A30

USE OF A QUALITY CONTROL PANEL FOR EVALUATION OF COLOUR OF FRESH PORK LOIN AND THE CORRELATION BETWEEN THE PANEL'S EVALUATION AND MEAT QUALITY TRAITS

MARCHEN ANDERSSON, JANNIK GODT AND SUSANNE STØIER, DANISH MEAT RESEARCH INSTITUTE, MAGLEGÅRDSVEJ 2, DK-4000 ROSKILDE, DENMARK

KEYWORDS - Colour evaluation, meat quality, pork, pH, pigment, WHC

BACKGROUND

One important quality parameter of fresh pork is the bright, red colour whereas a deviating colour is linked to poor quality. Nakai et al. (1975) developed based on Hunterlab L-, a- and b-values a colour scale(JPCS) which comprises 6 plastic blocks with a meatlike appearance. The blocks are utilised as references when the colour of fresh pork is evaluated.

The purpose of this study was to introduce a quality control panel to evaluate the colour of fresh pork based on the JPCS-scale and to correlate the colour scores with laboratory analyses of meat quality.

METHOD

124 loins were selected from one abattoir for a trial evaluation by the quality control panel. Of the 124 loins 100 were randomly selected whereas 24 were selected based on a subjective evaluation covering all extremes of colour variations.

The loins were frozen and stored at -20°C until start of the experiment. After thawing colour evaluation and -measurement were performed on two slices of the loin cut between the 4th and 6th lumbar vertebra. The slices were placed in white plastic trays with the surface of the cut upside. The trays were wrapped in oxygen permeable film and left for blooming at a temperature of 1-4°C for 1 hour. The evaluations of the two slices were statistically considered a double determination. The room used for the colour evaluation was lit by a standard CiE-light only. The glow(incondescent)lamp was adjustable so that the intensity of light was a constant 1000 LUX. The distance between the meat and the source of light was 65 cm. The evaluation was carried out by 5 trained panellists using the JPCS-blocks as reference. Scores given ranked from 1 to 6, with 1 as the lightest. A Minolta equipment was used for the colour measurement of the slices.

Two more experiments were carried out covering the correlation between panel scores and the laboratory analyses. In the first experiment 150 loins were selected based on pH_2 making the pH-variance as big as possible. For the second experiment 100 loins were randomly selected. After deboning meat samples of approx. 300 g were taken from each loin. The samples were used for laboratory analysis of pigment content (Hornsey, 56), water holding capacity (solubility of proteins) and pH-measurement. The loins were frozen and stored at -20° C. After thawing colour evaluation and -measurement took place as described above.

Evaluation of the Quality Control Panel. The Quality Control Panel was evaluated with respect to: 1) the sensitivity of the panellists (variance homogeneity among the panellists), 2) the means of the individual panellists, 3) the interaction, panellist - product, 4) the reliability of the panel mean score determined by Cronbach's alpha (Carmines and Zeller, 1979).

The following statistical model was formulated:

(1) $Y_{ijk} = \mu + D_i + P_j + DP_{ij} + \varepsilon_{k(ij)}$

where Y_{ijk} is colour evaluation performed by i'th panellist on j'th product (loin) in k'th repeat.

D_i is the level of the i'th panellist where $D_i \in N(0,\sigma^2_D)$, i = 1,..,l
P_j is the level of the j'th product (loin) where $P_j \in N(0,\sigma^2_p)$, j = 1,..,m
DP_{ij} is the interaction between panellist and the product prevailing when the panellists give different evaluation of the distance between products. $DP_{ij} \in N(0,\sigma^2_{DP})$.
$\varepsilon_{k(ij)}$ is the random error where $\varepsilon_{k(ij)} \in N(0,\sigma_e^2)$, k = 1,..,n

The reliability of a panel score is estimated by Cronbach's alpha. The reliability expresses the relationship between the variance of the true measurement of the colour score (T) and the variance of the panel colour score ($Y_{.jk}$):

$\alpha = V(T)/V(Y) = 1 - V(e)/V(Y)$, where e is random error.

If formula (1) is utilised at one repeat:

(2) $\alpha = 1 - [(\sigma^2_{DP} + \sigma^2_e)/l]/[(\sigma^2_{DP} + \sigma^2_e)/l + \sigma^2_P]$, where l is the number of panellists.

