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## Effect of wax coating treatments on shelf-life, sensory evaluation and pathological parameters of custard apple (*Annona squamosa* L.)

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### Abstract

The present investigation was conducted at Horticulture Processing Laboratory, Department of fruit science, College Of Agriculture, Indira Gandhi Krishi Vishwavidyalaya Raipur during the year 2019-2020. The treatment consisted 10 different concentration of paraffin wax emulsion along with polythene wrap and KMnO<sub>4</sub> (0.1%) viz. T<sub>0</sub>: Control, T<sub>1</sub>: paraffin wax emulsion (8%), T<sub>2</sub>: paraffin wax emulsion (10%), T<sub>3</sub>: paraffin wax emulsion (12%), T<sub>4</sub>: paraffin wax emulsion (8%) + polythene wrap, T<sub>5</sub>: paraffin wax emulsion (10%) + polythene wrap, T<sub>6</sub>: paraffin wax emulsion (12%) + polythene wrap, T<sub>7</sub>: paraffin wax emulsion (8%) + polythene wrap + KMnO<sub>4</sub> (0.1%), T<sub>8</sub>: paraffin wax emulsion (10%) + polythene wrap + KMnO<sub>4</sub> (0.1%), T<sub>9</sub>: paraffin wax emulsion (12%) + polythene wrap + KMnO<sub>4</sub> (0.1%) during 2, 4, 6 and 8 days of storage. To study the effect of wax coating treatments on sensory and pathological effects of custard apple. The overall best result is observed by treatment T<sub>8</sub> in all the sensory and pathological effects were observed under the superiority of treatment 10% paraffin wax emulsion coated fruits with wrapping polythene and KMnO<sub>4</sub> (0.1%) during storage period.

**Keywords:** Wax coating treatments, pathological parameters, custard apple, *Annona squamosa* L.

### Introduction

Custard apple are climacteric and have a very short storage life because of their rapid maturation after harvest. The fruit is an excellent energy source as it is high in carbohydrate. Custard apple is one of the finest and highly perishable fruit. It has its delightful taste, flavour, moderate market price and a high nutritional status. It is eaten as a dessert fruit, custard like edible pulp although the fruit pulp may be mixed with milk to form a drink or made into an ice-creams.

Fruit coatings are one such alternative as they improve not only the external appearance, but also modify the internal fruits atmosphere. It is a comparatively newer post-harvest treatment technique for fruits and vegetables to improve shelf-life due to its simple advantages that has practically replaced old commercial post harvest methods. Use of coatings has gained importance in reducing the moisture loss and maintaining firmness (Patel *et al.*, 2011) [9]. Coatings make good oxygen and lipid barriers at low to intermediate relative humidity, because the polymers can effectively make hydrogen bonds.

### Materials and Methods

The present investigation was undertaken at Processing Laboratory, Department of Fruit Science, College of Agriculture Raipur during the year 2019-2020. It consisted of 10 treatments and 3 replication which carried out in a Complete Randomized Design. Each replication consisted of 12 fruits in each treatment and total number of fruits 360 for experiment.

### Results and Discussion

The sensory evaluation and pathological parameters of custard apple fruits were recorded for the following variables *i.e.* Appearance, Colour, Flavour, Taste, Texture and Incidence of pathogens/ moulds (%) are presented in table. After alternating day of storage, the fruit stored under various treatment were sensorially evaluated by a panel of 5 judges from college staff using a 9 point hedonic scale (Amerine *et al.* 1965) [11].

