Removal of Kidney Fat before Chilling - Effect on Beef Tenderloin Yield, Color and Tenderness

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REMOVAL OF KIDNEY FAT BEFORE CHILLING – EFFECT ON BEEF TENDERLOIN YIELD, COLOR AND TENDERNESS[1]

P. E. de Felício[2], C. L. Kastner and D. M. Allen

Kansas State University[3,4], Manhattan 66506

Summary

Sixteen beef carcass sides were either conventionally dressed or stripped of kidney and pelvic fat before being chilled. After 3 d of chilling at 0 to 4 C, the tenderloins were removed and trimmed of external fat and psoas minor and iliacus muscles. The psoas major muscles were then vacuum packaged and stored 3 more days at 0 to 2 C. Two steaks were then cut 20 cm from the posterior end of each muscle. One steak was subjectively evaluated for color during a 4-d display period (polyvinyl chloride film) at 0 C; the other was used for Warner-Bratzler shear force evaluation. Shear force steaks were frozen until evaluated. No differences ($P>.05$) in chilled or aged weight, drip loss during aging or thawing and cooking losses were observed between treatments. The conventionally treated beef was lighter colored at d 0 ($P<.01$) and 1 ($P<.05$) of display, but no differences ($P>.05$) between treatments were detected at d 2 and 4. Color change analysis from d 0 through 4 showed less ($P<.01$) color change for the tenderloins with fat removed. Shear force means were higher ($P<.01$) for steaks from sides from which the kidney fat was removed before chilling (2.49 kg) than for those treated conventionally (2.26 kg).

(Key Words: Beef Tenderloin, Kidney Fat, Color, Tenderness, Yield.)

Introduction

For beef to remain competitive, efficiency must be maximized at every industry level. Removing kidney, pelvic and cod or udder fat before chilling reduces refrigeration and transportation costs and may improve the objectivity and accuracy of yield grading. Also, fat is removed more easily while hot and may be rendered into edible tallow before chilling. But chilling the unprotected tenderloin may affect yield, color and tenderness, a matter which has not been thoroughly investigated.

Any change in yield of the unprotected tenderloin during chilling would have to be balanced economically against the advantages of the method. Also, color and tenderness changes must be considered because color is the most important factor influencing consumer eye appeal and ultimate salability (Jeremiah, 1978), and the average consumer considers tenderness the most important palatability attribute (Lawrie, 1979).

Smith et al. (1976) reported that decreases in temperature occurred more slowly in fatter carcasses because of fat's insulating properties, increased carcass mass or both. The authors indicated that those factors (1) permit the muscles to remain in the temperature range conducive to proteolysis longer, and (2) minimize the effects of cold shortening. Meyer et al. (1977) also observed faster chilling rates and significantly less desirable taste panel scores for defatted beef loins than for loins with kidney fat and subcutaneous fat intact.

Our experiment was designed to determine whether fast chilling due to the removal of kidney fat would affect the yield and quality of the unprotected tenderloin.

Materials and Methods

Sides from each of eight beef carcasses were

[1] Contribution No. 81-383-j, Dept. of Anim. Sci. and Ind., Kansas Agr. Exp. Sta., Manhattan 66506.

[2] Instituto de Tecnologia de Alimentos, Campinas, São Paulo, Brazil. Sponsored by Conselho Nacional de Desenvolvimento Científico e Tecnólogico.

[3] Dept. of Anim. Sci. and Ind.

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TABLE 1. TEMPERATURE DECLINE IN THE TENDERLOIN, BY TREATMENT

Time, h	Temperature, C[a] Conventional	Unprotected
0[b]	40.0	39.0
1	39.0	30.0
5	31.0	21.0
10	25.0	13.0
24	13.5	3.0
48	2.5	.5

[a]Average temperature of two sides in each treatment.

