Title Simulation of pathogen inactivation in whole and fresh-cut cantaloupe (*Cucumis melo*) using electron beam treatment

Author Jongsoon Kim, Rosana Moreira and Elena Castell-Perez

Citation Journal of Food Engineering, Volume 97, Issue 3, April 2010, Pages 425-433

Keywords Dosimetry; Safety; e-Beam; Irradiation

Abstract

Cantaloupes (*Cucumis melo*) have been implicated in several recent *Salmonella* outbreaks. Electron beam irradiation at the required dose can effectively inhibit pathogens while maintaining produce quality. The objective of this study was to evaluate pathogen inactivation in cantaloupes for optimization of electron beam treatment using dose distributions from Monte Carlo simulation and computed tomography (CT) scan data. 3D geometry and component densities of whole cantaloupes and fresh-cut cantaloupes packed in plastic trays, extracted from CT-scan data, were entered into a radiation transport code (MCNP5) to simulate dose distributions. Lucite (4.2 cm) was used as an electron absorber when simulating high energy (10 MeV) irradiation to make the penetration depth similar to the lower energy (1.35 MeV) electron simulations.

For surface irradiation of the whole cantaloupe with a 1.35 MeV e-beam source, the penetration depth was ~0.7 cm, well beyond the cantaloupe rind. For an entrance dose of 1 kGy, the log-reductions for *Salmonella* (D_{10}-value of 0.359) were 3.30 ± 0.43 and 3.58 ± 0.58 at the depths of 0.2 and 0.4 cm, respectively. The dose uniformity ratio (D_{max}/D_{min}) up to 0.2 cm was improved from 1.81 to 1.15 with one beam rotation around the fruit. Surface irradiation using a 10 MeV e-beam source showed far less microbial reduction, only 1.58 ± 0.93 and 1.32 ± 0.84 at 0.2 and 0.4 cm, respectively.

Irradiation of fresh-cut cantaloupe with a 10 MeV e-beam source showed that the maximum dose of 1.1 kGy occurred at the 3.5 cm depth and the minimum dose of 0.81 kGy took place at 5.5 cm depth, with an average 2.99 ± 0.79 log reduction around the whole package.

These results provide valuable information for optimizing irradiation treatment planning for fresh produce.