SELECTION FOR DAILY GAIN, LOIN-EYE MUSCLE AREA, BACKFAT THICKNESS AND INTRAMUSCULAR FAT IN 7 GENERATIONS OF DUROC PIGS

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INTRODUCTION

Recently, the objective of selection in pigs has changed from meat production traits to meat quality traits, and research involving meat quality traits related to the taste and texture of meat has been reported (Cameron,1993 ; Hovenior, 1993). The delicious high quality pork production is effective against the import pork from abroad, in Japan. In 1995, a seven-generation selection experiment started at the Miyagi Prefecture Animal Industry Experiment Station. The object of this selection experiment was to study meat production traits and intramuscular fat as selection traits for Duroc pigs that has the highest content of intramuscular fat in pig breeds. This report introduces estimates of the genetic parameter and genetic trends of selection traits and correlated trait.

MATERIALS AND METHODS

Animals and measurement of meat production and meat quality. Twenty boars and thirty-five gilts of the Duroc breed were used as the base population. About 15 boars mated to about 50 gilts from the 1st generation to the seventh generation. After birth, at the 8th weeks, 1-2 male piglets (total 50 piglets) and 3-4 female piglets (total 110 piglets) from each litter were selected as candidate for boars and gilts. In total, 80 piglets (barrows and gilts) were selected as slaughter pigs from each litter. The performance test began when body weight reached 30kg and ended at 105kg. Boars were reared individually and fed *ad libitum* and gilts and barrows were reared with group feeding. Backfat thickness (BF) and loin-eye muscle area (EM) were measured with a Scanning Scope (KAIJYO CORPORATION, Model SR-100) using an ultrasonic wave at a 105kg body weight. Slaughter pigs were killed after 24 hours of starvation, and the carcasses were cooled at 4 ℃ for 24 hours. After measuring carcass traits, the *longissimus* muscle of each pig was sampled from a site two sections above the last rib. The intramuscular fat content (IMF) of the meat was analyzed using the Soxhlet extraction method, and the Tenderness (TENDERNESS) was measured using the Tensipresser (Model TTP-50BXⅡ, Taketomo-Electric Company, Japan) developed by Nakai *et al*. (1992).

Selection method. Selection of the first and second generations was realized using an index selection method based on relative desired gain (Yamada *et al*., 1975). Selection traits were DG, EM and BF. In order to inherit the genes of boars and gilts in the base population to the next generation, selection were made within-boars and within-litters for the boars and gilts, respectively. The breeding values of DG, EM, BF and IMF were estimated according to the BLUP animal model since the third generation. The breeding value was calculated using the PEST3.1 program (Groeneveld and Kovac, 1990) after estimating the genetic parameters using the VCE4.25 program (Neumaier and Groeneveld, 1998) considering the fixed effect of generation and sex and the random effects of individual additive genetic effect and error in the analysis models. Relative economic weights of selection traits were calculated from the relative desired gain. The aggregate breeding value was calculated by multiplying the relative economic importance to the estimated breeding value of each trait, and the selection was executed. About 15 boars and 50 gilts were selected at each generation.

RESULTS AND DISCUSSION

Table 1. Estimates of genetic parameters in Duroc line

	DG	EM	BF	IMF	TENDERNESS
DG	**0.510±0.03**	-0.088±0.064	0.352±0.048	0.216±0.062	-0.380±0.066
EM	-0.079	**0.490±0.029**	-0.424±0.051	-0.265±0.048	0.198±0.054
BF	0 .281	-0.290	**0.727±0.022**	0.200±0.049	-0.552±0.053
IMF	0.072	-0.239	0.202	**0.496±0.046**	-0.060±0.096
TENDERNESS	-0.340	0.184	-0.387	-0.195	**0.503±0.024**

Heritabilities (±s.e) is shown on the diagonal, phenotypic correlations, below the diagonal, and genetic correlations, above the diagonal, ±s.e.

Genetic parameter estimates are shown in Table1. Concerning the meat production trait under *ad libitum* feeding, the average estimates of heritability on DG and BF were 0.31 and 0.49, respectively (Clutter and Brascamp, 1998). In addition, the heritability of 0.47-0.48 was reported for EM (Sellier, 1998). The present estimate for EM was close to the one in this report but the estimates of DG (0.510) and BF (0.727) were higher than previously reported estimates. For intramuscular fat, the heritability estimate of 0.490 in the present experiment was similar to that reported by Hovenier (1993) and Sellier (1998), which averaged 0.5 in both cases. Tenderness is usually evaluated by a taste panel and the use of the Warner-Bratzler shears force. The heritability estimate by both evaluations varied from 0.21 to 0.37 (Hovenier, 1993). Sellier (1998) also reported an heritability of 0.29(0.18-0.70) using a taste panel and of 0.26 (0.17-0.46) using machine measurements. A comparatively high heritability (0.503) was estimated in the present experiment. The genetic correlation (r_G) and phenotypic correlation (r_P) between DG and EM was negative-low and those between DG and BF were positive-middle. For the genetic correlation between DG and BF under *ad libitum* feeding, an average value of 0.12(-0.26 - +0.55) was reported (Clutter, 1998). IMF was positively correlated with DG (r_G:0. 216, r_P:0. 072) and BF (r_G: 0.200, r_P: 0.202) and negatively correlated with EM (r_G: -0.265, r_P: -0.239). A desirable negative correlation was observed between Tenderness and DG, and a positive and undesirable relation was admitted between Tenderness and EM. Also a negative correlation between Tenderness and BF was undesirable. Finally, low and negative genetic (-0.060) and phenotypic (-0.195) correlations were estimated between IMF and Tenderness.

