Effects of 7 and 14 days of ageing on sensory qualities in beef *M. infraspinatus, M. longissimus dorsi* and *M. gluteus medius*

Å. Lagerstedt[1*], M. Lundesjö Ahnström[1], J. Hansson[2], L. Johansson[1], Å. Öström[2] & K. Lundström[1]

[1]Dept. of Food Science, Swedish University of Agricultural Sciences, Box 7051, SE-750 07, Uppsala, Sweden.
[2]Dept. of Restaurant and Culinary Arts, Örebro University, Sörälgsvägen 2, SE-712 60 Grythyttan, Sweden.
*E-mail: Asa.Lagerstedt@lmv.slu.se.

Abstract

Six young Aberdeen Angus bulls (age 15-18 months) from the same farm were slaughtered, with carcass weights from 266 to 353 kg, EUROP classification from R- to R+ and EUROP fatness from 3- to 3. Carcasses were cut day 3 and the muscles *Infraspinatus* (IS), *Longissimus dorsi* (LD) and *Gluteus medius* (GM) from both sides of the carcass were vacuum packaged and aged 7 or 14 days after slaughter at 4°C. After ageing the samples were frozen at -20°C. All samples were prepared in an oven (125ºC) to a final end temperature of 63°C, thereafter cut into cubes and served at room temperature. The sensory analysis was performed through profiling, by a trained sensory panel (8 persons). The samples were assessed in duplicates for the attributes bite resistance, tenderness, juiciness and flavour. IS was perceived to be the most juicy and tender cut and to have the lowest bite resistance at both day 7 and 14, whereas GM was the least tender. LD was the only muscle to obtain a lower bite resistance with ageing.

Introduction

Retail cuts from the hind quarter of the carcass are highly marketable, whereas cuts from chuck and round are sold at a lower price due to perceived or real problems with tenderness (Belew *et al*., 2003). On a carcass the chuck represents about 27 % (Paterson & Parrish, 1986). There are however muscles in the chuck that can be tender if handled in an approved manner such as the *Infraspinatus* (IS), also called flat iron steak (Von Seggern *et al*., 2005). IS has for some years been sold in USA as retail cut, mainly to restaurants. Most published studies on IS has been performed on steers and heifers. In Sweden, the slaughter mainly consists of young bulls and IS today is used for minced meat. The purpose of this study was hence to compare the sensory quality of IS with *Longissimus dorsi* (LD) and G*luteus medius* (GM) from young bulls to see if IS could be a sensorially high quality cut to be launched as a product on the Swedish market and establish what ageing time that is preferable.

Material and methods

Six young Aberdeen Angus bulls (age 15-18 months) from the same commercial farm were slaughtered. The carcass weight ranged from 266 to 353 kg and the EUROP classification varied from R- to R+, with a EUROP fatness from 3- to 3. The carcasses were kept in a chilling room at 4°C. The carcasses were cut day 3 and IS, LD and GM from both sides of the carcass were vacuum packaged and aged 7 or 14 days at 4°C, giving the two ageing treatments on the same anatomical site. GM was cut along the connective tissue band and the thinner dorsal part of GM was used in the study. After ageing the samples were frozen at -18°C until thawed in air in a refrigerator at 4°C for 36 hours until heat treatment. The meat was prepared on metal bars in an oven set at 125ºC to a core temperature of 58°C for GM and LD and to 61°C for IS due to the differences in muscle thickness, thus all samples reached the same final end temperature of 63°C. After cooking the samples were kept at room temperature for 1 hour before they were wrapped in aluminium foil and placed in a refrigerator at 4°C for 12 hours. The samples were kept at room temperature for 1 hour before the sensory assessments and served at room temperature to the panel. The meat was sliced with a cutting machine and then cut into cubes (10 x 10 x 5 mm) and served in a Petri dish with a three digit code randomly selected in the program Fizz (v. 2.10A, Biosystems for Windows) that was also used for the collection of the sensory data from the panel. The sensory attributes bite resistance, tenderness, juiciness and meat flavour intensity were judged through profiling on a scale from 1 (low intensity) to 9 (high intensity). Data were analyzed using Statistical Analysis System (version 9.1, SAS institute Inc., Cary, NC, USA). The model used for the sensory results included muscle and ageing time as a fixed effects, and animal and panellist as random effects.

Results and discussion

LD was the only muscle that received lower score for bite resistance with ageing (Table 1).

Table 1. Sensory attributes bite resistance, tenderness, juiciness and meat flavour intensity for the different muscles aged 7 or 14 days

	Infraspinatus		*Longissimus dorsi*		*Gluteus medius*	
	7 days	**14 days**	**7 days**	**14 days**	**7 days**	**14 days**
Bite resistance	2.32[a]	2.14[a]	3.16[a]	2.87[b]	3.27[a]	3.14[a]
Tenderness	7.35	7.50	6.86	7.07	6.46	6.64
Juiciness	6.62	6.72	6.35	6.46	6.31	6.31
Meat flavour int.	4.20[a]	4.12[a]	3.83[a]	4.07[b]	4.09[a]	4.15[a]

Different letters within variable and muscle indicate significant differences ($p < 0.05$) between values.

