Influence of Harvest Processes on Pork Loin and Ham Quality

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Summary and Implications

The influence of the timing and duration of slaughter processes on pork quality was evaluated. The results demonstrate that reducing the time to evisceration is less important than reducing the time to the initiation of carcass chilling. A shortened interval between stunning and cooling can be accomplished by decreasing time allowed for blood removal (dwell time) and scalding. A dwell time of 3 min should allow harvest facilities to maximize profits from blood yields and allow carcasses to enter the scalder at an earlier time postmortem. Lengthening the duration of scalding may result in a more rapid postmortem pH decline. It is recommended that each individual processing facility monitor scald times to determine the appropriate length of time needed to maximize hair removal and minimize time spent on the slaughter floor.

Introduction

Variation in fresh pork color, texture and water holding capacity continues to be a significant concern to the pork industry. If pork produced in the United States is to successfully compete in the global market, issues relating to product quality and uniformity must be addressed. Pork quality is influenced by many system "inputs". These include genetics, nutrition, on-farm handling, transport, pre-slaughter handling, early postmortem processing, evisceration, chilling and fabrication. It is clear that genetics can have a profound effect on quality. It is also clear that necessary handling and processing steps will either sustain or diminish the pork quality potential defined by the genetics and nutritional management of the pig. In essence, the pre-slaughter inputs (genetics, nutrition, transport and handling) set the stage for the response to the slaughter process. Harvest and processing steps cannot improve quality defined by the pre-slaughter inputs. Rather, the harvest processes must be developed with the goal of maintaining quality.

This project was designed to determine the consequence of changing the time of two key processing steps during harvest – exsanguination and scalding- on quality of fresh pork. Increasing "dwell time" prior to scalding may influence blood yield. Increasing scald time may decrease personnel needs in preparing the carcass for evisceration. This component of the pork processing chain is a vital link between producer inputs and final product quality. Information gained from this project will be used to allow processors to make informed decisions regarding early postmortem harvest procedures to produce high quality pork products as efficiently and consistently as possible.

Materials and Methods

32 crossbred (Duroc X Yorkshire) barrows and 32 (Duroc X Yorkshire) crossbred gilts were harvested at the ISU Meat Laboratory. 8 barrows and 8 gilts (average weight 113 kg) were slaughtered each week for a four-week period. A 2X2-treatment arrangement (16 pigs per treatment combination) was utilized. Carcasses were held for 5 or 10 minutes after sticking (dwell time) before entering the scald tank. Carcasses were placed in the scald tank for 5 or 8 minutes (water temperature of 60°C). Temperature and pH were measured on the inside ham muscle (semimembranosus) and loin muscle (longissimus) at 45 minutes, 2, 4, 6, and 24 hours postmortem. All carcasses were placed into the cooler at 50 minutes postmortem. This was done to avoid the effect of some carcasses in the short dwell time or scald time treatment groups entering the cooler earlier postmortem and to allow specific investigation of the influence of harvest treatments on pork quality.

Hams and loins were removed from the left side of the carcass at 24 hours postmortem. Two 2.5 cm chops from the last rib region of the loin were used to determine subjective scores of color (NPPC), firmness, wetness, and marbling. Drip loss and Hunter L*, a* and b* values were measured on longissimus chops from the center loin. The sirloin end of the loin was utilized to determine purge loss in a vacuum package for a 6-day storage period.

Hunter L, a, and b values were obtained on the semimembranosus and biceps femoris of the ham. Ultimate pH of the semimembranosus and biceps femoris from each carcass were recorded. Portions (approximately 1.5 kg) of the semimembranosus and biceps femoris were utilized to determine purge loss in a vacuum package for a 6-day storage period.

Results and Discussion

The total blood collected accounted for 3.59% of the live weight. Of the blood that was collected, 89.66% was collected in the first minute, and 7.91% was collected in the second minute (Figure 1). In other words, 97.57% of the total amount of blood collected was obtained in the first two minutes after sticking. These data are consistent with the results reported by Warris (1984). Very little blood was collected after two minutes, which provides evidence that processing facilities can decrease dwell time prior to scalding. Decreasing this time would allow for carcasses to enter the cooler at an earlier time postmortem, which may improve overall pork quality.

