# THE SIGNIFICANCE OF SARCOMERE LENGTH AND PROTEOLYSIS ON THE TENDERNESS OF BOVINE *M. LONGISSIMUS DORSI*

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## Background

Consumers surveys have revealed consistent eating quality, in which tenderness is a strong characteristic, is one of the most important attributes of beef. There are 3 phases *post-mortem* which have an influence on tenderness; the pre-rigor phase, rigor or the phase of maximum toughness and the tenderisation or post-rigor phase. The biochemical dynmaics of the pre-rigor phase influence the maximum contraction at rigor. Tenderisation may be defined as a decrease in toughness post-rigor (Hopkins and Thompson 2002) and mostly attributed to changes in the myofibrillar proteins. The extent of contraction at rigor may be monitored by measuring the length of the sarcomere and its influences on the rate of tenderisation (Herring et al 1967). The glycolytic behaviours pre-rigor are dependent on temperature and therefore can be altered through the chilling regime. Reducing the rate of the glcolytic pathway would enable the examination of the pre-rigor period and its effect on rigor.

## Objective

Examination of the early post mortem period using different rates of glycolysis to monitor the effect of proteolysis and sarcomere length on the tenderness of beef.

## Materials and methods

Hereford cross Friesian heifers were slaughtered at the research abattoir in The National Food Centre, Dublin. Hot-boned *longissimus dorsi* muscles (LD) (n=8) were split in half, one half was immersed in a water bath pre-set at 5ºC and the other half was immersed in 15ºC for the first 8 hours *post–mortem* before being transferred to a chill. Temperatures were selected on the basis of results presented by the authors in these proceedings. pH and temperature profiles were recorded. Samples were taken for sarcomere length at day 2, 7, 14 and 21 *post-mortem*. Steaks were cut on alternating days up to day 21and stored at –20º C for Warner Bratzler Shear Force (WBSF) analysis. Samples were taken at 1.5,4,8, 24, 48 hours *post-mortem* for analysis of myofibrillar protein profiles.

## Results and Discussion

Temperature had an effect on the rate of pH decline; LD incubated at 15ºC had an accelerated rate of pH decline when compared to those incubated at 5ºC. WBSF carried out over a 21-day period illustrated that the muscles incubated at 15ºC were more tender then those incubated at 5ºC, suggesting the occurrence of cold shortening (Fig 1). The greatest degree of tenderisation in muscles tempered at both 5ºC and 15ºC occurred before day 3 *post-mortem*. Analysis of a gradient 3-15% SDS-PAGE (Fig 2) illustrated that the differences in the rate of myofibrillar proteolysis, between muscles held at 5 and 15ºC, are minor. Therefore it is unlikely that the difference in tenderness is due to degradation of the myofibrillar proteins (Fig 2). The emergence of the 30kDa appeared similar over a 21-day period for both 5 and 15ºC (not shown). Temperature was found to have an impact on sarcomere lengths. Cold shortening of muscles tempered at 5ºC caused a greater maximum contraction at rigor than those tempered at 15ºC. Cold shortened sarcomeres (5ºC) did not lengthen significantly over time (table 1).

## Conclusions

The majority of tenderisation for both cold shortened and non cold shortened muscles occurred before day 3 post-mortem. Despite the fact that cold shortened muscle ages, it still remains tougher and than its non-shortened counterparts. A reduction in maximum toughness appears to be more favourable than an increase in tenderisation.

## References

Hopkins D.L., Thompson J.M. (2002). Factors contributing to proteolysis and disruption of myofibrillar proteins and the impact on tenderisation in beef and sheep meat. Aust. J. Agric. Res., 2002, 53, 149-166.

Herring H.K., Cassens R.G., Suess G.G., Brungardt V.H., Briskey E.J. (1967). Tenderness and associated characteristics of stretched and contracted bovine muscles. J. Fd. Sci. 32,317-323.

