THE USE OF FEEDING PATTERN TRAITS IN PIGS AS SELECTION CRITERIA TO IMPROVE THE ACCURACY OF SELECTION FOR FEED CONVERSION RATIO AND GROWTH TRAITS

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SUMMARY

The data comprised records from 1832 pigs fed *ad libitum* using single space electronic feeders. Genetic and phenotypic parameters were estimated for feeding pattern and performance test traits by multivariate restricted maximum likelihood with an individual animal model. The feeding pattern traits were included as selection criteria in the predicted indices, which resulted in an increase in the accuracy of selection, particularly for daily gain and feed conversion ratio. The inclusion of part test records for feeding patterns resulted in similar correlated responses to those when whole test records were used. It was concluded that feeding pattern traits could be used to improve the accuracy of selection. They may also be useful in reducing the length of the test period necessary for accurate measures of feed intake.

Keywords: pigs, feeding patterns, genetic parameters, selection, accuracy

INTRODUCTION

In the past the most common method of recording feed intake was to pen pigs individually, but this method of selection did not correspond to the group housing system common in production units and some genotype by environment interaction may have affected the accuracy of this method (Merks 1989). The advent of automatic feeders, however, has allowed accurate measures of individual feed intake in a group housing system. These feeders also provide other feeding pattern information, such as how many meals are taken each day and how big they are, which could be of use to further improve the accuracy of selection for feed conversion ratio and growth traits.

The main aims of this study were: to describe these feeding pattern traits and to estimate the genetic and phenotypic parameters between them and performance test traits; to determine the potential benefit of including feeding pattern traits as selection criteria in an index; and to predict the selection response in each trait from using different indices.

MATERIALS AND METHODS

The data used in these analyses were compiled from individual feeding records of 1832 pigs from 70 sire families. They were fed *ad libitum* using FIRE (feed intake recording

equipment, Hunday Electronics Ltd.) feeders at the Cotswold Pig Development Company. The pigs were on test between 45 kg (s.d. 2.8) and 95 kg (s.d. 6.8). Measurements of daily feed intake (DFI kg), feed intake per visit (FIV kg), number of visits per day (NV), duration of each visit (TV mins.), time in the feeder per day (TD mins), feeding rate (FR kg/min) and number of non-feeding visits per day (NFV), which was defined as a visit where less then 5 g of feed was consumed, were taken. Performance test traits of food conversion ratio (FCR kg/kg), average daily gain (ADG kg) (all as means of the 9 week test period) and backfat depth at the end of test (BF mm) were also measured. Feeding pattern traits and daily feed intake were also recorded in periods 1 to 4 on test, where each period was a mean of two weeks excluding the first week of test.

Heritabilities, genetic and phenotypic correlations of feeding pattern and performance test traits were estimated by restricted maximum likelihood (REML) with a multivariate individual animal model using the algorithm by Groeneveld (1994) in VCE REML version 3.2. The model included fixed effects of sex, pen, year and week of finishing test, parity of the dam, covariates of weight at start of test and litter size and random animal and common litter effects. These estimated parameters were included as selection criteria in five different indices, which were optimised in the usual way. Correlated responses to selection and correlations of the aggregate genotype with the index (r_{ih}) were predicted for each index. The aggregate genotype for these indices was based on daily gain (kg), lean percentage and food conversion ratio with economic weights of 40, 0.7 and -10 respectively, obtained from the Cotswold Pig Development Company. All traits in indices 1, 2, 3 and 6 were measured over the whole test period, but in indices 4 and 5 daily feed intake and feeding pattern traits were taken in periods 1 and 3 respectively.

Index 1: $I = 15ADG - 0.22BF - 3.4DFI$
Index 2: $I = 15ADG - 0.22BF - 3.3DFI + 0.76FIV - 0.20NV + 0.042TV$
Index 3: $I = 15ADG - 0.22BF - 3.3DFI - 0.22NV$
Index 4: $I = 14ADG - 0.27BF - 0.89DFI_1 - 4.5FIV_1 - 0.22NV_1 + 0.023TV_1$
Index 5: $I = 12ADG - 0.29BF - 2.4DFI_3 + 12FIV_3 + 0.18NV_3 + 0.031TV_3$
Index 6: $I = 11ADG - 0.27BF$

RESULTS

At both the genetic and phenotypic level, daily feed intake was highly associated with daily gain and had positive correlations with backfat depth and feed conversion ratio. Similarly feed intake per visit, time per visit and time per day were positively associated with daily gain and backfat depth (Table 1). Correlations between part and whole test records of feeding pattern traits were high (0.82 to 0.99) and their correlations with performance test traits were similar to the whole test period (not presented). The pattern of genetic and phenotypic correlations between feed intake per visit, time per visit and number of visits indicated that high feed intake per visit was associated with longer, fewer visits.

