# Genetic Correlations Between Lactation Performance And Growing-Finishing Traits In Pigs

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## Introduction

Through genetic selection and improved environment, productivity of sows has increased over the past decades. As a consequence, the risk of a negative energy balance of sows during lactation keeps increasing too. Excessive mobilization of fat from sow's body stores or, worse, mobilization of protein, will have detrimental effects on reproductive performance Whittemore and Morgan (1990).

Based on genetic parameters, it is not likely that current genetic selection for fertility traits will affect feed intake or body mobilization of lactating sows (Bergsma et al., 2008).

In integrated pork production systems, the cost-price of a slaughter pig is predominantly determined by the costs during the grower-finishing phase. It is therefore economically worthwhile to include growing-finishing characteristics in a breeding goal for dam lines.

The hesitation in selecting for leanness and feed efficiency in sows is based on the expectation that traits on a finisher pigs show a moderate or high, genetic correlation with the corresponding traits as a (lactating) sow. However, no research was found to confirm this expectation.

The objective of this study was to estimate genetic parameters for lactation performance traits and growing-finishing traits, and especially the genetic correlations between them.

## Material and methods

Observations of four farms were used in this study, which partly overlapped in pedigree.

**Lactation performance traits.** Lactation performance is used in this manuscript as a collective noun for seven different traits. These traits are briefly described below. A detailed description is given by Bergsma et al. (2009).

(1) Start weight (the body weight of a sow shortly after parturition) is estimated from the weight of the sow at transfer to the farrowing house (pre-partum observation) and weight of her live- and stillborn piglets at birth (post-partum observation). (2) Fat mass at start of lactation of each sow was estimated from her start weight and backfat thickness. Backfat thickness was recorded ultrasonically together with weight at transfer to the farrowing house. At weaning, weight of each sow was measured again. (3) Weight loss was estimated by subtracting body weight at weaning from start weight. Each sow was fed restricted during the first week after parturition according to an ascending scale (increased by a fixed amount each day). From week one until weaning sows were fed ad libitum ((4) ad libitum feed intake) or restricted ((5) restricted feed intake). Both traits were defined as the total amount

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of feed consumed by each sow during lactation, including the first week. (6) Litter weight gain is the weight of the piglets at weaning minus the sum of the birth weights of the piglets after cross fostering. Piglets were usually cross fostered within 48 hours after birth. (7) Lactation efficiency was defined as an energy efficiency of sows, and was calculated as output (x 100%) over input. Input was calculated as the sum of the energy out of body mobilization of the sow and energy out of feed intake above the energy needed for maintenance of the sow. Output equals the energy deposition in body protein or body fat of weaned piglets or piglets that died during lactation, including the energy needed for their maintenance. Energy input and output were estimated per sow per day averaged over the lactation period. All energy units were expressed in MJ Metabolisable Energy (ME).
The dataset contained 1156 observations on ad lib feed intake during lactation and 3231 observations on restricted feed intake.

**Growing-finishing traits.** For growing-finishing characteristics, five traits of interest were identified: growth rate (on-off test), back fat thickness, muscle depth, feed intake and feed efficiency. Back fat thickness was established at slaughter, using the Hennesy Grading Probe. The Hennesy Grading Probe also measures muscle depth. Daily Feed intake was averaged over the growing-finishing period. As a measure of feed efficiency, residual feed intake was calculated (for derivation: see Knol, 2001). Residual feed intake was the choice of trait because it mimics the efficiency of the energy metabolism of growing-finishing pigs as lactation efficiency does for sows.
The dataset contained 8426 observations on ad lib feed intake during growing-finishing-phase. Most dams in the dataset were not performance tested themselves. Growing-finishing traits were recorded on offspring.

**Estimation of Genetic Parameters.** Genetic parameters were estimated using ASREML software. A repeatability model was used for all lactation performance traits. The pedigree matrix contained three generations of parents. In total 36,220 animals were included in the pedigree matrix.
Genetic parameters for growing-finishing traits were estimated simultaneously. So were those for the lactation performance traits. Genetic correlations between growing-finishing traits and lactation performance traits were estimated bivariate. Effects, for which heritabilities were estimated, were excluded as fixed effects from the models in both bivariate and multivariate analyses.

## Results and discussion

Genetic parameters for lactation performance traits and for growing-finishing traits are presented in Table 1 and 2 respectively. Genetic correlations between lactation performance traits and growing-finishing traits are given in Table 3.
In the introduction we raised the expectation of a, at least, moderate genetic correlation between feed intake as a grower-finisher and as a lactating sow. Our study indicates that selection for growing-finishing characteristics yields ditto sows at start of lactation. For example, families which show a high feed intake as a grower-finishers show heavy ($r_{g=}$+0.27), fat ($r_g$=+0.36) sows at start of lactation. But after farrowing, genetic regulation of feed intake seems to differ, since there is no genetic correlation between feed intake as a

grower-finisher and both feed intake traits as a lactating sow ($r_g$=-0.13 and +0.12 with FIA and FIR respectively; both not significant).

