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Genetic variation in measures of feed efficiency and their relationships with carcass traits in Duroc pigs

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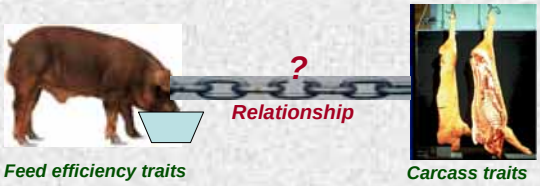
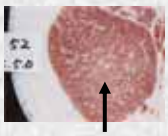
A selection program that improves the feed efficiency is expected to benefit the pig industry. However, the opportunity to improve production efficiency through exploitation of genetic variation in feed efficiency traits is dependent not only on the existence of genetic variation in pig but also on its genetic relationship with carcass traits.

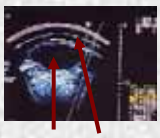


Genetic parameters for carcass traits and their genetic relationships with feed efficiency traits in seven generations of Duroc pigs were estimated.

Materials and Methods

Duroc pigs used in this study were a line that had been selected for daily gain (DG), loin eye muscle area (LEA), backfat thickness (BF), and intramuscular fat (IMF) through seven generations using index and BLUP methods. Genetic parameters for feed efficiency traits, i.e., feed conversion ratio (FCR) and residual feed intake (RFI) on 380 boars, and their relationships with carcass traits, i.e. LEA, BF, IMF, and meat tenderness (MT) on 1642 pigs (380 boar, 868 gilts, and 394 barrows) were estimated. Using an ultrasound (B-mode) color scanning technology (SR-100, Kaijo Corp., Tokyo, Japan), EMA and BF were measured on all live animals at 105kg on the left side at the location of half body


IMF


EMA Backfat


Tensipresser

length. The MT was measured using a Tensipresser (TTP-50BXII; Taketomo Electric Corp., Japan). The RFI for individual boars were estimated by the difference between actual and predicted feed intake. The predicted feed intake was estimated by the Japanese feeding standard. The following multi-trait animal model was used to estimate genetic parameters:

$$Y_{ijklm} = \mu_i + G_{ij} + S_{ik} + c_{il} + a_{im} + e_{ijklm}$$

where Y_{ijklm} = observation of trait i; μ_i = common constant for trait i; G_{ij} = fixed effect of selection generation j for trait i. The selection generation included the genetic effect of selection and the environmental effect at each generation; S_{ik} = fixed effect of sex k for trait i; c_{il} = random effect of common environment of littermates l for trait i; a_{im} = random additive genetic effect of animal m for trait i, and e_{ijklm} = random residual effect for trait i.

Results

Table 1 Means, h^2, and genetic (above the diagonal) and phenotypic (below the diagonal) correlations between FI and growth traits

Traits	Means±SD	h^2	Correlations		
			FI	DG	MWT
FI	2.62±0.23	0.53±0.06	-	0.77±0.04	0.26±0.12
DG	0.87±0.11	0.44±0.10	0.51	-	0.60±0.09
MWT	23.85±0.35	0.48±0.07	0.14	0.26	-

- The FI and growth traits were moderately to highly heritable (ranging from 0.44 to 0.53).
- The genetic and phenotypic correlations between DG and FI were high (0.77 and 0.51, respectively).
- The genetic correlation between MWT and FI was moderate (0.26), while the phenotypic correlation between them was low (0.14).

Table 2 Means, additive genetic variance, and h^2 for feed efficiency and carcass traits

Traits	RFI (kg/d)	FCR (kg/d)	BF (cm)	LEA (cm^2)	IMF (%)	MT (kgf/cm^2)
Mean	0.05	2.65	2.37	37.00	4.25	72.52
SD	0.17	0.22	0.42	4.05	1.46	12.73
σ^2_A	0.011	0.013	1.071	6.395	0.795	71.729
h2	0.34	0.27	0.72	0.46	0.40	0.45
±SE	*±0.15*	*±0.03*	*±0.02*	*±0.04*	*±0.03*	*±0.06*

- The feed efficiency traits were moderately heritable.
- The heritability for BF was high, while for all the other carcass traits were moderate.

Table 3 Genetic correlations between feed efficiency and carcass traits

Traits	BF	LEA	IMF	MT
RFI	0.78±0.08	-0.61±0.09	0.17±0.09	-0.20±0.13
FCR	0.48±0.09	-0.51±0.10	0.21±0.07	-0.12±0.14

- The genetic correlations of feed efficiency traits with BF (positive) and LEA (positive) were favorable.
- BF was more strongly correlated with RFI (r_g=0.78) than with FCR (r_g=0.48).

Conclusion

Moderate to high heritabilities for carcass traits suggest that a large genetic variability exists in Duroc pigs. Genetic correlations indicate that it is possible to select simultaneously for reduced RFI and BF. However, selection against RFI would give better correlated response in BF than that to selection against FCR.