DISTURBED MILK PRODUCTION IN YORKSHIRE SOWS

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SUMMARY
The heritability of disturbed milk production in Swedish Yorkshire sows was estimated to be 0.8 with a threshold model, using Gibbs sampling. Of the 6920 sows analysed, 4% showed disturbed milk production. An unfavourable genetic correlation was found between disturbed milk production and lean growth.
Keywords: Swine, Milk production, Genetic parameters, Bayesian analysis

INTRODUCTION
During recent years disturbed milk production has become a problem in Swedish Yorkshire (Large White) sows. In the third week of lactation, milk production decreases rapidly, and the udder dries up. Since the average weaning age in Sweden is five weeks, piglet mortality is very high in affected litters. Clinical observations and blood samples from 13 disturbed and 12 control sows in a previous study (Rydhmer *et al,* 1996) indicated that the disturbed sows had a good appetite during lactation, and when milk production decreased they seemed to be in an anabolic phase. None of the affected sows showed any evidence of metabolic disturbance, nor did they show any general signs of infection. The disturbance appeared most commonly in the second or third lactation, and gilts were only rarely affected. Some breeders claim that this disturbance is related to characteristics of "the modern type" of Yorkshire sow, that is a muscular sow with a compact body conformation. Therefore breeders suspect that disturbed milk production is a consequence of placing high weight on lean growth and low weight on maternal traits in the breeding program. The aim of this study was to estimate the heritability of disturbed milk production and the correlation between this disturbance and lean growth.

The assumption of normality, traditionally used in genetic analysis, does not hold for disturbed milk production recorded as a binary trait. Therefore a Bayesian analysis of a threshold model, using Gibbs sampling, was performed.

MATERIAL AND METHODS
The study was based on data from the litter recording scheme and included 6920 Swedish Yorkshire sows from 18 nucleus or multiplying herds. Only sows from herds with at least one reported case of disturbed milk production were used. The sows, born during 1990-1995, had 604 sires and 2030 dams. According to breeders' observations, reported to the breeding organisations ScanAvel and Avelspoolen, 286 of the 6920 sows showed disturbed

milk production. All other sows were assumed to be normal and were thus assigned a value of 0 for this trait. The individual index value from the field test (growth from birth to test, together with ultrasonic measurement of back fat thickness) was used as an estimate of lean growth. Lean-growth values were missing for 545 sows.

Genetic variation was estimated with a sire model including the fixed effects of year of birth of sire (8 classes) and birth herd of sow (18 classes) and the random effect of birth litter of sow (3706 litters) together with the random effects of sire and error. The heritability was estimated as $4\sigma^2 sire/(\sigma^2 sire + \sigma^2 litter + \sigma^2 e)$. Inference was based on posterior distributions achieved with the Gibbs sampling technique (Jensen, 1994). Disturbed milk production was assumed to be the observed result of a normally distributed underlying variable, called liability. In cases where the liability value of an individual exceeds a certain threshold value the disturbance is observed, as in the threshold model presented by Dempster and Lerner (1950). The liability values and missing values for lean growth were created by data augmentation, as described by Sorensen (1996). They were replaced by values drawn from normal distributions conditional on everything else in the model; hence, the standard linear methodology for the Gibbs sampler could be applied.

Uniform, improper prior distributions were used for the fixed effects. Vague priors were used for genetic and environmental variances and covariances. The environmental variance of the liability was assumed to be 1, and the threshold was set to 0. The Gibbs sampler was run as a chain with 278500 samples. The first 500 samples were regarded as the burn-in period and were therefore discarded. Thereafter every 20 iterations were saved, so that the chain was represented by 13900 samples. The Monte Carlo standard deviations of the posterior means were calculated as described by Sorensen *et al* (1995). To check the influence of the variance-covariance priors on the posterior distribution a second chain was created. Minimum values from the first chain were used as priors for the second chain, together with a new random seed.

RESULTS

The frequency of disturbed sows was 4.1% and varied from 0.2 to 10.7% between herds. The phenotypic mean of the lean growth index was 110.6 for disturbed sows and 110.0 for normal ones. Of the 604 sires 117 had disturbed daughters. Among the 48 sires with more than 30 daughters the frequency of disturbed daughters varied from 0 to 17%. Twenty sires had disturbed daughters in more than one herd, and 12 of them were AI boars.

