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Numerical and Experimental Investigation of Direct Solar Crop Dryer for Farmers

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Abstract. This article presents a theoretical and experimental investigation on effects of weather on direct solar crop drying technique. The SIMULINK tool was employed to analyze the energy balance equations of the transient system model. A prototype of the drying system was made and data were collected between the months of June and July in Perak, Malaysia. The contribution of intense sunny days was encouraging despite the wet season, and the wind velocity was dynamic during the period of investigation. However, high percentage of relative humidity was observed. This constitutes a hindrance to efficient drying process. The reported studies were silent on the effect of thick atmospheric moisture content on drying rate of agricultural products in tropic climate. This finding has revealed the mean values of insolation, wind speed, moisturized air, system performance efficiency and chili microscopy image morphology. The predicted and measured results were compared with good agreement.

INTRODUCTION

In this challenging period of reducing the carbon content of the atmosphere, every nation is subscribing to the use of renewable energy rather than hydrocarbon source. Hence, yearly abundant harvest of nation that engages in agriculture needs to preserve the farm products by solar drying which is cheap and ecofriendly. The open sun method of drying is still popular among farmers despite the shortcoming attached to its output.

Direct solar drying is the process of preserving the farm harvest by exposing the crops to the solar irradiance to reduce its percentage of water composition in which a transparent lid was used to seal the insolation in the drying chamber. The solar collector is usually absent in direct solar drying applications [1] [2] [3]. Solar drying of crops using direct approach is a standardized and well embraced technique [4]. The marketability of solar drying system still needs improvement [5].

Drying of crops is a means of lowering water activity to extend its shelf life. Mass and volume of dried crops are reduced, thus improves transportation [6] [7] [8]. Cash crops are majorly dried by open sun drying approach such as banana in Thailand [9]. Open sun drying of crops is a common practice in developing nations because of immediate reduced cost of drying [2] [10] [11] [12] [13]. Explicitly open drying has failed to meet up the requirements of global marketing due to long duration of drying period and the substandard quality of the products [2]. The most important variables to be considered for any solar drying techniques are insolation, air mass flow rate, temperature and relative humidity of the place where the drying operation is to be done [14] [15] [16].

The weather data of the place where the drying operation is going to be done must be seriously studied [17]. Hence, local atmospheric condition of Perak, Malaysia has been investigated by both measured and numerical analyses. Despite the bright sunny days during the study period, high relative humidity remains a challenge for any solar drying appliance in this environment. Microscopy images of chili of various ages was investigated. The direct solar drying was used in this finding to remove any bias that may be attached to the outcome of indirect and other advanced solar drying techniques.

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