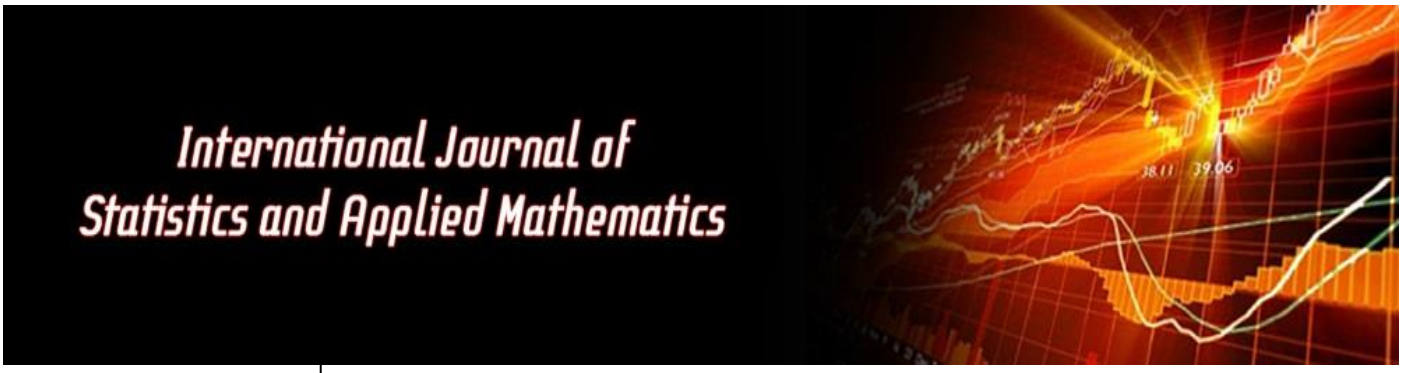
International Journal of Statistics and Applied Mathematics 2023; SP-8(6): 490-496



ISSN: 2456-1452
Maths 2023; SP-8(6): 490-496

https://www.mathsjournal.com
Received: 04-09-2023
Accepted: 05-10-2023

Asnath Prerna Minz
Guest Teacher, CHRS, Kotba, MGUVV, Durg, Chhattisgarh, India

Varsha Minz
Ph.D. Scholar, Department of Fruit Science, IGKV, Raipur, Chhattisgarh, India

Aditya Gaurha
Ph.D. Scholar, Department of Fruit Science, IGKV, Raipur, Chhattisgarh, India

Ashish
M.Sc. department of fruit Science, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Asnath Prerna Minz
Guest Teacher, CHRS, Kotba, MGUVV, Durg, Chhattisgarh, India

Effect of wax coating treatments on shelf-life and chemical composition of custard apple (*Annona squamosa* L.)

Asnath Prerna Minz, Varsha Minz, Aditya Gaurha and Ashish

Abstract
The present investigation was conducted at Horticulture Processing Laboratory in the 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 $KMnO_4$ (0.1%) *viz.* T_0: Control, T_1: Paraffin wax emulsion (8%), T_2: paraffin wax emulsion (10%), T_3: paraffin wax emulsion (12%), T_4: Paraffin wax emulsion (8%) + Polythene wrap, T_5: Paraffin wax emulsion (10%) + Polythene wrap, T_6: Paraffin wax emulsion (12%) + Polythene wrap, T_7: Paraffin wax emulsion (8%) + Polythene wrap + $KMnO_4$ (0.1%), T_8: Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%), T_9: Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%) during 2, 4, 6 and 8 days of storage. The overall best result is observed by treatment T_8 in all the chemical parameters were observed under the superiority of treatment 10% paraffin wax emulsion coated fruits with wrapping polythene and $KMnO_4$ (0.1%) during storage period.

Keywords: $KMnO_4$ and chemical parameter, paraffin wax emulsion, polythene wrap

1. Introduction
Custard apple (*Annona squamosa* L.) is one of the finest Tropical American fruit gifts to India. It is well recognised in India, Australia, California, Brazil and Mexico as fruit. Mostly a sub-tropical fruit has established in Andhra Pradesh with a tropical climate. In India, it is also known as 'Sweet sop' or Sugar apple. Custard apple is the "fruit of poor people". Custard apple are climacteric and have a very short storage life because of that a rapid maturation after harvest. All annonaceous fruits are indigenous to Tropical America where spread to different parts of the world. Fruits are heart shaped, fleshly syncarp formed by the fusion of the pistils and receptacle, pericarp is the edible part.

