TOWARDS BENCHMARKING BEEF LOIN STEAK COLOUR ACCEPTABILITY USING MINOLTA AND HUNTER COLORIMETERS

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Background

The importance of colour in meat merchandising is well recognised. Among the issues currently being faced by the meat industry particularly in meat export oriented countries are: the reduced colour display life of meat with extended aging/storage, the demand by retailers for supplier assurance of colour display life, and the lack of methods to determine the colour display life of meat early post-mortem. For any of these issues to be fully resolved, a standard instrumentally measurable benchmark colour for consumer acceptability of meat on display is needed. The benchmark should be established using commonly used instruments for meat colour determination such as Hunter and Minolta colorimeters. This study determined the consumer acceptability of beef steak using these two colorimeters and used the data to suggest benchmark colorimeter values for the consumer acceptability of beef loin steaks.

Methods

Longissimus dorsi et lumborum (LDL) from 12 heifers were hot boned and allowed to enter rigor at 15ºC for 24 h. Two centimetre thick steaks were cut from each loin sample; tray overwrapped and allowed to bloom for 3 h, then displayed in a simulated retail cabinet (4ºC) and assessed daily by an in-house consumer panel for 6 days. Fifty panellist, some of whom participated on all the 6 days assessed the colour acceptability of the steaks on a 9-point scale (1 = like extremely; 9 = dislike intensely) and indicated their willingness to buy the steaks by ticking one of three questions [yes, I would by this steak (1), may be (2) or no I wont buy this steak (3)]. Immediately after the subjective colour assessment, the steaks colour were measured instrumentally using Hunter Lab Miniscan and Minolta Colorimeter as described in Farouk and Swan (1998) and Farouk and Lovatt (2000) respectively. At another date, LDL muscles from 4 heifers with varying ultimate pH's – to obtain meat with a range of display colours – were sourced from the same supplier as the first LDL's at 24 h post-mortem to coincide with a yearly 4-day Agricultural Field-days. Two 2-cm thick steaks (one each for morning and afternoon sessions) were cut from each LDL on the morning of each field-day, tray overwrapped, allowed to bloom for 3 h and assessed by field-day participants who were attracted to our booth by the wafting aroma of a spiced beef roasting on a rotisserie. A total of 506 Field-day participants expressed their willingness to buy the steaks using the same questionnaire as the ones used in the in-house panel. Colour of each steak was measured using the Minolta Colorimeter before the field-day panel assessment and immediately after assessment by each assessor. Regression analyses were done using Genstat (2005) statistical software package. A Bayesian smoothing technique (Upsdell, 1994) was used to estimate the splines and their 95% confidence intervals. The R^2 quoted was calculated as 1-residual variance/total variance. The correlations quoted were the standard Pearson correlations.

Results and discussion

CIE L*, a* and b* were the parameters determined with the Hunter and Minolta colorimeters from the in-house steaks and from these values hue angle and chroma were calculated. L* and chroma were higher and a*, b* and hue angle were lower when colour were measured using Minolta colorimeter relative to Hunter (Table 1).

Table 1. Mean in-house steaks colour measured across storage using Minolta and Hunter colorimeters

Colorimeter	Beef steak colour attributes				
	L*, lightness	a*, redness	b*, yellowness	Hue angle (º)	Chroma
Minolta	42.2 ± 2.5	15.9 ± 5.0	7.1 ± 1.9	24.3 ± 2.4	17.4 ± 5.3
Hunter	35.1 ± 2.6	17.0 ± 2.6	14.6 ± 1.9	40.7 ± 4.0	22.5 ± 2.9

The Hunter b* values were twice that from Minolta resulting in higher hue angle (brownness) from Hunter colorimeter. Brewer et al. (2006) reported similar findings in pork. The % of in-house panellists willing to buy beef loin steaks purely on the steaks colour increased with the decrease in Hunter ($r = -0.83$, $P < 0.01$) and Minolta ($r = - 0.74$; $P < 0.01$) hue angles respectively. There was a significant correlation between Hunter and Minolta hue angles ($r = + 0.8$; $P < 0.001$; ***Hunter Hue =1.36*Minolta Hue + 7.26***). Because of the strong correlation between the two colorimeters, only Minolta was used for the Field-days colour measurements. The mean Minolta hue angles for the four steak colour categories used for the field-days were 15.4°, 17.1°, 19.1° and 20.6°. The Percentage of consumers willing to buy beef steaks from the in-house and field-days increased with redness of steaks (a*) (Fig. 1). Because the steaks used in the field days were presented freshly bloomed to the panellists every day with little or no further change in colour, their willingness to buy increased with Minolta hue angle up to 24° – the maximum level of hue angle reached in those steaks. For the in-house panel where the colour of the steaks were allowed to change with storage from the initial fresh bloomed colour of the first day of measurement, panellist willingness to buy decreased with the increase in hue angle. When the two sets of data from the two panels were viewed together, a clear trend emerged (Fig. 1) indicating the range of Minolta hue angle values within which the majority of the consumers would be willing to buy the beef loin steaks in this study. These values were Minolta hue angles 19-25° or the calculated Hunter hue angles 33-41°. The reason for the lower acceptance or willingness to buy the steaks with hue angles lower than 19° or 33°, respectively could be due to the steaks being too red or dark red which deviates from the bright cherry red colour accustomed by the consumer.

