated from the value at 30, 40, 50 and 60 % Hen Housed Production (HHP).

Statistical Analysis

Variances between hens $\alpha^2 W$ and within hens $\alpha^2 E$ were determined by equating each mean square from the ANOVA table to its expectation and solving the two resulting equations according to Becker (1984).

$$\alpha^2 W = \frac{Msi - MSe}{K} \quad \dots\dots\dots(1).$$

Where: Msi = Mean Square for individuals.

MSe = Mean Square for error.

K = number of measurements per individual.

Repeatability values were estimated from the variances using:

$$R = \frac{\alpha^2 W}{\alpha^2 W + \alpha^2 E} \quad \dots\dots\dots(2).$$

All data collected were subjected to statistical analysis using SAS/STAT, programmed by SAS Institute (2003).

Results and Discussion

Moderate Repeatability estimate (R) was obtained for body weight in Fulani Ecotypes chicken from day old to 10 weeks (0.50), higher value (0.91) was however obtained from 11 to 20 weeks age (Table 1). From day old to 10 weeks age, R estimates for body parts such as body girth and

drumstick length were above average (0.65) and (0.67), respectively. While R obtained for body length, wing length, keel length, thigh length, shank length, and shank diameter were very low R estimates (0.29 to 0.39) as shown in Table 1. Moderate to high R estimates obtained for YI, body weight from day old to 10 weeks, and from 11 to 20 weeks were within the range of Repeatability estimates reported by Sola-Ojo and Ayorinde (2011) where 0.99 R was obtained for body weight in Anak 2000 and Arbor Acres broilers, and 0.98 for Shavers and Ross at ages of 2 and 4 weeks respectively. Kabir *et al.* (2008) also reported repeatability estimates for body weight in Anak 2000 strain to be 0.91, 0.99, 0.96, and 0.90 at 2, 4, 6, and 8 weeks, respectively, while repeatability estimates of other linear body measurement reported by Kabir *et al.* (2008) were high except for the breast width, at week 2, back length and breast width at week 4 and shank length and breast width at week 6. Body parts R estimates obtained for FE chicken in this study were low and did not correspond with those obtained for broilers except that of body girth and drumstick length that corresponds with moderate and high R estimates reported for some body parts in broiler chickens strain (Sola-Ojo and Ayorinde, 2011; and Kabir *et al.* 2008). Repeatability estimates for egg production and quality traits were above average, moderate and low. Low R estimates were obtained for egg weight and yolk Index (0.26 and 0.08), while moderate R estimates of 0.43 was obtained for Egg shell quality and Haugh Unit at 30% Hen House Production (Table 2). At 40 % Hen Housed Production, Egg shell quality had high R estimates (0.60) but Haugh Unit and Egg weight had moderate R estimates of 0.41 while Yolk Index had a very low R estimates of 0.01. (Table ii). At 50% HHP, moderate R was estimated for EW and ESQ (0.42, 0.43) and low R was estimated for Yolk Index and Haugh Unit (0.02 and 0.26). At 60% HHP Egg Shell Quality had moderate R estimates of 0.48, HU had 0.42, EW and YI had low estimates of 0.32 and 0.16, respectively.

The present results indicated a consistently low R estimates for YI of FE eggs, and moderate to high estimates for ESQ at all level of HHP. EW had moderate R at 40% and 60% and this corresponds with the findings of Ayorinde and Sado (1988) where repeatability estimates of 0.58 to 0.60 were reported for egg weight from

Sala-Ojo *et al.*: Repeatability of growth and egg production in Fulani ecotype chicken
 Table 1: Repeatability Estimates of Growth Traits in the Fulani Ecotype chicken from Dayold to 20 weeks

Traits	0-10 weeks			11- 20 weeks		
	α^2_i	α^2_e	R	α^2_i	α^2_e	R
Body weight	3878	3870	0.50	5481	5305	0.91
Body girth	8.58	4.18	0.67	1.68	3.21	0.68
Drumstick length	5.10	2.72	0.65	1.00	1.54	0.39
Wing length	3.85	9.40	0.29	1.76	1.88	0.48
Keel length	1.28	1.98	0.39	0.21	0.61	0.26
Thigh length	0.65	1.49	0.30	0.60	0.28	0.69
Shank length	0.95	2.15	0.31	0.49	0.36	0.58
Shank diameter	0.01	0.02	0.33	0.02	0.02	0.52

Table 2: Repeatability Estimates for Egg quality Traits in the Fulani Ecotype chicken at 30, 40, 50 and 60% Hen Housed Production

Traits	α^2_i	α^2_e	R
30% HHP			0.26
EW	3.720	10.570	0.43
ESQ	0.030	0.004	0.08
YI	0.060	0.660	0.43
HU	106.900	138.900	
40% HHP			0.41
EW	6.010	8.710	0.60
ESQ	0.001	0.015	0.01
YI	0.001	0.540	0.41
HU	222.400	322.000	
50% HHP			0.42
EW	5.950	8.160	0.43
ESQ	0.003	0.004	0.02
YI	0.010	0.570	0.26
HU	83.000	242.69	
60% HHP			0.32
EW	52.950	12.740	0.48
ESQ	0.005	0.080	0.16
YI	0.120	0.630	0.42
HU	163.500	227.910	

W = Egg weight, ESQ = Egg shell Quality, YI = Yolk index, HU= Haugh unit.
 α^2_i = individual variance α^2_e = error variance R=Repeatability estimate

records of individual egg weight taken over a 56 day period from Hubbard layers. It was low however compared to an estimate of 0.76 for egg weight in white Leghorn chickens by (Ibe 1985), and fall within the range reported by Korolev (1976), where an estimate of 0.46 to 0.71 were reported for the egg weight in different lines of white Leghorns. A relatively closer estimate of 0.68 was also reported for White leghorn and Australop pullets by Kotaiah *et al.* (1976).

However, the difference in repeatability estimates for egg quality traits reported is in line with the submission of Ibe (1995) and Toye *et al.* (2012) where it was stated that discrepancies in Egg quality traits repeatability in layers will always occur as a result of different genetic background and environmental circumstances.

Conclusion

This study shows that body weight at early and

later stage of growth in FE chicken as well as Egg shell quality will require fewer records for genetic improvements. This is because they have relatively high repeatability estimates, while usage of linear body measurements, yolk index and Haugh units will require larger record for genetic improvement in the Fulani Ecotype Chickens. Traits such as body weight, body girth, drumstick length, Egg weight and Egg shell quality are traits with high Repeatability estimates in FE chicken. Repeatability estimated in this study will be useful as a tool for identification of genetic potential of FE chickens especially in the traits examined, and it will assist the breeder in any programme design for improvement of meat and egg production in the Fulani Ecotype Chickens.

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