THE RELATIONSHIP BETWEEN CONSUMER SCORES, TRAINED TASTE PANEL SCORES AND OBJECTIVE MEASUREMENTS OF TENDERNESS

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Background

The relationship between sensory evaluation and objective measurement of meat tenderness is influenced by a variety of factors. Bouton et al (1975) demonstrated that over 75% of the variation in tenderness, as assessed by a trained taste panel, could be explained using Warner Bratzler shear values, compression values and cooking loss measurements. Shackelford (1995) showed that the strength of the relationship between sensory panel scores of overall tenderness and shear force measurements varied widely with different muscles (R^2=0.00 for *M. gluteus medius* to R^2 =0.73 for *M. longissimus thoracis et lumborum*). Such differences are indicative of the weaker relationship between tenderness in high connective tissue muscles and objective measurement of tenderness by devices which primarily measure myofibrillar toughness (e.g. shear force). Any post slaughter treatment which alters the relative contribution of the myofibrillar and connective tissue component to the toughness of muscle may also affect this relationship, though not necessarily that between assessment by trained taste panel and untrained consumers.

Objective

To determine the ability of laboratory measurements and trained taste panel assessment of tenderness to predict consumer assessment of tenderness for beef subjected to post-slaughter electrical stimulation and ageing treatments.

Methods

As part of a larger study, one side from each of 120 beef carcasses was electrically stimulated (high voltage, 1100 volts peak, 14.3 pulses/sec, 55 seconds duration) and striploins (*M. longissimus thoracis et lumborum)* from both sides were collected after 24 hours chilling. Striploins were halved and vacuum packed, with one half frozen (-20°C) on day one and the other,after 30 days ageing at 2°C. Caudal and cranial halves were assigned alternately to the two ageing treatments. This provided a complete block design with 480 cells (120 animals*2 stimulation*2 ageing treatments).

Consumer assessment. Two 22mm thick steaks were cut from each of the frozen samples using a bandsaw and then thawed at 5°C for 48 hours prior to cooking. Steaks were trimmed of epyimysium to a weight of 125g and pH recorded prior to cooking in a waterbath at 80°C for 10 minutes to achieve a medium degree of doneness. Six cubes (1.5cm^3) were cut from the centre of each steak and stored at 1°C overnight prior to tastings. Steaks and cubes were randomised across consumers, such that each consumer received a unique combination of six samples to maximise linkages between tasters. A total of 5,760 cubes were evaluated using 680 untrained consumers. Each consumer tasted six cubes per session, assessing tenderness on a 10cm line scale anchored by the words extremely tough and extremely tender. Means tenderness scores were obtained for each of the 480 cells using the mixed model procedure in SAS, adjusted for cell, order (fixed effects) and taster (random effect).

Taste panel A trained taste panel assessed a subset of 188 of the samples (47 animals*2 stimulation treatments * 2 ageing treatments). Steaks were prepared, cooked and presented for assessment as for consumer evaluation. Means for each of the 188 cells were obtained as described for consumer scores.

Objective measurement. Peak force and compression were measured on all samples as described by Bouton *et al.* (1971).

Prediction of consumer scores. Consumer taste panel scores were predicted using a model which contained fixed effects for ageing and stimulation and covariates for pH, peak force and compression measurements and all significant first order interactions, using all 480 cells. The model was re-run within stimulation and ageing treatments. A similar procedure was used to predict consumer scores from trained taste panel scores, within stimulation and ageing treatments.

Results and Discussion

For the full data set (480 cells) pH, compression, peak force and (peak force)^2 gave a good prediction of consumer scores (R^2=0.63, RSD=9.3), with all terms adding significantly to the prediction. There was an interaction between compression and ageing treatment (P<0.001), and between stimulation and ageing treatments (P<0.001). When the prediction models were run within stimulation and ageing sub-groups, the R^2 decreased (Table 1) due to the decrease in variation of scores within each sub-group, but there was little change in the RSD and therefore the accuracy of prediction. The relationship between consumer tenderness scores and peak force was negative (P<0.0 1) and curvilinear, with the rate of change in tenderness as scored by the consumer decreasing at the higher (tougher) peak force measurements, particularly in meat that had not been aged (Table 1). The relationship between consumer scores and compression measurements was affected by ageing, with a higher negative relationship in the aged than non-aged product (Table 1). Figure 1 shows that predicted consumer scores (adjusted for differences in peak force and pH) for meat with low compression values were higher in aged product than in non-aged product. . The discrepancy between consumer scores and compression values in tender aged versus tender non-aged striploin, a low connective tissue muscle, suggests that some other factor is influencing the consumer scores in this product. The change in relative contribution of peak force and compression to the prediction of consumer scores in aged meat compared to non-aged meat is consistent with the dogma that the myofibrillar contribution to toughness (measured by peak force) is the dominant factor in non-aged low connective muscle. In meat that was aged for 30 days, the myofibrillar variation in toughness would be expected to decline, whereas the connective tissue component (indicated by compression values) would increase in relative importance (Shorthose and Harris, 1991).

The relationship between actual consumer scores and scores given by the trained taste panel is shown in Figure 2. When using trained taste panel scores to predict consumer scores for tenderness, the regression coefficient for all subgroups was *ca.* 0.7 (Table 2). This indicates that a one unit increase in a trained taste panel score was equivalent to 0.7 units for the consumer panel, suggesting that the trained panellists used more of the 100 point scale relative to the consumer panel. This was most likely a function of the training procedures used for trained panellists. The stability of the regression coefficients relating trained taste panel scores to consumer tenderness scores, regardless of the markedly different tenderness between treatments, suggests that the relationship between the two scores was robust. The accuracy of predicting consumer panel from trained taste panel scores was similar in all stimulation by ageing sub-groups (Table 2).

