Abstract

Mango (Mangifera indica L.) fruit is a valuable fruit in Kenya due to its nutritive value and economic importance. However, at least 40 to 45% of mango fruit is lost during postharvest handling primarily due to inadequate storage facilities for mango fruits. In this study, saturation efficiency and cooling capacity of an unloaded improved evaporatively cooled store for onfarm storage of mango fruits were simulated. The cooler had a storage space of 0.75 m3 and its dimensions were 0.84 m x 0.84 m x 1.5 m. The external surfaces of the cooler were sprayed with a near infrared reflecting (NIR) paint. The cooler was constructed from locally available materials including hardwood and charcoal. The charcoal was kept moist by water dripping by gravity from horizontally laid pipes on the roof. The flow of water from an overhead tank approximately 2 m high to the cooler was monitored using a flow meter. The excess water which dripped was collected by gutters fixed at the lower ends of the charcoal walls and channeled to a water reservoir. A 12V pump was used to pump the water back to the overhead tank while a 12V fan located centrally on one of the sides directly opposite the door was used to draw air into the cooler. The pump and fan was powered by a 70Ah battery recharged by a 125 W solar panel. A computer model to simulate the saturation efficiency and cooling capacity of the cooler was developed on a java platform. The input parameters of the model were inlet air conditions, water conditions, air properties at selected ambient condition, and charcoal cooler characteristics. At varied inlet air velocities ranging from 3.0 m/s to 4.0 m/s at an interval of 0.2 m/s, the actual saturation efficiency of the cooler ranged from 68.9% to 66.9% while the predicted ranged from 69.0% to 66.9%. The actual cooling capacity of the cooler ranged from 1055667 kJ/h to 136477 kJ/h while the predicted ranged from 105726 kW/h to 136680 kW/h. The high coefficient of determination (R^2=0.999) indicated a strong correlation between the actual and predicted results. A root mean square error (RMSE) corresponding to the actual and predicted saturated efficiency was 0.028% while that corresponding to the actual and predicted cooling capacity was 118 kJ/h. At 95% level of confidence, t test results showed no significant difference ($t_{calculated}$, 0.06; $t_{critical}$, 2.23) between the actual and predicted saturation efficiency. The t test results also indicated no significant difference ($t_{calculated}$, 0.01; $t_{critical}$, 2.23) between the actual and predicted cooling capacity.