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Effect of post harvest chemicals on physiological loss in weight, fruit decay and shelf life of custard apple (*Annona squamosa* L.) during storage

LV Pimpalpalle, VS Khandare and YA Gaonkar

Abstract
The experimental study was conducted on "Effect of post harvest chemicals on physiological loss in weight, fruit decay and shelf life of custard apple (*Annona squamosa* L.) during storage'' at Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani and framed in Complete Randomized design (CRD). Custard apple fruits were harvested at physiological stage of maturity. Fruits were graded, washed and dried under fan. After that fruits were treated with 1-Methylcyclopropene (1-MCP) at two concentrations 100ppb and 200ppb for 24 h duration and coated with Chitosan-1% and wax. Treated fruits were subsequently packed in corrugated fibre board boxes and stored at ambient temperature.
The results was concluded that the combined application of 1-Methylcyclopropene 200ppb and chitosan 1% as a to inhibited the physiological loss in weight, ripening and extend shelf life and maintain quality of custard apple fruit during storage.

Keywords: Chemicals, physiological loss in weight, fruit decay, shelf life, custard apple

Introduction

Custard apple (*Annona squamosa* L.) is one of the finest fruit gifted to India by Tropical America. Custard Apple is also known as Sugar Apple. Custard apples are climacteric and have a very short storage life due to their fast ripening after harvest. The fruit is an excellent source of energy as it high in carbohydrate. The fruit contains vitamins-C and minerals such as calcium, phosphorus potassium.

The custard apple fruit is mostly used as a dessert for its delicious taste and nutritive values. The fruit is a good source of carbohydrates (23.5%), minerals (0.9%), and proteins (1.6%). (Gopalan *et al*. 1991) [6], reported moisture 73.5, carbohydrates 23.9, proteins 1.6, fats 0.3, calcium 0.02, phosphorous 0.04 and iron 0.01 percent respectively. It is also a good source of vitamin A and C. The fruit yields about 40 percent pulp having 26.4 Brix (TSS), 5.5 pH and 0.5 per cent tannins. Skin of fruits is high in phenols and causes rapid browning and strong off flavor during storage and processing. Ancorine is an alkaloid extracted from custard apple which had insecticidal properties. The custard apple seed contains 25.5% oil. The oil is suitable for soap and paint industries. The seed cake can be used as manure.

The processed products and by-products of custard apple are nutritionally important. The custard apple fruit pulp is of pleasant taste, texture and flavor. It is sweet and slightly acidic. The food value is associated with sugar (12 to 22%) and protein (1.6%). It finds important to either to preserve the fruits by monitoring the shelf life of fresh fruit or fruit pulp as secondary raw material for transforming in the form of different new products facilitating value addition.

Custard apple is one of the most delicious and highly perishable fruit. It has its delightful taste, flavor, moderate price in markets and a high nutritional status. Overall the importance of fruits in domestic and export market as a fresh fruits and processed products. Under ordinary condition, fruits can keep well only for 3-4 days after harvest. The physiological changes in fruit occur continuously after harvest. By reducing these changes, the shelf-life of mature fruits can be effectively increased. The cold storage is not feasible for custard apple because at low temperature, the blackening or discolouration of fruits is increased. Extension of shelf-life may be possible by checking the transpiration rate, respiration rate and microbial infection. Certain post harvest chemical treatments are given to harvested fruits of custard apple like 1-MCP, Chitosan, Polyamines (Putercine, spermine) etc.

The visual appearance is the first quality impact that leads the consumer to accept a product. The enzymatic browning reaction catalyzed by polyphenol oxidase (PPO) affects the preservation of pulp. Control of enzymatic browning during processing and storage is important to preserve the sensorial quality of fruit pulp. Till today several methods have been used to facilitate the inhibition of *in vivo* PPO activity in fruits and vegetables. Addition of chemicals, pH adjustment, and exclusion of oxygen (deaeration), refrigeration and thermal treatments are among the most effective methods. The injured tissues of fruit on exposure to air rapidly get darkened, due to the conversion of phenolic compounds to brown melanin, in presence of PPO. The most responsible substrate for this enzyme is diphenols and monophenols. Flavonoids and tannins also act as substrates.

