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# Extension of Shelf Life of Custard Apple *(Annona squamosa* L.*)* through Post Harvest Treatments

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**In the present study, various treatments *viz* dipping in 500 ppm bavistin solution, packaging in 150 gauge LDPE bags, packaging in 150 gauges LDPE with ethylene absorber and packaging of bavistin treated fruits in 150 gauge LDPE bags were applied on custard apple to enhance its shelf life. The treated custard apple fruits were kept at 25-30°C (ambient), 20 and 10°C to determine the effect of temperature and analyzed after every two days interval for various changes. During storage of custard apple, at all temperatures, physical loss in weight, titrable acidity and total soluble solids were found to increase, while the pH was found to decrease. The investigation at ambient conditions (temperature 25-30°C, RH 60-85%) showed that minimum loss in fruit weight was achieved, when fruits were treated with bavistin and packed in LDPE bags with ethylene absorber. This treatment was proved to be the best on account of slower increase in acidity total soluble solids.**

**Key words:** Annona squamosa L., Post harvest treatment, Physico-chemical properties, Shelf life.

*Annona squamosa* L. (custard apple, sharifa, sitaphal, sugar apple, sweetsop) is one of the important minor fruit crops of India. Custard apple is a shallow-rooted, hardy plant which can flourishes well even under dry conditions. Owing to the presence of the alkaloid annonaine in the entire Annonaceae family, the vegetative parts of the alkaloid annonas are bitter and are not touched by goats and cattle (Bose, 1985). Custard apples are mostly consumed as table fruits. Edible portion or pulp is creamy or custard like, granular with a good blend of sweetness and acidity, which many vary with the species. The pleasant flavour and mild aroma have universal liking. At present, custard apples are packed in bamboo basket, which are lined with 1 or 2 layers of the newspaper sheets. These layers do not provide sufficient cushioning effect and therefore, they are bruised during transportation. Moreover, bamboo baskets and the paper sheets do not check the drying of custard apples, thereby causing wilting and loss of weight. The storage life of fruits can be extended by checking the rate of respiration, transpiration and disease infection through post-harvest treatments like waxing, applying fungicides and growth regulators and storing under vacuum in polyethylene bags. The post-harvest losses of custard apple are very high and it ranges between 25-30%. These losses occur due to lack of proper storage facilities, improper handling, rapid ripening and microbial spoilage. The present study was therefore, undertaken to investigate the various treatments for preserving the freshness and extending shelf life of custard apple.

## Materials and Methods

Ten sound fruits were taken for determination of morphological and physico-chemical properties. In the control (T-1) sample, fruits were kept as such under different storage temperatures (10, 20 and 25-30°C). In treatment T-2, custard apple fruits were dipped in bavistin solution (500 ppm) for 2 min. After dipping, fruits were removed and exposed to the open atmosphere for drying of adherent moisture. In treatment T-3, custard apple fruits, without any prior treatment, were packed in the LDPE bags (12.5 ´ 18 cm, 150 gauge) and sealed. The treatment T-4 was the combination of treatments T-2 and T-3. In treatment T-5, custard apple fruits were treated with bavistin solution and packed in the LDPE bags with ethylene absorber. Ethylene absorber was prepared by mixing white cement (77%), sand (20%) and powdered potassium permanganate (3%). The mix was moistened to 20%, mixed thoroughly and granulated (Jayaraman and Raju, 1992). The granules were packed in the form of blankets (1.2×0.7 cm) in muslin cloth. About 2.5 g of ethylene absorber was used for each kg of fruit. First lot from each treatment was kept at ambient temperature (25 –30°C, 65-90% relative humidity), while second lot was kept in the BOD incubator (at 20°C, 65% relative humidity) and third lot was kept in the refrigerator (at 10°C, 65 % relative humidity). Observations of fruit were recorded at two days interval. Fruit pulp was prepared and homogenized and used for chemical analysis.

For determination of physiological loss in weight (PLW), the initial weight of fruit was recorded prior to packaging and subsequently at two days interval.

