CARCASE Hanging

When pre-rigor muscle is placed under sufficient tension to prevent shortening of the muscle fibers during rigor there is a large improvement in tenderness. As a result a number of techniques have been developed which place pre-rigor muscle under tension. These early attempts often comprised 'racks' of stretching devices which were applied to the hot carcass. These devices proved not to be commercial and it was not until the early 70's that workers from the US and Australia experimented with pelvic hanging that the concept of stretching muscles as a technique to improve tenderness had a resurgence.

It is interesting that although the results of stretching pre-rigor muscle are clear cut, the mechanisms by which the increased tension causes an increase in tenderness are not clear. Stretching or restraining pre-rigor muscle results in an increased sarcomere length, relative to unrestrained muscle. As sacromere length increases there is a resultant increase in tenderness up until a sarcomere length of about 2.0 microns. If greater tension is applied the sarcomere length can further increase up to about 3.2 microns, although there is little further improvement in tenderness. A number of theories have been put forward to explain this increase in tenderness.

One of the most commonly quoted is that stretching results in a decrease in the overlap between the actin and myosin filaments in the myofibres of the muscle bundles and that this contributes to increased tenderness. Another hypothesis is that the stretched muscle has a decreased fiber diameter and in cooked meat this results in decreased toughness. This decrease in fibre diameter would increase the density of connective tissue but as suggested by Swedish workers this would place the connective tissue under tension, which may result in it reacting differently to heat during cooking. Another hypothesis is that stretching the muscle pre-rigor results in the actin filaments not bonding as tightly to the Z-disks.

Regardless of the mechanisms, stretching pre-rigor muscle results in more tender meat and the meat requires less ageing. As described in the following pages a number of procedures have been developed which utilise this result to improve meat quality.

Tenderstretch

A means of avoiding the toughening that occurs with muscle shortening during rigor is to hang the carcass in such a way that there is maximum tension on the muscles and they cannot shorten during rigor. This was investigated 20 years ago by Drs Shorthose and Harris from CSIRO Cannon Hill using a process called tenderstretch. However because of a perceived inconvenience and extra costs tenderstretching was never implemented at this time. Now tenderstretching is a critical control point as part of several MSA pathways there is a mechanism for processors to be rewarded for the additional costs incurred and its acceptance appears assured.

The above figure shows the shape of both normally hung and tenderstretch carcasses. The normally hung carcass is suspended via the archilles tendon, which places decreased tension on a number of muscles. The loin muscle is effectively on the inside curvature of the backbone and is not under tension during rigor. Also in a normally hung carcass many of the muscles in the leg are not under tension and can shorten. In contrast the backbone in a tenderstretch carcass is straight and so there is tension on the loin muscle which prevents it from shortening during rigor. In addition because the tenderstretch leg hangs in a more natural position there is tension on most muscles and so shortening cannot occur.

The earlier work of Shorthose and Harris showed that the tenderstretch hanging position has a positive effect on the loin and cube roll cuts, rump, silverside, round, and topside muscles. It had no effect on the fore-quarter cuts and the eye round and there was a slight detrimental effect on the fillet muscles. The cuts, which are affected by tenderstretch, are shown in the following diagram.

Work is currently underway to assess the variability in the response of tenderstretch carcasses. Initial results have shown that tenderstretch causes an 8 to 10 point increase in MQ4 score and it is likely that it will be an integral part of a number of MSA pathways to produce high quality beef.

Tendercut

The tendercut process is an alternative means of improving tenderness to the tenderstretch method. The process involves stretching the muscles of the loin and hindlimb so that they go into rigor in the stretched state. Whilst the tenderstretch process uses the pelvic hanging position to increase the tension on the loin and hindlimb muscles, the tendercut process applies a similar tension on the muscles by breaking the vertebrae and pelvic bones in the hot carcass.

