A trial for early prediction of PSE and DFD pigmeat by measuring pH and the percentage of PAS-positive fibres

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SUMMARY: Longissimus dorsi muscles taken from 36 heavy pigs were evaluated for the pH and the percentage of fibres with glycogen at 2 hours after slaughter. On this basis, the final quality of the meat was predicted, with special regard to DFD and PSE conditions. Then the muscles were classified according to the characteristics showed at 24 hours p.m., which are mostly relevant for processing aged cured products. A good agreement was found between the prediction and the actual final quality, even though a wide range of colour values was observed among the normal muscles.

INTRODUCTION: The total amount of meat and fat are very important characteristics to be evaluated for grading pig carcasses.

The quality of lean meat and fat should also be taken into consideration for carcasses of heavy pigs, which are currently used to produce aged cured hams like the Italian "prosciutto crudo" and aged cured loins like the Italian "lonza" or "lombetto", since salt and water exchanges during the curing period and dehydration during the aging period are greatly affected by some characteristics of the raw material.

Products derived from poor quality meat frequently show low quality and even defects which make them at times unfit for human consumption, especially if the raw material is thought to be of standard quality and therefore is processed according to standard procedures (RUSSO et al., 1989; SEVERINI et al., 1989). Changes in some processing steps can reduce and partially eliminate the negative effects (MAGGI and ODDI, 1988). Therefore, knowing quality of the meat before processing is of utmost importance in selecting the most suitable raw material for the various needs.

DFD and PSE are two widely known conditions which make the meat unsuitable for high quality aged cured products because the muscles show an atypical ability to absorb salt and lose water (SEVERINI et al., 1986). The proper detection of these conditions, whether severe or slight, can prevent technological disadvantages and economical losses.

This research was carried out to collect further data on the relationship between the muscular glycogen content early after slaughter and the final DFD and PSE conditions in pig meat.

MATERIALS AND METHODS: Samples of Longissimus dorsi muscles taken from 36 heavy pigs (live weight > 140Kg) at the level of the 4-8th ribs were used for this experiment. The animals were slaughtered in the winter of 1990-91 in a commercial abattoir after electrical stunning and the carcasses were dressed as usual.

The muscles were selected by evaluating the pH at 45 min post mortem and then transported to our laboratory in a chilling bag. At 2 hours p.m. the pH (pHi) was measured again and the water holding capacity (WHCi) was evaluated by using the filter paper method and calculating the meat area / fluid area ratio. Samples of the central part of the muscles were frozen, sectioned and stained according to the PAS method to detect glycogen in the fibres. No less than 300 fibres, randomly selected on microscopic fields, were evaluated for the glycogen

content and classified into three groups: positive, weakly positive and negative.

At 24 hours p.m. the pH (pHu), WHC (WHCu) and colour reflectance of the freshly cut surface (Minolta Chromameter CR 200, CIE, L* a* b* system, 1976) were measured.

On the basis of the pH value and the percentage of glycogen-positive / glycogen-negative fibres detected at 2hr after slaughter the muscles were classified as possibly normal, DFD and PSE. At 24hr the muscles were definitely classified on the basis of all measurements carried out and compared to the previous prediction.

RESULTS AND DISCUSSION: The data collected at 2hr after slaughter and the final expected quality are reported in Table 1 and Figure 1. The pH reached by the muscle at 2hr p.m. is the result of the glycogenolytic-glycolytic activity which took place up to that time while the percentage of fibres which still had a certain amount of glycogen represents the reserve for the glycolytic metabolism which should lead to a further decrease of the pH (SEVERINI et al., 1990).

Therefore, muscles with a relatively high pHi and a high percentage of strongly PAS-positive fibres were predicted to have a low ultimate pH and a good final quality, whereas those with a very large number of weak PAS-positive and PAS-negative fibres were expected to present a slightly high and high final pH and to be normal/slightly DFD and DFD, respectively. In the first case the muscles are likely to have derived from non stressed pigs and in the second case from pigs which were stressed before slaughtering in such a way that the glycogen store was greatly reduced, both in SR-pigs or SS-pigs.

On the contrary, muscles with relatively low pHi probably derived from SS-pigs. However, those with a very high percentage of PAS-negative fibres might have been weakly stressed

TABLE 1

Group	n. samples	pHi	% fibres with PAS reaction average value (min./max. values)			prediction
			+	±	-	
A	13	> 6.20	67.7 (30-80)	11.8 (0-18)	19.8 (4-40)	normal
B	3	> 6.20	6.0 (0-18)	68.7 (53-77)	25.3 (23-29)	normal/slightly DFD
C	7	> 6.20	0.0	20.7 (0-65)	79.3 (35-100)	DFD
D	3	6.02-6.05	0.0	11.3 (0-32)	88.7 (68-100)	slightly DFD
E	5	5.99-6.08	21.2 (0-61)	33.6 (11-46)	45.2 (28-61)	slightly PSE
F	5	< 5.80	0.0	1.0 (0- 2)	99.0 (98-100)	PSE

