EFFECT OF PELVIC SUSPENSION IN BEEF ON YIELD, SHEAR FORCE AND SARCOMERE LENGTH OF VALUABLE CUTS WITH EMPHASIS ON *M. SEMIMEMBRANOSUS*

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Background

Within the meat industry fast throughput and high yield in connection with slaughter is of economical importance. Electrical stimulation and fast chilling of the carcasses is one way to diminish variation in meat quality. The demands of high efficiency must be followed by high demands regarding meat quality. Because the conditions during slaughter and chilling can influence tenderness it is of great concern that the slaughtering conditions are kept under control.

Objective

The objective of this investigation was to study if pelvic suspension in comparison with normal hanging of the carcasses by the Achilles tendon would improve yield and tenderness of valuable cuts.

Methods

Carcasses within the weight range 206 - 367 kg from 34 young Swedish Red and White bulls were selected on the slaughter line. All carcasses were electrically stimulated (low voltage, 30 sec) 20 min after bleeding. The left side from each carcass was re-hanged by the pelvic bone approximately 60 min after exsanguination, while the right side was left hanging by the Achilles tendon. The carcasses were chilled during 50 minutes in a chilling tunnel, starting with -2°C, passing a zone with -4°C and then back again to -2°C. The final temperature in the centre of *M. semimembranosus* was approximately 30°C after this time period. The carcasses were stored in a chilling room at 2-4°C until cutting two days after slaughter.

All retail cuts were weighed and the length and width were measured. Quality characteristics were studied for *M. semimembranosus* (SM) from 34 carcasses, and *M. adductor* (AD) from 7 carcasses, *M. longissimus dorsi* (LD) from 4 and *M. psoas major* (PM) from 2 carcasses. The SM was separated from AD, vacuum-packed and stored at 4°C for 7 days. After this storage, the drip loss in the vacuum-bag was measured and samples for tenderness measurement and sarcomere length determination were taken out from the muscle. Samples for sarcomere length determination were prepared according to Cross *et al.* (1980) and tenderness samples were vacuum packed and stored for another week before freezing at -20°C.

The Warner-Bratzler shear force method (Honikel, 1998) was used for measurement of tenderness. The samples were thawed at 4°C during night and while still slightly frozen cut into pieces with the dimension 12 × 4.5 × 4.5cm. To standardise the preparation, the samples were vacuum-packed and heated in water bath for 2h in 70°C, then cooled in tap water for 30 min. The cooked meat samples were stored at 4°C until measurement of shear force was performed the next day. From each sample, strips (30 × 10 × 10 mm) were cut out following the muscle fibre structure. A minimum of 10 strips from each sample were analysed using a Stable Micro Systems Texture Analyser HD 100 (Godalning, UK) equipped with a Warner-Bratzler shear force blade with a rectangular hole (Honikel, 1998).

The effects of suspension method and carcass were included in the statistical model. Levels of significance: ns = $p > 0.10$; # = $p \leq 0.10$; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.

Results and discussion

The Pelvic suspension had a great effect on the shape of the different cuts from the hindquarter. The length of the SM increased more than 30%, as shown in Table 1, making the cut more suitable for slicing. Pelvic suspension also prevented AD from contracting and gave the muscle a tenderloin appearance. The elongation of the muscles influenced the length of the sarcomeres which in SM was significantly longer ($p=0.001$) in sides hanged by Pelvic suspension compared to sides hanged by the Achilles tendon. The elongation of sarcomeres in SM due to Pelvic suspension has been shown earlier by Bouton *et al.* (1973), and their study also showed a difference in sarcomere length between Pelvic and Achilles tendon suspension larger than 1µ. The water holding capacity was improved with Pelvic suspension, both the drip loss during storage and the cooking loss. The total drip loss was 2.3 percentage units lower for Pelvic suspension sides. Eikelenboom *et al.* (1998) found a tendency towards lower drip loss for Pelvic suspension treatment and a significant reduction in cooking loss for the SM muscle at cooking temperatures over 60°C.

The results from the Warner-Bratzler shear force measurements (Figure 1) confirm earlier results by Hostetler *et al.* (1970) and Bouton *et al.* (1972) showing that tenderness is improved in carcasses hanged by Pelvic suspension for muscles SM, AD and LD, but slightly reduced in PM. This study showed a significant difference in shear force between Pelvic suspension and control sides for SM ($p=0.001$), with a 21% decrease in shear force. The number of samples was low for the other muscles and thus not meaningful to test statistically. The decrease in shear force due to Pelvic suspension was 20 and 39 % for AD and LD, respectively, with an increase in shear force of 7 % in PM.

