ASPECTS OF THE GROWTH OF SELECTED COLD-TOLERANT PATHOGENS AND *ESCHERICHIA COLI* ON BEEF

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ABSTRACT

Strains of the cold-tolerant pathogens *Aeromonas hydrophila*, *Listeria monocytogenes*, and *Yersinia enterocolitica* were inoculated onto high-ultimate pH beef slices. Sample steaks were either packaged under vacuum or carbon dioxide atmosphere and stored at temperatures of + 10, 5, 2, 0 and -2°C. In vacuum-packaged meat, *Aeromonas hydrophila* and *Yersinia enterocolitica* grew at all storage temperatures at rates that were similar to or greater than that of the spoilage flora. *Listeria monocytogenes* did not grow in vacuum-packaged meat at -2°C, and at higher temperatures generally grew at growth rates similar to or less than that of the spoilage flora. In samples packaged under carbon dioxide, all three organisms grew at +10°C, but only *Yersinia enterocolitica* grew at +5°C. None of the test organisms grew under carbon dioxide at temperatures of +2°C or lower temperatures.

Storage life of high ultimate-pH beef packaged under carbon dioxide atmosphere was extended by at least a factor of two, and at the lower storage temperatures by up to a factor of three if compared with vacuum-packaging.

The hygienic adequacy of a hot-boning process of beef in a commercial New Zealand meat plant was assessed by a temperature function integration (TFI) technique. The potential proliferation of mesophilic organisms was estimated

using the growth of *Escherichia coli* as an example. The growth potential was calculated from 50 temperature histories for the slowest cooling site on a carcass and within a carton. In the first survey of 50 temperature histories the mean calculated growth potential was 9.3 generations of growth, with a mean time of 13.3 hours to reduce the temperature of the meat to +7°C. The mean calculated proliferation for the improved hot-boning process was 7.1 generations of growth of *Escherichia coli* which is comparable to results that had been obtained for conventional cold boning. The mean time to reduce the temperature to +7°C was 12.2 hours with a range from 9 to 16.5 hours. The maximum observed microbial proliferation was less than that found in the conventional carcass cooling operation.

A profile through the geometric centre of a cooling carton of hot-boned meat revealed the location of the point of highest potential proliferation of mesophilic bacteria, i.e. the slowest cooling spot within a carton. In cartons cooling with lids closed over the mass of hot-boned beef this was located at the midway point between the geometric centre and a point halfway between the geometric centre and the surface of the cooling meat mass.

Observed proliferations of inocula of *E.coli* in cooling cartons were compared with the proliferations calculated from the temperature histories obtained from sites adjacent to the inoculas and found to agree within a range of ± 1 generation

in 81% of comparisons. In 62% of comparisons the calculated growth potential exceeded the actual observed growth.

The value of TFI evaluation for the purpose of process assurance and regulatory hygienic processing control is described. Suggestions for a need to assess other current meat processes, in particular, offal cooling for its mesophilic growth potential are made. The possibility of replacing some of the current bacteriological sampling regimes with TFI monitoring is also discussed.

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