EFFECT OF EARLY PROCESSING AND GLYCOL CHILLING ON STORAGE, RETAIL DISPLAY AND TENDERNESS OF BEEF ROUNDS

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SUMMARY

Accelerated processing of beef carcasses after 24 hours of chilling was compared to the conventional process of chilling for 48 hours prior to processing. Of the accelerated processed rounds, 6 received no further chilling (WP); 12 were chilled for 45 min in -4°C solution of glycol (GC-4); and, 12 were chilled 30 min in -11°C glycol (GC-11). Control rounds (12) left on carcass until 48 hour postmortem (PM), chilled the fastest; warm processed rounds, the slowest. Glycol chilled rounds chilled at an intermediate rate. All rounds had an internal temperature of <4°C by day 3 PM. There were no differences among treatments in post-storage evaluation of purge loss, muscle color or discoloration, or off-odor. All values were within acceptable ranges. Differences were found in post-storage evaluation of fat discoloration. Rounds from GC-11 had more (P<.03) discoloration than those from other groups, perhaps due to freezing of the outer perimeter during chilling. There was more uneveness (P<.08) of muscle color of rounds from the warm processed treatment. No significant differences were found among treatments in retail evaluation scores for muscle color or discoloration, purge, consumer desirability, off-odor, or in shear force values. The general lack of differences in evaluation scores indicated that accelerating the processing time to 24 hr PM would not be deleterious to the product if the rounds are chilled sufficiently after boxing.

INTRODUCTION

The consumer has continued to find cheaper alternatives for beef although many beef producers find that selling prices do not cover production costs. The cost of beef could be reduced through increased processing efficiency. Thus, the industry could regain some of its former strength.

Beef processing involves slaughter of the animal, chilling of the carcass for 24 hr at -1 to 1°C, grading of carcass, chilling of the carcass for an additional 24 hr (to allow thick cuts to chill), fabrication, packaging and boxing of the cuts. For vacuum packaged beef primals, the internal temperature of cuts before packaging should be below 5°C (50°F) to prevent microbial spoilage during storage. Once cuts are boxed, they chill very slowly, if at all. This system of chilling for at least 24 hours is inherently inefficient because of the high energy usage and refrigeration space requirements associated with chilling intact carcass sides and slow movement of the product through the plant (i.e., high inventory costs).
An approach to lowering processing costs would be to reduce in-plant time and chilling time. Since the thin cuts (e.g., loin, flank, rib) are sufficiently chilled for fabrication and packaging at 24 hr, only the thick cuts (e.g., round, chuck) need additional chilling. A processing system where the carcass is processed at 24 hr with the thick cuts being further chilled would be commercially feasible with little change in the present system. However, little is known about the effect of this early processing on the development of the aging process or the effect of rapid chilling on the whole muscle cuts at 24 hr PM.

OBJECTIVE

Determine the effect of early processing (24 vs 48 hours after slaughter) and glycol chilling of beef rounds on storage, retail and tenderness characteristics.

PROCEDURE

Twenty-one steers with an average carcass weight of 318 kg (700 lbs.) and grade of "Good" were slaughtered. Carcasses were split and then chilled at -1 to 1°C for 24 hr. Sides were randomly distributed between early processing treatments and the control treatment (C). The three early processing treatments consisted of a warm processed treatment (WP) without additional chilling, and WP with two glycol chilling treatments. In the WP treatment group, 6 rounds were removed at 24 hr postmortem (PM), vacuum packaged, boxed (one per box) in corrugated cardboard boxes and stored at -1 to 1°C until day 15 PM. Rounds from glycol treatments were treated as WP rounds except that after vacuum packaging 12 rounds were immersed in a shower of -4°C propylene glycol for 45 min (GC-4) and another 12 rounds were chilled for 30 min at -11°C (GC-11). After glycol chilling rounds were boxed and stored as with WP rounds. Control sides were chilled until 48 hr PM before the rounds were removed, vacuum packaged, boxed and stored until day 15 PM.

Prior to packaging, all rounds were evaluated for storage characteristics: muscle color and discoloration, unevenness of lean color, fat discoloration and odor. At the end of the storage period (15 d PM), the purge (fluid) loss was calculated using weight differences. Top round steaks were removed (2.5 cm thick), placed on retail trays and wrapped with retail film. Retail packages were placed in a retail display case maintained at 2 to 4°C under typical retail lighting conditions. Retail characteristics were evaluated at 1, 24, and 48 hr of display. After display, steaks were frozen at -20°C. Steaks were thawed at 2°C for 18 hr then broiled until the internal temperature reached 70°C (medium doneness). When steaks were cooled to ambient temperature, 1.27 cm diameter cores were removed parallel to muscle fibers for Warner Bratzler shear force determinations (tenderness).
RESULTS AND DISCUSSION

