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Performance and Nutritional Evaluation of Moringa Leaves Dried in a Solar-Assisted Heat Pump Dryer Integrated with Thermal Energy Storage

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Abstract : Plants used for medicinal purposes are extremely perishable, owing to moisture-enhanced enzymatic and microorganism activity, climate change, and improper handling and storage. Experiments have shown that drying the medicinal plant without affecting the active nutrients and controlling the moisture content as much as possible can extend its shelf life. Different traditional and modern drying techniques for preserving medicinal plants have been developed, with some still being improved in Sub-Saharan Africa. However, many of these methods fail to address the most common issues encountered when drying medicinal plants, such as nutrient loss, long drying times, and a limited capacity to dry during the evening or cloudy hours. Heat pump drying is an alternate drying method that results in no nutritional loss. Furthermore, combining a heat pump dryer with a solar energy storage system appears to be a viable option for all-weather drying without affecting the nutritional values of dried products. In this study, a solar-assisted heat pump dryer integrated with thermal energy storage is developed for drying moringa leaves. The study also discusses the performance analysis of the developed dryer as well as the proximate analysis of the dried moringa leaves. All experiments were conducted from 11 a.m. to 4 p.m. to assess the dryer's performance in “daytime mode”. Experiment results show that the drying time was significantly reduced, and the dryer demonstrated high performance in preserving all of the nutrients. In 5 hours of the drying process, the moisture content was reduced from 75.7 to 3.3%. The average COP value was 3.36, confirming the dryer's low energy consumption. The findings also revealed that after drying, the content of protein, carbohydrates, fats, fiber, and ash greatly increased.

Keywords : heat pump dryer, efficiency, moringa leaves, proximate analysis
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