

## **Effect of Calcium Chloride for Enhancing Shelf Life of Custard Apple Fruits (*Annona squamosa* L.) during Storage**

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### **Abstract**

An experiment was conducted to find out the effect of post harvest treatments and polyethylene packages with / without ventilation on shelf life of custard apple fruits. The fruits were treated in various chemicals viz., calcium chloride 2%, potassium permanganate at 4% and fruits smeared with mustard oil and packed with 150 and 200 gauge thickness of polyethylene bag with / without ventilation respectively. When fruits treated with 2% calcium chloride and packed in 150 gauge 0.5% ventilation were found in better shelf life (9.80 days) and helps to return the quality of fruits and thus increases the shelf life. The lowest specific gravity was recorded in ripen fruits (1.032) and minimum PLW (2.83%) higher organoleptic score 3.60, 3.72, 3.82 and 2.95 / out of 5.0 score taste, color, flavor and over all acceptance respectively as compared to fruits in control.

**Key words :** Calcium chloride, Shelf life, Custard apple fruits, Storage.

The indigenous fruits which are locally available in a particular season play a vital role in the nutrition of rural mass. Easily available, indigenous fruits can serve as major source of vitamins and minerals for most of the rural population. Custard apple is even sometimes considered as poor man's rich food in the arid zones of South India. The plant thought to be indigenous to tropical America mainly grown in the arid zone of India and Africa. Of the 100 species of *Annona* only the custard apple cherimoya, *Soursoup* and *Ateyamoya* one of the major commercial importance, of these custard apple (sitphal) is the most important and widely used as dessert fruit having the maximum production efficiency. Custard apple is found mostly in semi arid region in India. In Karnataka the area under custard apple is increasing slow out of five edible species one (*Annona squamosa* L.) custard apple is commonly impartment the fruits of custard apple are very delicate and highly perishable. The biochemical changes in the fruits after harvest occur at faster rate and fruit become unfit for consumption the abundant supply of custard apple fruits in the market from the majority of orchards takes place in a short span which cause glut in the market, thereby causing reduction in price. This leads to loss in total returns to the farmer. Also fruits can-

not be stored for a longer period at ambient condition so it becomes essential that fruit must be transported to the distant market without spoilage. The present study was undertaken to investigate the possibilities the biochemical changes and spoilage of fruits could be slow down to certain extent without damages and fruit quality of extending the shelf life of custard apple fruit use of chemicals and synthetic coatings and packaging of fresh fruits have a great significance in reducing the wastage and enhancing the storage life of the fruits.

### **Methods**

The experiment was conducted in factorial completely randomized block design 20 fruits were indicated in each packages the fruits were evaluated every two days interval physiological loss in weight softening indices and organoleptic score by using 5.0 point scale. The experimental materials were obtained from the University of Agricultural Sciences, GKVK, Bangalore factorial complete randomized block design observation was recording PLW, organoleptic evaluation and shelf life subjected to the following treatments.

Custard apple fruits of uniform size, shape and

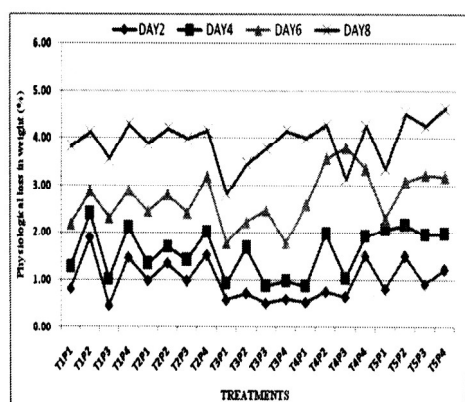


Figure 1. Physiological loss in weight (%).

color were harvested at maturity stage. The fruits were brought to the laboratory with least damage washed properly with tap water and shade dried. Treatments were then made by dipping the custard apple fruit in prepared solution calcium chloride at 2% and potassium permanganate at 4%. For 20 minutes control fruits were dipped in normal water. After

