

Experimental and numerical analysis of thermodynamic performance of microwave dryer of onion

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Abstract

The present study was designed for the experimental and modeling investigations on thermodynamic analysis of drying onion slices using four microwave power levels (100, 350, 500, and 750 W) and the four samples thicknesses (2.5, 5, 7.5, and 10 mm). A multilayer feedforward artificial neural network was employed in order to predict energy and exergy performance of the dryer and the prediction success were compared using three evaluation criteria. The average values for energy efficiency and specific energy loss ranged from 13.52% to 37.94% and from 1.35 to 7.43 MJ/kg_{water}, respectively. Findings showed that the exergy efficiency changed from 11.79% to 30.84%. In addition, the statistical analysis revealed that higher microwave power levels and the thinner samples significantly ($p < .05$) enhanced both the energy and exergy efficiencies. The obtained results for exergy improvement potential (accounted for 37.83%–69.41% from the total exergy inlet) indicated that the drying process has good potential for exergy performance improvement. Based on the modeling outcomes, the energy efficiency was well predicted by an artificial neural network with a topology of 3–18–18–1 and LM training algorithm and threshold function of Tan–Tan–Lin. However, the best topology for the exergy efficiency prediction had 3–20–16–1 structure, LM training algorithm and Log–Log–Lin transfer function (R^2 of .94).