EFFECT OF CHILLING RATE ON PORK QUALITY DEVELOPMENT

Neal Matthews[1*], Clay Eastwood[1], Xuenan Chen[1], Andrzej Sosnicki[1], and Brandon Fields[1]
[1]PIC Global Technical Services, Hendersonville, Tennessee, USA

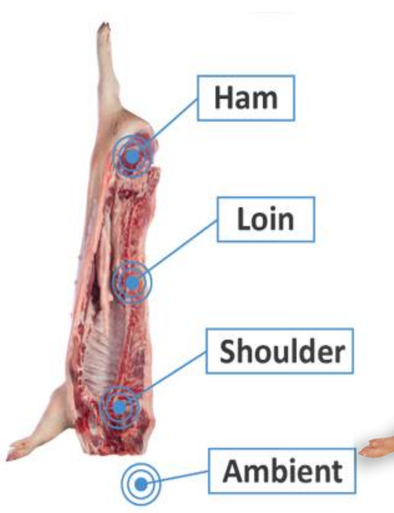
INTRODUCTION

Ante-mortem stress and carcass chilling rate are two important factors in the development of pork quality [1]. Blakely [2] reported that aggressive chilling improved pork pH and colour. Matthews [3] reported that optimum quality was obtained when *peri-mortem* stress was minimised (group movement at stunning) combined with aggressive chilling (less than -10 °C during the first 2 h *post-mortem*) under commercial conditions. As many large modern pork processing facilities have moved to CO_2 stunning with group animal movement, the *ante-mortem* stress component has become less important than the chilling component in developing high quality pork. The purpose of this research was to further elucidate the effect of chilling rate in commercial slaughter plants using CO_2 stunning with group animal movement.

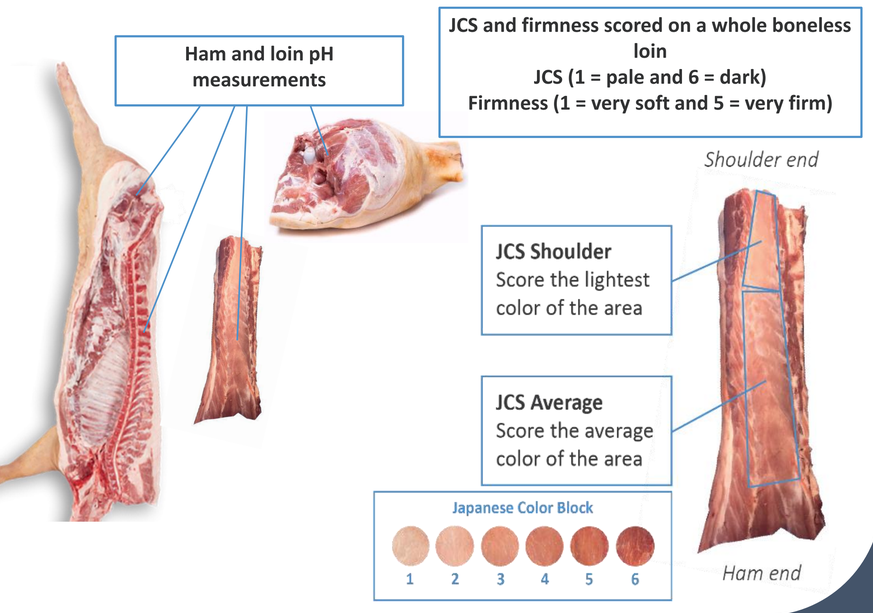
MATERIALS AND METHODS

- Data were collected from 21 commercial pork slaughter plants in North America and Europe using CO_2 stunning with group animal movement.
- Slaughter plants with ambient temperatures below -10 °C during the first 2 hours of chilling were considered aggressive chilling (AC; n = 11) while those above -10 °C were considered conventional chilling (CC; n = 10).
- Chilling data were collected on a minimum of 10 carcasses across multiple days at each processing plant to account for variation.
- Ham (*semimembranosus*) and loin (last rib) pH were measured at two different time points: initial pH (pHi) was collected immediately before chilling and ultimate pH (pHu) was collected approximately 20-22 h *post-mortem*.
- Subjective loin quality measurements, Japanese Colour Score (JCS) and firmness, were collected on boneless loins.
- The pH and loin quality data were collected over 2 days with multiple measurement sessions during the day (n > 275 per processing facility).