2. Materials and Methods
The present investigation was undertaken at Processing Laboratory, Department of Fruit Science, and 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.

Treatment Details

S. No.	Treatments	Notations used
1.	Control	T_0
2.	Paraffin wax emulsion 8%	T_1
3.	Paraffin wax emulsion 10%	T_2
4.	Paraffin wax emulsion 12%	T_3
5.	Paraffin wax emulsion 8% + Polythene wrap	T_4
6.	Paraffin wax emulsion 10% + Polythene wrap	T_5
7.	Paraffin wax emulsion 12% + Polythene wrap	T_6
8.	Paraffin wax emulsion 8% + Polythene wrap + $KMnO_4$ (0.1%)	T_7
9.	Paraffin wax emulsion 10% + Polythene wrap + $KMnO_4$ (0.1%)	T_8
10.	Paraffin wax emulsion 12% + Polythene wrap + $KMnO_4$ (0.1%)	T_9

3. Results and Discussion

The chemical parameters of custard apple fruits were recorded for the following variables *i.e.* TSS, pH, acidity, ascorbic acid, reducing sugar, non-reducing sugar and total sugar are presented in table.

3.1 Total soluble solids (%)

The treatment T_8 (paraffin wax emulsion 10% + $KMnO_4$ (0.1%) + polythene wrapped) recorded maximum total soluble solids contents (31.2, 33.47, 35.16, 38.33%) followed by Treatment T_9 and T_7. However, the treatments T_2 & T_3 and T_3 & T_4 having the respective total soluble solid 32.34 & 33.25 and 33.25 & 33.91 were recorded non-significant differences with each other at 8th day of storage.

Table 1: Effects of post-harvest treatments on total soluble solids of custard apple during storage periods

Total Soluble Solid (%)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	21.15	23.50	25.00	26.93
T_1	Paraffin wax emulsion (8%)	23.05	24.75	25.83	28.96
T_2	Paraffin wax emulsion (10%)	26.83	28.11	29.83	32.34
T_3	Paraffin wax emulsion (12%)	27.16	29.33	30.33	33.25
T_4	Paraffin wax emulsion (8%) + polythene wrap	28.16	29.81	32.28	33.91
T_5	Paraffin wax emulsion (10%) + polythene wrap	28.33	30.85	32.85	35.15
T_6	Paraffin wax emulsion (12%) + polythene wrap	27.33	29.13	31.39	33.02
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	29.33	32.45	34.25	35.72
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	31.20	33.47	35.16	38.33
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	30.20	32.07	34.09	37.06
	SEM±	0.25	0.27	0.30	0.41
	CD at 5%	0.76	0.82	0.89	1.21

3.2 pH

The data recorded on pH of custard apple fruit seems to be affected by various post-harvest treatments are presented. It is revealed from the data that pH value, of custard apple during storage period was not much significantly influenced with each other at 5% level of significance. The maximum pH values of custard apple was recorded under the treatment T_8 followed by the treatment T_9 & T_7 having respective.

Table 2: Effects of post-harvest treatments on pH of custard apple fruit during storage

pH					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	5.16	5.13	4.99	4.50
T_1	Paraffin wax emulsion (8%)	5.22	5.21	5.03	4.74
T_2	Paraffin wax emulsion (10%)	5.21	5.20	5.06	4.82
T_3	Paraffin wax emulsion (12%)	5.23	5.20	5.08	4.93
T_4	Paraffin wax emulsion (8%) + polythene wrap	5.28	5.26	5.12	5.06
T_5	Paraffin wax emulsion (10%) + polythene wrap	5.30	5.29	5.13	5.09
T_6	Paraffin wax emulsion (12%) + polythene wrap	5.26	5.24	5.16	5.10
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	5.34	5.33	5.20	5.14
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	5.37	5.35	5.26	5.22
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	5.32	5.31	5.20	5.17
	SEM±	0.008	0.008	0.001	0.02
	CD at 5%	0.02	0.02	0.03	0.04