Considering all above constraints, like less shelf life, enzymatic browning, bitter taste developed due to limonine, blackening of pulp, maximum percentage of decaying of fruit etc. custard apples have to be disposed off in local market. So now need to developed such a technology or methods to increase the shelf life of custard apple. It will help in better utilization of custard apple fruits. Hence, the present study was undertaken to analysed to used of different post harvest chemicals to increase the shelf life and control the physiological loss in weight as well as decaying percentage of fruits.

Material and methods

The clean dried fruits were washed then divided into main lots each containing 15 fruits and subjected to various treatments, i.e. T1-1-MCP-100 ppb; T2-1-MCP - 200 ppb; T3-Putrescine – 1 mM T4 -Paraffin Wax; T5-Chitosan - 1%; T6; 1-MCP - 100 ppb + Putrescine – 1 mM; T7-1-MCP – 100 ppb + Paraffin Wax; T8-1-MCP – 100 ppb + Chitosan - 1%; T9 -1-MCP - 200 ppb + Putrescine – 1 mM; T10 -1-MCP - 200 ppb + Paraffin Wax; T11 -1-MCP - 200 ppb + Chitosan -1%; T12 -Putrescine – 1 mM + Paraffin Wax; T13 -Putrescine – 1 mM + Chitosan -1%; T14 -Paraffin Wax + Chitosan - 1% and T15 –Control. Each treatment was replicated thrice (3 replication). Treated fruit were packed in CFB boxes and stored in ambient temperature and record PLW, Fruit decaying percentage and shelf life.

Fruits were weighed during storage at regular intervals with the help of an electronic balance. Physiological loss in weight was calculated by using the following formula and data were expressed in percentage.

$$\text{PLW (\%)} = \frac{\text{(Initial weight - weight after known storage period)}}{\text{Initial weight}} \times 100$$

Fruit decay (%)

The percentage of fruit decay was calculated by using the following formula:

$$\text{Percentage of fruit decay} = \frac{\text{No. of decayed fruits}}{\text{Total No. of fruits}} \times 100$$

Results and discussion

Effect of post harvest treatments on physiological loss in weight (%)

The effect of 1-Methylcyclopropene, Chitosan, Putrescine and paraffin wax coating at ambient temperature on rate of changes of physiological loss in weight is presented in Table 1 and Fig.1. The physiological loss in weight of fruits was found to increase with the advancement of storage period irrespective of treatments. At 3rd day of storage, there were no PLW was found in T_7, T_{10} and T_{14} treatments. Significantly lowest physiological loss in weight was recorded in treatment T_7 (0.04%) and T_{10} (0.05%) over rest of the treatments except treatment T_{14} (0.10%) which was at par with treatment T_7 and T_{10}, while highest PLW was recorded in treatment T_{15} (13.21%) during 6th day of storage. During the 15th day of observation, the treatment T_{10} (8.60%) was registered a lower PLW which was at par with T_7 (9.10%) and T_5 (11.40%). The higher PLW was shown in treatment T_{11} (14.03%).

The physiological loss in weight of fruits was found to increase with the advancement of storage period irrespective of treatments. At 3rd day of storage, there were no PLW was found in T_7, T_{10} and T_{14} treatments. Significantly lowest physiological loss in weight was recorded in treatment T_7 (0.06%) and T_{10} (0.05%) over rest of the treatments except treatment T_{14} (0.06%) which was at par with treatment T_7 and T_{10}, while highest PLW was recorded in treatment T_{15} (11.85%) during 6th day of storage. During the 15th day of observation, the treatment T_{10} (7.86%) was registered a lower PLW which was at par with T_7 (8.20%) and T_5 (13.78%). The higher PLW was shown in treatment T_{11} (13.85%).

