EFFECTS OF TENDERING TREATMENTS ON 2 BREEDS OF NORWEGIAN LAMB

B.N.NILSEN, T.NÆS, H.J.SKARPEID and K.I.HILDRUM
MATFORSK, Norwegian Food Research Institute, Osloveien 1, N-1430 Ås, NORWAY

Keywords: Low volt electrical stimulation, lamb, tenderness, breeds

Background: The effects of chilling rate, electrical stimulation, aging time and tenderness on lamb have been the subjects of many studies (Chrystall *et al*, 1984, and Simmons *et al*, 1997). While the singular effects of each of these treatments are well documented, there is less knowledge about the interactions between treatments. Furthermore, the tenderness of different lamb breeds and the effects of tenderizing treatments on these have not been much explored.

Objectives: The aim was to study the effects of low voltage electrical stimulation (LVES), chilling rate and aging time for tenderness of 2 Norwegian breeds of lamb, and the synergies between the treatments.

Material and Methods: Male progeny (n=32) of 2 Norwegian breeds of lamb, Spæl and Dala, were used in the study. 16 animals of each breed showed an average carcass weight of 17.6 kg for Spæl and 20.0 kg for Dala. The lambs were slaughtered as a single group at a commercial slaughterhouse after being transported for 50 minutes from the farm. Two minutes after stunning half of the carcasses (8 Spæl and 8 Dala) were exposed for LVES (100V, 12.5 Hz, pulse 5 msec, 56 sec), the other half were not stimulated (NS). 30 minutes after slaughtering *M.Longissimus Dorsi*, (LD), muscles were removed, wrapped in plastic bags and held at approximately 2°C and 10°C for 21hours, before ageing at 3°C for 2 and 7 days. During aging time the drip loss was recorded.
At the end of aging time each muscle were cut in 2*15cm pieces, heat treated in a water bath at 70°C for 50 minutes, cooled to room temperature in ice and frozen by –40°C. The cooking loss was recorded for each sample. After thawing overnight at 3°C, the samples were tempered for 2 hours at 20C before subjected to Warner-Brazler (WB) shear force analysis. The instrument was an Instron Universal Testing Machine, fitted with a triangular knife. The speed was 250 mm/min, and data were collected every 0.2 mm. Maximum shear force from 10 sub-samples per sample were averaged and used in the calculations.
For sensory analysis, the frozen samples were thawed as above and re-cooked in a water bath at 65°C for 1 hour. Cubes, 1*1*2cm, with a core temperature of 63°C were cut parallel to the muscle fibers and evaluated by a 12 member sensory panel. The panelists had been trained according to international standards (ISO). A 9 point descriptive scale (9= extremely tender or extremely juicy. 1=extreamly tough or extremely dry). All samples were served randomly and in replicates.
Analysis of variance (ANOVA) was performed in MINITAB, version 12 on Windows.

Results and Discussion: LVES proved efficient in accelerating early post mortem decline in pH, both in fast and slowly chilled meat. For LVES and fast chilled meat the pH was below 6.0 after 4 hours, which was 0.9 units beneath the corresponding NS. As expected the pH fall was even faster in slowly chilled meat, where pH reached 6.0 after 2 hours. The fast chilled meat reached a temperature of 10°C after 4 hours post mortem, which indicated that the samples may be cold shortened (CS). The slowly chilled meat reached a temperature below 20°C after 4 hours post mortem, which means that warm shortening probably was avoided (Wahlgren *et al*, 1997). Based on WB shear force values, both slow chilling and LVES were efficient tenderizing treatments in lamb (Figure1). The toughest samples were obtained on non-stimulated, fast chilled samples, which was probably caused by CS. Increasing the aging time from 2 to 7 days did not improve tenderness in these samples, which confirmed a condition in the meat that did not age easily. LVES yielded most effects at lambs chilled at 10°C, as the slow chilling had already aged the meat. An alternative to LVES was slow chilling at 10°C, which gave tender meat at the same level as LVES. A combination of LVES and slow chilling did not improve the tenderness any further. Increasing the ageing from 2 to 7 days did not improve the tenderness of meat aged at 10°C further. Both the effects from chilling and LVES proved to be significant (95% level), both on the basis of sensory tenderness values and WB shear force.
The average of intra muscular fat content was 2.2% for Spæl and 1.8% for Dala lamb. Meat from Spæl had significant less ($p<0.04$) total drip loss than from Dala. There were no significant differences in drip loss related to LVES or chilling temperature. For cooking losses there were sigificant differences between breeds ($p=<0.222$), with less cooking loss for Spæl. No significant effect of LVES on cooking loss was observed. In Figure 2, the effects of chilling rate and LVES on each breed are shown, as measured by sensory tenderness. Chilling rate yielded effects on tenderness of both breeds. As for LVES, the effects on the 2 breeds seemed different. LVES of Spæl gave positive effects at both chilling rates. For Dala the LVES effect was less clear. While no significant effects were found at the highest chilling rate, a negative effect of LVES was observed at the lowest chilling rate. This is in agreement with earlier observations of the detrimental effect of LVES and low chilling rate on tenderness. In Figure 3 the interaction between LVES and breeds is shown, which also proved significant in the ANOVA. The reason for the different behaviour towards LVES on the 2 breeds in this respect is not known.

