MECHANICAL TENDERISATION AND ENHANCEMENT IMPROVE EATING QUALITY OF BEEF FROM DAIRY COWS

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Introduction

Denmark has a significant production of beef from calves and young bulls in addition to a large production of beef from dairy cows because of the large milk production. Beef from young bulls is primarily exported to Southern Europe, while veal and beef from the dairy cows mainly is sold on the Danish market. Beef from dairy cows has a larger variation in eating quality compared to beef from heifers and steers. Both mechanical tenderising and enhancing beef have been demonstrated to improve the eating quality of beef from beef cattle (Jeremiah *et al*, 1999; Baublits *et al*., 2006), however the potential of applying the methods to beef from dairy cows have not been investigated. In this study the potential of applying mechanical tenderisation and enhancement to produce steaks from the loin and knuckle from dairy cows was investigated.

Materials and Methods

The study included 90 loins (*M. Longissimus dorsi*) and 90 knuckles from 45 dairy cows - mainly Holstein Friesian - slaughtered at the age of 54 months (± 10) in a commercial slaughter plant. After deboning the samples were vacuum packed and stored at 2°C. On day seven post mortem the loins were divided in two (the cranial and cardial end) and the knuckles were divided into *M. Vastus lateralis* and *M. Rectus femoris*. The samples had a pH mean of 5.6 and a standard deviation of 0.13 and were distributed for four treatments: 1) control (Control), 2) mechanical tenderisation using a Ross Tenderiser TC 700M (Mec), 3) enhancement by multi needle injection of 6% brine (0.6% salt and 0.3% sugar in the final product; Brine 1), and 4) enhancement by multi needle injection of 8% brine (0.6 salt, 0.4% sugar and 0.25% sodium-bicarbonate in the final product; Brine 2). The samples were cut into 2 cm steaks and packaged two and two in consumer packages. Three different packaging methods were used: 1) MA-packing in 80% O_2 and 20% N_2, 2) MA-packing in 70% N_2 and 30% CO_2 and 3) vacuum packing. The packages were stored at 2°C for seven days before the steaks were pan fried to an internal temperature of 65°C, followed by a sensory profiling of tenderness, juiciness, fried and boiled beef flavour and warmed-over flavour (WOF). Cooking method and sensory profiling as described by Clausen (2004). PROC MIXED in SAS was used to calculate least square means (LSM).

Results and Discussion

Mechanical tenderisation improved the tenderness of steaks from loin and knuckle compared to control steaks (Figure 1). The mechanically tenderised beef was slightly less juicy compared to control steaks, while the flavour was unaffected (Table 1).

Enhancement using flavour-neutral brines also improved the tenderness of steaks from loin and knuckle, and the enhanced beef was significantly more tender than the mechanically tenderised beef. Furthermore, steaks enhanced

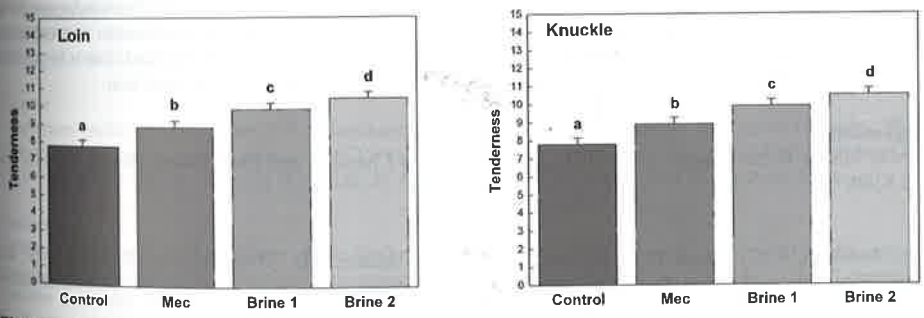

Figure 1: Tenderness in steaks of loin and knuckle, which have been mechanically tenderised (Mec), or enhanced with Brine 1 or Brine 2 and control steaks. Sensory scale from 0 (= nothing) to 15 (= very intense). LSM are shown and bars with different letters are significantly different.

Table 1: Juiciness, fried and boiled beef flavour and warmed-over flavour (WOF) in steaks of loin and knuckle, which had been mechanically tenderised or enhanced with brine. LSM are shown and rows with different letters are significantly different.

