Title Computer simulation of radio frequency (RF) heating in dry food materials and quality evaluation of RF treated persimmons

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Abstract

Radio frequency (RF) heating is a novel heat treatment that has been explored for control of pests and pathogens in several agricultural commodities such as fresh fruits, dry nuts, food grains, legumes and flours. A major problem for the technology to be commercially applicable is its non uniform heating in different food materials. It is important to understand, investigate and analyze the complex behavior of RF heating. The present research was aimed to study RF heating uniformity in food materials.

As a preliminary step of the research, RF heating was experimentally evaluated in 'Fuyu' persimmon, a selected specialty crop fruit. The objective was to develop a RF based heat treatment protocol to control Mexican fruit fly in persimmon. Quality parameters, including weight loss, firmness, soluble solids, titratable acidity, peel and pulp color, and calyx browning of persimmons were evaluated after 7 days of RF heat treatments. Results showed that RF heat treatment provided potential for disinfestations of persimmons with acceptable quality.

As a next step, a computer model was developed to simulate RF heating in dry food materials using finite element software FEMLAB. The aim of this part of the study was to understand the complex behavior of RF heating in the dry food materials. Whole wheat flour was selected as a representative material for dry food materials. Simulated and experimental results showed that temperature values were higher at the corners and lower sections of flour in a rectangular container after RF heating.

The computer model was further used to investigate the effect of different influencing parameters on heating uniformity in dry food materials placed between two parallel electrodes. Results showed that smaller values of dielectric properties resulted in better RF power uniformities in the samples. RF power uniformity in cuboid shaped samples, placed on the bottom electrode, first decreased and then increased with the increase in sample size. Reducing electrode gap improved RF power uniformity. This research is useful to understanding the RF heating mechanism, to improve heating uniformity in agricultural commodities, and to design and scale up efficient RF systems.