The Effect of Major and Minor Genes on Pig Traits and Profitability

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Introduction

Two common objectives in genetic improvement programs for pigs are to:

- increase growth rate
- reduce carcass fat

Two types of genes affect these traits:

- major genes of large effect and known position on the genome. The best example in pigs is the halothane gene. This gene can easily be substituted into or removed from a population since its presence can be detected with certainty with a DNA probe.
- minor genes of unknown number and position on the genome. The frequency of these genes is increased in the population by selection and this give rise to permanent changes in growth rate and carcass leanness. Selection is the process of replacing breeding animals by their offspring found to have better breeding values for growth rate and fat. With the halothane gene absent from the population, these breeding values are the sum of the effects of minor genes for these two traits. Breeding values are estimated by careful performance testing and mathematical treatment of the measurements taken both on the animal itself and its relatives.

Methods

As detailed by McPhee *et al.* (1988, 1994, 1995), experiments were performed which gave estimates of the changes expected in growth rate and carcass leanness from the following processes:

- increasing the frequency of minor genes by 5 generations of selection
- substituting normal genes by either one or two halothane genes

Results

The following tables report the changes brought about by each process. In addition to growth rate and fat, the two traits under direct selection, other traits of economic importance which were not under direct selection, are also reported.

Table 1. Changes in performance, carcass and survival traits with selection for minor genes and substitution of the halothane gene

Traits	Mean	Selection for minor genes	Substitution of	
			1 hal. gene	2 hal genes
Carcass wt (kg)	73.7	+7.4	-1.7	-6.5
Backfat (mm)	16.9	-5.4	-0.9	-1.6
FCR	2.9	-0.25	-0.12	-0.15
Food Intake (kg.d)	2.5	+0.18	-0.15	-0.36
Mortality (%)	0.9	+0.1	+2.5	+15.8

Table 2. Changes in meat quality traits with selection for minor genes and substitution of the halothane gene

Traits	Mean	Selection for minor genes	Substitution of	
			1 hal. gene	2 hal genes
pH_{45}	6.49	+0.17	-0.23	-0.46
Reflectance (FOP)	25.2	-5.9	+4.4	+9.6
L (CIE)	43.6	-3.2	+1.5	+3.1
Water loss (%)	22.6	-4.3	+1.9	+4.1
Cured yield (%)	92.8	+2.1	-2.3	-5.5
PSE (%)	9.0	-8.0	+10.1	+21.6

Table 3. Contributions to profit/sow/yr from changes in important traits with selection for minor genes and substitution of the halothane gene

Traits	Selection for minor genes	Substitution of	
		1 hal. Gene	2 hal genes
Carcass weight	+252	-58	-221
Backfat	+140	+23	+42
Food eaten	-91	+70	+170
Mortality	-3	-83	-383
PSE	+	-	- -
Total ($)	+298	-48	-392

Conclusions

Under the conditions of this study, selection for increased growth rate and reduced backfat, in the absence of the halothane gene, gave substantial economic gain. This has resulted largely from heavier carcasses, of increased leanness, more than compensating for a rise in mortality and a reduction in dressing %. Substitution of a single halothane gene had a small negative effect on profitability but two halothane genes substantially reduced profitability. The increase mortality and reduced carcass weight more than outweighed an improvement in carcass lean and a reduction in food use. Changes in meat quality could not be quantified economically but selection reduced the incidence of PSE and the halothane gene increased it.

References

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