Process Optimization for Drying of Khoa using Fluidized Bed Dryer

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Introduction

Drying is an important as well as most energy intensive unit operation in process industry. Time required to complete the drying process is very important aspect as cost of production depend on it. Fluidized bed drying is most acceptable process in-terms of final quality of dried product as well as shorter drying time. Compare to other drying process, fluidized bed drying process yield brighter color, lower moisture content with low temperature in less time.

Objective

To optimize three different parameters for optimization of drying of khoa (batch size (1400-1500g), air velocity (7-23 m/s) and inlet air temperature (50-70ºC)).

To study sensory attributes of khoa after drying based on body & texture, colour and appearance and overall acceptability.

Methodology

In the drying chamber the product bed was supported by a small screen at bottom of the drying chamber. The known amount of product (Khoa) was filled in the sliding trolley. It was introduced in the dryer through sliding roller wheel. This door was then closed with the help of air pressure. Preliminary trials were conducted to determine the fluidization behaviour of Khoa in the drying chamber at different mass of material, at different velocity and at different inlet air temperature. Next step was starting of an air blower at fixed air velocity. The velocity of air was kept such that proper fluidization of the product was maintained as observed through the sight door. The velocity of the air was measured at the outlet of dryer with the help of standard anemometer. After setting of the airflow, the air heater unit was started. Some time was taken to get steady state temperature of the inlet air. The temperature of air was measured with the help of a digital temperature indicator. The thermocouple is fixed at the inlet of air of the dryer unit. Simultaneously the exhaust air temperature was also noted. From the above temperatures, the values of input heat energy were calculated.

During the trial, constant watch on outlet air temperature and relative humidity as well as watch on the drying behaviour through the sight door was kept. At the end of the experiment, air compressor and the power supply to the heater were stopped. Then the air blower was stopped when the temperature of exhaust air reached down to about 50°C. The dry bulb and wet bulb temperatures of the inlet air, outlet air and the air in the room were measured. Humidity readings for the above condition of air with the help of standard hair line hygrometer were also taken. Optimization was carried out using response surface methodology (RSM) based on three factors and sensory attributes.

Result and Discussion

Optimization parameter for drying of Khoa was evaluated as batch size (1464 g) air velocity (12.97 m/s) and inlet air temperature (70ºC).

Energy requirement per kg of moisture removed (ER/MO kWh/kg) for drying of Khoa was 1.58 kWh/kg of water evaporated. Thermal efficiency and energy efficiency for drying of Khoa were 29.58 % and 41.72% respectively. Optimized values for body and texture, colour and appearance and overall acceptability were 7.56, 7.63 and 7.4 respectively.