

SURROGATE BACTERIA

SURROGATE BACTERIA FOR IN-PLANT CRITICAL CONTROL POINT VALIDATION OF THERMAL INACTIVATION OF *LISTERIA MONOCYTOGENES*

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Heat treatment of meat and poultry is among the most common of processing techniques to assure their microbiological safety and is considered a critical control point in the Hazard Analysis Critical Control Point (HACCP) system. However, it is not feasible in processing plants to validate thermal processes on a periodic basis using pathogenic bacteria. Hence, a suitable non-pathogenic (surrogate) microorganism is needed for process validation and verification. The goal of this research was to validate the relationship of thermal destruction of the surrogate non-pathogenic *Enterococcus* sp. B2354 (formerly known as *Pediococcus* sp. NRRL B-2354 and *Micrococcus freudenteii*) to that of pathogens of concern in meat products (*Listeria monocytogenes* and *Salmonella*).

Several trials were done to determine the heat resistance of *Enterococcus* sp. B2354, *L. monocytogenes* 101M, and *S. Senftenberg* 775W at four temperatures (58, 62, 65, and 68°C) in ground beef of 4% (lean) and 12% (normal) fat content. In lean ground beef, *L. monocytogenes* was more sensitive to thermal inactivation at 58 and 62°C than *S. Senftenberg*, but slightly more resistant at temperature above 62°C. However, in normal ground beef, *L. monocytogenes* was consistently more heat sensitive than *S. Senftenberg* at all four temperatures tested. Higher fat content protects bacteria from thermal inactivation, especially at temperatures lower than 68°C. D-values for *Enterococcus* sp. B2354 in lean and normal ground beef were 4.5 to 18 and 3.6 to 15 times greater, respectively, than those for the most resistant pathogenic microorganisms (*L. monocytogenes* or *S. Senftenberg* 775W) at all temperatures tested, with the greatest difference in D-values occurring at 58° and 62°C. These results indicate that thermal treatments of ground beef at 58° to 68°C that kill *Enterococcus* sp. B2354 will also kill *Salmonella* and *L. monocytogenes*. Hence, depending on the margin of safety desired, processors could use this strain of *Enterococcus* sp. B2354 as a surrogate for validation studies of thermal processes in lean and normal ground beef at 58° to 68°C.

In search for a less heat resistant surrogate than *Enterococcus* sp. B2354, the heat resistance of two other potential surrogate microorganisms, *Pediococcus parvulus* HP and *Pediococcus acidilactici* LP, isolated from a commercial meat starter culture, was compared with the three strains under study (*L. monocytogenes* 101M, *S. Senftenberg* 775W, and *Enterococcus* sp. B2354) in broth at 62°C. D-values of *P. parvulus* HP and *P. acidilactici* LP were lower than those of *Enterococcus* sp. B2354 but 4.1 and 2.5 times greater, respectively, than those of the most resistant pathogen (*S. Senftenberg* 775W). Therefore, these two *Pediococcus* strains may serve as alternate surrogates for validation studies when a less heat resistant surrogate is desired; however, studies at additional temperatures are needed with these strains for validation of the entire range of 58° to 68°C.