Electrical stimulation and wrapping avoids toughening effect of high *pre rigor* temperatures in beef

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1 Introduction

- Muscle will shorten at the onset of *rigor mortis* – the extent of shortening will depend on energy level and temperature in the muscle
- Muscle shortening affects meat tenderness
- *Pre rigor w*rapping can prevent shortening
- Electrical stimulation accelerates the *rigor* process whereby detrimental effects of cold shortening by fast chilling and freezing is avoided
- Electrical stimulation appears to have other roles so that even when cold shortening is avoided, electrical stimulation can still impact on tenderness

2 Aim

Study the effect of electrical stimulation, wrapping and *pre rigor* temperature on beef tenderness

3 Materials and Methods

70 *M. Longissimus lumborum* muscles from 35 steers were subjected to the following *pre rigor treatments*:

1. Electrical stimulation/no electrical stimulation (ES/NES)
2. Wrapping (wrapped/unwrapped)
3. *pre rigor* temperatures (15°C/35°C)

Once *rigor mortis* was reached, samples were aged at 15°C for up to 90 h. Shear force was measured using a MIRINZ tenderometer. Ageing was indexed to rigor.

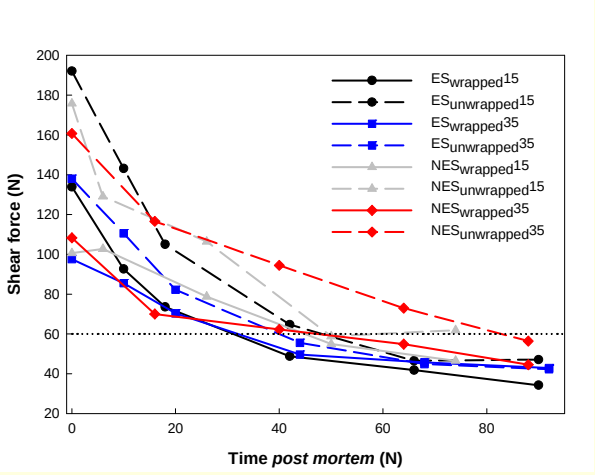

Figure 1 Shear force (LSMeans – error bars have been omitted for clarity) in muscles subjected to electrical stimulation/no electrical stimulation (ES/NES), *pre* rigor temperature of 15°C/35°C and wrapping.

4 Results and discussion

The *pre rigor* treatments provided a large variation in individual shear force values at *rigor* (from 46 to 265 N). However, as the meat aged the shear force of all treatment groups decreased and eventually reached acceptable values (Figure 1).

Key findings

- **At rigor, the shear force of ES muscles (141 N) was not significantly different to NES muscles (136 N) – $p_{stimulation\ at\ rigor} = 0.56$.**
- **Although NES muscles reached acceptable tenderness levels after ageing (52 N), the shear force of aged ES muscles (42 N) was significantly lower – $p_{stimulation\ after\ ageing} < 0.0001$.**
- **At *rigor*, the shear force of unwrapped muscles (168 N) was higher than for wrapped muscles (110 N) – $p_{wrapping\ at\ rigor} < 0.0001$.**
- **Although unwrapped muscles reached acceptable tenderness levels after ageing (52 N), the shear force of aged wrapped muscles (42 N) was significantly lower – $p_{wrapping\ after\ ageing} < 0.0002$.**

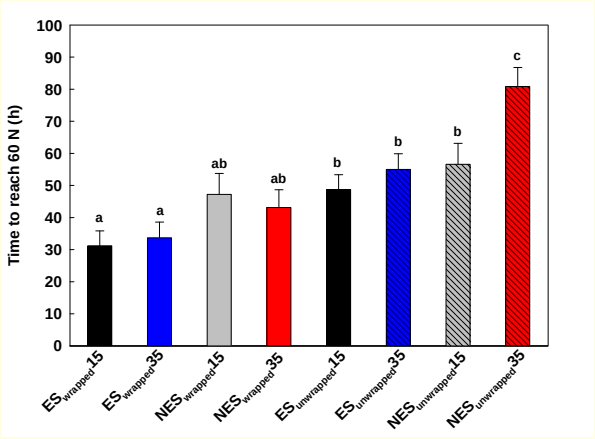

Figure 2 Time to reach a shear force of 60 N (LSMeans and SE) for muscles subjected to electrical stimulation/no electrical stimulation (ES/NES), *pre rigor* temperatures of 15°C/35°C and wrapping. Treatments with different letters are significantly different ($p < 0.05$)

Although the mean shear force values for all treatments groups were acceptable after full ageing, there was a large variation in shear force during the ageing period. When using the time to reach 60 N as a threshold for acceptability, these differences became further obvious (Figure 2). Muscles that were either wrapped and/or electrically stimulated reached acceptable shear force values significantly earlier than those that were not. It took almost three times longer for $NES_{unwrapped}35$ muscles to reach 60 N than for the $ES_{wrapped}35$ muscles. Furthermore, the *pre rigor* temperature only had a significant effect when the muscles were not wrapped or not electrically stimulated.

5 Conclusion

We conclude that electrical stimulation immediately post slaughter confers a degree of protection from toughening of wrapped and unwrapped muscle at both high and low *pre rigor* temperatures enabling acceptable and fast tenderisation and its use can be beneficial to meat quality, by reducing both high temperature shortening and cold shortening.