COMPARISON OF DIFFERENT METHODS TO EVALUATE FRESH PORK COLOUR[1]

Monique J. Van Oeckel, Nathalie Warnants and Ch.V. Boucqué

Agricultural Research Centre – Ghent, Department Animal Nutrition and Husbandry, Scheldeweg 68, B-9090 Melle-Gontrode, Belgium. Tel. 09/252.26.01, fax. 09/252.52.78, e-mail : rvv@pophost.eunet.be

Background

One of the most important quality traits of fresh pork in the decision of purchase by the consumer is the colour of the meat. In the eyes of the consumer, fresh pork is expected to have a homogeneous reddish-pink colour. Even though the consumer is not always aware of this expectation, few consumers will buy a dark red or an extreme pale piece of pork. In meat processing, however, colour is less stringent as a mixture is made of meat from different origins together with other ingredients, enabling some colour correction, at least when the colour deviation is not associated with other defaults, as poor water binding capacity, toughness or microbial contamination. Because the perception of colour is very dependent on the observer, it's of importance to know the value of objective colour measurements in relation to the subjective judgement of acceptable pork colour. Furthermore, colour can only be integrated as an economical factor in the meat industry if it's possible to predict the ultimate colour of the meat, early in the slaughter line. This would create selection possibilities to different destinations, for example to fresh meat consumption and to heated, fermented or dried meat products. A new promising and practically usable technique is the Double Density Light Transmission (DDLT), which measures a reflection spectrum at 850 nm while penetrating the carcass. The latter technique is analogous to the Capteur Gras/Maigre (CGM), which is officially recognised in Belgium, since November 1996, as a classification apparatus for estimating lean meat content in the carcass. Considering the obligation for export slaughterhouses to classify all carcasses, it would be an enormous trump if the same apparatus simultaneously gives a clear idea about the meat quality.

Objectives

In this study we want to evaluate the relation between the subjective estimation of colour by the Japanese colour scale with the objective measurements of FOPu, Göfo and LabScan II 0°/45°. Furthermore, this study will investigate the prediction capacity of pH1, FOP1 (light scattering), PQM1 (conductivity) and DDLT measurements, 45 minutes post mortem in the slaughter line, for ultimate colour of the pork.

Materials and methods

Meat samples of in total 120 animals, belonging to two sexes (barrows and gilts) and three genotypes (Piétrain x Belgian Landrace, Piétrain x Seghers hybrid en Piétrain x Large White), were included in this trial. The different pig breeds were chosen in order to obtain a broad range of colour data. Forty-five minutes post mortem, pH1 (Knick type 654, with an ingold Xerolyt electrode, Knick, Berlin, Germany), FOP1 (FOP = Fibre Optic Meat Probe, TBL Fibre Optics Group Ltd., Leeds, England; measures light scattering via glass fiber optics) and PQM1 (Pork Quality Meter, Tecpro GmbH, Aichach, Germany; measures conductivity) were determined at the third/fourth last rib of the longissimus thoracis. In addition to this, a reflection spectrum at 850 nm was established with the DDLT apparatus (Sydel, Lorient Cédex, France) as the probe penetrates the longissimus thoracis at 7 cm beside the midline between the third and fourth last rib. The area beneath the obtained curve divided by the width of the spectrum, is possibly a measure for the prediction of the meat quality. Twenty-four hours after slaughter, the longissimus thoracis et lumborum was sampled and sectioned in 13 pieces (± 2,5 cm), as shown in figure 1, for different meat quality measurements. Piece 4 was reserved for the following determinations : japcolour (Japanese colour score grades, FHK Co., Tokyo), FOPu, Göfo (Göttinger Fotometer, Ernst Schütt jr., Göttingen, Germany) and LabScan II 0°/45° (HunterLab, Hunter Associates Laboratory, Inc., Reston, Virginia, USA). Japcolour consists of six plastic disks with a meat-like appearance that are developed using objective colorimetry (Nakai et al., 1975). They range from score 1 to 6, from a pale grey tinge to a dark purple hue. Göfo measures the diffuse reflectance at the surface of the fresh meat as an indication of colour or degree of whiteness (white-black axis) (Pfeiderer und Zagožen, 1969). Labscan II 0°/45° is a spectrocolorimeter, which measures the percentage of light reflection from 400 nm to 700 nm, with intervals of 10 and 20 nm, with illuminant D65, a 10° observer (CIE, 1964) and a 30 mm or 1.81 inch diameter light surface. The instrument was calibrated with a black tile and a white tile (Standard No. LS. 13575), and the background of the 2.5 cm thick meat slices consisted of a neutral grey-brown coloured wooden board. The LabScan II measurement resulted in the CIE (1976) L* value for lightness (black-white axis), CIE a* value for redness (red-green spectrum), CIE b* value for yellowness (yellow-blue spectrum), hue (= arctan (CIE b*/CIE a*)) and saturation or chroma (= $(\text{CIE } a^{*2} + \text{CIE } b^{*2})^{1/2}$).

