

REPEATABILITY ESTIMATES OF SOME GROWTH TRAITS IN FOUR BROILER STRAINS AT DIFFERENT AGES

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ABSTRACT

A total of two hundred and eight (208) broiler chicks belonging to four strains (Anak 2000, Arbor Acre, Ross and Shavers), were used to estimate repeatability of some growth traits at ages 2, 4 and 6 weeks. The traits considered were Body weight, (BW), Body length, (BL), Body girth (BG), Drumstick length (DL), Keel length, (KL), Shank length (SL), Shank diameter (SD) and Wing length (WL). Repeatability estimates of body weight were (0.99) for Anak 2000 and Arbor Acre at ages 2, 4, and 6 weeks, Shavers at 6 weeks and Ross at ages 4 and 6 weeks. It was (0.98) for Shavers at ages 2, and 4 weeks, and Ross at 2 weeks of age. Estimates obtained for other traits measured were highly repeatable (≥ 0.60) across the strains. Medium repeatability estimate of 0.50 was obtained for shank length in Anak 2000 at 2 weeks of age while lower repeatability estimates obtained were 0.46 and 0.32 for SL and SD in Arbor Acre at 4 weeks of age, 0.35 for shank length and shank diameter and 0.43 for wing length in Shavers at 2 weeks. All the traits considered in the Ross strain were highly repeatable (≥ 0.83), indicating possible high expected response from selection for the traits.

Key words: Broiler strains, Age, Growth traits, Repeatability

INTRODUCTION

The major sources of poultry meat in the Nigerian markets are chicken broilers, spent layers and cockerels. Broilers are specially made for meat production because they have short turn-over rate, better feed conversion ratio, rapid growth rate and ability to utilize feedstuffs and by-products which are regarded as wastes and of no nutritional value to man. The performance of a broiler bird is determined partly by its genotype and partly by environmental factors (Boukwamp *et al.*, 1973; Edward and Denman, 1975). Evaluation of the performance of farm animals is done using various indices, most especially the growth and development traits as well as body conformational traits. Linear body part measurements have heritable basis and play a major role in the subsequent carcass yield of an animal (Falconer, 1989). Body parts such as keel length and width, body length, shank length are not independent of one another but

when observed separately tend to disclose facts which include the ability to select superior individuals. A number of external parts were known to be positively correlated with body weight (Maciejowski and Zieba, 1982) while some have been reported to constitute growth criteria (Korolev, 1976; Ibe, 1994, 1995 a and b). Selection of better breeds or strains has gone a long way in producing quick and rapid transformation in animal protein supply (Nawathe and Larmode, 1987). One of the tools used for selection by breeders is the repeatability estimate. Repeatability estimate is the ratio of the broad genetic variance and the portion of the environment to the phenotypic variance. It is a measure of the similarity of successive records that are made by an individual and a measure of an individual's ability to repeat its ranking in a population and successive records (Falconer, 1989; Ibe, 1995). Repeatability estimates of growth traits in broiler strains at different ages will

RESULTS AND DISCUSSION

Repeatability estimates and estimated variance components of body weight and linear body measurements in Anak 2000, Arbor Acre, Ross and Shavers at weeks 2, 4, and 6 are shown in Tables 1, 2, 3, and 4, respectively. The estimates ranged from low to medium to high. However, the majority of the growth traits observed had high repeatability estimates.

Anak 2000 strain had a very high repeatability of 0.99 for body weight at weeks 2, 4, and 6 (Table 1). All the body parts measured in the strain had higher repeatability at early stage of growth and development, except the estimate for shank length that was moderate at 2 weeks of age. This is an indication that Anak 2000 can be selected at early stage for growth traits.

The results of Arbor Acre (Table 2) showed that, this broiler strain had high repeatability estimates for body weight and the body parts measured at week 2 (0.88 to 0.99). High repeatability estimates also were obtained for BW, BL, BG, DL, KL, and WL at week 4 while lower estimates were obtained for SL (0.46) and SD (0.32). High repeatability estimates (0.61 to 0.99) were obtained for all the body parts and body weight at the age of 6 weeks. Therefore, all the growth traits are important in selection of Arbor Acre for growth traits at 6 weeks of age.

All the repeatability estimates for Ross strain were very high (0.83-0.99) from 2 to 6 weeks. None of the traits observed in Ross had medium or low repeatability estimates. This is an indication that all the growth traits in Ross have ability to repeat their

outstanding performance and maintain ranking in successive records.