	Loin				Knuckle			
Treatment	Control	Mec	Brine 1	Brine 2	Control	Mec	Brine 1	Brine 2
Juiciness	9.4^{a}	8.8^{b}	9.9^{a}	9.9^{a}	9.4^{a}	8.3^{b}	9.9^{c}	9.1^{a}
Fried beef flavour	5.9^{a}	5.8^{a}	5.1^{b}	4.9^{b}	4.8^{ab}	5.0^{b}	4.5^{a}	4.5^{a}
Boiled beef flavour	1.5^{a}	1.6^{a}	2.3^{b}	2.2^{b}	2.0^{a}	2.2^{a}	2.4^{ab}	2.8^{b}
WOF	3.3^{a}	3.7^{ab}	4.5^{c}	3.9^{b}	3.7^{a}	3.6^{a}	4.8^{b}	4.5^{b}

* For abbreviations see Figure 1.

with Brine 2 were more tender than the steaks enhanced with Brine 1 (Figure 1). Marinating reduced the fried beef flavour, while boiled beef flavour and WOF were slightly more intense compared with the control steaks (Table 1). The changes in flavour were relatively small compared with the large positive effect of enhancement on tenderness.

Steaks from loins were generally more tender than steaks from knuckle. However, the effect of both mechanical tenderisation and enhancement was larger in steaks from knuckle compared with steaks from loin, as the tenderness improvement was 0.7 sensory units higher in steaks from knuckle compared with steaks from loin irrespectively of whether they was tenderised or enhanced.

The knuckle consists of several muscles. Prior to processing the cut was divided into *M. Vastus lateralis* and *M. Rectus femoris*, and these were distributed evenly on the four treatments. The results showed that there was a large difference in tenderness of the two muscles. The overall average tenderness in *M. Vastus lateralis* was 5.1 while it was 8.0 in *M. Rectus femoris*.

It is important to keep this difference in mind when producing steaks from the knuckle. When enhancing *M. Rectus femoris* using Brine 2, one can obtain steaks that are almost two sensory units more tender than control steaks from the loin. In contrast, steaks from *M. Vastus lateralis* enhanced with Brine 2 would still be less tender than control steaks from the loin (Figure 2).

The effect of packaging methods will not be reported here. However, there were no interaction between treatments and packaging methods.

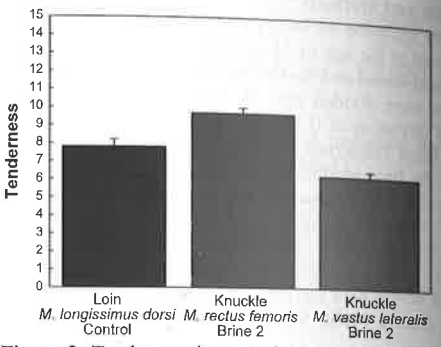

Figure 2: Tenderness in control steaks of loin and in steaks of knuckle enhanced with Brine 2 from either *M. Rectus femoris* or *M. Vastus lateralis*. Sensory scale from 0 (= nothing) to 15 (= very intense).

Conclusions

This study showed that mechanical tenderisation improved the tenderness of steaks from both loin and knuckle from dairy cows by more than one sensory unit, without affecting the flavour of the meat. Flavour-neutral enhancement by 6-8% improved tenderness to an even larger extent (> 2 sensory units), but also reduced fried beef flavour and enhanced boiled beef flavour and WOF. However, the flavour changes were small. The study also demonstrated, that it is possible to produce steaks from enhanced *M. Rectus femoris*, that are more tender than steaks from untreated loin.

Acknowledgements

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References

Baulits, R.T., Pohlman, F.W., Brown Jr., A.H., Yancey, E.J. and Johnson, Z.B. (2006). Impact of muscle type and sodium chloride concentration on the quality, sensory, and instrumental colour characteristics of solution enhanced whole-muscle beef. *Meat Science*, 72: 704-712.

Clausen, I. (2004). Sensory evaluation of beef loin steaks stored in different atmospheres. In: Proceedings of 50th ICoMST, Helsinki, Finland, pp 377-380.

Jeremiah, L.E., Gibson, L.L. and Cunningham, B. (1999). The influence of mechanical tenderisation on the palatability of certain bovine muscles. *Food Research International*, 32: 585-591.