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HERITABILITY AND REPEATABILITY ESTIMATES OF GROWTH AND LINEAR BODY MEASUREMENTS OF MALE AND FEMALE BROILER LINES

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Abstract

This study was designed to estimate the genetic parameters (h^2, R) for growth and linear body measurements in male and female broiler lines in NAPRI, Shika, Zaria. A total of 350 broiler birds were used, which consisted of 100 birds each for sire and dam line and 75 birds each for sire control and dam control. The growth and linear body measurements traits considered are body weight (BW), body length (BL), Body girth (BG), Thigh length (TL), keel length (KL) and Shank length (SL) which were measured biweekly. The heritability estimates for body weight and linear body measurements from 2 to 8 weeks ranged from low to high (0.05± 1.63 to 0.58 ± 0.73) except for thigh length at 8 week which was high (0.81 ± 1.27) in sire line. It ranged from low to high in dam line (0.04 ± 1.50 to 0.9± 0.11). The heritability estimates for sire control ranged from low to high (0.02± 2.11 to 0.46± 1.09). It was also observed low for dam control except in body girth and shank length at 2 weeks of age. The repeatability estimates for body weight were generally low for both the selected lines and the control birds ranging from 0.001 to 0.193 across all ages. Repeatability of linear body measurements were also low though moderate with body girth at 2 weeks (0.350) and body girth at 4 weeks (0.251) for dam line, keel length at 6 week (0.271) for sire line and keel length at 6 weeks (0.291) for dam line. Differences obtained in heritability estimates could be attributed to line effects and sampling error due to small data. Low repeatability estimates revealed that high numbers of records are required to realize high expected response to selection.

Keywords: *Broiler birds, Heritability, Repeatability, Body weight and Body linear measurement*

INTRODUCTION

The performance of broiler birds is determined by its genotype and environmental factors (Boukwamp *et al.*,1973; Edward and Denman, 1975). 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). Selection of better breeds or strains has gone a long way in producing quick and rapid transformation in animal proteins supply (Nawathe and Lamorde, 1987). Some of the genetic parameters used for selection by breeders are repeatability, heritability and genetic and phenotypic correlations.

According to Falconer (1989), fewer records are required to realize a high expected response from selection in traits with high repeatability estimates while those with low repeatability estimates will require larger number of records. Gaya *et al.* (2006) had shown genetic correlation between body weight at different ages and carcass traits and 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. They also indicated that

heritability estimate for body weight at different ages for evaluation of genetic variability and considerable direct additive genetic effects seemed to exist in the expression of body composition traits. Kabir *et al.*(2006*)* reported that mean values of body weight at various ages showed good performance. They also noted that heritability estimates observed for body weight and shank length decreases with increasing age of birds. This study was therefore designed to estimate the genetic parameters (h^2, R) for growth and linear body measurements in male and female broiler lines in NAPRI, Shika, Zaria.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Poultry Research Programme of National Animal Production Research Institute (NAPRI) Shika, Zaria, Kaduna State. Shika lies between latitude 11^0 12`N, longitude $7^0$ 33`E and at altitude of 640m above sea level. The area falls within the Northern Guinea Savannah having an average annual rainfall of 1100mm (Akpa and Jokthan, 1996).

Experimental Birds and Management

The birds used for this study comprised of 4 groups each of sire line, dam line, sire control and dam control line from a collapsed groups of Hubbard and Anak broiler birds in National Animal production Research Institute (NAPRI). Broiler starter mash with crude protein of 24.96% and energy of 2767.62 was given to the chicks at the first four weeks while broiler finisher mash with crude protein of 23.23 and energy of 2839.64 was given at the last four weeks of age. The same type of feed was given to all the groups. Water and feed were provided *ad-libitum.* All rations were formulated and mixed at the feed mill of the Institute (NAPRI) with appropriate composition as shown in Table 1.

Data Collection and Analysis

The weight of individual birds and other linear body measurements were taken every two weeks for a period of eight weeks using a measuring scale in grams (g) and measuring tape in centimeter respectively. The linear body measurements considered were body length (BL), body girth (BG), thigh length (TL), keel length (KL), and shank length (SL) in (cm). Data for body weight and linear body measurements were subjected to variance components of SAS (2002) and their heritability and repeatability were estimated using the expression described by Falconer (1989):

Repeatability

The repeatability R was estimated using the standard expression given by Falconer (1989) as shown below:

$$R = \frac{\sigma^2_s}{\sigma^2_s + \sigma^2_e}$$

Where; R = Repeatability estimates; σ^2_s = Sire variance component; σ^2_e = Variance due to error;