At the age of 2 weeks Shavers had higher repeatability estimates that ranged from 0.86 to 0.95 for BW, BL, BG, and DL, medium repeatability of 0.58 for KL and low repeatability estimates of 0.35 and 0.43 for SL, SD, and WL. Table 4 indicates that all the body parts measured had high repeatability estimates in Shavers except SD (0.35) which could be regarded as moderate. At week 6 BW, BL, BG, DL, and WL were highly repeatable with estimates of 0.99, 0.95, 0.86, 0.83 and 0.71, respectively. Keel length and SD were moderately repeatable and had values of 0.56 and 0.54 in Shavers strains.

Higher repeatability estimates obtained for the broiler strains in this study correspond with the reports of Kabir *et al.* (2008) where high repeatability estimates were reported for growth traits in Anak 2000 broiler strain. The chicken strains used in this study have the greater ability to repeat their present performance in the future. High repeatability estimates obtained showed that fewer records are required to estimate the potential of these birds across the strains and to realise a high expected response from selection. However, larger records are required for those with lower repeatability, especially shank length and shank diameter in Arbor Acre strain, shank length, shank diameter and wing length in Shavers strain at two weeks of age. This is in agreement with the report of Falconer (1989), which states that fewer records are required to realise a high expected response from selection in traits with high repeatability estimates while those with low repeatability estimates will require larger number of records.

help the farmer to estimate the potential of the broiler birds and know those birds that will be of high

response to selection in any future programme designed for improvement of body weight in a flock.

MATERIALS AND METHODS

Four strains of commercial broiler used for this study were obtained from different hatcheries at day old (55 Ross, 51 Anak, 51 Shavers, and 51 Arbor Acre broiler strains). Day-old chicks were brought to the Animal Pavilion Unit of the Department of Animal Production, Faculty of Agriculture, University of Ilorin on the same day. They were weighed, wing-tagged and randomly distributed into electrically-heated battery cages for brooding. The chickens were fed standard broiler diet (NRC, 1984) formulated to meet their nutrient requirements. Feed and water were given to the birds *ad libitum*. Necessary medication and vaccination programmes were observed accordingly. Measurement of individual body weight and other body parts was done at weeks 2, 4 and 6. Body weight (BW) was measured in gram at the initial stage with the aid of Scout II electronic top loader balance (600g) and 10-kg measuring scale thereafter, while the body parts were measured in centimetres with the aid of tape rule and vernier callipers as follow:

- Body length (BL): Measured with the aid of a tape rule from the nasal opening with the neck carefully stretched and along the back to the tip of the pygostyle.
- Body girth (BG): Determined by winding a tape rule beneath the wing and around the region of the breast.
- Shank length (SL): Measured using a pair of vernier callipers as the distance from the foot pad to the hock joint.

- Shank diameter (SD): Diameter was measured using a pair of vernier callipers at the middle of the left shank of each bird.
- Thigh length (TL): Taken with the use of a tape rule from the tip of the tarsus to the ball joint.
- Keel length (KL): Measured from the cranial to the caudal terminals of the keel bone using a tape rule.
- Wing length (WL): Measured with the aid of a tape rule with the wing stretched and the measurement taken from the humerus-coracoid junction to tip of the digit.

Data collected were analyzed using SAS (1993) procedure from which the analysis of variance was generated to obtain the variances for estimating repeatability. Repeatability values were estimated from the variances using the method of Becker (1984). The model used was of the form:

$$Y_{ijk} = \mu + P_i + I_j + e_{ijk}$$

Y_{ijk} = record of the j^{th} animal in the i^{th} measurement period

μ = Population mean

P_i = Fixed effect of the i^{th} period of measurement

I_j = Random effect of the j^{th} individual

e_{ijk} = Random error

Repeatability was estimated from the expression:

$$R = \sigma^2_i / \sigma^2_i + \sigma^2_e, \text{ where}$$

σ^2_i = Individual birds variance

σ^2_e = Variance due to error

$\sigma^2_e + \sigma^2_e$ = Phenotypic variance

R = Repeatability

Repeatability Estimates of Some Growth Traits in Four Broiler Strains at Different Ages

Table 1: Variance components and repeatability estimates for growth traits in Anak 2000 at different ages