Conclusion

Scores given by a trained taste panel form the basis for a robust prediction of consumer assessment of meat from various post slaughter treatments. The most appropriate objective measurements for the prediction of consumer scores, however, will vary with post slaughter treatment, and the consequent relative contribution to toughness of the myofibrillar and connective tissue components.

Pertinent literature

Bouton, P.E., P.V. Harris and W.R. Shorthose. 1971. *J. Food Science.* **36**:435.
Bouton, P.E., A.L. Ford, P.V. Harris and D. Ratcliff. 1975. J *Texture Stud.* **6**: 315.
Shackelford S.D., T.L. Wheeler and M. Koohmaraie. 1995. *J Anim. Sci.* **73**:3333.
Shorthose, W.R. and P.V. Harris. 1991. In "Growth Regulation in Farm Animals", *Advances In Meat Research,* **7**: 515.

Table 1 Prediction of consumer tenderness scores from objective laboratory measurements. The regression equation was calculated for stimulation and ageing sub-groups. Regression coefficients ± s.e., coefficient of determination (R^2) and residual standard deviation (RSD) are presented.

	Non stimulated Non aged		Non stimulated Aged		Stimulated Non Aged		Stimulated Aged	
Number	120		120		120		120	
Mean score	37.8		53.8		56.9		64.2	
Intercept	-18.8	±46.3	5.20	±75.3	66.94	±49.7	84.91	±19.7
pH	19.69	±8.14	18.94	±12.87	5.21	±8.80	3.18	±3.21
Compression	-7.99	±3.24	**-17.12**	±4.41	-8.16#	±4.25	**-17.94**	±3.54
Peak force	**-5.03**	±1.48	-3.25	±2.25	**-5.53**	±1.88	-0.986	±2.60
(Peak force)^2	**0.134**	±0.07	0.06	±0.13	0.203#	±0.11	.112	±0.20
R^2	0.49		0.44		0.27		0.40	
RSD	8.89		10.7		10.13		7.42	

Coefficients in bold type are significant at P<0.05, (#, P=0.06)

Table 2. Prediction of consumer tenderness scores from trained taste panel scores. . The regression equation was calculated for stimulation and ageing sub-groups. Regression coefficients ± s.e., coefficient of determination (R^2) and residual standard deviation (RSD) are presented

	Non-stimulated Non-aged		Non-stimulated Aged		Stimulated Non-aged		Stimulated Aged	
Number	47		47		47		47	
Intercept	12.66	± 3.22	9.97	± 4.97	18.22	± 5.91	17.01	±6.47
Trained taste panel score	**0.65**	± 0.08	**0.79**	± 0.09	**0.67**	±0.10	**0.68**	± 0.09
R^2	0.59		0.62		0.49		0.53	
RSD	8.06		8.93		9.21		7.32	

Coefficients in bold are significant at P<0.001

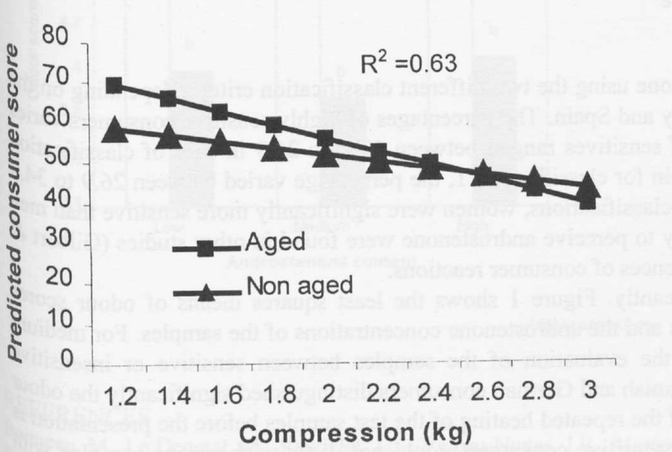

Figure 1. The relationship between predicted consumer tenderness scores and compression values (kg)

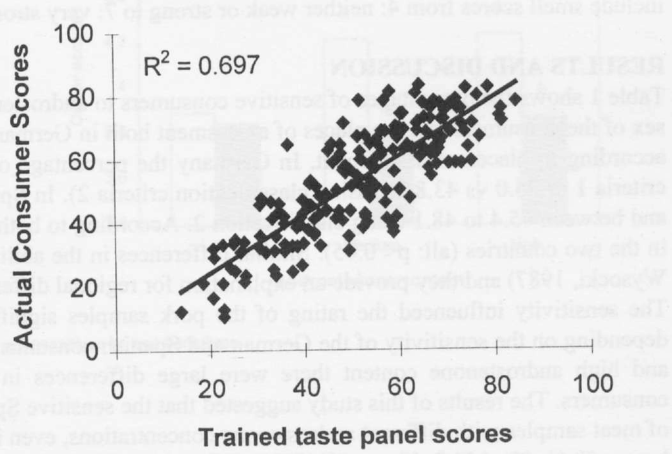

Figure 2. The relationship between actual consumer tenderness scores and scores from the trained taste panel