Genetic Parameter Estimates For Body Weights In Horro Chicken Of Ethiopia

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Introduction

Horro is an indigenous chicken type named after the western part of Ethiopia near the Blue Nile gorge. There are about 30,000 chickens restricted to this original environment. The Horro chickens are generally considered to be poor producers of eggs and meat although the population has a wide range of morphologic and genetic diversity. Recently a genetic improvement program was started to increase productivity of Horro chickens in Ethiopia. The program aims to make Horro chickens more profitable for the poor people in these regions and conserve the existing genetic diversity. If this program is successful then it will be used as a benchmark for other indigenous chicken genetic resources of Ethiopia.

A successful breeding program requires genetic parameters. There is a lot of literature on genetic parameters for growth of commercial poultry populations (see review by Chambers (1990)) however, these values may not be applicable to Horro chickens. There are some estimates for growth traits in unselected indigenous African chickens (Gondwe 2005; Norris and Nigambi 2006) but there are no estimates for Ethiopian chickens. Thus, the aim of this study was to estimate heritabilities and genetic and phenotypic correlations for growth traits to understand which traits should be included in breeding programs for Horro chicken.

Material and methods

Experimental population and traits measured. The study was done at the Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Centre (DZARC). The selection line was established from eggs purchased from village market sheds in Horro. The pedigree descended from 26 sires and 260 dams and were hatched and raised at the poultry research farm of DZARC. Parents were housed in floor cages with 1 male and 10 females in each cage. Each cage had a trap nest for individual recording of egg production and pedigree. The offspring were hatched in 3 batches between January and February 2008 and reared under a standard management and feeding regime similar to that of the base line. All chicken were vaccinated against Newcastle and Marek's diseases at 1 day old, Gomboro at 1 week and fowl pox at 10 weeks. The chickens were reared in deep litter houses with natural lighting. Live weight growth was measured every 2 weeks for the first 8 weeks then every 4 weeks for the next 8 weeks. Traits recorded were: body weights at hatch (BW0) and body weights in weeks 2 (BW2), 6 (BW6), 8 (BW8), 12 (BW12) and 16 (BW16).

Statistical analyses. Heritabilities were estimated using a univariate animal model with common environment using the ASREML procedure (Gilmour, A.R., Gogel, B. J., Cullis, B.R. *et al*. 2006). The following linear model was used.

$$\mathbf{Y} = \mathbf{X}b + \mathbf{Z}a + \mathbf{Z}c + e$$

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Where, **Y** = vector of observations; b = vector of fixed effects of sex and hatch number; a = vector of random direct genetic effects; c = vector of random common environmental effects; e = vector of residual effects; and **X**, **Z**a and **Z**c are incidence matrices relating records to fixed, direct genetic and common environmental effects, respectively. Maternal genetic effects could not be estimated due to the small data size. The common environmental effect did not exist for body weights in weeks 12 and 16 and was excluded from the model. Correlations were estimated using a bivariate analysis. Because convergence could not be achieved when the common environmental effect was included in the model, correlations were estimated with animal as the only random effect.

Results and discussion

The mean body weights (Table 1) were generally within the ranges reported for unselected indigenous populations in north western Ethiopia and other parts of Africa (Gueye 1998; Halima, H., Neser, F.W.C., vanMarle-Koster, E. *et al*. 2007). Heritabilities and the correlations between pairs of traits are presented in Tables 2 and 3. Estimates of direct heritability ranged from 0.15 (BW6) to 0.40 (BW0). A review by Chambers (1990) indicated that heritabilities of growth traits in commercial breeds of chickens ranged from moderate to high (0.40-0.70). The estimates obtained in this study were below these ranges and those of Malawian chickens reported by Gondwe (2005). However, they compare well with values for the corresponding traits reported for similar, unselected populations of chickens in other parts of Africa (Norris and Ngambi 2006; Momoh and Nwosu 2008) and were even higher compared to additive direct heritabilities estimated for body weights of indigenous chickens of Mexico (ranging from 0.07 at 16 weeks to 0.21 at 8 weeks; Prado-González, E.A., Ramírez-Avila, L., and Segura-Correa, J.C. 2003). Congruent with the findings of Prado-González, E.A., Ramírez-Avila, L., and Segura-Correa, J.C. (2003) and Norris and Ngambi (2006). These results suggest that common environmental effects are less important as sources of variation after hatch.