**Treatment Details**

S. No.	Treatments	Notations used
1.	Control	T <sub>0</sub>
2.	Paraffin wax emulsion 8%	T <sub>1</sub>
3.	Paraffin wax emulsion 10%	T <sub>2</sub>
4.	Paraffin wax emulsion 12%	T <sub>3</sub>
5.	Paraffin wax emulsion 8% + Polythene wrap	T <sub>4</sub>
6.	Paraffin wax emulsion 10% + Polythene wrap	T <sub>5</sub>
7.	Paraffin wax emulsion 12% + Polythene wrap	T <sub>6</sub>
8.	Paraffin wax emulsion 8% + Polythene wrap + KMnO <sub>4</sub> (0.1%)	T <sub>7</sub>
9.	Paraffin wax emulsion 10% + Polythene wrap + KMnO <sub>4</sub> (0.1%)	T <sub>8</sub>
10.	Paraffin wax emulsion 12% + Polythene wrap + KMnO <sub>4</sub> (0.1%)	T <sub>9</sub>

**1. Appearance**

The marks obtained from the panel of judges regarding appearance of fruit were significantly shown best in fruit coated with paraffin wax 10% with KMnO<sub>4</sub> wrapped with polythene (8.63, 9, 8.66, 7.33), The poor performance is shown by control (7.26, 7.45, 5, 3.5) which were uncoated fruit after 2, 4, 6, 8 days of storage.

**2. Colour**

All the treatment were maintain the external colour from dark green to light, yellow green colour till 4<sup>th</sup> day of storage. As the days of storage prolonged the fruit were reduces their external colour black except T<sub>8</sub> which is yellowish green compare to other treatments at par with T<sub>9</sub> and T<sub>7</sub> as they were yellowish green with few black spots. From white to creamy white internal colour is maintained by fruit coated with paraffin waxed with KMnO<sub>4</sub> wrapped with polythene at 2<sup>nd</sup> day to 6<sup>th</sup> day of storage while other treatments are maintained creamy white colour at 4<sup>th</sup> day of storage. Whereas control fruits are creamy white till 4<sup>th</sup> day of storage. It may have been attributed by delay of the senescence process, slower metabolic activity as well as enzymatic reaction which led to slower internal colour degradation.

**3. Taste**

Maximum marks are given to coated fruits rather than uncoated fruits of T<sub>8</sub> (9, 9, 8, 7.67) according to consumer's acceptability at 2,4,6 and 8 days of storage followed by T<sub>7</sub> and T<sub>9</sub> with (9, 8.66, 7.66, 5.66) and (9, 8, 7, 6.2) at same days of storage respectively. From the marks given by panel of judges were indicate that as the days of storage extend it decreases the taste of fruit this is because increase in total sugar solids in custard apple fruits. Similar results are revealed by Jawadagi *et al.* (2013) [5].

**4. Flavour**

Maximum score obtained in T<sub>8</sub> (9, 9.2, 8.34, 8) at 2, 4, 6, 8

days of storage followed by T<sub>9</sub> and T<sub>7</sub> with (9, 8.7, 8.16, 7) and (9, 8.66, 8.11, 6.65) at same days of storage respectively. However, T<sub>8</sub> score significantly higher score than other treatments and gives natural pleasant flavour. It may be due to delay in ripening which preserve the flavour for longer periods of time and release good flavour in certain fruits which have been coated with paraffin wax and wrapped with polythene. Minimum score obtained in uncoated fruits with 7, 6.67, 4.67, 1 as the days extended 2, 4, 6, 8 days of storage they gradually degraded their flavour.

**5. Texture**

A good texture is observed in T<sub>8</sub> & T<sub>9</sub> up to 6<sup>th</sup> day of storage with score of 9 and on 8<sup>th</sup> day of storage paraffin wax 10% with KMnO<sub>4</sub> wrapped with polythene retain its value whereas minimum score obtained by control in all the days of storage. Very strong and appropriate fruit texture has been found with extended storage on paraffin wax. Firmness under paraffin wax coated fruit was reasonable enough as fruit firmness is one of the most important variables in deciding the consistency of fruits after harvest. Fruit softening due to degradation of insoluble protopectine into soluble pectin or to cell disintegration leading to increased membrane permeability. Masalkar and Grande (2005) [6], Jawadagi *et al.* (2013) [5].

