CANADIAN MEAT SCIENCE ASSOCIATION

VERY FAST CHILLING OF BEEF CARCASSES

J. L. Aalhus, M. E. R. Dugan and W. M. Robertson, AAFC, Lacombe

Carcass chilling is perhaps the most costly procedure in the meat industry, consequently the profitability of the meat industry is highly dependent on fast throughput. However, for the past 20 years the commonly accepted rule of thumb for beef carcass chilling has been to ensure that the meat does not fall below 10 °C within 10 h postmortem to avoid cold-induced toughening (Bendall 1972). Recent reports have challenged this rule of thumb and indicate that Very Fast Chilling (VFC), namely the attainment of –1 °C at 5 h postmortem, can result in improvements to tenderness (Davey and Garnett 1980; Bowling et al. 1987; Sheridan 1990). These results are contradictory to known mechanisms of toughening (cold shortening) and very limited information on VFC has been published (Joseph 1996).

Previous work at Lacombe on rapid chilling has been mainly conducted on pork (Jones et al. 1991, 1993) since pork has a limited susceptibility to cold shortening. Studies on beef (Aalhus et al. 1991, 1994) applied blast chill temperatures of –20 or –40 °C for 3 h or less. Carcasses in the 1991 study attained deep hip temperatures of only 11 °C at 4 h postmortem, well above the defined values for VFC. However, the carcasses used in the 1991 study were unusual in that their backfat ranged from a minimum of 0 to a maximum of 69 mm; it is not known what rate of temperature decline could be achieved in normal market animals (estimated Canada 1 yield grades). As well, the working definition of VFC (-1 °C at 5 h postmortem) is acknowledged to be a loose recommendation at the present time (Joseph 1996), and it is unknown if different scenarios of rapid chilling would be as efficacious in terms of tenderness. Thus, the present study was directed towards finding appropriate combination(s) of chilling times and temperatures for production of VFC tender beef.

To determine the conditions necessary to achieve VFC, 96 carcasses of an estimated Canada 1 grade were used. The right side of each carcass was assigned to blast chilling conditions of either –20 °C (48 sides) or –35 °C (48 sides) while the left side was assigned to control chilling conditions (2 °C for 24 h; 96 sides). Within each blast chill temperature, 12 blast chilled sides were removed from the tunnel at each of four times (3,5,7 or 10 h) and chilled for the remainder of the 24 h period at 2 °C. VFC conditions were not achieved in the deep hip region but were reached in the longissimus thoracis (LT) by approximately 6.5 h under rigorous chilling regimes (7 or 10 h of blast chilling at –35 °C). After 7 d aging LT from sides blast chilled at –35 °C for 10 h were more tender (6.52 vs. 8.50 kg shear force: P=0.006) than their respective control sides. Categorizing shear force into tenderness categories resulted in a higher proportion of tender (≤5.6 kg; 25.0 vs. 0.0%) and probably tender (>5.6 ≤7.85 kg; 58.33 vs. 33.33%) shears in the –35 °C blast chilled sides than in the control sides (P=0.06: Figure 1). However, these differences disappeared with extended aging to 21 d (Figure 2). Hence, the VFC advantage would be a reduction in the necessary aging time to achieve an acceptable product. The extreme chilling regime also resulted in significant reductions in cooler shrink, a slower rate of pH decline, an increased perception of marbling, darker meat colour and increased drip losses at retail (Table 1).

Carcass chilling can, therefore, obviously influence a number of meat quality traits in addition to traits of economic importance. Adoption of a defined chilling regime, balancing quality and safety concerns, cooler and shrink losses, and carcass grade considerations could thus be advantageous to the beef industry.

For further information, please contact Dr. Jennifer Aalhus at (403) 782-8116 or aalhusj@em.agr.ca.

References

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Table 1: the effects of very fast chilling (blast chilled at –35°C for 10 h) on moisture losses and quality traits

Trait	CON	VFC	P
Cooler shrink, g.kg-1	11.25	-0.31	0.0001
Marbling score	432	453	0.0410
PH			
45 min	6.76	6.75	0.8718
24 h	5.61	5.77	0.0038
Minolta colour, 24 h			
L*	36.1	30.6	0.0001
Hue	24.6	23.4	0.5604
Chroma	21.7	17.9	0.0006
Drip loss, g.kg-1	34.80	74.05	0.0001

Figure 1: The proportion of shears categorized as tender (≤ 5.60), probably tender (>5.6 ≤7.85), probably tough (>7.85 ≤9.6) and tough (>9.6) in control sides and sides blast chilled for 10 h at - 20°C or –35°C after 7 d of aging.

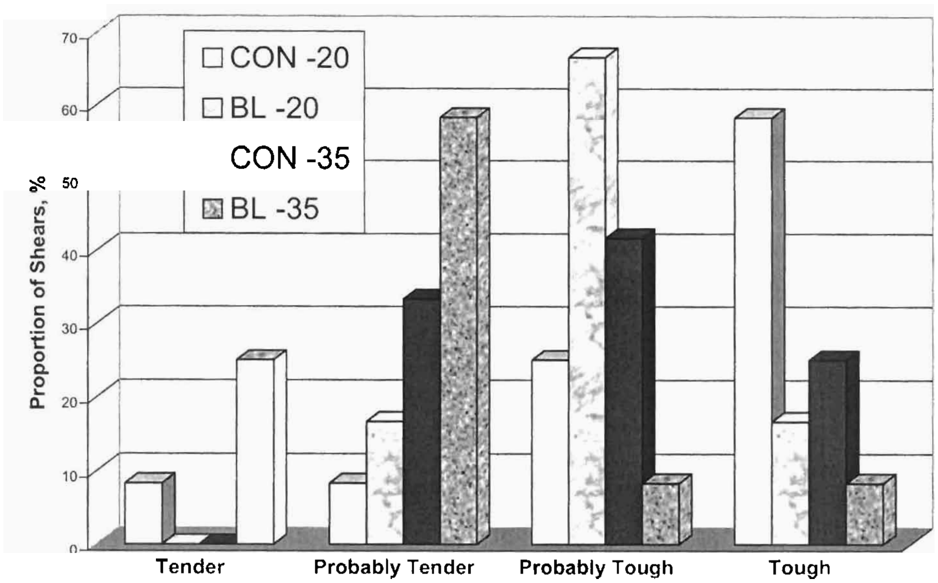

Figure 2: Shear force difference between control and sides blast chilled for 3, 5, 7 or 10 h at –35°C after 1, 7, 14 or 21 d of aging