Drying Kinetics of Mango Seeds in a Greenhouse-type Solar Dryer

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Abstract

A greenhouse-type solar dryer is employed in drying mango seeds, which are insignificant by-products in a mango processing facility. Wireless sensor networks (TelosB nodes) were used in monitoring process conditions such as temperature (T), relative humidity (RH), and illuminance (lux) inside the solar dryer. Moisture contents during the drying period were measured at different sample tray levels (tray 1, tray 3, and tray 5) and the drying kinetics were established. Drying curves of the sample for sunny, cloudy, and rainy conditions were compared. The drying rates and effective diffusivity were calculated and estimated for the different sample tray levels and for the three weather conditions during the nine-month experimental period. Results showed that the tray level has a significant effect on the drying rates and effective diffusivity of the samples wherein the drying rate is faster for higher tray levels. The same phenomenon is observed for the three weather conditions, and the fastest drying rates were observed during sunny periods. Curve fitting was done using the obtained drying kinetic data. Applying the 14 empirical thin-layer drying models, the drying of mango seeds in the greenhouse-type solar dryer can be best described by the approximation of the diffusion model. The drying kinetics for mango seeds established in this study is a first for a fully functioning industrial-scale greenhouse-type solar dryer. This study is found to be useful in the design and scale-up of a solar dryer wherein agricultural by-products can be dried more efficiently using solar energy, thereby reducing energy costs.