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Impact of Microwave and Air Velocity on Drying Kinetics and Rehydration of Potato Slices

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Abstract : Drying is one of the most used methods for food preservation, which extend shelf life of food and makes their transportation, storage and packaging easier and more economic. The commonly dried method is hot air drying. However, its disadvantages are low energy efficiency and long drying times. Because of the high temperature during the hot air drying, the undesirable changes in pigments, vitamins and flavoring agents occur which result in degradation of the quality parameters of the product. Drying process can also cause shrinkage, case hardening, dark color, browning, loss of nutrients and others. Recently, new processes were developed in order to avoid these problems. For example, the application of pulsed electric field provokes cell membrane permeabilisation, which increases the drying kinetics and moisture diffusion coefficient. Microwave drying technology has also several advantages over conventional hot air drying, such as higher drying rates and thermal efficiency, shorter drying time, significantly improved product quality and nutritional value. Rehydration kinetics of dried product is a very important characteristic of dried products. Current research has indicated that the rehydration ratio and the coefficient of rehydration are dependent on the processing conditions of drying. The present study compares the efficiency of two processes (1: room temperature air drying, 2: microwave/air drying) in terms of drying rate, product quality and rehydration ratio. In this work, potato slices (≈2.2g) with a thickness of 2 mm and diameter of 33mm were placed in the microwave chamber and dried. Drying kinetics and drying rates of different methods were determined. The process parameters included inlet air velocity (1 m/s, 1.5 m/s, 2 m/s) and microwave power (50 W, 100 W, 200 W and 250 W) were studied. The evolution of temperature during microwave drying was measured. The drying power had a strong effect on drying rate, and the microwave-air drying resulted in 93% decrease in the drying time when the air velocity was 2 m/s and the power of microwave was 250 W. Based on Lewis model, drying rate constants (kDR) were determined. It was observed an increase from kDR=0.0002 s-1 to kDR=0.0032 s-1 of air velocity of 2 m/s and microwave/air (at 2m/s and 250W) respectively. The effective moisture diffusivity was calculated by using Fick's law. The results show an increase of effective moisture diffusivity from 7.52×10-11 to 2.64×10-9 m2.s-1 for air velocity of 2 m/s and microwave/air (at 2m/s and 250W) respectively. The temperature of the potato slices increased for higher microwaves power, but decreased for higher air velocity. The rehydration ratio, defined as the weight of the the sample after rehydration per the weight of dried sample, was determined at different water temperatures (25℃, 50℃, 75℃). The rehydration ratio increased with the water temperature and reached its maximum at the following conditions: 200 W for the microwave power, 2 m/s for the air velocity and 75°C for the water temperature. The present study shows the interest of microwave drying for the food preservation.

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