The tendercut process was initiated by Drs Claus and Marriott in 1991, where they tested four carcasses in the meat abattoir at Virginia Polytechnic Institute and State University in the US. Based on data from in-plant testing conducted in

a major commercial facility, Claus and Marroit have reported improvements in tenderness of over 35% using the tenderstretch process, particularly in beef animals with inherently less tenderness meat.

The tendercut process involves sawing the vertebral column at the 12th/13th rib junction and the ischium at the rump/butt junction. In addition to breaking the vertebrae at the 12/13th rib junction, all tissues surrounding the loin are cut, such that it is the only dorsal component holding the forequarter to the hindquarter .

The breaking of the bone and cutting of the muscles surrounding the loin is shown in the adjacent figure. As shown in the figure the adipose tissue dorsal to the longissimus muscle is also cut to expose the epimysium. This cut is then continued around the medial side of the loin muscle and the Multifidus dorsi completely severed. Intercostal connective tissue and muscle are then cut between the 12th and 13th costal bones. This latter cut is extended approximately 12 cm from the lateral edge of the loin muscle. A photo of the tendercut break at the loin is shown

The second treatment site involves sawing the ischium at the same site used to separate the butt/rump joints. If the cutting of the ischium is done with a saw it is unavoidable to damage the fillet muscles. If the current MSA evaluations prove promising then a device to break the ischium without damaging the fillet will be developed for any commercial applications. A photo of the tendercut break at the butt/rump joint is also shown.

The tendercut process overcomes some of the problems of tenderstretching, particularly the problem of carcasses breaking the pelvic bone or the ileo-sarcal ligament and dropping, the extra chiller space required and the need to perhaps rehang the carcass if prior to boning. MSA has undertaken a comparison of 14 carcasses, whereby one side of each carcass was tenderstretched and the other tendercut. These results should be available shortly and the results will be posted at this web site.

For more information on the tendercut process visit the web site of Claus and Marriot at the following addressPublications on the Tendercut Process B.Wang, H., Claus, J.R., and Marriott, N.G. 1994. Selected skeletal alterations to improve tenderness of beef round muscles. J. Muscle Foods 5:137-147. C.Wang, H., Claus, J.R., and Marriott, N.G. 1996. Prerigor treatment and endpoint temperature effects on U.S. Choice beef tenderness. J. Muscle Foods. 7:45-54.

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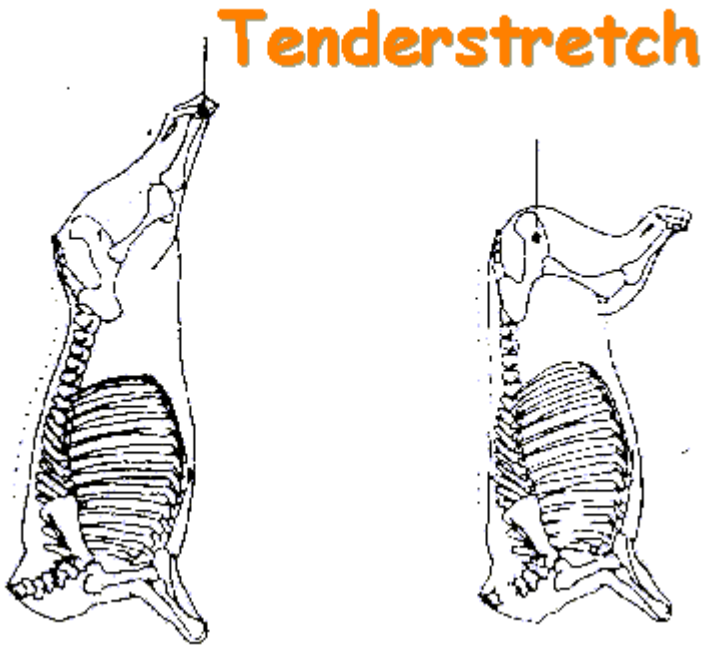

