OBJECTIVE COLOUR MEASUREMENTS OF FRESH PORK LOIN A COMPARISON OF THE FAHELLPHO-MARIENSEE, THE GÖFÖ AND THE ELECTRO PHOTOMETERS

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Introduction

A portable instrument which allows the objective measurement of the colour of fresh pork can find much application in the assessment of meat quality, both in breeding and in general experimental work. Several instruments have been developed for this purpose (Lohse & Pfau (1964), Steinhauf et al (1966), Charpentier & Verge (1967) and MacDougall et al (1968)), all of which are battery-driven filter devices. Of these instruments, two were available to us at the time of the experiment, the Fahellpho-Mariensee and the Göfo photometers.

The aim of this work was to compare the Fahellpho and Göfo photometers with a non-portable instrument, the Elrepho (Carl Zeiss, Oberkochen) to see which was the most suitable for indicating subjective scores for the colour of pork loin as given by the Danish National Research Institute for Animal Husbandry.

Experimental

1. Comparison of Fahellpho / Elrepho values and subjective colour score

Samples of longissimus dorsi muscle from the last rib to the hip bone were cut from pig carcasses 24 hours after slaughter. Immediately after removal, the colour of each loin muscle was visually judged by one of the professional judges using a scale developed by the Danish National Research Institute for Animal Husbandry (Clausen & Nørtoft-Thomsen (1961)). The colour of the end of the longissimus dorsi muscle nearest the last rib was then measured 3 times evenly over the surface (one reading at each position) with the Fahellpho photometer. These measurements were carried ut by the same person each time. The measuring surface of the Fahellpho was wiped clean with lens paper between each measurement. A 2 cm thick slice was then cut from the loin at the position of measurement and the slice was vacuum-packed. The samples were allowed to stand 20 - 30 minutes to ensure that the surface pigment was present as myoglobin. The samples were then re-vacuum-packed (to eliminate any meat juice present) and the colour of the slices was measured 3 times on each side using the Elrepho photometer (filter R53). The average values were calculated.

11 This procedure was carried out on 79 longissimus dorsi samples, which were chosen so that as far as possible there was an equal number of samples in each of the colour score groups. The experiment took 4 days to complete.

II. Comparison of Göfo / Elrepho values and subjective colour score

59 samples of longissimus dorsi muscle were chosen and treated as described under I, with 2 exceptions. The colour measurements after visual judging were carried out with the Göfo photometer, and the visual assessment of colour was carried out by a second professional judge.

The average values for each colour score were calculated for each instrument and the relationships between the colour score and the 3 instruments respectively, as well as between 3 instruments themselves were determined.

Results

The average values of the various subjective scores for colour are shown in Tables 1 and 2 for the comparison of the Fahellpho and Göfo photometers respectively, and the equations of the regression lines between subjective colour score and the 3 instruments, and between the 3 instruments themselves, are shown in Tables 3 and 4 respectively.

Comparison of visual colour score and results given by the 3 instruments

All 3 instruments gave values with good linear relationships with subjective colour score. The Fahellpho could indicate the subjective score for colour $\pm$ 0.64 units, the Göfo $\pm$ 0.64 units and the Elrepho $\pm$ 0.60 units (judge no. 1) and $\pm$ 0.80 units (judge no. 2). All values are at the 95 % confidence level. These standard deviation values mean that reflection values for 2 adjacent colour scores are not significantly different from one another, while reflection values of colour scores separated by 1.0 units are.

Comparison of the results given by the 3 instruments themselves

Both the portable instruments gave values for colour which showed good relationships with corresponding values given by the non-portable Elrepho photometer.

Comparison of the subjective colour scores given by the 2 judges

Using the results of the Elrepho measurements, it appeared that judge no. 1 was more consistent in scoring for colour than judge no. 2 (s value was smaller). In addition, the two judgesscored on different levels. The regression line for visual colour score v $R_{Elrepho}$ was on a significantly higher level (by 0.38 units) for judge no. 2.

Discussion

The results showed that the 2 judges were not equally consistent in their scoring for colour, neither were they on the same level, and this was in spite of the fact that both had many years experience in judging the colour of pork loin, and had not infrequently trained together to make their scoring more consistent. This disagreement between observers has been frequently reported in the literature, most recently by Hegarty (1969) and Elliot (1969). In part this disagreement is caused by the inability of the judges to remember the level of scoring when the samples are presented for assessment separately (as in this experiment), and in part it is caused by the fact that the total colour range in the samples presented affects the colour score given (author, unpublished work). At all events an objective method of measuring colour is necessary, if measurements carried out on different occasions are to be compared.

All the instruments tested could give a good indication of the subjective colour of the loin muscle. In all cases, the correlation coefficient between the subjective assessment and the objective measurement was high (0.90 - 0.94), much higher than others reported in the literature. For example, Steinhauf et al (1966) obtained a correlation coefficient of 0.69 between subjective colour scores and Fahellpho values, Weniger et al (1965) a coefficient of 0.74 between subjective colour scores and reflectance values, while Carpenter et al (1965) found coefficients varying from 0.51 to 0.62 between visual assessments of colour and Hunter L values. However, from a practical point of view, each of the instruments has advantages and disadvantages, so that the experimental conditions etc., will dictate which instrument will be most suitable for a given purpose. Of the 2 portable instruments the Göfo is most to be preferred,

since it is quicker and easier to use than the Fahellpho, and is free from the errors introduced by eye fatigue. Although Fahellpho values have been found to vary only slightly with the person carrying out the measurement (Lohse & Pfau (1964)), the number of measurements that can be carried out by a single observer at any one time is limited by eye fatigue. In our experience an observer became tired after measuring about 15 samples (45 individual measurements).

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Table 1. Average values for the various visual scores for the comparison of Fahellpho and visual score

Visual score	Number of samples	$R_{Fahellpho}$	$R_{Elrepho}$
0.5	5	92.6	29.9
1.0	12	92.8	28.9
1.5	15	86.7	26.3
2.0	17	74.9	22.1
2.5	16	68.2	19.4
3.0	14	57.4	16.8
3.5	-	-	-

Table 2. Average values for the various visual scores for the comparison of Göfo and visual score

Visual score	Number of samples	$R_{Göfo}$	$R_{Elrepho}$
0.5	4	21	31.4
1.0	9	27	28.1
1.5	10	30	28.4
2.0	10	37	26.4
2.5	10	52	20.4
3.0	10	60	18.2
3.5	6	63	16.1

Table 3. Relationships between visual score and the 3 instruments.

Experiment	Number of pigs	Equation of regression line	s	r
I	79	Visual score = 5.8072 - 0.0506 $R_{Fahellpho}$	0.32	-0.91
	79	Visual score = 5.2937 - 0.1461 $R_{Elrepho}$	0.30	-0.92
II	59	Visual score = -0.2445 + 0.0547 R_{Gofo}	0.32	0.94
	59	Visual score = 5.6754 - 0.1486 $R_{Elrepho}$	0.40	-0.90

Table 4. Relationships between the 3 instruments themselves

Experiment	Number of pigs	Equation of regression line	s	r
I	79	$R_{Fahellpho}$ = 14.7130 + 2.6956 $R_{Elrepho}$	3.73	0.96
	79	$R_{Elrepho}$ = -3.3439 + 0.3434 $R_{Fahellpho}$	1.33	0.96
II	59	R_{Gofo} = 106.0867 - 2.6284 $R_{Elrepho}$	5.70	-0.93
	59	$R_{Elrepho}$ = 38.1608 - 0.3284 R_{Gofo}	2.01	-0.93