



EFFECT OF PORK PIGMENT ADDITION ON THE COLOUR OF COOKED HAMS FROM EXUDATIVE MEAT

M.A. Oliver^{*}, J. Polo[§], N. Panella^{*}, J. Arnau^{*}, M. Gil^{*}, M. Contreras[§], S. Morera[§] and J. Ruiz[§].

^{*} IRTA. Centre de Tecnologia de la Carn. Granja Camps i Armet. 17121 Monells. Girona. Spain.

[§] APC EUROPE, S.A. R&D Department. Avda. Sant Julià 246-258. Pol. Ind. El Congost. 08400 Granollers. Spain.

Background

Pork quality refers to meat technological aspects such as colour, water-holding capacity, cooking losses or texture, as well as to sensorial properties. The genetic background of the pigs (Oliver et al., 1994; Gil et al., 2003) and the ante-mortem treatment constitute sources of variation in pork quality (Van der Wal, Engel & Hulsege, 1997). Pale, soft and exudative meat (PSE meat) may appear as a result of both factors (Gispert et al., 2000) and affects the colour and quality of cooked ham. The pale colour of PSE meat is explained by the protein denaturation (Bendall & Wismer-Pedersen, 1962). PSE is a technological defect found on average in 6% of the hams in Spain, but this percentage can be higher depending on genetics and pre-slaughter treatment in the abattoir (Gispert et al., 2000). As a consequence, the hams become exudative and some muscles can be very pale or show bicolour with a decrease in the quality of the final product. Moreover, other factors such as the diet can influence meat colour as well. In this sense, Ramirez et al. (2002) found that supplementation with Fe in the pigs' diet modified the lightness of the meat positively, producing a reddish pork meat. On the other hand, colour stability in cooked ham is affected by light and by oxygen content and probably by some components of the brine such as sodium ascorbate (Farkas et al., 1990).

Objectives

The aim of this study was to ascertain the effect on the colour and colour stability of the final product from exudative hams by the addition of porcine pigments to the brine used in the processing of cooked hams.

Materials and methods

Selection of the raw hams: Thirty-three hams were selected at 15 h *postmortem* (pm) in a local processing plant on the basis of pH and electrical conductivity (EC) in the *Semimembranosus* muscle (if pH < 5.6 or CE > 6 μ S, PSE meat) in order to have three groups of 11 hams each: group 1 (control, with normal meat quality hams), group 2 (control, with exudative hams) and group 3 (APRORED -pork pigments- with exudative hams). The weight of the hams was 10,62 \pm 0,74 kg.

Pork pigment: APRORED is a 100% water soluble food preparation based on pork pigments (stabilized hemoglobine) used as an ingredient in the meat processing industry (APC Europe).

Cooked hams process: The hams were weighed before and after muscles were boned-out. Subcutaneous and intermuscular fat, connective tissue, bone and rind were removed. Two hundred and ten grams of brine per kg of meat were injected into the pork legs. The brine - containing 0.35 % phosphate, 0.05 % ascorbate, 0.80 % dextrose, 0.05 % carragenate, 1.7 % NaCl, 0.01 % nitrite, and with 0.04 % of APRORED in the case of group 3 - was injected into the pork legs to increase their weight by 21 %. After injection, raw hams were placed in the vacuum tumbler and a vacuum was drawn to 200 mbar. The tumbling schedule was set for the hams to rotate a total of 2100 revolutions at 4 °C (3 periods of 60-90 min of continuous tumbling). The hams were packed into aluminium moulds and then placed in an oven and cooked to an internal temperature of 65 °C using a cabinet temperature of 70 °C. The total cooking time was approximately 8 h.

Colour measurements: Colour measurements were carried out with a Minolta Chroma Meter CR-200 using the white tile provided by the manufacturer as the internal standard and set to illuminant C. Triplicate measures were taken on *Biceps femoris* (BF) and *Semimembranosus* (SM) muscles. The measurements were expressed as CIE L*a*b* (CIE, 1976). After this, a study of the stability of the colour was done on slices 15 mm thick on the SM and BF muscles of cooked hams. Measurements at time 0 were taken immediately after cutting the slices, and then at times 15, 30 and 120 minutes. The pigment content was determined in the fresh and cooked hams using the method of Hornsey (1956) based on the determination of total pigments by means of extraction with acetone as the principal solvent (Hornsey, 1956).



