RESEARCHREPORT
PORK QUALITY

Title: Optimization of Commercial Harvest Processes that Affect Pork Water Holding Capacity and Color - **NPB # 02-032**

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Date Received: December 22, 2003

Abstract: The objective of this study was to determine the impact of duration of carcass scalding on pork loin color, water holding capacity and texture. Commercial pigs (n=655) were slaughtered at a commercial processing facility on two days within one week. Three hundred thirty six pigs were harvested and assigned to scald duration treatment groups of 7.6 (n=161) or 5.6 (n=175) min. The procedure was replicated on a separate day (7.6 min scald, n=150; 5.6 min scald, n=169) with the slaughter order of the treatments reversed. As a consequence of a shorter scalding duration, carcasses in the 5.6 min scald treatment entered the cooler 5 min earlier than the 7.6 min scald treatment. Loin temperature and pH were recorded as carcasses entered the cooler, at 2 h and 6 h postmortem. Loins representing each treatment group were selected for meat quality evaluation. Loin quality traits measured at 24 h (n=260) included pH, temperature, color, and drip loss. Purge loss, color, pH, and star probe values were measured on chops aged 5 d postmortem (n=160). The longer duration of scalding resulted in higher loin pH as carcasses entered the cooler ($P< 0.01$), but lower pH at 2 h postmortem ($P <0.01$). Loin pH did not differ between treatments at any other time measured. Treatment did not influence loin temperature at cooler entry or 2 h postmortem. The longer duration of scalding produced pork loins with greater drip loss ($P<0.01$), and higher L* values at 24 h postmortem ($P<0.05$).

At 5 d postmortem, loins from carcasses in the longer scald treatment had higher L* values ($P<0.01$), b* values ($P<0.01$), and greater discoloration as determined by hue angle ($P< 0.05$). Treatment differences for loin a* values, purge, cook-loss, and star probe values were not observed. These data suggest that shortening the duration of scalding, coupled with earlier entry in the cooler, has no detrimental effects on pork quality and may improve pork color and water holding capacity.

Introduction: Consistent production of *high quality pork* must receive significant attention if fresh pork produced in the United States is to compete successfully in the global market. A portion of the production of poor quality pork can be attributed to known sources of variation, such as the halothane gene (Piedrafita et al., 2001) and the RN gene (LeRoy et al., 1990). However, a great deal of the variation in pork quality cannot be explained (Forrest et al., 1998). Early postmortem processing of pork carcasses is a vital link between producer inputs and final product quality. Carcass handling early in the harvest process (most notably efficient removal of heat) can also have significant influence over pork quality. Many recommendations developed to maintain pork quality during the harvest process have focused on rapid processing and initiation of chilling (Honikel, 1999). Definition of how early postmortem harvest procedures can affect pork color and water holding capacity is necessary to develop new and updated approaches to improve pork quality, consistency, and value. This, in turn, will contribute to expanded markets for pork products in domestic and international venues.

Objectives: The central hypothesis for this project is: *Decreasing the duration of the scalding and hair removal process will result in a slower pH decline and improved pork color and water holding capacity*. The proposed project was defined to answer the question of how harvest procedures can influence pork quality and value. This specific area of research is consistent with area 7 (Harvest Factors) in the Pork Quality call for proposals.

1. *Determine the impact of duration of scalding and hair removal on pork loin color*
2. *Determine the impact of duration of scalding and hair removal on pork loin water holding capacity*
3. *Determine the impact of duration of scalding and hair removal on pork loin texture.*

Materials & Methods: The experiment was replicated on two occasions. Six hundred fifty five pigs pigs were assigned to scald duration treatments (7.6 minute scald, n=311; 5.6 minute scald, n=344). The more rapid chain speed from exsanguination until the end of scalding resulted in the carcasses in the 5.6 minute scald group exiting the scald tank approximately 5 minutes earlier than carcasses in the 7.6 minute scald group. This time advantage was realized at the end of the harvest process as carcasses in the shorter scald group entered the cooler five minutes earlier than the control (7.6 minute scald) group. Loin pH (last rib) and temperature (6^{th} rib) were measured at a fixed location in the process chain as the carcasses entered the cooler (approximately 30-35 minutes postmortem). Loin pH and temperature were measured at 2 and 6 hours postmortem.

Loins from sixty-four representative carcasses from each treatment group were selected for quality evaluation immediately after fabrication 1 day postmortem. Fresh pork color (Minolta), firmness, drip loss, pH and temperature were measured. Samples from forty representative loins from each treatment group were evaluated five days postmortem at the Iowa State University Meat Laboratory. Purge loss, color (Hunter Lab Mini Scan (D65, 10° observer), pH, and star probe texture were measured.

Results: The more rapid scald treatment resulted in approximately 5 minute decrease in the duration processing on the harvest floor. The 7.6 minute scald duration resulted in higher loin pH as the carcasses entered the cooler (approximately 30 minutes postmortem), but had lower loin pH values at two hours postmortem. Scald duration did not influence ultimate pH. Temperature of loins in the 5.6 minute scald treatment group was lower than temperature of the control group at 2 hours postmortem. Treatment did not affect temperature at any other time point measured. Temperature and pH data are summarized in Table 1.