Heritability

Heritability for body weight and linear body measurements was estimated using the expression described by Falconer (1989):

$$h^2 = \frac{4\,\sigma^2_s}{\sigma^2_T}$$

Where; h^2 = Heritability estimates; σ^2_s = Variance due to sire, σ^2_T = Total phenotypic variance

RESULTS AND DISCUSSION

Heritability (h^2) and repeatability estimates for body weight and linear body measurements

The results for heritability (h^2) and (R) repeatability (R) estimates for body weight and linear body measurements were presented in Table 2, 3, 4 and 5. The h^2 estimates obtained from this study ranged from low to moderate for body weight in sire line 0.07±1.67, 0.18±0.41, 0.19±0.36 and 0.27±1.31, for 2, 4, 6 and 8 weeks of

age, respectively. These results agreed with the reports of Siripholvat *et al.* (1995) who also reported low h^2 estimates of their experimental birds. Adeyinka *et al.* (2004) however, obtained moderate to high h^2 estimates for body weight at different ages in naked neck broilers. The implication of low to moderate h^2 values obtained in this work is that selection based on individual alone will not yield substantial genetic gain and that offspring will perform less than the parent. The h^2 estimate of body length and thigh length for sire and dam line were high across week 2 and 4. Also, the h^2 of body weight, body girth and shank length was high for dam line ranging 0.77 to 1.00 at week 4. The high h^2 estimate could be as a result of additive gene (dam) effect that gave rise to high genetic variability and the implication of this is that individual selection will lead to high genetic gain. There was an increasing trend in h^2 of body weight with age in sire line. These results agreed with the reports of Chambers (1990). Heritability estimates for body weight of dam line decreases with increasing age of birds across Table 2, 3, 4 and 5. This observation is in line with the report of Kabir *et al.* (2006). They reported h^2 which ranged from 0.892± 0.330 at 20 weeks to 0.420±0.214 at 40 weeks for body weight and 0.505±0.260 at 20 week to 0.302±0.211 at 40 week for shank length for two strains of Rhode Island chickens. The differences obtained in the heritability of the body weight could be attributed to genetic and or environmental influence.

The h^2 estimates ranged from low to high for linear body measurements. The highest estimate was observed in the dam line (0.91±0.14). The h^2 estimates for linear body measurements ranged from low to high for dam line and other groups (sire and dam control). This agreed with the reports of Singh and Julvan (2007) who reported low to moderate h^2 for body linear measurements in van-cob broiler chickens. The low h^2 estimates obtained in this study for some of the linear body measurements from 2 to 8 weeks of age is in line with the reports of Adeyinka *et al.* (2004) who observed similar results for naked neck broiler chicken.

Results of this study revealed low to moderate repeatability (R) estimates ranging from 0.001 to 0.193 for all the groups for body weight and 0.010 to 0.350 for linear body measurements across all ages in Table 2, 3, 4 and 5. The low to moderate estimates of R obtained in this study disagreed with the result of Kabir *et al.* (2010), who reported high R of 0.921 to 0.985 for body weight at 2 to 4 weeks of age in broiler chickens. The values for linear body measurements obtained in this study are within the range obtained by Kabir *et al.* (2010) (0.170 to 0.962). It also disagreed with report of Sola-Ojo *et al.* (2011) which revealed high R for body weight(0.99)and body parts measured(0.61 to 0.99) at week 2, 4 and 6 for Arbor Acre broiler strain. The differences obtained in this study could be as a result of breed/or line difference and environmental effect. Low R obtained implies that high numbers of records are required to estimate the potentials of these birds across lines and to realize high expected response from selection.

CONCLUSION

Differences obtained in the heritability estimate (h^2) with respect to all the lines are indication of genetic influence on these parameters. Low (h^2) obtained for body weight and linear body measurements imply that high environmental effects could be attributed and it implies that selection based on individual performance alone may not be advisable. Likewise, low repeatability estimates (R) implies that chicken lines used in this study have lower ability to repeat their present performance in the future and also high numbers of records are required to realize high expected response for selection.

REFERENCES

Adeyinka I. A. Adejoh, E., Abubakar B. Y., Sekoni, A. A. and Abeke, F. O. (2004). Genetic parameter estimates of the body weights and linear measurements, in a population of naked neck broiler chickens. In: *Proceeding of the 29th Annual Conference of the Nigerian Society of Animal Production.* 29. 40-43

Akpa, G.N., and Jokthan, G.E.,(1996). Effect of feedind and routine management in rabbit production in Zaria area of Kaduna State, Nigeria. *Agricultural System in Africa*. 6(1):60-64

AOAC (1995). *Official methods of Analysis*. 17th Edition, Association of Official Analytical Chemistry, Washington D.C.

