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Heritabilities and genetic correlations between body weight and pecking behaviour in Nigerian local chicken

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Abstract

Heritabilities and genetic correlations between body weight and pecking behaviour in a population of Nigerian local chicken were estimated at the age of 4, 8, 12, 16 and 20 weeks using intrasire regression of offspring on dam. The heritability estimates of body weight were low to moderate in size and ranged from 0.07±0.38 to 0.33±0.34. The estimates of heritability of pecking behaviour were low to high in magnitude and ranged from 0.00±0.45 to 0.52±0.78. The genetic correlations between body weight and pecking behaviour at the respective ages (4, 8, 12, 16 and 20 weeks) were negative. The low to high heritability estimates for body weight and pecking behaviour indicate that appreciable additive genetic variance exists for both traits. Therefore, there is much scope for the improvement of body weight and reduction of pecking behaviour in the local chicken by intra population selection. The negative genetic correlations between body weight and pecking behaviour suggests that improvement in the body weight of the local chicken through selection will result to correlated reduction of pecking behaviour.

Key words: Additive Genetic Variance, Correlated Reduction, Selection

Introduction

The Nigerian local chicken is characterized by small body size, slow growth rate as well as being inferior to the exotic in egg production traits (Adebambo et al., 1999). Observations on the pecking and resting behaviour of the local chicken indicated that they had higher frequency of pecking per 30 minutes compared to the exotic strains (Udeh, 2003). Therefore any programme designed for the improvement of bodysize and egg production traits of the local chicken should also include the improvement of the bird welfare. Su et al. (2005) reported that feather pecking was a heritable trait which may be reduced by genetic selection. Knowledge of the genetic parameters (heritabilities and genetic correlations) is necessary for designing an appropriate breeding plan for genetic improvement of the local chicken in these traits. Estimates of heritabilities and genetic correlations between growth traits in the local chicken had been reported by some authors. For example, Ndofor-Folong et al. (2006) reported heritability ranges of 0.23 to 0.56 and 0.25 to 0.46 for body weight in the light and heavy ecotype local chicken respectively. Momoh and Nwosu (2008) reported that heritability for body weight in Nigerian heavy ecotype local chicken and its crosses with the light ecotype ranged from 0.04 to 0.36. Similarly, Adeleke et al. (2011) reported heritability estimates for body weight in pure and crossbred local chicken that ranged from 0.05 at day old to 0.45 at 16 weeks of age. Some other authors namely Nwosu and Asuquo (1985), Ebangi and Ibe (1994) and Ogbu and Nwosu (2010) reported heritability estimates for growth traits that were moderate to high in magnitude. Such information is not available for pecking behaviour in the Nigerian local chicken. The objective of this study was to estimate heritabilities and genetic correlations between body weight and pecking behaviour in a population of Nigerian local chicken.

Materials and Methods

The base population comprised 350 local chicken established at day old at the poultry breeding unit of the Department of Animal science, Enugu state university of science and technology, Enugu. The base population was sourced from villages in Enugu and Ebonyi states.

The F_1 population comprised 400 chicks of both sexes obtained from the mating of 10 wing banded cocks and 100 hens randomly selected from the base population.

The mating design was such that one cock mated ten hens in ten replicate groups. All the mating was

random in floor pens. The 400 chicks were produced in a single batch by pedigree hatching.

The chicks were brooded for 6weeks and reared to 20 weeks of age by adhering to standard management procedures described by Oluyemi and Roberts (1979). Commercial chick mash diet which on analysis yielded 20% cp and 2685 kcal ME/kg were fed to the birds from dayold to 8weeks of age. From 8-18 weeks of age they were fed with growers mash containing 2642 kcal ME/kg and 16% CP. From 18-20 weeks the birds were provided with layers mash containing 2676 kcal ME/kg, 17% cp and about 3% calcium. Ad libitum water was also provided throughout the period. The sexes were separated at 6 weeks of age when the males had become distinct from the females. From 6 weeks to 20 weeks, only the female progeny data were recorded.