The variation between different carcasses was reduced using Pelvic suspension compared to Achilles tendon suspension. As can be seen in Figure 2, the shear force was reduced with the variation among SM muscles from Pelvic suspension treatment being considerably smaller. The coefficient of variation decreased from 26% for Achilles tendon suspension to 12% for Pelvic suspension. Sörheim et al. (2001) also found that the between animal variation in tenderness of LD was reduced with Pelvic suspension in carcasses chilled fast, but not with slow chilling. Also the within animal variation for shear force decreased significantly in our study, as the coefficient of variation decreased from 13.3% to 10.0% ($p=0.001$; Table 1), with a corresponding decrease in the variation for

the sarcomere length from 11.3 to 6.5% (p=0.001). This suggests that the frequency of unacceptable tough meat can be avoided using Pelvic suspension. This is especially useful when high chilling speed and fast throughput is demanded.

Conclusions

With the type of chilling used in this experiment, Pelvic suspension had a positive effect on the tenderness in *M. semimembranosus, M. longissimus dorsi* and *M. adductor* as well as on other quality characteristics influencing yield and thus profitability. The adductor muscle had the appearance and shear force comparable to the most valuable muscle, the tenderloin (*M. psoas major*). This must of course be verified with the use of sensory tests. The variation between animals in tenderness was lower from pelvic suspended carcasses, which is of great commercial interest, since an even and high quality product is important for the marketing. If the consumers feel confident with the product quality they will accept the higher price necessary for covering the costs for the extra labour required with Pelvic suspension.

References

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Table 1. The effect of Pelvic and Achilles tendon suspension on various quality traits for *M.Semimembranosus*

Trait	Achilles Tendon	Pelvic Suspension	Standard error	Level of sign.
Length of muscle (cm)	35.4	48.6	0.74	***
Sarcomere length (µ)	1.62	2.93	0.03	***
Drip loss during storage (%)	2.8	1.6	0.1	***
Cooking loss (%)	28.7	27.6	0.2	***
Shear Force (N)	67.7	53.3	2.0	***
Coefficient of variation for Shear Force	13.3	10.0	0.6	***

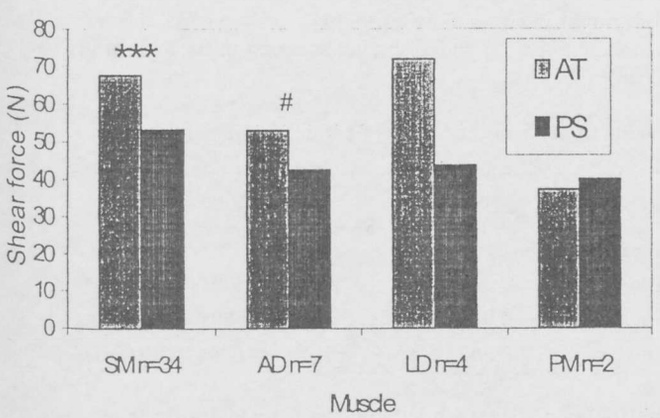

Figure 1. The effect of Pelvic (PS) or Achilles tendon (AT) suspension on shear force in different muscles.

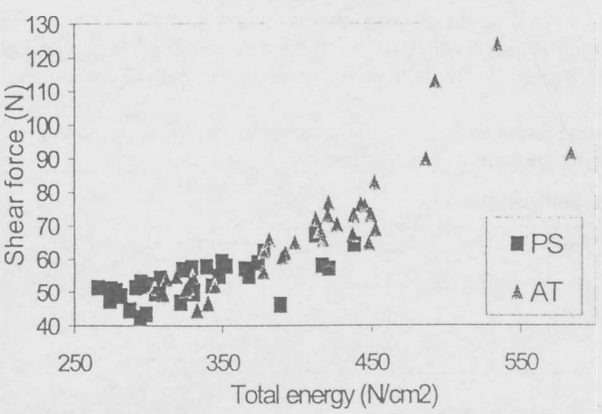

Figure 2. The effect of Pelvic (PS) or Achilles tendon (AT) suspension on the variation between animals in shear force in *M. semimembranosus*.