WITHIN-LITTER EFFECT OF THE HAL-1843 HETEROZYGOTE ON LEAN GROWTH IN PIGS

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SUMMARY

Differences between Nn and NN were estimated within litters by HAL-1843 typing 905 pigs from three sire lines : one pure, one synthetic, and one F_1 cross. Pigs were fed *ad libitum* either wet or dry from 45 to 95 kg liveweight on three farms. Compared to NN over lines, only one out of four backfat depths (K) was conclusively reduced in Nn (−0.55 s.e. 0.24 mm). There were nonsignificant indications that while Nn backfat was reduced in the pure line, it was increased in the cross. There were no conclusive effects of Nn on growth rate, but evidence of a small reduction in the cross (−35 s.e. 19 g/day). Judged solely from these traits, and without direct measures of lean yield, the commercial advantage of Nn over NN would be very small and would not justify its longterm retention.

INTRODUCTION

It is well established that the positive phenotype (nn) at the halothane locus shows advantages in lean yield accompanied by disadvantages in meat quality and stress susceptibility (Webb *et al.*, 1987). From studies so far it appears that the heterozygote (Nn) is intermediate between the two homozygotes (nn and NN) for all of these traits (Barton-Gade, 1984; Simpson and Webb, 1989; Pommier *et al.*, 1992). The apparently additive effect on lean yield has led to the production of Nn slaughter pigs in industries where poorer meat quality carries little or no financial penalty.

However, the absence until recently of an accurate method for distinguishing Nn from NN suggests that the relative performance of Nn may have been poorly estimated. Nn were either specially produced by crossing lines approaching homozygosity, or identified by linkage with blood types (eg. Lundström *et al.*, 1989). Comparisons among lines carry the risk of sampling differences at other loci.

The HAL-1843[1] DNA test (Fujii *et al.*, 1991; Otsu *et al.*, 1991) now allows accurate comparisons among genotypes within litters. This paper estimates the differences in growth rate and backfat between Nn and NN from a programme of routine DNA typing to eliminate the gene from three different lines.

[1] The HAL-1843 trade-mark is licensed from THE INNOVATIONS FOUNDATION Toronto, Ontario, Canada owner of the trade-mark

MATERIALS AND METHODS

HAL-1843 genotype was determined for entire boars and gilts from three lines (Table 1). Line A was derived from a single breed, and selected on rate of lean growth for over 10 generations as a closed population. Line B was a closed synthetic containing Pietrain and Hampshire. Line C was an F_1 cross of Line A with a fourth synthetic line. The three lines were performance tested from 45 to 95 kg live weight on separate farms. They were fed ad libitum on a diet containing 13.8 to 14.3 MJ/kg DE and 1.0 to 1.4% lysine. Lines A and C were fed dry pellets, and Line B a liquid diet containing whey.

Table 1. Numbers of observations

Line	Litters	Boars	Gilts	NN	Nn	nn
A	111	56	140	140	53	3
B	84	71	91	73	78	11
C	176	547	–	464	83	–

Ultrasonic backfat was measured at 95 kg liveweight, in the midline over the shoulder and loin, and 6.5 and 8.5 cm off the midline at the last rib for P2 and K respectively. Differences among halothane genotypes were estimated by least-squares absorption of litters and fitting sex and the regression of fat depths on live weight. Sex x genotype interactions were nonsignificant.

RESULTS

As expected Line B on liquid feeding was slower growing and fatter than A or C (Table 2). Not included in the tables, the 11 nn pigs in Line B showed significant fat reductions ($P<0.05$) of 3 to 4 mm at P2, K and Loin positions.

Table 2. Means, standard deviation and sex difference

	Line				
Trait	A	B	C	s.d.	Boars-gilts
Ultrasonic fat depth:					
P2 mm	9.8	11.7	11.2	1.9	−1.4
K mm	14.9	13.1	12.9	2.4	−1.4
Loin mm	11.4	13.5	11.9	2.4	−3.6
Shoulder mm	29.1	37.6	34.3	4.0	−3.1
Liveweight gain g/day					
birth to 45 kg	462	434	475	40	−1
45 to 95 kg	991	666	916	105	70
d.f. within litters	72	65	360	–	–

Compared with NN over all lines, Nn showed significantly less fat only at K (Table 3). Although there was a nonsignificant indication of a reduction at P2, there was no evidence of a difference at the shoulder or loin. Nn showed a consistent but nonsignficant reduction for all fat depths in pure Line A, but a consistent increase for all fat depths in crossbred Line C. There was no consistent effect of Nn on growth rate, but there was evidence of a nonsignficant reduction in crossbred Line C.

Table 3. Differences Nn-NN with standard errors by line

Trait	Line			
	A	B	C	All
Fat depths:				
P2 mm	−0.58 (*0.44*)NS	−0.39 (*0.62*)NS	+0.26 (*0.33*)NS	−0.27 (*0.19*)NS
K mm	−0.64 (*0.75*)NS	−0.57 (*0.67*)NS	+0.16 (*0.37*)NS	−0.55 (*0.24*)*
Loin mm	−0.46 (*0.59*)NS	+0.19 (*0.88*)NS	+0.44 (*0.62*)NS	−0.13 (*0.24*)NS
Shoulder mm	−0.45 (*1.00*)NS	+0.31 (*1.31*)NS	+0.21 (*0.37*)NS	+0.03 (*0.40*)NS
Average mm	−0.53 (*0.36*)NS	−0.12 (*0.46*)NS	+0.27 (*0.22*)NS	−0.23 (*0.14*)NS
Gain g/day:				
birth to 45 kg	−4.1 (*6.8*)NS	−0.6 (*11.9*)NS	−10.2 (*6.8*)NS	−2.6 (*4.0*)NS
45 to 95 kg	+19.3 (*24.6*)NS	−1.0 (*32.0*)NS	−35.3 (*18.7*)NS	−9.2 (*10.5*)NS

DISCUSSION

This within-litter comparison of Nn and NN does not show a conclusive fat advantage for Nn. While K fat was significantly reduced over the three lines, there is at least a suggestion that fat depths were *increased* in crossbred Line C. This would imply a different effect of Nn in the presence of heterosis. Again there were no conclusive Nn effects on growth rate, but a tendency towards a small reduction particularly in crossbred Line C.

A recent Canadian study using the DNA test showed no advantage for Nn over NN in either growth rate of backfat, but an increase in carcase yield (Pommier *et al.*, 1992). Similarly, Nn produced by crossing phenotypically positive and negative British Landrace selection lines failed to show advantages in either growth rate or backfat (Simpson and Webb, 1989). Measures of Nn lean yield tended to be intermediate between homozygotes but were not conclusively different from NN. There is evidence that the effect of the mutant gene n may increase with slaughter weight (Sather *et al.*, 1991).

Commercial producers are frequently paid on lean proportion estimated only from backfat and carcase weight. Using a regression of −0.990 % lean per mm P2 estimated from dissections (Unpublished data), a reduction of 0.58 mm P2 in Line A (Table 3) would amount to an increase of ca 0.57% lean worth around £0.40 per pig. However, it seems likely that differences in fat depths across halothane genotypes may under-estimate the true differences in lean yield. The benefits of Nn can therefore only be assessed by carcase dissection.

Nevertheless this study suggests that the advantages in reduced fatness may be small and variable, and certainly not sufficient to justify longterm retention of the halothane gene in the face of other disadvantages. One may speculate that the halothane locus accounts only for a small proportion of the genetic variation in fatness, leaving plenty of variation from other loci on which to select.

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