Effects of preslaughter anaesthesia on meat quality characteristics from pigs of different halothane genotypes.

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SUMMARY:

Preslaughter handling of pigs causes stress which, together with genetic components, will influence meat quality. The effects of minimal stress before slaughter on some muscle quality characteristics were conducted.

Three lines of Belgian Landrace pigs differing in their genetic susceptibility to halothane (nn, Nn and NN) were anaesthesized and kept in a "steady state" during 45 minutes. After this period the animals were slaughtered. No differences between the three genotypes could be found in the pH and the temperature at 45 minutes and 24 hours after slaughter in both the m. semimembranosus (SM) and the m. longissimus dorsi (LD). Hunter L*-values and drip loss were higher for the nn-genotypes compared with the NN-pigs. However, none of the examined animals showed PSE conditions.

It may be suggested that due to the low preslaugther stress the pH at 45 minutes after slaughter no differences in pH can be seen between pigs differing in their susceptibilty towards stress. Color and water binding capacity seem to be related to the genetic background.

INTRODUCTION:

The meat quality of pigs is related to metabolic events taking place in the muscle before slaughter. The metabolism is influenced by both genetic and environmental factors (Cassens et al., 1975). A well known example of a poor meat quality is called PSE meat (Pale, Soft and Exudative). This type of meat is caused by a rapid acidification of the muscle during the first hour after slaughter. The low pH in combination with a high carcass temperature causes muscle proteins to denaturate. This denaturation would directly explain for the pale colour and indirectly for a shrinkage of the myofibrils causing the drip loss (Honikel and Kim, 1986, Offer and Knight, 1988).

A major gene which influences porc quality is called the halothane gene (n). Pigs that are homozygous for this recessive gene are likely to give rise to PSE meat. Lundström et al. (1989) showed that heterozygous genotypes (Nn) will show meat quality characteristics that are intermediate to nn- and NN-animals. Important environmental factors affecting muscle quality are the events that occur in the period before slaughter. Preslaughter handling causes stress which will influence the energy metabolism in the muscle and thereby the ultimate meat quality (Tarrant, 1989).

In this study anaesthesia was used to study the effect of minimal stress before slaughter. Pigs of different halothane genotypes were anaesthesized for 45 minutes before slaughter after which muscle quality characteristics were measured in the m. longissimus dorsi (LD) and m. semimembranosus (SM).

MATERIALS and METHODS:

Twenty-eight Belgian Landrace pigs of three different halothane genotypes (nn, Nn and NN) were obtained from a commercial breeding company. The pigs were kept at an experimental farm nearby the slaughter house.

At each day of the experiment three pigs (nn, Nn and NN) were given a Stresnil^{R} (azaperone, Janssen Pharmaceutica, Tilburg) injection prior to their transport to the slaughterhouse. One after another the animals were

anaesthesized by using a combination of Stresnil^{R} and Hypnodil^{R} (metomidate, Janssen Pharmaceutica) anaesthesia. The pigs were kept in a "steady state" by the use of an intravenous infusion via the ear vein. Blood-gas analysis was performed with blood collected from the femoral vein (catheterized via the v. saphena) and the use of a blood-gas analyser (type ABL2, Radiometer, Zoetermeer). All pigs were anaesthesized and slaughtered according to a fixed schedule in order to rule out any interaction between genotype and the time between arrival and treatment.

After 45 minutes the animals were bleeded and slaughtered. The acidity of the LD and SM was measured using a pH-meter connected with an Ingold electrode at 45 minutes and after 24 hours post-mortem. Temperature of the LD and SM was determined at 45 minutes after bleeding. Rigor mortis of the SM was measured at 45 minutes post-mortem. The next day a freshly cut surface was prepared from a LD sample taken at the height of the 3th-4th rib. The water holding capacity was measured after a bloom period of 10 minutes according to the filter paper absorption method of Kauffman et al. (1986). After a 30 minutes bloom period the colour was determined by measuring L*-, a*- and b*-values with a Hunter Labscan. Three measurements were made across the cut surface and the results were averaged.

The variables of interest were analysed with an analysis of variance model. Factors in the analysis were 'day of treatment', 'order of treatment' (first, second, last) and genotype (nn, nN, NN). Genotypes were compaired pairwise with Fishers LSD method (t-test with a pooled error variance).