Our primary objective was to determine the impact of early postmortem processing traits on overall pork quality. Analysis was conducted with scald time, dwell time, harvest date, and sex of the animal as the independent variables. The longer scald time tended to result in a lower loin pH 45 minutes (P = 0.058) and two hours postmortem (P=0.09; Table 2). We observed lower temperatures at 2 hours postmortem in the semimembranosus muscles of carcasses in the shorter dwell time and scald time treatment groups (Table 3). These observations suggest that altering the harvest procedure has the potential to alter pH and temperature in the early postmortem period.

Although harvest treatments appeared to minimally influence pH and temperature decline early postmortem, treatment effects on pork quality measures were not consistently observed. No treatment differences in subjective quality scores or measures of water holding capacity were identified. The longer scald treatment tended to result in higher Warner-Bratzler shear force, indicating that pork tenderness may be influenced by this early postmortem processing procedure (Table 4).

It is necessary to develop harvest procedures that maintain the quality defined by pre-slaughter inputs. This report demonstrates that duration of the dwell time and the scald time has the potential to influence pork quality. It is expected that an abbreviated dwell time and/or scald time would decrease the amount of time necessary to reach the cooler. The impact of decreasing the processing time in combination with earlier chilling on pork color and water holding capacity remains to be defined.

Table 1. Least squares means for percentage of blood collected, based upon the amount collected and the live weight of the animal, during the first five minutes after exsanguination (n = 61).

Time after sticking (min)	***% of Blood Collected***	SEM	% Blood based on Live Wt.	SEM
0 – 1	90.77	0.56	3.22	0.043
1- 2	7.33	0.43	0.26	0.017
2 –3	1.33	0.15	0.05	0.005
3 –5	0.57	0.08	0.02	0.003
TOTAL	100		3.55	0.047

Table 2. Least squares means for temperature and pH in the longissimus dorsi (loin) at 45 min, 2, 4, 6, and 24 h postmortem.

	Temperature °C					***pH***				
Time	5 min dwell	10 min dwell	5 min scald	8 min scald	Std. Error	5 min dwell	10 min dwell	5 min scald	8 min scald	Std. Error
45 min	35.89	35.78	35.83	35.83	0.256	6.25	6.23	6.30	6.19	0.042
2 h	26.36	26.98	26.39	26.95	0.329	5.88	5.88	5.95	5.82	0.057
4 h	15.22	15.58	15.21	15.59	0.349	5.78	5.74	5.82	5.71	0.049
6 h	10.44	10.93	10.74	10.63	0.462	5.70	5.69	5.72	5.67	0.031
24 h	2.17	2.03	2.09	2.10	0.054	5.57	5.56	5.55	5.58	0.017

No significant differences were found at the P < 0.05 level.

Table 3. Least squares means for temperature and pH in the semimembranosus (ham) at 45 min, 2, 4, 6, and 24 h postmortem.

	Temperature ºC					***pH***				
Time	5 min dwell	10 min dwell	5 min scald	8 min scald	Std. Error	5 min dwell	10 min dwell	5 min scald	8 min scald	Std. Error
45 min	36.22	36.36	36.25	36.33	0.246	6.29	6.23	6.28	6.24	0.068
2 h	28.83a	27.33b	27.28z	28.88y	0.495	5.88	5.86	5.90	5.83	0.070
4 h	21.44	21.63	21.46	21.61	0.380	5.64	5.65	5.65	5.64	0.047
6 h	16.60	16.95	16.52	17.02	0.524	5.55	5.56	5.54	5.57	0.029
24 h	2.82	2.81	2.88	2.74	0.075	5.59	5.60	5.56z	5.62y	0.019

[ab] For dwell comparisons within a row, means without a common letter differ (P < 0.05).
[yz] For scald comparisons within a row, means without a common letter differ (P < 0.05).

Table 4. Loin Warner-Bratzler shear force least squares means for dwell time and scald time processes (n=64).

	Dwell Time		**Scald Time**		
	5 min	**10 min**	**5 min**	**8 min**	**SEM**
Warner-Bratzler Shear Force (kg)					
Day 3	3.39b	3.78a	3.52	3.65	0.12
Day 5	3.45	3.59	3.44	3.61	0.12
Day 7	3.49	3.68	3.42z	3.76y	0.12

[yz] For scald comparisons within a row, means without a common letter differ (P < 0.05).