Sensorial evaluation of the ham colour: The red colour of cooked ham was assessed by two-experienced panellists according to a 10 point scale for red colour (1 =very pale; 10 = very dark).

Statistical analysis: Data were analysed using the General Linear Model procedure of the Statistical Analysis System (SAS., 1988).

Results and discussion

Table 1 shows the Least Squares Means and Standard Errors of the meat quality variables for the three groups of hams selected on the basis of pH and EC at 15 h p.m. in the SM muscle.

Meat quality: pHu was significantly lower in groups 2 and 3 than in group 1 (5.55, 5.54 and 5.67 respectively) as expected. With respect to EC, group 1 showed lower values (4.35) than groups 2 and 3 (15.81 and 13.84). Although significant differences were found between groups 2 and 3, they were considered not important from the meat quality point of view: both groups showed a very high mean value of EC indicating exudative meat (Oliver et al., 1991).

Colour: The variable related to colour (L^*) measured in the SM of the fresh hams was significantly different in group 2 in relation to groups 1 and 3. No significant differences have been observed in L^* value in the BF muscle although there was a tendency to have pale meat in group 2. With respect to pigment content (acid haematin) no significant differences in fresh or cooked hams were found. However, the cooked hams of group 2 presented lower concentration of acid haematin (28.97) than the other groups (34.06 and 33.19). This result could indicate a positive effect of APRORED in the colour of the final cooked ham obtained from exudative hams. This effect could also be observed in the visual assessment of the cooked hams: there was an increase in visual redness (VS) in both muscles in group 3 (Table 1), which in BF was statistically significant. The correlation between L^* value and Visual assessment in SM and BF muscles was -0.60.

Colour stability: The L^* value after slicing was higher in group 2 for both muscles at all times (Fig. 1), but the difference was not significant. The a^* value was significantly higher for group 3 than for groups 1 and 2 at all times, due to the Aprored addition. Regarding b^* value, no significant differences were found in SM and BF muscles at any time.

Conclusions

The study of the colour in cooked hams from normal and exudative meat indicated that the group of hams treated with APRORED had L^* and a^* values and visual redness assessment more similar to normal hams than to exudative hams, probably as a consequence of the effect of pigment addition on the colour of cooked ham. However, a second trial is in course to confirm these preliminary results.

Table 1. Least Squares Means and Standard Errors of meat quality variables for the three groups of hams studied in the *Semimembranosus* and *Biceps femoris* muscles.