**6. Incidence of pathogens/ moulds on Custard apple**

It has been observed from the data that there was significantly effect of different treatments on the initial pathogen affect of the custard apple fruit. This shows that all the post- harvest treatment delay the development and growth of pathogens after 6 day of storage. And none of the fruits were affected by pathogens up to last day of storage in T<sub>7</sub>, T<sub>8</sub>, T<sub>9</sub>. Paraffin wax has sealed the opening on the fruit surface preventing pathogen occurrence there. Although untreated fruits (Control), CaCl<sub>2</sub> (1 and 2%) and KMnO<sub>4</sub> (0.01 and 0.05%) handled fruits at 6 days of storage were infected by pathogen.

**Table 1:** Effect of post-harvest treatments on appearance of custard apple

Notation	Treatments	Appearance			
		2	4	6	8
T <sub>0</sub>	Control	7.26	7.45	5	3.5
T <sub>1</sub>	Paraffin wax emulsion (8%)	7.67	8.25	5.67	4.50
T <sub>2</sub>	Paraffin wax emulsion (10%)	8.03	8.25	5.65	4.67
T <sub>3</sub>	Paraffin wax emulsion (12%)	8.33	8.5	6.01	5.53
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	8	8.55	7.25	5.65
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	7.99	8.35	7.6	6.5
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	8.5	8.5	7.75	6.33
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	8.5	9	8.44	7.15
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	8.63	9	8.66	7.33
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	8.5	9	8.5	7.28
	SEm±	0.10	0.28	0.32	0.34
	CD at 5%	0.31	0.85	0.97	1.01

**Table 2:** Effects of post-harvest treatment on external colour of custard apple

Notation	Treatments	External Colour			
		2	4	6	8
T <sub>0</sub>	Control	YG	YG	BG	B
T <sub>1</sub>	Paraffin wax emulsion (8%)	LG	YG	BG	B
T <sub>2</sub>	Paraffin wax emulsion (10%)	LG	YG	BG	B
T <sub>3</sub>	Paraffin wax emulsion (12%)	LG	YG	BG	B
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	DG	YG	BG	B
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	DG	LG	YG	B
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	DG	LG	YG	B
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	DG	LG	YG	YBG
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	DG	LG	YG	YG
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	DG	LG	YG	YBG

DG= DARK GREEN LG= LIGHT GREEN YG= YELLOWISH GREEN YBG=YELLOWISH GREEN WITH BLACK SPOT BG= BLAKISH GREEN

**Table 3:** Effects of post-harvest treatments on Internal Colour of Custard apple

Notation	Treatments	Internal Colour			
		2	4	6	8
T <sub>0</sub>	Control	W	CW	DW	BW
T <sub>1</sub>	Paraffin wax emulsion (8%)	W	CW	DW	BW
T <sub>2</sub>	Paraffin wax emulsion (10%)	W	CW	DW	BW
T <sub>3</sub>	Paraffin wax emulsion (12%)	W	CW	DW	BW
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	W	CW	DW	DW
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	W	CW	DW	DW
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	W	CW	DW	DW
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	W	CW	CW	DW
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	W	CW	CW	DCW
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	W	CW	CW	DCW

W = WHITE CW= CREAMY WHITE DCW= DULL CREAMY WHITE BW=BLAKISH WHITE

**Table 4:** Effects of post-harvest treatments on Taste of custard apple

Notation	Treatments	Taste			
		2	4	6	8
T <sub>0</sub>	Control	8	5.58	2.63	1
T <sub>1</sub>	Paraffin wax emulsion (8%)	8	7	4.66	1
T <sub>2</sub>	Paraffin wax emulsion (10%)	8	7	5	2
T <sub>3</sub>	Paraffin wax emulsion (12%)	8.33	7.33	5.35	2.33
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	8.33	7.67	6	3.66
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	8.67	7.67	6	3.67
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	9	8.33	6.33	5.67
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	9	8.66	7.66	5.66
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	9	9	8	7.67
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	9	8	7	6
	SEm±	0.18	0.23	0.36	0.27
	CD at 5%	0.53	0.69	1.08	0.81