The genetic and phenotypic correlations between hatch weight and all other traits were generally low. Among the other growth traits, the genetic correlations ranged from 0.51 (BW2 with BW16) to 0.99 (BW12 with BW16) and the phenotypic correlations from 0.27 (BW2 with BW16) to 0.85 (BW6 with BW8). The genetic correlations were similar to those estimated in commercial breeds to 16 weeks of age (Chambers 1990), but higher than those reported by Gondwe (2005) for Malawian indigenous chickens. Ignoring the common environmental component in the bivariate analysis is not likely to have affected the results unfavourably since the affects were very small or non-existent in all growth traits other than hatch weight.

Table 1: Basic statistics and variance components of body weights in Horro chickens

Period (weeks)	No. Animals	No. Records	Sires	Dams	Mean (g)	σ^2_a	σ^2_c	$\sigma^2 e$
hatch	1456	1307	25	143	24.7	3.9	3.7	2.0
2	1434	1306	25	142	57.0	19.1	11.4	71.7
6	1330	1303	25	141	163.4	197.4	43.8	1073.3
8	1262	1248	25	138	242.2	516.9	36.6	2643.2
12	1092	1090	25	136	420.0	2399.0		12410.0
16	845	845	25	132	603.9	9673.0		33220.0

σ^2_a, additive genetic variance; σ^2_c, common environmental variance; $\sigma^2 e$, residual variance

Table 2: Heritabilities of direct genetic (h^2) and common environmental (c^2) effects for body weights

Period (weeks)	h^2 (±s.e.)	c^2 (±s.e.)
0 (hatch)	0.40 (0.23)	0.39 (0.10)
2	0.19 (0.11)	0.11 (0.05)
6	0.15 (0.08)	0.03 (0.03)
8	0.16 (0.08)	0.01 (0.03)
12	0.16 (0.05)	-
16	0.23 (0.06)	-

Table 3: Genetic (below diagonal) and phenotypic (above diagonal) correlations between growth traits

Trait	BW0	BW2	BW6	BW8	BW12	BW16
BW0		0.45 (0.03)	0.22 (0.03)	0.15 (0.03)	0.09 (0.03)	0.10 (0.03)
BW2	0.71 (0.08)		0.64 (0.02)	0.53 (0.02)	0.37 (0.03)	0.27 (0.03)
BW6	0.46 (0.10)	0.85 (0.06)		0.85 (0.01)	0.59 (0.01)	0.40 (0.03)
BW8	0.37 (0.11)	0.77 (0.08)	0.97 (0.02)		0.74 (0.01)	0.56 (0.02)
BW12	0.25 (0.13)	0.54 (0.13)	0.68 (0.11)	0.86 (0.06)		0.82 (0.01)
BW16	0.30 (0.12)	0.51 (0.13)	0.67 (0.12)	0.82 (0.08)	0.99 (0.03)	

BW0, hatch weight; BW2, BW6, BW8, BW12, BW16, body weights at weeks 2, 6, 8, 12 & 16, respectively.

Conclusion

Compared to the other traits and ignoring hatch weight body weight at 8 weeks of age was more strongly correlated with all growth traits (r_g = 0.77-0.97 and r_p = 0.53-0.85). Thus, selection for this trait is expected to have a positive correlated response in growth from 2 to 16 weeks of age. Given the generally low heritabilities for the other body weights in this study, body weight at 8 weeks is a good selection criterion when breeding for improved growth in Horro chicken.

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