Table 1. Temperature and pH in pork loins during first 24 hours postmortem

	5.6 minute Scald	7.6 minute Scald	Treatment Significance
pH			
30 minutes postmortem	6.5	6.6	$P < 0.05$
2 hours postmortem	6.4	6.3	$P < 0.01$
6 hours postmortem	6.3	6.3	Not Significant
24 hours postmortem	5.8	5.8	Not Significant
Temperature (°C)			
30 minutes postmortem	41.0	41.0	Not Significant
2 hours postmortem	23.6	24.5	$P < 0.10$
6 hours postmortem	8.3	7.5	Not Significant
24 hours postmortem	5.3	5.3	Not Significant

1. Determine the impact of duration of scalding and hair removal on pork loin color

The 5.6 minute scald treatment resulted in lower Minolta L* values (indicating darker pork; Table 2). However, treatment did not influence color intensity as Minolta a* and b* were note influenced by treatment. The shorter scald treatment tended to result in pork loin chops with lower hue angle values (indicating less discoloration). These observations were confirmed by results from the quality evaluation 5 days postmortem (Table 3). Reducing scald duration resulted in lower Hunter L values (darker pork), and a lower mean hue angle (less discoloration).

Table 2. Pork loin color and drip loss collected 1 day postmortem.

	5.6 minute Scald (n=132)	7.6 minute Scald (n=134)	Treatment Significance
Minolta L*	44.72	45.48	$P < 0.05$
Minolta a*	6.05	5.79	Not Significant
Minolta b*	2.87	2.99	Not Significant
Hue angle (degrees)	24.85	26.78	Not Significant
Drip Loss	2.15	2.79	$P < 0.05$

Table 3. Pork loin color and purge loss collected after five days of storage.

	5.6 minute Scald (n=81)	7.6 minute Scald (n=82)	Treatment Significance
Hunter L	44.53	45.56	$P < 0.01$
Hunter a	5.77	5.78	Not Significant
Hunter b	9.76	10.04	< 0.01
Hue angle (degrees)	59.43	60.10	< 0.05
Purge Loss (%)	0.79	0.83	Not Significant

2. Determine the impact of duration of scalding and hair removal on pork loin water holding capacity

Drip loss was lower in loins from carcasses in the 5.6 minute scald group (Table 2). However, scald duration did not affect purge lost in vacuum bags during a 5 day storage period (Table 3).

3. Determine the impact of duration of scalding and hair removal on pork loin texture.

The duration of scalding did not influence cooked pork star probe values (Table 4), indicating the pork tenderness is not specifically influenced by the treatment. The star probe standard deviation within each loin tended (P= 0.065) to be less in the loins from the short scald. This indicates more consistency within the loin. Significant correlations between star probe values and purge loss (r=.480) and drip loss (r=.609) indicate that loins with poor water holding capacity had higher star probe values (indicating a less tender product.

Table 4. Effect of scald duration on cooked pork loin star probe values.

	5.6 minute Scald (n=81)	7.6 minute Scald (n=82)	Treatment Significance
Star Probe, kg	5.95	6.17	Not Significant
Cook loss, %	24.79	25.01	Not Significant

Discussion: These results support our hypothesis that improving chilling rate by decreasing processing time will improve pork quality. The results indicate that altering harvest process can influence the pork color and water holding capacity. Of importance is the observation that the shorter duration of scalding consistently resulted in darker pork loins that exhibited significantly less drip loss. A likely explanation for this observation is that the shorter duration of scalding resulted in a higher pH after the initial chilling period (2 hours postmortem). Additionally, the loins in the 5.6 minute scald group tended to be cooler (23.6 °C compared to 24.5 °C) than the loins from carcasses in the 7.6 minute scald group. The results indicate that small, but significant improvements in the consistency of fresh pork could be achieved by studying how slaughter processes can be altered. Although the results of the project do not represent processes at all harvest facilities in the country, it is conceivable that similar process improvements could be studied in different facilities.

Lay Interpretation: It is well understood that many producer inputs influence fresh pork quality. These inputs include swine genetics, nutrition and handling. It is necessary to develop harvest procedures that maintain the quality defined by pre-slaughter inputs. Maintenance of quality is a key component during the harvest and chilling phase of the pork production chain.

The results of this project are important because they demonstrate that subtle differences in the harvest process have the potential to improve fresh pork color and water holding capacity. Proteins that contribute to pork color and water holding capacity are damaged by a combination of high temperature and acid (low pH) conditions. The shorter duration of scalding used in this study resulted in an earlier initiation of carcass chilling, a slightly lower loin temperature 2 hours postmortem, and a higher loin pH 2 hours postmortem. The end result is an improvement in pork color and water holding capacity.

References:

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