TECHNOLOGICAL ABILITY OF THE PSE/DFD STATUS IN A MODEL COOKED PRODUCT

ROSEIRO L.C., SANTOS C., GON, ALVES H., VIEIRA J. and MELO, R.

Instituto Nacional de Engenharia e Tecnologia Industrial, Departamento de Tecnologia das Ind_strias Alimentares, LISBOA - Portugal

S-IVB.26

SUMMARY

The present work concerns the study of technological ability of the PSE/DFD status in a model-cooked product.

Samples of the M. *longissimus dorsi* from eighty pork carcasses were divided into three quality categories (PSE/NORMAL/DFD) according to pH1 (60 min. *post-mortem*), pH_{24}, drip $losses_{24}$ and $color_{24}$ (24h *post-mortem*). The assays consisted in injecting the meat 24h *post-mortem* with two curing brines, with and without phosphates. The injected meat was cooked at 80¡C during 1h. The technological ability was evaluated through the following parameters: brine gain, cooking loss, final product color and tenderness. A sensorial evaluation took also place for the salt taste and tenderness characteristics.

The analysis of results showed, for the two brines used, significative differences among the different pork quality categories concerning cooking losses and final product tenderness . In meats injected with brine without phosphates, the PSE showed cooking losses greater (30,3%±2,85) than NORMAL (27,7%±3,12) and DFD (18,8%±4,27) meats. When curing brine with phosphate was used, the PSE showed cooking losses (18,7%±3,45) identical to the NORMAL meat (18,9%±3,06), but greater than DFD (13,0%±1,71). The same tendency was found in the tenderness analysis.

The color after cooking as well as the final salt taste did not influence the product quality, not showing significative differences in the three meat categories.

Introduction

The technological influences of PSE pork on meat products are well known (Wirth, 1980). The PSE meat is a consequence of the occurrence of a fast muscular glycogen to lactic acid conversion, promoting an early *post-mortem* acidification, when the carcass temperature is still high. As a consequence, *rigor mortis* is reached very soon (45 minutes *post-mortem*) and the denaturation of muscle sarcoplasmic and contractile proteins gives a poor appearance to the meat (paleness) and a poorer water holding capacity, reflected by higher drip and cooking losses. A different problem but also related to the same *post-mortem* process of glycolysis is referred to the DFD meat (Dark, Firm, Dark) in which the muscle glycogen content have been depleted before slaughter, and the complete *post-mortem* acidification phenomenon is not possible. This meat appears darker than usual and with a higher ultimate pH, making easier the bacteriological deterioration and decreasing shelf life.

When used by meat processors, these two meat categories can promote several technological problems of great economic concern. As a consequence of the reduced water holding capacity of PSE meats the derived products are supposed to appear dryer, harder and showing a low processing yield. The salt content could be higher and the color paler than normal (Severini *et al.*, 1989). On other hand, the DFD has been referred to be advantageous as a raw material for cured cooked products and, in fact, is often recommended for such products (Wirth, 1980). The cooking process ensures an adequate shelf life and its excellent water holding capacity allows higher yields than in products made from normal meat quality.

The objective of this study was to appreciate the technological ability of the PSE and DFD meats in a model cooked product.

Material and methods

Eighty pork samples from the left side *Longissimus dorsi* between the last dorsal and third lumbar vertebra (about 400g each), were removed from pig carcasses (LW or LW cross breeds; LWxLR) randomly selected on line at approximately 1 hour after slaughter. After pH_1 measurements (Portable pH meter HI 8314, HI 2031 electrode, Hanna Instruments, Limena, Italy), one steak 1.5cm thick and weighting approximately 80 g was cut from the meat block, cleaned of superficial fat, and packed in other sealed plastic bag. After a storage period of 24 hours at 4¡C, this slice of meat was used for pH_{24}, drip loss (Honikel *et al*, 1986), color (L,a,b) and total pigment content (Hornsey, 1956) in order to distinguish the three meat categories: PSE (pH_1 <5.9; Lvalue >53; drip loss>2%), Normal (Lvalue <53; drip loss<2%), DFD (pH_{24} >6.0).

For technological assays, the samples were half divided (±150g) being each piece injected (±10%) and immersed (24 hours) using two different brines (with and without phosphates). The composition of the brines was calculated in order to obtain a final product with a NaCl and an added P_2O_5 content of the 2% and 0.5%, respectively. Before to be vacuum packed the cured meats were weighted (partial and total brining gain determination - see formulae) and then cooked at 80¡C during 1 hour. After cooking they were immediately cooled in ice-water and reweighted (partial and total cooking loss evaluation - see formulae) being afterwards repacked and stored at ±4¡C over night, for further color (Colorgrad System/05, BYK - Gardn Silver Spring, MD 20910 USA), tenderness (tenderometer J.J. Instruments) and salt content determination (AOAC, 1980).

Subjective tenderness and salty taste have also been evaluated through a panelist group. For the objective tenderness evaluation the cooked meat was cut in blocks (10mmx20mmx50mm) being used a Volodkewich Jaws System (Slaugteries Forskningsinstitut, 1993) across the fibers (compression speed - 7cm/min; compression rate - 60%).

The data were analyzed using a Factorial model analysis of variance based on a completely randomized block experimental design (Norman and Bailey, 1981). Multiple range analysis of means was performed by the LSD test (Least Significant Difference test) to 95% of the probability.