Table 1. Mean values of shear force (kg $10^{-1}/cm^2$) and sensory evaluation (sensory units) during aging for slowly and fast chilled lamb exposed for low volt electrical stimulation (LVES) and no stimulation (NS).

Variables	Slowly chilled ,SPÆL		Slowly chilled, DALA		Fast chilled, SPÆL		Fast chilled, DALA	
	LVES	NS	LVES	NS	LVES	NS	LVES	NS
Tenderness, day 2	7.1	5.1	5.3	6.6	5.8	4.4	4.8	4.3
Warner Bratzler, day 2	39.7	27.8	38.2	32.1	33.7	69.7	44.6	84.0
Warner Bratzler, day 7	30.1	50.9	31.0	34.0	25.2	67.6	46.8	74.9

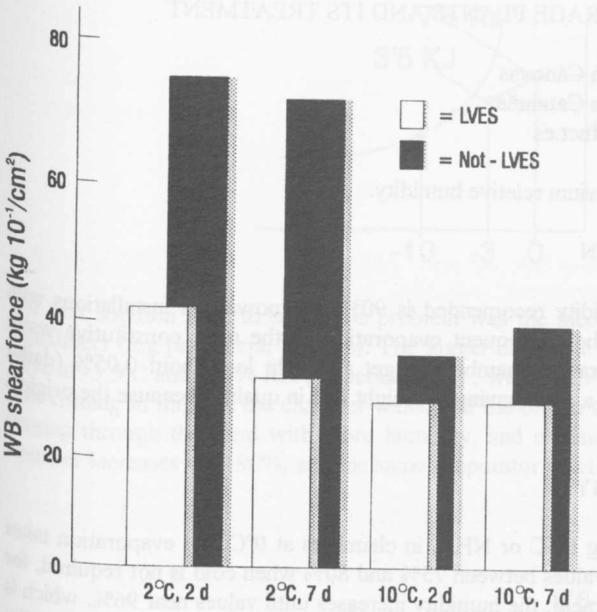

Figure 1, Effects of LVES, chilling temperatures and ageing time on tenderness of lamb loins, measured by WB shear-press

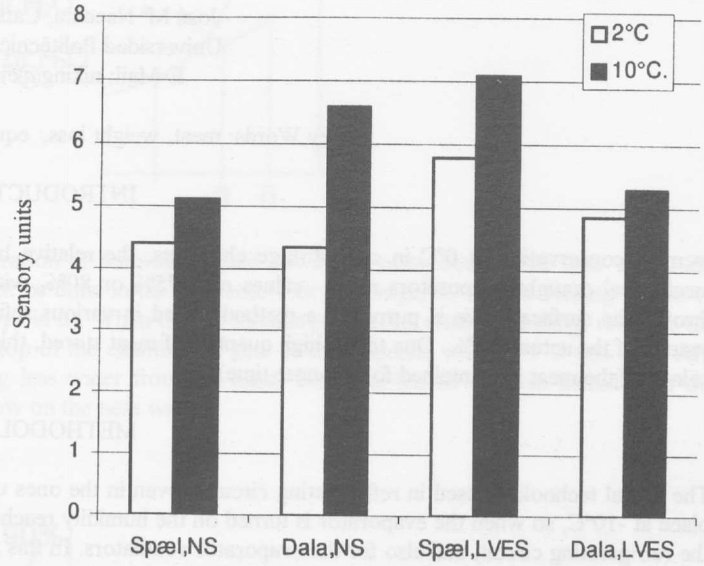

Figure 2, Effects of chilling rates and LVES on breeds measured by sensory tenderness

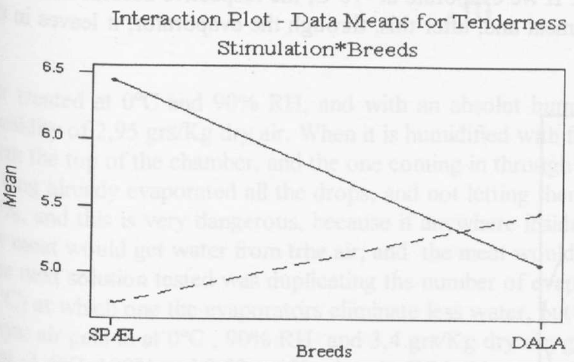

Figure 3, Interaction between LVES and breeds

Acknowledgements

The authors appreciate the contributions from Kjetil Toresen and Terje Frøystein from Norway Mat; Geir Tøgrsen and the sensory group at MATFORSK. Sæter Forsøksgård, Kvikne is particularly thanked for their cooperation.

References:

Chrystall, B.B., Devine, C.E., Ellery, S., Wade, L. New Zealand Jnl. Agric. Res. 27, 513 (1984)

Simmons, N.J., Gilbert,K.V., Cairney,J.M. The effect of low voltage stimulation on pH fall and meat treatment in lambs. Proc 43rd Int. Congress of Meat Science and Technology, Auckland, New Zealand, 1997

Wahlgren, N.M., Olsson U., Tornberg, E. The influence of different temperature-time courses on muscle shortening and beef tenderness. Proc 43rd Int. Congress of Meat Science and Technology, Auckland, New Zealand, 1997