ABSTRACT

The study was undertaken to study and characterize the effects of various operational parameters e.g., pretreatment, temperature, microwave power level, air velocity, etc. on microwave assisted convective dehydration of banana slices. The study was conducted in five different stages.

Osmotic dehydration of banana slices (Dwarf Cavendish) was studied at five levels each of temperature (25°C, 35°C, 45°C, 55°C & 65°C), solution to sample ratio (1, 3, 5, 7 & 9) and concentration of sugar solution (40, 50, 60, 70 & 80°brix). A modified second order rotatable design was adopted for three factors each at five levels. The moisture loss and sugar gain were monitored at hourly intervals for four hours. Response Surface Methodology was used to optimize the osmotic dehydration with special reference to maximum moisture removal and minimum solids gain. The study indicated that about 15% of the initial moisture could be removed from the banana slices after one hour of osmosis at a sugar concentration of 70°brix, solution to
and microwave power level (140 W, 210 W & 280 W) were considered in triplicate. The study indicated that high initial moisture content and high microwave power for finishing drying reduced the overall drying time considerably, thereby, reducing the deleterious effects like case hardening and caramelization. The product retained most of its quantitative parameters. The optimum conditions for the use of microwaves as finishing drying were the application of 280 W of microwave power after drying the product to a level of 50% w.b. moisture content using convective dehydration.

Finally, an attempt was made to compare the product of microwave assisted convective drying with those of pure convective drying, pure microwave drying, freeze-drying, and partial convective followed by microwave drying. Hot water blanching (5 min. within boiling water) pretreatment was given to all the samples before subjecting them to drying. The drying methods were compared in terms of drying time, overall drying rate, rehydration ratio, total soluble solids, total sugar, reducing sugar, nonreducing sugar, total carbohydrate, nonenzymatic browning, tannin and energy use efficiency. Sensory evaluation of the products obtained by the various drying methods was also conducted. Microwave assisted convective drying was found to be the quickest method of drying (45 min.) which had high sensory scores (7.73 for colour, 7.75 for flavour, 6.89 for texture and 7.71 for overall acceptability on the 10 point hedonic scale) and an excellent energy use efficiency (56.73%) whereas freeze dried product was found to be the best in terms of retention of total and reducing sugars (89% and 93%), tannin content, NEB and total carbohydrates (81%).

A mathematical model for the complete dehydration process has been proposed and tested which could facilitate the process control. The models for osmotic and microwave assisted dehydration were developed separately and then put together to describe the entire dehydration process.

Mass transfer during osmotic dehydration of banana has been studied with respect to the solution concentration (40-80°Brix), temperature (25-65°C) and solution to sample ratio (1-9). The diffusion coefficients have been calculated using the sorption data by a method of successive approximations. The diffusion coefficient
has been empirically correlated with the process variables and a high degree of correlation ($R^2 = 0.91$) was observed between predicted and experimental values. The solution of Fick’s law for unsteady state mass transfer in a plane sheet has been used to predict the moisture ratios over the entire experimental range. The error between the observed and the predicted values of moisture ratios was less than 10% indicating the adequacy of Fick’s law in describing the process of diffusion over the experimental range.

The microwave assisted dehydration, pure convective and microwave dehydration were also suitably modeled in order to facilitate the estimation of moisture loss at any given time during dehydration.

The study has suggested that microwave assisted convective dehydration could produce banana slices comparable to freeze drying in terms of most of the biochemical parameters in shorter time period and with higher energy use efficiency. The reduction in time and energy made the product more affordable for the domestic market.