A PROCEDURE TO ACCELERATE THE CHILLING RATE OF PORCINE SEMIMEMBRANOSUS MUSCLE

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Introduction

Pale zones in the deep part of porcine *M. semimembranosus* (SM) have been shown to be very similar to the classical PSE meat (Laville *et al.*, (2005). According to Offer and Knight (1988) inherited susceptibility to stress and severe stress at slaughter lead to a high rate of *post mortem* glycolysis. As a result of a high rate of *post mortem* glycolysis, temperature in PSE carcasses may rise by 3°C soon after slaughter. Lawrie (1998) noticed that increasing environmental temperature has also been known to accelerate *post mortem* glycolysis. According to Ruusunen and Puolanne (2004), as a light muscle, SM utilizes glycogen to a greater extent than dark muscles. This may lead to lactate accumulation in the muscle already in live animal (Pösö and Puolanne 2005). As a consequence, the initial *post mortem* pH can be quite low in SM. Chilling in commercial abattoir starts usually at 45 min *post mortem*. According to Offer and Knight (1988) the rate of cooling of muscle fibres is dependent on their depth from the meat surface and so is also the rate of glycolysis: higher temperature and lower pH could be expected in deep parts of muscle. Seyfert *et al.*, (2004) reported that colour in bovine *M. biceps femoris*, (BF) *M. recturs femoris* (RF) and *M. vastus lateralis* (VL), which were partly detached from the hind leg before chilling, was darker than in muscles of an intact hind leg. As the paleness in deep porcine SM seems to be of PSE origin, we set up a trial where the distal part of SM was partly detached from the body before chilling. The aim of this project was to study if it was possible to influence the rate of temperature and pH fall in deep SM by partly detaching the muscle before chilling.

Materials and Methods

A total of 19 pig carcasses weighing 79–110.5 kg (mean 94.3 kg) and of meat percentage 56.0–65.0 (mean 59.8) were selected in a standardised abattoir. The distal part of SM in the left hind leg of each carcass was detached from the body by knife at 45 min *post mortem*. The proximal part of the SM was left attached to the hind leg so the distal part of SM hung away from the body. The right hind leg was kept intact during chilling. During the two phase chilling, the carcasses went first through a blast chilling room (air temperature -15°C) during the period from 45 min to 2 h *post mortem*. After that, the carcasses were kept in a chilling room at a constant temperature of 2°C until 24 h *post mortem*. The temperature of the proximal (deep) part of SM was measured at the time of partial detaching at 45 min and 2 h, 2.5 h, 4 h and 24 h *post mortem* on both sides of the carcass. The pH value was measured at 45 min, 2.5 h, 4 h and 24 h *post mortem*. The sample for pH determination was taken from the deep SM with a stainless steel biopsy probe. The muscle sample of 0.3 g was mixed immediately in 3 ml Na-I-acetate solution (5 mmol Na-I-acetate + 150 mmol KCl). The pH value was measured at 20 °C with a pH meter Knick Portamess 911 (Knick Electronische Me Gerate Gmb & Co, Berlin, Germany) connected to an electrode Mettler Inlab 427 (Mettler-Toledo Process Analytical Inc, USA). At 24 h *post mortem* each SM was split and after a blooming time of 20 min colour (L* a* b*) was measured with Minolta CR-400 on the bloomed surface of each muscle. Drip loss was determined according to Honikel (1998): 80–100g of SM from the part next to the end of *M. adductor* was weighed and kept in a plastic bag for 2 d at 4°C. After that the piece was weighed again and the drip loss was expressed as a percentage of the original weight. The statistical analyses between the partly detached SM and the intact SM muscles were carried out using the Independent Samples T-test with SPSS 12.0.1 (2004) for Windows.

Results and Discussion

The pH of the deep SM was 6.49 and temperature 40.5°C at the time of partial detaching. We then observed a major difference in temperature decline during chilling: At 2 h, 2.5 h and 4 h *post mortem* the temperature in partly detached SM was 10–13°C lower than in intact SM ($p<0.001$) (Fig. 1.). At 24h *post mortem* the partly detached SM was only slightly colder than the intact SM ($p<0.05$). We also observed a significat change in the rate of pH fall in the partly detached SM compared to the intact SM. At 2.5 h and 4 h *post mortem* the pH of partly detached SM was 0.3–0.4 units higher than that of intact SM ($P<0.001$) (Fig. 2). At 24 h no difference was observed in the pH. It can be concluded that the *post mortem* glycolysis was slower but glycogen was utilized to the same extent as no difference in pH at 24 h *post mortem* was observed. Our pH and temperature data at 45 min *post mortem* are close to observations of Tikk *et al.*, (2006) who reported that the temperature of porcine deep SM was 40–40.5°C and the pH 6.25–6.5 at 45 min *post mortem*. In a study on beef Seyfert *et al.*, (2004) reported a faster temperature decline in BF, RF and VL when they had partly detached the *quadriceps* muscles (the beef knuckle). They also observed that the deep SM beside the partly detached beef knuckle was approximately 10°C colder than the SM beside the intact beef knuckle during the first seven hours *post mortem*. Seyfert *et al.*, (2004) recorded the rate of pH fall only in SM and found that the increased rate of chilling was not enough to slow the rate of pH fall in SM which is contrary to the results in the present study. We did

not observe any difference in colour between the partly detached SM and the intact SM (P>0.1) which is contrary to the BF, RF and VL colour results of Seyfert *et al.*, (2004).

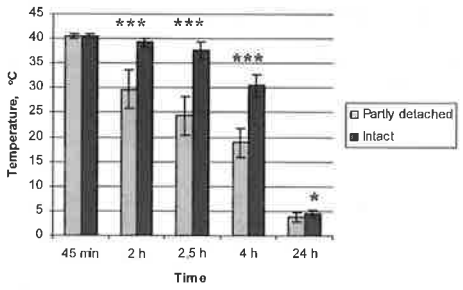

Figure 1: The temperature decline (± s.d.) of partly detached and intact SM. Difference between adjacent columns: *** p<0.001; *p<0.05.

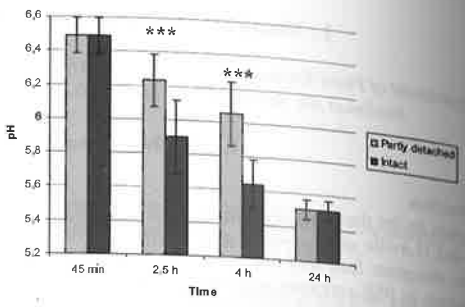

Figure 2: The pH decline (± s.d.) of partly detached and intact SM. Difference between adjacent columns: *** p<0.001.

A lowered rate of pH decline would be expected to improve the water retention both in raw meat and cooked meat products. In the present study the drip loss in the partly detached SM was lower than in intact SM (3.5% vs. 4.7%; p<0.01). More important from the industry point of view is, however, the total weight loss and total cost of the process. According to Daudin and Kuitche (1996) most of the weight loss is generated during the first hours after slaughter while the carcass is still warm. A new surface for water evaporation in a partly detached SM would be critical, and the total weight loss of the hind quarter would be an important parameter to measure. Further studies are needed to clarify the total effect of the partial detaching of SM on the costs and profits in the meat industry.

Conclusions

Partly detaching the SM from the carcass before chilling accelerates the chilling rate of deep SM, slows tremendously the rate of pH fall and reduces the drip loss in the deep SM. It does not influence the pH value at 24 h.

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