DOES FREEZING POSITIVELY OR NEGATIVELY AFFECT SHEAR FORCE AND SENSORY QUALITY IN BEEF?

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Introduction

The eating satisfaction of beef is due to a combination of tenderness, juiciness and flavour (Koohmaraie, 2002), yet the most important quality aspect for many consumers is tenderness (Koohmaraie, 1994). Consumers prefer meat that has not been frozen. This means that the industry and the retailers supply the market with fresh meat, which has not first been frozen and then thawed. However, most research studies evaluating meat tenderness and shear force are done on aged meat that has, until heat treatment, been frozen. When meat is frozen the cell membranes are damaged, which results in a lower water holding capacity and a higher cooking loss, and consequently, less juicy meat. It has been found that the freezing can positively affect shear force for beef *longissimus dorsi* (LD) (Enfält *et al.,* 2004). Meat that was tenderized for 7 days and then frozen and thawed had the same shear force values as LD that was tenderized for 21 days. Similar results have been found by Shanks *et al.,* (2002). The aim of this study was to find whether shear force values, cooking losses and sensory qualities differ between fresh and frozen meat judged by both consumers and a sensory panel.

Materials and Methods

Nine young bulls of the Swedish Holstein breed, 13-17 months of age (average 15.5 months), were slaughtered at a commercial slaughter plant. All animals came from the same farm and were fed the same feed. They were graded as O to O- (average O) with a fat content of 2+ to 3 (average 2+) according to the EUROP scale and had a slaughter weight of 289.9-311.6 (average 302.6 kg). Both LD muscles from each animal were used. The pH was measured 48 h post mortem. Both LD muscles were cut in 4 pieces (8 samples per animal) for shear force and sensory analysis. The pieces were weighed, randomized within animal and vacuum packed and stored at 4°C for 2, 7 or 14 days, day 0 being the day of slaughter. At each of those times one sample from each animal was either cooked to measure shear force or frozen at -20°C for cooking later. The frozen pieces were thawed for 24 h at 4°C before heat treatment. All samples were heat treated in a 70°C water bath for 2 h. After heat treatment the pieces were cooled in a water bath with running cold water for 30 min and then stored at 4°C until next day before being analyzed. Shear force was measured with a Warner-Bratzler shear force instrument (WB). Sensory analyses were performed with a sensory panel and a consumer test. The meat for the sensory testing was wrapped in aluminium foil and heat treated in an oven at 150°C, until a final temperature of 69°C. The meat was stored at 4°C until next day and cut in 3-mm-thick slices. The meat had room temperature at testing. Parameters judged by the 8 panellists were tenderness, juiciness and meat taste. The scale used for the panel test was 1-10 (1 very low, 10 very high). For the consumer test 140 consumers had to choose whether they preferred the fresh or the frozen sample (from the same animal). Cooking and purge or thawing losses were measured on samples after 7 days of ageing. The combined losses (purge, thaw and cooking) were measured for samples day 2, 7 and 14. Data were analyzed using the mixed procedure in Statistical Analysis System (version 9.1, SAS institute Inc., Cary, NC, USA). The model used for shear force and losses included the fixed effects of aging time, treatment (fresh or frozen), their interaction, and animal as a random effect. For the sensory results the model included treatment as a fixed effect, and animal and panellist as random effects.

Results and Discussion

Both ageing and freezing influenced shear force values. As expected shear force values declined with longer ageing time ($p< 0.0001$) in agreement with results by e.g. Monsón *et al.*, (2004). The frozen samples had significantly ($p=0.005$) lower shear force values compared to the fresh samples (LSM 49.1 and 56.4, respectively). Meat aged for 2 days and then frozen had the same shear force value as unfrozen meat that had been aged for 7 days (Table 1), which agrees with results by Shanks *et al.*, (2002) and Enfält *et al.*, (2004). The fresh meat had improved sensory qualities, as shown by higher meat taste, juiciness and tenderness. The consumer test showed no significant differences between the fresh and frozen meat ($p=0.25$). Water loss was higher in the frozen meat on all testing occasions except at 14 days (Table 2).

Table 1: Shear force (N), (LSM) in fresh and frozen meat after 2, 7 or 14 days of ageing.

	Treatment		Levels of significance		
	Fresh	Frozen	Treatm.	Day	T*D
Day					
2	68[a]	58[b]			
7	58[bc]	51[cd]			
14	43[d]	38[e]			
Overall	56	49	0.005	0.001	0.634

Different letters indicate significant differences ($p<0.05$) between values.

Table 2: Water Loss (LSM) in fresh and frozen meat after 2, 7 or 14 days of ageing.

	Treatment	
	Fresh	Frozen
Sensory test, 7 days		
Thawing/purge loss	2.5[a]	4.2[b]
Cooking loss	27.3[a]	32.2[b]
Combined loss, WB		
day 2	16.7[a]	22.1[b]
day 7	23.9[a]	29.4[b]
day 14	20.0	23.8

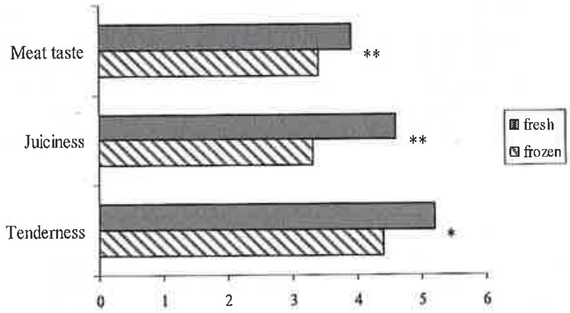

Figure 1: Sensory quality (LSM) in fresh and frozen LD; *($p<0.05$), **($p<0.01$), ***($p<0.001$).

Conclusions

Meat that was frozen and then thawed is more tender according to shear force measurements but is not perceived as more tender by the sensory panel. On the contrary, they experience the fresh meat to be more tender, juicy and having more meat flavour. It might be that meat flavour and juiciness influence the overall sensory impression, leading to the perception of a higher tenderness in fresh meat in comparison with frozen. The panellist's perception that the fresh meat was juicier concurred with the water loss results.

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