DEVELOPMENT OF TEMPERATURE-CONTROLLED MULTICOMMODITY SOLAR TENT DRYER

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ABSTRACT

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Solar drying is becoming a popular alternative to mechanical dryers due to the cost of electricity and the rising popularity of clean energy. The design and fabrication of the temperature-controlled solar tent dryer aimed to solve the underlying challenges in drying commodities such as fish, vegetables, fruits, etc., with traditional open-sun drying, i.e., the provision of clean and free-contaminant food. A temperature-controlled solar tent dryer was designed, constructed, and tested to harness solar energy for drying crops at the Center of Hydroponics and Aquaponics Technology at Central Luzon State University. The structure measured 2 m x 2 m x 2 m and consisted of a frame assembly, 15 drying trays, a heating chamber filled with rocks and steel wool, and a temperature control system that regulates a 12V DC fan connected to a solar panel and battery.

A single-factor experiment was laid out in Randomized Complete Block Design. The sample position in terms of layer assignment served as the lone factor. The drying rate, drying capacity, moisture content, color changes, and water activity were analyzed using analysis of variance (ANOVA).

The drying capacity of the solar tent dryer was evaluated for tilapia and mushrooms, yielding 0.70 kg/hr and 0.54 kg/hr, respectively. The total drying time was approximately 28 hours for both commodities. The drying rate was calculated based on moisture content

changes per hour. The fastest drying rate for tilapia was observed at Layer 1 and Layer 4, while the slowest was at Layer 3. For mushrooms, the fastest drying rate was observed at Layer 1, and the slowest was at Layer 3.

The drying temperature inside the solar tent dryer ranged from 35°C to 52°C, resulting in an average drying rate of approximately 3% kg of water per hour. The final moisture content of the dried products was lowest at Layer 1 and highest at Layer 3 for both tilapia and mushrooms.

The changes in color between raw and dried products were also analyzed using reflectance values in the RGB color space. It was observed that both commodities indicate a loss of RGB colors. The water activity of the dried products on the other hand met the safe moisture reference indices, ensuring quality features and storage stability.

The cost of fabricating the solar tent dryer was Php 43,668.93, with an annual depreciation cost of Php 4, 148.55. The return on investment for the solar tent dryer was calculated to be 75.57%, with a break-even point of Php 0.71, suggesting that if ventured, it would generate profits over its ten-year lifespan.

In summary, the study demonstrated that the solar tent dryer was efficient in drying agricultural products. The drying process was significantly faster compared to conventional open sun drying. With no significant differences between layers in terms of drying capacity, moisture content, and water activity of the products, this implies that the dryer was able to provide a uniform drying condition inside the drying chamber.

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