Trait	2 weeks			4 weeks			6 weeks		
	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R
BW	1956.00	17.99	0.99	19400.19	185.28	0.99	26718.61	260.27	0.99
BL	1.53	0.03	0.98	5.67	0.06	0.98	4.20	0.07	0.98
BG	2.61	0.04	0.99	2.80	0.29	0.90	2.67	0.04	0.98
DL	0.30	0.20	0.60	0.30	0.15	0.66	0.42	0.05	0.89
KL	0.43	0.07	0.86	0.47	0.19	0.71	0.23	0.08	0.80
SL	0.10	0.10	0.50	0.23	0.02	0.92	0.20	0.04	0.83
WL	0.74	0.01	0.98	0.27	0.01	0.96	0.96	0.02	0.97
SD	0.06	0.03	0.66	0.63	0.01	0.98	0.14	0.31	0.82

BW = body weight, BL = body length, BG = body girth, DL = drumstick length, KL = keel length, SL = shank length, WL = wing length, SD = Shank diameter

Table 2: Variance components and repeatability estimates for growth traits in Arbor Acre at different ages

Trait	2 weeks			4 weeks			6 weeks		
	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R
BW	987.07	11.22	0.99	4299.34	9.02	0.99	17653.54	41.34	0.99
BL	1.03	0.01	0.90	3.34	0.06	0.98	2.82	0.11	0.96
BG	0.66	0.07	0.90	2.61	0.10	0.90	1.66	0.28	0.85
DL	0.37	0.07	0.83	1.23	0.12	0.66	0.43	0.09	0.84
KL	0.69	0.01	0.98	0.67	0.11	0.71	0.25	0.06	0.97
SL	0.11	0.02	0.84	0.38	0.44	0.92	0.44	0.11	0.80
WL	0.14	0.01	0.93	3.11	0.53	0.96	1.11	0.07	0.61
SD	0.16	0.22	0.88	0.09	0.22	0.98	0.11	0.02	0.84

BW = body weight, BL = body length, BG = body girth, DL = drumstick length, KL = keel length, SL = shank length, WL = wing length, SD = Shank diameter

Table 3: Variance components and repeatability estimates for growth traits in Ross at different ages

Trait	2 weeks			4 weeks			6 weeks		
	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R
BW	1326.05	16.36	0.99	13541.18	4.83	0.99	36776.88	220.89	0.99
BL	1.16	0.22	0.84	5.44	0.07	0.98	6.68	0.24	0.96
BG	0.63	0.01	0.99	3.00	0.04	0.98	3.36	0.04	0.98
DL	0.25	0.00	0.99	0.95	0.15	0.86	0.65	0.03	0.95
KL	0.55	0.01	0.98	0.16	0.01	0.92	0.62	0.04	0.94
SL	0.24	0.02	0.91	0.15	0.09	0.94	0.22	0.18	0.92
WL	0.52	0.03	0.94	0.76	0.01	0.99	0.99	0.04	0.96
SD	0.11	0.01	0.99	0.07	0.01	0.98	0.20	0.04	0.83

BW = body weight, BL = body length, BG = body girth, DL = drumstick length, KL = keel length, SL = shank length, WL = wing length, SD = Shank diameter

Table 4: Variance components and repeatability estimates for growth traits in Shavers at 2, 4 and 6 weeks of ages

Trait	2 weeks			4 weeks			6 weeks		
	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R	σ^2_i	σ^2_e	R
BW	936.12	15.18	0.98	5291.36	82.33	0.98	14690.00	101.32	0.99
BL	1.19	0.12	0.94	5.09	0.32	0.94	2.29	0.12	0.95
BG	0.95	0.15	0.86	3.60	0.16	0.95	0.68	0.08	0.86
DL	0.12	0.01	0.92	2.26	0.10	0.95	0.58	0.18	0.83
KL	0.14	0.10	0.58	0.27	0.10	0.94	0.13	0.01	0.56
SL	0.05	0.10	0.35	0.26	0.01	0.72	0.26	0.02	0.71
WL	0.37	0.50	0.43	0.97	0.43	0.69	1.43	0.12	0.86
SD	0.05	0.10	0.35	0.13	0.10	0.55	0.13	0.11	0.54

BW= body weight, BL= body length, BG = body girth, DL= drumstick length, KL= keel length, SL= shank length, WL = wing length, SD = shank diameter.

CONCLUSION

The Ross strain showed higher repeatability estimates for all the traits measured at all ages, indicating that it would require fewer records to realise

a high expected response from selection for those traits.

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