INFLUENCE OF POSTMORTEM INJECTION OF CALCIUM CHLORIDE ON TENDERNESS OF PORK LONGISSIMUS MUSCLE

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Summary

Twenty-seven pork carcass sides were assigned randomly to either blast chilling for 1 h at -13°F followed by 23 h chill at 34°F or a standard chill at 34°F for 24 h. At 24 h postmortem, the longissimus muscle from the center loin region was removed and divided into anterior and posterior halves. Halves were assigned randomly to either calcium-chloride ($CaCl_2$) injection or non-injected controls. Those receiving $CaCl_2$ were injected with a .3 molar solution at 10% pump by weight. Muscles then were stored for 3 d at 34°F before 1-in chops were removed, cooked to an internal temperature of 160°F, and allowed to cool for 2 h before six .5 in cores were sheared. The Warner-Bratzler Shear (WBS) values were lower (more tender) for the $CaCl_2$-injected loins than controls. Blast chilling decreased the combined purge and cooking losses compared to standard chilling. A second trial was conducted to determine the influence of only a 10% water injection on WBS and cooking loss. Five loins were divided into anterior and posterior halves and assigned randomly to either water injection or non-injected controls. Water injection did not influence either WBS or cooking loss values. In conclusion, 24 h postmortem injection of $CaCl_2$ enhances the tenderness of pork longissimus muscle.

(Key Words: Pork, Calcium Chloride, Tenderness.)

Introduction

Tenderness is an important quality characteristic in pork. Postmortem storage (aging) at refrigerated temperatures gradually increases meat tenderness by proteolysis of myofibrillar proteins. Recent research has indicated that the calcium-dependent calpain system is involved in the tenderness observed during postmortem aging. Injecting carcasses or muscles with $CaCl_2$ has accelerated postmortem aging and improved meat tenderness in beef and lamb. In addition, the postmortem rate of temperature decline could influence the rate of glycolysis (pH decline) and proteolysis. Therefore, our objectives were to determine 1) the influence of injecting pork loin muscles with $CaCl_2$ on WBS values (tenderness) and 2) the influence of rapid chill on pork loin WBS values.

Procedures

Twenty-seven market hogs were slaughtered at the KSU Meats Laboratory. From these, 14 right sides were blast chilled for 1 h at -13°F, then chilled for the remainder of 24 h at 34°F. The other 13 right sides were chilled for the entire 24 h at 34°F. At 24 h postmortem, 27 center loin sections, measured from the 4th rib to the 2nd lumbar vertebrae, were boned out and closely trimmed. The loins then were divided equally into anterior and posterior halves at approximately the 10th rib. The treatment halves were injected with a .3 molar solution of $CaCl_2$ through the lateral sides with a 5-needle hand stitch pump injector at 50 p.s.i. until 110% of initial weight was reached (110%+/-.72% pump). The loins then were vacuum packaged and aged for an additional 3 d at 34°F, for a total of 4 d of aging. At 4 d postmortem, purge weights were taken and loins were cut into 1-in-thick chops. Chops from the 8th rib of the anterior and

12th rib of the posterior halves were used for analysis. Chops were weighed and cooked to an internal temperature of 160°F in a Blodgett dual-air-flow oven. Temperature was monitored using thermocouples attached to a Doric Minitrend 205 temperature monitor. Chops were cooled at room temperature for 2 h, blotted, and reweighed before six .5-in cores were taken perpendicular to the chop surface and sheared using a Universal Instron.

On a follow-up study, loins from five right carcass sides were obtained at 24 h postmortem to determine if the water or injection procedure that was used in our initial study affects WBS values. The same procedures were used with the following exceptions: 1) only standard chill was used, and 2) the injection was 100% water.

Results and Discussion

Rapid chilling (blast chill for 1 h followed by chilling at 34°F) compared with standard chilling (34°F), decreased ($P<.0001$) longissimus muscle temperature at 2 h, but not ($P>.10$) at 45 min and 24 h postmortem (Table 1). Rapid chilling did not affect ($P>.10$) purge, had a tendency ($P=.09$) to increase cooking loss, and increased ($P=.03$) combined percentage of purge and cooking loss. Muscle pH measured at 45 min, 2 h, and 24 h and Warner-Bratzler shear values were similar ($P>.10$) for carcasses that were blast and standard chilled. By increasing chilling rate, combined percentage of purge and cooking loss was reduced without negatively affecting tenderness (WBS).

