THE USE OF A FIBRE OPTIC PROBE FOR THE DETECTION OF PALE PORK

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SUMMARY

A fibre optic probe instrument was designed for the detection of pale soft exudative (PSE) pork without cutting the carcass. The probe measures the light scattering properties of the muscle and was shown to be as effective as the EEL reflectometer in detecting PSE meat.

L'UTILISATION D'UNE SONDE D'OPTIQUE DE FIBRES POUR DECELER LE PORC PALE

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RESUME

Une sonde d'optiques de fibres fut conçue pour déceler le porc pâle, mou et en état d'exsudation (PSE) sans couper la carcasse. La sonde mesure les propriétés de diffusion de la lumière des muscles, et se révéla aussi efficace que le réflectomètre EEL pour déceler la viande PSE.

ÜBER VERWENDUNG EINER OPTISCHEN FASERSONDE FÜR DEN NACHWEIS VON BLEICHEM WEICHEM FLEISCH

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ZUSAMMENFASSUNG

Ein optisches Faserprobeninstrument wurde für den Nachweis von blassem, weichem, exsudativschweinefleisch (PSE) ohne Aufschneiden des Schlachtkörpers entworfen. Die Sonde misst die Lichtdiffusionseigenschaften der Muskulatur und erwies sich genauso effektiv wie das EEL-Reflektometer beim Nachweis von PSE-Fleisch.

ИСПОЛЬЗОВАНИЕ ОПТИЧЕСКОГО МЫШЕЧНО-ПРОБНОГО ИНСТРУМЕНТА ДЛЯ ОБНАРУЖЕНИЯ НЕЖИРНОЙ СВИНИНЫ.

представлено Д.Н. Роудсом.

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Оптический мышечно-пробный инструмент был создан для обнаружения нежирной мягкой экссудативной свинины (PSE) без проникновения в тушу. Такой пробный инструмент измеряет светорассеивающие свойства мышцы и при обнаружении нежирной свинины (PSE) оказался таким же эффективным, как и рефлектометр (EEL).

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INTRODUCTION

The pale soft exudative (PSE) condition in pork can be detected by measuring either the muscle pH shortly after slaughter or the paleness of the meat after rigor mortis. The former technique suffers from calibration difficulties and particularly from the danger of electrode breakage in factory practice, and the latter, though simpler in principle and in use, from the necessity of cutting the carcass to expose an area of muscle sufficiently large to take reflectance measurements. This paper describes the application of the reflectance principle to assess the paleness of meat using a robust probe which is simple to use and is non-destructive to the carcass.

EXPERIMENTAL

Fibre optic probe. As shown schematically in Fig. 1, the probe consisted of a 1 m length of incoherent flexible glass fibre optic guide contained in a metal and plastic coated sheath and terminated with a 20 cm stainless steel ferrule. The junction of the ferrule with the sheath was protected by a nylon handle. The probe required a sharp point and the optical window needed to be abraded during insertion to avoid adherence of fat and compression of the meat. The end of the fibre bundle was therefore carefully flexed round a 45° arc, mounted in the metal tip and cut and polished at right angles to the axis of the fibres to form the window. This design is necessary because it is not possible to cut the fibre optic directly at 45° without losing light by internal reflection. The diameter of the window was 3.5 mm and the diameter of the ferrule was 5.5 mm. The guide was connected to the measuring unit by a Y junction. Light from a filament bulb was transmitted through one leg of the Y and light, returning from the sample to the unit by the other, was detected by a photo-transister with peak sensitivity between 700 and 1000 nm.

Calibration. The instrument was set to zero with the tip inserted into a black cavity, and the scale adjusted to 70 by placing the tip in contact with an arbitary light scattering standard using a shield surrounding the tip to exclude stray light. This setting gave probe values for pork similar in magnitude to those obtained on the EEL reflectometer. The standard was a 2.3 mm sheet of opal perspex painted on the underside with an optically infinite layer of white paint.

Carcass selection and measurement. Measurements were made by inserting the probe into the M.Longissimus dorsi between each rib from the 9th to the 15th on 80 Large White and 24 Pietrain carcasses 24 to 48 hours after slaughter. Reflectance was then measured by an EEL reflectometer at 6 positions in the M. Longissimus dorsi after sectioning[1]. The Kubelka-Munk scatter coefficient (S) was then measured on samples selected on the basis of the probe measurements using the technique of mounting 2 mm thick slices of pork on white and black backgrounds and measuring the luminous reflectance on a Gardner Colour Difference Meter[2].

RESULTS AND DISCUSSION

Each carcass was measured at 6 locations on the M.Longissimus dorsi by both the fibre optic probe and the EEL reflectometer. The mean probe values for each carcass ranged from 27 to 93 and the EEL values from 32 to 77 showing a significant correlation between the two (Fig. 2). An EEL value of >58 is indicative of paleness when assessed visually [1] and hence probe values of >60 indicate definite paleness and probe values between 50 and 60 can be considered as borderline between normal and opaque pork.

