PHENOTYPIC VARIANT IN GROWTH AND DEVELOPMENT AMONG MALE AND FEMALE ARBOR ACRES CHICKEN STRAINS

Abe, O.S.[1,2], Ayankoso, M.T. [1], Olayinka, D.O. [1], Adewumi, B.O. [1], Tyogbea, T.T. [2] and Olaniyi, W.A.[1]
[1]Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria
[2]Aquatech College of Agriculture and Technology, Ibadan, Oyo State, Nigeria
Corresponding author: olugbenga.abe@aaua.edu.ng/ abeolugbenga@gmail.com

Abstract
The performance of broiler birds is determined by its genotype and environmental factors which are determinants of variations in the phenotype. A total of fifty (50) day-old Arbor Acres broiler chicken were used for the study. Body weight (g) were measured using a digital sensitive scale while the linear body measurements (cm); wing length (WL), shank length (SL), thigh length (TL), comb length (CL), back length (BL), breast girth (BG) and keel length (KL) were measured with the aid of a measuring tape. The experiment lasted for 28 days. Data collected were subjected to one-way analysis of variance (ANOVA) to generate the variance components using SAS statistical package. The variance components were subsequently used to generate the genetic parameters. The results showed that male chickens (237.10g) were superior in body weight to female chickens at 2 weeks (231.55g), though some of the linear traits (WL, TL and CL) were better in female chickens. The results of the body weight for female chickens (569.92g) were superior at the 4th week than the male chickens (545.23g). The heritability estimates was highest in BG and KL for female chickens while SL presented the highest value of 0.71 and the lowest value of 0.50 in male and female chickens respectively. Amongst the linear body measurements, SL (0.68cm) and BL (0.68cm) had the highest repeatability value in male chickens while repeatability value was highest in CL (0.66cm) amongst the linear measurements in male chickens. It was concluded that male chickens perform better than female chicken early in life. Arbor Acre chickens could be effectively selected on the basis of KL at 2 weeks, and SL and KL at 4 weeks because their heritability was moderate to fairly high for improved performance and significant genetic gain in subsequent generations.

Introduction

Intensive research in the area of breeding and nutrition has had great impact on the poultry production in recent times through targeted traits of interest with respect to variance components. The performance of broiler birds is determined by its genotype and environmental factors (Edward and Denman, 1975) which determines the phenotype. In animal breeding, it is imperative to determine breeding value with the objective of classifying the best individuals that will be the parents in the next generation, and quantifying its contribution to the genetic gain (Grosso *et al*., 2010). Some of the genetic parameters used for selection by breeders are repeatability, heritability and genetic correlation. The presence of correlation between body weight at different ages and other body traits and their heritability and repeatability estimates, suggested that direct selection for body weight at 38 and 42 days of age could produce indirect genetic gain for breast muscle, leg and eviscerated body weight (Gaya *et al*., 2006).

Kabir *et al*. (2006) reported that mean values of body weight at various ages and heritability estimates observed for body weight and shank length decrease with increasing age of birds. The concept of heritability can be expressed in terms of the proportion of the variation in a given trait within a population that is not explained by the environment or random chance (Gazzaniga *et al.,* 2008; Wray and Visscher, 2008). Furthermore, repeatability estimates are important tools for quantifying the transmitting ability and its ability to maintain it performance and ranking within a test group on subsequent generations (Udeh, 2010). The poultry breeders have tried over time to establish the relationship between body weight and conformation traits with respect to feeding using heritability and repeatability parameters as tools, as this information reflects on the feed efficiency as well as the performance of broiler chickens (Kabir *et al*., 2008; Sola-Ojo and Ayorinde, 2011; Ubani *et al*., 2011). Okon *et al*. (1996) also reported that the

knowledge of these linear body measurements will result in greater economic returns once the breeders can effectively combine body weight and conformation traits. This study aimed at evaluating the variation between the body weight, linear body measurements, heritability and repeatability in male and female broiler chickens at different ages.

