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OBJECTIVE DETECTION OF PSE/DFD PORK USING ELECTRONIC GRADING PROBES

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SUMMARY

Three electronic grading probes, the Hennessy Grading Probe (GP-II), Fat-O-Meater (FOM) and Destron Pork Grader (PG-100) were assessed for their ability to detect PSE/DFD in pork.

Carcasses were probed either 60 min or 24 hr postmortem. Probings were made between the 3rd and 4th last ribs, 7 cm lateral to the mid-line on the left side of the carcass. The relationship between the probe measured mean internal muscle reflectance and the subjectively determined quality of the boneless loins was used to assess the three probes. The quality of the boneless loins was subjectively assessed 24 hr postmortem using a five-point descriptive scale for paleness and structure in use in Canada since 1984 to describe PSE/DFD in pork.

Our results show that early postmortem reflectance measurements were of no value in detecting PSE/DFD in pork. Furthermore, despite relatively strong correlations between mean internal muscle reflectance measured 24 hr postmortem and the subjectively determined quality score, the extent of overlapping among quality scores in the distribution of the mean internal reflectance within each quality score precluded the definition of unique reference values for each quality score. Consequently, the detection at 24 hr postmortem of PSE/DFD in pork using the GP-II, FOM and PG-100 was also judged to be unsatisfactory.

INTRODUCTION

Pork quality can be influenced by a pale, soft and exudative condition (PSE) or by a dark, firm and dry condition (DFD). The presence of either of which affects both the manufacturing properties of pork and aesthetic appearance of the final product. Until PSE/DFD in pork are completely eliminated through genetic selection and appropriate pre- and post-slaughter management procedures (Eikelenboom, 1985), there will be a continuous need for detection, under commercial conditions, of PSE/DFD in pork to allow handling of these types of products in a proper manner.

Since 1984, quality standards for the identification of PSE/DFD in pork based on the visual evaluation of paleness and structure of the m. longissimus and m. gluteus medius have been in Canada used to assess the extent of PSE/DFD in pork. However, visual assessment under commercial conditions are subject to variability due mainly to differences among individuals in their perception of paleness and structure. Moreover, visual subjective assessment under a commercial environment is often difficult. Hence, there is a need to evaluate objective methods for predicting meat quality at the slaughterhouse.

The objective of this study was then to evaluate the potential of three electronic grading probes, namely the GP-II, FOM and PG-100, for detecting PSE/DFD in pork using the mean internal reflectance of the m. longissimus. Two probing times, 60 min and 24 hr postmortem, were selected only because these two times represent the periods at which detection of PSE/DFD in pork is practically feasible under commercial conditions.

MATERIALS AND METHODS

The data used in this study were collected at a commercial abattoir. Each carcass was probed on the left side between the 3rd and 4th last rib 7 cm lateral to the exposed surface of the split carcass. Three electronic grading probes were used: GP-II (Hennessy and Chong Ltd., Auckland, New Zealand), FOM (SFK, Hvidovre, Denmark) and PG-100 (International Destron Technologies, Markham, Ontario, Canada). The number of carcasses probed was: 60 min postmortem: 712, 976 and 229 for the GP-II, FOM and PG-100, respectively; 24 hr postmortem: 536, 734 and 268.

The coefficient of correlation between the mean internal muscle reflectance recorded with the GP-II, FOM or PG-100 and the quality score of the boneless loins was used to evaluate the usefulness of a particular probe (SAS, 1985). Mean internal muscle reflectance was defined as the mean of the reflectance values over the depth of the m. longissimus less those recorded for the first and last 4 mm of muscle thickness. Using a five-point descriptive scale, each boneless loin was subjectively evaluated 24 hr postmortem for paleness (1: extremely pale, 5: extremely dark) and structure (1: extremely soft and exudative, 5: extremely firm and dry) (Agriculture Canada, 1984).

RESULTS AND DISCUSSION

When the reflectance of the muscle was recorded 60 min postmortem, the relationship between the mean internal muscle reflectance and the quality score of loins was poor, as evidenced by low coefficients for all three electronic grading probes (Table 1). Our results suggest there is little point in attempting to detect PSE/DFD in pork less than 1 hr postmortem. Seidler et al. (1984), despite observing a relatively strong relationship between the water holding capacity (Grau-Hamm press method) and the FOM 'reflectance value RW' measured at 45 min postmortem (r = .83), also concluded that the differentiation of PSE and non-PSE carcasses at 45 min postmortem was not adequate. Our results, however, do not support the suggestion by Sack et al. (1984) that the FOM 'reflectance value RW' measured 50 min postmortem could provide "reliable information about the PSE condition in muscles."

TABLE 1. Relationship between the subjective quality of boneless loins and mean internal muscle reflectance recorded 60 min and 24 hr postmortem

	Time postmortem	
	60 min	24 hr
GP-II		
Paleness	-.39[a]	-.68
Structure	-.38	-.58
FOM		
Paleness	-.01[NS]	-.53
Structure	-.02[NS]	-.50
PG-100		
Paleness	-.29	-.45
Structure	-.30	-.49

[a]Coefficient of correlation. NS: Non-significant. All other coefficients, P<.01.

