THE EFFECT OF SELECTION FOR LEAN GROWTH ON MEAT QUALITY IN PIGS

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SUMMARY

A line of pigs was selected for increased rate of growth of lean for 5 generations. Response to selection was measured by comparing the performances of pigs from the selected line with those from an unselected control line in the final generation.

Significant responses were recorded for a number of traits measured on the live animal. These were 0.13 ± .01 kg/d for growth rate, -0.27 ± .04 mm for food conversion ratio and -2.3 ± .5 mm for fat depth measured by echo-sounder. On the carcass, responses in mid-line fat measurements averaged -1.8 ± .6 mm, side fat measurements -2.2 ± .5 mm, and eye muscle area 1.0 ± .3 cm^2. There was no significant change in muscle acidity, colour or marbling or in the incidence of malignant hyperthermia syndrome under halothane anaesthesia.

It was concluded that selection had improved both the rate and efficiency of lean growth but had no effect on meat quality or the frequency of the hal+ gene.

INTRODUCTION

A number of studies have reported an unfavourable genetic association between lean content of the pig carcass and lean quality as measured by muscle acidity, colour and water holding capacity (Scheper 1979). Much of this unfavourable association has been attributed to the single gene hal+, homozygotes for which react to the anaesthetic halothane (Eikelenboom, Minkema and van Eldik 1976). This gene is favourably correlated with lean content but can result in PSE (pale, soft, exudative) pork. Its frequency is expected to rise in populations subject to strong selection for leanness and has been found to vary between breeds (Webb et al. 1985).

This paper reports the results of selection in a pig herd for high rate of lean growth. Response is measured in the quantity and quality of lean and the incidence of halothane reactors by comparing the selected line with an unselected control line.

MATERIAL AND METHODS

Selection procedure Two genetically similar lines, a selected and a control were formed from a synthetic foundation of Large White and Landrace. A detailed description of the conduct of the lines is given by McPhee et al. (1988).

Briefly, the selected line comprised 6 boars and 36 sows. Boars were replaced after siring 6 litters and sows after 2 farrowings by their best offspring selected for high weight of lean in their hams predicted from liveweight and ultrasonic fat measurements made after a 12 week performance test commencing at 25kg liveweight.

The following prediction equation was derived from a preliminary dissection study:

$$HL = 6.72\,GR - .06F + 1.56 \quad (r^2 = 0.71)$$

where HL = weight of lean in the ham (kg), GR = growth rate (kg/d) and F = ultrasonic fat depth (mm).

The control line was maintained to permit the estimate of genetic change in the selected line divorced from environmental change. It was maintained by the procedure designed to minimise genetic change and the rate of inbreeding using the pedigree control technique described by Gowe, Robertson and Latter (1959).

Evaluation of Selection Response Genetic change in the selection line was measured after 5 generations of selection by comparing the performance of its pigs with that of the control line.

During growth, measurements were made of daily liveweight gain, food conversion ratio and ultrasonic fat depth. Approximately one hour after slaughter, pH measurements were taken with a pH meter (Townson and Mercer, Australia) in the *splenius* muscle of the neck, in the *longissimus* muscle of the back and the *vastis lateralis* of the hind leg. After holding in a 5°C chiller for 24 hr, pH measurements were again taken at the same sites as the slaughter measurements. Also at slaughter, backfat measurements were made with vernier calipers along the mid-line of the split carcass at the shoulder, mid-back and loin positions.

One side of each carcass was then cut through at the level of the last rib and scored for colour and fat marbling (Anon. 1969). Measurements taken on the eye-muscle were maximum width (A), maximum depth (B) perpendicular to A, giving an estimate of eye muscle area EMA = 2AB/3. Subcutaneous fat depths were measured at C (over B) and at K, the ventral end of the A axis of the eye muscle.

Halothane testing was carried out on all pigs weaned in generation 5 using the technique described by Eikelenboom et al. (1976). Reactors which survived this test were eligible for performance testing in the normal way.

RESULTS

Selection Response

Live Traits In Table 1 are given live animal measurements on 48 pigs of each sex sampled from the selected and control lines and grown from 25 kg to 85 kg on *ad libitum* feeding.

The selected line was significantly faster growing and more efficient than the control line and had lower ultrasonic fat depths and higher predicted weights of lean in the ham.