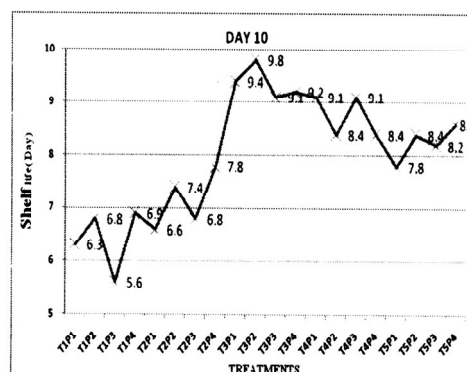


Figure 2. Shelf life (days).

treatment, the fruits were shade dried and packed in 150 and 200 gauge polyethylene bag with / without ventilation at 0.5% ventilation. The bags are provided 20 holes by using formula  $\pi r^2$ ; 150 and 200 gauge thickness of size polyethylene bag of 20 × 30 cm was used for the study twenty circular holes of 0.4 cm<sup>2</sup> diameter were punched in each polyethylene bag at equidistance from each other.

No. of ventilation = actual area of the bag × percent-

Table 1. Effect of pre-treatments and polyethylene packages changes on physical characters of custard apple (*Annona squamosa* L.) during storage.

Treatments	Physical characters			Organoleptic characters (5.0 scale)			
	Sp gravity (g/cc)	Shelf life (days)	PLW (%)	Taste	Color	Flavor	Accept ability
T <sub>1</sub> P <sub>1</sub>	1.044	6.25	3.82	3.65	3.05	2.85	2.32
T <sub>1</sub> P <sub>2</sub>	1.047	6.75	4.12	3.55	3.60	3.07	2.85
T <sub>1</sub> P <sub>3</sub>	1.048	5.62	3.56	3.42	3.42	2.92	2.75
T <sub>1</sub> P <sub>4</sub>	1.044	6.87	4.29	3.50	3.42	2.90	2.60
T <sub>2</sub> P <sub>1</sub>	1.048	6.62	3.89	3.42	3.37	2.92	2.57
T <sub>2</sub> P <sub>2</sub>	1.045	7.37	4.20	3.30	3.50	3.00	2.65
T <sub>2</sub> P <sub>3</sub>	1.045	6.75	3.98	3.25	3.40	2.75	2.57
T <sub>2</sub> P <sub>4</sub>	1.036	7.75	4.16	3.27	3.37	2.87	2.55
T <sub>3</sub> P <sub>1</sub>	1.034	9.37	2.83	3.60	3.32	3.82	2.60
T <sub>3</sub> P <sub>2</sub>	1.032	9.80	3.45	3.60	3.72	3.82	2.95
T <sub>3</sub> P <sub>3</sub>	1.036	9.50	3.78	3.60	3.80	3.42	2.87
T <sub>3</sub> P <sub>4</sub>	1.034	9.70	4.15	3.60	3.72	3.47	2.90
T <sub>4</sub> P <sub>1</sub>	1.338	9.12	4.00	3.65	3.57	3.40	2.70
T <sub>4</sub> P <sub>2</sub>	1.033	8.25	4.28	3.60	3.62	2.85	2.95
T <sub>4</sub> P <sub>3</sub>	1.033	9.12	3.15	3.52	3.67	2.77	2.65
T <sub>4</sub> P <sub>4</sub>	1.039	8.37	4.26	3.37	3.55	2.92	2.52
T <sub>5</sub> P <sub>1</sub>	1.046	7.75	3.36	3.25	3.55	3.02	2.55
T <sub>5</sub> P <sub>2</sub>	1.036	8.35	4.52	3.32	3.37	2.67	2.32
T <sub>5</sub> P <sub>3</sub>	1.046	8.20	4.26	3.27	3.15	2.67	2.27
T <sub>5</sub> P <sub>4</sub>	1.034	8.65	4.63	3.15	3.17	2.67	2.25
SE ±	0.175	0.15	0.17	1.46	0.24	1.48	1.50
CD 1%	0.032	0.58	0.65	2.76	0.92	2.79	2.83

