How well do pH, colour and shear force predict eating quality of beef evaluated by untrained consumers?

I. J. Lean[A,E], G. Tarr[B], R. Polkinghorne[C,D] and J. Thompson[D]

[A]S*cibus*, Camden, NSW 2570 Australia
[B]School of Mathematics and Statistics, The University of Sydney, Sydney, NSW 2006 Australia
[C]Birkenwood Pty. Ltd, Murrurundi, NSW 2338 Australia
[D]School of Environmental and Rural Science, University of New England, Armidale, NSW 2350 Australia
[E]Email: ianl@scibus.com.au

Meat quality assessed by consumer panels is the basis of the Meat Standards Australia (MSA) evaluation system. We assessed the merit of ultimate pH (UpH), colour, and shear force in predicting a composite consumer sensory score (MQ4), and detection of high-quality (HQ, defined as MQ4 >64) or low-quality (LQ, defined as MQ4 <46.5) beef. The MQ4 measures consumer's acceptability of cooked beef based on four major characteristics that rate a satisfying beef-eating experience: tenderness, juiciness, flavour, and overall 'liking'. We hypothesised that UpH, colour and shear force would not significantly improve the prediction of the root mean square error (RMSE) for MQ4, nor predictive values for HQ or LQ beef when UpH, colour, and shear force were separately added to basal predictive models for those eating quality outcomes.

We extracted 4,166 observations of grilled striploins from 103 studies from the Meat Standards Australia (MSA) database. Studies include striploin eating quality, >18 carcasses per treatment, the estimated proportion of *Bos indicus,* sex of cattle (female or steer), and whether hormonal growth implants were applied during backgrounding or finishing. Both linear-mixed and logistic regression models were developed using Stata (Version 15, StataCorp, Tx) or R (R Core Team, 2019). The following effects were included *a priori* on the basis that these were used in the current MSA model; an interaction between carcass weight and ossification, hormonal growth promotant (yes or no), sex (steer or heifer), marbling (100-620), ossification scores (100-500), hump height (mm), carcass weight (kg dressed weight), ribfat depth (cm), and days that the meat was aged (7 or 14 d). Test variables, that is, ultimate pH (UpH) and UpH dichotomised (UpHD; 0 to 5.7 and >5.7), meat colour (1-7, light to dark) and shear force (kg) were tested with the *a priori* effects to determine whether test variables to the base model were significant when added to the base model and, more critically, whether these improved predictions of MQ4 in LQ or HQ beef.

Effects of UpH and UpHD (0 to 5.7 and >5.7) were significant for MQ4 and LQ ($P<0.05$), but not HQ beef ($P>0.30$). Meat colour (1-7, light to dark) was not significant for MQ4, LQ or HQ ($P>0.05$). Neither UpH measure, nor colour improved the root mean square error (RMSE) for MQ4 or sensitivity or specificity of LQ or HQ. Shear force (kg) was significant for MQ4, LQ, and HQ and improved RMSE ~6% and sensitivity of LQ or HQ detection by 4% (Table 1).

Shear force may not be readily related to consumer evaluations of tenderness (Van Wezemael et al., 2014) and is not a carcass-side test. However, innovations in implementation of shear slice testing methods provide the potential for practical application of this test (Shackleford et al., 1999).

The lack of merit in colour and UpH tests raises questions to the value of measuring these to predict eating quality. The difference between significance and predictive values of UpH, significant for MQ4 and LQ but which did not improve prediction for these is clear. While benefit was observed for shear force measures, measurement of this trait in a practical setting is a challenge. Further methods for evaluation of meat quality are needed.

Table 1. The RMSE for MQ4, sensitivity, and specificity for LQ and HQ steaks for baseline models and models containing UpH or UpHD or colour or shear force.

Measure	Baseline Model	UpH	UpHD	Colour	Shear Force
RMSE	10.3	10.3	10.3	10.3	9.67
Sensitivity LQ	0.554	0.556	0.556	0.552	0.605
Specificity LQ	0.833	0.833	0.833	0.833	0.854
Sensitivity HQ	0.428	0.430	0.438	0.428	0.471
Specificity HQ	0.956	0.956	0.956	0.957	0.956

References

Shackelford SD, Wheeler TL and Koohmaraie M (1999) *Journal of Animal Science*. **77**, 2693-2699.
Van Wezemael L, De Smet S, Ueland Ø and Verbeke W (2014) *Meat Science*. **97**, 310-315.

Thanks to Meat and Livestock Australia for support for this work