Bacteriological Quality of Ground Beef Prepared from Hot and Chilled Beef Carcasses

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ABSTRACT

The bacteriological quality of ground beef chub packs prepared from beef sides at 2 h postmortem (hot-boned) and opposite sides conventionally chilled for 24 h at 3 C (cold-boned) were compared at the time of preparation and at 3-day intervals up to 45 days of storage at 0 C. Aerobic plate counts (APCs) in ground beef from hot-boned beef were either significantly lower or not significantly different from APCs in ground beef from cold-boned carcasses. There were no significant differences of any practical importance in Most Probable Numbers (MPNs) of coliforms and Escherichia coli between hot-boned and cold-boned ground beef stored at 0 C. Ground beef prepared from hot-boned beef offers great potential to the meat industry for energy conservation. The bacteriological quality of ground beef from hot-boned carcasses does not limit and might enhance the feasibility of boning carcasses before chilling.

Fabrication of beef carcasses before they are chilled (“hot” boning) could have several advantages as an alternative to conventional beef fabrication. Removal of excess fat and bone before chilling could save considerable energy in terms of total refrigeration. Additional advantages could include savings in costs of transportation, labor and investment. In recent years researchers investigated characteristics of hot-boned bovine muscle (1,3,5-10,12). Most of these studies were concerned with the effect of hot boning on tenderness and eating quality of meat from Good and Choice grade beef carcasses. Fabrication of ground beef utilizes a large proportion of the bovine carcass. Few, if any, data have been reported on the feasibility of producing ground beef from hot-boned beef carcasses. Such ground beef might have potential problems, which include textural changes, color differences and shelf-life, and inordinate bacterial counts would be prohibitive. We compared the bacteriological quality and shelf-life of ground beef prepared from hot- and cold-boned beef carcasses.

MATERIALS AND METHODS

Product fabrication

Four USDA Utility grade beef carcasses were used in this investigation. The animals were slaughtered and the ground beef was prepared and stored at a commercial beef slaughtering-and-further-processing plant. At 2 h postmortem, the top round, strip loin and ribeye cuts were removed from one side of each carcass. At 24 h postmortem, the comparable muscles were removed from the sides that had been chilled at 3 C. The remainder of the meat from the boned carcasses was used immediately (2 and 24 h postmortem) for the ground beef fabrication.

The hot-boned meat was chilled by addition of CO₂ snow (0.1 kg of CO₂/kg of meat) during ground beef fabrication. The hot-boned meat from the four sides (about 450 kg) was ground through a kidney plate. Two-thirds of the CO₂ snow was added, and the coarsely ground meat was mixed 3 min. The meat was then ground through a 0.32-cm plate, after which the ground beef was packaged in oxygen-impermeable polyethylene casings to make 5-lb chub packs. The ground beef from the four chilled sides was prepared in the same manner except that CO₂ snow was not used. Fat content of the ground beef was about 21%.

Forty-eight ground beef chub packs from the hot-boned batch and 48 from the cold-boned batch were stored at 0 C. Three chub packs from each batch were transported (45 min) to the laboratory for bacteriological analyses after 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42 and 45 days of storage.

Bacteriological analyses

Three locations within each chub pack were sampled aseptically to obtain a 25-g sample that was blended 2 min in 225 ml of sterile Buttermilk's phosphate diluent (11). Serial dilutions of the samples were plated in duplicate on three sets of Plate Count Agar (Difco Laboratories, Detroit, MI) plates. Aerobic plate counts (APCs) were determined after the duplicate sets of plates were incubated 7 days at 5 C, 3 days at 20 C or 2 days at 35 C.

Most Probable Numbers (MPNs) of coliforms and Escherichia coli were determined by methods described in the Bacteriological Analytical Manual for Foods (4). All EC-broth (Baltimore Biological Laboratory, Cockeysville, MD) tubes showing gas after 24 or 48 h at 45.5 C were streaked onto Levine's eosin methylene blue agar (BBL) for detection of typical E. coli colonies.

The logarithms (base 10) of the bacterial counts were treated statistically by analysis of variance (ANOVA) and Duncan's (2) multiple range test.

RESULTS AND DISCUSSION

There were no significant differences in initial APCs (5, 20, or 35 C) between the ground beef prepared from hot-boned and that prepared from cold-boned carcasses (Table 1). With one exception (APC 5 C at 3 days of storage) during the 45-day study, the APCs (5, 20, and 35 C) in ground beef from hot-boned were either significantly lower or not significantly different from APCs of ground beef from cold-boned carcasses.

The bacterial counts of the hot-boned ground beef did not increase as rapidly during storage as those of cold-boned. With hot-boned ground beef, APCs at 5 and 20 C did not increase significantly from 0-day counts until day 30 of storage at 0 C; APCs at 35 C were significantly higher than 0-day counts after 33 days. With ground beef from chilled carcasses, APCs at 5, 20 and 35 C were significantly higher than 0-day counts after 18, 21, and 24 days of storage, respectively.

After 45 days of storage, there were no significant
differences in APCs (5, 20, or 35 °C) between hot- and cold boned ground beef, but the APCs were slightly lower in the hot. Both products had reached the end of their microbiological shelf-life. During 45 days of storage, the APCs at 5, 20, and 35 °C increased 2.55, 1.78, and 1.65 logs/g, respectively, in the hot boned ground beef, and 3.08, 2.04, and 1.70 logs/g, respectively, in the cold boned ground beef. The appearance and odor of both hot- and cold boned ground beef were acceptable through 42 days of storage, but a slight off-odor was detected at 45 days.

MPNs of coliforms and E. coli were very low initially and throughout the 45-day storage study (Table 2). There were no significant differences of any practical importance in numbers of these bacteria between hot- and cold boned ground beef.

Our data indicate that ground beef prepared from hot boned carcasses as described above has bacteriological quality and shelf-life that are equal to or better than those of ground beef prepared from chilled carcasses. As an alternate processing method, fabrication of ground beef from hot boned carcasses offers the meat industry great potential for energy conservation.

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REFERENCES