Materials and Methods

Experimental Birds and Management

A total of fifty (50) 1-day-old Arbor Acres broiler chicken weighing between 41 and 48 g were used for the study. The chicks were brooded in a brooding house with the aid of guard to limit their movement and conserve heat. Charcoal was used as a source of heat for the brooding. All vaccination schedules and management procedures were followed for the chicks and the pen respectively. The chicks were reared on deep litter pens with wood-shavings as litter material. The floor of the pen was kept dry always by replacing any wet litter when necessary. Anti-stress vitamins and antibiotics were administered via water at various times to check against possible infections. The chicks were fed *ad libitum* with starter crumbles containing 24.0% Crude Protein (CP) from day old till 4 weeks of age. Clean drinking water was provided. The experiment lasted for 28 days.

Data Collection Procedure

Body weight (g) of the individual birds were measured using a Camry® digital scale, with a maximum capacity of 5000g with an accuracy of 0.5g, every two weeks while the linear body measurements (cm) were also taken every two weeks with the aid of a measuring tape. Measurement were carried out early in the morning before feeding. The following linear body measurements were taken using tape measure; Wing length (WL) was measured by stretching the wing and measuring from the armpit of the bird to the end of the wing, shank length (SL) was taken from the hock joint to the metatarsal pad, thigh length (TL) was taken as the length between the hock joint and the pelvic joint, comb length (CL) was measured from one end to another at the joining site to the head, back length (BL) was measured from the insertion of the neck into the body to the beginning of the tail at the back side of the bird, breast girth (BG) was measured as the circumference of the breast region and keel length (KL) was measured from the chest bone to the end of the abdomen region as described by Sadick *et al*. (2020) and Udeh *et al*. (2011).

Data Analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using SAS (SAS, 2004) to estimate variance components which was utilized in the estimation of heritability (h^2) and repeatability (R) of growth traits.

Heritability (h^2) = $\sigma^2 g / \sigma^2 p$; where $\sigma^2 g$ = genetic variance; $\sigma^2 p$ = phenotypic variance

Repeatability= $\sigma_i^2 (\sigma_i^2 + \sigma_e^2)^{-1}$; where; σ_i^2 = individual variance component, σ_e^2 = error, $\sigma_i^2 + \sigma_e^2$ = total phenotypic variance

Results and Discussion

Mean body weight and linear body measurements at 2 weeks of age

The results from the Table 1 showed that male chickens had higher body weight (237.10g) at two weeks compared to their female counterpart (231.55g). The 2 weeks body weight obtained in this study for both male and female chickens was higher when compared to the report of Kabir *et al.* (2008) using Anak broiler (191.63g) and Ojo *et al*. (2015) using Hubbard broiler chickens (204.40g) but it was lower in comparison to the report of Ojedapo (2013) in Marshall broilers (374.78g). The superior body weight recorded in male chickens reflected in higher SL (6.86cm) and KL (5.13cm) while female chickens had higher values in other linear body measurements. The heritability (h^2) was moderate for body weight and linear body traits ranging from 0.44 to 0.57 in males and 0.40 to 0.54 in females. The results of this study gave an indication that these traits are slightly influenced by environmental factors. Male chickens had higher repeatability (R) value in body weight and most of the linear body measurement than female chickens. The highest R of 0.56 in male chickens was recorded in CL. Likewise the highest R of 0.61 was recorded for body weight in male chickens. This mean that Arbor Acre chickens could be effectively

selected at 2 weeks based on CL. However, high R estimates of between 0.90 and 0.99 have been reported for body weight in broiler chickens reared in the tropics (Kabir *et al*., 2008)

Table 1: Means ± SE of body weight and linear body measurement of Arbor Acre strains at 2 weeks of age.

