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EFFECT OF SEX AND GENOTYPE ON TISSUE DISTRIBUTION AND CARCASS GRADING IN SWEDISH PIGS

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INTRODUCTION

The objective of pig production is to obtain carcasses with optimal proportions of lean meat and fat. A grading system that fulfils the requirement of reliable estimates of carcass characteristics is one of the essential tools in the procedure. Since 1984, the Hennessy Grading Probe (HGP) has been used in Sweden. The estimate of the proportions of lean meat is based on two measures of backfat thickness over the loin muscle and one measure of the muscle itself. The probing sites are at the last rib and 3/4 last rib, as in most other systems where probing is used in the commercial pig grading (Hansson, 1985).

In the Swedish system the proportion of lean meat is defined as the amount of lean meat as a percentage of the carcass (head excluded), as it was regarded essential to use the same definition in commercial grading as in the breeding program (Andersson, 1980). The equation used for the estimate of lean meat is based on dissections performed on carcasses produced in the early 1980s. At that time, most of the slaughter pigs were two-breed crosses (white breeds) and very few three-breed crosses or entire males. Today most of the slaughter pigs are produced in systems with three-breed crosses where Hampshire or Duroc is the terminal sire. The use of entire male pigs for meat production has also increased during recent years. These factors may influence the reliability of the system and the prediction equation in use. Results of carcass assessment in the breeding program as well as some preliminary results from the commercial jointing indicate that the meatier carcasses from three-breed genotypes may be underestimated. It was therefore decided by the industry to undertake a test and control of the present system.

The aim of this experiment was to study the influence of sex and genotype on the accuracy of the prediction equation and composition of pig carcasses.

MATERIALS AND METHODS

The pig carcasses were sampled from the slaughter line at four abattoirs in different regions of Sweden in order to include carcasses of various origin. The information concerning the pigs' genotype was obtained from the farmers. The carcasses were from three genotypes: two-breed crosses (white breeds), or three-breed crosses with either Hampshire or Duroc as the terminal breed. The carcasses were selected so as to be uniformly distributed over the lean meat percentage range. Entire male pigs as well as gilts and castrates were included, and the carcasses were selected within the weight range 68 to 96kg. At grading the linear measure of backfat was recorded at the last rib and measures of backfat and muscle thickness at the 3/4 last rib with the Hennessy Grading Probe.

After cooling, the carcasses were transported to our experimental station in Uppsala for assessment and dissection. The evaluation of the proportion of lean meat was based on jointing the right half of each carcass into well defined ham, back, bacon side and shoulder by perpendicular cuts at the front edge of the hip bone and over the fourth rib. The back was separated from the bacon side by a cut through the ribs close to the loin muscle. All subcutaneous and visible fat was trimmed from ham and back. The proportion of lean meat + bone in these two joints was used to calculate the estimated lean meat percentage in the whole carcass by use of the prediction equation presented in Hansson and Andersson (1992). This simplified cutting procedure and equation are the same as used in the pig progeny testing scheme

(Andersson, 1980). To ascertain the validity of the equation used, 40 carcasses were selected for full dissection.

The left side of the carcass was cut according to commercial rules to give the composition as well as the yield of joints. All the joints except spareribs were cut boneless.

All calculations were performed using the Statistical Analysis System (SAS Institute Inc., 1989). In the GLM procedure, the effects of sex and genotype were regarded as fixed.

RESULTS AND DISCUSSION

Least squares means for the main carcass characteristics are reported in Tables 1 and 2. The 221 selected carcasses corresponded fairly well to the average for all carcasses during the period in question (Hansson, 1993). As they were not a random sample of the genotype populations, the measures may not be regarded as average values for the genotypes or sexes. However, some figures should be commented on. The Hampshire pigs had a thicker loin muscle and a meatier ham. This was known already when the system was introduced and the thicker loin muscle of Hampshire pigs was one reason for including this measure in the prediction equation. Entire male pigs had a thinner loin muscle despite the high lean content in the carcasses. Compared with carcasses produced a decade ago (Hansson, 1985) when the system with percentage lean was introduced, backfat thickness is still about the same. The thickness of the loin muscle has increased by about 10%. The combined effect of breeding for meatiness, changes in the feeding routine and increased carcass weight has increased the lean meat content by giving a larger and meatier ham and a larger loin muscle.

New, alternative prediction equations, based on the combined use of the linear measures of fat and loin muscle, have been calculated from the carcass data. The most reliable of the equations was used to ascertain whether there would be any bias in the estimation of carcass percentage lean. As the predicted and estimated values did not fully agree, the carcasses were grouped into four categories according to their dissected lean meat percentages. The least-squares mean of the difference between estimated and dissected lean meat percentage in each group is presented in Table 3 for the three genotypes. Despite the high R^2 and low residual standard deviation, obtained with the equation, the difference was greater than one percentage unit in some of the groups. The greatest underestimate in the commercial grading was obtained for the carcasses with the highest lean content. For the Hampshire-type carcasses an underestimation was found over the whole meat percentage range.

Various steps can be taken to overcome the problem of underestimation of certain carcasses can be taken. In an experiment and test of different grading apparatuses in Germany, Branscheid *et al.* (1989), found it difficult to avoid the underestimation in the meatier genotypes, when the grading was based on backfat and loin muscle thickness only. Even when they included the measure ham width this was not enough to overcome the problem of bias. Kempster and Cook (1989) discussed the problem of bias in the common EEC grading schemes and drew attention to the variation between breed types as one of the causes. Busk (1989) concluded, from dissections performed on carcasses from three breeds in Denmark, that it will be necessary to include a constant for each breed-type to overcome the problem of bias when estimating lean meat percentage. In the Danish automated grading system, fat thickness measures are determined in the ham in order to improve the prediction as well as to give a direct measure of lean content in ham (Nielsen and Verwohlt, 1991). With an automated grading system it is possible to take probings at several sites simultaneously, and thus it will be possible to improve the accuracy. We have tried to measure the thickness of subcutaneous fat in ham manually, but did not find the measurements reliable enough to be used in a grading system, and for practical purposes we cannot recommend manual measurements by probe in the ham.

