

SEX-LINKAGE AS A FACTOR IN THE INHERITANCE OF SEX DIFFERENCES FOR BODY WEIGHT IN TWO STRAINS OF CHICKENS

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SUMMARY

The interactions « sex × Sire families » and « sex × dam within Sire families » in two strains of chickens, *Dokki-4* and *White Plymouth Rock*, were studied for body weight at 6 and 8 weeks of age. The results showed that Sire × sex interactions were not significant ($P > 0.05$) in all cases, but dam families within Sire × sex interactions were significant ($P < 0.05$) in three cases out of four. The interaction between dam families and sex for *Plymouth Rock* was not significant ($P > 0.05$) at 8 weeks of age. The effect of sex-linked genes and the low magnitude of heritability of sex-differences were discussed.

INTRODUCTION

Many investigators showed evidence of the importance of sex-linkage in the inheritance of quantitative characters and some concluded that its effects are too great to be ignored for maximum efficiency in breeding, BEILHARZ (1962).

With respect to the phenomenon of sexual dimorphism in poultry, only researches proved the superiority of selection based on dam families over that based on sire families, SHAKLEE *et al.* (1952), AYOUB and MÉRAT (1972).

BEILHARZ (1960) explained the results of SHAKLEE *et al.* (1952), by the fact that cocks generally distribute identical sex chromosomes as well as autosomal chromosomes to offsprings, while dams (being X-) distribute their sex chromosomes in different manner. This reason may be the cause of the low estimates of heritabilities for body weight differences found by AYOUB and MAGRABY (1975), as the method

suggested by KINNEY and SHOFFNER (1965) for the estimates of $h^2_{(1-2)}$ gives only estimates based on sire components of variance. The present work therefore was designed to test the interaction « sex \times sire families » and « sex \times dams within sire families » in two strains of chicken in order to detect the effect of sex-linkage in the inheritance of sex differences.

MATERIAL AND METHODS

Two strains of chickens, namely *Dokki*₄ and *White Plymouth Rock*, were used in this study. Data on body weight at 6 and 8 weeks of age were analysed using the unequal number model described by SNEDECOR and COCHRAN (1967).

RESULTS

Differences between Sire families

For *Dokki*₄ strain (table I) highly significant differences in body weight at 6 and 8 weeks of age were observed between both sexes, and sires families, However the sire \times sex interaction was insignificant at the same ages.

TABLE I

Analysis of variance of body weight at 6 and 8 weeks of age using sire families for Dokki₄ strain

Analyse de variance du poids corporel à 6 et 8 semaines d'âge sur les familles de père pour la lignée Dokki₄

Age in weeks	S.V.	d.f.	Ms.	F
6	Between sexes	1	1 259.6	33.2**
	Between sires	7	228.8	6.0**
	Sire \times sex	7	7.8	0.2 NS
	Interaction			
	Residual	295	33.9	
8	Between sexes	1	922.1	12.54**
	Between sires	7	278.5	3.78**
	Sire \times sex	7	65.1	0.89 NS
	Interaction			
	Residual	273	73.5	

** Significant at 1 p. 100 level.

* Significant at 5 p. 100 level.

NS Not significant.

TABLE 2

Analysis of variance of body weight at 6 and 8 weeks of age using sire families for White Plymouth Rock strain
Analyse de variance du poids corporel à 6 et 8 semaines d'âge sur les familles de père pour la lignée Plymouth Rock blanche

Age in weeks	S.V.	d.f.	Ms.	F
6	Between sexes	1	975.0	50.0**
	Between sires	7	62.7	8.95**
	Sire × sex	7	22.2	1.14 NS
	Interaction			
	Residual	515	19.5	
8	Between sexes	1	2 477.0	30.49**
	Between sires	7	123.3	1.52 NS
	Sire × sex	7	77.0	0.95 NS
	Interaction			
	Residual	471	81.2	

** Significant at 1 p. 100 level.

* Significant at 5 p. 100 level.

NS Not significant.

TABLE 3

Analysis of variance of body weight at 6 and 8 weeks of age using dams families for Dokki₄ strain
Analyse de variance du poids corporel à 6 et 8 semaines d'âge sur les familles de mère pour la lignée Dokki₄

Age in weeks	S.V.	d.f.	Ms.	F
6	Between sexes	1	299.9	8.56**
	Between dams within sires	23	160.4	4.58**
	Sex × dams within sires	23	118.7	3.39**
	Interaction			
	Residual	167	35.0	
8	Between sexes	1	787.9	10.84**
	Between dams within sires	23	205.4	2.83**
	Sex × dams within sires	23	256.5	3.53**
	Interaction			
	Residual	144	72.7	

** Significant at 1 p. 100 level.

* Significant at 5 p. 100 level.

