Experimental investigation on black pepper drying in a hot air cabinet dryer for optimized energy performance

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Degree of Master of Engineering

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ABSTRACT

Open sun drying is the widely used passive method for black pepper drying, but due to its limitations such as unavailability on rainy days, lack of controllability, degradation of food quality, loss of volatile oil, and improper drying, the active dryers have become more popular than the open sun drying method. Among these active dryers, tray dryers are extremely popular in medium and small-scale black pepper processing industries because they are small in size, simple in design and lower capital cost comparative to other dryers. It is extremely important to identify the optimum drying temperature and the hot air velocity for black pepper drying process on a convective tray dryer to minimize the total energy while improving the quality of the black pepper. The drying properties of black pepper were examined in a convective thermal tray dryer during this investigation. In house built experimental setup was used to understand the variations of moisture ratio (MR) during the drying. The experiments were carried out in different temperatures of 50 °C, 55 °C and 60 °C and, for three different air speeds of 0.4ms^{-1}, 0.8 ms^{-1} and 1.2 ms^{-1}. The observed experimental results were fitted with the existing drying models. Model coefficients and constants were evaluated by using the MS Excel software. The Logarithmic model was discovered as the best drying model to explore the black pepper drying on a convective hot air tray dryer with an average RMSD (root mean square deviation) of 0.0140. The total amount of time required to decrease the moisture content (MC) to 12% (minimum secure storage MC) in dry basis under various drying settings were computed using the logarithmic model equation. The total drying energy required to dry 1 kg of raw black pepper for different drying conditions was calculated and, a surface plot of total drying energy against temperature and air speed was generated. Based on the contours of the surface plot, the drying conditions which minimize the total drying energy were determined.

Keywords: Black Pepper, Drying models, Energy optimization, Tray drying

PUBLICATIONS

1. Virantha, I. and **Wijewardane M.A.** 'Determine the Optimum Operating Conditions for Black Pepper Drying in a Cabinet Type Tray Dryer to Minimize the Total Drying Energy'. 7th International Conference on Sustainable Technology and Engineering – i-COSTE 2021, Australia, 2021 (IEEE Xplore –DOI: 10.1109/CSDE53843.2021.9718440)

DECLARATION

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Virantha E.A.I

The above candidate has carried out research for the master's Thesis under my supervision

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Dr. Wijewardane M.A

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

RH	Relative Humidity
DB	Dry Basis
WB	Wet Basis
MC	Moisture Content
MR	Moisture Ratio
DM	Drying Model