QUALITY CHARACTERISTICS OF CHILLED AND WARMED EXCISED PORCINE LONGISSIMUS OBTAINED FROM PIGS STUNNED BY CAPTIVE-BOLT

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SUMMARY

The postmortem development of colour and water holding capacity in pork *longissimus* removed at 1 h postmortem from carcass of 30 pigs slaughtered by captive-bolt stunning and exsanguination was studied. Excised muscles were maintained under either 1°C or 30°C and the differences in quality characteristics were compared. Results revealed that those characteristics measured changed with the postmortem time and the temperature treatments had little effect on the development of the ultimate muscle appearance. Results also indicated that delay chilling did not affect the measured quality characteristics of pork *longissimus*. It is suggested, hot processing of pig carcass has no adverse effect on muscle appearance.

INTRODUCTION

The concept of hot or accelerated pork processing has been developed for fresh cuts as well as cured, and energy savings to the processing industry have been estimated at 40 to 50% (Kastner, 1977). Acceptance of this concept, however, has been slow and difficult among modern abattoirs and packing plants. The uncertainty of high incidence of PSE pork has been the major reason for the reluctance. Several studies have shown that, between accelerated or conventionally processed pork chops, no acceptability differences could be found although accelerated-process tended to be slightly tougher and showed lower final pH values with slightly higher microbial counts. (Marsh et al., 1972, Hinnergardt et al., 1973, Hose et al., 1980). Few studies, however, concerned the likelihood that hot processing may facilitate the development of PSE pork, particularly from pigs experienced severe stress.

Fresh and warm pork is traditionally consumed in Asia countries and is still selling at retail to compete with those refrigerated because consumers believe that the "old fashion pork" gives a better appearance and taste. This contradicts the current knowledge that the higher temperature will provoke the occurrence of PSE pork.

To clarify both concerns, the study then is designed to investigate the effects of 2 different storage pork temperatures on some quality characteristics of pork *longissimus* obtained from stressed pigs.

EXPERIMENTAL METHODS

The pork used came from 30 crossbred (Yorkshire x Landrace) pigs weighing 100 kg liveweight. Animals were stunned by captive-bolt to exacerbate the occurrence of PSE and to allow easier observation of any treatment effects. The pigs then were exsanguinated, scalded, dehaired and dressed. At 30 min postmortem, the *longissimus* of both sides were exposed and cut transversely at the fifth rib and a section of each muscle posterior to the cut (35 cm in length) was removed from the carcass. At 45 min postmortem, a transverse cut was made (5 to 6 cm thick) on both samples and objective measurements of pH (pH1), temperature (T1), colour (C1) and water holding capacity (WHC1) were conducted on the freshly cut surface. The left *longissimus* was then refrigerated at loC and the right was kept under 30°C with 72% RH. At 4, 8, 12 and 24 h postmortem, a sample (5 to 6 cm) was cut from both *longissimus* and muscle pH, temperature, colour and WHC were determined. Muscle pH was measured using an electrode probe attached to a meter and inserted at the centre and four surrounding areas and the average value was used for statistical analysis. Temperature was measured by a thermistor probe inserted at the centre of the cut surface of the sample. A colourimeter was used to measure meat colour and expressed as Y%. Water holding capacity was determined by filtered paper method pressed under 70 MPa for 2 min.

RESULTS

It was found that the pH_1 value of 30 samples studied varied and clustered at three different levels. The whole data of pH_1 then were ranked and, from the top order, every 10 values were grouped. Muscle samples, therefore, could be separated into 3 groups of high, medium or low pH_1. The highest rank group gave a mean pH_1 of 5.88 which was significantly higher than 5.54 shown by the lowest group. Mean pH_1 value of the

Table 1. Quality characteristics of pork longissimus muscle taken from pigs 1h postmortem

Differentiation	pH_1#	Colour	WHC
Group 1	5.88^{a}	14^{a}	1.9^{a}
Group 2	5.79^{ab}	20^{b}	2.0^{a}
Group 3	5.54^{b}	26^{c}	2.5^{b}

Measured at 45 min postmortem.

