POST MORTEM GLYCOLYSIS IN VEAL CARCASSES; INFLUENCE ON MEAT QUALITY.

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SUMMARY

An evaluation of slaughter procedures in The Netherlands revealed that they varied considerably. The impact of the resulting rates of glycolysis on veal quality was assessed in two experiments conducted in slaughter plants A and B. In plant A, carcasses were not stimulated and chilling was mild. In plant B, carcasses were electrically stimulated and chilled rapidly. In plant A, sorting was based upon pH_{3h}; fast glycolysers$\approx pH_{3h}$<6.0; normal glycolysers$\approx pH_{3h}$=6.3; slow glycolysers$\approx pH_{3h}$>6.7. Compared to fast glycolysers, normal and slow glycolysers yielded meat with shorter sarcomeres, lower L-values at day 1, and higher shear forces at day 8. Shear forces and cooking losses of meat from slow and normal glycolysers were lower at day 1 than at day 8, indicating that rigor was incomplete at 1 day post mortem. In plant B, selection was based upon pH_{45min}; fast glycolysers$\approx pH_{45min}$<6.0; normal glycolysers$\approx pH_{45min}$=6.3 and slow glycolysers$\approx pH_{45min}$>6.7. In this case, rate of glycolysis had little effect on meat quality. We conclude that the rate of glycolysis does not explain the variation in veal quality. Use of electrical stimulation combined with rapid chilling reduces the variation in glycolytic rate. Furthermore, electrical stimulation permits deboning at 24 h post mortem without risk of toughening. When carcasses are not stimulated, the time of deboning may be more important.

Introduction

In veal production, ante-mortem conditions are relatively constant, meaning that variations in veal quality are primarily due to post mortem conditions. An evaluation of slaughter procedures in The Netherlands revealed that they varied considerably. Consequently, there was a large variation in both the rate of glycolysis and muscle temperature decline.

It is well known that temperature and rate of glycolysis are important determinants of meat quality. Rapid chilling of slow glycolysing muscles may induce cold shortening, resulting in toughening and a decreased water-holding capacity (whc). On the other hand, rapid chilling may compensate for the negative effects of fast glycolysis (e.g. extensive protein denaturation resulting in low whc and inactivation of ageing enzymes; for review see Smulders et al. 1991).

Most of the research on the effects of glycolysis and temperature on meat quality has been performed in pork and beef. Information on veal quality and the effects of rate of glycolysis and temperature decline is very limited. In the present study, the impact of the rate of glycolysis on veal quality was assessed.

Materials and methods

The study consisted of two experiments conducted in slaughter plants A and B. In plant A, carcasses were not stimulated (NS) and chilling was mild (0-1°C). In plant B, carcasses were electrically stimulated (ES; 3000V, 0.83 Hz, 1.5 ms pulse width / 35 V, 14Hz) and chilled rapidly (three chilling compartments: air velocity of 8 ms^{-1}, temperature -14°C, -8°C and -4°C, for 30 min each, followed by storage at 3±1°C).

At 45 min and ca. 3 h post mortem, pH and temperature in the loin were assessed. At the end of day 0 (the day of slaughter), data were processed and selection criteria were assessed. In plant A, carcasses were selected based upon pH of the longissimus muscle (LM) at 3 h (pH_{3h}) post mortem, whereas in plant B selection was based on pH 45 min post mortem (pH_{45min}). Carcasses were sorted into three groups (n=8): fast (10th percentile), 'normal' (50th percentile), and slow (90th percentile) glycolysers.

At 1 day post mortem, both LMs of the selected carcasses were excised. At that time, and after 8 days vacuum storage at 0-2°C, meat quality parameters were assessed.

The pH and temperature decline in LM was monitored with a portable pH meter equipped with a combined (glass, reference) electrode and a digital thermometer.

Samples were exposed to air for ca. 1 h before colour L- (lightness), a- (redness) and b- (yellowness) values were measured using a Minolta reflectometer.

Drip losses (used as indicator of whc) were determined by weighing samples before and after storage.

Sarcomere lengths were assessed by measuring the first order laser diffraction bands using the procedure described by Koolmees et al. (1986).

