COMPARISONS BETWEEN OBJECTIVE MEASUREMENTS AND VISUAL ASSESSMENT OF PORK MUSCLE QUALITY.

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Background At present it is difficult for the industry to determine the technological quality of pork meat prior to the production of cooked ham. Pale, soft, exudative (PSE) pork poses many problems for ham processors with the colour and sliceability of the final product being of major concern. Recent problems experienced by ham producers have centred on the quality of the raw material, namely topside muscles, which are composed of *M. semimembranosus* and *M. adductor*. As visual assessment is the only method currently available to these producers, they require objective methods of assessing the quality of raw material prior to processing. Providing them with quality specifications for this raw material will give a firm basis for either rejecting meat or for processing it in a different manner to normal, good quality meat. In the past work in this area has tended to focus on early post-mortem measurements on other muscles through out the carcass (Somers *et al.*, 1985, Warriss and Brown, 1995; Joo *et al.*, 1998). Following discussions with the industry it was decided that the first step to addressing this problem was to compare instrumental measurements of meat quality with visual assessments. Based on research findings to date (Somers *et al.*, 1985, Warriss and Brown, 1995; Joo *et al.*, 1998 & Mullen *et al.*, 1999) we decided to use pH, electrical and colour measurements and compare them with visually assessed poor and normal quality raw material.

Objectives The present study was conducted to investigate the relationship between objective (colour, electrical, pH) and subjective (visual) methods of assessing pork quality prior to processing into ham. Results from this study would contribute towards developing quality specifications for pork meat used in the production of hams.

Methods - Pork topsides were obtained from a large ham producing company. This company buys in this product for further processing. Industry personnel, who had experience with pork assessment, visually assessed muscles as being 'poor' or 'good' quality. Poor quality hams were segregated on the basis of paleness of colour. In particular this paleness tended to be located in the middle part of the topside (*adductor*) which is located deep in the hind leg, close to the femur (see Figure 1). Twenty-four 'poor' and 24 'good' quality topsides were selected for further analysis, which took place at 7 days post-mortem.
Colour measurements were recorded on the CIE L*a*b* scale using a portable HunterLab Miniscan XE and the percentage reflectance of red light was recorded using an Optostar Meat Colour Gauger. Each reading was taken in triplicate in the palest area as described above, as this was the main area on which they were visual assessed. The location at which the measurements were taken is shown in Figure 1. Electrical conductivity (PQM) and pH (Orion) were then recorded, in triplicate, in this region also. Digital photographs were taken of all muscles and stored on file for reference.
Warner Bratzler (WB) shear force and cook loss values were determined on 2.54cm slices of meat using the method of Shackelford *et al.*, (1991). Drip loss measurements were recorded in duplicate from each muscle using the method of Honikel and Hamm (1994).
Results were analysed using ANOVA, Spearmans correlation coefficient (SAS) and by scatterplot analysis (Excel).

Results and Discussion - pH and electrical conductivity measurements were not effective in segregating 'good' from 'poor' quality meat (Table 1). As the muscle had been aged for 7days it was not anticipated that pH would identify the poorer quality meat. No abnormally high pH readings, which may have indicated DFD (dark, firm, dry) meat, were noted. It is possible that conductivity measurements would need to be recorded earlier post-mortem to ascertain its ability to segregate the two quality classes. However, the focus of this trial was on later post mortem times as this industry had no access to the meat early post mortem.
While the colour measurements a* and b* did not segregate the two quality types both the L* and the percentage reflectance values appeared to be quite successful (Figure 2). Spearmans correlation coefficients confirmed this relationship between visually assessed meat and both L*(r=0.82) and reflectance (r=0.79). Confidence intervals for L* and reflectance are shown in Table 2. Both reflectance and L* correlated well with each other (r=-0.91). A strong relationship between reflectance (measured with an EEL meter) and L* value (r=0.91) has also been reported by Warris and Brown (1995). Correlations between EEL reflectance and panel score of colour have been observed in the *M. longissimus dorsi* (r=0.78) (Somers *et al.*, 1985). Similarly strong correlations between L* and objective colour (r=-0.82) have been observed in the *longissimus* muscle (van Oeckel *et al.*, 1998).
No differences were observed in WB, cook loss or drip loss values between the two groups (Table 1). It was anticipated that any differences in exudation may not be apparent at this time point (7days post-mortem).

Conclusions – Both reflectance and the L* value of colour performed well as objective methods of segregating the quality of pork topsides prior to processing into hams. Subsequent analysis with larger numbers of samples have also supported this finding. The next phase of this work will involve objectively segregating topsides and verification that the quality of the final product reflects the predicted quality.

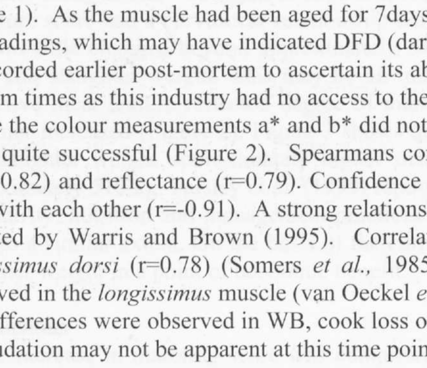

Figure 1. Location of CIE L*a*b*, reflectance, pH and conductivity readings.

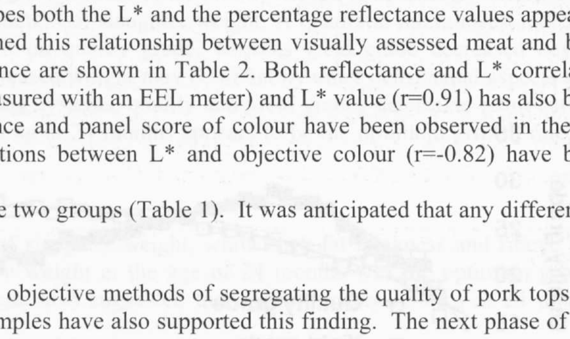

Figure 2. Scatterplot for the CIE L* and reflectance values for topsides visually segregated into poor and good quality classes.

Table 1. CIE L*a*b*, reflectance, Warner Bratzler shear force (WB), cook loss, dripl oss, pH and conductivity measurements on 'good' and 'poor' quality pork topside (*M. semimembranosus* and *M. Adductor*) muscle at 7 days post-mortem.

	'GOOD' n=24		'POOR' n=24	
	Mean	SD	Mean	SD
CIE L*	50.36 [a]	3.87	58.74 [b]	2.34
CIE a*	10.40	2.28	9.00	1.39
CIE b*	16.94	1.82	17.82	1.14
Reflectance (%)	59.17 [a]	7.45	43.64 [b]	5.19
WB (N)	34.35	6.56	37.22	9.50
Drip loss (%)	1.2	0.3	1.4	0.5
Cook loss (%)	31.9	2.9	32.5	2.5
pH	5.62	0.11	5.54	0.11
Conductivity mS/cm	18.84	0.87	17.61	1.37

Means in the same row with different superscripts are different $p<0.0001$. SD – standard deviation.

Table 2. Lower and upper confidence intervals for mean reflectance and CIE L* values on pork topside muscles. Following visual assessment the topsides were allocated to a 'good' or 'poor' quality class.

Confidence Interval	REFLECTANCE				L*			
	'Good'		'Poor'		'Good'		'Poor'	
95%	56.16	62.42	41.48	45.86	48.73	51.99	57.75	59.73
99%	55.09	63.54	40.69	46.64	48.14	52.58	57.40	60.08
99.5%	53.59	64.99	39.68	47.66	47.38	53.34	56.94	60.54

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