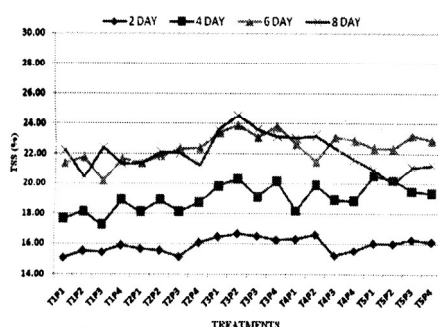


Figure 3. Total soluble solids (°Brix).

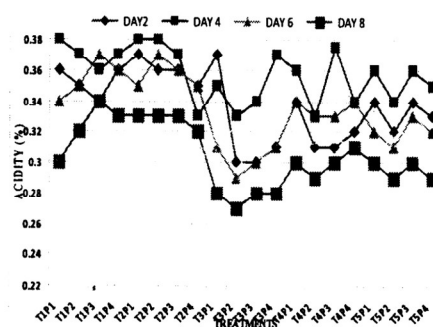


Figure 4. Titrable acidity.

age of ventilation /area of the hole.

Where,  $25 \times 20$  cm actual utilized space = 510 sq cm  
 Area of the hole =  $\pi r^2$ . Where,  $\pi = 3.14$ .  $r^2 = 0.4\pi \times r \times r = 3.14 \times 0.2 \times 0.2 = 130$  sq cm. No of ventilation =  $510.00 \times 0.05 / 0.130 = 19.65$ . Twenty samples kept under each replication and polyethylene bags are sealed mechanically. The experiment was carried out in completely randomized block design with five treat-

ments, four packages and replicated with four times. The observations were recorded in PLW, organoleptic evaluation and shelf life subjected to the following treatments. Pre treatments :  $T_1$  = Control (Fruits without any treatments),  $T_2$  = Fruits dipped in cold water for five minutes,  $T_3$  = Fruits dipped in  $CaCl_2$  2%,  $T_4$  = Fruits dipped in  $KMnO_4$  4%,  $T_5$  = Fruits smeared with mustard oil. Packages :  $P_1$  = 150 gauge polyeth-

**Table 2.** Effect of pre-treatments and polyethylene packages changes on chemical characters of custard apple (*Annona squamosa* L.) during storage. Pre-treatments (T) :  $T_1$ —Control.  $T_2$ —Dipped in cold water,  $T_3$ —Treated with  $CaCl_2$ ,  $T_4$ —Treated with  $KMnO_4$ ,  $T_5$ —Smeared with mustard oil. Packages (P) :  $P_1$ —150 Gauge without ventilation,  $P_2$ —150 Gauge with ventilation (0.5%),  $P_3$ —200 Gauge without ventilation,  $P_4$ —200 Gauge with ventilation (0.5%).

