RELATIONSHIPS BETWEEN INSTRUMENTAL AND SENSORY DATA OF BEEF FROM ACHILLES- AND PELVIC SUSPENDED CARCASSES

Maria Lundesjö Ahnström*[1], Lisbeth Johansson[1], Melvin C. Hunt[2] & Kerstin Lundström[1]

[1]*Department of Food Science, P. O. Box 7051, SE-750 07 Uppsala, Swedish University of Agricultural Science*
[2]*Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS 66506 USA*

Maria.Lundesjo.Ahnstrom@lmv.slu.se

Keywords: Beef, Heifer, Shear force, Compression, Sensory analysis

Introduction

Correlations between sensory evaluation and objective measures of meat tenderness have shown to vary considerably. The strength of these correlations seem to vary depending on gender (Peachey et al. 2002). It would therefore be of interest to see if the correlations also depend on the within-animal variation. In earlier studies we have shown that pelvic suspension significantly reduced within-animal variation in Warner-Bratzler peak force measurements (Lundesjö Ahnström et al. 2006), but no further investigations on different instrumental measurements of tenderness was performed.

The aim of this study was to investigate the relationships between different instrumental measurements and sensory tenderness for *M. longissimus dorsi* muscle with low and high within-animal variation. This difference in variation was produced by comparing companion sides of Achilles- and pelvic-suspended carcasses.

Materials and methods

Angus heifers (n=20) were slaughtered at 18 months of age. Carcasses were electrically stimulated (low voltage, 30 s) 30 min after exsanguination. The left side from each carcass was hung by the obturator foramen of the pelvic bone while the right side was suspended by its Achilles tendon. Carcasses were chilled at +2 to +4 °C for 48 h. The whole *M. longissimus dorsi* from both sides was removed, vacuum-packed and aged for 7 days at +4 °C. Steaks for sensory (20 cm) and instrumental tenderness (10 cm) evaluations were removed and aged for another 7 days before being frozen. A Stable Micro System Texture Analyser HD 100 (Godalning, UK) was used to determine shear and texture parameters (Table 1) following the procedure of Honikel (1998). A trained sensory panel performed a descriptive sensory analysis where the attributes (Table 1) were judged on an intensity scale from 0 to 100. Statistical evaluation was performed using the Procedure Mixed in SAS (Version 9.1, SAS Institute Inc., Cary, NC, USA). The statistical model included suspension method as a fixed factor and animal as a random factor. In addition, the effect of panel member also was included as a random factor for the sensory traits.

Table 1. Shear and textural variables for shear, compression and sensory analysis

Shear variables	
Shear Force (N)	Maximum peak force
Total Energy (Nmm)	The area under the curve
Shear Firmness (N/mm)	The slope of a line drawn from the origin of the curve to its peak
Double Compression variables	
Hardness (N)	Peak of first compression curve
Springiness (mm)	Width of the second curve
Cohesiveness	The ratio of the area under the second curve to the area under the first curve
Gumminess	Hardness × Cohesiveness
Sensory Variables	
Tenderness	Overall tenderness judged after chewing 8 times
Bite resistance	Force needed to bite through a slice of meat

Results and Discussion

Significant differences between Achilles- and pelvic-suspended sides were found for all traits except shear firmness (Table 2). Pelvic suspension lowered values for longissimus shear force (20%), hardness (10%) and bite resistance (37%) and increased the values for tenderness (27%) compared to muscle from Achilles-suspended sides. Pelvic suspension also significantly decreased the within-animal variation for shear force and bite resistance while the within variations were similar for the compression traits.

Shear force, total energy and shear firmness from Achilles-suspended sides were all correlated to sensory tenderness. Springiness was the only compression-type variable that was significantly correlated to sensory tenderness. This confirms the results from Brady and Hunecke (1985) who also showed poor correlations between compression traits and sensory tenderness. But it is contradictory to Toscas *et al.* (1999), who claimed compression to be the best predictor of tenderness. For the pelvic-suspended sides no instrumental tenderness measurements were correlated to sensory tenderness. This is likely due their higher level of tenderness and lower variation within these samples.

Table 2. LS-means and coefficients of variation for measurements of tenderness of longissimus steaks from Achilles- and pelvic suspended sides and sensory tenderness correlations to the other traits

	Means			Coefficient of variation			Correlation to tenderness			
	Achilles	Pelvic	*P* -value	Achilles	Pelvic	*P* -value	Achilles	*P* -value	Pelvic	*P* -value
Shear force	36.1	28.7	**0.007**	21.2	13.2	**0.003**	-0.46	**0.040**	0.02	0.933
Total energy	193.7	152.4	**0.001**	19.5	15.5	0.080	-0.45	**0.049**	0.15	0.526
Shear firmness	4.7	4.4	0.369	23.2	21.9	0.552	-0.48	**0.031**	-0.06	0.821
Hardness	93.7	84.4	**0.001**	13.4	11.6	0.198	-0.21	0.369	0.10	0.708
Springiness	1.3	1.2	**0.015**	26.3	26.4	0.965	-0.50	**0.024**	-0.16	0.493
Cohesiveness	11.0	9.4	**0.001**	17.5	16.1	0.209	-0.17	0.464	-0.19	0.433
Gumminess	1053.0	800.2	**0.001**	25.2	22.3	0.107	-0.23	0.323	-0.08	0.743
Bite resistance	45.7	29.0	**0.001**	16.6	11.3	**0.002**	-0.93	**0.001**	-0.93	**0.001**
Tenderness	49.6	67.9	**0.001**	29.2	32.5	0.232	-	-	-	-

For the Achilles-suspended sides, it was interesting that hardness correlated well to marbling (r= -0.51 *P*=0.02) and fat class (r = -0.59, *P*=0.006, data not shown). These traits were not correlated to any of the shear tests and the results indicate that compression more than shear force is influenced by marbling.

In this study the possibilities to predict sensory tenderness by instrumental measurements were low, especially for pelvic-suspended sides. For Achilles suspended sides, the shear tests showed a higher correlation to sensory tenderness compared to most of the compression measurements.

Conclusions

Strength or lack of strength of correlations between instrumental measures of tenderness and sensory tenderness should be tenured with caution. The amount of variation between post-mortem treatments of the same animal's carcass may significantly alter correlation strength and direction. This analysis clearly shows that larger within-muscle variation will more clearly differentiate instrumental variables that are more strongly related to sensory analyses.

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