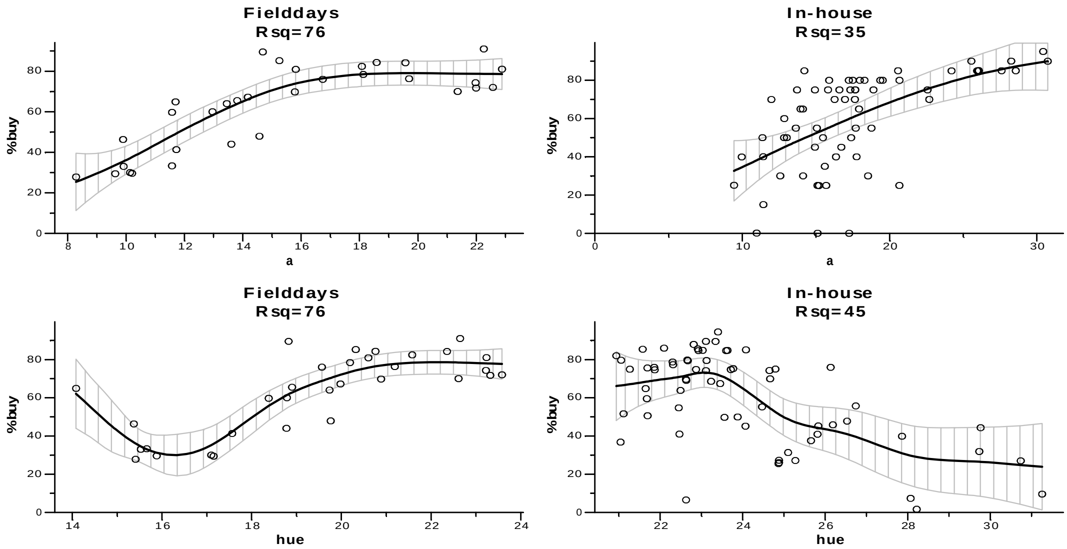

Figure 1. Relationship between in-house and field days consumer willingness to buy beef steaks and Minolta CIE a* (redness) and Hue angle (brownness)

The correlation between the consumer willingness to buy and instrumental measure of brownness (hue angle) was higher in the Field-days data compared to the in-house (Fig. 1). This could be because the Field-days panellists were presented samples with predetermined colour and were required to assess the colour once compared to the in-house panel that assessed the same steaks daily as their colour changed. This might create a bias due to panellist's anticipation of colour change with time. The data on the consumer willingness to buy suggests that not more than 85% of the consumers were willing to buy steaks on the basis of colour at any one time. This may mean other factors such as the effect of the colour of the adjacent steak played an important role in determining the acceptability of the steaks. In other words, as the colour of the adjacent steak changes, the willingness of the consumer to buy the other steak with a better colour increases and vice versa.

Conclusion

Data from this study suggest that the likelihood of a beef steak on retail display being purchased by a consumer was greatly enhanced when the steak's hue angle was within the range of 19-25° or 33-41° measured using Minolta or Hunter colorimeters respectively. These values can be used by the meat industry as benchmarks for beef colour acceptability and for modelling colour stability early post-mortem. The effect of the colour of the adjacent steak should also be properly determined and modelled to enable retailers develop a method for displaying steaks or introducing fresh trays of steaks in display cabinets in order to maximise the impact or reduce the effect of the adjacent steak.

References

Brewer, M.S., Novakofski, J. and Freise, K. (2006). Meat Science 72, 596-602.
Farouk, M. M. and Swan, J.E. (1998). Meat Science 50(2), 245-256.
Farouk, M.M. and Lovatt, S.J. (2000). Meat Science 56, 139-144.
GenStat. 2005. GenStat - Eighth Edition. Version 8.1.0.156. VSN International Ltd., Oxford.
Upsdell, M. P. (1994). The New Zealand Statistician 29 (2), 66-81.