The injection of $CaCl_2$ into longissimus muscle resulted in minimal increases in the percentage of purge ($P=.10$), cooking loss ($P=.08$), or the combination of the two ($P=.08$) (Table 2). However, $CaCl_2$ injection reduced ($P<.0001$) WBS values of pork longissimus muscle compared with non-injected controls. The Ca^+ is theorized to increase the activity of the calcium dependent proteases (calpain) and increase muscle tenderness.

In the follow-up study, water injection had no effect ($P=.64$) on WBS values and only a minimal effect ($P=.11$) on cooking loss. Therefore, the enhanced tenderness of $CaCl_2$-injected loins was primarily due to $CaCl_2$ and not the addition of water or injection procedure. In conclusion, the incorporation of $CaCl_2$ into pork loins at 24 h postmortem increases tenderness as indicated by a reduction in WBS values.

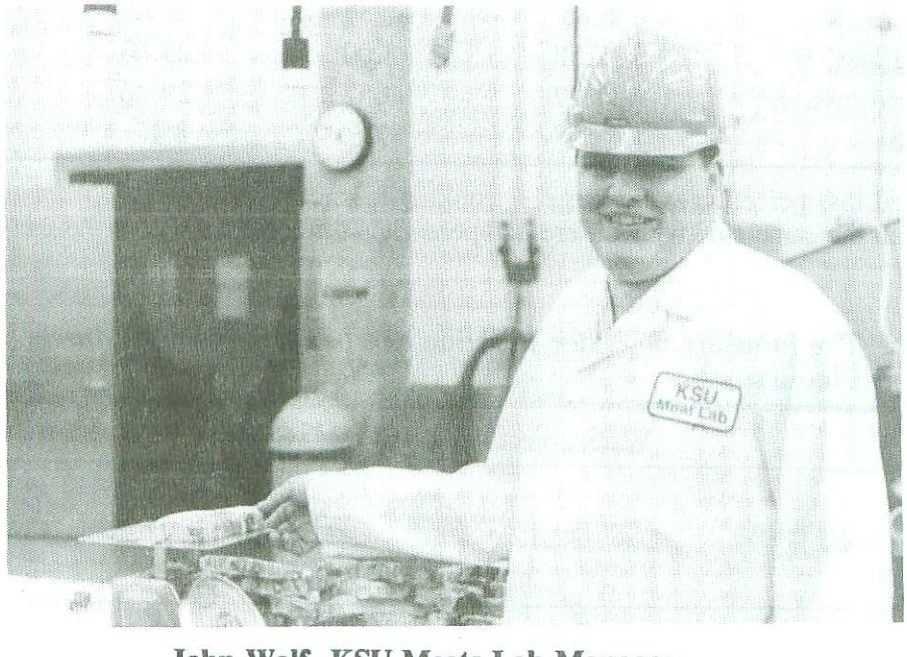

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Table 1. The Influence of Chill Method on Pork Longissimus Muscle Characteristics

Item	Blast chill	SE	Standard chill	SE
Number	14		13	
Temperature, °F				
45 min	102.18	.47	102.04	.56
2 h	75.11[b]	2.25	89.33[c]	2.66
24 h	33.84	1.28	34.09	1.51
ph				
45 min	6.07	.05	6.13	.05
2 h	5.73	.05	5.66	.06
24 h	5.54	.04	5.43	.05
Purge loss, %	5.65	1.29	6.43	1.66
Cooking loss, %	25	2.47	33.21	3.18
Combined loss, %[a]	29.22[b]	1.81	37.52[c]	2.33
WBS, lb	7.39	.28	7.34	.33

[a]Combined loss percentages = purge + cooking loss.
[bc]Means in the same row with different superscripts differ ($P < .05$).

Table 2. The Influence of $CaCl_2$ Injection on Pork Longissimus Muscle Characteristics

Item	$CaCl_2$ injection	SE	Control	SE
Number	27		27	
Purge loss, %	6.85	1.37	5.22	1.37
Cooking loss, %	32.58	3.00	25.63	3.00
Combined loss, %[a]	37.27	3.52	29.46	3.52
WBS, lb	6.59[b]	.06	8.11[c]	.06

[a]Combined loss percentages = purge + cooking loss.
[bc]Means in the same row with different superscripts differ ($P < .05$).

Table 3. The Influence of Water Injection on Pork Longissimus Muscle Characteristics

Item	Water injection	Control	SD
Number	5	5	
Cooking loss, %[a]	32.12	28.96	3.43
WBS, lb[a]	7.98	8.42	2.01

[a]No treatment difference ($P > .10$).