^{abc}Means in the same column bearing different superscript are different significantly.

Table 2. ANOVA test of effects of grouping, temperature treatment and time on quality characteristics of pork longissimus

Treatment	pH	Colour	WHC	Temp
Grouping (A)	*	*	*	NS
Temperature (B)	NS	NS	NS	*
Time (C)	*	*	*	*
A x B	NS	NS	NS	NS
A x C	*	NS	NS	NS
B x C	NS	NS	NS	NS
A x B x C	NS	NS	NS	NS

*at least $P < 0.05$

middle group was 5.79 and it differed little to other 2 mean values (Table 1). This separation, according to muscle pH_1 value, also differentiated samples with different C_1 and WHC_1. Results in Table 1 evidently demonstrated that those muscles with lower pH_1 also exhibited an inferior appearance (pale and watery). The group differences in quality characteristics of *longissimus* were considered into the overall statistical analysis and, according to a design of 2 x 3 x 4, the ANOVA test was done and the results were summarized in Table 2. It could be seen from Table 2 that the temperature treatment had little effect on the quality characteristic measured and the variations of muscle pH, colour and WHC during the study period were due entirely to the time effect. Results clearly indicated that muscle temperature, whether maintained at 1°C or 30°C, had no effect on the development of muscle colour and WHC from 1 to 24 h postmortem.

Significant interaction was only found when group x time under changes of pH value (Table 2). Further analysis revealed that the significant interaction arose from the significant pH drop of high pH1 group (from $pH_1 = 5.88$ to $pH_{12} = 5.62$) during study period, while other 2 group muscles showed little further changes from 1 to 24 postmortem. The pH value of muscles of all 3 groups declined little from 12 to 24 h postmortem.

The reflectance increased along with the time in muscles of all 3 groups. Since there was no significant interaction when group x time under muscle colour (Table 1), the increase of muscle paleness could be seen as parallel among 3 groups.

As the postmortem time increased, *longissimus* pressible water also increased. There was no significant difference between any groups in WHC at 24 h postmortem although WHC in muscles of group 3 was significantly lower than those of either group 1 or group 2 (table 1).

DISCUSSION

The pH_1 value could only account for 24% of the variation in the ultimate colour of the pork *longissimus*. Combing pH_1 and T_1 measurements caused little improvement since together they account for only 26% of the variation in meat colour (Martin et al., 1975). Thus, using values of muscles pH_1 and T_1 to identify PSE can be misleading, although PSE pork is characterized by a combination of low pH_1 and high T_1 values (Swatland, 1982; Yang et al., 1974). The risk of provocation of high incidence of PSE pork by delay chilling due to hot processing, therefore, should be very small and according to the results of the present study, it can be ignored. The results also indicated that the time limit to complete fabrication immediately after slaughter may not be critical since prolonged delay in muscle chilling has no significant effect on the ultimate appearance of pork *longissimus* (Table 1).

It is understood that, if muscle protein has already been denatured within 1 h post mortem, PSE will inevitably developed. Owing to the captive-bolt stunning was used, the pH_1 value of muscles studied were low (27/30 below 5.9). This suggests that the postmortem glycolysis of *longissimus* studied was accelerated and by the time of 1 h postmortem, the development of ultimate muscle appearance has already finished. This probably is the reason for the ineffectiveness of temperature treatment shown in this study.

CONCLUSION

The experimental evidence implicates that, for those *longissimus* with pH_1 lower than 5.9, hot processing has no adverse effect on muscle appearance. These is no advantage to leave pork *longissimus* in a warm environment once excised from the carcass. The belief in old fashion type pork is ungrounded. Refrigeration should be applied on excised pork as soon as possible simply to minimize the microbial counts.

ACKNOWLEDGEMENTS

Financial support provide by Council of Agricultural is gratefully acknowledged.

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