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The reduction in weight was expressed on percentage basis. Acidity of pulp was calculated by visual titration method. Total soluble solids were determined using hand refractometer. The pH of pulp was determined using digital pH meter (Ranganna, 1979).

Data obtained during the course of investigation were subjected to statistical analysis to know the effect of different treatment and storage temperature on the physico-chemical sensory characteristics of the product. The statistical analysis was done on the basis of Split Plot in Randomized Block Design. Statistical analysis was carried out on these transformed data, with main plot as five different treatments and sub plot as three different storage temperature arranged in completely randomized design with four replications.

**Results and Discussion**

***Physico-chemical properties of custard apple***

Morphological and physico-chemical properties of the fresh custard apple fruits are given in Table 1.

**Table 1. Morphological and physico-chemical composition of fresh custard apple fruits**

| Properties | Average value |
|---|---|
| Polar length (cm) | 6.9 |
| Major diameter (cm) | 7.7 |
| Minor diameter (cm) | 7.2 |
| Weight (g) | 183.1 |
| Peel (g) | 91.3 |
| Seed (g) | 10.2 |
| No. of seeds | 29.2 |
| Pulp (g) | 79.7 |
| Core (g) | 2.4W |
| Specific gravity | 1.1 |
| Volume ($cm^3$) | 161.5 |
| Sphericity ($cm^3$) | 0.9 |
| Peel (%) | 49.8 |
| Pulp (%) | 43.4 |
| Seed (%) | 5.7 |
| Titrable acidity (%) | 0.20 |
| Ascorbic Acid (mg/100 g) | 6.4 |
| Total soluble solid ($^o$Brix) | 12 |
| Moisture (% w.b. ) | 26.32 |
| Pulp/peel ratio | 0.90 |
| PH | 6.6 |

***Effect on shelf life***

As shown in Fig. 1, the shelf-life of custard apple fruits increased with the lowering of storage temperature. This was due to reduced rate of bio-chemical changes at lower temperature. Custard apple fruits with treatments T-3, T-4 and T-5 have higher shelf life as compared to treatments T-1 and T-2 because of better protection against the factor which deteriorates fruits. Treatments, T-5 has the highest shelf-life at all storage temperature. This was due to presence of ethylene absorber used in this treatments, which might have delayed the ripening of the fruit.

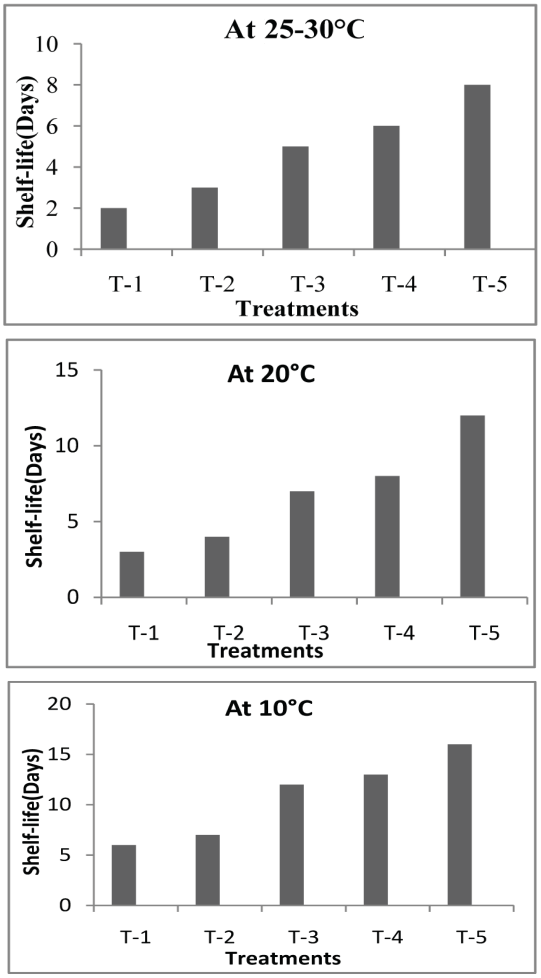



**Fig. 1 Effect of temperature on the shelf life of custard apple**

***Effect on physiological loss in weight (PLW)***

The physiological loss in weight of the custard apple fruits increased with the increase in storage duration in all the treatments at all storage temperatures (Fig. 2). This may be due to transpiration and respiration losses. Physiological loss in weight was higher in those treatments, which were not packed in the LDPE bags.

