

CONSUMER EVALUATION OF THE USE OF pH 5H P.M. AS A PREDICTOR OF MEAT QUALITY

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Background.

Texture is one of the major sensory qualities of meat at the moment of consumption. More specifically for beef, tenderness was found in several studies to be the most important quality attribute to consumers, even though it is known that the consumer's evaluation of food quality is one of the more problematic areas in the study of consumer behaviour (Grunert, K.G., 1996). Inconsistency in beef quality is particularly damaging as tenderness and flavour, unlike colour and fat, are attributes the consumer cannot judge until the meat is being eaten. Product quality has been very difficult to predict, control and label in meat production and variability in meat tenderness has been recognised to be a considerable problem for the meat industry (Bickerstaffe et al., 1996). Fast and objective instrumental methods for the analysis of meat quality prediction at the early post mortem period are therefore being developed. The possibility of using the rate of pH-fall and pH 5 h p.m. as a marker for predicting meat quality early post mortem (Göransson A. et al., 2000) was verified in this investigation using consumers.

Objective.

The aim was to verify the possibility of using the rate of pH-fall and pH 5 h p.m. as a marker for predicting meat quality using consumer evaluation.

Materials and Methods.

The material consisted of 59 young bulls and heifers (Swedish Lowland breed), 29 non-electrically stimulated and 30 electrically stimulated carcasses. The carcasses were not tender-stretched. The pH-value of *M. longissimus dorsi*, LD, was measured 3, 5, 8, 24 and 48 hours post-mortem. The pH was measured using a Knick Portamess 911 pH-meter with a Xerolyte glass combination electrode.

Pairs of muscles from each animal were excised the day after slaughter and cut into 2 pieces for the Warner-Bratzler shear force measurements and 4 pieces for the consumer evaluation, vacuum packed and frozen after ageing for 9 days at +4°C, prior to analysis.

The meat samples for the Warner-Bratzler shear force measurements were sliced into 3.5-cm thick pieces. The frozen samples were thawed for 24 hours and then cooked for 80 minutes at 74°C, followed by 25 minutes in an ice bath. Every sample was cut in the fibre direction, having an area of $15 \times 7 \text{ mm}^2$ and a length of 20 mm. Shear force measurements were performed on an Instron 4301, with a modified cutting device developed by Bouton and Harris (1978). The thickness of the blade was 1.0 mm with a square opening of $26 \times 21 \text{ mm}^2$. A mean value of ten measurements was used for each sample.

178 randomly-chosen naive consumers participated in the consumer study. The 59 LDs were divided into 4 groups with the same variation in Warner-Bratzler shear force. Each consumer assessed 15 samples, 7 stimulated and 8 non-stimulated or vice versa. The consumers came to the laboratory three times and were given meat from 5 randomly selected carcasses. The meat samples were fried in slices to an internal temperature of 72°C. The thickness of every sample was 20 mm. Panellists were requested to take breaks of three minutes between samples and were given water. They were asked to rate overall liking on a hedonic scale of nine categories ('Dislike very much' – 'Like very much'). The categories were subsequently given scores from 1 to 9 for the purposes of statistical analysis. The consumers-acceptability was determined by asking whether the taste and tenderness of each meat sample was acceptable or not.

The gender and age of the consumers, and the frequency with which they cooked and ate beef, were recorded.

Statistical analysis.

The classification of consumers and rated scores were initially compared using Chi-squared (χ^2) tests. The mean overall liking was analysed using generalised linear models (GLM). The percentage of consumers who showed some degree of dislike for tenderness or taste for any sample was analysed using generalised linear models (GLM) and correlated to pH5 and Warner-Bratzler shear force measurements. The non-linear pH-model was developed using SigmaPlot 5.0. Statistical calculations were performed using SYSTAT, the system for statistics, v.8.0, 1998.

Results.**pH measurements**

Electrically stimulated muscles showed a fast pH fall. There was also a significant difference between non-electrically and electrically stimulated animals also at long times ($p < 0.000$ at 48 h post-mortem). The experimental data were fitted to a single exponential decay model expressed as

$$\text{pH}(t) = \text{pH}_\infty + (\text{pH}_0 - \text{pH}_\infty) \cdot \exp(-t/\tau) \quad (1)$$

where pH_∞ is the ultimate pH value, pH_0 is the initial pH and τ is a time constant typical of the decline rate (Göransson et al., 2000).