[b]0 = beginning of chilling period (approximately 1 h postmortem).

alternately assigned to the following treatments: (1) conventional dressing (C) – kidney, pelvic and cod fat left intact, or (2) experimental dressing procedure (Up) – kidney and pelvic fat removed on the slaughter floor, so that the tenderloin would chill unprotected.

After chilling the tenderloins in the sides for 3 d at 0 to 4 C, we excised them from the loins, trimmed external fat, removed psoas minor and iliacus muscles and vacuum packaged and stored the psoas major muscle another 3 d at 0 to 2 C. We then recorded drip loss and cut two steaks (2.5 cm thick) 20 cm from the posterior end of each muscle. One steak, wrapped in polyvinyl chloride film, was subjectively evaluated for color during a 4-d display period (0 C) under 1076 lux of natural white light; the other steak was weighed, wrapped in freezer paper, frozen and stored at −26 C until it was cooked for Warner-Bratzler shear analysis.

Temperature Decline. Two sides from each treatment were used for the recording of temperature data. Thermistor probes were inserted into the psoas major muscle at the last lumbar vertebra. Cooler temperature also was recorded.

Color. A four-member panel scored color on the basis of the Lamb Color Standards published by the American Lamb Council (undated). The standards consist of pictures numbered 1 (cherry red) through 5 (dark red), with 1 and 2 highly desirable in appearance, 3 acceptable, 3.5 marginally acceptable and 4 and 5 unacceptable. Also, numbers 3 through 5 account for some degree of brown discoloration.

TABLE 2. MEAN SQUARES FROM VARIANCE ANALYSES FOR THE VARIABLES STUDIED

Source	df	Psoas major weight: Chilled	Psoas major weight: Aged 3 d	Drip loss	Color scores: d 0	Color scores: d 1	Color scores: d 2	Color scores: d 4	Color change	Warner-Bratzler shear	Thaw plus cooking losses
Treatments	1	.0100	.0090	.0561	1.2712**	.5220*	.0156	.0961	2.0664**	.2116**	.0049
Blocks	7	.1535**	.1505**	.0734	.6151**	.8266**	.4661**	.2708	.1973	.3897***	92.7849**
Error	7	.0117	.0110	.1047	.0794	.0668	.0687	.0886	.1101	.0078	9.5588

*P<.05.
**P<.01.
***P<.001.

TABLE 3. MEANS AND STANDARD ERRORS OF PSOAS MAJOR WEIGHTS AFTER CHILLING AND AFTER AGING, AND DRIP LOSS DURING AGING, BY TREATMENT

Treatment	Psoas major weight (chilled), kg	Psoas major weight (aged 3 d), kg	Drip loss, %
Conventional[a]	1.884 ± .112	1.864 ± .111	1.065 ± .131
Unprotected[a]	1.834 ± .089	1.816 ± .089	.947 ± .071

[a]Means in the same column do not differ (P>.05).

Shear Force. Steaks for Warner-Bratzler shear measurements were weighed, thawed overnight at 2 C and oven broiled at 177 C to an internal temperature of 68 C, as determined by thermocouples. Weight after cooking was recorded to determine thaw plus cooking losses, and the steaks were cooled at room temperature for 1 h before six 1.3-cm diameter cores were removed from each steak and sheared.

Statistical Analysis. Data were subjected to analysis of variance with each animal considered as a block, and carcass halves, which were alternately assigned to treatments, were considered as the experimental units. The Statistical Analysis System (SAS, Barr et al., 1979) was used to compute the analysis of variance.

Results and Discussion

Temperature decline, recorded at intervals up to 48 h from the beginning of the chilling period, is presented in table 1. Time 0, as shown in the table, was the point when the carcasses were placed into the cooler (approximately 1 h postmortem). Temperatures of tenderloins from C dressed sides remained above 13 C for about 25 h, while temperatures of the Up tenderloins reached 13 C about 11 h postmortem.