The body weight of the birds was recorded at 4 weekly intervals. The pecking behaviour was observed for 30 minutes daily at the period of 9.00 am, 12.00 pm and 9.00 pm by counting the number of times birds pecked or intimidated others at the introduction of feed and during feeding. In order to reduce or minimize errors in the experiment, stress factors such as diseases, harsh weather, poor ventilation and poor lighting among others were adequately monitored and taken care of in lines with the guides established by Duncan (1981). The average number of pecking in 30 minutes was subjected to square root transformation before analysis. Heritabilities were estimated by intrasire regression of offspring on dam (Becker, 1984). The statistical model used to fit the data was

$$Zij-\alpha_i = \mu + \beta (X_{ij}- X...) + e_{ij}$$

Where Z_{ij} is the mean of the records of the offspring from a mating of the ith

sire to the jth dam
μ= common mean
α_i= the effect of the ith sire
β= is the regression coefficient of Z on X
X_{ij}= is the record on the jth dam mated to the ith sire
$\bar{X}$… is the phenotypic mean
e_{ij}= the deviation of the mean of the progeny.

The regression coefficient of Z on X is computed as

$$b= \frac{Cov_{D(XZ)}}{\delta^2 D_{(XX)}}$$

Where $\delta^2 D$ is the variance of dams within sires
Heritability is estimated as 2b

The genetic correlations were obtained using intrasire dam-mean of offspring covariances method (Becker, 1984). The standard errors of heritabilities and genetic correlations were calculated using standard expressions.

Results and Discussion

Estimates of heritability of body weight and pecking behaviour at different ages are shown in Table 1. The heritabilities of body weight were lower than the heritability estimates of pecking behaviour in all the age periods except 12 weeks. This is in agreement with the observations of Falconer and Mackey (1996) that characters connected with the reproductive fitness of animals such as body weight usually have lower heritability due to consistent natural selection pressure compared with most qualitative traits. The heritability estimates of body weight in this study were low to moderate in size and ranged from 0.07 at 8 weeks to 0.33 at 20 weeks. This indicates that additive genetic variance exists moderately for this trait. It also implies that favourable response is expected if the local chicken is subjected to either mass or pedigree selection for body weight under the prevailing environmental circumstances. The heritability range observed for body weight in this study were in close agreement with the ranges of 0.04 to 0.36 and 0.05 to 0.45 reported by Momoh and Nwosu (2008) and Adeleke et al. (2011) respectively. Similarly, the pecking behaviour has appreciable additive genetic variance which gave rise to a heritability of low to high in size with range of 0.00 to 0.78. Rodenburg et al. (2003) reported heritability estimates of 0.10 at young age and 0.24 at adult age for pecking behaviour in layer strains of chicken which fall within the range observed in this study. This means that there is a possibility of minimizing this trait in Nigerian local chicken by selection. Selection against this trait in the local chicken is best undertaken at 4-8weeks or 16-20 weeks of age. According to Kjaar et al. (2001), selection for or against feather pecking behaviour is possible using direct observations. Table 2 presents the genetic correlations between body weight and pecking behaviour at 4, 8, 12, 16 and 20 weeks of age respectively. The genetic correlations between body weight and pecking behaviour at the respective ages were all negative. This implies that selection for higher body size in the local chicken will bring about correlated reduction in pecking behaviour. A similar observation was reported by Kjaar and Sorensen (1997) in white leghorns.

Table 1: Estimate of heritability (h^2) of bodyweight and pecking behaviour in the local chicken

Age (weeks)	Bodyweight (h^2)	Pecking behaviour (h^2)
4	0.27 ± 0.32	0.52 ± 0.78
8	0.07 ± 0.38	0.37 ± 0.89
12	0.13 ± 0.19	0.00 ± 0.45
16	0.27 ± 0.25	0.36 ± 0.44
20	0.33 ± 0.34	0.50 ± 0.29

Table 2: Genetic correlation coefficient between bodyweight and pecking behaviour in the local chicken

Traits	Genetic correlations coefficient
Bodyweight at 4wks and pecking behaviour at 4wks	-0.39 ± 0.98
Bodyweight at 8wks and pecking behaviour at 8wks	-0.96 ± 1.51
Bodyweight at 12wks and pecking behaviour at 12wks	-0.47 ± 0.00
Bodyweight at 16wks and pecking behaviour at 16wks	-0.47 ± 1.06
Bodyweight at 20wks and pecking behaviour at 20wks	-0.20 ± 0.77

Conclusion

The heritability estimates of body weight were low to moderate in size and ranged from 0.07 to 0.33.The heritability estimates of pecking behaviour were low to high in magnitude and ranged from 0.00 to 0.78. The genetic correlations between body weight and pecking behaviour at the respective ages were negative suggesting that selection for higher body size in the local chicken will result to correlated reduction in pecking behaviour.

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