**Table 5:** Effects of post-harvest treatments on Flavour of custard apple

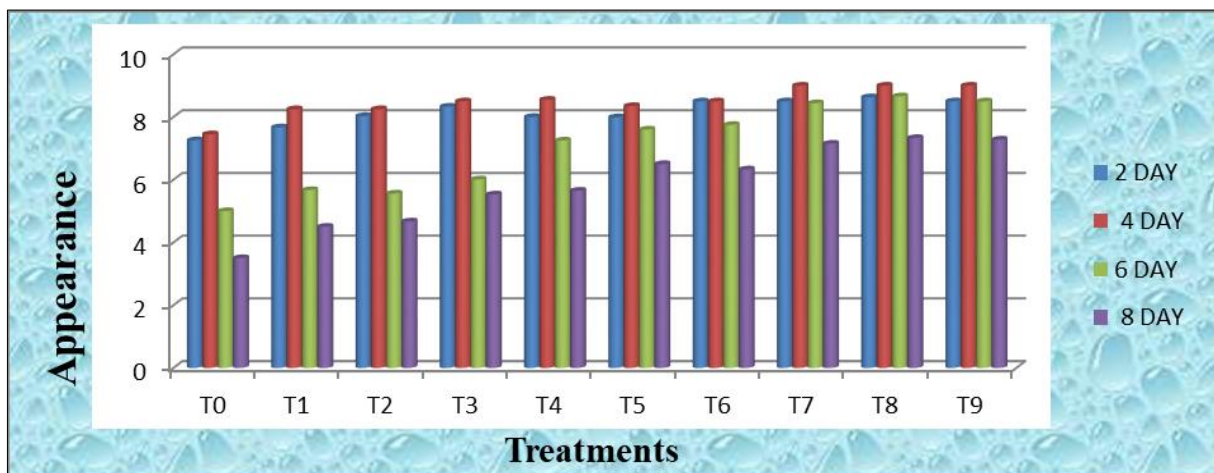
Notation	Treatments	Flavour			
		2	4	6	8
T <sub>0</sub>	Control	7	6.67	4.67	1
T <sub>1</sub>	Paraffin wax emulsion (8%)	7.67	7.33	5	2
T <sub>2</sub>	Paraffin wax emulsion (10%)	7.67	7.34	6	2.65
T <sub>3</sub>	Paraffin wax emulsion (12%)	8	7.67	6.33	3
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	8	7.67	7.33	4.66
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	8.67	8.33	7.33	5.33
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	8	8.33	7.67	6
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	9	8.66	8.11	6.65
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	9	9.2	8.34	8
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	9	8.7	8.16	7
	SEm±	0.11	0.23	0.38	0.31
	CD at 5%	0.33	0.70	1.14	0.94

**Table 6:** Effects of post-harvest treatment on Texture of custard apple

Notation	Treatments	Texture			
		2	4	6	8
T <sub>0</sub>	Control	7.33	5.67	3.67	1.67
T <sub>1</sub>	Paraffin wax emulsion (8%)	8	7.67	5.33	3
T <sub>2</sub>	Paraffin wax emulsion (10%)	8.33	7.67	5.67	3.67
T <sub>3</sub>	Paraffin wax emulsion (12%)	8.33	8	6	4.67
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	8.67	8.33	6.33	5
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	8.67	8.33	7	6.33
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	8.66	8.67	7	6
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	9	9	8.67	7
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	9	9	9	8
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	9	9	9	7.67
	SEm±	0.05	0.18	0.25	0.36
	CD at 5%	0.15	0.54	0.76	1.08