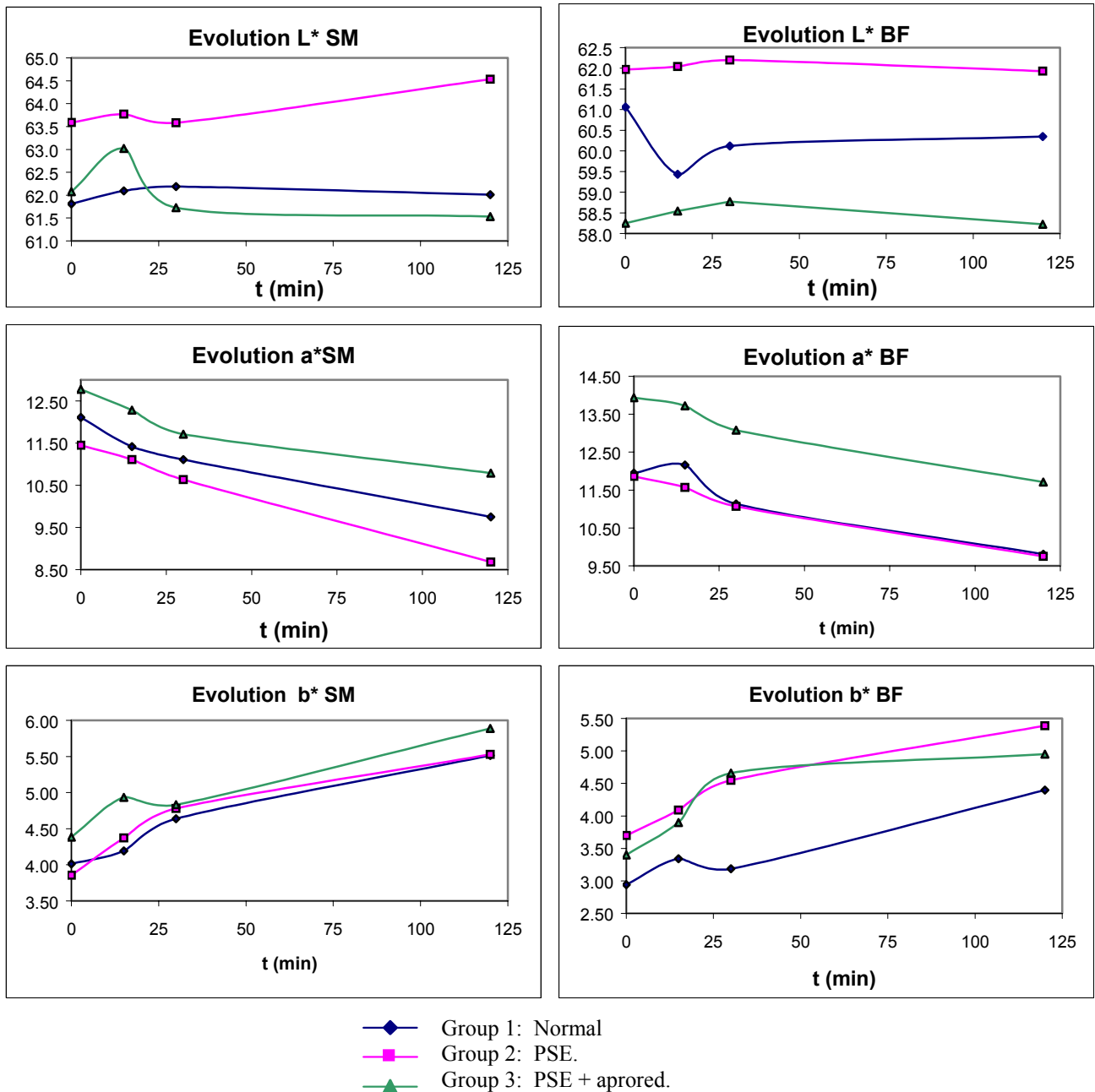
	GROUP 1		GROUP 2		GROUP 3	
	(N)		(PSE)		(PSE+APRORED)	
	LSM	S.E.	LSM	S.E.	LSM	S.E.
<i>Meat Quality variables in fresh hams</i>						
pHu (in SM)	5.67 ^a	0.03	5.55 ^b	0.03	5.54 ^b	0.03
EC (μ s) (in SM)	4.35 ^c	0.31	15.81 ^a	0.31	13.84 ^b	0.31
L^* SM	45.25 ^b	0.95	48.59 ^a	0.945	46.61 ^b	0.945
L^* BF	45.25	0.74	46.80	0.74	45.52	0.77
Acid haematin (μ g/g) in SM	27.70	2.85	29.12	2.99	29.30	2.86
<i>Pigment content (acid haematin) and visual assessment of cooked hams</i>						
Acid haematin (μ g/g) in SM	34.06	3.03	28.97	3.18	33.19	3.03
Visual redness (VSM) ¹	2.75	0.13	2.64	0.13	3.04	0.13
Visual redness (VBF) ¹	3.11 ^b	0.14	2.92 ^b	0.14	3.59 ^a	0.14

¹: Visual assessment of the red colour in the SM and BF muscles from 1 (very pale) to 10 (very red).

^{a, b, c}: Least Squares Means with different superscripts within a row differ significantly ($p < 0,05$)



Fig.1. Evolution of CIELAB variables in *Semimembranosus* (SM) and *Biceps femoris* (BF) muscles at different times after slicing for the three groups of hams studied.



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