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Effects of Temperature and Glycolysis Rate on Tenderness of Hanwoo Beef at 24 h *Postmortem*

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Introduction

The properties of meat that consumers are interested in are strongly affected by the physical conditions that are imposed on the carcass in the first few hours *postmortem* (O'Halloran, Troy, Buckley & Reville, 1997). These effects are exerted through anaerobic glycolysis, the *postmortem* breakdown of glycogen to lactic acid (Marsh, 1993), the rate of the breakdown of ATP determines the rate of *postmortem* glycolysis. Also, Marsh (1993) reported that the extent of glycolysis wasa powerful influence on several meat qualities, and that the rate of glycolysis was a major determinant of tenderness through its effect on temperature and pH and hence its influence on proteolytic enzyme activity. A lot of research has been conducted on the effects of temperature and glycolysis rate on tenderness of Hanwoo beef in electrical stimulation, but there are a few researches in no electrical stimulationfor Hanwoo beef. A method used early during processing, that could predict tenderness of beef at the time of consumption, would be beneficial for both consumers and the industry (Rødbotten, Nilsen & Hildrum, 2000). The purpose of this work, therefore, was to investigate the effect of temperature, pH, R-values and glycogen contenton tenderness of Hanwoo beef at 24 h *postmortem* in non-electrical stimulation.

Materials and methods

Thirty Hanwoo bulls, 18~20 months of birth, were randomly selected immediately after slaughter. Each carcass was conventionally hung, dressed and centrally-split into two sides. Carcasses were then chilled at 2 °C under factory conditions for 24 h *postmortem.* Each *M. longissimus dorsi* (LD) ribbed between the last rib and the first lumbar vertebrae

was measured for temperature, pH, R-values (R248, R250 and R258) and glycogen content at 1, 3, 6, 12, and 24 h *postmortem.*

Results and discussion

The temperature of LD muscles at 1h *postmortem* showed a range of 34.1 to 34.8 ℃ for both the tender and tough group (Fig. 1), and they decreased linearly ($p<0.05$) with increasing times *postmortem.* The rate of temperature fall per hour showed the highest in the tough and tender groups at 3 and 6 h *postmortem* respectively, compared to the other times. However, the rate of temperature fall, in general, had little difference in both groups after 6 h *postmortem.* The pH was linearly decreased ($p<0.05$) with *postmortem* time in both the tender and tough groups (Fig. 2). The rate of pH fall showed the pH of the tender

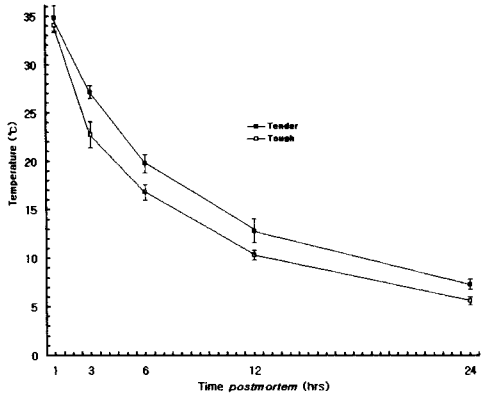

Fig. 1. The effect of temperature(℃) on tenderness of *M. longissimus* at *postmortem* 24 hrs.

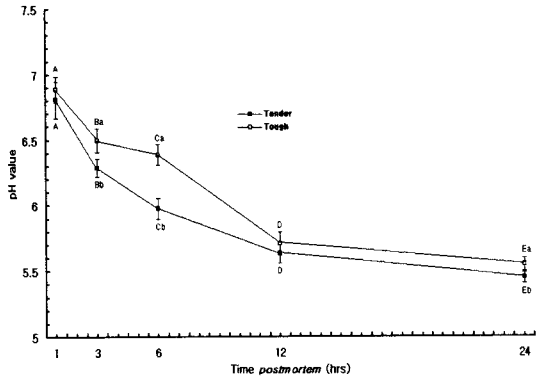

Fig. 2. The effect of pH on tenderness of *M. longissimus* at *postmortem* 24 hrs.

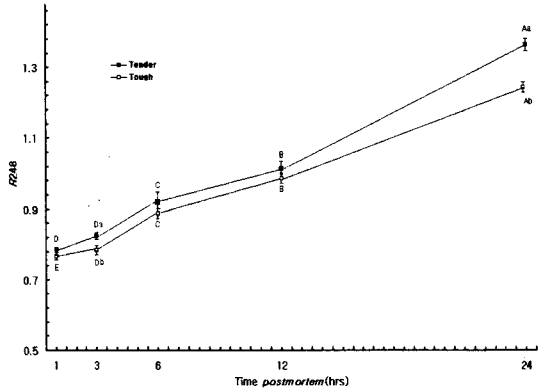

Fig. 3. The effect of R248 on tenderness of *M. longissimus* at *postmortem* 24 hrs.

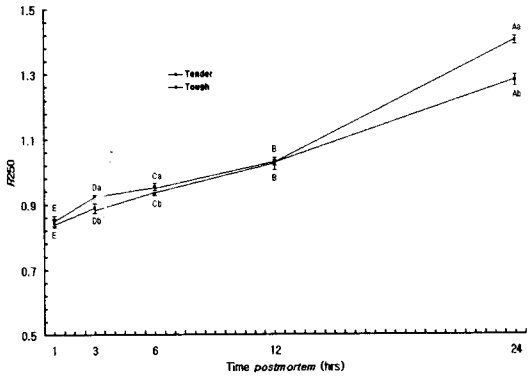

Fig. 4. The effect of R250 on tenderness of *M. longissimus* at *postmortem* 24 hrs.