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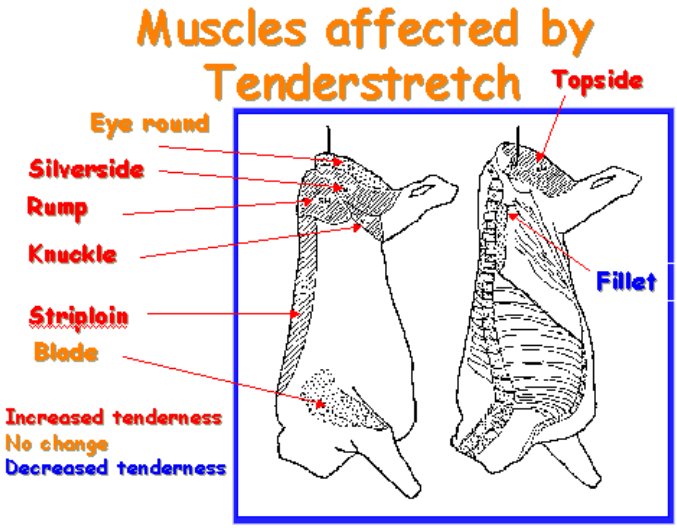
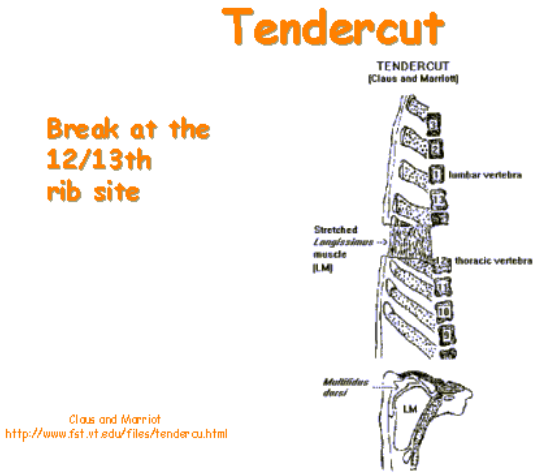


Extensive re-evaluation of the merits of tenderstretch have now been completed by MSA. The results which have been summarised by Ferguson et al (1999) indicate that even in the presence of stimulation there are benefits to be gained form tenderstretching, particularly for some of the hindquarter cuts. The results from a series of MSA experiments are shown in Table 2 and show a highly significant hanging method x muscle interaction. As expected, there was no effect of tenderstretch on the forequarter muscles with the exception of the striploin. In stark contrast, eating quality was significantly improved by tenderstretch in the majority of the hindquarter muscles. The notable exceptions to this trend were the fillet and eye round. Both of which are stretched in conventionally hung sides and in the case of the fillet more likely to shorten in the tenderstretched state. As an alternative means of achieving the benefits of carcass stretching without some of the operational issues other forms of carcass suspension are also under investigation (see Tendercut).

Tendercut



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Break at the 12/13th rib site

Claus and Marriot
http://www.fst.vt.edu/files/tendercu.html

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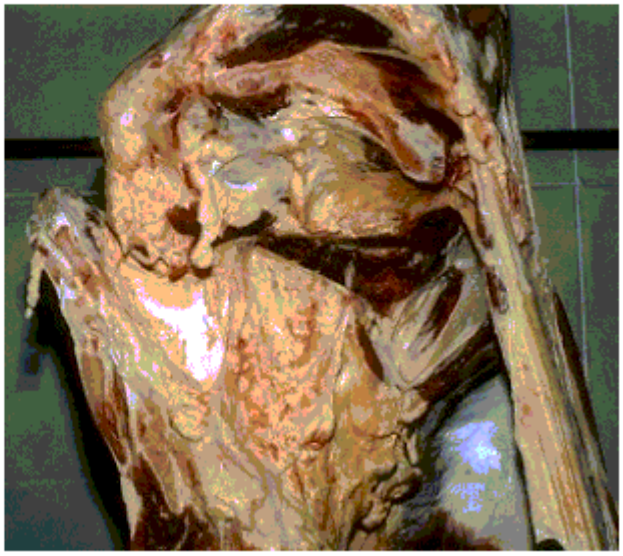
Break at the butt/ rump joint



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