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HERITABILITY OF THE DIFFERENCES IN BODY WEIGHT BETWEEN SEXES AT DIFFERENT AGES IN TWO STRAINS OF CHICKENS

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SUMMARY

The aim of this investigation was to study the genetic parameters of sexual dimorphism for body weight at 4, 6 and 8 weeks of age for two strains : *Dokki 4* and *White Plymouth Rock*.

The estimates of heritabilities of sex differences in body weight from sire component of variance at different ages ranged from -0.20 to 0.06 . These estimates suggest a very low magnitude of the inheritance of this trait and confirm that selection for sexual dimorphism through the sires is not expected to be effective.

INTRODUCTION

In advanced poultry industry, sexual-dimorphism received great attention during the last 8 years, since broiler production requires uniformity in body weight at market age. Regarding the fact, that males reach the suitable weight before females, due to sex-difference, a commonly occurring phenomenon in avian species, the degree of divergence between sexes has its economic importance.

The published heritability of the difference in weight between males and females ranged from -1.30 to 0.36 : BUVANENDRAN (1969), EISEN and LEGATES (1966), YOSHIDA and COLLINS (1967), AYOUB and MÉRAT (1972). The aim of this paper was to investigate the genetic parameters of sexual dimorphism for body weight at 4, 6 and 8 weeks of age for the strains, *Dokki 4* and *White Plymouth Rock*.

MATERIAL, AND METHODS

Two breeds of chickens were used. The first was *Dokki 4*, developed by back-crossing, *Barred Plymouth Rock* to *Fayoumi* for 4 generations and kept selfmaintained since 1958 at *Dokki* experimental farm. The second was *White Plymouth Rock* which was imported from Holland about 20 years ago and was selfmaintained since at the same farm. 80 pullets from each breed were single sire mated in 8 groups, each of 10 dams and 1 sire. 855 pedigreed chickens of the two breeds were obtained, of which 323 were *Dokki 4* and 532 were *Plymouth Rock*. Chickens were weighed to the nearest gm at 4, 6 and 8 weeks of age. Only dams having at least two progeny of each sex were used and equal numbers of progeny of each dam were recorded for analysis. Observation on each dam family was taken as the difference between the mean of the two sexes ($\bar{x}_m - \bar{x}_f$). The form of the analysis of variance and expected mean squares (EMS) are the same as given by KINNEY and SHOFFNER (1965) and as used in the paper by AYOUB and MÉRAT (1972). Heritability of the difference between sexes was calculated using the following formula.

$$h^2_{(1-2)} = \frac{4 \sigma_s^2}{\sigma_s^2 + \sigma_d^2 + \sigma_{iw}^2}$$

where σ_s^2 = variance due to differences between sires,

σ_d^2 = variance due to differences between dams,

σ_{iw}^2 = variance due to differences between full-sibs.

Some explanation is due to illustrate the estimation of $h^2_{(1-2)}$, since there is no direct estimate for $\sigma_{iw(1-2)}^2$ and $\sigma_{d(1-2)}^2$. EISEN and LEGATES (1966); BUVANENDRAN (1969), explained this point as follows :

$$\sigma_{(1-2)}^2 = \sigma_{s1}^2 + \sigma_{s2}^2 - 2 \text{cov}_{(1-2)}.$$

Thus σ_{iw}^2 was obtained by substituting the values of σ_{iw}^2 obtained for males and females in hierarchical analysis of variance on an individual basis (between and within full-sib families), according to KEMPTHORNE (1957). Assuming the expectation of $\text{cov}_{(1-2)}$ as Zero σ_d^2 is then obtained by substitution.

RESULTS AND DISCUSSION

Mean body weight

The average weights and variances of males and females for the two breeds, given in table 1, show that the difference between the two sexes increases with advancing age, and the variances from male data are greater than those from females in general. These results hold true with many available references.

Heritability estimates of sex differences in body weight

The results presented in table 2 give h^2 estimates ranging from -0.20 to 0.06 ; these estimates suggest a very low magnitude of the inheritance of this trait. The negative values of $h^2_{(1-2)}$ were found in 4 cases out of 6. A similar negative estimate was obtained by AYOUB and MÉRAT (1972), at 8 weeks of age (-1.30), using the strain « Jouy ». They stated that this negative value was due to the sampling error generally associated with such estimates based on limited sire numbers, the estimates of negative values in this case corresponding to a very weak variation between sire families.

TABLE I
Body weights and variances
Poids du corps et variances

Age in weeks	Females			Males			Difference between males and females (g)
	<i>n</i>	\bar{x} (grams)	V	<i>n</i>	\bar{x} (grams)	V	
1. Dokki Strain							
4	168	176	1 226	155	192	1 410	16
6	155	296	4 288	157	312	4 051	16
8	155	378	6 635	134	408	8 475	30
2. Plymouth Rock							
4	301	171	1 634	231	173	1 140	2
6	301	297	3 405	230	323	4 179	25
8	285	381	7 846	225	429	8 759	48

TABLE 2
*Variance components and heritabilities of sexual dimorphism
for Dokki and White Plymouth Rock at different ages*
*Composants de la variance et héritabilités du dimorphisme sexuel
pour Dokki et White Plymouth Rock à différents âges*

Age in weeks	Source of variation	d.f.	Variance component	h_s^2
1. Dokki Strain				
4 weeks of age	Sire	7	0.32	0.06
	Dam within Sire	24	— 3.54	
6 weeks of age	Sire	7	— 3.44	— 0.20
	Dam within Sire	23	— 2.47	
8 weeks of age	Sire	7	— 3.99	— 0.12
	Dam within Sire	23	— 20.14	
2. Plymouth Rock Strain				
4 weeks of age	Sire	7	— 0.43	— 0.07
	Dam within Sire	54	— 2.00	
6 weeks of age	Sire	7	0.05	+ 0.00
	Dam within Sire	54	5.60	
8 weeks of age	Sire	7	— 4.44	— 0.11
	Dam within Sire	54	16.31	

The estimates of h^2 of the body weight differences obtained from literature were generally low, e.g. EISEN and LEGATES (1966), working on Mice found estimates of $h^2_{(1-2)}$ as 0.010, 0.084 and 0.142, for three, six and eight weeks weights respectively. YOSHIDA and COLLINS (1967), reported a heritability estimate of 0.09 for sex differences in quails at 4 weeks of age; they also stated that after their selection experiment, the sex difference in body weight in selected lines remained unchanged.

Findings from the present investigation confirm other findings in the literature, that selection for sexual dimorphism through the sires is not expected to be effective.

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RÉSUMÉ

HÉRITABILITÉ DES DIFFÉRENCES DU POIDS CORPOREL ENTRE SEXES A DIFFÉRENTS AGES DANS DEUX SOUCHES DE VOLAILLES

Le but de cette recherche était d'étudier les paramètres génétiques du dimorphisme sexuel du poids corporel à 4, 6 et 8 semaines d'âge pour les deux souches : *Dokki 4* et *Phlymouth Rock blanche*.

Les estimations d'héritabilité des différences entre sexes pour le poids corporel basées sur la composante « père » de la variance aux différents âges allaient de —0,20 à 0,06. Ces estimations suggèrent un très faible ordre de grandeur de l'héritabilité de ce caractère et laissent prévoir un manque d'efficacité de la sélection pour le dimorphisme sexuel basée sur le père.

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