Associations of objective physical measurements of beef meat samples and tenderness assessed by a trained taste panel

D W Ross[1], R I Richardson[2], E A Navajas[1], N Prieto[1], J J Hyslop[1], D Marriott[2], G Simm[1], R Roehe[1]
[1]SAC, Edinburgh, United Kingdom, [2]University of Bristol, Langford, United Kingdom
Email: dave.ross@sac.ac.uk

Introduction Meat tenderness is the single most important quality attribute in consumer acceptance studies of meat eating quality. Several mechanical-based techniques have been developed to provide an objective measure of meat tenderness that have good correlation with sensory tenderness, as assessed by trained taste panel. The classic Warner-Bratzler shear force technique (WBSF) has shown correlations with sensory tenderness in the range of -0.39 to -0.77 (Van Oeckel *et al*., 1999; Shackelford *et al*., 1999a**)**, whilst the Volodkevitch bite test attempts to imitate the incisor biting action by a compression method. A rapid slice shear force (SSF) test, which uses only one steak and hot meat (significant benefits in a commercial environment), had a stronger correlation with taste panel tenderness scores than WBSF (Shackelford *et al*., 1999b). The Meat Industry Research Institute of New Zealand (MIRINZ) test results, transformed into categories, was highly correlated (-0.97) with sensory tenderness (Bickerstaffe *et al*., 2001). The objective of this study was to evaluate the associations between objective physical measures (SSF, MIRINZ and Volodkevitch) and taste panel tenderness scores in beef.

Materials and methods Meat samples of 150 animals, 41 crossbred Aberdeen Angus (AAx) and 43 crossbred Limousin (LIMx) steers, and 32 and 34 crossbred AAx and LIMx heifers were used. One hundred animals were sourced from SAC farms and 50 selected from commercial farms. The M. *longissimus thoracis et lumborum* was sampled from the left side of the carcass at 48 hours post-mortem (pm), dissected into the 11th and 12th ribs cut, a 13th rib cut and the remaining lumbar cut. The SSF test was applied to 3 day aged fresh meat from the 13th rib cut, all other tests were carried out on prior frozen meat. The residue of 13th rib cut was used for the MIRINZ test, in which samples were heated in a water bath to 75 ºC and 10 sub-samples of 10 mm by 10 mm cross-section orthogonal to muscle fibre orientation were analysed according to MIRINZ tenderometer protocol. Meat from the 11-12th rib cut was aged at 2ºC for 14 days pm and subsequently used for trained taste panel assessment (cooked to a centre temperature of 74ºC). The Volodkevitch test was applied to the first 100 mm of the cranial end of the lumbar cut after 10 days ageing. For the Volodkevitch test, a 75mm section of muscle was cooked in an 80ºC water bath to a centre temperature of 78ºC and 10 blocks cut as for the MIRINZ test protocol. Subsequently, a 25 mm section of the lumbar cut was taken for SSF test on 14 day aged meat. SSF tests were carried out according to the protocol described by Shackelford *et al*. (1999b) with the exception that samples were cooked in a clam-shell grill to a centre cooking temperature of 71ºC. Descriptive statistics and Pearson correlations were obtained using Genstat 8.1 and statistical tests of correlations between each test and taste panel were conducted according to Russo (2003).

Results Descriptive statistics and Pearson correlations between objective physical measurements of beef meat samples and sensory tenderness are presented as a correlation matrix in Table 1. Mean SSF at 3 and 14 days pm showed the expected increase in tenderness with increasing maturity of meat. The 3 day SSF and MIRINZ measures showed higher correlations with taste panel tenderness scores but only 3 day SSF was significantly different from Volodkevitch and SSF 14 day results, but not from MIRINZ test. The MIRINZ correlation was not significantly different from either Volodkevitch or SSF 14 day tests. Correlation coefficients of Volodkevitch and 14 day SSF measures are towards the lower level published in the literature.

Table 1 Means, standard deviations (SD), coefficients of variation (CV) and correlations of mechanical and sensory tenderness measurements (units are in Newtons, N, apart from category panel scores which range 1-8)

	Descriptive statistic				Correlation.(r) *			
Test	n	Mean	SD	CV(%)	r (taste)**	r (Volod)	r (MIRINZ)	r (SSF 14)
SSF 3 day PM (N)	150	188.1	70.3	37.4	-0.60^{a}	0.49	0.69	0.50
SSF 14 day PM (N)	150	124.7	32.8	26.3	-0.47^{b}	0.52	0.41	
MIRINZ (N)	131	60.6	23.7	39.1	-0.58^{ab}	0.37		
Volodkevitch (N)	150	50.4	14.2	28.3	-0.47^{b}			
Taste panel texture	150	4.8	0.73	15.3				

* All correlation coefficients were significantly different from zero (P<0.001)
** Correlation coefficients with different superscripts are significantly different (P<0.05)

Conclusion The earlier SSF carried out at 3 days pm resulted in a higher association with sensory tenderness than with either of the tests on aged samples. Therefore, SSF measurements recorded early after slaughtering can be used to estimate tenderness of matured meat assessed by a taste panel.

Acknowledgements We thank SG RERAD for funding and Scotbeef, MLC Signet Breeding Services and QMS for support.

References

Bickerstaffe, R., Bekhit, A.E.D., Robertson L.J., Roberts, N. and Geesink, G.H. 2001. Meat Science 59, 303-315.
Shackelford, S.D., Wheeler, T.L. and Koohmaraie, M. 1999a. Journal of Animal Science 77, 2693–2699.
Shackelford, S.D., Wheeler, T.L. and Koohmaraie, M. 1999b. Journal of Animal Science 77, 1474–1481.
Van Oeckel, M.J., Warnants, N. and Boucque, C.V. 1999. Meat Science 53, 259-267.
Russo. 2003. Statistics for the Behavioural Sciences, Psychology Press