Physiological loss in weight was observed to be higher when fruits were stored at ambient and 20$^o$C. This may be due to higher rate of respiration and

transpiration at these temperatures. Physiological loss in weight was decreased at ambient and very less at 10°C. At low temperature of storage, biochemical changes in the surface tissue of fruits were slowed down, which resulted in the lower rate of respiration and transpiration. Similar observation was also reported by Tuwar *et al*. (1997).

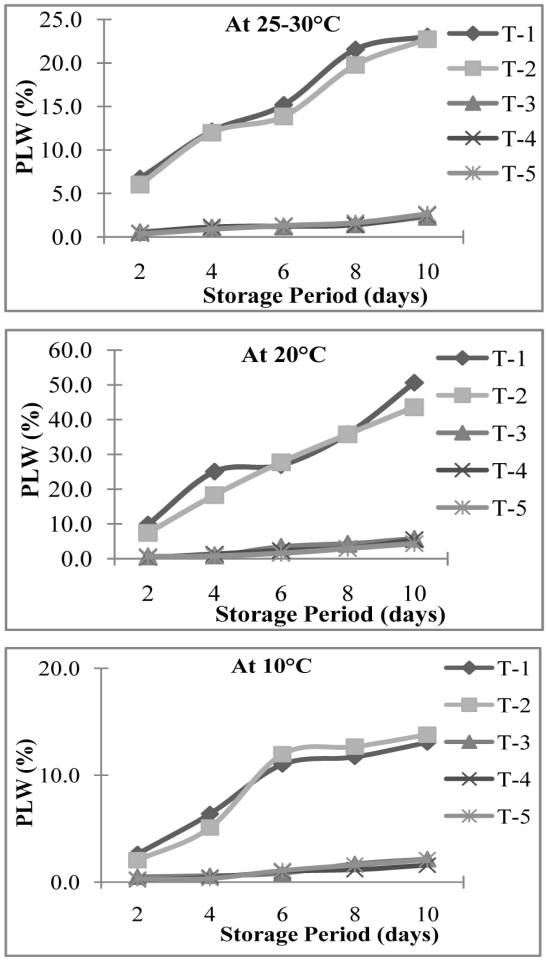
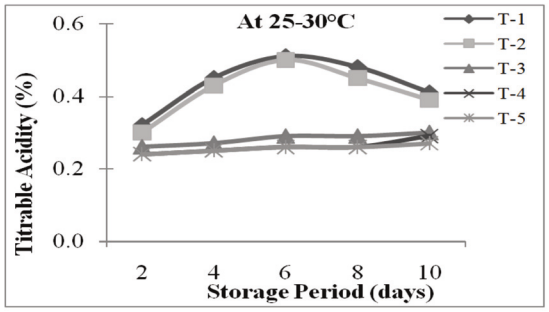



**Fig. 2 Variation of PLW of custard apple fruits with treatment kept at different temperature**

Significant effect of treatments, storage days and interaction of treatments and storage days on physiological loss in weight at 5 per cent level was observed. This was possibly due to increase in PLW as storage period advanced.