The physiological loss in weight of fruits was found to increase with the advancement of storage period irrespective of treatments. At 3rd day of storage, there were no PLW was found in T_7, T_{10} and T_{14} treatments. Significantly lowest physiological loss in weight was recorded in treatment T_7 (0.05%) and T_{10} (0.05%) over rest of the treatments except treatment T_{14} (0.08%) which was at par with treatment T_7 and T_{10}, while highest PLW was recorded in treatment T_{15} (12.53%) during 6th day of storage. During the 15th day of observation, the treatment T_{10} (8.23%) was registered a lower PLW which was at par with T_7 (8.65%) and T_5 (9.09%). The higher PLW was shown in treatment T_{11} (13.94%).

As an expected result, PLW of fruits was altered with treatment applied and use of 1-MCP + Chitosan gave superior results over other treatments with respect to keeping PLW rate low under both the storage conditions. This low PLW of fruits may be attributed to diminished biological activities (respiration, ethylene evolution, inactivation of enzymes and restricted movement of free water). The above findings confirmed with the work done by Jeong *et al.* (2002) [8] and Prange and Delong (2003) [12].

Effect of post harvest treatments on fruit decay (%)

The effect of various treatments on percentage of decay incidence is presented in Table 2 and graphically presented in Fig.2. At 3rd day of storage of custard apple fruits decay incidence was not found in all treatments. At 6th day of storage also decay incidence was not found in treatments T_{10} and T_{11} and T_{14}. At 6th day of storage, lowest decay incidence was found in treatment T_{13} (0.12%) and T_8 (0.18%) followed by in treatments T_7 (0.87%) and T_5 (1.29%). The highest (12.57%) rate of decay was recorded in treatment T_{15}. There were no decay incidence found in treatments $T_{14.}$ At 12th days of storage, the rate of decay incidence was increasing significantly with the advancement of time under the storage period. On 15th day of storage, maximum decay incidence (13.84%) was recorded in treatments T_4 and minimum decay was recorded in treatment T_{14} (9.20%) over rest of the treatment except treatments T_{11} (9.12%) which was at par with treatment T_{10} (9.23%), T_8 (8.53%) and T_7 (8.67%).

At 3rd day of storage of custard apple fruits decay incidence was not found in all treatments. At 6th day of storage also decay incidence was not found in treatments T_{10} and T_{11} and T_{14}. At 6th day of storage, lowest decay incidence was found in treatment T_{13} (0.10%) and T_8 (0.10%) followed by in treatments T_7 (0.66%) and T_5 (1.17%). The highest (11.40%) rate of decay was recorded in treatment T_{15}. There were no decay incidence found in treatments $T_{14.}$ At 12th days of storage, the rate of decay incidence was increasing significantly with the advancement of time under the storage period. On 15th day of storage, maximum decay incidence (12.18%) was recorded in treatments T_4 and minimum decay was recorded in treatment T_{14} (6.48%) over rest of the treatment except treatments T_{11} (7.10%) which was at par with treatment T_{10} (7.19%), T_8 (7.46%) and T_7 (8.21%).

At 3rd day of storage of custard apple fruits decay incidence was not found in all treatments. At 6th day of storage also decay incidence was not found in treatments T_{10} and T_{11} and T_{14}. At 6th day of storage, lowest decay incidence was found in treatment T_{13} (0.11%) and T_8 (0.14%) followed by in treatments T_7 (0.66%) and T_5 (1.17%). The highest (11.40%) rate of decay was recorded in treatment T_{15}. There were no decay incidence found in treatments $T_{14.}$ At 12th days of storage, the rate of decay incidence was increasing significantly with the advancement of time under the storage period. On 15th day of storage, maximum decay incidence (13.01%) was recorded in treatments T_4 and minimum decay was recorded in treatment T_{14} (7.85%) over rest of the treatment except treatments T_{11} (8.11%) which was at par with treatment T_{10} (8.21), T_8 (8.53%) and T_7 (8.67%).

Effect of post harvest treatments on shelf life (days) of custard apple fruits

The effect of post harvest treatments on the shelf life of custard apple is presented in Table 3 and graphically depicted in Fig.3.

