Abstract

Non-uniform heating caused by the different orientations and locations of in-shell walnuts may be a major problem in developing a large-scale radio frequency (RF) treatment for postharvest phytosanitary and quarantine regulations in international trade. A mathematical model was developed based on normal distributions of walnut temperatures against frequency to study the influence of the number of RF units and intermittent stirrings on heating uniformity. The model was validated by experiments with a good accuracy. It was determined by experiments that the rise in standard deviation of walnut temperatures at any time during RF heating increased linearly with the rise in mean temperature. The ratio, defined as uniformity index, depends upon the design of a RF unit, and has a significant influence on the number of stirrings needed to achieve the desired insect mortality. For a uniformity index value of 0.165, a minimum of two stirrings was needed to meet the different desired temperature distributions for insect controls, such as the lowest temperature of 48 °C and mean temperature of 67 °C for a 99.9968% mortality or the lowest temperature of 50 °C and mean temperature of 64 °C for a 99.9% mortality.