Slaughter Traits In Table 2 are given the measurements made on the carcasses of selected and control line pigs after performance testing.

Subcutaneous fat depths were significantly lower in the selected line than the control line pigs at all measurement positions except the mid point of the mid-line. At this point the line difference was in the same direction but was not significant. Compared with the control line, eye muscle areas were significantly higher in the selected line but dressing % was lower. There was no difference in carcass length.

Table 1: Means of live animal traits measured on the selected and control lines at generation 5

Line	Growth Rate (kg/d)	Food Conv. ratio	Fat Depth (mm)	Ham Lean (kg)
Selected	.91	2.68	15.3	6.76
Control	.78	2.95	17.6	5.75
S.E.	0.01	0.03	0.3	0.06
Sig. Diff+	**	**	**	**

Signif. of line diff. (** p<.01)

Table 2: Means of carcase measurements made on pigs from the selected and control herds in generation 5

Line	Fat Depth (mm)					Eye Musc.	Dress	Length
	Sh	Mid	C	K	Loin	Area (cm^2)	(%)	(cm)
Selected	36.0	23.6	15.3	20.5	18.4	30.9	75.5	78.9
Control	38.4	24.5	17.6	22.6	20.5	29.9	76.2	79.0
S.E.	0.7	0.4	0.4	0.4	0.5	0.3	0.2	0.2
Sig. Diff.+	**	n.s.	**	**	**	*	*	n.s.

+ Signif. of line diff. (n.s. not significant, * p<.05, **p<.01)

No significant line differences could be found for any of the meat quality traits. Mean pH values at the neck, mid and leg sites of measurement were 6.42 ± .02, 6.71 and 6.53 at slaughter and 6.68 ± .03, 6.21 and 6.20 after chilling for 24 hr. Colour and marbling scores of the *longissimus* muscle averaged 3.19 ± -.05 and 1.64 ± .06 respectively.

Halothane Reaction From the control and selected lines respectively, a total of 95 litters of 659 pigs and 92 litters of 798 pigs were tested for their reaction to halothane. The numbers of reactors found were 7 pigs (1.1%) in the control herd and 10 pigs (1.3%) in the selected line, frequencies which did not differ significantly between the two herds.

DISCUSSION

Selection has brought about a considerable increase in both the rate of lean growth and the percentage of lean in the carcass at slaughter weight. Although no direct measurements of lean were made, the close inverse association between subcutaneous fat depth and lean content of the pig carcass has been well established (Evans and Kempster 1979). The decline in dressing percentage of the selected line would appear to have adverse economic consequences. Although not measured, part of this decline is likely to have resulted from a reduction in flare and kidney fat which were retained and weighed with the carcass.

Muscle acidity measured 1 hour and 24 hours after slaughter (pH_1 and pH_2) have traditionally been used as measures of meat quality in pigs (Scheper et al. 1979). Low values of pH_1 have been associated with the PSE (pale, soft, exudative) condition and high values of pH_2 with the DFD (dry, firm and dark) condition. The pigs in question travelled 600km to slaughter, and as much as 24 hours could elapse between leaving the research centre and slaughter. It is therefore unlikely that muscle glycogen levels would be high at slaughter. This would favour the development of DFD (high pH_2) over PSE (low pH_1) and there is some evidence to support this expectation. The average values for pH_1 and pH_2 of 6.55 and 6.37 were higher than the values of 6.36 and 6.10 obtained by Smith, McPhee and Natoli (1988) for pigs travelling for only one hour from the boar performance testing station to the same abattoir.

There was no indication of any difference between the selected and control lines for muscle acidity either on the freshly slaughtered carcasses or after chilling for 24 hours, and this absence of any line difference extended to colour and fat marbling score of the eye muscles. Comparisons in a variety of breeds and countries show that the recessive halothane gene can have a positive effect on carcass leanness (Webb et al. 1985). Webb and Simpson (1986) found this to be the case in a herd of Pietrain/Hampshire but the association was relatively weak in a herd of British Landrace. They postulated that the strength of the association was greatest in genotypes with more muscular genetic backgrounds. This may account for the absence of a correlated response in halothane incidence and lean content in the present study where the lines were based on Large White and Landrace, two breeds which do not show extreme muscular conformation.

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