It was observed that the highest shelf life was observed in treatament T_8 (15.25 days) which was at par with tretement T_{11} (14.89 days) and T_7 (14.31days) whereas lowest shelf life was observed in treatment T_{15} (4.82 days).

It was observed that the highest shelf life was observed in treatament T_8 (15.15 days) which was at par with tretement T_{11} (14.77) and T_7 (14.13) whereas lowest shelf life was observed in treatment T_{15} (4.38).

It was observed that the highest shelf life was observed in treatament T_8 (15.15 days) which was at par with tretement T_{11} (14.83) and T_7 (14.22) whereas lowest shelf life was observed in treatment T_{15} (4.60).

Since 1-MCP is known to delay senescence by blocking the evolution of ethylene, it there by inhibited fruit softening (Blankenship and Dole, 2003; Jeong *et al.* 2002) [8]. Maximum fruit firmness in Chitosan coated fruits could be attributed to the permeability property of the coating and its effects on the fruits (Buescher, 1979) [3] and provided better way to reduce the evaporation and avoided shrinkage (Medlicott *et al.,* 1987) [11]. A similar results were also obtained in other fruits including apple (Watkins *et al.,* 2000) [13], kiwifruit (Boquete *et al.,* 2004) and banana (Boonyaritthongchai and Kanlarayat, 2010) [1].

In this study it was found that the decay controls of treated custard apple fruits was better as compared to untreated fruits. Chitosan treated fruit inhibited the growth of a wide variety of bacteria and fungi as compared to the control treatments. El-Ghaouth *et al.* (1991) [5] suggested that chitosan induces chitinase, a defense enzyme (Mauch *et al.* 1984) [10], which catalyzes the hydrolysis of chitin, a common component of fungal cell walls (Hou *et al.* 1998) [7]. The results suggested that chitosan extend the shelf life, limit the growth of fungi, and decrease the spoilage without affecting on ripening characteristics of fruit (Lam and Diep, 2003) [9]. The lower decay in treated fruits may be due to stimulation of some natural defence mechanism included by 1-MCP, in addition to maintaining tissue integrity during storage and ripening. Further it may also ascribed to its inhibitory effects on disease and disorder incidence as reported by Dong *et al.* (2002) [2] in apricots.

Table 1: Effect of post harvest treatments on physiological loss in weight (%) of custard apple fruit during storage.