Treatments	TSS (°Brix)	Acidity (%)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	pH	Ascorbic acid (mg/100 g)
$T_1P_1$	22.25	0.30	12.90	6.67	21.20	6.24	12.44
$T_1P_2$	20.45	0.32	12.20	7.10	21.30	6.23	13.42
$T_1P_3$	22.42	0.34	12.30	8.02	20.89	6.32	13.85
$T_1P_4$	21.35	0.33	13.72	8.22	21.94	6.31	13.28
$T_2P_1$	21.40	0.33	12.41	7.47	20.29	6.28	13.86
$T_2P_2$	22.12	0.33	13.42	7.52	21.74	6.24	13.14
$T_2P_3$	22.05	0.33	13.90	7.57	21.87	6.32	13.20
$T_2P_4$	21.25	0.32	14.22	7.10	21.32	6.24	13.65
$T_3P_1$	23.60	0.28	14.60	9.12	21.10	6.46	14.75
$T_3P_2$	24.57	0.27	14.82	9.24	23.82	6.67	14.88
$T_3P_3$	23.60	0.28	13.30	9.20	20.92	6.58	14.63
$T_3P_4$	23.15	0.28	14.22	8.87	23.27	6.46	13.86
$T_4P_1$	23.05	0.30	14.35	8.27	22.37	6.34	13.885
$T_4P_2$	23.20	0.29	13.42	9.20	22.57	6.43	14.08
$T_4P_3$	22.37	0.30	14.60	7.50	22.10	6.58	13.62
$T_4P_4$	21.62	0.31	14.20	7.22	21.42	6.53	13.54
$T_5P_1$	20.97	0.30	13.95	7.45	21.40	6.56	14.06
$T_5P_2$	19.97	0.29	14.30	6.65	20.75	6.42	13.62
$T_5P_3$	21.12	0.30	12.47	6.92	21.39	6.24	13.22
$T_5P_4$	21.50	0.29	14.05	8.20	22.25	6.21	13.16
SE ±	0.788	0.01	1.880	0.27	0.91	0.17	1.764
CD 1%	2.965	0.05	7.073	1.03	3.44	0.65	6.786

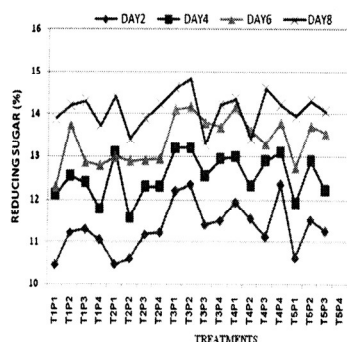


Figure 5. Reducing sugar (%).

ylene bag without ventilation,  $P_2 = 150$  gauge polyethylene bag with 0.5% ventilation,  $P_3 = 200$  gauge polyethylene bag without ventilation,  $P_4 = 200$  gauge polyethylene bag with 0.5% ventilation.

### Results and Discussion

*Annona squamosa* is a typical fruit characterized by short life and highly perishable under ambient condition. The fruit ripe on third day, retain edible status up to day 4 and rapidly shows symptom of deterioration after fourth day and become unfit for consumption on fifth day of storage. The dynamic transformation of fruit is mainly due to rapid degradation and metabolism. In this context experiment was carried out to identify suitable post harvest treatments, to increase the shelf life of fruit. The results associated with physico-chemical changes during storage.

#### *Shelf Life (Days)*

Similarly the data on the interaction effect of polythene package and pre-treatments showed significant difference with respect to shelf life of fruits where longest shelf life was showed in fruits treated with calcium chloride and stored in 150 gauge polythene bags with 0.5% ventilation (9.80 days) followed by fruits treated with  $\text{CaCl}_2$  and stored in 200 gauge polyethylene bag without ventilation (9.40 days). The lowest shelf life was recorded in control fruits (5.60 day) and stored in 200 gauge polythene bag without ventilation. This could be ascribed to accumulation of high ethylene inside the polybag, which create lower rate of metabolic activities and

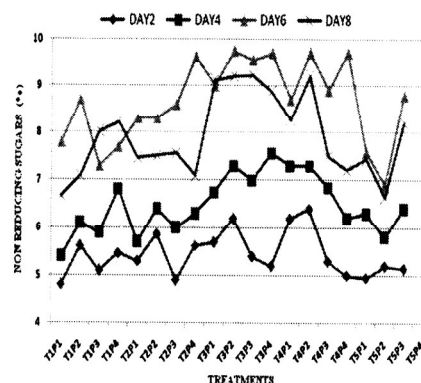


Figure 6. Non-reducing sugar (%).

maintained high relative humidity reduces bio-chemical changes, as observed by Sathyan et al. (1), Singh et al. (2).

