Evaluation of One Metric Ton Capacity Solar Assistant Evaporative Cooler for Preservation of Lime (*Citrus aurantifolia*)

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ABSTRACT

An experiment was conducted to investigate on low cost storage device called Evaporative Cooling Chamber to extend the postharvest life of *Citrus aurantifolia* with ambient condition storage .Results revealed that the best storage method was Evaporative Cooling Chamber for increase the postharvest life up to forty five days without wilting, low ripening percentage and without chemical changes (pH and Total Soluble Solids (TSS)).

Hence it is recommended that further studies should be carried out to test the suitability of this cooler for other perishables.

KEY WORDS: ***Citrus aurantifolia*** (lime) ,Evaporative Cooling Chamber

INTRODUCTION

Most of the postharvest losses of fruits and vegetables in developing countries are due to the lak of proper storage facilities. Postharvest loss of fruits and vegetables are estimated about 30-40 percent of the total production in Sri Lanka (Institute of Postharvest Technology Annual Report,2001).The considerable amount of lost especially at the retail level due to lak of proper storage facilities resulting is loss of weight, wilting and ripening (Institute of Postharvest Technology Annual Report,2001).

Refrigerated cool storage is the best method of storing fruits and vegetables and also they are expensive to built and run. In Sri Lanka cold storage facilities are relatively high technology that require higher capital and running cost which is beyond the scope of the majority of rural farming community.

The present trend in developing countries is to produce simple low cost coolers, most of which depend on evaporative cooling which is cheap and does not require any power to operate(Karlsson.E, 1988).The evaporative cooling chamber works on the basic principles of cooling by evaporation.

The Institute of Postharvest Technology, Anuradhapura has developed an Evaporative Cooling Chamber that can be built in any part of the country using locally available material. Because it can be built from bricks, river sand and cadjans. In addition to that there must be a nearby source of water.The floor of the chamber is built by the layers of small granite particles. The walls are built with a double layer of bricks leaving a gap of about three inches between the two layers of bricks. The gap is filled with sand. Alone the top of the cavity place perforated PVC pipe are laid to provide water to wet the sand (Figure 1).

About 1200 bricks are needed to build a chamber of the dimension shown which has a capacity of about 1000 kg. The top of the chamber is covered with the hard board .The whole structure should be covered with the cadjans roof to provide shade. In Sri Lanka cost of construction is about Rs. 20,000.

There are two main harvesting seasons of *Citrus aurantifolia* in Sri Lanka (Institute of Postharvest Technology Annual Report,2001).*Viz,* from March to April and from July to August (Institute of Postharvest Technology Annual Report,2001).More than 70% of the production is produced during that period and price is reduced drastically in that period (Institute of Postharvest Technology Annual Report,2001).During off season price goes up. Therefore, by increasing postharvest life income generated by lime can be increased.

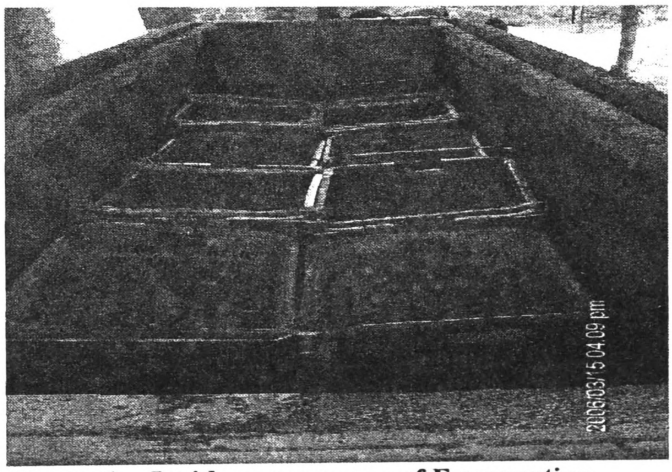

Figure 1 – Inside appearance of Evaporative Cooling Chamber:

MATERIALS AND METHODS

The experiment was carried out at the Institute of Postharvest Technology, Jayanthi Mawatha, Anuradhapura, in the low country Dry Zone (IL2) of Sri Lanka, from February to July 2006. Thousand kilograms of *Citrus aurantifolia* (Lime) which are

harvested early in the morning in same day was used for the experiment.

