

Title Effect of treating lettuce surfaces with acidulants on the behaviour of *Listeria monocytogenes* during storage at 5 and 20 °C and subsequent exposure to simulated gastric fluid

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Abstract

The effect of acid decontamination on the growth/survival of *Listeria monocytogenes* on fresh lettuce (*Lactuca sativa*) during storage and subsequent exposure to a simulated gastric fluid was studied. Fresh lettuce, inoculated with *L. monocytogenes* (3 log cfu/cm²), was immersed (20 °C, 90 s) in water (W), lactic acid (LA), acetic acid (AA), propionic acid (PA) and citric acid (CA) at concentrations 0.5 and 1.0%, and then stored aerobically at 5 and 20 °C for 20 and 10 days, respectively. The immediate post-treatment reduction of *L. monocytogenes* was less than 1 log cfu/cm² for all treatments tested. The level of *L. monocytogenes* on W treated lettuce did not change during storage at 5 °C but increased significantly ($P < 0.05$) and reached levels of 10⁶–10⁷ cfu/cm² at 20 °C. The residual effect of acid decontamination treatments during storage was found to be strongly dependent on the type and concentration of the acid solution. Decontamination with 0.5% AA, PA and CA did not have any antimicrobial effect and in some cases stimulated growth of the pathogen. The latter could be attributed to suppression of lettuce natural microflora. In contrast, decontamination with 0.5% LA resulted in a decrease of the pathogen during storage at 5 °C and in an extended lag phase at 20 °C. Increasing the concentration of acid solutions to 1% resulted in a rapid decline of *L. monocytogenes* for all acids tested except for CA, in which the behaviour of the pathogen was similar to that observed in W treated lettuce. The results from the sensory analysis showed that decontamination of lettuce with AA and PA led to a significant ($P < 0.05$) negative effect on the overall appearance of lettuce while the sensory score of samples treated with LA and CA during storage was very close to that of W treated lettuce ($P > 0.05$). The above results from the sensory analysis were confirmed by color analysis of lettuce. In order to evaluate the potential acid adaptation phenomena induced by acid decontamination interventions, the survival of *L. monocytogenes* during exposure to a simulated gastric fluid after prior storage of decontaminated lettuce was studied. The results showed that the tested decontamination treatments did not increase the acid tolerance of *L. monocytogenes*. In contrast, LA treatments sensitized the pathogen to the acidic simulated stomach conditions indicating a decreased virulence potential.