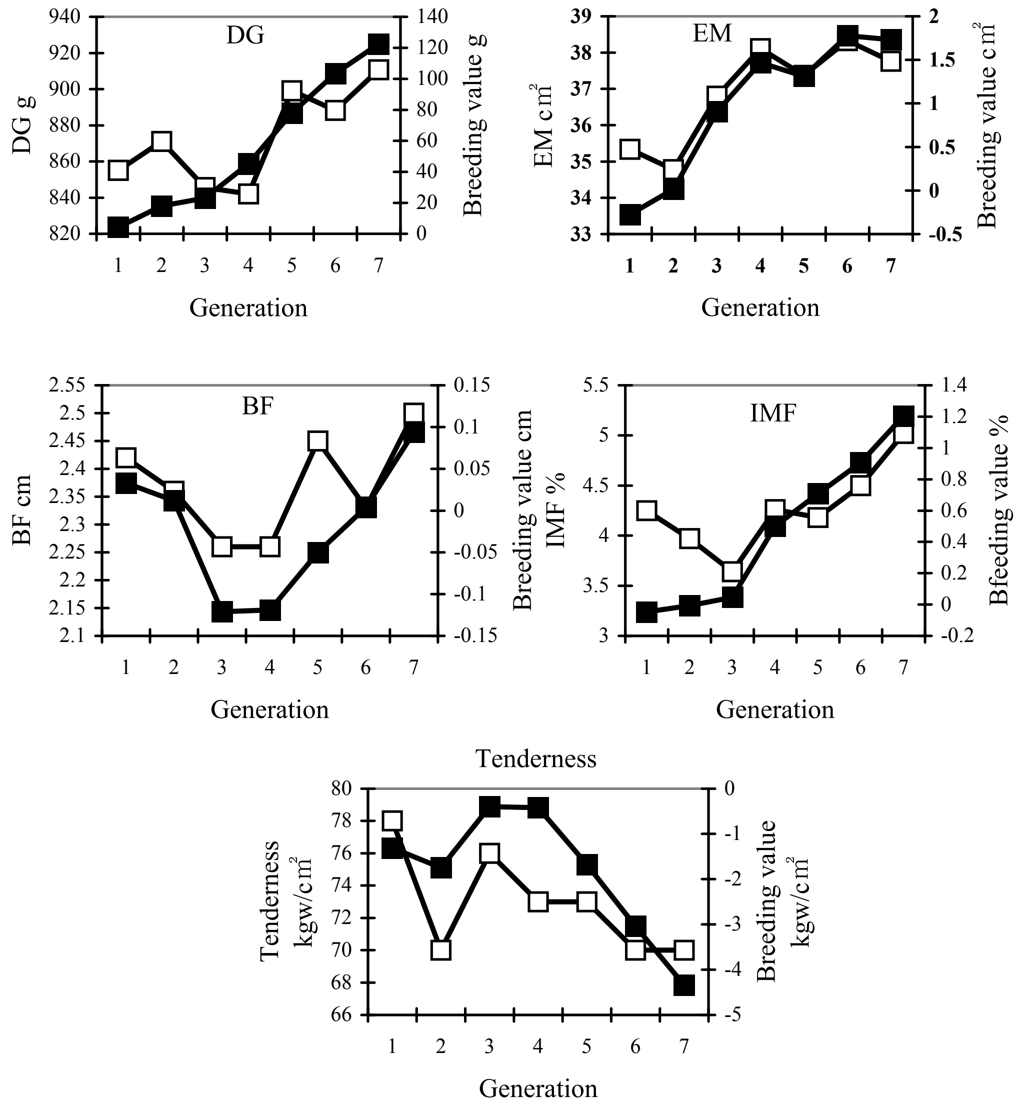

Figure 1. Estimated phenotypic (-□-) and genetic (-■-) trends for selection traits (daily gain, loin-eye muscle area, backfat thickness, and intramuscular fat) and correlated traits (Tenderness) in the Duroc line

There were contradicting reports about the correlation between Tenderness and IMF. It can be concluded that the correlation is low from the present result. The selection response for DG, EM, BF and IMF and the correlated responses of TENDERNESS are shown in Fig.1. For an initial generation of the selection, the selection differential was small because the selection was conducted within-boars and within-litter. As a result, the selection response for DG, EM, and IMF stagnated. However, the selection response of DG, EM, and IMF advanced because the selection differential was enlarged by the BLUP method from the third generation. On the other hand, the genetic improvement gain of the BF was set as almost 0, considering the influence on the carcass and the meat quality trait. However, the BF actually grew faster as the IMF increased. Although TENDERNESS was not a selection trait, the phenotypic value and the breeding value decreased after the fourth generation, and the meat became soft. The IMF increased since the third generation. As a result, at the seventh generation, the mean of IMF exceeds 5.0% and 87.5% of 81-slaughter pig was graded 4.0-5.0 according to the marbling score of NPPC (1991) .

CONCLUSION

The selection for DG, EM, BF, and IMF was conducted using BLUP animal model during 7 generations in Duroc pigs. The performances of meat production and meat quality have been improved considerably. The mean of IMF exceeds 5.0%, and the marbling score 4.0-5.0 accounted for 87.5% of the total pigs. Moreover, the meat tenderness was improved as a correlated response, and the meat became soft. The effectiveness of selection to improve meat quality was proven by the present results.

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