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Performance of locally made low-cost evaporative cooling pad alternative to commercial pad

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Abstract

The dry and hot climate in Ethiopia's rift valley areas significantly impacts the postharvest life of fruits and vegetables. The loss is mainly due to a need for cooling facilities along the supply chain from harvesting to final marketing. Commercial mechanical refrigerators are expensive and beyond the capacity of local farmers and value chain actors to use in different stages of postharvest activities. However, evaporative cooling (EC) rooms can be constructed for dry and hot climates, but the pad is not locally available or expensive. This work attempted to develop a low-cost EC pad as a component of a low-cost EC system to replace the commercial pad. A fiber from the Enset plant (*Ensete ventricosum*) was used as a cellulose fiber to construct a 1 m $\times$ 0.5 m $\times$ 0.5 m wetting pad using galvanized metal. Air was pressurized through an equal-sized galvanized metal tunnel using a 300-watt air fan; however, water was continuously pumped from the water reservoir and sprinkled on the top of the pad using a 120-watt water pump. Air velocity (m/s), pad thickness (cm), water flow rate (m^3/s), and fiber orientation(vertical versus horizontal)) at different levels were independent variables to investigate the performance of the pad. The study showed that EC efficiency varied from 70.5$\pm$3.5 to 87.2$\pm$5.8 %. The horizontal orientation of fiber at 18 cm thickness with the lowest air velocity (1.053 m/s) and water flow rate of 0.15 m^3/s resulted in the most inadequate performance as compared to the highest with similar fiber orientation at 32 cm thickness, 2.6 m/s airflow, and 0.23 m^3 /s water flow rates. At the highest EC efficiency, the temperature inside the chamber was lower than outside by 5.9oC, and the RH increased by 29.3 %. Results from the study indicated that a low-cost EC pad could be constructed from locally available resources to replace the expensive commercial pad.

Keywords: Cooling efficiency, evaporative cooling, food loss, postharvest, Rift Valley

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