**Table 7:** Effects of post-harvest treatments on incidence of pathogen (%) on custard apple

Notation	Treatments	Percentage of fruits affected by pathogens/moulds (%)			
		2	4	6	8
T <sub>0</sub>	Control	0	0	16.33	33.33
T <sub>1</sub>	Paraffin wax emulsion (8%)	0	0	8.33	25.00
T <sub>2</sub>	Paraffin wax emulsion (10%)	0	0	0	8.33
T <sub>3</sub>	Paraffin wax emulsion (12%)	0	0	0	16.33
T <sub>4</sub>	Paraffin wax emulsion (8%) + polythene	0	0	8.33	16.33
T <sub>5</sub>	Paraffin wax emulsion (10%) + polythene	0	0	0	8.33
T <sub>6</sub>	Paraffin wax emulsion (12%) + polythene	0	0	0	8.33
T <sub>7</sub>	Paraffin wax emulsion (8%) + polythene + KMnO <sub>4</sub> (0.01%)	0	0	0	0
T <sub>8</sub>	Paraffin wax emulsion (10%) + polythene + KMnO <sub>4</sub> (0.01%)	0	0	0	0
T <sub>9</sub>	Paraffin wax emulsion (12%) + polythene + KMnO <sub>4</sub> (0.01%)	0	0	0	0