3.3 Titrable Acidity (%)

During the storage period the acidity of custard apple fruit reduced under all treatments during 8 days of storage. In the present study decrease in acidity could be explained with the fact that organic acid might be utilized rapidly in respiration or conversion of organic acid into sugar from pre- climacteric to post-climacteric stages. Acidity per cent and storage periods followed a linear decline trend on account of conversion of organic acids into sugar. The minimum acidity (0.28, 0.25, 0.22, 0.19%) was recorded under the treatment paraffin wax emulsion (10%) + $KMnO_4$ (0.1%) + polythene wrap) followed by the treatment T_9 and T_7.

Table 3: Effect of post-harvest treatments on terrible acidity (%) of custard apple fruit during storage

Acidity (%)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	0.47	0.43	0.39	0.35
T_1	Paraffin wax emulsion (8%)	0.37	0.34	0.30	0.28
T_2	Paraffin wax emulsion (10%)	0.35	0.31	0.29	0.27
T_3	Paraffin wax emulsion (12%)	0.34	0.32	0.30	0.27
T_4	Paraffin wax emulsion (8%) + polythene wrap	0.33	0.31	0.28	0.26
T_5	Paraffin wax emulsion (10%) + polythene wrap	0.34	0.30	0.26	0.24
T_6	Paraffin wax emulsion (12%) + polythene wrap	0.32	0.31	0.28	0.24
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	0.31	0.30	0.27	0.23
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	0.28	0.25	0.22	0.19
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	0.31	0.28	0.27	0.22
	SEM±	0.007	0.01	0.02	0.02
	CD at 5%	0.02	0.04	0.08	0.09

3.4 Ascorbic Acid (mg/100g pulp)

The decrease in ascorbic acid and content on prolonged storage might be mainly due to oxidation phenomenon. The superiority of treatment T_8 (paraffin wax emulsion (10%) + $KMnO_4$ (0.1%) + polythene wrap) recorded maximum ascorbic acid content (45.06, 44.09, 38.38, 36.75 mg /100g pulp) which was followed by the treatment T_9 and T_7.

Table 4: Effect of post-harvest treatments on ascorbic acid (mg/100g pulp) of custard apple fruit during storage

Ascorbic acid (mg/100g pulp)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	35.73	33.34	27.07	18.41
T_1	Paraffin wax emulsion (8%)	37.46	35.4	30.27	20.13
T_2	Paraffin wax emulsion (10%)	38.73	36.46	32.19	22.39
T_3	Paraffin wax emulsion (12%)	40.68	39.25	33.34	24.63
T_4	Paraffin wax emulsion (8%) + polythene wrap	41.27	37.64	34.14	26.19
T_5	Paraffin wax emulsion (10%) + polythene wrap	41.58	38.34	34.86	27.80
T_6	Paraffin wax emulsion (12%) + polythene wrap	42.12	40.27	34.97	31.72
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	43.60	41.38	36.57	34.22
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	45.06	44.09	38.38	36.75
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	42.35	40.47	35.25	33.44
	SEM±	0.10	0.16	0.38	0.36
	CD at 5%	0.30	0.49	1.15	1.07

3.5 Total sugar (%)

As per the data is concerned, the maximum total sugar content (27.14, 29.41, 30.88, 24.90%) was recorded under superiority of treatments T_8 at 2, 4, 6 & 8 days of storage period, respectively. The treatment T_8 paraffin wax emulsion (10%) + $KMnO_4$ (0.1%) + polythene wrap) proved to be significant among all other treatments followed by treatment T_9 and T_7 having respective total sugar contents 25.24, 26.24, 27.28 & 23.15% and 23.79, 25.85, 27.57 & 23.15% at present investigation.

The total sugar per cent of fruit showed an increasing trend up to 6 days of storage and thereafter declined on 8th days of storage period. Increase in total sugar might be due to partial hydrolysis of complex carbohydrate.