Cooking losses were determined by weighing samples before and after heating in polyethylene bags in a water-bath at 75°C to a core temperature of 70°C, followed by chilling in running tap water for 40 min (Boccard et al., 1981). Subsequently, rectangular samples of 1 cm^2 cross section were cut at right angles to the muscle fibre direction. Shear force was measured using a draw-bench (Adamel Lhormargy) equipped with a Warner Bratzler device.

For taste panel evaluation, samples were cooked and cut as described for shear force. The tenderness was evaluated by a panel (n=10) using a pair-wise comparison. The panelist was asked to indicate which of the two samples was the most tender.

Data were analyzed with SAS using the method of least-squares (GLM procedure).

Results and discussion

In plant A, variation in $pH_{45\ min}$ was relatively limited, whereas pH_{3h} varied greatly. Therefore, in plant A, sorting was based upon pH_{3h}; fast glycolysers$\approx pH_{3h}<6.0$; normal glycolysers$\approx pH_{3h}=6.3$; slow glycolysers$\approx pH_{3h}>6.7$.

At 3h post mortem, average temperature in carcasses at plant A (20.3°C) was only slightly higher than the average temperature at plant B (18.1°C)

Meat quality data for the samples of plant A are included in Table 1. Unexpectedly, pH at day 1 ($pH_{day\ 1}$) of the slow and normal glycolysers was significantly higher than $pH_{day\ 1}$ of the fast glycolysers. Generally, faster glycolysis does not result in a lower ultimate pH. Most likely, muscle of the slow and normal glycolysers had not yet reached the ultimate pH. This implies that, in these carcasses, muscles were excised before rigor was complete.

Differences in rate of glycolysis did not affect drip losses. The lower cooking losses at day 1, in meat from slow and normal glycolysers, may be explained by the higher $pH_{day\ 1}$.

At day 1, L-values of fast glycolysers were slightly, but significantly, higher than those of the other groups. After 8 days storage, these differences had disappeared.

Compared to fast glycolysers, normal and slow glycolysers yielded meat with shorter sarcomeres. It seems unlikely, that the mild chilling induced this shortening. Probably, the sarcomere shortening resulted from the afore-mentioned pre-rigor excision.

Rate of glycolysis, and associated sarcomere shortening, did not affect shear forces at day 1. Yet, at day 8, shear forces of the samples from the slow and normal glycolysers were significantly higher than those of the fast glycolysers. Moreover, shear forces of the slow and normal glycolysers increased during storage. This is unusual since shear forces generally decrease during storage. The pH-values, sarcomere lengths and increase in shear force during storage strongly suggest that, at day 1, the samples of the slow and normal glycolysers had been cooked pre-rigor. The difference in shear force of slow and normal, and fast glycolysers at day 8 is explained by the difference in sarcomere length; shorter sarcomeres are generally associated with higher shear forces.

In plant B, the ES induced rapid glycolysis; pH decline was considerably faster than in plant A. In a large percentage of the carcasses, pH_{3h} was close to the ultimate pH and exhibited little variation. Therefore, selection was based on the pH_{45min}; fast glycolysers$\approx pH_{45min}<6.0$; normal glycolysers $\approx pH_{45min}=6.3$ and slow glycolysers$\approx pH_{45min}>6.7$.

In plant B, rate of glycolysis had little effect on meat quality (Table 2). Possibly, rapid chilling compensated for the potentially negative effect of fast glycolysis on drip losses. Electrical stimulation effectively accelerated pH decline, thereby preventing cold shortening. Furthermore, the accelerated pH decline allowed for deboning at 1 day post mortem without risk of shortening.

Conclusion

We conclude that the rate of glycolysis does not explain the variation in veal quality. Use of electrical stimulation combined with rapid chilling reduces the variation in glycolytic rate. Furthermore, electrical

stimulation permits deboning at 24 h post mortem without risk of toughening. When carcasses are not stimulated, the time of deboning may be more important. A risk analysis indicated that under plant A conditions, deboning at 24 h post mortem would result in toughening in more than 50% of the carcasses.

References

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