**Fig 1:** Effects of post-harvest treatments on Appearance of custard apple



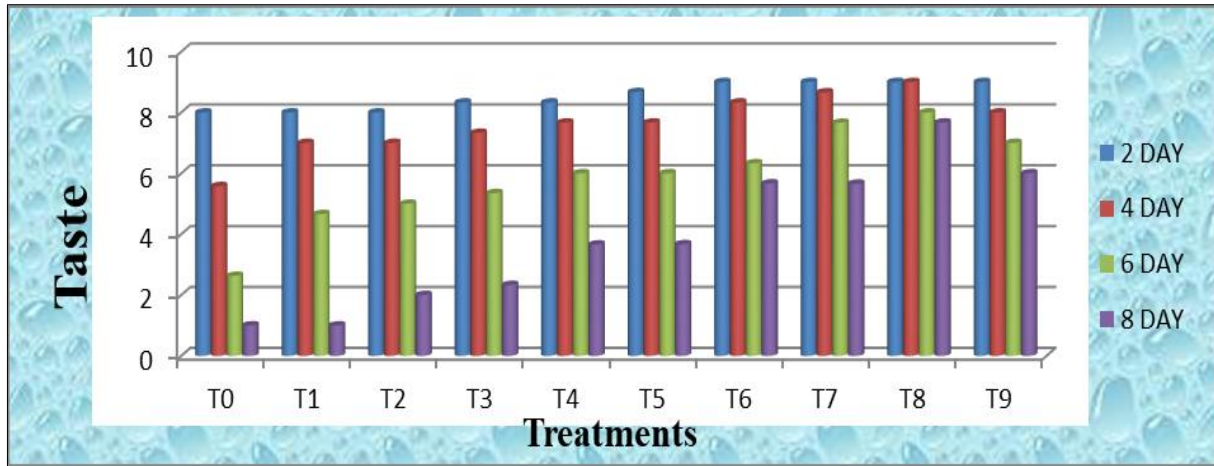


Fig 2: Effects of post-harvest treatments on Taste of custard apple

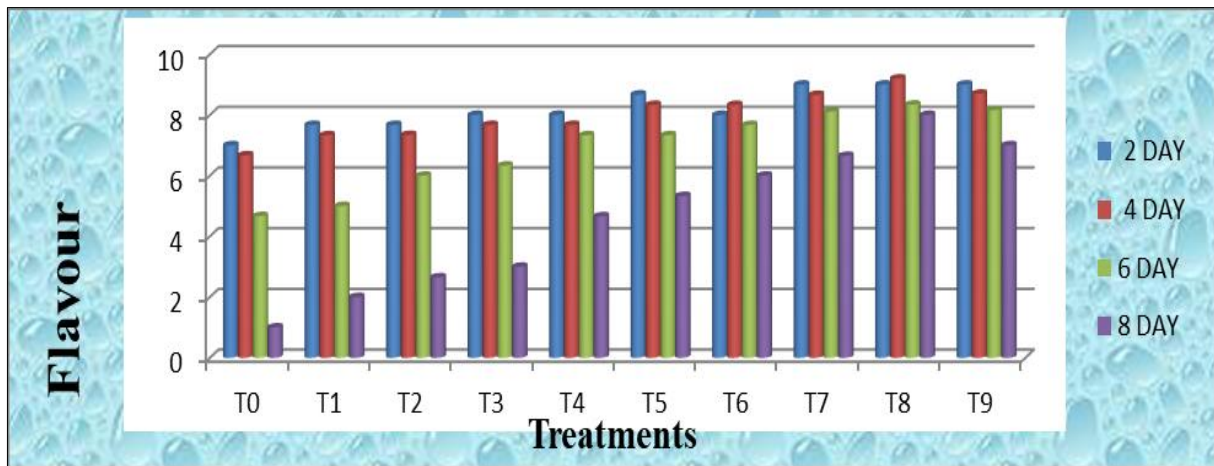


Fig 3: Effects of post-harvest treatments on Flavour of custard apple

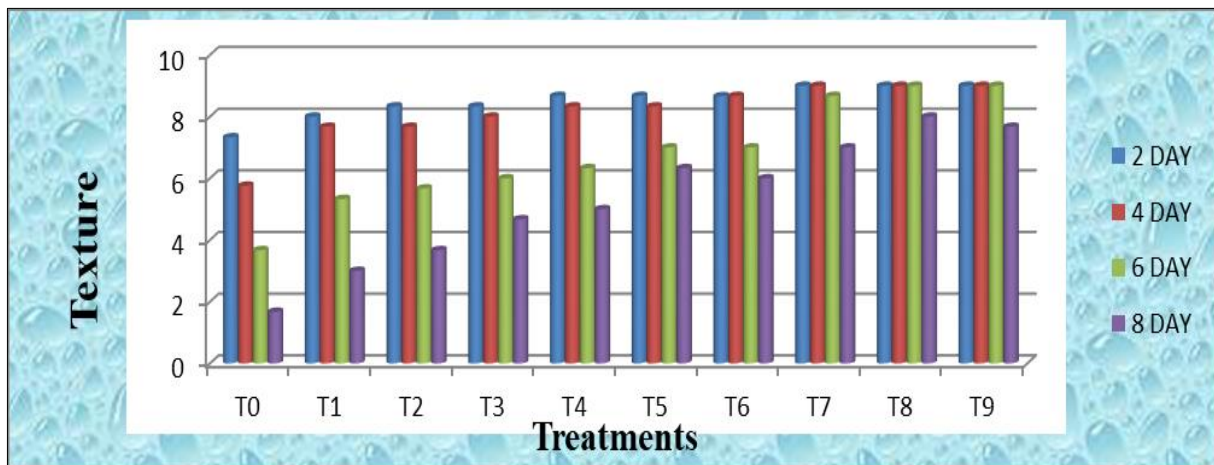


Fig 4: Effects of post-harvest treatments on Texture of custard apple

**Conclusion**

The present investigation entitled “effect of wax coating treatments on shelf-life and sensory evaluation and pathological parameters of custard apple (*Annona squamosa* L.)” The paraffin wax (10%) with KMnO<sub>4</sub> (0.01%) and polythene wrapping delay ripening process and extending shelf life and increases the market demand. The overall sensory parameters are higher in paraffin wax (10%) with KMnO<sub>4</sub> (0.01%) and polythene wrapping which are superior in quality and storage ability of custard apple up to 8 days. In the event of a microbial population appearing on the fruit surface it was observed early emergence in untreated fruits

with pathogens up to 6<sup>th</sup> day of storage whereas paraffin wax (10%) with KMnO<sub>4</sub> (0.01%) and polythene wrapping were unaffected by pathogens after 8 days of storage.

**Suggestions for future work**

The result of this analysis gives several recommendations based on which line of research should be followed up further:

- Custard apple can be further analysed under various agro-climatic conditions stable yield and quality condition.

- Experiment can be achieved by packaging of custard apple with different cladding materials with thickness of LDPE containers.
  - Experiment can be achieved by using changed custard apple fruit in modified atmospheric packaging with inert gases such as CO<sub>2</sub>.
  - Relatable findings, on the effect of chemicals from anti-ethylene, packaging products, vapours preservation and modified atmosphere storage should be performed with these combination to determine their economic effectiveness and standardized fruit shelf-life techniques.
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