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OBJECTIVE AND SENSORIAL EVALUATION OF PORK QUALITY: A COMPARATIVE STUDY.

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INTRODUCTION

Fresh pork is normally evaluated for quality parameters on a subjective basis at various levels from the slaughterhouse to the consumer. A need for standardization of such judgments is strongly felt, especially in the case of pork intended for processing. This investigation was carried out with the aim of testing the relationship between sensorial evaluation and objective measurement of some pork quality parameters. The first step was to have a team of experts express their evaluation against a common grid. Secondly, sensorial evaluation has to be compared with objective measures.

METHODS AND MATERIALS

The research was carried out in three slaughter sessions. Quality evaluation was performed on the fresh hams just after trimming for Parma ham processing at about 24 hours post-mortem. Quality parameters chosen for sensorial analysis were fat firmness, lean colour and exudation. Lean colour was also measured objectively with a Minolta Chromameter CR200/08 on a fresh cut of *m.semimembranosus* at its caudal end. Fat firmness was measured with a Fat Hardness Meter on the inner layer of subcutaneous fat in between *m.semitendinosus* and *m.biceps femoris*. Duplicate measures were taken both for colour and for fat firmness. Sensorial evaluation of lean colour took place under a light intensity of 1000 lux, with solar light spectrum lamps, and aided by the use of the standard meat quality pictures produced by Agriculture Canada (undated). No standards were available for lean exudation and fat firmness and, therefore, a set of fresh hams was chosen to create commonly agreed upon standards for these characteristics.

Parameters evaluated by sensorial analysis were described by a 5-point scale (Table 1) and the evaluation was carried out by a team of five experts.

Of the three slaughter sessions, the first dealt with a reduced number (i.e.,:45) of hams which were evaluated off the trimming line. During the second and the third sessions, the hams (421 and 425 respectively) were evaluated on the line at a processing speed of about 400 to 500 pieces per hour.

Just after trimming, during the second and third sessions, a sample of subcutaneous fat was collected from the area where the firmness measure had been taken, packaged under vacuum and stored at -20°C until used for the determination of iodine number (A.O.A.C., 1984).

All carcasses were classified according to the EEC classification grid. pH was measured on *m.semimembranosus* at 45 minutes and 24 hours post-mortem.

The results were analyzed with the Statistical Analysis System (S.A.S., 1985). In the tables, statistical significance has been indicated by "*=P<0.05; **=P<0.01; ***=P<0.001".

RESULTS AND DISCUSSION

Summary statistics of the collected data from the three slaughter sessions are given in Table 2. Pigs were of the heavy type with a cold carcass weight above 120kg and an average lean content falling into class "R" of the European grid. The incidence of low quality meat, whether PSE, DFD, or with a 24 hours post-mortem pH<5.40, was low. None of these conditions exceeded 2% in any of the three sessions.

Average sensorial values varied around the normal condition especially as regards colour and exudation. More most frequent classes are, in order, number 2, 3 and 4 for lean colour and exudation, and class 2 and 3 for fat firmness. There was a tendency towards soft fat, as indicated by class 2 which was more common at the second slaughterhouse.

Sensory evaluation, as performed in this investigation, cannot be compared with sensory evaluation carried out by a panel under laboratory conditions. A slaughterhouse environment is certainly a difficult one for sensory evaluation, but hams cannot be evaluated in a laboratory since they are a perishable and valuable product. Trimming lines work normally at relatively fast speeds, ranging from 500 to 900 pieces per hour. Evaluation under such conditions is difficult because it is not easy an easy task to hams off the line.

Among the characters studied, sensory evaluation pf exudation was complicated by the lack of standards. The difficulties of obtaining fat firmness scores were further compounded with difficulties in measuring fat temperature.

The Fat Hardness Meter takes only three seconds to stabilize prior for a firmness measurement while a thermocouple requires at least 10 seconds to measure temperature. The consequence, at least in the working conditions of the present investigation, was that the exact temperature of the fat of each ham undergoing firmness measurement could not be known. For this reason an average temperature has been obtained from separate measurements of one from every 10 trimmed hams. Such a temperature was around 3 to 4°C in the first two sessions but very near to 0°C in the third session. The firmness values have not been adjusted to a standard temperature as suggested by the producers of the Fat Hardness Meter but simply compared with sensorial values.

Sensorial evaluation of colour has been related with the C.I.E. L*,a* and b* values obtained with the Minolta measures. Chroma (Saturation) and Hue angle have also been considered (McLaren, 1980). The results (Table 3) show highly significant relationships of sensorial evaluation with the L* value and hue angle. The perception of pork colour by the human eye appears to be influenced, first by the degree of lightness and then the balance between the red (a*) and the yellow (b*) coordinates. The intensity of the red in itself (a*) and the global colourfulness (Chroma or Saturation) of the sample play a less important role. Meat of low quality (pale or very pale) is therefore perceived as lighter (in the sense of a great luminosity) and with a pronounced yellow tint, but not necessarily with lower red or colour intensities. Similar results were reported by Chizzolini *et al.* (1993a; 1993b) and Murray and Jones (1988).

Exudation, as evaluated by experts, is better related to L* and Hue angle than to the other colour coordinates. Correlation coefficients are lower, as compared to colour measurements. These results, nevertheless, are an interesting validation of the importance of L* and Hue angle. Higher coefficients between sensorial colour and exudation could suggest a leading effect of the former over the latter.

