GENETIC PARAMETERS FOR PERFORMANCE TRAITS OF PIGS RECORDED UNDER AD LIBITUM AND RESTRICTED FEEDING

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SUMMARY

Genetic parameters were estimated in Large White and Landrace pigs for performance traits recorded under *ad libitum* and restricted feeding using electronic feeders in commercial conditions. Data included 3,950 records for *ad libitum* feeding and 3,275 records for restricted feeding. The level of restriction in feed intake was 11 %, which did not result in different heritabilities between feeding regimes, but reduced variance components for all performance traits under restricted feeding. The feeding regime did influence genetic correlations between performance traits. Selection for feed conversion ratio under *ad libitum* feeding will mainly reduce feed intake and only slightly increase growth rate. In contrast, selection for feed conversion ratio under restricted feeding will strongly increase growth rate but not reduce feed intake. Feed intake and feed conversion ratio were genetically different traits when recorded under different feeding regimes.
Keywords: Pigs, genetic parameters, performance traits, feeding regime, electronic feeders

INTRODUCTION

In most breeding programs, pigs are selected for efficient lean meat growth under *ad libitum* feeding. However, selection experiments have shown that selection for lean meat growth under restricted feeding may be preferable (McPhee *et al.* 1988; Cameron and Curran 1995). These selection experiments were conducted in research herds where pigs were individually penned and the level of restriction was well controlled to minimise the variation in feed intake. This might not be feasible in commercial conditions where animals are group penned and electronic feeders have to be used in order to restrict feed intake for individual pigs.

The aim of this study was to obtain estimates of heritabilities and genetic correlations for performance traits of group penned pigs performance recorded under *ad libitum* and restricted feeding using electronic feeders in a commercial herd.

MATERIAL AND METHODS

This project was conducted in cooperation with Bunge Meat Industries (BMI) where data were recorded between February 1996 and October 1998. It was planned to performance record four litter mates, two boars and two gilts, under *ad libitum* and restricted feeding. These pigs were either Large White or Landrace pigs. The actual performance test was started during the later part of the growth curve at approximately 19 weeks of age. Electronic feeders developed by BMI were used to record individual feed intake. Three electronic feeders were installed in each pen which accommodated a group of approximately 30 pigs each. Pigs were given one week to adapt to the feeding device and then tested over a period of five weeks. On average, daily feed intake was restricted by the electronic feeders for each individual pig to 2.55 kg in boars and 2.45 kg in gilts. Animals which exceeded these limits were excluded from the restricted group. In total, 3,950 pigs were tested under *ad libitum* feeding and 3,275 animals were available for restricted feeding.

The traits presented in this paper are growth rate from birth until start of test (ADG1). At start and end of test animals were weighed once and feed intake was recorded during test. The traits available from this test were growth rate (ADG2), average daily feed intake (FDINT) and feed conversion ratio (FCR). At the end of test, backfat at the P2 site was recorded with real time ultrasound (LP2). Feed intake was 11 % lower in the restricted group in comparison to the *ad libitum* group. This reduction in feed intake reduced means in growth rate during test and backfat by 10 % and 6 % respectively. Means for feed conversion ratio did not differ between the two feeding regimes.

Development of model. Fixed effects were analysed using the SAS procedure GLM (SAS, 1993). As a result of the design of this project, management group defined as the group of pigs kept in one pen accounted also for the effect of sex, pen and group size as well as possible feeder effects. Therefore, the fixed effect model included only management group and breed of the animal. Linear covariables fitted were weight of the animal at start of test for feed intake and feed conversion ratio and weight of the animal at test finish for backfat. Variance components were estimated using VCE4 (Groeneveld 1998) through a series of univariate and bivariate analyses. The random part of the model included the litter effect in addition to additive genetic and residual effects. Litter effect was significant for both growth rate traits and feed conversion ratio (Table 1).

RESULTS AND DISCUSSION

Growth rate before test was not influenced by feeding regime and heritability and litter effect estimates were similar for both groups. (Table 1). Feed intake under *ad libitum* feeding had a heritability of 0.27. This agrees well with results by Hermesch (1996) who estimated heritabilities for feed intake recorded in single pens for the same populations. The use of electronic feeders therefore did not cause a change in heritability estimate for feed intake under *ad libitum* feeding. Although, variance components were reduced for feed intake under restricted feeding in comparison to the *ad libitum* group, this trait still had a heritability of 0.16. This heritability indicates that not all pigs were restricted in their feed intake. This might explain why heritabilities for growth rate, feed conversion ratio and backfat did not differ significantly between feeding schemes. Cameron and Curran (1995) also found comparable heritability estimates between feeding regimes. In contrast, McPhee *et al* (1988) found higher heritabilities for growth rate and backfat under restricted feeding. Lower variance components for all three traits under restricted feeding in comparison to *ad libitum* feeding are in agreement with results of McPhee *et al* (1988) and Cameron and Curran (1995).

Correlations. The feeding system influenced genetic correlations between traits. Genetic correlations between feed intake and both growth rate traits and feed conversion ratio were lower under restricted feeding (Table 2). Furthermore, feed conversion ratio was highly correlated with growth rate during test under restricted feeding (rg: -0.86) but only lowly correlated with growth rate under *ad libitum* feeding (rg: -0.11). Although genetic correlations between growth rate traits and backfat were lower under restricted feeding, these differences were not significant. In comparison, McPhee *et al* (1988) found a positive genetic correlation between these traits under *ad libitum* feeding (rg: 0.35) and a negative genetic correlation under restricted feeding (rg: -0.22).