Posterior distributions for all estimates were well approximated by normal distributions. The heritability for disturbed milk production was high (Table 1). There was an unfavourable genetic correlation between disturbance and lean growth. All Monte Carlo standard deviations for the presented mean values were below 0.006. The rate of mixing was slow, especially for the heritability of disturbed milk production which had a correlation of 0.15 between sampled heritability values when the lag was 200 samples. Results from the second chain are not presented here since no difference between chains in any of the estimated genetic parameters was larger than 0.02.

Table 1. Genetic parameters for disturbed milk production and lean growth. Mean, mode, median, standard deviation and 95 percent confidence interval from the posterior distribution (13900 samples)

Parameter	Mean	Mode	Median	Standard deviation	95% conf. int.
h^2, disturbed milk production	0.79	0.78	0.77	0.18	0.47-1.17
h^2, lean growth	0.37	0.37	0.37	0.07	0.24-0.53
Genetic correlation	0.39	0.37	0.39	0.15	0.07-0.65
Environmental correlation	-0.07	-0.09	-0.07	0.06	-0.18-0.04

DISCUSSION

To our knowledge this type of disturbed milk production has not been described previously in the literature. One reason for this could be that in countries where piglets are weaned around three weeks of age the disturbance would not be observed. However, under certain conditions sows can wean their piglets after only a few weeks of lactation. For instance, this has been reported from stressful environments (Pedersen *et al*, 1997) and from systems where sows and piglets are group housed two weeks after farrowing, in large pens (Hultén *et al*, 1995).

Disturbed milk production, as recorded in this study, is a difficult trait to handle in breeding evaluation and selection. It is a binary trait, and the disturbance has a very low frequency. Further, it can only be recorded on lactating sows, and some sows show the disturbance late in life. Thus many sows that are genetically predisposed for disturbed milk production will be culled after first or second lactation without showing the disturbance. There is little doubt that not all cases of disturbed milk production have been reported, and all sows for which no report was available were classified as normal. Further, the definition of disturbed milk production is still unclear, so some of the 286 disturbed sows probably suffered from other diseases, such as agalactia. From 1994 and onwards, breeders have been asked to report all cases of disturbed milk production to the breeding organisations. Older records are thus based on breeders' notes about culling reasons dating from a time when this disturbance was not yet well known.

The high heritability for the disturbance may be an effect of the repeated measurements (all lactations until culling) used for each sow. An alternative method of estimation would be to use an animal model for the sow and include all lactations as repeated measurements.

In the Swedish pig breeding goal, reproduction is included together with lean growth and other production traits. However, the selection traits are litter size (number of piglets born alive) and farrowing interval. Thus a disturbed sow, even though she is a catastrophe for her piglets and a severe problem for her owner, is not downgraded in the breeding evaluation. This illustrates the importance of including piglet growth or maternal ability to take care of the litter in the breeding program, especially when piglets are weaned at high ages. Milk production is, of course, not a binary trait, and it is possible that the disturbed sows in this study represent the left tail of the normal distribution of milk production. Milk production itself cannot be recorded on a sufficiently large number of sows, even though milk machines for sows have been used in experiments (Reiner *et al*, 1995), but piglet growth is an indicator of milk production. Piglet weighings in the nucleus herds could reveal whether the disturbed sows are poor milk producers already at the first lactation. However, lactation is a process with two active parts; the mother and the piglets. The behaviour of the piglets, e g the udder massage, has an important influence on the duration of milk production (Algers, 1993). It could therefore be interesting to include the father of the piglets in the model.

The genetic correlation found between lean growth and milk production justifies the breeders' concern about the relation between reproduction and production traits in the breeding goal. DeNise *et al* (1983) found an unfavourable genetic correlation between back fat and piglet survival in a selection experiment, and Nelson *et al* (1990) suggested that selection for extreme leanness could reduce milking ability.

Disturbed milk production has a high heritability and is unfavourably correlated to lean growth. It can therefore be concluded from this study that breeders should avoid relatives to disturbed sows when selecting young breeding animals. However, since this disturbance often occurs in later parities, gilts and boars from the first litter are already being used as breeding animals by the time that the dam shows disturbed milk production. Thus we can not trust a natural selection in this case, even though most piglets in affected litters will die. Therefore a continuous breeding evaluation of Yorkshire animals, concerning this disturbance, is necessary.

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