Treatments	Physiological loss in weight (%)																	
	2014-2015						2015-2016						Mean Value					
	(Storage Days)						(Storage Days)						(Storage Days)					
	0	**3**	**6**	**9**	**12**	**15**	**0**	**3**	**6**	**9**	**12**	**15**	**0**	**3**	**6**	**9**	**12**	**15**
T1	0.00	0.05	0.13	5.26	10.32	12.39	0.00	0.05	0.19	5.10	10.22	12.53	0.00	0.05	0.16	5.18	10.27	12.46
T2	00.0	0.04	0.11	4.60	9.46	11.70	00.0	0.06	0.17	4.64	9.48	11.92	00.0	0.05	0.14	4.62	9.47	11.81
T3	0.00	0.03	0.80	2.98	9.20	10.20	0.00	0.05	0.16	4.54	8.06	11.82	0.00	0.04	0.12	3.76	8.63	11.01
T4	0.00	0.02	0.05	2.52	5.50	8.20	0.00	0.00	0.09	2.48	4.30	9.98	0.00	0.01	0.07	2.50	4.90	9.09
T5	0.00	0.02	0.10	3.20	8.60	11.40	0.00	0.10	0.24	7.38	12.18	13.78	0.00	0.06	0.17	5.29	10.39	12.59
T6	0.00	0.03	0.10	4.20	8.60	10.11	0.00	0.04	0.10	2.98	6.92	10.43	0.00	0.03	0.10	3.59	7.76	10.27
T7	0.00	0.00	0.04	2.20	4.80	9.10	0.00	0.00	0.06	1.68	3.38	8.20	0.00	0.00	0.05	1.94	4.09	8.65
T8	0.00	0.07	0.20	6.08	11.80	13.10	0.00	0.07	0.16	5.178	11.74	12.50	0.00	0.07	0.18	5.93	11.77	12.80
T9	0.00	0.03	0.10	4.10	7.20	10.20	0.00	0.01	0.08	2.32	6.18	9.5	0.00	0.02	0.09	3.21	6.69	9.89
T10	0.00	0.00	0.05	1.78	3.44	8.60	0.00	0.00	0.05	1.20	2.90	7.86	0.00	0.00	0.05	1.49	3.17	8.23
T11	0.00	0.08	0.20	6.56	12.85	14.03	0.00	0.06	0.20	5.80	11.89	13.85	0.00	0.07	0.20	6.18	12.37	13.94
T12	0.00	0.01	0.08	3.58	6.47	9.80	0.00	0.01	0.06	2.14	4.59	8.74	0.00	0.01	0.07	2.86	5.53	9.27
T13	0.00	0.05	0.12	3.96	8.70	11.45	0.00	0.03	0.10	3.10	7.10	9.53	0.00	0.04	0.11	3.53	7.90	10.49
T14	0.00	0.00	0.10	3.10	6.78	10.23	0.00	0.00	0.06	2.84	4.62	8.79	0.00	0.00	0.08	2.97	5.70	9.51
T15	0.00	6.12	13.21	-	-	-	0.00	5.00	11.85	-	-	-	0.00	5.56	12.53	-	-	-
S.E. ±	NS	0.08	0.01	0.04	0.09	0.11	NS	0.07	0.01	0.04	0.08	0.11	NS	0.22	050	0.04	0.17	0.86
C.D. @ 5%	NS	0.02	0.05	0.14	0.28	0.35	NS	0.021	0.05	0.12	0.27	0.35	NS	0.67	1.52	0.12	0.51	2.58

T_1 -1-MCP-100 ppb, T_2-1-MCP - 200 ppb, T_3-Putrescine – 1 mM, T_4- Paraffin wax, T_5-Chitosan - 1%, T_6-1-MCP -100 ppb + Putrescine – 1 mm, T_7-1-MCP –200 ppb + Paraffin wax, T_8-1-MCP – 100 ppb + Chitosan - 1%, T_9-1-MCP - 200 ppb + Putrescine – 1 mM, T_{10}-1-MCP - 200 ppb + Paraffin wax, T_{11}-1-MCP - 200 ppb + Chitosan -1%, T_{12}- Putrescine – 1 mM + Paraffin wax, T_{13}- Putrescine – 1 mM + Chitosan -1%, T_{14}-Paraffin wax + Chitosan - 1%,T_{15}-Control.