**Table 1 Heritability (on diagonal) and genetic correlations amongst lactation performance traits; Bold printed correlations differ from zero (p<0.05)**

| | WTS | FMS | WLL | FIA | FIR | LWG | LE |
|---|---|---|---|---|---|---|---|
| WT at start (kg) WTS | *0.50* | **0.64** | **-0.54** | 0.20 | 0.23 | -0.16 | **0.35** |
| Fat mass at start (kg) FMS | | *0.47* | **-0.31** | -0.08 | 0.08 | -0.27 | -0.05 |
| WT loss lactation (kg) WLL | | | *0.19* | **-0.49** | **-0.43** | **-0.31** | **-0.26** |
| Ad lib lactation FI (kg) FIA | | | | *0.31* | **0.83** | **0.62** | **-1.02** |
| Restricted lactation FI (kg) FIR | | | | | *0.14* | **0.28** | **-0.33** |
| Litter weight gain (kg) LWG | | | | | | *0.15* | **0.55** |
| Lactation efficiency (%) LE | | | | | | | *0.04* |

**Table 2 Heritability (on diagonal) and genetic correlations amongst growing-finishing traits; Bold printed correlations differ from zero (p<0.05).**

| | DG | BF | LD | FI | RFI |
|---|---|---|---|---|---|
| Daily gain (g/d) DG | *0.19* | 0.11 | -0.02 | **0.67** | 0.06 |
| HGP back fat (mm) BF | | *0.34* | -0.08 | **0.39** | **-0.51** |
| HGP muscle depth (mm) LD | | | *0.23* | **-0.23** | **-0.19** |
| Feed intake (kg/d) FI | | | | *0.17* | **0.29** |
| Residual feed intake (kg/d) RFI | | | | | *0.08* |

**Table 3 Genetic correlations between lactation performance traits and growing-finishing traits; Bold printed correlations differ from zero (p<0.05)**

| | WTS | FMS | WLL | FIA | FIR | LWG | LE |
|---|---|---|---|---|---|---|---|
| Daily gain (g/d) DG | **0.45** | 0.13 | -0.28 | -0.16 | 0.35 | 0.12 | -0.10 |
| HGP back fat (mm) BF | 0.08 | **0.63** | **-0.36** | -0.43 | -0.05 | **-0.27** | -0.15 |
| HGP muscle depth (mm) LD | -0.05 | -0.08 | -0.06 | ne[1] | -0.22 | -0.11 | 0.06 |
| Feed intake (kg/d) FI | **0.27** | **0.36** | -0.12 | -0.13 | 0.12 | -0.17 | -0.19 |
| Residual feed intake (kg/d) RFI | -0.16 | **-0.25** | 0.14 | 0.11 | -0.02 | -0.16 | -0.32 |

[1]n.e. = Not estimable

Leaner genotypes at start of lactation or as a grower-finisher tend to loose more weight during lactation ($r_g$ fat mass and weight loss = -0.31; $r_g$ back fat and weight loss = -0.36). Whittemore and Morgan (1990) suggested that lean genotypes of sows may be less likely to mobilize fat stores than fatter genotypes. Our results falsify this self protecting mechanism. There is a (negative) phenotypic relation between fatness of the sow at start of lactation and feed intake during lactation. This phenomenon might have affected our estimates since there is no measure of fatness included in the model for feed intake during lactation, although including fat mass as such, did not affect our genetic correlation estimate (results not shown). Our estimates of genetic correlations are primarily based on mother-offspring comparison. The mothers of which information was used in this study were dam lines or commercial crosses of dam lines. Selection pressure in these lines is predominantly on fertility characteristics. Information on sire lines hardly contributed to the genetic correlations since no information on lactation performance traits were available for these lines. Therefore genetic correlations originate from a population with only mild selection pressure on growing-finishing traits.

There are moderate to strong (negative) genetic correlations between feed intake during lactation and weight - and fat losses during lactation (Bergsma et al., 2008). Culling decisions of farm managers on breeding farms on sows after weaning are, probably affected by feed intake since severe body mobilization is expected to negatively affect the performance in the next production cycle. This raises the expectation that there is a continuous selection on feed intake during lactation.

At Iowa State University, differences between generation 6 of a selection line on residual feed intake and a control line were analyzed (Young et al., 2010). They concluded that selection on low residual feed intake as a grower-finisher significantly reduces feed intake as a lactating sow. Contrary to our results, these results suggest that there is a positive genetic correlation between feed intake as a grower-finisher and as a lactating sow, since one might expect a positive correlation between residual feed intake and feed intake as a growing-finishing pig as well ($r_g$=0.29 in our study).

Genetic correlations can change over time as a consequence of selection. This might explain the differences found in both studies. No direct selection on residual feed intake took place in our population, while the Iowa State-population was selected for residual feed intake only.

## Conclusion

Selection for growing-finishing characteristics in the investigated (dam line) populations are not a risk for lactation performance characteristics. Severe (unilateral) selection on feed efficiency during growing-finishing might negatively affect feed intake during lactation on the long run.

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