Table 1. Proportion of variation explained by fixed effect model (R^2), estimates of heritabilities (h^2) and litter effects (c^2) both with standard errors (s.e.) and variance components for performance traits

Trait	R^2	h^2	s.e. h^2	c^2	s.e. c^2	σ^2_a *	σ^2_c	σ^2_e
***Ad libitum* feeding**								
ADG1	0.14	0.17	0.03	0.18	0.02	502	526	1867
ADG2	0.27	0.08	0.02	0.07	0.02	1435	1267	14299
FDINT	0.34	0.27	0.03	-	-	0.026	-	0.071
FCR	0.33	0.10	0.02	0.08	0.02	0.020	0.015	0.168
LP2	0.40	0.50	0.03			3.19	-	3.19
Restricted feeding								
ADG1	0.23	0.22	0.03	0.14	0.02	585	354	1676
ADG2	0.38	0.09	0.02	0.06	0.02	1138	822	11504
FDINT	0.52	0.16	0.03	-	-	0.004	-	0.018
FCR	0.48	0.09	0.02	0.07	0.02	0.020	0.014	0.178
LP2	0.39	0.48	0.04	-	-	2.58	-	2.80

* σ^2_a : additive genetic variance, σ^2_c : variance due to litter effect, σ^2_e : environmental variance

Table 2. Genetic correlations (first row) and environmental correlations (second row) with standard errors (in brackets) between performance traits recorded under the same feeding system (below diagonal: *ad libitum* feeding; above diagonal: restricted feeding)

	ADG1		ADG2		FDINT		FCR		LP2	
ADG1			0.28	(0.12)	0.18	(0.12)	-0.41	(0.12)	-0.04	(0.08)
			-0.16	(0.02)	0.06	(0.02)	-0.01	(0.03)	0.21	(0.04)
ADG2	0.34	(0.11)			0.41	(0.12)	-0.86	(0.04)	-0.18	(0.10)
	0.01	(0.02)			0.47	(0.02)	-0.92	(0.01)	-0.06	(0.03)
FDINT	0.33	(0.10)	0.70	(0.07)			0.14	(0.14)	0.50	(0.08)
	0.04	(0.04)	0.55	(0.01)			-0.10	(0.02)	0.05	(0.03)
FCR	-0.05	(0.10)	-0.11	(0.15)	0.68	(0.08)			0.60	(0.09)
	-0.11	(0.02)	-0.70	(0.01)	0.16	(0.02)			0.08	(0.03)
LP2	0.12	(0.08)	-0.03	(0.09)	0.45	(0.06)	0.58	(0.07)		
	-0.02	(0.03)	0.02	(0.03)	0.19	(0.03)	0.14	(0.02)		

Genetic correlations between traits recorded under different feeding systems are presented in Table 3. Environmental correlations could not be obtained since traits were recorded on different animals. Growth rate and backfat were genetically the same trait under both feeding schemes. However, feed intake and feed conversion ratio were genetically different traits in both feeding regimes (rg for FDINT: 0.85; rg for FCR: 0.71) which was tested with a likelihood ratio test (Meyer 1993). In addition, genetic correlations with other traits differed between feeding systems. Selection for feed conversion ratio under restricted feeding will increase growth rate under *ad libitum* feeding (rg: -0.82) but not decrease feed intake under *ad libitum* feeding (rg: -0.12). These genetic correlations are of particular interest given that the breeding objective is based on *ad libitum* feeding but candidates for selection may be performance recorded under restricted feeding.

Table 3. Genetic correlations with standard errors (in brackets) between performance traits recorded under different feeding systems

	R_ADG1*		R_ADG2		R_FDINT		R_FCR		R_LP2	
A_ADG1*	0.97	(0.04)	0.20	(0.08)	0.41	(0.12)	-0.06	(0.06)	0.03	(0.08)
A_ADG2	0.30	(0.10)	1.00	(0.00)	0.72	(0.10)	-0.82	(0.09)	-0.15	(0.10)
A_FDINT	-0.04	(0.09)	0.54	(0.10)	0.85	(0.06)	-0.12	(0.11)	0.21	(0.07)
A_FCR	-0.25	(0.10)	-0.59	(0.11)	0.43	(0.12)	0.71	(0.09)	0.50	(0.09)
A_LP2	-0.12	(0.04)	-0.02	(0.10)	0.54	(0.07)	0.59	(0.10)	0.99	(0.02)

R_trait_name: performance trait recorded under restricted feeding; A_trait_name: performance trait recorded under *ad libitum* feeding

CONCLUSIONS

The feeding regime did not influence heritability estimates for performance traits but variance components were reduced under restricted feeding. The feeding regime influenced genetic correlations between traits. Selection for feed conversion ratio under *ad libitum* feeding will mainly reduce feed intake and lowly increase growth rate. In contrast, selection for feed conversion ratio under restricted feeding will increase growth rate but not reduce feed intake. Further work will include multivariate analyses and evaluation of benefits of these differences for breeding programs.

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