Title Validation of irradiation of broccoli with a 10 MeV electron beam accelerator

Author J. Kim, R.G. Moreira and M.E. Castell-Perez

Citation Journal of Food Engineering, Volume 86, Issue 4, June 2008, Pages 595-603

Keywords Complex shape; Dose distribution; Monte Carlo simulation; CT-scan

Abstract

Electron beam irradiation can inhibit pathogens in fresh produce while maintaining its quality. However, proper dose determination in complex-shaped produce is difficult, and needs further evaluation to ensure adequate irradiation treatment. The objective of this study was to establish the best treatment for irradiation of a broccoli head by comparing simulated dose distributions from Monte Carlo simulation and computed tomography (CT) scan data with those measured using standard dosimeters (alanine pellets and radiochromic films). Values of 3-D geometry and component densities of a broccoli head were entered into a radiation transport code (MCNP5) to simulate dose distribution. The broccoli head was irradiated with a 10 MeV double beam (top and bottom) linear accelerator. Dose levels ranged from 1 to 3 kGy.

Several irradiation strategies were simulated (position of the product related to the beam entrance and, beam sources) and compared with the experimental data. The best results were obtained when the broccoli was irradiated at a 132.5° angle using the double beam configuration. The D_{max}/D_{min}, a measure of the dose uniformity, was 1.72 around the floret and, 2.22 for the whole broccoli.

These results provide valuable information for irradiation treatment planning of complex-shaped fresh produce, thus ensuring that the product is uniformly exposed to the target dose while preserving its quality attributes.