Glycol chilling involves chilling of propylene glycol and then using this material to chill the product. This system is currently used to chill packaged ground beef and sausage, and is more efficient than using chilled air. At 24 hours, the internal temperature of the rounds was approximately 13°C (55°F) and needed additional chilling. The control rounds chilled more quickly than rounds from other treatments, even though they remained in the carcass. This was expected since the cardboard boxes act as insulation and slows the chilling of boxed cuts. The warm processed rounds had the slowest decline in temperature and did not attain 4°C until approximately 58 hr post processing. The two glycol treatments elicited approximately equivalent chilling rates which were intermediate to those of C and WP rounds. This lack of difference was surprising since the GC-11 treatment resulted in surface freezing, or crusting, of approximately 1 cm. This crust dissipated quickly after removal from glycol. The GC-4 treatment caused no crusting and was expected to result in a slower internal chilling of the round. This was not evident in this study, perhaps due to the additional 15 min of glycol chilling for the GC-4 rounds. Rounds, regardless of treatment, stabilized at 4°C during day 3 PM. Differences in temperatures among treatments at any given time were small (2 to 3°C). The lack of differences in internal temperatures could be attributed to factors such as the low volume of carcass in the chill cooler and small number of boxes per pallet, allowing for fairly rapid heat dissipation. However, under commercial conditions a different decline of round temperature might be expected as the chill cooler and pallets would be more heavily packed and it would take longer for the warm processed and control rounds to chill. Glycol chilled cuts should still chill fairly rapidly because the final temperature is more dependent on equilibration of the chilled outer portion.

Mean scores for storage evaluation factors are shown in table 1. Purge is the fluid lost from meat during storage. Purge loss percentages were not significantly different (P>.10) among treatments and color values indicated acceptable lean color (cherry red) before and after storage. Discoloration of lean was minimal to non-existent in pre-storage evaluation and less than 10% of the surface was discolored after 15 days storage. There were no significant differences (P>.10) among treatments in lean color or discoloration. Prior to packaging, no differences among treatment were detected for the extent of fat discoloration. However, after storage the rounds in the GC-11 treatment group had more (P<.03) discoloration of the fat cover than did those of other treatment groups. This discoloration was grayish and may have been caused by the crust freezing which occurred with this treatment. Initially, there were no differences among treatments in unevenness of muscle color; the average score for each treatment indicated that there was a very slight unevenness of color in the rounds. In the post-storage evaluation, the WP rounds were more uneven in muscle color (P<.08) than the others, suggesting slower cooling rate. Off-color scores were not affected by treatments (P>.10) and very little off-odor was detected.
Shear force values were not different (P > .10) among treatments
Table 1. Since the muscles of the accelerated processed rounds should
have been in rigor at the time of fabrication and temperature decline
post-processing was comparable to those of the control, no differences
were expected, particularly after extensive aging (15 d). Cuts from all
treatments were of accelerated tenderness.

The lack of significant differences between accelerated treatments
and control indicated that it is feasible to process the entire beef car-
cass at 24 hr as opposed to 48 hr, if the chilling of the thick primals
is strictly controlled. The adoption of such an accelerated processing
system would require little change in the existing processing line and
would increase the efficiency of processing. While liquid contact chilling
systems may not be a requirement for the type of accelerated processing
described here, their use might be advantageous in assuring good quality
control. The cost effectiveness of installing such a system would depend
on the volume of beef processed at a given plant and the plant's ability
to control the chilling of the thicker, heavier cuts.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Evaluation</th>
<th>C</th>
<th>WP</th>
<th>GC-4</th>
<th>GC-11</th>
<th>Level of Significance</th>
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<tr>
<td>Purge loss, %</td>
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<td>.55</td>
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<td>2.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.6&lt;sup&gt;b&lt;/sup&gt;</td>
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<sup>a</sup>C = control rounds chilled 48 hr before fabrication and vacuum packaging; WP = warm processed rounds chilled 24 hr before fabrication and vacuum packaging; GC-4 = rounds chilled as in WP but immersed in shower of -4°C glycol for 45 min before being boxed; GC-11 = as in GC-4 except immersed in -11°C glycol for 30 min. Rounds from all treatments were boxed and stored at -1 to 1°C for 15 d.

<sup>b,c</sup>Means in the same row bearing a different superscript differ at the level indicated. NS indicates non-significant (P<.01).

<sup>d</sup>Muscle color scale: 8 = very light cherry red; 5 = cherry red; 1 = very dark red.

<sup>e</sup>Muscle discoloration scale: 8 = none; 5 = 20% to 50%; 4 = 75% to 90% discolored.

<sup>f</sup>Fat discoloration scale, unevenness of color, off-odor scales: 1 = none; 2 = slight; 3 = moderate; 4 = extreme.

<sup>g</sup>Values greater than 5.5 indicate that the meat is tough.