PRELIMINARY INVESTIGATION ON DEVELOPING LOW COST EVAPORATIVE COOLING CHAMBER

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ABSTRACT
A prototype of portable low cost evaporative cooler was designed for short term storage of fruits and vegetables at the market. Preliminary studies revealed that the minimum inside temperature varies between 17-18 ^{o}C when ambient temperature was 31 ^{o}C. Further studies are in progress to develop the prototype evaporative cooler to achieve best cooling efficiency.

***Key words*:** Evaporative cooling chamber , Cooling efficiency

1. INTRODUCTION

With the rapid increasing of the world human population, demand for food has risen significantly. There are multiple challenges faced by the mankind to produce more food to feed the growing population with decreasing rural work potency, accumulation of contaminants in soil, access to nutritious foods, postharvest losses (PHL). Developing countries with low gross domestic production (GDP) per capita suffers the most impact of this situation. PHL occurs throughout the chain from farm to fork, which cuts off the real income of the harvest and this further affects the developing countries.

Much of the post-harvest losses of fruits and vegetables in developing countries is due to the lack of proper storage facilities. While refrigerated cool stores are the best method of preserving fruits and vegetables they are expensive to buy and run. Consequently, in developing countries there is an interest in simple low-cost alternatives, many of which depend on evaporative cooling which is simple and does not require any external power supply.

The basic principle relies on cooling by evaporation. When water evaporates it draws energy from its surroundings which produce a considerable cooling effect. Evaporative cooling occurs when air, that is not too humid, passes over a wet surface; the faster the rate of evaporation the greater the cooling. The efficiency of an evaporative cooler depends on the humidity of the surrounding air.

Evaporative cooling systems are commonly used in countries where the climate is hot and dry. Several studies have been devoted to the application of evaporative cooling principles in extending the postharvest life of fruits and vegetables.

Low temperature and high relative humidity can be achieved by using less expensive methods of evaporative cooling [1]. Evaporative cooling has been reported for achieving a favorable environment in the storage structure for fruit and vegetables [3] and [4].

The present study was therefore planned to design and develop a low cost, portable evaporative cooling system that could be utilized to store fruits and vegetables to avoid postharvest losses.

2. METHODOLOGY

2.1. Evaporative cooling

Evaporative cooling was the main concept used in low energy cooling system and it's process that cools air through the evaporation of water by employing water's large enthalpy of vaporization. The temperature of dry air can be dropped significantly through the phase transition of liquid water to water vapor.

2.2. Design and implementation

In this machine the main scope was to maintain the container temperature which is appropriate to preserve some specific fruits and vegetables. For that the container temperature was displaced outside. The container which store food was connected to evaporative cooler through a passage. The evaporative cooler consists of 12v fan powered by two 6v Lithium – ion batteries. Air allowed to flow into the cooler by three passages with evaporative pads. The water supply for the cooler was done by water pump which is also powered by same batteries. A pipe line running above the evaporative pads keeps them wet by supplying water via minute holes. A reserve tank was placed under the container to recycle drainage water of cooling pads. A outlet for a reserve tank can be used to pour some water in a emergency situation. For the high efficient cooling both container and cooling chamber were insulated. Styrofoam used as insulating material in container. The frame work of the whole container was made of wood considering easiness of handling, cost and biodegradability.

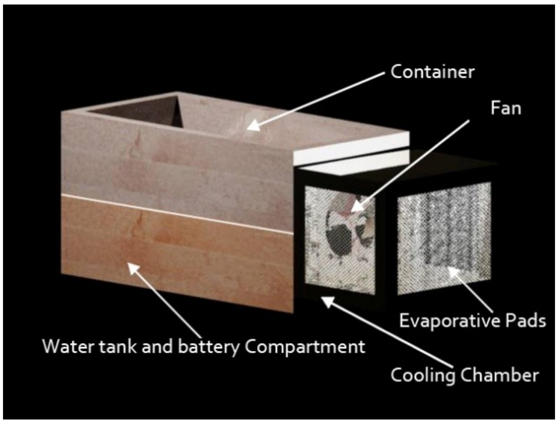

Figure 1. View of evaporative cooler

2.3. Cooling Efficiency

Analysis of the moist air properties is important to look at the suitability of a given modified air condition for fruit and vegetables storage in hot climate. After storing some tropical type of fruits temperature variations inside the chamber was monitored over 24 hrs with one hour interval.

2.4. Data Analysis

Data analysis was done in SPSS. Graphs were plotted in MS Excel

3. RESULTS

The change in temperature over the 24 hrs of period is shown in the Figure 2.

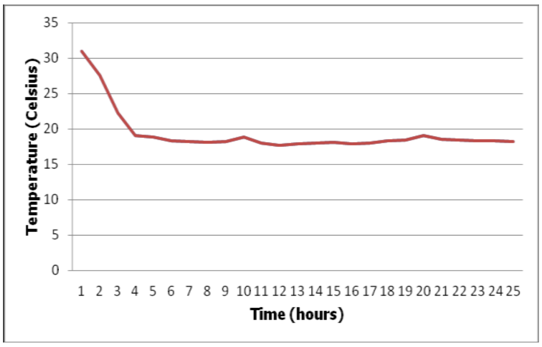

Figure 2. Variation of the temperature inside the cooling chamber over 24 hrs of period.

As shown in the figure inside temperature was gradually decreased to about 17 ^{0}C within three to four hours and temperature remains in the same throughout the study period.

The cooler seems to be fairly adoptable for small scale fruit sellers who need short period of storage of their produce. The main advantage of this product is using low amount of energy for the operation and the cooling process, the cost for it is also going to be less.

However this product has its own limitations. Firstly, the maximum temperature it can drop is around 18-17 °*C* which may not be enough to some variety of fruits or vegetables. Secondly there is no mechanism to control the relative humidity (RH), which can lead to fungus growth inside of the container, and there is no method of controlling the rate of flow of water and the speed of the fan. And lastly, it works best when the outside air temperature is considerably high.

In future studies this proto type of cooling chamber will be improved with added a solar panel with mechanism to regulate RH, water flow rate. The cooling efficiency will be further improved in future to drop the temperature to about 14-15 ^{0}C.

4. CONCLUSION

A prototype of evaporative cooling chamber was developed with reasonable cooling efficiency inside the cooling chamber. Studies are in progress to develop this prototype cooling chamber with high efficiency.

5. REFERENCES

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