In EEC Council Regulation no 3220/84 it is stated that a subjective assessment of muscle development in the principal parts of the carcass may be used to estimate its commercial value. In some of the member states however, the objective measurements are supplemented with a subjective score for the conformation of the ham (Walstra, 1989).

The effects of genotype on lean meat and fat distribution in the carcasses are given in Table 4. There were small and non-significant differences between the genotypes for most of the traits. Hampshire pigs were earlier often said by breeders to have larger and meatier hams, but this statement could not be verified in the carcasses tested. The progeny from Duroc sires had a lower proportion of fat in the mid part, mainly depending on shorter carcasses.

CONCLUSION

The prediction equation used in pig carcass grading must be based on dissections performed on the present genotypes and sexes. As the animal material changes over time and when the equation is used on types and sexes other than those included in the dissections, bias in the prediction can be expected. The results obtained in this study confirm this problem and support our intention to recalculate the prediction equation now in use. We are well aware of the risk of inaccurate estimates for the very meaty pigs, even with a new prediction equation. Since the differences between the three genotypes studied were so small -- and for most traits also non-significant -- it will be possible to use the same prediction equation for all carcasses produced. In some of the EEC countries the objective measures taken with the probe are combined with a subjective scoring of ham shape. This is a possible solution also for Swedish conditions if the new prediction equation will not satisfy our demand of accuracy.

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Table 1. Least-squares means (LSM) and standard error (S.E.) for carcass weight and carcass characteristics in the three breed-crosses studied.

	White pigs		Hampshire-cross		Duroc-crosses	
	LSM	S.E.	LSM	S.E.	LSM	S.E.
# of pigs	60		104		57	
Carcass weight, kg	74.4	0.56	75.5	0.42	75.1	0.57
Backfat, mm	16.6	0.62	16.5	0.46	15.2	0.58
Muscle, mm	50.2	0.87	51.6	0.65	48.9	0.88
Lean + bone, %						
in ham	78.4	0.54	79.4	0.41	78.9	0.55
in back	75.3	0.80	76.1	0.60	77.5	0.81
Lean meat, %	60.8	0.54	61.7	0.40	61.6	0.55

Table 2. Least-squares means (LSM) and standard error (S.E.) for carcass weight and carcass characteristics in the three sexes studied.

	Castrates		Gilts		Entire males	
	LSM	S.E.	LSM	S.E.	LSM	S.E.
# of pigs	70		96		55	
Carcass weight, kg	75.5	0.53	76.2	0.44	73.1	0.44
Backfat, mm	18.0	0.57	15.3	0.48	14.9	0.64
Muscle, mm	49.3	0.81	53.1	0.67	48.4	0.91
Lean + bone, %						
in ham	76.5	0.51	79.4	0.42	80.9	0.57
in back	72.6	0.75	78.0	0.62	78.3	0.84
Lean meat, %	59.0	0.50	62.2	0.42	63.0	0.56

Table 3. Least-squares means (LSM) and standard error (S.E.) between the predicted and dissected lean meat percentage in carcasses of
different meatiness.

	Lean meat percentage <58		58-62		62-65		>66	
	LSM	S.E.	LSM	S.E.	LSM	S.E.	LSM	S.E.
White pigs								
Castrates	1.04	0.59	1.30	0.60	0.62	0.61	-1.80	0.96
Gilts	0.16	0.88	1.39	0.54	0.06	0.40	-2.29	0.48
Entire males			2.44	1.26	0.21	0.81	-1.07	0.86
Hampshire-crosses								
Castrates	-0.46	0.47	-0.40	0.57	-1.30	0.40	-1.05	0.55
Gilts	0.67	0.56	0.18	0.57	-0.39	0.35	-1.54	0.34
Entire males			-0.33	0.74	-1.44	0.28	-3.23	0.55
Duroc-crosses								
Castrates	1.60	0.89	2.06	0.90	0.40	0.70		
Gilts	1.31	1.02	-0.05	0.64	0.23	0.43	-0.97	0.32
Entire males			-0.35	0.90	-1.47	0.40	-1.47	0.43

Table 4. Effect of genotype on lean meat and fat distribution (%) in carcasses. Least-squares means (LSM) and standard error (S.E.)

	Castrates		Gilts		Entire males	
	LSM	S.E.	LSM	S.E.	LSM	S.E.
Lean meat (%) in:						
Neck	12.79^{a}	0.13	12.72^{a}	0.09	12.73^{a}	0.12
Shoulder	19.80^{ab}	0.17	19.97^{a}	0.11	19.45^{b}	0.11
Loin muscle	10.50^{a}	0.12	10.86^{b}	0.08	10.62^{ab}	0.12
Bacon side	7.91^{a}	0.12	7.84^{a}	0.08	7.93^{a}	0.12
Ham	28.93^{a}	0.17	29.24^{a}	0.11	29.07^{a}	0.16
Fat (%) in:						
Fore part	29.19^{a}	0.34	28.77^{a}	0.23	29.50^{a}	0.33
Mid part	41.76^{a}	0.34	41.67^{a}	0.23	40.30	0.33
Ham	29.05^{a}	0.30	29.56^{ab}	0.20	30.20^{b}	0.28

Means with the same letter are not significantly different (P>0.05).