

Mathematical Modelling of Drying Kinetics of Cantaloupe in a Solar Assisted Dryer

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Abstract : Crop drying, which aims to reduce the moisture content to a certain level, is a method used to extend the shelf life and prevent it from spoiling. One of the oldest food preservation techniques is open sun or shade drying. Even though this technique is the most affordable of all drying methods, there are some drawbacks such as contamination by insects, environmental pollution, windborne dust, and direct exposure to weather conditions such as wind, rain, hail. However, solar dryers that provide a hygienic and controllable environment to preserve food and extend its shelf life have been developed and used to dry agricultural products. Thus, foods can be dried quickly without being affected by weather variables, and quality products can be obtained. This research is mainly devoted to investigating the modelling of drying kinetics of cantaloupe in a forced convection solar dryer. Mathematical models for the drying process should be defined to simulate the drying behavior of the foodstuff, which will greatly contribute to the development of solar dryer designs. Thus, drying experiments were conducted and replicated five times, and various data such as temperature, relative humidity, solar irradiation, drying air speed, and weight were instantly monitored and recorded. Moisture content of sliced and pretreated cantaloupe were converted into moisture ratio and then fitted against drying time for constructing drying curves. Then, 10 quasi-theoretical and empirical drying models were applied to find the best drying curve equation according to the Levenberg-Marquardt nonlinear optimization method. The best fitted mathematical drying model was selected according to the highest coefficient of determination (R^2), and the mean square of the deviations (χ^2) and root mean square error (RMSE) criteria. The best fitted model was utilized to simulate a thin layer solar drying of cantaloupe, and the simulation results were compared with the experimental data for validation purposes.

Keywords : solar dryer, mathematical modelling, drying kinetics, cantaloupe drying

Conference Title : ICSEERES 2023 : International Conference on Sustainable Energy Engineering and Renewable Energy Systems

Conference Location : Barcelona, Spain

Conference Dates : February 16-17, 2023