

Title Growth of *Listeria monocytogenes* on iceberg lettuce and solid media
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Abstract

The growth of pathogenic bacterium *Listeria monocytogenes* on fresh-cut iceberg lettuce under constant temperatures was modelled in order to investigate microbial safety during distribution of this vegetable. We examined the effects of several incubation temperatures, ranging from 5 to 25 °C, on bacterial growth. These data were fitted to the Baranyi model and the curves showed a high correlation coefficient at all temperature ($R^2 > 0.95$). In addition, the native bacterial flora of the lettuce did not affect the growth rate of *L. monocytogenes* regardless of incubation temperature. However, the lag time was reduced at a ratio of native bacteria to inoculated *L. monocytogenes* (100:1) at low incubation temperatures (5 and 10 °C). Furthermore, the maximum population density (MPD) was increased at a low ratio of native to inoculated *L. monocytogenes* (1:1) at all incubation temperatures. These results were compared with the previous work published by Buchanan et al. (1989) [Buchanan, R.L., Stahl, H.G., Whiting, R.C., 1989. Effects and interactions of temperature, pH, atmosphere, sodium chloride, and sodium nitrite on the growth of *Listeria monocytogenes*. J. Food Prot. 52, 844–851] that is being developed at the US Department of Agriculture (USDA) Agricultural Research Service's Pathogen Modelling Program (PMP). The broth-based Buchanan model for *L. monocytogenes* was found to markedly deviate from the observed data. In order to investigate this discrepancy, we examined the effects of medium environment and nutrient content on *L. monocytogenes* growth using tryptic soy agar plates (TSAP) and agar plates (AP) containing 1.7% sucrose. The inoculated bacteria on both TSAP and AP showed slower growth rates than that predicted by the PMP. The MPD of bacteria grown on TSAP was similar to the PMP model ($\sim 9 \log_{10}$ CFU/ml or plate (circle of diameter of 90 mm)) regardless of the incubation temperature. By contrast, the MPD observed on AP was $4 \log_{10}$ CFU lower than that observed on TSAP or predicted by the PMP. Both the growth rate and the MPD of *L. monocytogenes* on AP were similar to those on lettuce. These results suggest that the solid medium and poor nutrient content inhibited the growth of *L. monocytogenes* on lettuce. The growth rates of the inoculated *L. monocytogenes* on all media were described using Ratkowsky's simple square root model.