#### *Physiological Loss in Weight (%)*

Effect of polyethylene gauges and post harvest treatments on eighth days of storage  $\text{CaCl}_2$  treated fruits and in 150 gauge polyethylene bag without ventilation recorded significantly lowest Physiological loss in weight well documented by Shyamamma (3). The fruit stored under ambient condition shows significantly higher PLW, fruit were exposed to high temperature and lower relative humidity thus all the physiological and metabolic activities might have increased under ambient condition as reported by Naik and Rokhade (4), in guava and Kukanoor (5) in mango.

#### *Organoleptic Characters*

The taste of the pulp was significantly high in fruits treated with  $\text{CaCl}_2$  and stored in 150 gauge polyethylene packages with 0.5% ventilation. This could be attributed due to combined effect of calcium chloride and polyethylene packaging material, due to changes in valuable compounds of fruit pulp of *Annona squamosa* in by altering the of storage condition as observed by Vishnuprasanna (6) in custard apple.

Highest color of the pulp was recorded in fruits treated with  $\text{CaCl}_2$  and stored in 200 gauge polyethylene packages without ventilation followed by fruits treated with  $\text{CaCl}_2$  and stored in 150 gauge poly-

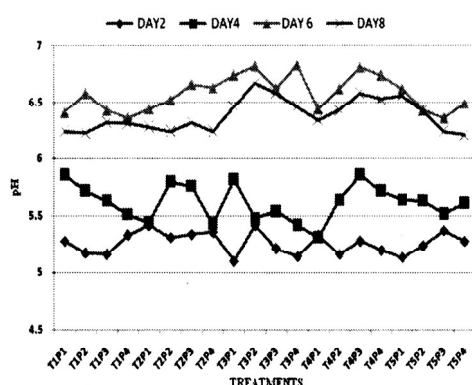


Figure 7. pH of custard apple.

ethylene package without ventilation. Which is attributed to thickness of polyethylene bag reduced the activity of enzymes and reduced temperature which is responsible for degradation of cellulose and formation of anthocyanin pigment and other pectin substances as observed by Vishnu Prasanna (6) in custard apple.

The effect post harvest treatments and polyethylene packages significant difference among the treatments calcium chloride treated fruits significantly registered highest flavor stored at 200 gauge ventilation bag which is on par with potassium permanganate and stored at 150 gauge with ventilation at the end of storage day. This could be attributed to minimum changes in bio-chemical activities and lowers sugar and acidity the ripe fruit stored at low temperature had slightly higher score for flavor as observed by Shashirekha et al. (7) in custard apple.

The highest overall acceptance was recorded in fruit packed 150 gauge and 200 gauge with 0.5% ventilation respectively at day 8 and storage. The lowest overall acceptance was recorded in and fruits stored at 150 gauge polyethylene bag without ventilation. This may be due to reducing color development and spoilage as observed by Aradhya et al. (8), in pomegranate and Choudhary and Dhaka (9), in citrus fruit.

#### Total Soluble Solids ( $^{\circ}$ Brix)

In the interaction effect of polyethylene gauges and post harvest treatments on eighth days of storage  $\text{CaCl}_2$  treated fruits recorded significantly higher total soluble solids and fruits stored in 150 gauge

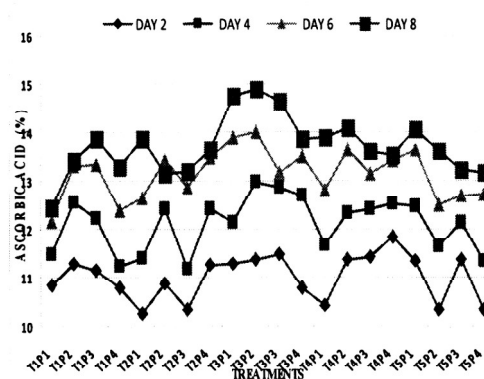


Figure 8. Ascorbic acid (%).

polyethylene bag with ventilation. Sugar might have been utilized in the process of respiration effect of polyethylene bag and post harvest treatments arresting the ripening process decrease the acid contents and conversion of sugar ethylene stimulation as observed by Ingawale and Patgaunkar Jadhav (10). The lowest total soluble solids was registered in mustard oil treated fruits and fruit stored in 150 gauge thickness bag with ventilation which is at par with the control fruits and fruits stored in 150 gauge polyethylene bag with ventilation. This may be due to higher physiological loss in weight confirming Jindal et al. (11) in sapota.