Table 1: Means, s.d., heritabilities (in bold type), genetic (below diagonal) and phenotypic correlations (above diagonal) over the whole test period

	DFI	FIV	NV	TV	TD	NFV	FR	FCR	ADG	L%	BF
mean	*2.06*	*0.198*	*10.1*	*6.01*	*58.3*	*0.88*	*0.042*	*2.11*	*0.99*	*57.3*	*11.9*
s.d.	*0.27*	*0.072*	*2.82*	*3.66*	*26.5*	*0.73*	*0.054*	*0.23*	*0.13*	*2.05*	*2.50*
DFI	**0.21**	0.24	0.08	0.06	0.10	-0.08	0.03	0.41	0.63	-0.45	0.36
FIV	0.22	**0.27**	-0.58	0.39	-0.04	-0.39	0.02	0.07	0.21	-0.12	0.15
NV	0.07	-0.86	**0.34**	-0.32	0.15	0.27	0.00	0.08	0.07	-0.04	0.03
TV	0.09	0.93	-0.79	**0.11**	0.81	-0.13	-0.38	-0.16	0.05	-0.01	0.02
TD	0.31	0.13	0.10	0.45	**0.07**	0.03	-0.95	-0.01	0.03	-0.01	0.08
NFV	-0.44	-0.46	0.38	-0.35	-0.19	**0.06**	0.02	0.08	0.09	0.04	0.08
FR	0.00	0.06	-0.02	-0.33	-0.96	-0.07	**0.49**	0.08	0.09	-0.02	0.08
FCR	0.65	-0.12	0.31	-0.27	-0.14	0.13	0.16	**0.12**	-0.24	-0.30	0.03
ADG	0.61	0.49	-0.29	0.33	0.46	-0.59	0.13	-0.15	**0.25**	-0.21	0.39
L%	-0.72	-0.29	0.01	0.07	-0.03	0.09	-0.55	-0.86	-0.31	**0.56**	-0.85
BF	0.78	0.35	-0.15	0.17	0.08	-0.17	0.45	0.29	0.42	-0.97	**0.38**

standard errors of heritabilities = 0.02 to 0.08; standard errors of r_g = 0.02 to 0.14

Predicted correlated responses, using these estimated parameters in the indices, are shown in Figure 1. The inclusion of feeding pattern traits in the index (indices 2 and 3) resulted in a higher predicted response in daily gain and feed conversion ratio but a decrease in the response of lean percentage. The inclusion of part test records for feeding pattern traits (indices 4 and 5) led to little difference from the original index (index 1) of daily gain, backfat and daily feed intake.

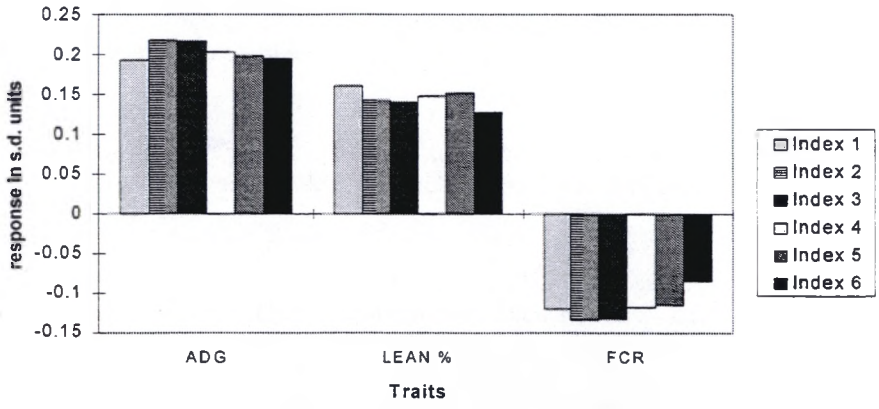

Figure 1: Correlated response, in standard deviation units, for each trait in the aggregate genotype selected on each index

The correlation of the aggregate genotype with each index, which is a measure of the accuracy of selection, showed a similar pattern to that seen in Figure 1, indicating that the most accurate selection was achieved when feeding pattern traits were included in the index with an increase from 0.51 to 0.57 between indices 1 and 2. When only daily gain and backfat were included (index 6) the accuracy of selection was considerably lower at 0.46.

DISCUSSION

Moderate heritabilities and genetic correlations for feeding pattern traits indicate that they could be successfully incorporated into a breeding program to increase the accuracy of selection. Daily feed intake had a small association with other feeding pattern traits but high correlations with performance test traits (Table 1), indicating that feeding behaviour had little effect on overall daily feed intake. Similar results were noted by Von Felde *et al.* (1996) and Labroue *et al.* (1996). Feeding rate (FR) was a positively skewed trait and log transformation to reduce non-normality resulted in a greatly reduced heritability so FR was not considered as a selection criterion. Therefore feed intake per visit, time per visit and number of visits were chosen as selection criteria in these indices.

The use of feeding pattern traits to improve the accuracy of selection for performance test traits appears to be effective and resulted in higher correlated responses for ADG and FCR. The high correlations between the feeding pattern traits included in the index implied there was little new information gained by including all of them as selection criteria. The most effective and robust method may be to include number of visits per day alone with the performance test traits because it had the highest heritability of the feeding pattern traits and can be negatively weighted in an index to improve food conversion ratio and daily gain. The predicted correlated responses from indices 4 and 5 suggest that there may also be potential to shorten the test period by measuring food intake in a single test period. The correlations between part and whole test records were high, which would allow more pigs to be tested on the feeders so increasing selection intensity with little loss in accuracy.

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