NS Not significant.

Similar results were obtained for *white plymouth Rock* strain with respect to the effect sex, at 6 and 8 weeks of age. But the variance between sires was highly significant at 6 weeks and not significant at 8 weeks of age. The interaction between sire families and sex, was found to be insignificant, F value being 1.14 and 0.95 (table 2) at 6 and 8 weeks respectively.

Differences between dam families

In the *Dokki* strain (table 3), highly significant differences were observed in both weights at 6 and 8 weeks of age between sexes, dams families within sires and for the dam families within sires \times sex interaction. In *White plymouth Rock* (table 4) a highly significant difference between sexes was observed at the two ages studied. The analysis of variance showed significant differences between dams within sires ($P < 0.05$) in both ages. The interaction proved to be significant at 6 weeks of age (1.40) at 5 p. 100 level of significance but not at 8 weeks of age (F value being 1.05).

TABLE 4

Analysis of variance of body weight at 6 and 8 weeks of age using dams families for Plymouth Rock strain

Analyse de variance du poids corporel à 6 et 8 semaines d'âge sur les familles de mère pour la lignée Plymouth Rock

Age in weeks	S.V.	d.f.	Ms.	F
6	Between sexes	1	842.1	23.79**
	Between dams within sires	54	48.2	1.36*
	Sex \times dams within sires	54	49.6	1.40*
	Interaction			
	Residual	390	35.4	
8	Between sexes	1	2 825.6	37.90**
	Between dams within sires	53	119.9	1.61
	Sex \times dams within sires	53	78.1	1.05
	Interaction			
	Residual	349	74.5	

** Significant at 1 p. 100 level.

* Significant at 5 p. 100 level.

NS Not significant.

GENERAL, DISCUSSION AND CONCLUSION

In general the results showed that sire \times sex interactions were insignificant in all cases, but dam families within sire \times sex interactions showed significance in three cases out of four, the interaction between dam families and sex for *plymouth Rock* failing to reach significance at 8 weeks of age (table 4). The inheritance of sex-linkage in the two strains may perhaps be different, although this cannot be unequivocally proven by the present data. On the other hand, AYOUB and MAGRABY (1975) obtained low heritability estimates of sex differences for the same two strains, which were explained by the mathematical derivation showed by EISEN and LEGATES (1966). Since the genetic variance of the difference between males and females was reported to be twice the genotype \times sex interaction, the heritability in the narrow sense of the difference between sexes for the trait can be written as follows :

$$h^2_{(1-2)} = 2\sigma_{GS}^2 / \sigma_{P(1-2)}^2$$

where σ_{GS}^2 is the additive genotype \times sex interaction variance component, and $\sigma_{P(1-2)}^2$ is the phenotypic variance of the differences between sexes for the trait. This derivation assumes that the trait is controlled primarily by additive autosomal genes, and the effect of sex-linkage, dominance and epistasis are not included. Thus the low estimates obtained for $h^2_{(1-2)}$ in these two strains may be largely due to the small magnitude of Sire \times Sex interaction as found in the present work. Moreover, the expected genetic progress as shown also by EISEN and LEGATES (1966) is $\Delta G(1-2) = \sqrt{2} ih'_{(1-2)} \sigma_{GS}$.

(Prime notation denotes a Parameter free of scaling effect). One may then conclude according to the results obtained herein of Sire \times Sex interaction, that no great change is expected if selection is based on sire families.

The present study may suggest the need of the development of a method or system of mating to estimate heritability of the difference between sexes for the trait based on the dams component of variance.

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RÉSUMÉ

FACTEURS LIÉS AU SEXE DANS L'HÉRÉDITÉ DES DIFFÉRENCES ENTRE SEXES
POUR LE POIDS CORPOREL DANS DEUX LIGNÉES DE POULES

Les interactions sexe \times famille de père et sexe \times famille de mère intra-père ont été étudiées dans deux lignées de poules, *Dokki-4* et *Plymouth Rock blanche* pour le poids corporel à 6 et

8 semaines d'âge. Les résultats montrent que les interactions sexe \times père ne sont significatives dans aucun cas ; par contre l'interaction sexe \times mère intra-père est significative ($P < 0,05$) dans trois cas sur quatre, cette interaction n'atteignant pas le seuil de signification pour la lignée *Plymouth Rock* à 8 semaines d'âge. L'effet des gènes liés au sexe et les faibles valeurs de l'héritabilité des différences entre sexes sont discutés.

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