Temperature Measurement Locations



pH and Subjective Quality Measurement Locations



RESULTS

- Temperature decline rates were accelerated with AC in the ham, loin, and shoulder. Ham and loin curves were lower (P < 0.05) from 4 to 20 h *post-mortem* in plants with AC. Shoulder curves were lower (P < 0.05) from 3 to 20 h *post-mortem* in plants with AC (Figure 1).
- Loin pHi tended (P = 0.10) to be higher in the plants with AC, but ham pHi was not affected (P > 0.10) by chilling type (Table 1).
- Loin (P < 0.0001) and ham (P < 0.05) pHu were higher in plants with AC. Similarly, the % of pHu values below 5.60 were lower (P < 0.01) in both the ham and loin in plants with AC.
- Average and shoulder JCS were both higher (P < 0.01) in plants with AC.
- The % of JCS < 2.5 was lower (P < 0.05) for both the average and shoulder JCS in plants with AC.
- Loin firmness score was not affected (P > 0.10) by chilling type, but the % of loin firmness scores < 2.5 tended (P = 0.10) to be lower in the plants with AC.

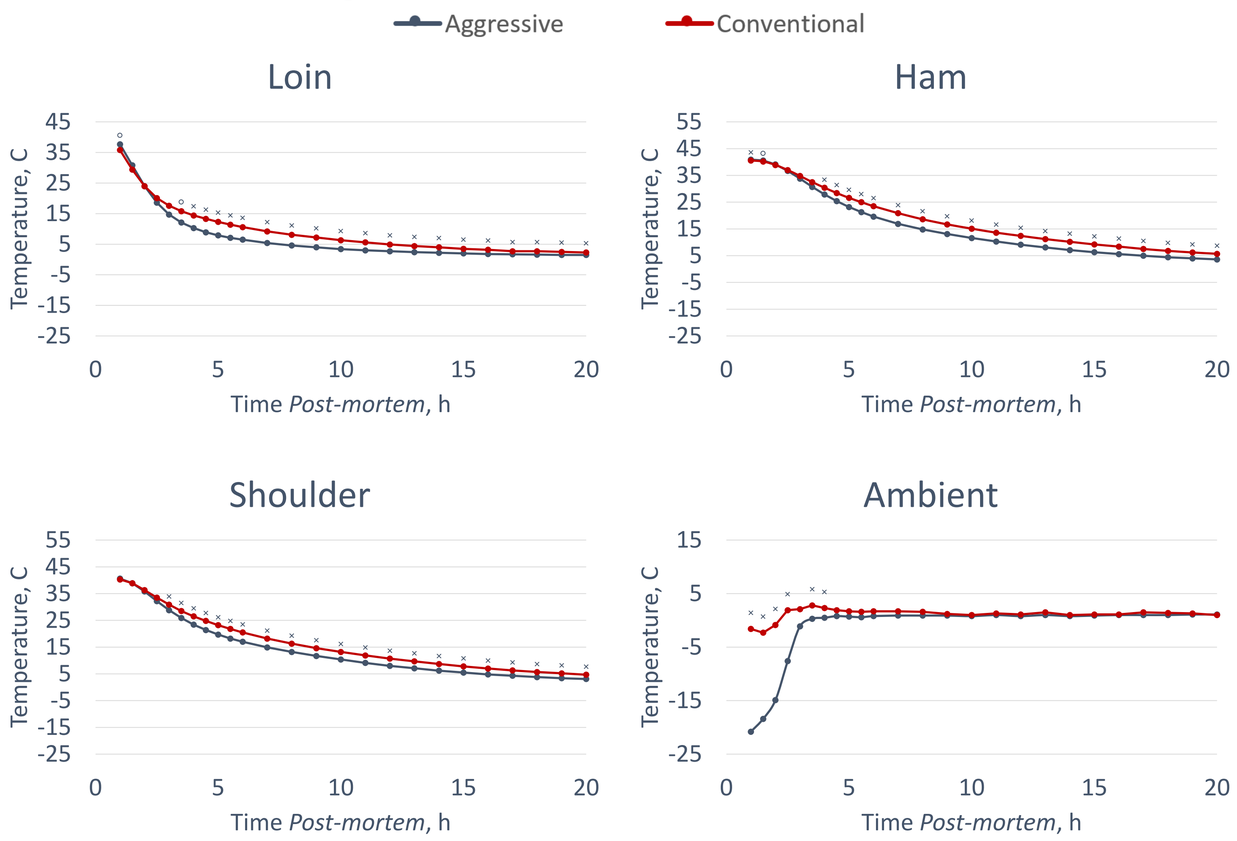
Table 1. Effect of Chilling Rate on Pork Quality