Among the other parameters measured (i.e., pH, carcass weight, meat content and trimmed ham weight) only pH appears to have an influence on colour and exudation. Correlation coefficients are low. This investigation has come across very few extreme cases of PSE, DFD or acid meat, and, therefore, the measurement of pH cannot be of great value, in this case.

Fat firmness evaluations (Table 4) are linked by correlation coefficients ranging from 0.51 to 0.67. They are lower than the ones regarding meat colour. However, the lack of standards and the problems with temperature measurement of the Fat Hardness Meter could be a reasonable explanation. Both sensorial and objective evaluations have been compared with iodine number. Correlation coefficients are relatively high as for the second session but lower in the third. The reason could lie in the lower fat temperature in session 3. Further trials, which are now under way, have up to now given correlation values around 0.5 between objective firmness and iodine number.

Fat firmness was also related to carcass parameters, such as weight, meat content and fat thickness, although to a lower extent as compared to iodine number.

CONCLUSIONS

This research has shown that subjective evaluation of pork colour is best expressed, under the C.I.E. L*, a* and b* system, by lightness (L*) and by the balance between the red and the yellow coordinates (Hue angle). Objective measurement of subcutaneous fat firmness, carried out by the Fat Hardness Meter on the trimming line of cold fresh hams, has met with problems as regards temperature measurement.

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REFERENCES

AGRICULTURE CANADA. (undated). *Pork Quality, Publication 5180/B*. Ottawa, Canada.

A.O.A.C. 1984. *Official Methods of Analysis*. Washington D.C., Association of Official Analytical Chemists. 14th Ed.

CHIZZOLINI, R., NOVELLI, E., BADIANI, A., ROSA, P., and DELBONO, G. 1993a. *Meat Sci.* 34:49.

CHIZZOLINI, R., NOVELLI, E., BADIANI, A., DELBONO, G., and ROSA, P. 1993b. *Meat Sci.* 34:79.

McLAREN. 1980. In: *Development in Food Colours*. Applied Science Publ., London. p.27.

MURRAY, A.C., and JONES, S.D.M. 1988. In: JONES, S.D.M., MURRAY, A.C., SATHER, A.P., JEREMIAH, L.E., and GREER, G.G. (eds). *Pork Quality: A Technical Review*. Techn. Bull. 2. 11E. Lacombe Research Station, Agriculture Canada.

S.A.S. 1985. *SAS User's Guide: Statistics*. SAS Institute, Cary, N.C.

Table 1. Sensorial evaluation grid.

Score	Lean		Fat
	Colour	Exudation	Firmness
1	very pale	very wet	very soft
2	pale	wet	soft
3	normal	normal	normal
4	dark	dry	hard
5	very dark	very dry	very hard

Table 2. Summary of the data collected (Mean and S.D.).

	Session 1	Session 2	Session 3
Carcass wt, kg	122.05 ± 12.77	140.28 ± 14.83	131.73 ± 16.16
Meat content,%	49.66 ± 3.07	46.34 ± 3.56	47.00 ± 3.88
Ham wt, kg	11.10 ± 0.95	13.29 ± 1.31	12.64 ± 1.40
pH 45min	6.41 ± 0.23	6.39 ± 0.27	6.42 ± 0.23
pH 24h	5.74 ± 0.21	5.57 ± 0.10	5.72 ± 0.15
L*	45.76 ± 3.82	47.28 ± 3.49	46.81 ± 4.12
a*	9.16 ± 1.49	10.03 ± 1.77	8.57 ± 1.84
b*	4.24 ± 1.01	5.31 ± 1.09	4.45 ± 0.99
Hue angle	0.43 ± 0.08	0.49 ± 0.08	0.49 ± 0.10
Saturation	10.12 ± 1.62	11.38 ± 1.90	9.70 ± 1.86
Firmness	742.10 ±100.31	503.92 ±124.46	702.42 ±114.29
Iodine #	60.36 ± 1.77	61.20 ± 3.11	62.40 ± 3.35
Sensor. colour	2.86 ± 0.77	2.59 ± 0.56	2.66 ± 0.53
Exudation	2.89 ± 0.34	2.74 ± 0.47	2.75 ± 0.32
Sensor. firmness	2.55 ± 0.63	2.32 ± 0.58	3.18 ± 0.69

Table 3. Correlation coefficients between sensorial and objective evaluations of pork colour.

	Session 1	Session 2	Session 3	Sessions 1-3
L*	-0.694***	-0.589***	-0.553***	-0.577***
a*	0.229	0.229***	0.359***	0.240***
b*	-0.406**	-0.313***	-0.225***	-0.290***
Hue angle	-0.690***	-0.594***	-0.546***	-0.566***
Saturation	0.078	0.103	0.254***	0.124***

Table 4. Correlation coefficients between sensorial evaluation of pork exudation and objective colour measures.

	Session 1	Session 2	Session 3	Sessions 1-3
L*	-0.409**	-0.291***	-0.255***	-0.275***
a*	//	-0.199**	//	-0.089*
b*	-0.224	-0.345***	-0.215***	-0.278***
Hue angle	-0.332*	-0.192***	-0.252***	-0.221***
Saturation	//	-0.253***	//	-0.145**
Sensory colour	0.399***	0.529***	0.355***	0.452***

Table 5. Correlation coefficients between sensorial and objective evaluations of fat firmness and with iodine number.

	Fat firmness objective	Iodine #
Sensorial		
Session 1	0.566***	
Session 2	0.505***	-0.246**
Session 3	0.574***	-0.631***
Sessions 1-3	0.671***	-0.228***
Objective		
Session 1		
Session 2		-0.343***
Session 3		-0.603***
Sessions 1-3		-0.240***