EFFECTS OF PH- AND TEMPERATURE DECLINE CURVES ON PORK QUALITY DETERMINED UNDER DIFFERENT COMMERCIAL CHILLING CONDITIONS

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Introduction

Pork quality is determined by the interaction between genetic and environmental factors. The genetic make-up of a pig, the entire system of live animal production and handling through initial chilling and finally storage and handling of the meat and case-ready products all play significant roles in influencing drip loss of pork (Andersen, 2000). Pork quality characteristics like drip loss and colour are determined by the interaction between postmortem pH and temperature in the muscle. High postmortem muscle temperature in combination with a low pH can cause denaturation of muscle proteins and a decrease in the electrostatic repulsion between myofilaments. The subsequent increase in light scattering properties and the extent of lateral shrinkage of the myofibrils provokes the meat to become pale, soft, and exudative (Offer, 1991). The rate of postmortem pH decline is determined by preslaughter stress conditions and the presence of the halothane gene (Cassens *et al.*, 1975; Klont, 1994). A rapid temperature decline in combination with a slow pH decline is essential to produce high quality pork. Rapid chilling of pig carcasses is a very important aspect of improving pork quality for of two reasons. First of all the direct effect on carcass temperature leads to less muscle denaturation. Secondly, quickly lowering the temperature postmortem will decrease the velocity of all biochemical reactions taking place in the muscle after slaughter, thereby also decreasing the rate of pH decline (Savell *et al.*, 2005). The objective of this study was to review the effects of carcass pH and temperature decline curves, in two commercial slaughterhouses with distinct differences in carcass chilling, on pork quality characteristics.

Materials and Methods

Two batches of 60 pigs of two different genetic backgrounds were delivered to slaughterhouse A and B during two different slaughter days. All pigs were offspring of Pietrain boars. The difference in genetic background was related to the percentage of Duroc (0 or 50%) in the sow. Each batch consisted of 30 female pigs and 30 castrates. Hot carcass weight for each individual carcass was collected. The pH at 45 minutes, 3, 6, and 24 hours after slaughter was measured in the loin of each carcass at the height of the 3rd and 4th rib. Temperature probes were inserted in loin muscles of six carcasses before the chilling process. The day after slaughter one loin per carcass was collected for measurements of ultimate pH, and Minolta colour values. A boneless loin sample of more than 100 grams was taken from the blade end of the loin, which was weighed in and stored in a case ready meat tray that contained a meat juice absorbing layer. The loin samples were weighed after 48 hours to determine the drip loss percentage. Data were analyzed using the GLM procedure of SAS. Fixed effects included in the model were: day of slaughter (day 1 or 2), genotype, sex and the interactions between slaughter day and genotype. Carcass weight was included as a covariate for all traits.

Results and Discussion

Slaughterhouse A exposed carcasses to a 25 minute cooling with a higher air flow before storage in the cooler at 2 to 4°C. The fastest chilling regime was applied by slaughterhouse B that started the chilling process after 45 to 50 minutes with a 2½ hour blast chilling of effectively -14°C after which the carcasses were kept at 2 to 3°C until cutting at 24 hours postmortem. In Figure 1 the pH decline curves are extrapolated based on the 4 postmortem pH measurements, and compared with the measured carcass cooling profiles. We arbitrarily defined a critical time zone, which is based on the time it takes to get the average pH below 5.8 after slaughter. Each graph has an arrow that shows the time after slaughter when the muscle temperature gets below 30°C. Our assumption is that the further this arrow reaches into the critical time zone the better the pork quality will be, because of the importance of the relationship between postmortem muscle temperature and pH. Low pre-slaughter stress levels and a fast chilling and cooling regime of slaughterhouse B created a relatively high starting pH at 45 minutes and a slow pH decline curve. The slower pH decline curve of slaughterhouse B compared with A will at least in part be caused by the more extreme chilling and cooling regime as described by Savell *et al.*, (2005). The consequences for the pork quality traits are shown in Tables 1 and 2. In general the best meat quality was produced at slaughterhouse B with the lowest drip loss % (2.13% ± 0.70, compared to 2.81% ± 1.12 for abattoir A) and darkest colour with an average L* value of 52.5 ± 4.0 (compared to 54.4 ± 3.9 for abattoir A). Bertram *et al.*, (2001) also found increased water holding capacity in pork with faster chilling rates.

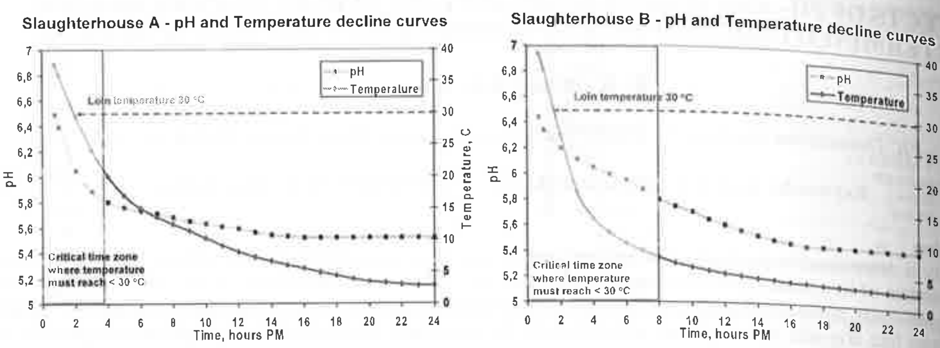

Figure 1: The pH and temperature profiles of pigs processed at 2 different slaughterhouses (A, B).

Table 1: Means and SD of meat quality measurements carried out at abattoir A with two different genotypes.

Variables	Day 1		Day 2		Significance level P		
	Genotype 1	Genotype 2	Genotype 1	Genotype 2			
	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Breed	Day	Breed x Day
N =	56	58	60	59	P =	P =	P =
Carcass weight kg	91.4 ± 5.2	90.8 ± 5.7	93.4 ± 6.6	88.7 ± 6.1			<.01
L* value	55.6 ± 3.9	52.8 ± 3.9	54.4 ± 4.1	54.6 ± 3.0			<.001
A* value	9.1 ± 1.4	9.9 ± 1.5	8.4 ± 1.8	9.3 ± 1.8	<.0001	<.01	
Drip loss %	2.30 ± 0.82	2.30 ± 0.70	2.94 ± 1.18	3.67 ± 1.13			<.01

Table 2: Means and SD of meat quality measurements carried out at abattoir B with two different genotypes.

Variables	Day 1		Day 2		Significance level P		
	Genotype 1	Genotype 2	Genotype 1	Genotype 2			
	Means ± SD	Means ± SD	Means ± SD	Means ± SD	Breed	Day	Breed x Day
N =	62	58	59	59	P =	P =	P =
Carcass weight kg	93.7 ± 5.6	89.2 ± 5.2	95.1 ± 6.5	88.9 ± 4.5	<.0001	n.s.	
L* value	53.9 ± 2.8	51.6 ± 3.3	54.3 ± 3.4	49.9 ± 8.1			<.05
A* value	6.8 ± 1.0	6.4 ± 1.4	7.6 ± 1.2	8.1 ± 1.4			<.01
Drip loss %	1.99 ± 0.64	2.32 ± 0.65	2.20 ± 0.75	2.02 ± 0.71			<.01

Conclusions

The results confirm the importance of fast chilling for good pork quality by both reducing carcass temperature and slowing down the rate of pH fall. Based on these results we recommend that as a general rule the temperature at 2 hours post mortem in the loin should be below 30 – 32 °C.

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