PERFORMANCE INVESTIGATION OF FOOD SOLAR DRYING SYSTEM

By

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ABSTRACT

Agricultural production suffers from higher production costs and lower efficiency of traditional methods used in agricultural operations, especially post-harvest operations, where drying is a challenge for producers to increase production costs and lower production quality. Therefore, the study examined ways to expand the use of new and renewable energies in post-harvest operations, especially the drying of agricultural materials, because of their physical and environmental revenues that are compatible with local and global requirements**.**

The aim of this work is developing and evaluate an automated measurement and system data logger for continuous monitoring of solar hot air dryer for natural convection solar cabinet dryer. measurements includes monitoring drying process for sliced banana (Musa acuminata) relation to weather parameters such as ambient air temperature, relative humidity, wind velocity. Which ensures precise measurements and reproduction of experiments. An electronic measurement system was used for measurement of temperature, humidity, air speed, a solar intensity. a programmable microcontroller ship and code were used to control measurement, timing, and data storage twenty-four hours/day. *All* measurements data was collected and saved in storage memory card. results showed that the solar dryer moisture removal rate achieved -0.018, while the moisture removal rate with mean of electrical thermal dryer were (-0.956 at 105 °c, -0.552 at 70 °c, and -0.513 at 50 °c). the electronic measurement-data logging system was able to give an accurate measurement and assessment to the drying system and process. it was found that air leakage from the system and poor insulation inhibit the air flow over the solar absorber plate and drying chamber causing thermal leakage form the bottom and dryer sides. it was recommended to supply the solar dryer with an air fan, seal the drying air leakage, and air-lock at the entrance to control air flow as well as the temperature of the drying process.

Key words: Solar drier, Banana, automated measurement

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INTRODUCTION

Drying is one of the important postharvest processes of agricultural products. It can extend shelf-life of the harvested products, keep quality, improve the bargaining position of the farmer to maintain relatively constant price of his products and reduces postharvest losses and lower transportation costs since most of the water are taken out from the product during the drying process. When drying foods, the key activity is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavor, texture and color of the food. Drying is a process of removing moisture to a safe level, the equilibrium moisture content, which is defined as the moisture content in equilibrium with the relative humidity of the environment. The equilibrium moisture content is divided into, static and dynamic. While the static is used for food storage process, dynamic is used for drying process. The drying process is experimentally obtained and presented as moisture content on x-axis and rate of drying on y-axis. (**Murthy, 2009**). Drying using the sun under the open sky for preserving food and agricultural crops has been practiced since ancient times. However, this process has many disadvantages: spoilt products.due to rain, wind, moisture and dust; loss of produce due to birds and animals; (**Sharma et al. 2009**). Other problems are associated with it; for example: area required to dry the fruit is quite large, fruits are not dried uniformly, drying is not possible in a humid environment and the exposure of the product to the open air for a long duration can be considered risky due to birds eating fruits and dust from the external environment. (**Hosamani, and Desai. 2013**). . New techniques of drying such as heated air drying due to hygienic and economic considerations have been developed (**Das et al. 2004 and Motevali et al. 2010**). Air drying and solar drying are among the most common techniques used to preserve banana. An alternative solution for traditional drying method and to overcome the problem of natural drying, indirect type solar dryer is used. The main reasons are as follows, indirect type solar drying

maintains good product quality compared to Natural drying.

Time for drying process can be significantly reduced as compared to natural drying. Dried foods can be preserved for a long time period and the product becomes extremely lightweight hence easy for transportation. **(Hosamani and Desai, 2013**) described a design idea to produce small scale with good quality dry fruit product to the consumer which is perseveres with its original taste without leading to caramelization (Sugar burning) and reduction in the nutritional value. The quality and color of the dried product depend upon the techniques used for drying process. The microcontroller is used and programmed to control and manage the overall process of the unit. An Arduino microprocessor which controls the overall operation of the system and automates tasks such as temperature and humidity control, sample weight loss. **(Nwakubal et al ,2017)** reported that banana is a climacteric fruit and perishable in nature having relatively high postharvest losses of about 20 - 30 %. **Ekanayake and Bandara (2002)** estimated average production of one Fadden under the Egyptian conditions to be 12.98 tones banana. Knowledge on physical and mechanical properties of banana fruits of different varieties in order to introduce proper postharvest handling and packaging technologies are important. The texture of banana plays a major role in determining the ripening qualities which determines the shelf life. Fruit texture plays a key role for process ability of the goods to food processor and of eating quality to the consumer. Shrinkage of the cells, browning, loss of re drying ability, wettability and case hardening are some common problems associated with drying of tropical fruits, which reduce their market value and general acceptability (**Dalgleish and Andy 1988; McMinn and Magee 1997; Singh et al. 2008).**

This Study Aims To:

Improve the efficiency of drying units of solar agricultural crops by analyzing the performance of a solar drying unit to study some of the engineering and design factors affecting the efficiency associated with the

quality of drying processes with solar dryers.

Developing and evaluation of an automated measurement and system data logger for continuous monitoring of solar hot air drier for natural convection solar cabinet drier. Measurements includes monitoring drying process for sliced banana (***Musa acuminata***) in relation to weather parameters such as ambient air temperature, relative humidity, wind speed, which ensures precise measurements and reproduction of experiments