Estimates Of Genetic Parameters For Daily Gain and Carcass Traits for Japanese Large White Swine

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Introduction

In commercial pig breeding, selection for increased growth rate and reduced backfat thickness has been commonly practiced. Selection decisions have been based on estimated breeding values (EBVs) or expected progeny differences (EPDs) for these traits. An optimum selection strategy should aim at increasing the rate of growth and improving carcass composition simultaneously. However, combined selection for increased daily gain and reduced backfat thickness may lead to a decreased rate of genetic progress, if genetic antagonisms exist between daily gain and the carcass traits. It is therefore imperative to estimate genetic parameters for daily gain and carcass traits, which would then be used for calculating EBVs and EPDs. This study presents estimates of heritabilities, and genetic and phenotypic correlations for daily gain and carcass traits for Japanese Large White swine.

Material and Methods

Data on daily gain and carcass measurements were obtained from the Iwate and Miyazaki provinces of Japan. Only records with sire and dam identification numbers and herd identification were used in the analysis. Records on 1256 barrows of the Japanese Large White breed born between 1982 and 1986 were used. The test period started when the animals were approximately 65 lb and ended at approximately 200 lb live weight. The animals were fed ad libitum in groups of five. At the end of the test period, the animals were individually weighed and subsequently slaughtered. The traits of interest were:

- average daily gain (ADG), the average daily weight gain over the test period;
- dressing percentage (DOP), the carcass weight as a percent of live weight;
- carcass length (CCL), the length taken on the horizontal warm suspended carcass from the symphis pubis to the atlas joint;
- loin eye area (LEA), a planimeter area measure of a tracing of the longissimus dorsia;
- average backfat thickness (ABF), the average of three backfat thicknesses, measured on the shoulder, midline, and last rib; and
- proportion cut ham (PCH), the proportion of ham lean weight relative to the total ham weight expressed as a percentage.

Data were analyzed by VCE (Groeneveld, 1997) under an animal model including all the six traits. All traits were adjusted for body weight at slaughter.

Results

Estimates of heritabilities and their standard errors, as well as genetic and phenotypic variances, are presented in Table 1. The heritability estimate for ADG was moderate, at .32. Heritabilities for carcass traits ranged from .43 to .71.

Estimates of genetic correlations among the traits, with their standard errors, are presented in Table 2 (below the diagonal). Also in the table are phenotypic correlations among the traits (above the diagonal). The genetic correlation between daily gain and backfat thickness was estimated to be close to zero, at .06. Correlations between ADG and other carcass traits were low and negative, ranging from -.14 to -.34. Corresponding values of phenotypic correlations ranged from -.02 to -.10. Genetic correlations among carcass traits were variable, ranging from -.65 to .37, while phenotypic correlations ranged from -.36 to .26. The genetic correlation of ABF with PCH (r = -.65) was greater in magnitude then the correlation of LEA with PCH (r = .37). The moderate genetic correlation between LEA and ABF (-.37) indicates that the addition of LEA to the selection criteria would increase the rate of genetic progress for PCH and likely for total carcass lean.

Discussion

The estimates of genetic parameters for daily gain and backfat thickness found in the present study are consistent with those from previous reports. In a comprehensive review of estimates of heritability for ADG (Hutchens and Hintz, 1981), an average of .38 was reported. This is consistent with the estimate of .32 obtained from the present study. Estimates of heritability for carcass traits are consistent with previous reports. In this study, the data sample was small, and therefore the estimates are likely less accurate than those from the literature with large samples. The moderate heritability for daily gain and the moderate to high heritability estimates for carcass traits indicate that genetic improvement of daily gain and carcass composition through selective breeding should be effective. The low negative correlations between daily gain and carcass traits suggest that selection for daily gain alone is likely to have some negative effects on carcass composition.

Implications

These results support the conclusion that selection to maximize the rate of growth may lead to some deterioration in carcass composition. However, the genetic correlations between growth rate and carcass composition were small and variable. Selection for LEA in addition to growth rate and backfat thickness should increase the rate of genetic improvement for carcass lean percentage.

References

Groeneveld, E. 1997. VCE4 User's Guide and Ref. Man. IAHAB, FAL, D31535 Neustadt. Holtystrasse 11. Germany.

Hutchens, L.K., and R.L. Hintz. 1981. Oklahoma State Univ. Agric. Exp. Stat. Tech. Bull. T-155.

Table 1. Estimates of heritability with standard errors, and genetic and phenotypic variances for daily gain and carcass traits.

Trait	Heritability	Genetic variance	Phenotypic variance
Daily gain (ADG), lb/day	.32 ± .05	.0129	.0400
Dressing percentage (DOP)	.43 ± .05	1.37	3.17
Carcass length (CCL), in.	.56 ± .03	.392	.704
Loin eye area (LEA), in.^{2}	.65 ± .03	.107	.163
Average backfat thickness (ABF), in.	.71 ± .04	.0139	.0197
Proportional cut ham (PCH)	.52 ±.05	.83	1.59

Table 2. Estimates of genetic and phenotypic correlation among carcass traits and average daily gain. Genetic correlations and standard errors are below the diagonal; phenotypic correlations are above the diagonal.

Trait[1]	ADG	DOP	CCL	LEA	ABF	PCH
ADG		-.10	-.02	-.07	.04	-.03
DOP	-.21 ± .08		-.05	.26	.22	-.16
CCL	-.14 ±.05	.17 ± .07		-.03	-.28	-.10
LEA	-.34 ± .06	.36 ± .07	.0 ± .05		-.20	.08
ABF	.06 ± .08	.22 ± .05	-.08 ± .03	-.37 ± .05		-.36
PCH	-.17 ± .08	-.28 ± .04	-.11 ± .06	.37 ± .06	-.65 ± .05	

[1] See Table 1 for definitions of abbreviations.