Before storage of lime, the Evaporative Cooling Chamber was treated with spray of 0.05% chlorine solution and the sand layer was saturated by a water. Nine samples (5kg) of lime with shallow plastic crates were used for data collection. Two treatments were compared during the experiment *viz*

T1 - Inside the Evaporative Cooling Chamber
T2 – Outside the Evaporative Cooling Chamber

Six replicates (R1,R2,R3,R4,R5,R6) of (T1).*viz.* Bottom of the left side(R1),Top of the left side(R2),Bottom of the middle (R3), top of the middle (R4), Bottom of the right side (R5), top of the right side (R6).And six replicates of T2 (R7,R8,R9,R10,R11,R12) were arranged.

Sand layer of evaporative cooling chamber was saturated by water twice a day in the morning and in the afternoon throughout the storage period. Weight loss (kg), Weight of spoiled fruits, Weight of fully yellow coloured fruits of each and every replicate were measured at three days interval from three days after storage. One fruit was randomly select from each and every replicate to measure the pH (Using pH meter) and the firmness (using penitrometer) at the same time. Temperature and RH inside the Cooling Chamber and outside were recorded thrice a day by using Wet and Dry Bulb Thermometers.

Increase of postharvest life of lime was evaluated by analyzing data using SAS (Two Sample t Test).

RESULTS AND DISCUSSION

Average temperature and relative humidity inside the cooling chamber were 21 C° and 94% , and in ambient condition 36 C° and 70% respectively.

1. Weight Loss

Table 1 – Weight loss percentage of two Treatments:

Trat	Replicates						Avg
ments	1	2	3	4	5	6	
1	39	40.4	42	38	42	44.4	40.97
2	73	86	82	81	80.8	81	79.47

A significant variation of weight loss between two treatments was observed one week after storage of *Citrus aurantifolia* (Figure 2). The continuous Weight loss of all replicates could be observed during whole storage period. (Figure 1).But outside the Evaporative Cooling Chamber (T2) showed the highest weight loss than inside the Evaporative Cooling Chamber (T1) (Figure 2).After 45 days T1and T2 showed 40.97 % and 79.47 % weight loss (Table 1).

According to the results of two sample t test Weight Loss was significantly different in the cooling chamber (T1) and outside the cooling chamber (T2) ($p<0.05$).There was no significant difference of weight loss of replicates in both treatments($p>0.05$).

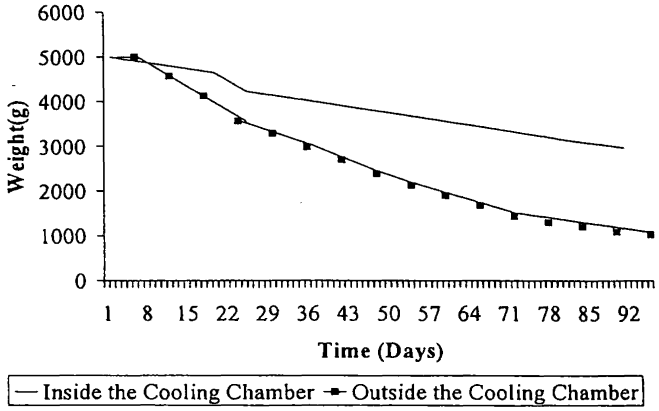

Figure 2 - Weight loss during storage period inside evaporative cooling chamber and outside evaporative cooling chamber:

2. Ripening and colour Variation

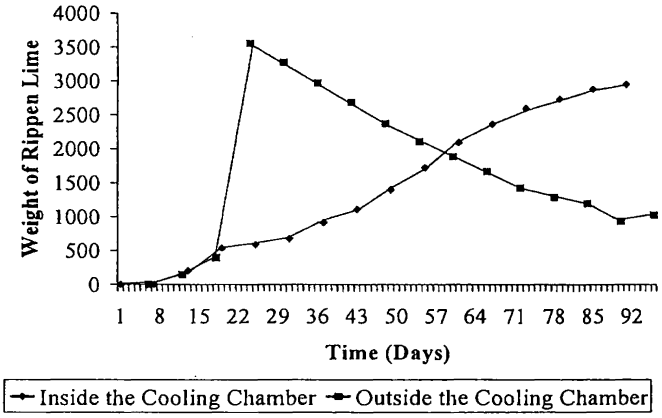

Figure 3 - Ripening during storage period inside evaporative cooling chamber and outside evaporative cooling chamber:

A significant difference in colour variation could be observed from one week after storage between Inside the Cooling Chamber (T1) and outside the Cooling Chamber (T2) (Figure 3).After first week all fruits of *Citrus aurantifolia* were ripen outside the Cooling Chamber (T2) (Figure 3).The yellow colour development of fruits inside the Cooling Chamber (T1) was continuously increased, But rate was very low compare to the outside of the Cooling Chamber (T2).

Analyze of data showed that there was a significant difference of colour development between inside the Cooling Chamber (T1) and outside the Cooling Chamber (T2) ($p<0.05$) (Figure 3).

3. Wilting

Inside the Cooling Chamber (T1) wilting of fruits may not observed throughout the storage period (Figure 4). Outside the Cooling Chamber (T2) wilting was started from three days after the beginning of storage (Figure 4).

According to the Two sample t test wilting percentage of fruits showed significant difference

between inside the Cooling Chamber(T1) and outside the cooling chamber (T2)($p<0.05$)(Figure 4).

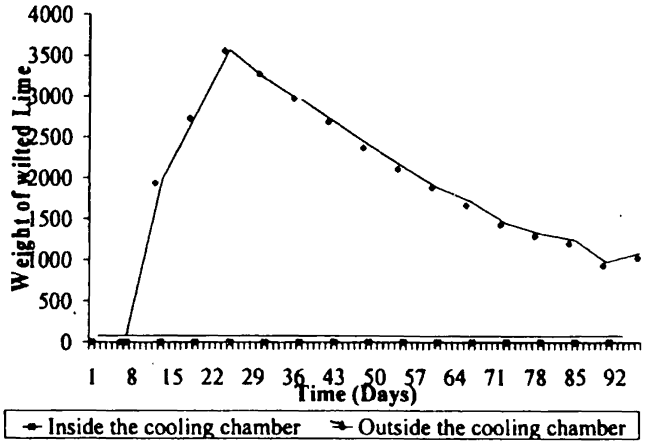

Figure 4 - Wilting during storage period inside evaporative cooling chamber and outside evaporative cooling chamber:

4. Microbial Spoilage

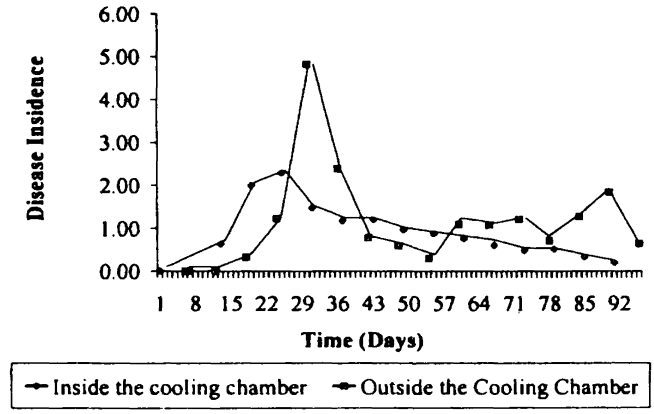

Figure 5 - Disease incidence during storage period inside Evaporative cooling Chamber and outside:

Spoilage of *Aspergillus spp.* and *Penicillium digitatum* were observed two weeks after storage (Figure 5).