#### Titrateable Acidity (%)

Interaction effect of polyethylene gauges and post harvest treatments on day 8 of storage  $\text{CaCl}_2$  treated fruits recorded significantly lowest titrateable acidity and fruits stored in 150 gauge polyethylene bag with ventilation. This might be due to polyethylene was also found beneficial in arresting the ripening process and fruits packed in 100 gauge polyethylene bag with 2% vent showed, external appearance daily softening and acidity decrease in chlorophyll content as observed by Ingawale and Patgaunkar Jadhav (10) in custard apple.

#### Non-Reducing Sugar (%)

The interaction suggested non-significant differences on the last day storage non reducing sugar

retention was very in fruits of high  $\text{CaCl}_2$  (14.82 %) and  $\text{KMnO}_4$  whereas, its retention in fruits of control and mustard oil treatments combination were significantly low. This could be attributed to lower rate of metabolic activities and reduced storage temperature as observed by Praveen and Pandey (12), Kumble and Chavan (13) in custard apple.

#### *Reducing Sugar (%)*

The interaction suggested non-significant differences on the last day storage reducing sugar retention was very in fruits of high  $\text{CaCl}_2$ . This could be attributed to reducing sugar content of fruit increased during the period of ripening efficiency of polyethylene packages and chemical lower rate of metabolic process and involve a series of bio-chemical changes, in many climacteric fruit starch being the primary energy reserve is synthesized in amloplast during storage, as observed by Vishnuprasanna (6), and Praveen and Pandey (12), in custard apple.

#### *pH*

Interaction effect of polyethylene gauges and post harvest treatments on day 8 of storage  $\text{CaCl}_2$  treated fruits recorded significantly higher pH and fruits stored in 150 gauge polyethylene bag with ventilation. The lowest pH was registered in mustard oil treated fruits and fruit stored in 150 gauge thickness bag with ventilation which is at par with the cold water fruits and fruits stored in 150 gauge polyethylene bag with ventilation. This could be attributed, the increase in pH of fruit during ripening, corresponding decrease in acidity caused by degradation of acids during ripening and senescence observed by Rajani (14), Karlra et al. (15) in mangoes.

#### *Ascorbic Acid (mg/100 g)*

Interaction effect of polyethylene gauges and post harvest treatments on day 8 of storage  $\text{CaCl}_2$  treated fruits recorded significantly highest ascorbic acid and fruits stored in 150 gauge polyethylene bag with ventilation which is next best to  $\text{CaCl}_2$  which is attributed to correlated to the congenial atmosphere of spoilage vapor from the fruit through transportation the level of ascorbic acid were found to be al-

ways higher in poly bag, low respiration rate and transpiration rate polyethylene better sealing maintained fruit firmness as a result increases the starch contents observed by Kukanoor (5) in mango fruit.

#### *Disease Incidence (%)*

The interaction effect of pre-treatments and polythene package showed significant differences. The lowest disease incidence registered in fruits treated with  $\text{KMnO}_4$  and stored in 150 gauge without ventilation bags on par with fruits treated with  $\text{CaCl}_2$  stored in 150 gauge with ventilation bags. The highest disease incidence was recorded in fruits dipped in cold water and stored and fruits at 200 gauge polythene bag without ventilation (14.71 %) followed by control fruits and stored in 150 gauge polythene without ventilation. This could be attributed to control physiological detritions of fruits the production of ethylene has to be eliminated Mustaffa et al. (16) in banana and fruit surface coating chemicals reduces the activities of amylase and poly galactouranase by maintaining firmness and minimize rate of respiration, might be due to anaerobic condition which helps in multiplication micro flora Jindal et al. (11).

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