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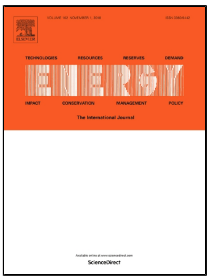

Application of artificial neural network method for prediction of osmotic pretreatment based on the energy and exergy analyses in microwave drying of orange slices

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Application of artificial neural network method for prediction of osmotic pretreatment based on the energy and exergy analyses in microwave drying of orange slices

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Abstract

In the present study, artificial neural network (ANN) method was applied for predicting osmotic pretreatment based on the energy and exergy analyses in microwave drying of orange slices. For this purpose, the oranges were cut into slices with a thickness of 4 mm and treated with salt (NaCl) and distilled water solution (7% by weight) for 30, 60, and 90 min as osmosis pre-treatment. Then, they were dried in three replicates using a microwave dryer and at three powers of 90, 360, and 900 W. The statistical analysis results showed that the osmosis time is significant for the energy efficiency and exergy efficiency and specific exergy loss at 1% level. The highest energy and exergy efficiency was observed at 900 W and in the osmosis time of 90 min. The highest energy and exergy efficiency was observed at 42.1% and 31.08%, respectively. The maximum exergy loss was seen at 360 W and osmosis time of 60 min. The osmosis time did not affect the specific energy loss. The microwave power was statistically significant for all the parameters (energy and exergy) such that with increasing the microwave power, the energy and exergy efficiency increased, while the specific exergy and energy loss decreased. Overall, with increasing osmosis time and microwave power, the energy and exergy levels of the microwave dryer increased. The maximum coefficient of determination (R^2) in a network containing 6 neurons in the hidden layer was 0.999 for energy efficiency, $R^2 = 0.871$ for specific energy loss, $R^2 = 0.999$ for specific exergy loss, and $R^2 = 0.972$ for exergy efficiency. This amount was seen in a network containing 4 neurons in the hidden layer.

Keywords: microwave dryer, energy, exergy, osmosis, orange, pre-treatment

1. Introduction

Drying is one of the oldest methods for preserving agricultural and food products. One of the main goals of drying agricultural products is moving the water in solids to the surface of the product to a certain extent. Drying is performed in order to reduce the amount of microbial activity in the product and minimize the amount of chemical interactions in order to minimize the damage imposed on agricultural products[1][2]. Drying also increases the life of the product and, by reducing the weight and volume of products, facilitates the packaging, transporting, and storage of the products, leading to reduced costs. In addition to the above-mentioned cases, drying can control the market of different products so that the desired product can be used in sensitive situations [3]. In practice, drying is a process that requires a high energy consumption due to the latent heat of water evaporation. In this regard, 10% of the total energy consumption in the food industry is related to drying food. Therefore, the drying of agricultural products reflects energy efficiency in the production of food products and it is very important in industrial uses [4]. Microwave drying