Boukwamp, E.L.; D.E. Igbe and C.J. Wabeck (1973). Strains influenced on broiler part yield. *Poultry Science. J*. 2:1517-1523

Chambers J. R. (1990). Genetics of growth and meat production in chickens in Crawford R. D. (Eds). *Poultry Breedings and Genentics.* Elsevier, Amsterdam, the Netherlands, 559-643.

Edward, H.M. and Denman, F.(1975). Carcass composition studies: Influence on of breed, sex, and diet in gross composition of the carcass and fatty acid composition of the adipose tissue. *Poultry Science Journal*, 52:1230-1238

Falconer, D.S.(1989). *Introduction to Quantitative Genetics*, 3rd Edition. Longman Scientific and Technical London

Gaya, L.G., Ferraz, B.S., Balieiro, J.C.C., Mattos, E.C., Costa, M.A., Michelan F.T., Felicro, A.M., Rosa, A.F., Mourcio, G.B., Eler, J.P., Silva, M.E.B., Quieroz, L., Afaz, A.L.M., Longo, N.M., Garavazo, B.R. and Nakashima, S.H. (2006). Heritability estimates for meat Quality traits in male Broiler line. *8th World congress on Genetics Applied to Livestock Production.* August 13-18, 2006, Belo Horizonto, MG. Brazil.

Grosso, J.I.B.M., Baliero, J.C.C., Eler, J.P., Ferraz J.B.S., Mattos, E.C., and Michelan, F. T. (2010). Comparison of different models to estimate genetic parameters for carcass traits in a commercial broiler line. *Genetic and Molecular Research* 9(2): 908-918.

Kabir, M., Nwagu, B.I. and Anthony, A.V. (2010). Comparative study of growth and linear body measurements in Anak and Hubard Broiler breeds in the Northern Guinea Savannah Zone of Nigeria. *Journal of Agriculture, Forestry and Social Sciences (JOAFSS).* Vol. 8, No. 1, 2010.

Kabir, M., Oni, O.O., Akpa G. N. and Adeyinka I.A. (2006) Heritability estimates and the interrelationships of body weight and shank length in Rhode island Red and White chickens. *Pakistan Journal of Biological Sciences*, 9(15) 2892-2896.

Nawathe, D.R. and A.G. Larmorde (1987).Newcastle disease and poultry farming in Nigeria. *Nigeria Livestock Farmer*. 7: 1- 4

SAS(2002). *Statistical analysis system multiple incorporation*. Users' Guide Statistical version Cary, NC. USA.

Siripholvat V. Chansawang S. and Sanguanphan S. (1995). Heritability of the body weight of crossbred broiler chickens selected in five generations. *Kasetsart Journal of Natural Science*, 29:28-37.

Singh, C. B. and Julvan M. H. (2007). Genetic and non genetic factors affecting body conformation traits in Van-Cob broiler strain. *Indian Journal of Animal Research*. 41(2):29.

Sola-Ojo, F.E. and Ayorinde, K.L. (2011). Repeatability Estimates of some growth traits in four broiler strains at different ages. *Nigerian Journal of Genetics*. 25, 118 – 123

Table 1: Composition of the Experimental Diets

	PERCENTAGE	
Ingredients	Broiler Starter	Broiler Finisher
Maize	45.00	52.00
Groundnut cake	30.00	30.00
Soyabean meal	15.00	10.00
Maize offal	4.60	2.50
Lime stone	3.00	1.50
Bone meal	1.50	3.00
Salt	0.30	0.30
Lysine	0.15	0.20
Methionine	0.15	0.20
Premix*	0.25	0.30
Total	100	100
Calculated analysis		
ME(Kcal/Kg)	2767.62	2839.64
Crude Protein (%)	24.96	23.23
Crude Fibre (%)	3.82	3.45
Ether Extract (%)	5.16	5.22
Methionine	0.47	0.50
Methionine + Cysteine	0.85	0.86
Lysine	1.20	1.13
Calcium	1.75	1.74
Phosphorous available	0.90	0.89

*The premix used in this study supplied the following nutrients (Kg/diet): Vit A: 20,000,00, IU Vitamin E. 500 I, thiamin (B) 2,000mg, Riboflavin (B2) 3500mg, Vit (B3) 20000mg, Panthothenic acid (B5) 6,600ml, Pyridoxine (B6) 3600mg, Vitamin (B12) 20mg, folic acid 400mg, Vitamin 20000mg, Methionine 10,000mg, antioxidant 12.5g, Ca 18%, P.Mn 8.0g, Zn ug Iodine 0.12g.