Table 5: Effect of post-harvest treatments on total sugar (%) of custard apple fruit during storage

Total Sugar (%)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	15.74	18.21	20.49	17.67
T_1	Paraffin wax emulsion (8%)	18.91	20.05	21.72	18.25
T_2	Paraffin wax emulsion (10%)	20.95	22.45	23.38	19.21
T_3	Paraffin wax emulsion (12%)	22.81	23.30	23.82	20.56
T_4	Paraffin wax emulsion (8%)+ polythene wrap	22.50	23.8	24.82	21.18
T_5	Paraffin wax emulsion (10%)+ polythene wrap	23.61	24.63	25.51	21.18
T_6	Paraffin wax emulsion (12%)+ polythene wrap	23.63	25.38	26.47	21.66
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KmnO_4$ (0.1%)	23.79	25.85	27.57	23.15
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KmnO_4$ (0.1%)	27.14	29.41	30.88	24.9
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KmnO_4$ (0.1%)	25.24	26.24	27.28	23.15
	SEM±	0.06	0.13	0.14	0.19
	CD at 5%	0.20	0.41	0.42	0.58

3.6 Reducing sugar (%)

The effect of paraffin wax emulsion along with $KmnO_4$ & polythene wrap on reducing sugar content of custard apple at ambient temperature are in treatment T_8 paraffin wax emulsion (10%) + $KmnO_4$ (0.1%) + polythene wrap recorded maximum reducing sugar per cent (21.14, 22.22, 23.64,

13.86%) followed by treatment T_9 and T_7 having respective reducing sugar percentage of 19.69, 20.48, 21.39 & 12.53% and 18.07, 19.58, 21.15 12.23% at 2, 4, 6 & 8 days of storage period under present experiment.

Table 6: Effect of post-harvest treatments on reducing sugar (%) of custard apple fruit during storage

Reducing Sugar (%)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	12.50	14.66	16.34	10.62
T_1	Paraffin wax emulsion (8%)	14.63	15.58	17.03	10.72
T_2	Paraffin wax emulsion (10%)	16.39	17.89	18.25	10.67
T_3	Paraffin wax emulsion (12%)	17.05	18.12	18.43	11.24
T_4	Paraffin wax emulsion (8%) + polythene wrap	17.12	18.22	18.74	11.51
T_5	Paraffin wax emulsion (10%) + polythene wrap	17.62	18.48	19.28	11.45
T_6	Paraffin wax emulsion (12%) + polythene wrap	17.65	18.88	19.69	11.71
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	18.07	19.58	21.15	12.23
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	21.14	22.22	23.64	13.86
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	19.69	20.48	21.39	12.53
	SEM±	0.02	0.07	0.18	0.13
	CD at 5%	0.09	0.22	0.54	0.38

3.7 Non-Reducing sugar (%)

The maximum non-reducing sugar content of custard apple fruit (6.02, 7.3, 7.24 & 11.04%) was noticed under the superiority of treatment T_8 paraffin wax emulsion (10%)+ $KMnO_4$ (0.1%) + polythene wrap, the minimum non-reducing sugar (3.24, 3.55, 4.15 & 7.05%) was observed under control. The storage period affects non-reducing sugars of custard apple as in uncoated fruits shows minimum content of sugar (3.24%) on 2nd day of storage, while it increases moderately (7.05%) on 8th day of storage period. Among all the treatments, the treatment T_8 was found superior in respect to non-reducing sugar content in custard apple fruit. The increment of non-reducing sugar might be due to conversion of polysaccharides to monosaccharide's on increasing level of non-reducing sugar.

Table 7: Effects of post-harvest treatments on non-reducing sugar (%) of custard apple fruit during storage

Non-reducing Sugar (%)					
Notations	**Treatments**	**Storage days**			
		2	**4**	**6**	**8**
T_0	Control	3.24	3.55	4.15	7.05
T_1	Paraffin wax emulsion (8%)	4.28	4.47	4.69	7.53
T_2	Paraffin wax emulsion (10%)	4.66	4.56	5.13	8.54
T_3	Paraffin wax emulsion (12%)	5.13	5.18	5.39	9.32
T_4	Paraffin wax emulsion (8%) + polythene wrap	5.38	5.58	6.08	9.67
T_5	Paraffin wax emulsion (10%) + polythene wrap	5.99	6.15	6.23	9.73
T_6	Paraffin wax emulsion (12%) + polythene wrap	5.98	6.50	6.78	9.95
T_7	Paraffin wax emulsion (8%) + polythene wrap + $KMnO_4$ (0.1%)	5.72	6.27	6.42	10.91
T_8	Paraffin wax emulsion (10%) + polythene wrap + $KMnO_4$ (0.1%)	6.02	7.30	7.24	11.04
T_9	Paraffin wax emulsion (12%) + polythene wrap + $KMnO_4$ (0.1%)	5.55	5.76	5.89	10.98
	SEM±	0.05	0.12	0.08	0.12
	CD at 5%	0.15	0.37	0.23	0.36

