EFFECT OF PELVIC SUSPENSION ON SENSORY AND INSTRUMENTAL EVALUATION OF HEIFERS AND YOUNG BULLS

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Background

One of the major problems for the beef meat industry is inconsistency in meat quality and especially in tenderness. Koohmaraie (1996) showed that unacceptable variation in tenderness was the biggest reason for consumer dissatisfaction. This variation is due to a natural variation in the animal material and to quality differences between sexes, heifers being generally more tender than bulls (Jeremiah, 1991). It is also known that the conditions during rigor development are the most important factor controlling tenderisation (Dransfield, 1994). It is therefore of interest to study the influence of the pre-rigor suspension method on carcasses. Suspension from the achilles tendon is used in general but to get a stretching effect on the hindquarter muscles and to prevent muscle shortening, pelvic suspension is more effective (Hostetler et al., 1970).

Sensory evaluation is a valuable tool in expressing the overall quality of a meat sample but the correlation between sensory evaluation and instrumental measures of meat tenderness are very variable (Szczesniak, 1968). In order to investigate this relationship and to be able to perform both sensory and instrumental evaluation on smaller samples, e.g. from smaller muscles, the strips from the instrumental tenderness measurement were used also for sensory evaluation.

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 tenderness and sensory perception of meat from both heifers and young bulls.

Methods

Carcasses from Swedish red and white cattle were selected on the slaughter line; 7 heifers (248.5- 301.4 kg) and 7 young bulls, (234.8-309.7 kg). All carcasses were electrically stimulated (low voltage, 30 sec) within 30 minutes after bleeding. The left side from each carcass was re-hanged by the pelvic bone approximately 60 minutes after exsanguination while the right side was left hanging in the Achilles tendon. The carcasses were chilled during 50 minutes in a chilling tunnel, starting with -2^{O} C, passing a zone with -4^{O} C and then back again to -2^{O}. The carcasses were stored in a chilling room at 2-4^{O} C until cutting 2 days after slaughter when the M. longissimus dorsi was weighed. pH was measured in the center of the muscle at the 11th rib. The whole muscle was vacuum-packed and aged for 7 days at 4^{O} C. Samples for sensory analyses (200 mm) and Warner-Bratzler measurements (100 mm) were then taken out and frozen at -20^{O} C.

The Warner-Bratzler (WB) shear force method (Honikel, 1998) was used for measurement of instrumental tenderness. The WB samples were thawed at 4^{O} C over night and then placed in a waterbath (20^{O} C) for 1 hour. After vacuum packing, the samples were heated in a waterbath for 2 h at 70^{O} C. The weight was measured before freezing, after thawing and after cooking.

The cooked meat samples were stored at 4^{O} C until the measurement of shear force was performed the next day. From each sample, strips (40 x 10 x 10 mm) were cut out following the muscle fibre structure. A minimum of 8 strips from each sample were analysed using a Stable Micro System Texture Analyser HD 100 (Godalning, UK) equipped with a Warner-Bratzler shear force blade with a rectangular hole (Honikel, 1998).

The sensory samples from the M.longissimus dorsi were prepared in an oven at 125^{O} C until the internal end-point temperature of 70^{O} C was reached. A selected and trained panel of 7 judges performed the sensory analysis. The samples were served room-tempered to the judges in replicates as rectangular, 3.8mm thick slices and the attributes bite resistance, tenderness and juiciness were judged on a scale from 0-100. The sensory panel also analysed the strips from the Warner-Bratzler measurement (20 x 10 x 10 mm) in replicates for the same attributes.

Statistical evaluation was performed using the Procedure Mixed in SAS (Ver. 8e, SAS Institute Inc., Cary, NC, USA). The model contained the fixed effects of sex and suspension method and the interaction between these, and the random effect of individual. For the sensory evaluation the random effect of panel member was also included.

Results and Discussion

The results from the Warner-Bratzler shear force measurements (Figure 1) confirm earlier results (Hostetler, et al. 1970; Bouton and Harris, 1972; Fisher, 1994) showing that tenderness is improved in pelvic suspended carcasses. Pelvic suspended young bulls had a shear force value equal to achilles suspended heifers, indicating that young bulls can reach the tenderness level of heifers.

The water holding capacity was improved with pelvic suspension compared to achilles suspension, as measured by both the purge during storage (0.59 vs 0.87%; $p=0.003$) and the cooking loss (17.7 vs 18.5%; $p=0.005$). Heifers, compared to young bulls had significantly higher purge during storage (0.93 vs 0.52%; $p=0.0008$) but lower cooking loss (17.2 vs 19.1%; $p=0.01$). There were no significant differences in thawing loss.

The traditional sensory evaluation of slices (Figure 3a) showed that the bite resistance was lower and that the tenderness of meat was improved for pelvic suspended sides compared to sides suspended from the achilles tendon for both young bulls and heifers. As seen in Figure 3a, the difference between the treatments was more pronounced for young bulls. This agrees with the results from the Warner-Bratzler measurements and with the results by Fisher (1994), where the biggest tenderising effects of pelvic suspension were observed in the bull group. For juiciness, there was no significant difference for young bulls, while the pelvic suspended heifers were somewhat juicier than the achilles suspended.