Results and discussion

In table 1 the correlation coefficients between all ...

between chroma and japcolour. Within the objective colour measurements it seemed that CIE L*, Göfo and FOPu were strongly related with each other. Hue was particularly well correlated with CIE a*, likewise, chroma and CIE b* showed a very high correlation.

The subjective japcolour prediction by the on-line methods, was best performed by DDLT (r = -0.53), followed by FOP1 (r = -0.44), pH1 (r = 0.41) and PQM1 (r = -0.39). Of the instrumental colour determinations 24 hours post mortem, the light scattering by means of FOPu was strongest correlated with the on-line measurements, with resp. r = 0.70, 0.61, -0.56 and 0.55 for DDLT, FOP1, pH1 and PQM1. Slightly lower, but still very significant, correlation coefficients were obtained between on the one side Göfo and CIE L* and on the other side the on-line measurements. No or only very small improvements could be made in the prediction of japcolour, FOPu, Göfo and CIE L*, by combining different on-line techniques in a multiple linear regression approach (results not shown).

Conclusions

Of all the instrumental colour measurements, CIE L* (r = -0.82) followed by FOPu (r = -0.70) and Göfo (r = 0.70), were most meaningful correlated with the subjective colour assessment by japcolour. The subjective japcolour could be predicted by the on-line instruments, pH1, FOP1, PQM1 and DDLT, with a determination coefficient between 15 and 28 %. Furthermore, it could be concluded that the ultimate colour, determined by japcolour, FOPu, Göfo and CIE L*, could be better predicted by means of the DDLT than by the classical instruments FOP1, pH1 and PQM1. This means that besides lean meat percentage, obtained by carcass classification with CGM, additional information can be gained about the intrinsic quality, in particular the colour, of the meat.

Literature

Nakai, H., Saito, F., Ikeda, T., Ando, S. and Komatsu, A. (1975). Bull. Nat. Inst. Anim. Indust., Chiba, Japan, 29 : 69.

Pfeiderer, U.E. und Zagožen, F. (1969). Genauigkeit bei Farbhelligkeitsmessungen. Schweinezucht und Schweinemast, 71(11) : 322-325.

Acknowledgements

The authors wish to thank Covavee C.V.B.A. (Leuven, Belgium), Sydel S.A. (Lorient Cedex, France) and VLAM (Vlaamse Dienst voor Agro-marketing, Brussels, Belgium) for the practical and financial support, M. Audenaert, R. Danneels, B. De Bock, E. De Graeve, M. De Paepe, A. Lateur, R. Limpens, J. Slock and H. Uitterhaegen for all practical help with the conduction of the trial.

Table 1. Pearson correlation coefficients between the different methods

	Japcolour	FOPu	Göfo	CIE L*	CIE a*	CIE b*	Hue	Chroma
Japcolour								
FOPu	-0.70***							
Göfo	0.70***	-0.80***	-					
CIE L*	-0.82***	0.82***	-0.83***	-				
CIE a*	0.39***	-0.23*	0.31***	-0.53***	-			
CIE b*	-0.50***	0.53***	-0.46***	0.48***	0.33***	-		
Hue	-0.62***	0.45***	-0.51***	0.75***	-0.91***	0.07	-	
Chroma	-0.16	0.26**	-0.16	0.07	0.75***	0.88***	-0.41***	-
PH1	0.41***	-0.56***	0.58***	-0.53***	0.13	-0.26**	-0.25**	-0.12
FOP1	-0.44***	0.61***	-0.58***	0.58***	-0.15	0.29***	0.27**	0.14
PQM1	-0.39***	0.55***	-0.50***	0.49***	-0.07	0.28**	0.20**	0.17
DDLT	-0.53***	0.70***	-0.59***	0.60***	-0.19	0.28**	0.28**	0.12

Significance levels : ***P ≤ 0.001; **P ≤ 0.01; *P ≤ 0.05.

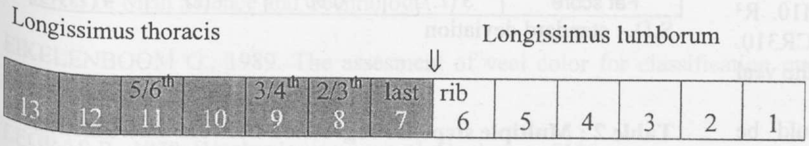

Figure 1. Dissection of the Longissimus lumborum et thoracis