COMPARISON OF DIFFERENT OBJECTIVE METHODS USED FOR THE DETECTION OF THE PORK PSE/DFD STATUS

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SUMMARY

The prediction of porcine muscle PSE/DFD status, through the measurements of the pH_1, R-value and protein solubility 1h after slaughter, has been evaluated on the *Longissimus dorsi* of five hundred carcasses.

The pork classification into the different quality categories (PSE/NORMAL/DFD) was determined based on the results obtained for the pH_1 (1h *post-mortem*), $drips_{24}$ and pH_{24} (24h *post-mortem*). The color (Lab) 24h *post-mortem* were also determined.

The interrelationships among the different pork quality indicators were studied. The pH_1, R-value and the protein solubility showed significative correlations with the $drips_{24}$ respectively $r=-0.669;p<0.001$, $r=0.543;p<0.001$, $r=-0.431;p<0.001$. Regarding the L value, the same significance was found for pH_1 and protein solubility, whereas for R-value it was rather low ($p>0.05$).

Despite the good correlation between pH_1 and $drips_{24}$, a significative amount (16%) of the samples can be erroneously associated with a high degree of exsudation. Regarding the pH_1/R-value association it didn't also prove to be a safe method for PSE identification, nevertheless the high percentage (98%) of detection of the real PSE situations. Using this method, about 16% of the analysed carcasses were misclassified as that. Although the protein solubility identify well the PSE situation, it did not differenciate significantly the normal from the DFD samples.

Introduction

Meat quality in pig carcasses became a matter of increasing concern for the portuguese domestic market, during the last five years, probably due to the supermarkets selling system. So, the interest in assessing meat quality in order to fullfill the demand for pork with good water holding capacity and color is more and more a real fact, at least, for the most representative pig slaughter companies. Otherwise, a great effort is being made in Portugal to improve transport and lairage conditions, being the meat quality measurement very important to evaluate the introduced modifications.

The methodology used for meat quality evaluation, as well as the technical requisits to be observed, change according the type of the experiments (Barton-Gade, 1980). If the quality has to be evaluated in large number of carcasses "on line" and no damage on them is allowable (quality control), then, its assessment needs to be made instrumentaly and in a fast way (Lundstrom *et al.*, 1984). However, for research purposes and using small lots of animals, other methods can be used.

According to Bendall and Swatland (1988), the pH_1-index (pH<6.0 at 45min *post-mortem*) gives a fairly good indication of the likely incidence of PSE meat at 24 h *post-mortem* or more, having both, the rate and the extent of muscle acidification, a great effect upon meat color, softness and degree of fluid loss. On the other hand, Honikel and Fisher (1977) have shown that the measurement of the ATP to IMP transformation at 1 hour *post-mortem* combined with pH_1 was a good method to predict PSE/DFD status. Yet, the percentage of soluble sarcoplasmic and myofibrillar proteins is pointed out by Barton-Gade (1992) as the best laboratory method for the water binding capacity estimation.

Our objective is to study the ability of the 3 methods refered above for pig meat PSE/DFD status evaluation.

Materials and methods

For this study a population of 500 slaughter pigs (LWxLR and Belgium LR) with an average carcass weight of 80 kg has been used. The transport duration and the resting time in lairage varied enormously, from 50 to 200 km and from 2 to 24 hours, respectively. These *ante-mortem* parameters were not controled. An high voltage stunning device with restrainer (220 volts/5s) was used for the animal slaughtering. The carcasses suffered a fast cooling at 17 min after slaughter during approximately 45 min (-4 °C and an air flow of 4m/s) and after that, they were kept under refrigeration overnight.

In order to minimize any differences due to the uncontroled ante-mortem factors, the carcasses were sampled randomly from the line, with a maximum of 20 per day. Imediately after the first cooling phase, the pH_1 values (1 hour *post-mortem*) were recorded in the left side *Longissimus dorsi* muscle (Hanna Instruments, portable HI 8314 pH-meter with a combination electrode HI 2031, Italy) between the 3th and 4th last ribes. From the same loin and corresponding to the place where the electrode was inserted, three slices were cut (± 80 g each), cleaned of superficial fat and transfered to plastic bags. One of them was immediately deep frozen in dry ice (-70 °C) for further R-value determination (Honikel and Fisher, 1977). The other ones were kept at +4 °C and used for drip loss (Honikel, 1987), pH_{24} (Methrom, 654 pH-meter, Swiss), color (L, a, b-Cologard System/05, BYK-Gardn Silver Spring, MD 20910, USA) and protein solubility evaluation according Barton-gade (1980) with minor modifications (BCA Standard method for protein determination), 24 hours *post-mortem*.

The meat quality classification was based on pH_1, pH_{24}, drip loss and color (L value), according with the Table 1.

The data were analysed 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

The means and standard deviations for the different studied meat quality parameters can be seen in Table 2. The results show that among the three meat categories exist a highly significant difference ($P<0,001$).

Despite that, when pH_1 is used alone in PSE/DFD status evaluation we can conclude that it is still a poor predictor of the meat quality 24h *post-mortem*, once a considerable amount of carcasses is erroneously classified (Figure 1).

Around 16% of the samples showed a $pH_1 < 5.9$ and revealed a good water holding capacity whereas a smaller percentage (Å 10%) with a $pH_1>5.9$ exceeded the drip loss limit (2%) stablished by us as unacceptable. However, taking in mind the inexistance, so far, of any accurate method for pork quality evaluation on line (Barton-Gade, 1992) and that the pre-slaughter treatment (difficult to standardize) affects the relationship between this parameter and the meat quality the day after slaughter (Barton-Gade,1980), it seems that its contribution for the PSE status detection can be important.

Concerning the R-value, and despite the significant differences verified among the three meat categories (Table 2), its relationship with the pH_1, according to what Honikel and Fisher (1977) describe, doesn't clearly accomplish the objective of meat quality evaluation (Figure 2). In fact, if the carcasses developing the PSE status were very well classified through this method, many others (Å 16%), exactly with the same combination didn't show any significant exudation later. Otherwise, the differentiation ability between Normal and DFD carcasses through the R-value/pH_1 relationship doesn't exist at all. In our conditions, DFD and Normal meats showed the same variation of results, regarding the R-value.

Similar conclusions have been found by Barton-Gade (1980). According this researcher (Barton-Gade, 1992) such disagreement in relation to Honikel and Fisher work is basicaly due to the differences of stress susceptibility existing between the studied pig populations.

In Figure 3 is showed the relationship between total soluble protein and drip loss 24h *post-mortem*. The correlation coefficient (r=-0.43) is poor and quite similar to that found by Lopez-Bote *et al.* (1989). According them, in a population like ours, exibiting the three lean meat categories, the total soluble protein would be a reasonably good index of quality. However, the picture presented in Figure 3 doesn't allow us to differentiate the meat quality based on the total soluble protein concentration. The majority of the samples classified as PSE presented the same total soluble protein content than Normal and DFD.

Conclusions

The methods tested in this study didn't confirm their basic objective, it means that, they can't be used alone or in association for an accurate assessment of the meat quality (PSE/DFD status) on line. Neverthless, being the pH_1 measurement easy to perform and not time consuming, it can be usefully utilized in surveys of the PSE condition on the slaughtered population, as well as, to evaluate the influence of modifications introduced in any ante or post-mortem factor.

Regarding R-value/pH_1 association it differentiate quite well the really PSE carcasses but also include in this group many others showing a normal beahvior 24 h *post-mortem*.

The method based on the total soluble protein concentration didn't reveal, in our conditions, any interest for the meat quality classification.

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