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Design and Construction of A Solar Dryer for Mango Slices

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Abstract

Based on preliminary investigations under controlled conditions of drying experiments, a natural convection solar dryer was designed and constructed to dry mango slices. This paper describes the design considerations followed and presents the results of calculations of design parameters. A minimum of 16.8m² solar collector area is required to dry a batch of 100 kg sliced mango (195.2 kg fresh mango at 51.22 % pulp) in 20 hours (two days drying period). The initial and final moisture content considered were 81.4 % and 10 % wet basis, respectively. The average ambient conditions are 30°C air temperature and 15 % relative humidity with daily global solar radiation incident on horizontal surface of about 20 MJ/m²/day. The weather conditions considered are of Khartoum, Sudan. A prototype of the dryer was so designed and constructed that has a maximum collector area of 1.03m². This prototype dryer will be used in experimental drying tests under various loading conditions. The constructed solar dryer was used to dry thin layer of mango slices, variety Kitchner from about 81.2 % moisture content (wet basis) to 15.6% (wet basis) in 8 hours. Thin layer solar drying experiments were conducted for mango slices (*Mangifera indica* L) variety Kitchner at 3mm slice thickness. Three different mathematical models available in literature namely, Lewis, Henderson & Pabis and Page models were used to evaluate the best fit of experimental data. The best fit of the thin layer solar drying of mango slices was obtained by Page's model which fitted very well the experimental data with high value of R² (0.98) and low value of χ^2 , SSE and MSBE. According to the results, Page model could satisfactorily describe drying curve of mango slices.

Keywords: Construction, design, drying constant, mango slices, modelling, solar dryer