The sensory evaluation of the Warner-Bratzler strips showed that samples from heifers and young bulls of both treatments were significantly different from each other ($p<0.01$) concerning both bite resistance and tenderness (Figure 3b). The results from the evaluation of juiciness on the Warner-Bratzler strips were contradictory to the results from the traditional sensory evaluation of slices. However, the sensory panel found it difficult to judge the juiciness of the Warner-Bratzler strips.

There was a high correlation between Warner-Bratzler shear force and sensory evaluated bite resistance of the Warner-Bratzler strips $r=0.92$ ($p<0.001$) (Figure 2). The correlation between Warner-Bratzler shear force and the traditional sensory evaluation of slices on bite resistance was somewhat lower, $r=0.79$ ($p<0.001$). The sensory evaluation of the Warner-Bratzler strips and the traditional sensory evaluation of slices followed the same pattern for bite resistance and tenderness (figures 3a and 3b). It could be noted that the differences in bite resistance and tenderness between heifers and young bulls were increased when the Warner-Bratzler strips were used.

Conclusions

The results from this study show that with the use of pelvic suspension young bulls can approach the tenderness of heifers. This was clear from both the sensory and the instrumental evaluation. The results also show that it was possible to use the Warner-Bratzler strips to evaluate the sensory attributes bite resistance and tenderness.

Pertitent literature

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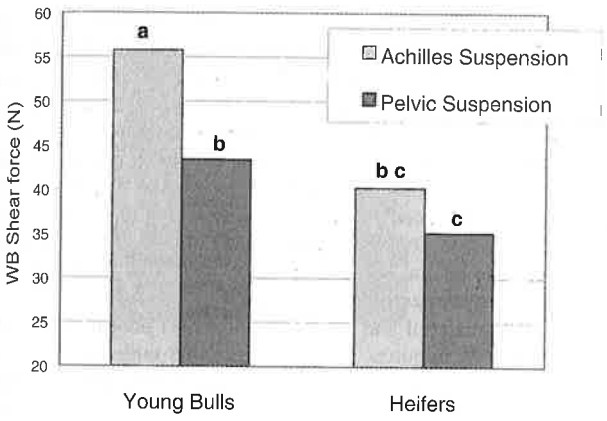


Figure 1. The effect of pelvic and achilles suspension on WB shear force in heifers and young bulls.

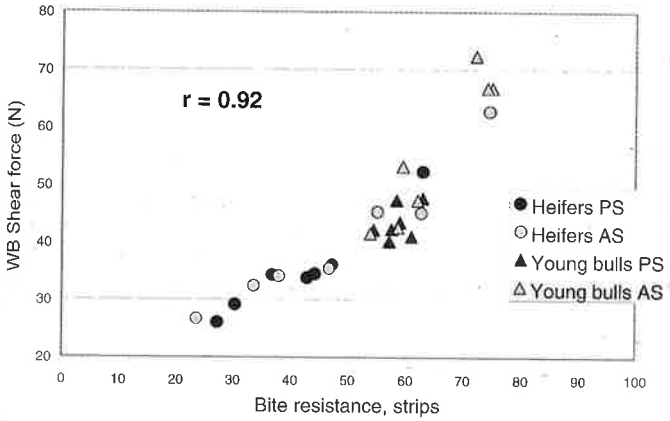
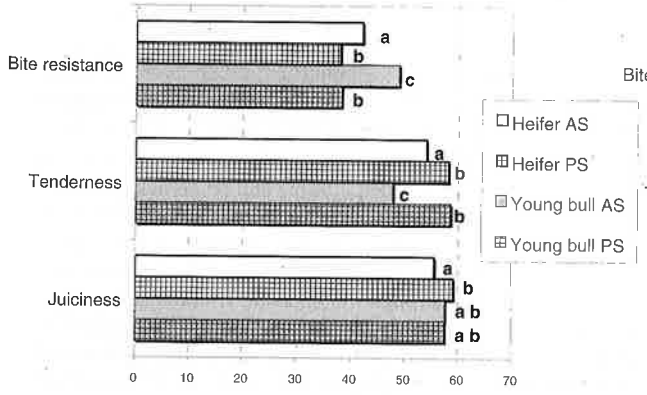
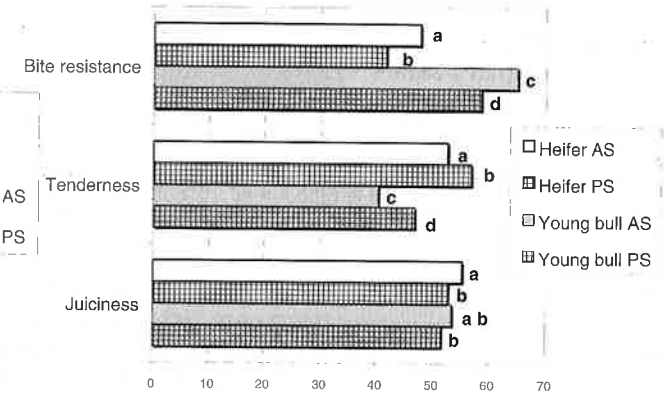


Figure 2. The relationship between WB shear force and bite resistance of sensory evaluated WB strips.



a. Traditional sensory evaluation of slices



b. Sensory evaluation of WB strips

Figure 3. The effect of pelvic and achilles suspension on bite resistance, tenderness and juiciness in heifers and young bulls, a) traditional sensory evaluation of slices; b) sensory evaluation of WB strips.

[a,b,c,d] Bars with no superscript in common differ significantly ($p<0.05$).