Table 2: Estimates of h^2s and R for body weight and linear measurements for broiler lines at 2 weeks of age

Traits	h^2s				R			
	Sire	Dam	Sire Control	Dam Control	Sire	Dam	Sire Control	Dam Control
BW	0.07±1.67	-	0.34±1.25	0.4±1.14	0.018	0.069	0.084	0.100
BL	0.48±0.98	0.76±0.37	0.08±1.75	0.43±1.08	0.119	0.190	0.021	0.108
BG	0.58±0.87	1.40±0.44	0.18±1.56	0.66±0.91	0.129	0.350	0.045	0.165
TL	0.4±1.06	0.78±0.33	0.02±1.86	0.27±1.39	0.102	0.194	0.005	0.098
KL	0.32±1.22	0.31±1.07	0.25±1.43	0.12±1.65	0.112	0.079	0.063	0.029
SL	0.36±1.12	0.28±1.12	0.03±1.85	0.66±0.91	0.090	0.070	0.007	0.165

BW=Body weight, BL= body length, BG=Body girth, TL= Thigh length, KL=keel length, SL=Shank length

Table 3: Estimates of h^2s and R for body weight and linear measurements for broiler lines at 4 weeks of age

Traits	h^2s				R			
	Sire	Dam	Sire Control	Dam Control	Sire	Dam	Sire Control	Dam Control
BW	0.18±0.41	0.77±0.36	0.12±1.90	0.01±1.89	0.050	0.193	0.030	0.001
BL	0.58±0.73	0.75±0.39	0.09±1.96	0.16±1.59	0.145	0.188	0.021	0.040
BG	0.05±1.63	1.00±1.12	0.02±2.11	0.26±1.84	0.013	0.251	0.006	0.065
TL	0.31±1.19	0.91±0.14	0.13±1.88	0.26±1.84	0.083	0.227	0.032	0.064
KL	0.43±0.98	0.16±1.33	0.06±2.03	0.06±2.03	0.107	0.039	0.015	0.089
SL	0.11±1.53	0.78±0.35	0.25±1.56	0.26±1.84	0.027	0.195	0.066	0.065

BW=Body weight, BL= body length, BG=Body girth, TL= Thigh length, KL=keel length, SL=Shank length

Table 4: Estimates of h^2s and R for body weight and linear measurements for broiler lines at 6 weeks of age

Traits	h^2s				R			
	Sire	Dam	Sire Control	Dam Control	Sire	Dam	Sire Control	Dam Control
BW	0.19±0.36	0.32±1.12	0.17±1.68	0.15±1.72	0.049	0.097	0.043	0.037
BL	-	0.08±1.16	0.34±1.40	0.19±1.16	-	0.020	0.086	0.047
BG	0.13±1.50	0.2±1.37	1.09±0.76	0.48±0.86	0.032	0.010	0.115	0.069
TL	0.2±1.37	0.08±1.57	0.2±1.50	0.17±1.86	0.058	0.021	0.065	0.041
KL	1.09±0.76	0.90±0.11	0.36±1.30	0.44±1.13	0.271	0.291	0.090	0.111
SL	0.48±0.89	0.09±1.50	0.35±1.31	0.35±1.10	0.121	0.021	0.89	0.090

BW=Body weight, BL= body length, BG=Body girth, TL= Thigh length, KL=keel length, SL=Shank length

Table 5: Estimates of h^2s and R for body weight and linear measurements for broiler lines at 8 weeks of age

Traits	H^2				R			
	Sire	Dam	Sire Control	Dam Control	Sire	Dam	Sire Control	Dam Control
BW	0.77±1.31	0.18±1.66	0.18±1.66	0.05±1.98	0.069	0.045	0.044	0.013
BL	0.06±1.69	0.64±0.62	0.32±1.37	0.19±1.54	0.161	0.161	0.080	0.048
BG	0.4±1.27	1.49±0.85	0.14±1.74	0.16±1.60	0.101	0.037	0.035	0.040
TL	0.81±1.27	0.19±0.55	0.05±1.92	0.19±1.54	0.202	0.048	0.014	0.048
KL	0.31±1.25	0.28±1.24	0.33±1.36	0.03±1.85	0.077	0.071	0.082	0.007
SL	0.39±1.10	0.28±1.24	0.04±1.94	0.34±1.26	0.098	0.071	0.010	0.094

BW=Body weight, BL= body length, BG=Body girth, TL= Thigh length, KL=keel length, SL=Shank length