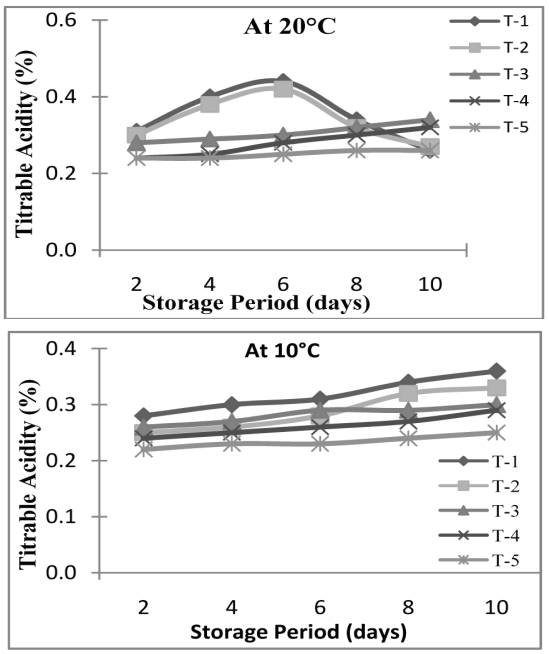
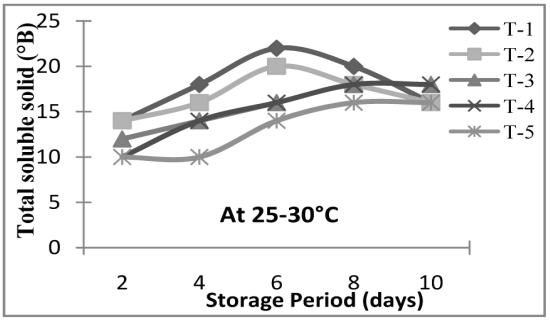




**Fig.3 Variation of titrable acidity of custard apple fruits with treatment kept at different temperature**

***Effect on titrable acidity***

Titrable acidity of the custard apple fruits tended to increase with the advancement in the storage duration in all treatment during storage at ambient, 20 and 10°C (Fig. 3). This may be due to decomposition of the starch. There was a fall in the titrable acidity after 6 days of storage at ambient and 20°C in the treatment T-1 and T-2. This may be due breakdown of the acids into water and carbondioxide. Custard apple stored at 10°C showed slower increase in the titrable acidity due slower metabolic activities at low temperature. Similar observation was reported by Sarode (2001) in banana and Khedkar *et al*. (1982) in guava.

There was significant effect of storage days and various treatments on titrable acidity of the custard apple at 5 per cent level was observed. This may be due to the ripening of custard apple fruits, which causes increase in acidity with advancement of storage period.



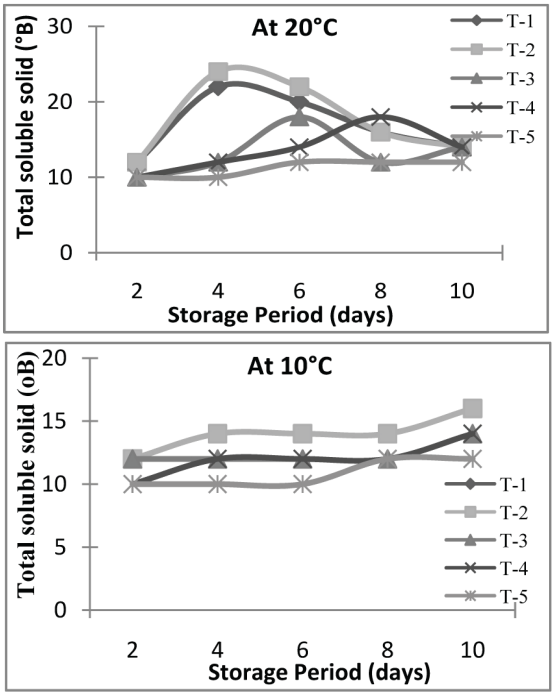



**Fig. 4 Variation of total soluble solid of custard apple fruits with treatment kept at different temperature**

***Effect on total soluble solids***

Variation in total soluble solids (TSS) of custard apple fruits against storage days with various treatments at different storage temperatures are shown in Fig. 4. In general, the TSS of custard apple fruits increased with increase in storage period in all the treatments. However, there was difference in TSS of fruits when stored at various temperatures. The increase in TSS was found to be minimum in T-5 for all three storage temperatures.