RESULTS and DISCUSSION:

Results for the meat quality characteristics are shown in Table 1. None of the interactions in the analysis of variance was significant (P>0.10). The pH at 45 minutes and 24 hours post-mortem do not show any differences between the three halothane genotypes. At 45 minutes after bleeding the pH is even rather high for all genotypes compared to normal situations (6.0-6.5)(Sybesma and van Logtestijn, 1967). Blood-gas analysis shows a slight acidification of the blood during the period of anaesthesia. Barton-Gade (1984) studied the effects of different preslaughter treatments on meat quality from pigs of different halothane genotypes. It was concluded that both genotype and preslaughter treatment had an influence on meat quality traits. The influence of stress before slaughter, however, was more pronounced for Nn- and NN-pigs than for nn-animals. The latter genotype showed relatively little effect of preslaughter treatment and might still show a high percentage of animals with PSE meat. During our study none of the pigs show PSE conditions due to the low post-mortem pH-fall and carcass temperature of all genotypes. It may be suggested that under these extreme low preslaughter stress conditions the genotype effect on post mortem pH-fall is very low.

The rigor, colour and drip loss , however, still show a significant genotype effect. Water holding capacity (WHC) and rigor are significantly higher for nn-pigs compared to NN-animals. The Nn-genotype has intermediate values. The Hunter L*-value of the NN-pigs is significantly lower than both the mean values of the Nn- and nn-genotypes. These results cannot be explained by the usual theories which are based on a fast post-mortem pH drop and a high carcass temperature, (Honikel and Kim, 1986, Offer and Knight, 1988). All genotypes had the same pH and temperature at 45 minutes post mortem.

Table 1. The mean values of meat quality characteristics from pigs of different halothane genotype (nn, Nn and NN) which were slaughtered after a period of minimal stress.

	NN		Nn		nn	
	mean	(se)	mean	(se)	mean	(se)
Number of pigs	10		8		10	
Live weight (kg)	124.8	(13.2^{a})	119.4	(17.4^{a,b})	114.3	(10.0^{b})
pH45 SM	6.82	(0.18)	6.78	(0.20)	6.80	(0.16)
pH45 LD	6.73	(0.13)	6.68	(0.14)	6.63	(0.22)
pH24h SM	5.59	(0.12)	5.58	(0.14)	5.53	(0.10)
pH24h LD	5.58	(0.09)	5.57	(0.13)	5.56	(0.11)
T45 SM (C°)	36.4	(0.9)	36.6	(0.9)	36.3	(0.6)
T45 LD (C°)	36.5	(1.0)	37.0	(1.1)	36.8	(0.8)
WHC (mg)	12.0	(5.3^{a})	18.6	(5.0^{a,b})	28.9	(15.4^{b})
Rigor mortis (45)	0.1	(0.3^{a})	1.3	(1.8^{a,b})	2.2	(2.0^{b})
Hunter L*-value	49.83	(3.95^{a})	52.63	(3.63^{b})	53.80	(4.02^{b})
Hunter a*-value	7.58	(1.06^{a})	7.11	(1.3^{a,b})	6.64	(1.28^{b})
Hunter b*-value	14.06	(1.47)	14.59	(1.25)	14.59	(0.80)

se = standard error, means with different superscripts differ significantly ($P < 0.05$)

Offer and Knight (1988) mentioned the fact that muscle with a higher percentage of fat contains a lower percentage of water. The significantly larger live weight of the NN-pigs compared with the other genotypes might be a reason for being more fatter and may be explaination the lower drip losses. A fatter muscle does not explain the darker colour or the lower rigor of the NN-animals. Colour and WHC still seem to be related to the genetic background (NN, Nn or nn) of the animals.

CONCLUSIONS:

It may be concluded that due to the low preslaughter stress the pH at 45 minutes post mortem remains rather high. No differences in pH are observed between pigs differing in their susceptibility towards stress. There are no cases of PSE meat which is probably cased by a combination of a low post mortem pH-fall and a low carcass temperature. Colour and water binding capacity still seem to be related to their genetic background.

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