Mean square values from variance analysis are reported in table 2. Treatment had no effect (P>.05) upon psoas major weight (chilled or aged 3 d), drip loss during aging or thaw plus cooking losses. Color scores on d 2 and 4 of display also were not affected (P>.05) by treatment. However, treatment affected the color scores on d 0 (P<.01) and d 1 (P<.05) of display, the color change during the period of display and Warner-Bratzler shear force (P<.01).

Psoas major yield (table 3) tended to be slightly higher for the C steaks before and after aging, but the respective differences of approximately 50 g between treatment means were not significant. Likewise, the difference in drip loss during aging, .12 percentage points in favor of the Up tenderloin, was not significant.

Color scores are presented in table 4. Steaks from the C treatment were lighter in color on d 0 (P<.01) and 1 (P<.05) of display than those from the Up treatment. The slower chilling rates and possible faster rates of pH decline in the C tenderloins may account for the initial

TABLE 4. MEANS AND STANDARD ERRORS OF COLOR SCORES, BY DAYS ON DISPLAY AND TREATMENT

Treatment	Color scores[a] d 0	d 1	d 2	d 4	Color change[b]
Conventional	1.67[f] ± .18	1.98[d] ± .25	2.83 ± .17	3.46 ± .13	1.79[e] ± .18
Unprotected	2.24[e] ± .23	2.34[c] ± .22	2.77 ± .19	3.30 ± .17	1.06[f] ± .07

[a]Color scores based on standard pictures: 1 = cherry red, 5 = dark red or brown.

[b]Color score for d 4 minus color score for d 0.

[c,d]Means in the same column followed by different superscripts differ (P<.05).

[e,f]Means in the same column followed by different superscripts differ (P<.01).

TABLE 5. MEANS AND STANDARD ERRORS OF WARNER-BRATZLER SHEAR FORCES AND THAW PLUS COOKING LOSSES, BY TREATMENT

Treatment	Warner-Bratzler shear force, kg	Thaw plus cooking losses, %
Conventional	2.26[a] ± .15	25.50 ± 2.62
Unprotected	2.49[b] ± .17	25.47 ± 2.43

[a,b]Means in the same column followed by different superscripts differ (P<.01).

lighter color in these samples than in the Up counterparts. According to Marsh (1954), the rate of postmortem glycolysis increases with increasing muscle temperature. Hallund and Bendall (1965) suggested that a combination of fast glycolysis and high temperature is responsible for the pale color of PSE pork. Taylor et al. (1980) reported a pattern of pale color for the inner portion of the semimembranosus muscles from conventionally chilled carcasses when compared with more rapidly and uniformly chilled hot-boned counterparts.

After 2 d of display, color differences were very small, and on the fourth day the Up steaks tended to be slightly lighter than the C steaks but C and Up color means for d 2 and 4 did not differ (P>.05).

The analysis of change-in-color scores from d 0 through 4 showed that the average change was greater (P<.01) for the C steaks (1.79 vs 1.06). This could mean a faster change in the state of pigment oxidation in the C steaks and more stable oxymyoglobin in the Up samples that were chilled faster.

C steaks had lower (P<.01) Warner-Bratzler shear force values than Up steaks (table 5). This finding agrees with work by Smith et al. (1976) and Meyer et al. (1977) indicating that the insulating fat slows the chilling rate and improves tenderness. Lochner et al. (1980) attributed differences in tenderness between fat and lean carcasses to the slower temperature drop in fat ones (during the first 2 to 4 h postmortem) regardless of cold shortening.

Research by others (Herring et al., 1965; Bendall, 1972 as cited by Cuthbertson, 1980; Cia and Norman, 1977) suggests that cold shortening did not occur in our Up treated steaks, first, because the temperature did not decline into the risk zone for cold shortening, and second, because the sarcomeres of the psoas major muscle were not permitted to shorten as the sides were suspended by the Achilles tendon during chilling.

The small difference in shear force in the range considered, although consistent, probably would not affect palatability.

Our results indicated that kidney and pelvic fat may be removed from carcasses before chilling with only minimal changes in tenderloin quality and yield.

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