The TSS of the custard apple fruits increased with the increase in the storage period till the full ripening stage in all treatments at all storage temperature. This may be due to conversion of complex polymers into simple substances. There was a fall in the TSS after 6 and 8 days during storage at ambient and at 20°C temperature, possibly because of decomposition of carbohydrates into $CO_2$ and $H_2O$. Rate of increase in the TSS is higher at ambient condition due to rapid ripening. At 10°C of storage temperature, the rise in the TSS value was found to be slower. These results are in agreement with the findings of Adsule and Tandon (1983) and Patel *et al*. (1993) who reported in guava.

There was significant effect with respect to storage days and treatments on the TSS of the custard apple fruits. For all the treatments as ripening advances, TSS of the fruit increased significantly.

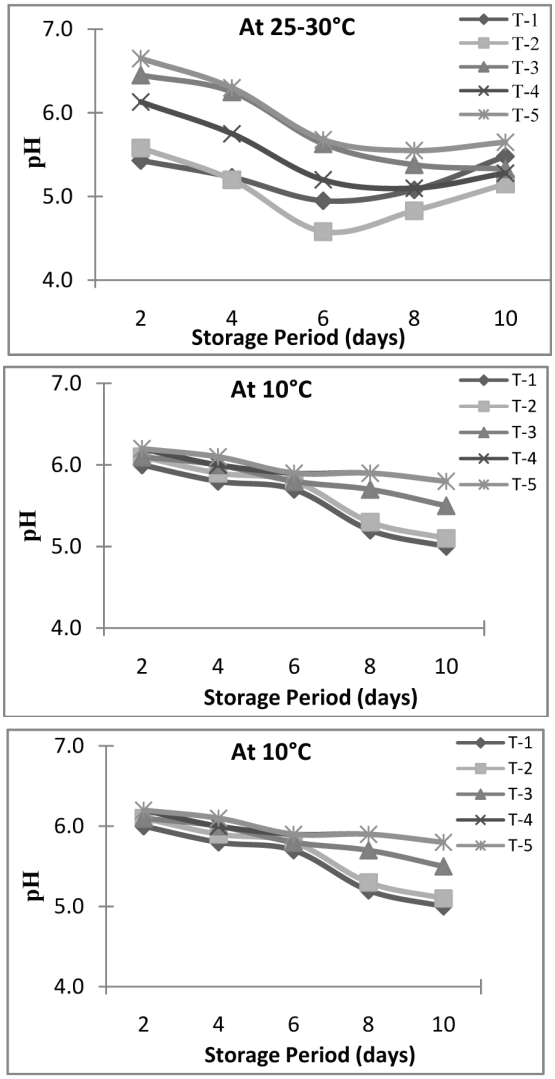



**Fig. 5 Variation of pH of custard apple fruits with treatment kept at different temperature**

***Effect on pH***

As shown in Fig. 5, the pH of custard apple fruits decreased with increase in the storage duration in all treatments at all temperatures *viz*. ambient, 20 and 10°C. As ripening advanced, acidity increased, which resulted in the decrease of the pH. Initially, rate of decrease in the pH was higher at ambient temperature because of higher rate of biochemical changes and rapid ripening.

At 10°C, pH of custard apple fruits with treatment T-3, T-4 and T-5 was nearly constant upto 10 days of storage. This may be because of reduced rate of biochemical changes due to low temperature and sealed environment. Similar observation was also made by Khedkar et al., (1982) in guava and Sravanthi *et al*., (2014) in custard apple.

There was significant effect of storage days and treatments on the pH of the custard apple fruits. This

shows that for all the treatments as storage period advanced, pH of the fruits decreased significantly.

## Conclusion

There existed a pronounced effect of storage temperature on shelf life of custard apple fruits. It was observed that fruits packed in LDPE bags undergone minimal changes in physico-chemical properties and controlled the ripening of custard apple fruits at all storage of temperature.

It may be concluded that storing custard apple fruits pre treated with bavistin solution (500 ppm) for 2 minutes and packed in LDPE bags (150 gauge) with ethylene absorber could be stored successfully up to 16 days at 10°C without much loss in fruit quality.

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