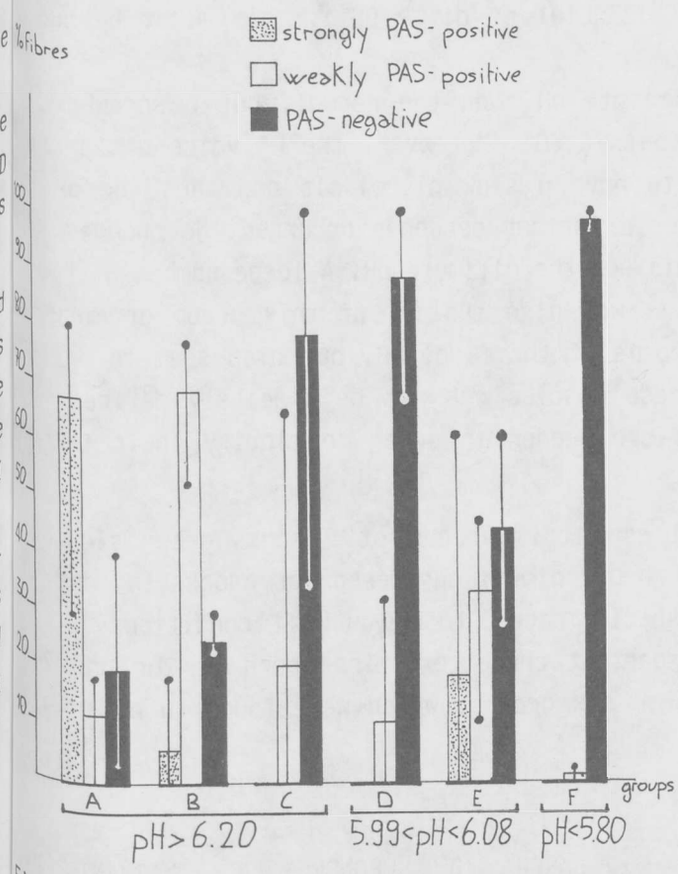

Fig. 1-Distribution of fibres with PAS-reaction

before slaughtering and therefore they were expected to show at least several characteristics of the slightly DFD muscles. But those with a high percentage of strong and weak PAS-positive fibres were predicted to become slightly PSE because they showed a relatively fast drop in the pH post mortem together with a large store of glycogen to be metabolized.

Finally, muscles with a low pHi and very few or no PAS-positive fibres were classified as PSE muscles because of their very fast glycolytic rate.

Table 2 shows the characteristics the muscles grouped in Table 1 presented at 2hr and 24hr post mortem.

The muscles of all six groups can be classified as was predicted, except one in group C. At 24hr p.m. this sample showed a lower pH (pHu 5.87) and was paler (L* 49.35) than the other muscles gathered in the same group at 2hr after slaughter. Indeed, the final characteristics of this

TABLE 2

Average values ±sd of pH, WHC and colour at 2hr and 24hr post mortem

Group	pH-2hr	pH-24hr	WHC-2hr	WHC-24hr	colour (24hr)		
					L*	a*	b*
A	6.45 ±0.16	5.65 ±0.13	1.33 ±0.73	0.60 ±0.10	47.85 ±3.19	8.77 ±2.94	5.05 ±1.39
B	6.53 ±0.15	5.92 ±0.07	0.69 ±0.05	0.65 ±0.12	47.40 ±2.39	5.99 ±1.15	4.19 ±0.48
C≡	6.45 ±0.20	6.37 ±0.21	1.22 ±0.62	0.89 ±0.29	41.67 ±2.27	9.34 ±1.07	3.89 ±0.58
D	6.04 ±0.02	6.04 ±0.03	1.15 ±0.12	0.69 ±0.11	44.58 ±1.40	7.75 ±0.26	4.03 ±0.25
E	6.05 ±0.03	5.68 ±0.06	0.86 ±0.18	0.54 ±0.05	52.04 ±1.76	8.13 ±1.75	5.67 ±0.90
F	5.75 ±0.05	5.67 ±0.08	0.72 ±0.11	0.57 ±0.04	51.10 ±2.11	9.14 ±1.90	5.60 ±0.87

≡ except one sample not homogeneus with the group.

muscle were not at all in disagreement with the prediction of DFD, but simply less severe and defined. The ultimate pH, in fact, was higher than normal, but not as high as in the severe DFD muscles, while the L* value was even higher than in normal muscles, a* value was the lowest among all the groups and b* value was very close to that of DFD muscles. On the other hand, a certain degree of variability in the colour was observed and a number of pale muscles detected among normal and slightly DFD muscles of groups A and B.

The results of studies carried out on muscles of heavy pigs showed that a wide range of variability in the colour can be detected in normal muscles of good quality carcasses

classified according to several parameters (CHIZZOLINI et al., 1991). This might be due to special treatment in pig feeding and husbandry.

Group B muscles had a slightly higher ultimate pH than the normal, but a somewhat low WHC at 2hr p.m. when the pH was still high (pHi >6.30). Moreover, the L* value at 24hr was as high as the normal. They were suspected to have a slow glycolysis and thus the pH was also measured at 48hr p.m. to evaluate whether a further decrease occurred. No changes were found compared to the pH at 24hr, therefore this was the ultimate pH. A large number of fibres with a weak PAS-positive reaction at 2hr p.m. was also typical of this group of muscles, which can be classified slightly DFD on the basis of the final pH, but also seem to present some peculiar characteristics. At present, these muscles can not be precisely defined, but they can be easily detected. Further studies are needed in order to clarify their technological characteristics.

CONCLUSIONS: The pH and percentage of fibres with glycogen at 2 hours after slaughter were measured in Longissimus dorsi muscles of heavy pigs slaughtered for processing and the final quality of the meat was predicted, with special regard to DFD and PSE conditions.

The evaluation of a number of the most important characteristics shown at 2hr and 24hr p.m. led to a classification of the muscles into six groups, which were found to be in good agreement with the prediction made.

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