PSE pork is pale because changes in the structure of the myofibrils and the precipitation of soluble proteins on them, produced by rapid fall in pH while the carcass remains warm, cause them to scatter more light. The value obtained with the fibre optic probe is a measure of the light scattering property of the muscle and the relationship of probe value to the scatter coefficient (S) is shown in Fig. 3. Typical value of S for normal pork is 0.2 and for PSE pork is 0.45[2]. The probe values were not affected by the levels of pigment concentration found in the pork.

Since the probe measures light scatter it has uses in meat quality assessment other than the detection of PSE pork. Work is currently in progress at the Meat Research Institute on its use as a tool for measuring fat thickness in pig carcasses and as an instrument for detecting dark cutting beef.

REFERENCES

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ACKNOWLEDGEMENTS

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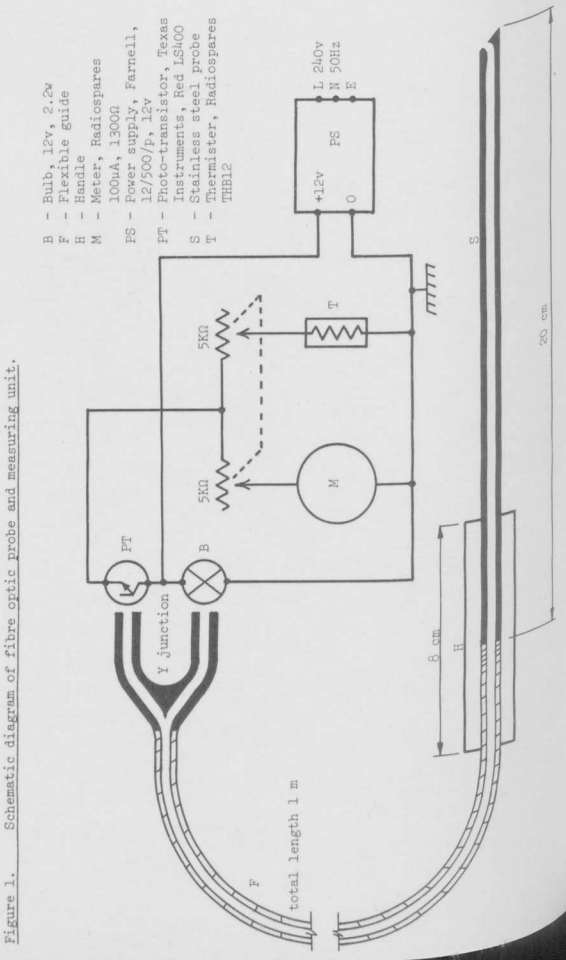
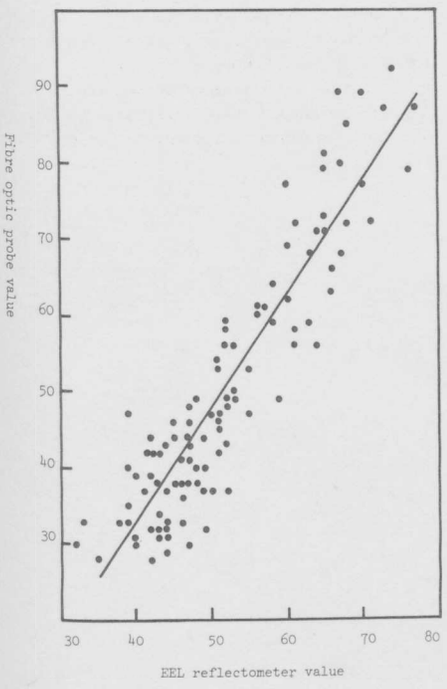


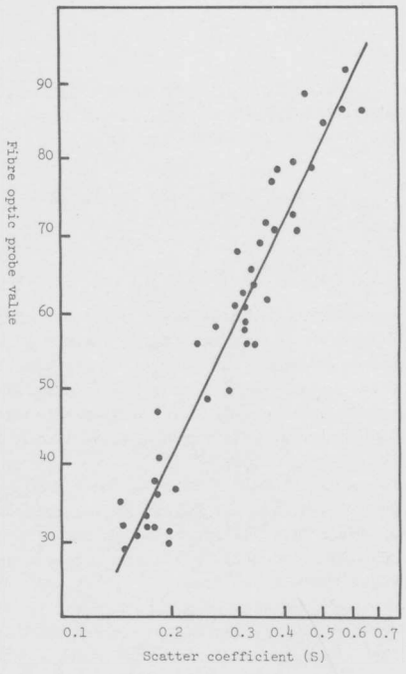
Figure 1. Schematic diagram of fibre optic probe and measuring unit.

Figure 2. Relationship between fibre optic probe value and EEL reflectometer value. Each point is the mean of six values within the M.Longissimus dorsi of one pig.



Probe value = -26.9 + 1.49 (±0.065) EEL value,
t = 22.9, r = 0.92

Figure 3. Relationship between fibre optic probe value and the luminous scatter coefficient (S). Each point is the mean of six values within the M.Longissimus dorsi of one pig.



Probe value = 10.9 + 103.9 (±4.6) $\log_{10}$10S
t = 22.6, r = 0.96