	Male	h^2	R	Female	h^2	R
BW	237.10 ±10.50	0.45 ±0.01	0.61 ±0.05	231.55 ±7.74	0.40 ±0.10	0.57 ±0.02
WL	10.20 ±0.17	0.48 ±0.03	0.48 ±0.00	10.28 ±0.17	0.41 ±0.07	0.48 ±0.02
SL	6.86 ±0.22	0.44 ±0.01	0.55 ±0.01	6.79 ±0.15	0.46 ±0.06	0.51 ±0.03
TL	9.00 ±0.15	0.51 ±0.01	0.48 ±0.00	9.24 ±0.16	0.45 ±0.08	0.49 ±0.02
CL	1.28 ±0.04	0.50 ±0.07	0.56 ±0.01	1.31 ±0.03	0.47 ±0.11	0.52 ±0.04
BL	9.80 ±0.24	0.56 ±0.10	0.51 ±0.01	9.93 ±0.16	0.47 ±0.05	0.48 ±0.02
BG	1.84 ±0.44	0.49 ±0.11	0.43 ±0.00	1.80 ±0.34	0.44 ±0.09	0.57 ±0.10
KL	5.13 ±0.13	0.57 ±0.06	0.51 ±0.01	5.08 ±0.12	0.54 ±0.05	0.53 0.04

WL = wing length, SL = Shank length, TL = Thigh length, CL = Comb length, BL = Back length, BG = Breast girth, KL = Keel length, h^2 = Heritability, R = Repeatability

Mean body weight and linear body measurements at 4 weeks of age

Table 2 showed that female chickens had higher body weight and linear body measurement than their male counterpart. The highest variance (1.24 cm) in linear measurements between male and female chickens was recorded in shank length. The results of the study showed that live body weight increased with age because there was a 42% increase in body weight at 4 weeks when compared to weight recorded at 2 weeks. Ojo *et al*. (2015) also reported in their study that age is an indicator of growth and physiological development in Hubbard broiler chickens. The heritability estimates was highest in BG and KL for female chickens while SL presented the highest value of 0.71 and the lowest value of 0.50 in male and female chickens respectively. Malik *et al.* (1997) in their study also reported higher estimate for SL in male chicken than female. The repeatability estimates was moderate to fairly high in both female and male chickens. The results showed that body weight was a highly repeatable trait in both female and male chickens. The heritability estimates obtained in this study is higher than what Ebangi and Ibe (1994) reported in their study. Amongst the linear body measurements, SL (0.68cm) and BL (0.68cm) had the highest repeatability value in male chickens while repeatability value was highest in CL (0.66cm) amongst the linear measurements in male chickens. Kabir *et al*. (2008) and Ubani *et al*. (2011) reported moderate to high estimates of R in linear body measurements of broiler chickens.

Table 2: Means ± SE of body weight and linear body measurements of Arbor Acre strains at 4 weeks of age.

	Male	h^2	R	Female	h^2	R
BW	545.23 ±26.93	0.55 ±0.01	0.74 ±0.08	569.92 ±26.41	0.58 ±0.03	0.74 ±0.10
WL	13.21 ±0.28	0.57 ±0.02	0.60 ±0.02	13.41 ±0.40	0.66 ±0.03	0.65 ±0.05
SL	12.43 ±0.97	0.50 ±0.02	0.68 ±0.05	13.67 ±0.25	0.71 ±0.03	0.50 ±0.09
TL	14.20 ±0.15	0.52 ±0.02	0.60 ±0.07	14.96 ±0.99	0.53 ±0.02	0.52 ±0.01
CL	1.82 ±0.05	0.60 ±0.03	0.64 ±0.08	1.92 ±0.06	0.57 ±0.03	0.66 ±0.10
BL	12.63 ±0.23	0.59 ±0.02	0.68 ±0.04	12.90 ±0.23	0.61 ±0.03	0.58 ±0.03
BG	2.13 ±0.04	0.61 ±0.03	0.60 ±0.02	2.15 ±0.06	0.53 ±0.02	0.64 ±0.03
KL	9.33 ±1.11	0.61 ±0.03	0.62 ±0.03	9.49 ±1.10	0.49 ±0.02	0.62 ±0.03

WL = wing length, SL = Shank length, TL = Thigh length, CL = Comb length, BL = Back length, BG = Breast girth, KL = Keel length, h^2 = Heritability, R = Repeatability

Conclusion

The heritability and repeatability estimates of linear measurement in this study were moderate to fairly high. Therefore, Arbor acre chickens could be effectively selected on the basis of body weight, shank length and keel length for improved performance and significant genetic gain in subsequent generations.

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