

Title The effects of electron beam irradiation and sanitizers in the reduction of pathogens and attachment prevention on spinach

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Abstract

The effects of electron beam (e-beam) irradiation and sanitizers in the reduction of *Escherichia coli* O157:H7 and *Salmonella* counts and attachment prevention on spinach was studied. Survival of these pathogens in spinach was observed at multiple times and temperatures. Inoculated spinach was examined by confocal microscopy to determine attachment sites and internalization of these pathogens. To determine the effectiveness of sanitizers in reducing pathogen numbers, inoculated spinach was treated with L-lactic acid, peroxyacetic acid, calcium hypochlorite, ozone, and chlorine dioxide. Inoculated spinach was exposed to e-beam irradiation and tested for counts of both pathogens immediately after irradiation treatment to determine bacterial reduction, and at 2 day intervals over 8 days to determine effects of ionizing irradiation on pathogen survival. Respiration rates were measured on spinach exposed to e-beam. The effectiveness of e-beam irradiation on the microbiological and sensory characteristics of spinach was studied. For spinach samples stored at 4°C and 10°C for 8 days, *E. coli* O157:H7 survived and grew significantly in samples stored at 21°C for 24 h. Confocal microscopy images provided valuable information on the attachment sites and internalization of the pathogens on spinach. The greatest reduction by a chemical sanitizer was 55°C L-lactic acid with a 2.7 log CFU/g reduction for *E. coli* O157:H7 and 2.3 log CFU/g reduction for *Salmonella*. Each dose of e-beam irradiation significantly reduced populations of both pathogens. Respiration rates of spinach increased as irradiation treatment doses increased. Total aerobic plate counts were reduced by 2.6 and 3.2 log CFU/g at 0.7 and 1.4 kGy, respectively. Lactic acid bacteria were reduced at both doses but grew slowly over the 35 day period. Yeasts and molds were not reduced in samples exposed to 0.7 kGy whereas 1.4 kGy had significantly reduced counts. Gas compositions for samples receiving 0.7 and 1.4 kGy were significantly different than controls. Irradiation did not affect the objective color or basic taste, aromatic or mouthfeel attributes of spinach. These results suggest that low dose e-beam irradiation may be a viable tool for reducing microbial populations or eliminating *E. coli* O157:H7 and *Salmonella* from spinach with minimal product damage.