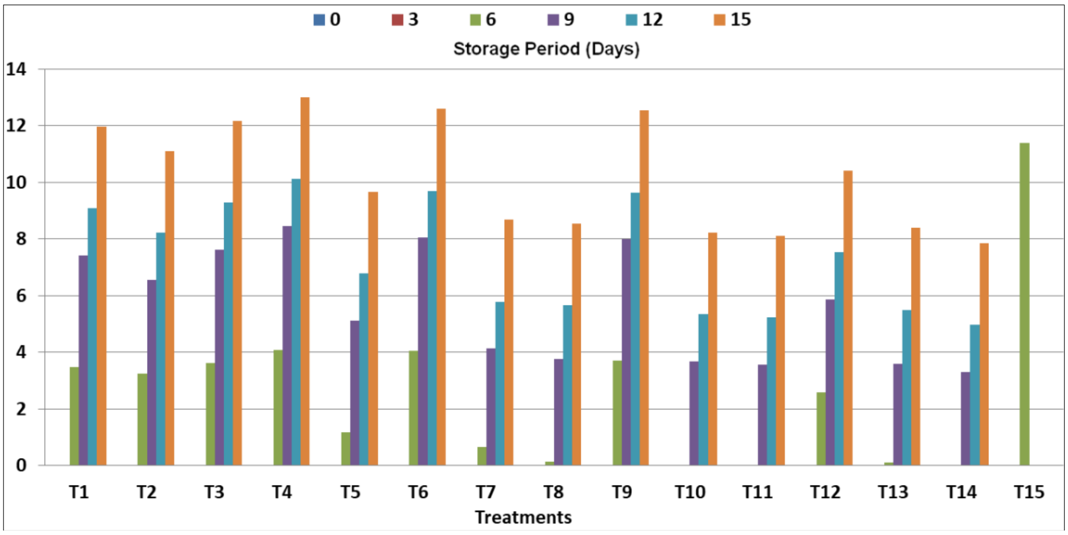

Fig 1: Effect of post Harvest treatments on physiological loss in weight (%) of custard apple fruit during storage.

Table 2: Effect of post harvest treatments on decaying percentage of custard apple fruit during storage.

Treatments	**Decay (%)**																	
	2014-2015						2015-2016						Mean Value					
	(Storage Days)						**(Storage Days)**						**(Storage Days)**					
	0	**3**	**6**	**9**	**12**	**15**	**0**	**3**	**6**	**9**	**12**	**15**	**0**	**3**	**6**	**9**	**12**	**15**
T1	0.00	0.00	3.93	8.30	10.00	13.10	0.00	0.00	2.99	6.52	8.14	10.82	0.00	0.00	3.46	7.41	9.07	11.96
T2	00.0	00.0	3.52	7.98	8.96	12.10	00.0	00.0	2.98	5.12	7.46	10.08	00.0	00.0	3.25	6.55	8.21	11.09
T3	0.00	0.00	4.10	8.14	10.32	13.10	0.00	0.00	3.16	7.10	8.24	11.24	0.00	0.00	3.63	7.62	9.28	12.17
T4	0.00	0.00	4.58	8.94	10.39	13.84	0.00	0.00	3.56	7.98	9.85	12.18	0.00	0.00	4.07	8.46	10.12	13.01
T5	0.00	0.00	1.29	5.46	7.15	10.12	0.00	0.00	1.05	4.78	6.39	9.20	0.00	0.00	1.17	5.12	6.77	9.66
T6	0.00	0.00	4.62	9.00	10.14	14.05	0.00	0.00	3.50	7.10	9.26	11.13	0.00	0.00	4.06	8.05	9.70	12.59
T7	0.00	0.00	0.87	4.41	6.44	9.13	0.00	0.00	0.45	3.85	5.12	8.21	0.00	0.00	0.66	4.13	5.78	8.67
T8	0.00	0.00	0.18	4.42	5.65	9.60	0.00	0.00	0.10	3.10	5.65	7.46	0.00	0.00	0.14	3.76	5.65	8.53
T9	0.00	0.00	4.40	9.84	11.05	13.61	0.00	0.00	3.00	6.12	8.23	11.45	0.00	0.00	3.70	7.98	9.64	12.53
T10	0.00	0.00	0.00	4.13	6.43	9.23	0.00	0.00	0.00	3.21	4.23	7.19	0.00	0.00	0.00	3.67	5.33	8.21
T11	0.00	0.00	0.00	4.18	6.46	9.12	0.00	0.00	0.00	2.94	3.98	7.10	0.00	0.00	0.00	3.56	5.22	8.11
T12	0.00	0.00	3.04	6.48	8.21	11.64	0.00	0.00	2.10	5.26	6.85	9.20	0.00	0.00	2.57	5.87	7.53	10.42
T13	0.00	0.00	0.12	4.12	6.00	9.56	0.00	0.00	0.10	3.08	5.00	7.22	0.00	0.00	0.11	3.60	5.50	8.39
T14	0.00	0.00	0.00	4.21	6.50	9.20	0.00	0.00	0.00	2.39	3.42	6.48	0.00	0.00	0.00	3.30	4.96	7.84
T15	0.00	0.00	12.57	-	-	-	0.00	0.00	10.23	-	-	-	0.00	0.00	11.40	-	-	-
S.E. ±	NS	NS	0.03	0.07	0.09	0.12	NS	NS	0.02	0.06	0.40	0.10	NS	NS	0.62	0.60	0.68	0.74
C.D. @ 5%	NS	NS	0.11	0.23	0.27	0.38	NS	NS	0.09	0.18	1.25	0.32	NS	NS	1.88	1.81	2.05	2.24