Probing at 24 hr postmortem resulted in improved relationships (Table 1). These compared favourably with those of Somers et al. (1984) who measured the internal muscle reflectance with a reflectometer or a Fibre Optic Probe (FOP) and subjectively scored the quality (five-point scale: 1 = extreme DFD and 5 = extreme PSE) of the m. longissimus (r = .71, .78). Correlations of similar order between water holding capacity of the m. longissimus and the internal muscle reflectance measured 24 hr postmortem have been reported by Lundström and Malmfors (1985) using the FOP, by Sack et al. (1984) using the FOM and by Barton-Gade and Olsen (1984) using the Automatic Danish Meat quality Probe.

The means and associated standard errors for mean internal muscle reflectance are presented in Table 2. For paleness and structure, the means for each score were statistically different (P<.05). Means also differed (P<.05) for each probe.

TABLE 2. Means (standard errors) for the mean internal muscle reflectance measured at 24 hr postmortem[a]

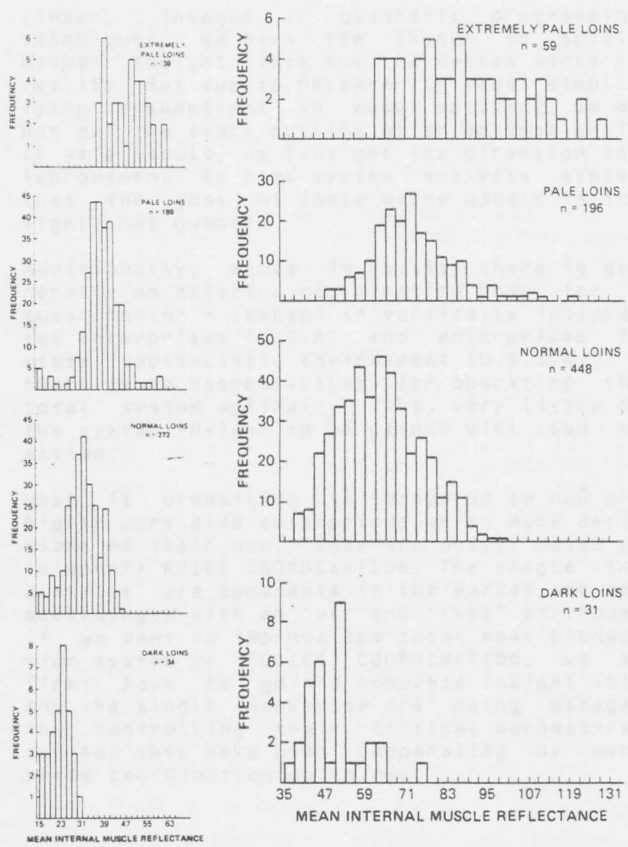
	Quality Score			
	1	2	3	4
GP-II				
Paleness[b]	47.0(1.6)	40.1(.5)	32.0(.4)	24.6(1.5)
Structure[c]	47.0(1.7)	39.2(.5)	33.2(.5)	25.6(1.5)
FOM				
Paleness	89.5(2.3)	72.9(.9)	63.7(.6)	50.2(1.5)
Structure	90.7(2.7)	73.3(.9)	63.7(.6)	47.1(1.3)
PG-100				
Paleness	52.3(1.8)	47.8(1.3)	40.1(1.3)	-
Structure	53.9(2.1)	47.0(1.4)	39.9(1.2)	-

[a]Means on the same line are at least different at the 5% probability level.
[b]Paleness: 1) extremely pale: 2) pale: 3) normal: 4) dark.
[c]Structure: 1) extremely soft and exudative: 2) soft and exudative: 3) normal: 4) firm and dry.

The usefulness, however, of an instrument is not in its ability to differentiate among means of various levels of a quality defect, but rather in its ability to identify these defects in individual boneless loins. Hence, for a parameter such as mean internal muscle reflectance to differentiate various quality scores, the frequency distribution of that parameter should be multi-modal where a given value for an individual boneless loin corresponds with a high level of probability to a unique quality score. If there is an overlap in the frequency distribution (i.e., a given value corresponds to more than one quality score), the discrimination of the various quality scores then becomes less precise.

Reference values for the mean internal muscle reflectance can be mathematically calculated for each score for which the mean internal muscle reflectance of a particular boneless loin is attributed with a high degree of probability to a unique quality score. If we arbitrarily set the level of probability at the very minimum acceptable level of 95%, the reference values are then defines as $\bar{x} \pm 2$ SD. However, due to relatively large standard deviations, the construction of a 95% confidence interval for each quality score resulted in considerably large areas of overlap between quality scores (close to 70% of all boneless loins fell within these areas). For instance, the overlapping of the mean internal muscle reflectance measured in normal and pale loins with the GP-II (95% intervals: 40.1 ± 11.8 and 47.0 ± 10.8, respectively) encompassed close to 40% of these loins: more specifically, 60.3% of the pale loins and 19.4% of the normal loins. This is further illustrated in Fig. 1a. Similar observations were made for the other quality scores and for the FOM (Fig. 1b) and PG-100.

Hence, despite relatively strong relationships between mean internal muscle reflectance and quality score, the lack of unique reference values for each quality score precluded the use at 24 hr postmortem of the GP-II, FOM and PG-100 for detecting PSE/DFD in pork.



a) b)

Fig. 1. Frequency distribution within each paleness score for the mean internal muscle reflectance measured 24 hr postmortem with the GP-II (a) and FOM (b).

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