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| **Title** | Combined effects of heat and acetic acid against foodborne pathogens for the preservation of asparagus |
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## Abstract

As increased consumption of fresh vegetables raises the possibility of contracting foodborne illnesses through contaminated produce. However, demand for minimally processed vegetables is increasing. Proper treatment methods should be evaluated to ensure the safety of minimally processed vegetables. The objective of this study was to evaluate the combined treatment of heat and acetic acid to control foodborne pathogens in asparagus. Each of three strains of *Escherichia colt* 0157:H7, *Salmonella Typhimurium,* and *Listeria monocytogenes* was used to inoculate into asparagus paste. Samples were prepared to achieve various concentrations of acetic acid (0, 0.25. 0.5. 0.75, 1, 1.5. and 2% (v/v)) by adding the appropriate amount of vinegar, 50g ground asparagus, and 2% (w/v) salt. Prepared culture cocktails of foodborne pathogens were inoculated into asparagus samples at a level of $10^{6\text{-}7}$ CFU/ml. Heat treatment of each sample was conducted in a water bath until internal temperatures reached to 40, 50, 60, and 75°C. Samples were stored at room temperature and enumerated at 0, 0.5, 1, 2, and 3 d. Combined treatment of heat and acetic acid showed synergistic effects against foodborne pathogens. More than 5 $\log_{10}$ reduction of *S. Typhimurium* was achieved with 1% acetic acid at 50°C, whereas 0.5% acetic acid required 75°C heat treatment. After 3 days of storage at room temperature, the level of *Salmonella* was below the detection limit with 1%-40°C treatment. *L monocytogenes* showed resistance to heat and acetic acid treatment. To obtain 5 $\log_{10}$ reduction at 1% acetic acid required 60°C heat treatment. *E. coli* 0157:H7 treated with 1% acetic acid showed 5 $\log_{10}$ reduction at 75°C. To achieve 5 $\log_{10}$ reduction at 50°C, at least 2% acetic acid was needed. These findings suggest that the synergistic effect of heat and acetic acid possibly lowered the temperature and amount of acetic acid required for minimally processed vegetables.