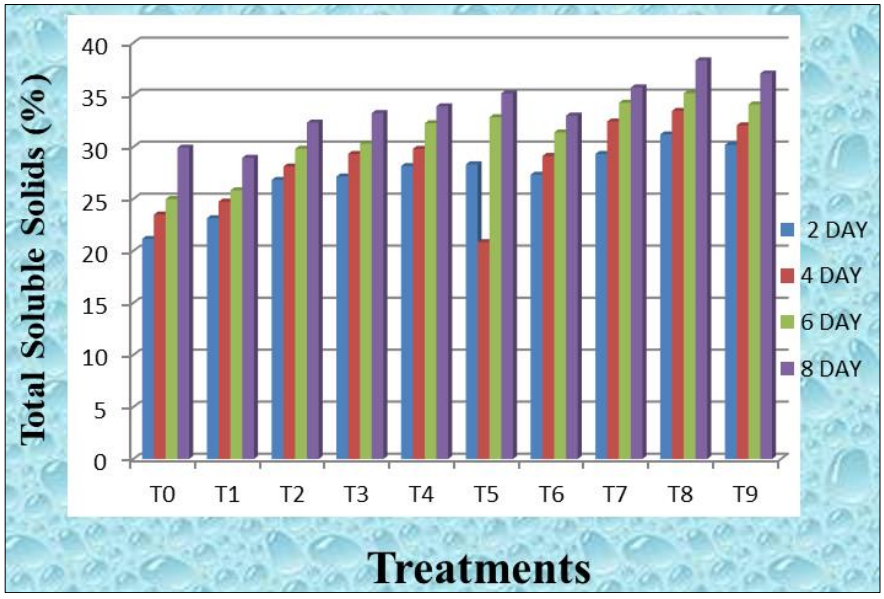


Fig 1: Effects of post-harvest treatment on total soluble solids (%) of custard apple