Table 1. Sensory traits for the tender and tough groups at *postmortem* 24 hrs

Sensory traits	Tender group (n=9)	Tough group (n=9)	*P*-value
Tenderness	7.4±0.7[a]	4.4±0.9[b]	0.0001
Juiceness	5.8±0.7	4.6±0.7	0.002
Overall Flavour	5.7±0.9	5.2±1.0	0.32
Overall acceptability	7.3±0.7[a]	4.6±0.9[b]	0.001

[a, b] Means in the same column with different letters are different.

group to be higher ($p<0.05$) than tough group until 6 h *postmortem*, but it showed the tender group to be lower in pH ($p<0.05$) than the tough group at 6 h and 12 h *postmortem*. The pH of the tender group was significantly lower ($p<0.05$) than that of the tough group at 3, 6 and 24 h *postmortem*. Our result indicates that the tenderness of Hanwoo beef at 24 h *postmortem* could be related to the pH of pre-rigor (3 and 6 h *postmortem*). During the contraction-relaxation cycle in pre-rigor muscle, adenosine 5'-triphosphate (ATP) is needed for muscle relaxation, but in the absence of ATP in *postmortem* muscle after rigor onset, actin and myosin remain tightly bound and extensibility is lost (Greaser, 1976). Simple methods of estimating ATP and thus rigor development have been sought by measuring the extent of dephosphorylation and deamination of adenine nucleotides into inosinic acid. The R248 value related to *postmortem* metabolism of muscle was significantly increased ($p<0.05$) with *postmortem* times in the tender group (Fig. 3). The increased rate per hour for R248 was shown to be highest (0.033) at 6h *postmortem*, whereas the lowest (0.013) was found at 3 h *postmortem* in the tender group. Although there was no significant difference in R248 between 1 h and 3 h *postmortem* in the tough group, the R248 value of muscle was significantly increased ($p<0.05$) after 3 h *postmortem*. Its increased rate per hour was the highest at 6 h for both groups. This result implies that *postmortem* metabolism related with R248 might largely occur at 6 h *postmortem* during carcass storage (2 ℃). The tender group had a significantly higher ($p<0.05$) R248 value than the tough group at 3 h and 24 h *postmortem*, while there were no significant differences between both groups at 1, 6 and 12 h *postmortem*. The R250 value of muscle was significantly increased ($p<0.05$) with times *postmortem* in both groups (Fig. 4). Although there were no significant differences in between the 1 and 12 h *postmortem*, the tender group had significantly higher ($p<0.05$) R250 value than tough group at 3, 6 and 24 h *postmortem*. The tender group also had a significantly higher ($p<0.05$) R258 value than the tough group at only 6h *postmortem*. The changes of glycogen content were significantly decreased ($p<0.05$) with time *postmortem* in the tender and tough groups (Fig. 6). The tender group induced faster depletion of muscle glycogen than the tough group. The

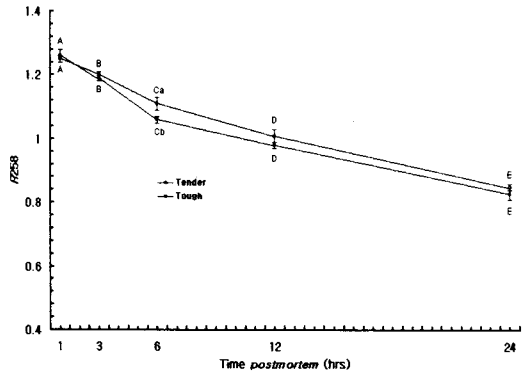

Fig. 5. The effect of R258 on tenderness of *M. longissimus* at *postmortem* 24 hrs.

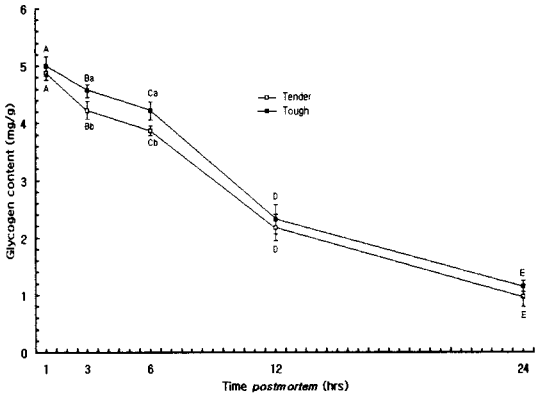

Fig. 6. The effect of glycogen content (mg/g tissue) on tenderness of *M. longissimus* at *postmortem* 24 hrs.

concentration of muscle glycogen at 3 h *postmortem* in the tender group was similar to that at 6 h *postmortem* in the tough group. This result was consistent with the change of muscle pH (Fig. 2). Sensory panel tenderness ratings showed the tender group as expected to be significantly tender($p<0.0001$). The tender group was juicier ($p<0.002$) than tough group due to the difference of intramuscular fat content between them. Panellists rated the tender group as having significantly higher overall acceptability rating ($p<0.0001$) than the tough group. No significant difference was found for overall flavour between both groups.

Implication

Our results indicate that muscle temperature and glycolysis rate of pre-rigor could be closely related to Hanwoo beef tenderness at 24 h *postmortem* and have potential to predict beef tenderness at 24 h *postmortem*.

References

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