At one repeat (2) is estimated as:

$\hat{\alpha} = 1 - 1/F_{product}$

where $F_{product}$ is the F test value in a two-sided ANOVA (MaCLennan, 1993).

The influence of the reliability on the correlation between the mean panel colour score and the objective colour evaluations is demonstrated in the formula "Correction for attenuation":

(3) $\rho(Y_1,Y_2) = \sqrt{(\alpha,\alpha_2)} * \rho(T_1,T_2)$

which describes how the correlation of the observed measurements (Y_1,Y_2) is reduced by measurement errors as compared to the correlation $\rho(T_1,T_2)$ between the two true measurements with no errors.

RESULTS

Evaluation of the panel. The variance homogeneity of the panel was tested using Bartlett's test resulting in one panellist being excluded from the panel as being too conservative in his use of the range of the reference-block. The variance homogeneity of the remaining 4 panellists was accepted.

The statistical analysis showed significant differences between the evaluations by the four panellists ($S^2_p = 0.15^2$). There was furthermore a significant difference between the loins ($S^2_p = 0.62^2$). The residual variance of the individual panellist evaluations was $S^2_e = 0.47^2$. The panellist-product interaction was not significant.

The reliability of the panel evaluation was equal to 0.88 which means that the observed correlation between the mean panel colour score and the objective colour evaluations will be reduced by no more than 6% as a consequence of random errors in the mean panel colour score. The reliability of the panel is on this basis considered satisfactory.

Correlation between panel evaluations and laboratory measurements. Following linear models for the correlation between the mean panel score and the laboratory measurements (pigment, pH and WHC) were made:

$Y_{.j.} = \beta_0 + \beta_1 x_j + \varepsilon_j$, where $\varepsilon_j \in N(0,\sigma_\varepsilon^2)$

where X_j either designates pH, pigment or WHC.

$Y_{.j.} = \beta_0 + \beta_1 pH + \beta_2 pigment + \beta_3 WHC + \varepsilon'_j$, where $\varepsilon'_j \in N(\sigma,\sigma'^2_\varepsilon)$

Provided β_{1-3} varies significantly from 0, the laboratory analysis will contribute to the explanation of the variance of the panel colour scores.

The three laboratory analyses each contribute significantly to the explanation of the variance of the panel colour score. Based on one of the laboratory analysis the colour score may be predicted in the interval of ±1 with an accuracy of 95%.

The models are evaluated by use of Root Mean Square Error (RMSE) which estimates the standard deviation of the residuals not explained by the models.

Table 1 - RMSE for meat quality traits

	pH	Pigment	WHC	Combination
Experiment 1	0.51	0.54	0.47	0.33
Experiment 2	0.57	0.55	0.52	0.35

In both experiments WHC stands out as the characteristic with the lowest RMSE, thus giving the bedst explanation of the colour scores. There are, however, no significant differences in the residual deviations of the three characteristics. The combination of the three characteristics will reduce RMSE further, and the colour score can be predicted in the interval of ±0.7 with an accuracy of 95%.

Van Laack et al.(1994) found that there was not an unambiguous correlation between the colour of the meat (brightness) and WHC, and that brightness is not necessarily a reliable predictor of WHC. The results of the two experiments confirm that the combination of pH, pigment and WHC give a better prediction of the colour of fresh pork evaluated by a trained quality control panel under standardised conditions.

CONCLUSION

It requires trained and tested control panels to produce reliable colour evaluations. Pigment, pH and water holding capacity are all quality traits that contribute to the colour of fresh pork.

REFERENCES

Carminer, E.G. & R.A. Zeller (1979). Reliability and Validity Assessment (Sage University Paper).
Hornsey, H.C. (1956). J.Sci. Food Agric., 7, 534.
MacLennan R.N. (1993). Interactive reliability with SPSS for Windows 5.0.
Nakai, H., Saito, F., Ikeda, T, Ando, S. & Komatsu, A. (1975). Bull. Nat. Inst. Anim. Indust., Chiba, Japan, 29, 69.
Van Laack, R.L.J.M., Kauffman, R.G., Sybesma, W., Smulders, F.J.M., Eikelenboom, G. & Pinheiro, J.C. (1994). Meat Science 38, 193.