T_1 -1-MCP-100 ppb, T_2-1-MCP - 200 ppb, T_3-Putrescine – 1 mM, T_4- Paraffin wax, T_5-Chitosan - 1%, T_6-1-MCP -100 ppb + Putrescine – 1 mm, T_7-1-MCP –200 ppb + Paraffin wax, T_8-1-MCP – 100 ppb + Chitosan - 1%, T_9-1-MCP - 200 ppb + Putrescine – 1 mM, T_{10}-1-MCP - 200 ppb + Paraffin wax, T_{11}-1-MCP - 200 ppb + Chitosan -1%, T_{12}- Putrescine – 1 mM + Paraffin wax, T_{13}- Putrescine – 1 mM + Chitosan -1%, T_{14}-Paraffin wax + Chitosan - 1%,T_{15}-Control.

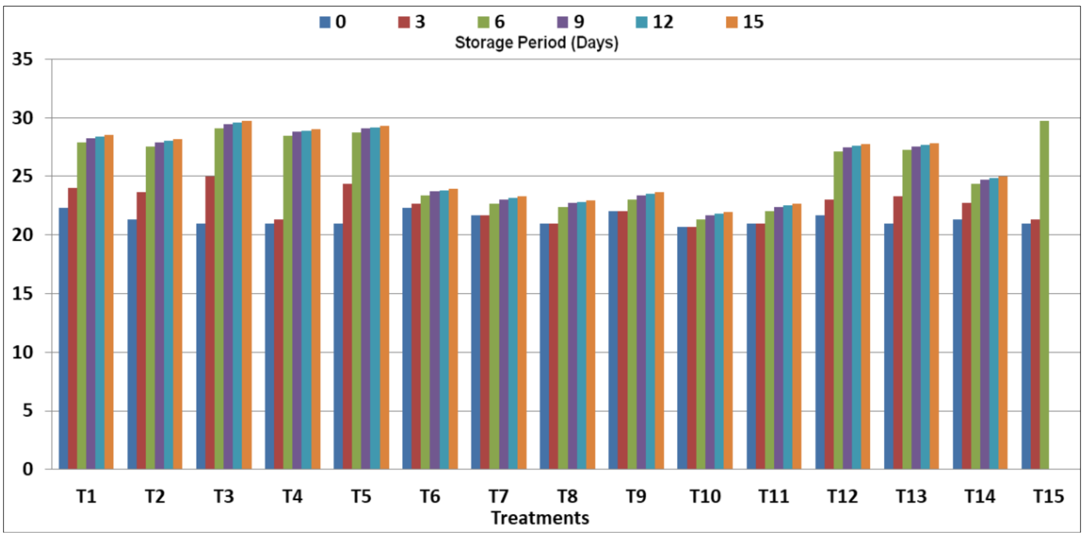

Fig 2: Effect of post Harvest treatments on decaying percentage of custard apple fruit during storage.

Table 3: Effect of post harvest treatments on shelf life (days) of custard apple fruit during storage.

