EFFECT OF LOIN PH AND TEMPERATURE DECLINE ON MEAT QUALITY TRAITS IN FOUR COMMERCIAL PLANTS

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I. INTRODUCTION

Temperature and pH are two major factors affecting development of meat quality. *Post-mortem* glycolysis determines the ultimate pH in meat, which correlates with water holding capacity, colour and sensory traits [1]. Controlling the rate of temperature decline is considered critical in slowing down *post-mortem* glycolysis and improving pork quality [2]. The objective of this project was to further evaluate the effect of temperature and pH decline on the development of pork quality in different commercial chilling systems.

II. MATERIALS AND METHODS

Data were collected from four different commercial US pork slaughter plants (Plant 1: n = 47; Plant 2: n = 76; Plant 3: n = 51; Plant 4: n = 36) with CO_2 stunning and group animal movement. All loin temperature and pH decline data were recorded using REED pH/ORP meters (REED R3000SD, Reed Instruments, Wilmington, NC, USA). Hanna pH electrodes (Hanna FC200B, Hanna Instruments, Woonsocket, RI, USA) were inserted in the loin at the last rib, while temperature probes (REED TP-07, Reed Instruments, Wilmington, NC, USA) were placed in close proximity to pH electrodes. Probes were randomly placed in carcasses on the slaughter floor prior to chilling with measurements logged every minute for approximately 20 h. Meat quality, including ultimate pH, subjective Japanese Colour Score (JCS) and firmness, objective colour measurements and 24-hour drip loss, was assessed at approximately 24 hours *post-mortem* on boneless loins from the same carcasses. Ultimate pH was measured on the ventral side of the loin using a Hanna pH meter (HANNA HALO HI9810322, HANNA Instruments, Woonsocket, RI, USA). Subjective JCS was evaluated on the entire ventral surface and shoulder-end only of the loins using a 1 to 6 scoring system (1 = pale, 6 = dark). Firmness was evaluated by bending the loins and scored on a 1 to 5 scoring system (1 = soft, 5 = very firm). Objective colour was measured as CIE LAB values using a colourimeter (CR-400, Konica Minolta, Tokyo, Japan). Drip loss was measured using the EZ-DripLoss method [3]. The samples were placed in drip loss tubes and stored at 4 °C for 24 hours. Sample weights and exudate weights were recorded for drip loss calculation. Data were analysed in SAS using PROC GLM procedures. Differences were considered significant at $P < 0.05$.

III. RESULTS AND DISCUSSION

Loin temperature decline rates varied among plants as Plant 4 chilled the slowest, followed by Plant 2, while Plants 1 and 3 chilled fastest. Initial temperature was similar among plants, although loins from Plant 3 had slightly higher temperatures compared with Plant 2 ($P < 0.05$). Loin temperature was the highest at Plant 4 from 1 to 18h *post-mortem* ($P < 0.05$), indicating the slowest chilling rate. Loin temperature was the lowest in Plant 1 from 1.5 to 10h *post-morte*m, and lowest in Plant 3 from 11 to 20h *post-mortem* ($P < 0.05$). The rate and extent of pH decline also varied among plants with loins from Plant 4 having the lowest pH values and fastest rate of decline, followed by Plant 2, Plant 1, and Plant 3 (highest pH values and slowest decline rate), respectively. At 40 minutes *post-mortem*, initial pH value was highest at Plant 3 and 4, followed by Plant 1, and lowest at Plant 2 ($P < 0.05$). Loin pH values were the highest at Plant 3 and lowest at Plant 4 from 2 to 20h *post-mortem* ($P < 0.05$).

The differences between temperature and pH decline curves reflected on the meat quality traits. The ultimate pH from bone-in loins was the highest in Plant 3 and lowest in Plant 4 ($P < 0.05$, Table 1). Boneless loins from Plant 3 had the highest ultimate pH values compared with loins from the rest of the plants ($P < 0.05$). Moreover, L* value was the highest in loins from Plant 4 and lowest from Plant 3 ($P < 0.05$). The higher ultimate pH and darker colour in Plant 3 could be a result of lower temperature and higher pH values from 11 to 20h *post-mortem*. The a* value was highest in loins from Plant 1 and lowest in Plant 2 ($P < 0.05$). The b* value was lowest in loins from Plant 3 compared with the rest of the plants ($P < 0.05$). The average and shoulder JCS were lowest in Plant 4 ($P < 0.05$), indicating the palest subjective colour. This is in agreement with previous work suggesting that lower ultimate pH resulted in lighter colour in pork [1]. Loins from Plant 4 had the highest firmness score, while loins from Plant 2 had the lowest firmness score ($P < 0.05$). In addition, 24-h drip loss percentage was greatest in loins from Plant 4 and least in Plant 1. This could be explained by a faster pH decline in Plant 4 that may negatively affect proteolysis of cytoskeletal proteins in meat [4].

Table 1 Effect of Commercial Pig Slaughter Plants on Pork Quality

	Loin Quality				
Plant	Plant 1	Plant 2	Plant 3	Plant 4	Pooled SEM
n	47	76	51	36	-
pH 40 min	6.49^{b}	6.41^{c}	6.60^{a}	6.60^{a}	0.03
pHu - Bone-in loin (BI)	5.90^{b}	5.77^{c}	5.96^{a}	5.72^{d}	0.02
pHu - Boneless Loin (BNLS)	5.61^{b}	5.58^{b}	5.72^{a}	5.59^{b}	0.02
BI vs. BNLS pHu Differential	0.30^{a}	0.18^{c}	0.24^{b}	0.12^{d}	0.02
L*	42.0^{c}	43.4^{b}	40.5^{d}	45.0^{a}	0.42
a*	7.45^{a}	7.01^{b}	7.11^{ab}	7.19^{ab}	0.15
b*	2.02^{a}	2.02^{a}	1.05^{b}	2.17^{a}	0.13
JCS Average	3.57^{a}	3.41^{ab}	3.56^{ab}	3.40^{b}	0.06
JCS Shoulder	3.12^{a}	3.05^{a}	3.25^{a}	2.81^{b}	0.08
Firmness	2.60^{ab}	2.47^{b}	2.62^{ab}	2.81^{a}	0.10
24-h Drip Loss, %	1.85^{b}	2.02^{ab}	2.12^{ab}	2.59^{a}	0.23

^{abcd} Means within a row lacking common superscripts were significantly different ($P < 0.05$).

IV. CONCLUSION

In modern commercial pig slaughtering facilities, different chilling rates can lead to variation in pH decline rates that affect pork quality. Overall, faster temperature decline resulted in slower pH decline rate, which led to darker colour, higher pH, and better water holding capacity. These data indicate potential relationships between *post-mortem* temperature and pH decline rates and their influence on the development of pork quality.

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