Responders

Gender on the panel was approximately equally represented, with a slight female majority. Two thirds of the consumers were aged between 18 and 50. About 25% claimed to always do the cooking, with most of the others claiming to cook 'often' or 'sometimes'. Between one third and a half said they ate beef every week. About 80% were always or often satisfied with beef, but more than one third claimed that it is difficult to cook it so that it is tender. The chi-squared (χ^2) test has been used to test for differences between groups for each of the 15 beef samples in the characteristics of the consumers surveyed. There were no

differences between the groups for the frequency-distribution of the consumers surveyed by age, frequency of beef consumption and level of satisfaction with beef.

Consumer scores.

There were significant differences ($p < 0.05$) between the satisfaction of consumers with tenderness for non-electrically and electrically stimulated LD muscles. The differences between the mean values of % of consumers satisfied with taste between non-electrically and electrically stimulated LD muscles were not significant ($p > 0.05$). The mean shear force measurements measured 9 days post-mortem also showed significant differences ($p < 0.05$) between non-electrical stimulation and electrical stimulation. The correlations between consumer ratings and shear force measurements and between consumer ratings and pH 5 hours post-mortem, respectively, for non-electrically and electrically stimulated LD muscles, are shown in Table 1. Correlations between consumer ratings and shear force measurements were found to be significant and satisfactory. WB shear force measurements showed a higher correlation with consumer ratings than pH 5 hours post-mortem, which was to be expected. However, the correlation between the % of consumers satisfied with tenderness and pH 5 h post-mortem was, overall, also significant ($r = -0.558$, $p = 0.000$) which could be related to the high correlation between shear force measurements 9 days post-mortem and pH 5 h post-mortem.

Table 1. Correlations between consumer ratings and shear force measurements; and between consumer ratings and pH 5 hours post-mortem, respectively, for non-electrically and electrically stimulated LD muscles.

Correlation model	ES n=30		NS n=29		Total sample n=59	
	Correlation coefficient	p-value	Correlation coefficient	p-value	Correlation coefficient	p-value
% of consumers satisfied with tenderness and WB shear force	-0.729	0.000	-0.710	0.000	-0.758	0.000
% of consumers satisfied with tenderness and pH 5h post-mortem	-0.390	0.032	-0.450	0.012	-0.558	0.000
overall liking and WB shear force	-0.752	0.000	-0.715	0.000	-0.742	0.000
overall liking and pH 5h post-mortem	-0.503	0.032	-0.288	0.778	-0.409	0.009

It could also be seen that meat with a pH 5h post-mortem lower than 6.0 and a pH fall having a time constant less (i.e. faster pH-fall) than 5 resulted in a higher probability of obtaining a higher degree of satisfied consumers, than was the case for slower pH courses and higher pH 5 hours post-mortem. To confirm this hypothesis, 14 animals in this study with a pH 5h post-mortem lower than 6.0 and a pH fall having a time constant less than 5, were selected. The mean % of consumers satisfied with tenderness was, for these animals, 76% and the mean value for overall liking was about 6.5, which is a satisfactory result. The mean % of consumers satisfied with tenderness for the animals with a pH 5h post-mortem higher than 6.0 and a pH fall having a time constant slower than 5 was about 49%, and the mean value for overall liking about 5.2, respectively.

Conclusions.

The rate of the pH-fall and pH measurements 5h p.m. were evaluated as predictors of beef quality perceived by consumers 9 days p. m. It was found that the correlation between the percentage of consumers satisfied with the tenderness and the pH measured 5h p.m. was significant ($r = -0.558$, $p = 0.000$). It could also be seen that meat with a pH 5h post-mortem lower than 6.0 and a pH fall having a time constant less than 5 resulted in a higher probability of obtaining a higher degree of satisfied consumers, than was the case for slower pH courses and higher pH 5 hours post-mortem.

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