	Chilling Type			
Trait	AC [a]	CC [b]	SEM	P > F
Loin pHi	6.68	6.64	0.01	0.10
Ham pHi	6.59	6.57	0.03	0.54
Loin pHu	5.74	5.61	0.01	0.0001
% Loin pHu's < 5.60	12.5	49.9	3.5	0.0001
Ham pHu	5.79	5.72	0.02	0.05
% Ham pHu's < 5.60	14.4	30.5	3.7	0.01
JCS Average Score	3.53	3.29	0.05	0.01
% JCS Average Scores < 2.5	0.7	2.4	0.5	0.05
JCS Shoulder Score	3.23	3.00	0.05	0.01
% JCS Shoulder Scores < 2.5	4.6	9.2	1.5	0.05
Firmness Score	2.61	2.42	0.12	0.31
% Firmness Scores < 2.5	32.5	48.3	6.3	0.10

[a] Aggressive chilling; LSMeans of 11 slaughter plants with aggressive chilling.
[b] Conventional Chilling; LSMeans of 10 slaughter plants with conventional chilling.

RESULTS

Figure 1. Temperature Decline Curves



X = Means at timepoint were significantly different (P < 0.05).
O = Means at timepoint tended to be different (P < 0.10).

CONCLUSIONS

These data were collected under commercial slaughter conditions in multiple slaughter plants and countries with varying *ante-* and *post-mortem* processes that could influence pork quality. However, when these plants are assessed by the rate of chilling, pork quality traits (pH and colour) were improved with accelerated chilling. These effects suggest that aggressive chilling is an integral component to improving pork quality.

REFERENCES

1. Berg, E. (2006). Critical points affecting fresh pork quality within the packing plant. http://porkgateway.org/resource/critical-points-affecting-fresh-pork-quality-within-the-packing-plant/
2. Blakely, A., Prusa, K., Fedler, C. A., Sherrard, G. B., Steadham, E. M., Stalder, K. J., Lorenzen, C. L., Huff-Lonergan, E., Lonergan, S. M. (2019). The effect of rapid chilling on pork carcasses during the early postmortem period on fresh pork quality. Meat and Muscle Biology 3:424-432.
3. Matthews, N., B. Fields, and A. Sosnicki. 2019. Analysis of Commercial Benchmarking Data to Assess the Relationship of Animal Handling and Carcass Chilling Rate on Pork Quality. In Proceedings 65th International Congress of Meat Science and Technology (pp. 241 – 242) 4-9 August 2019, Potsdam, Germany.

2023 PADOVA, ITALY
ICoMST
69th INTERNATIONAL CONGRESS of MEAT SCIENCE AND TECHNOLOGY