Treatments	Shelf life (days)		
	2014-15	2015-16	Mean Value
T_1 -1-MCP-100 ppb	12.69	12.23	12.46
T_2-1-MCP - 200 ppb	12.25	12.11	12.18
T_3-Putrescine – 1 mM	11.95	11.65	11.80
T_4-Paraffin wax	11.45	11.09	11.27
T_5-Chitosan - 1%	10.11	9.99	10.05
T_6-1-MCP -100 ppb + Putrescine – 1 mM	13.57	13.25	13.41
T_7-1-MCP – 100 ppb + Paraffin wax	14.31	14.13	14.22
T_8-1-MCP – 100 ppb + Chitosan - 1%	15.25	15.05	15.15
T_9-1-MCP - 200 ppb + Putrescine – 1 mM	13.48	13.20	13.34
T_{10}-1-MCP - 200 ppb + Paraffin wax	13.89	13.75	13.82
T_{11}-1-MCP - 200 ppb + Chitosan -1%	14.89	14.77	14.83
T_{12}- Putrescine – 1 mM + Paraffin wax	12.88	12.16	12.52
T_{13}- Putrescine – 1 mM + Chitosan -1%	13.14	13.00	13.07
T_{14}-Paraffin wax + Chitosan - 1%	11.31	11.23	11.27
T_{15}-Control	4.82	4.38	4.60
S.E. ±	0.14	0.138	0.04
C.D. @ 5%	0.43	0.425	0.12

T_1 -1-MCP-100 ppb, T_2-1-MCP - 200 ppb, T_3-Putrescine – 1 mM, T_4- Paraffin wax, T_5-Chitosan - 1%, T_6-1-MCP -100 ppb + Putrescine – 1 mm, T_7-1-MCP –200 ppb + Paraffin wax, T_8-1-MCP – 100 ppb + Chitosan - 1%, T_9-1-MCP - 200 ppb + Putrescine – 1 mM, T_{10}-1-MCP - 200 ppb + Paraffin wax, T_{11}-1-MCP - 200 ppb + Chitosan -1%, T_{12}- Putrescine – 1 mM + Paraffin wax, T_{13}- Putrescine – 1 mM + Chitosan - 1%, T_{14}- Paraffin wax + Chitosan - 1%,T_{15}-Control.

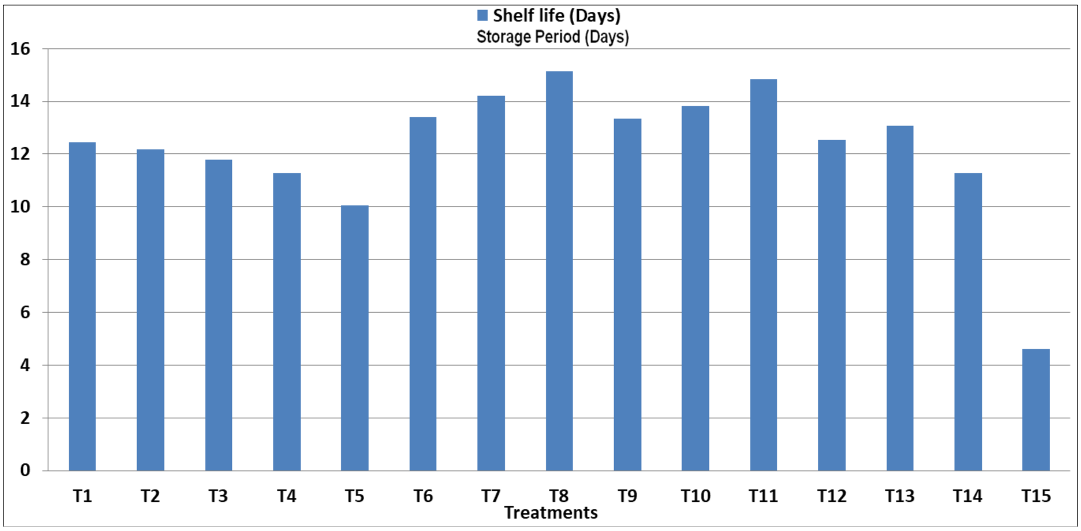

Fig 3: Effect of post Harvest treatments on ethylene evolution rate (ppm) of custard apple fruit during storage.

Conclusion

It is concluded that in custard apple the combined application of 1-Methylcyclopropene 200ppb and chitosan 1% as a post harvest tool may be integrated in to the supply chain management of custard apple fruit, to inhibit fruit ripening and extend shelf life and maintain quality of custard apple fruit during storage.

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