COMBINED EFFECTS OF AITCH BONE SUSPENSION AND CHILLING RATE ON THE TENDERNESS OF BEEF MUSCLES

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Introduction

The benefits of pre-rigor aitch bone suspension of beef carcass sides, also called Tenderstretch (TS), on the tenderness of various loin and round muscles were documented about 30 years ago (*Hostetler et al., 1972*). TS is suited for carcasses of other meat species as well, for example pork and lamb. Despite the potential benefits on tenderness, the TS technology was not implemented in the meat industry to any large extent until the mid 90's. TS is now being used commercially for beef carcasses in countries like Australia, Ireland, England, Sweden and Norway. Since the basic work on cold shortening (*Locker & Hagyard, 1963*), extensive knowledge has been achieved on optimum chilling of pre-rigor muscles to avoid contraction and resulting toughening. However, the combination of aitch bone suspension and different chilling rates of the carcasses is still little investigated.

Objective

To study the effects of aitch bone suspension of beef carcass sides in combination with fast or medium chilling rates on the tenderness of loin and round muscles.

Materials & methods

Non-stimulated carcasses of young bulls of Norwegian Red Cattle with an average weight of 280 kg were used. One side was suspended from the aitch bone or *obturator foramen* (TS) within 90 min post mortem, while the other side served as control by traditional Achilles tendon suspension (C). In experiment A, 2 x 9 sides were chilled fast to a loin core temperature of 5 °C at 10 h post mortem. In experiment B, 2 x 8 sides were chilled at a medium rate to a corresponding temperature of 9 °C. Muscles from the loin and round were measured for sarcomere length by the laser diffraction method. After 8 days ageing at 4 °C, the muscles were analysed for Warner-Bratzler (WB) peak shear force and sensory tenderness with a panel of 11 trained assessors. Analysis of variance with Tukey's multiple comparisons test was performed with SAS for Windows, Release 6.12 (SAS Institute Inc., Cary, NC, USA).

Results and discussion

Table 1 shows sarcomere lengths, WB values and sensory tenderness scores.

TS increased sarcomere lengths for *longissimus dorsi* (LD), *semimembranosus* (SM) and *rectus femoris* muscles compared to unstretched controls. However, sarcomeres were not significantly longer for the *semitendinosus* muscle, possibly because of its anatomical location and action in the live muscle, or its high content of connective tissue restricting the ability for stretching. The increase in sarcomere lengths caused by TS in the LD at fast and medium chilling rates was similar.

For the LD, TS decreased WB values and increased sensory tenderness scores at the fast chilling conditions. However, at the medium chilling rate, the LD and round muscles tested did not significantly differ in WB values or tenderness scores compared to the Achilles tendon suspension. Although the difference in the loin temperature 10 h post mortem only was 4 °C, the medium chilling rate seemed to reduce muscle contraction and produced tender meat from both TS and control carcasses. At the fast carcass chilling rate, the SM had low WB values, and its shear force was unaffected by TS. The high tenderness of the SM can be explained by a slower chilling rate of the large and deeply located SM than the LD near the surface of the carcass. The results of our study are in agreement with work by *Dreyer et al. (1979)*, who found that TS increased tenderness of beef LD at a chilling to 3 °C, but not 9 °C in the LD at 10 h post mortem.

Fig. 1 demonstrates that TS reduced the variation in sensory tenderness of the LD of the 9 carcasses at fast chilling conditions, particularly by increasing the tenderness of the toughest muscles. The standard deviation was 0.89 for the TS group and 1.42 for the unstretched control group ($p<0.05$).

Conclusions

TS increased the tenderness level and reduced the variation in tenderness of beef LD at fast chilling conditions. At the medium chilling rate, TS did not further improve the tenderness of loin and round muscles.

References

Dreyer, J.H., Rensburg, A.J.J. van, Naudé, R.T., Gouws, P.J. & Stiemie, S. (1979). *South African J. Animal Sci.* 9, 1 – 9.
Hostetler, R.L., Link, B.A., Landmann, W.A. & Fitzhugh, H.A. Jr. (1972). *J. Food Sci.* 37, 132 – 135.
Locker, R.H. & Hagyard, C.J. (1963). *J. Sci. Food Agricult.* 14, 787 – 793.

Table 1
Sarcomere length, Warner-Bratzler (WB) peak shear force and sensory tenderness score of beef loin and round muscles subjected to aitch bone (TS)/Achilles tendon (C) suspension and fast/medium chilling.

Chilling condition/ muscle	Sarcomere length (μm)		WB peak shear force (N/cm^2)		Tenderness score (1=tough, 9=tender)	
	TS	C	TS	C	TS	C
Exp. A - fast chilling rate						
Longissimus dorsi	2.0	1.6***	61	103***	6.3	3.9***
Semimembranosus	2.9	1.8***	56	53*	--	--
Exp. B - medium chilling rate						
Longissimus dorsi	2.2	1.8***	51	56*	6.0	5.3*
Semitendinosus	2.4	2.3*	55	57*	5.6	5.5*
Rectus femoris	2.0	1.8**	43	42*	--	--

*** $p < 0.01$
** $p < 0.05$
* not significantly different $p > 0.05$

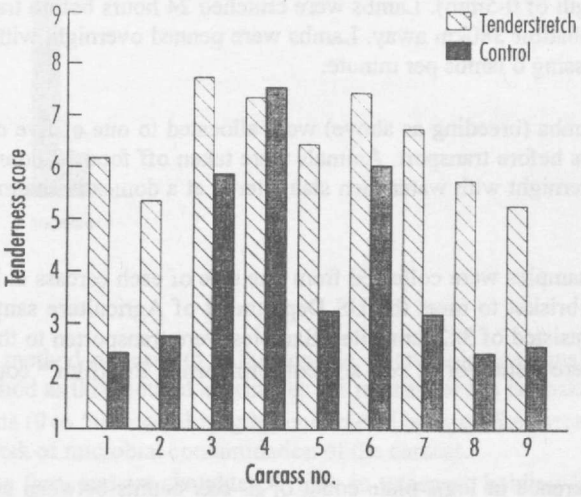

Fig. 1
Variation in sensory tenderness scores of beef *longissimus dorsi* muscles with aitch bone (Tenderstretch) or Achilles tendon (control) suspension at a fast chilling rate. Tenderness scale: 1 = tough, 9 = tender.