There was also a strong tendency towards improved tenderness ($p=0.059$). Scores for juiciness and tenderness for day 7 and 14 were not significantly different within muscle. IS had lower bite resistance and a higher numerical score for tenderness and was the most juicy compared with LD and GM at day 14 (Figure 1). In other sensory studies IS was found to be the second most tender muscle after *Psoas major* and more tender than both LD and GM (Shackleford *et al*., 1995; Rhee *et al*., 2004). McKeith *et al*. (1985) found overall tenderness, muscle juiciness and flavour desirability scores for IS from Angus steers to be higher numerically than LD, but the results were not significant. In the study by Paterson & Parrish (1986) IS had a higher score than LD for palatability and tenderness. Due to the location of IS on the scapula bone the muscle is not able to contract *post mortem*, leading to long sarcomeres. In the study by Rhee *et al*. (2004) sarcomere length from beef IS was found to be longer (2.25µm) than for LD (1.80µm) and GM (1.66µm). Wheeler *et al.* (2000) found that sarcomere lengths over 2.0µm increased the tenderness in pork muscles. In our study GM had the significantly lowest scores for all attributes compared with both IS and LD, even though we used the thinner dorsal part of GM that is considered to be a tender cut. Bite resistance and tenderness did not change significantly within IS from day 7 to14, meaning that an ageing period of 7 days would suffice.

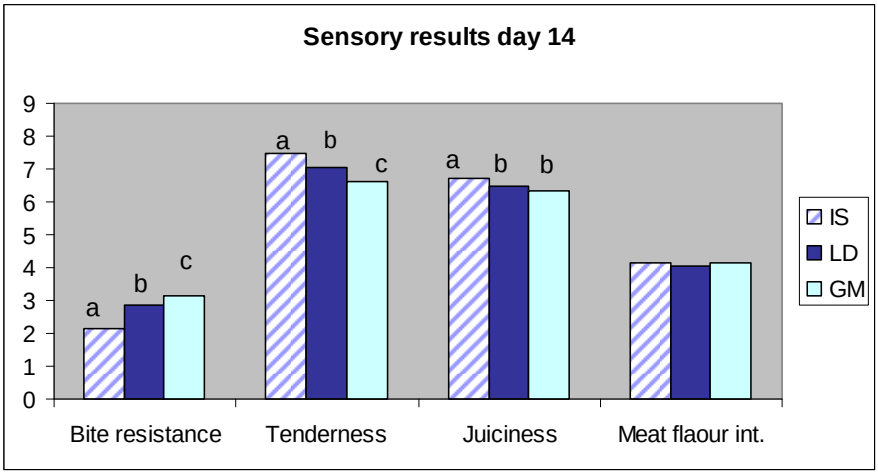

Figure 1. Sensory results for all muscles day 14, bars with different letters are significantly different ($p < 0.05$), bars without letters did not differ significantly.

Conclusion

In LD, we found significant differences in bite resistance and flavour intensity. There was also a strong tendency towards improved tenderness. IS was perceived to be the most juicy and tender cut and having the lowest bite resistance at both day 7 and 14, whereas GM was the least tender muscle in the study. An ageing period of 7 days for IS is sufficient as bite resistance was not significantly improved with 14 days of ageing. Our study shows that IS could be a high quality product for the Swedish market and if sold as such could increase the economic value of the chuck.

References

Belew, J. B., Brooks, J. C., McKenna, D. R., & Savell, J. W. 2003. Warner–Bratzler shear evaluations of 40 bovine muscles. *Meat Science*. 64, 507–512.

McKeith, F. K., DeVol, D. L., Miles, R. S., Bechtel, P.J. & Carr, T. R. 1985. Chemical and sensory properties of thirteen major beef muscles, *Journal of Food Science.* 50, 869-872.

Paterson, B. C. and Parrish, F. C., 1986.a sensory panel and chemical analysis of certain beef chuck muscles. *Journal of Food Science.* 51, 876-879.

Rhee, M. S., Wheeler, T. L., Shackelford, S. D., Koohmaraie, M. 2004. Variation in palatability and biochemical traits within and among eleven beef muscles. *Journal of Animal Science*. 82, 534-550.

Shackleford, S.D., Wheeler, T. L., & Koohmaraie, M. 1995.Relationship between shear force and trained sensory panel tenderness ratings of 10 major muscles from *Bos indicus* and *Bos taurus* cattle. *Journal of Animal Science. 73*, 3333-3340.

Von Seggern, D. D., Calkins, C. R., Johnson, D. D., Brickler, J. E., & Gwartney, B. L. 2005. Muscle profiling: Characterizing the muscles of the beef chuck and round. *Meat Science*. 71, 39–51.

Wheeler, T. L., S. D. Shackelford, and M. Koohmaraie. 2000. Variation in proteolysis, sarcomere length, collagen content, and tendernessamong major pork muscles. *Journal of Animal Science*. 78, 958–965.