

PERFORMANCE OF CABINET-TYPE SOLAR DRYERS BY INCORPORATING DUAL SUPPLY OF SOLAR POWER WITH FLAT-PLATE COLLECTOR AND PARABOLIC DISH

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Appropriate technologies for converting solar radiation to thermal energy are crucial for solar food drying in Sri Lanka. This study evaluated the performance of a cabinet-type solar dryer incorporating dual solar technologies: a flat-plate collector (FPC) and a parabolic dish concentrator (PDC). The system was designed to enhance thermal efficiency and reduce food drying costs using renewable energy. The dryer comprises an FPC, PDC, heat extraction and circulation system, air heating unit, sensors, and controlling system, photovoltaic (PV) panels, and a cabinet with multiple trays and an exhaust fan. The entire system operates solely on electricity generated by PV panels, ensuring sustainability. The heat from the PDC is transferred to the heat extraction and circulation system, which delivers heated air into the cabinet using a fan. Real-time data, including temperature, humidity, and airflow rates, were monitored by the controlling unit. Drying trials were conducted separately for FPC (T1), PDC (T2), and both FPC and PDC combined (T3), using ash plantain and moringa leaves as test samples. Results showed that T3 achieved the shortest drying time, reaching a moisture content suitable for storage (16% wet basis for ash plantain and 9% wet basis for moringa leaves) within 355 ± 2.5 minutes and 341 ± 10.6 minutes, respectively. T1 exhibited significantly higher overall efficiency compared to other treatments ($p \leq 0.05$). The efficiencies of FPC, PDC, and the heat exchanger were calculated as 25.54%, 80.53%, and 46.94%, respectively. Furthermore, the drying chamber maintained appropriate temperature and relative humidity levels, with adequate air velocity provided by the heat circulation system. In conclusion, the cabinet-type solar dryer utilizing dual solar technologies demonstrates an efficient and sustainable solution for small-scale farmers. However, further research is recommended to optimize the dryer's performance for various food products and environmental conditions.

Keywords: Food drying, Renewable energy, Solar thermal energy, Sustainable agriculture