Results and discussion

Table 1 shows the means, standard deviations and F test results found for the fresh meat characteristics related with the different meat categories (PSE, Normal and DFD).The pH_1, pH_{24}, drip losses 24h *post-mortem* and L value showed significant differences ($p<0.001$) among the three meat categories. No differences were found for the a and b color parameters and total pigment.

Brine Gain

Table 2 represents the means and standard deviations of the brine gain for the different meat quality groups. When phosphates were not added no significant differences were observed on the partial brine gain among the three meat categories. However, the water absorption of the PSE samples was slightly higher (0.7%) that the Normal ones.

The addition of phosphates originated an increase in the brine gain (partial and total) whatever the considered meat category. This increasing was always greater for PSE and Normal meat (2%) than for DFD meat (1%).

Adversely, when phosphates were added, the PSE situations showed a greater partial brine gain, compared with Normal and DFD meats. However, comparing the total brine gain among the three meat quality groups, the PSE meat showed a lower value (Figure 1). Identical results were obtained by Severini et *al.* (1986). According them, this is a consequence of the high drip loss during storage period before the brine injection. Structural changes in the muscle cell membrane have been suggested to explain the high drip loss in PSE meat (Fisher and Honikel, 1986; Honikel *et al*, 1986). This increasing membrane permeability could lead to an higher brine absorption and retention (Severini *et al.*, 1986).

Cooking Losses

The results show significant differences among the different meat categories when a brine without phosphates was used (Table 3). In this condition the PSE samples revealed greater cooking losses than Normal and DFD meats. However, the addition of phosphate turned the cooking losses of PSE and Normal meats identical but always greater than DFD (Figure 2).

The explanation for this cooking loss uniformity between PSE and Normal meats must be related with the structural changes of the myofibrillar lattice promoted by the polyphosphates, which increases the meat water holding capacity and decreases the cooking loss of fluid. This less differentiated behavior between PSE and Normal meats when phosphates are added was also found by Barton-Gade (1984).

Despite the DFD meat to be considered an abnormal quality condition, its use in cooked products processing represents a great economical advantage, expressed by the significant higher cooking yields.

Final Product Tenderness, Color and Salt Content

The results of the tenderness, color parameters (L, a, b) and salt content of the final product are presented in the Table 4. Significant differences were observed for the three meat categories. The PSE meats processed without phosphates originated final products less tender than Normal and DFD meats. However, when phosphates were used the final product obtained from the PSE reached a tenderness value similar to Normal meats.

No significant differences were noted on the final product color parameters (L, a, b) and salt content for the three meat quality groups (Table 4).

Regarding the uniformity of the final color, such fact can be explained by the inexistance of significant differences on total pigment content among the three meat quality groups (Table 1). Identical results are referred by Taylor et *al.* (1973) after bacon preparation from PSE and Normal *Longissimus dorsi* muscle.

Salter final meat products prepared from PSE meat are seldom referred (Severini *et al.*, 1986; Severini *et al.*, 1989). This could result from the more contracted PSE tridimensional myofibrilllar structure which would originate less available polar groups on the protein chains for the binding of saline ions.(Wirth, 1980; Severini *et al.*, 1986). In our study the low amount of salt addition (2%) and the introduction of polyphosphates could be the basic factors related with the impossibility of sensoric differentiation of the salty taste among the different samples.

References

AOAC. (1980). Methods of Analysis, Thirteenth Edition

Barton-Gade, P., (1984). Meat Quality Characteristics and their Importance for Processed Pork Products. Slagteriernes Forskningsinstitut, August.

Fischer, K. e Honikel, K.O. (1986) Electric Conductivity as an Indicator of Meat Quality and its Relationships to Glycolytic and Structural Changes in Pork. Workshop "On line and non Destructive Methods to Measure Meat Characteristis2. Theix, November.

Honikel, K.O.; Kim, C.J.; Hamm, R. e Roncales, P. (1986). Sarcomere Shortening of Prerigor Muscles and its Influence on Drip Loss. Meat Sci. 16, 267-282.

Hornsey, H.C., (1956). The Colour of Cooked Cured Pork. J. Sci. Food Agric., 7, August.

Norman, T.J. e Bailey, M.A., (1981). Statistical Methods in Biology. (2»ed) Ed. Hodder and Stoughton.

Severini, M.; Vizzani, A. e Cenci, G., (1986). Salt Uptake and Weight Change After Curing in Normal and PSE Porcine L. dorsi Muscle. In Proceedings of a 32th International Congress of Meat Science and Technology, Ghent, Belgica, p. 323.

Severini, M.; Vizzani, A. e Cenci, G., (1989). Problems Associated with Processing PSE Pigmeat for Aged Cured Hams and Loins. Ital. J. Food Sci., 1, 65-68.

Slagteriernes Forskningsinstitut. (1993). Method for Objective Determination of Meat Tenderness. Danish Meat Research Institute, DK 4000 Roskilde, Denmark.

Taylor, A.A.; Dant, S.J. e French, J.W., (1973). Processing Wiltshire Bacon from PSE-prone Pigs. J. Food Technol.. 8, 167.

Wirth, F., (1980). El pH y la Elaboraci___n de Productos C‡rnicos, Fleischwirtsch, 60, 24.