According to the two sample t test there was no significant difference in microbial spoilage inside the cooling chamber (T1) and outside the cooling chamber (T2) ($p>0.05$).and there was no sample effect on microbial spoilage in both treatments ($P>0.05$).

5. P^H and Total Soluble Solids (TSS)

There was no significant different in p^H and TSS values inside the cooling chamber (T1) and outside the cooling chamber (T2) ($p>0.05$).And there was no effect of samples on PH and TSS values ($p>0.05$).

The average pH value of T1and T2 was 2.3 (Figure 6). And Brix (TSS) value was changed between 6.0 and 6.5 in both treatments (Figure 7).

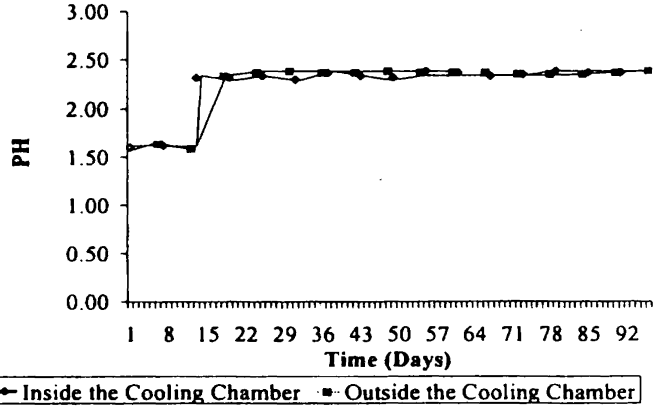

Figure 6 - P^H value during storage period inside Evaporative Cooling Chamber and outside Evaporative Cooling Chamber:

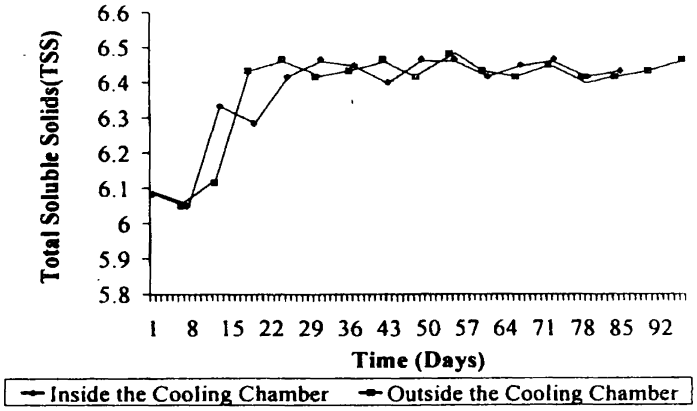

Figure 7 - Brix (TSS) value during storage period inside evaporative cooling chamber and outside evaporative cooling chamber:

CONCLUSIONS

Use of the Evaporative Cooling Chamber is more sucsessful in extending the postharvest life of *Citrus aurantifolia.*Using Evaporative Cooling Chamber postharvest life of *Citrus aurantifolia* can be extended 45 days. Due to the weight loss after 45 days the profit margin will be further reduced. Not only the weight but also the appearance and texture changed due to water loss. Shrinkage and loss of rigidity will reduce the consumer preference and eventually reduce the market demand for lime. The cooler will help to small-scale dealers to retain the texture rigidity and as well as to reduce weight loss. Therefore, their income can be increased. At the same time, this type of cooler can be used for domestic use. By using this type of coolers the postharvest losses can be reduced to a considerable extent.

Use of evaporative cooling chamber can be recommended as a low cost storage method suitable for rural *Citrus aurantifolia* growers who are unable to afford electricity and high cost cold storage facilities. It could be suggested that further studies are needed to improve the low cost Evaporative cooling Chamber for other perishables. Such as, Cabbage, Carrot, Green Chillies, Curry Chillies,

Mukunuwenna, Brinjal, Beans, Okra, Gotukola, Kang Kung, Thampala,Mea etc.

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