ABSTRACT

The Foaming and Foam-Mat Drying of Papaya and Pumpkin Purees

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Foaming and foam-mat drying studies were conducted to investigate the foaming and drying behaviour of papaya and pumpkin purees towards the development of a dehydrated product which could readily lend itself to value addition. Frozen and thawed (untreated, single strength) pumpkin and papaya purees were successfully foamed with 5% glycerol monostearate to form low density stable foams of 0.22 g/ml and 0.25 g/ml after 10 and 15 min of whipping time respectively. Increase in foam concentrate volume 3-4 fold ensured a highly porous structure. Other foam inducers-Soy Protein Isolate, Methyl Cellulose, Dream Whip and 3 different grades of Methocel either produced no foams or foams with poor oven stability. Osmosed purees (30, 40 or 60 °Brix) did not allow for successful foam formation or heat stable foams.

Foam-mats of 3 thicknesses (0.002, 0.005 and 0.008 m) were dried at 45, 60, 75 and 90°C at an air-flow rate of 1.5 m/s in a forced, air convection oven to a porous, friable, crisp solid which was easily converted into a powder. Drying took place exclusively in the falling rate period and moisture movement was adequately described by the diffusion model. Fick's second law-applied through linear regression, nonlinear regression and the method of slope solutions produced effective moisture diffusivity, D_e. The method of slopes was found to be the most appropriate method for estimating D_e and yielded, values ranging from 5.55×10^{-9} and 4.72×10^{-9} m^2/s for pumpkin and papaya respectively. Activation energy, E_a ranged from 36 to 46 kJ/mol for FMD pumpkin and papaya indicating a stronger water-substrate bond when compared to 23 to 26 kJ/mol for non-foamed purees. D_e was also shown to relate to temperature by the Arrhenius relationship. In addition, a strong thickness–D_e relationship was observed.

The purees physical structures were enhanced through foaming; became more porous and allowed for faster moisture movement by the main mechanism of diffusion. Drying times were considerably reduced; energy savings realized through a higher dryer throughput, product quality retained and a microbiological safe readily rehydratable powder was produced from drying a 0.005 m thick foam

mat at 60°C. The FMD pumpkin could be a more readily acceptable alternative to non-foamed purees compared to that of papaya. Approximately 17 kg of pumpkin and 10 kg of papaya purees yielded 1 kg of foam-mat dried powder respectively.

Keywords: Lisa P Harrynanan; foaming; foam-mat drying; papaya; pumpkin; *Carica papaya*; *Cucurbita maxima*; effective moisture diffusivity; method of slopes; nonlinear regression.