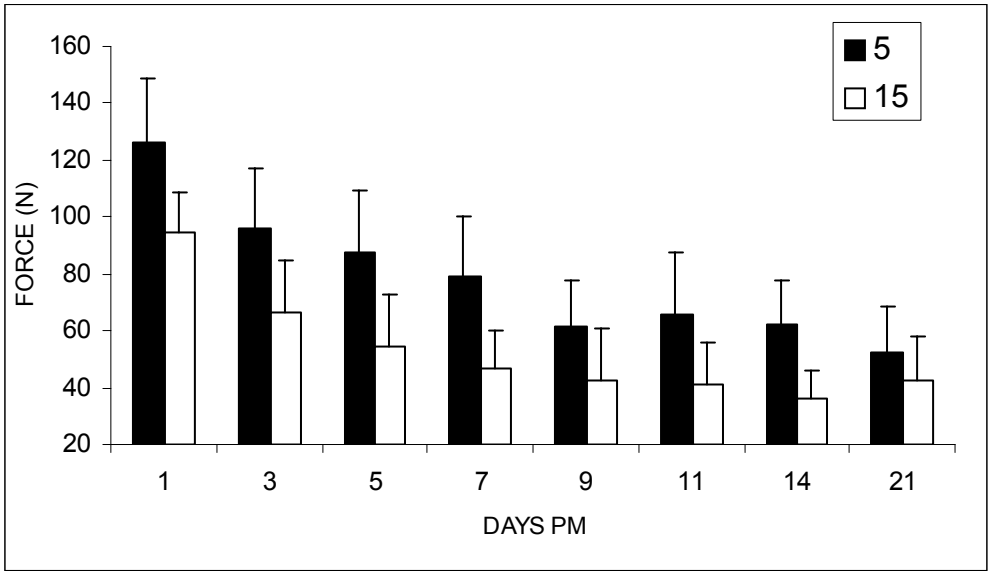


**Figure 1**: Warner Bratzler shear force measurements (n=8) for bovine *M. longissimus dorsi with* pre-rigor incubation temperature of 5 and 15ºC.

**Table 1**: Sarcomere length (µm) of bovine *M. longissimus*

| | **Day 2** | **Day 7** | **Day 14** | **Day 21** |
|---|---|---|---|---|
| **5ºC** | 1.51± 0.19 | 1.55±0.14 | 1.43±0.16 | 1.46±0.12 |
| **15ºC** | 1.64±0.17 | 1.76±0.12 | 1.73±0.11 | 1.69±0.12 |

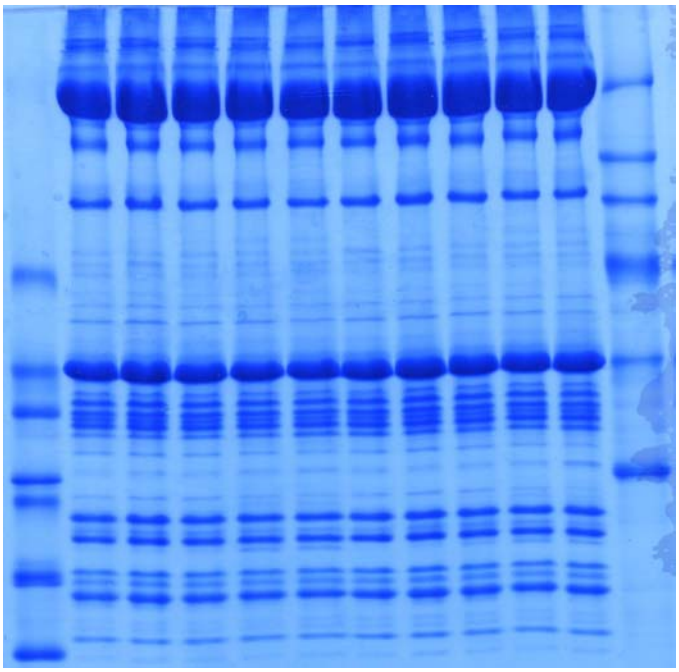

**Figure 2** : Myofibrillar protein profiles. 3 –15 % gradient SDS-PAGE. Lane 1-12; low molecular weight marker; 5ºC time 0; 5ºC 4hrs; 5ºC 8hrs; 5ºC 24hrs; 5ºC 48 hrs; 15ºC time 0; 15ºC 4 hrs; 15 ºC 8 hrs; 15ºC 24 hrs; 15ºC 48 hrs; high molecular weight marker.