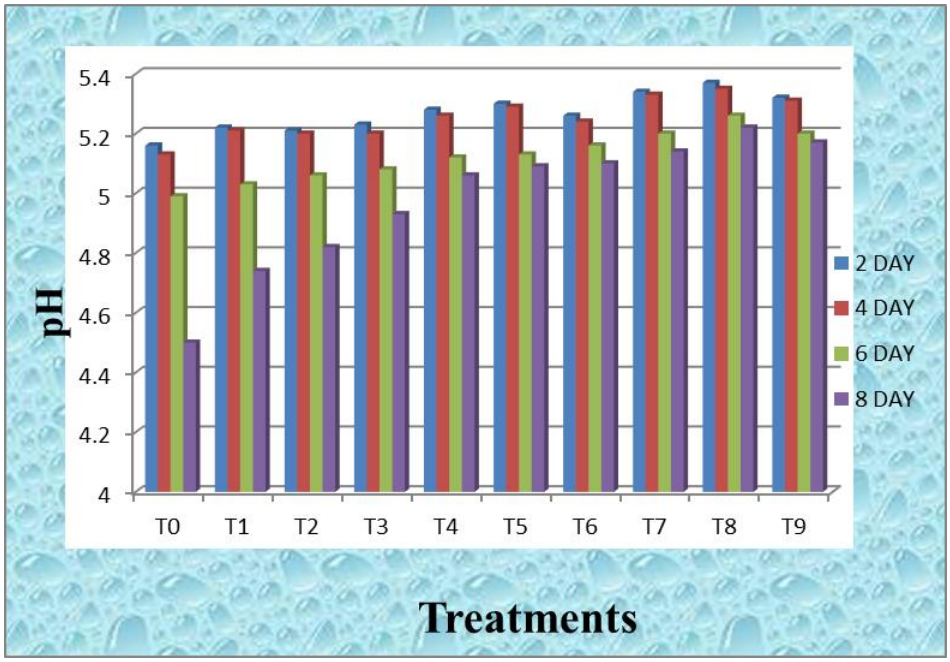


Fig 2: Effects of post-harvest treatment on pH of custard apple

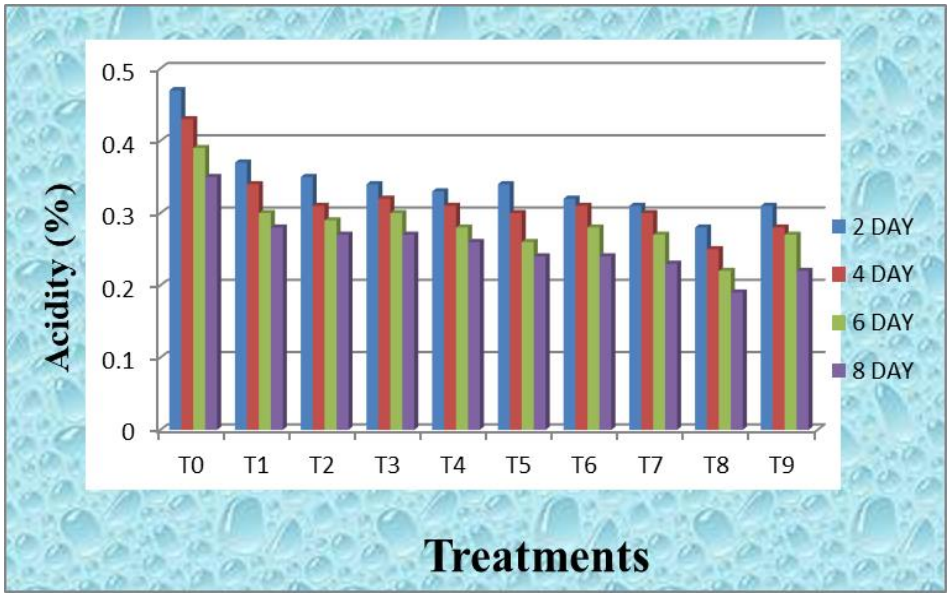


Fig 3: Effects of post-harvest treatment on acidity (%) of custard apple

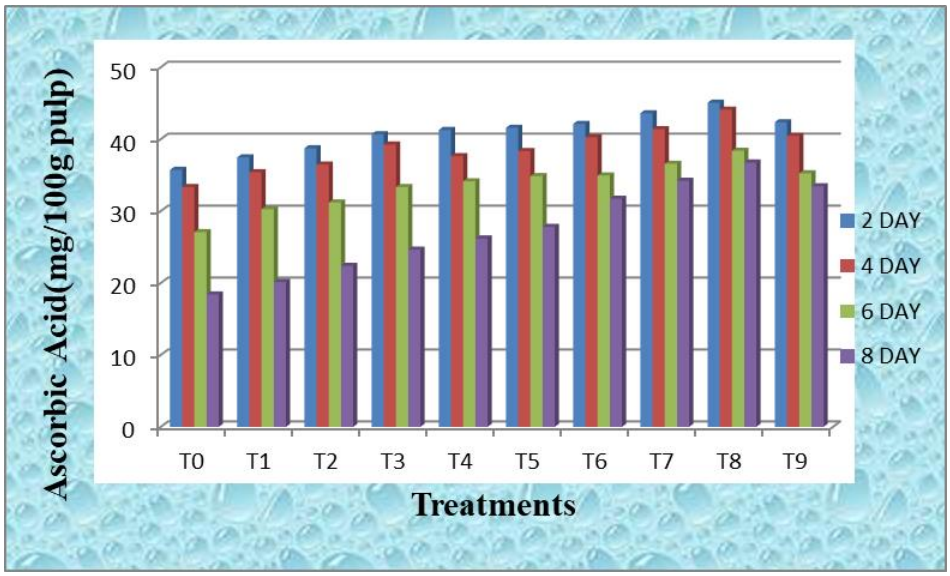


Fig 4: Ascorbic Acid (mg/100g pulp) as influenced by different post-harvest treatment during storage in custard apple

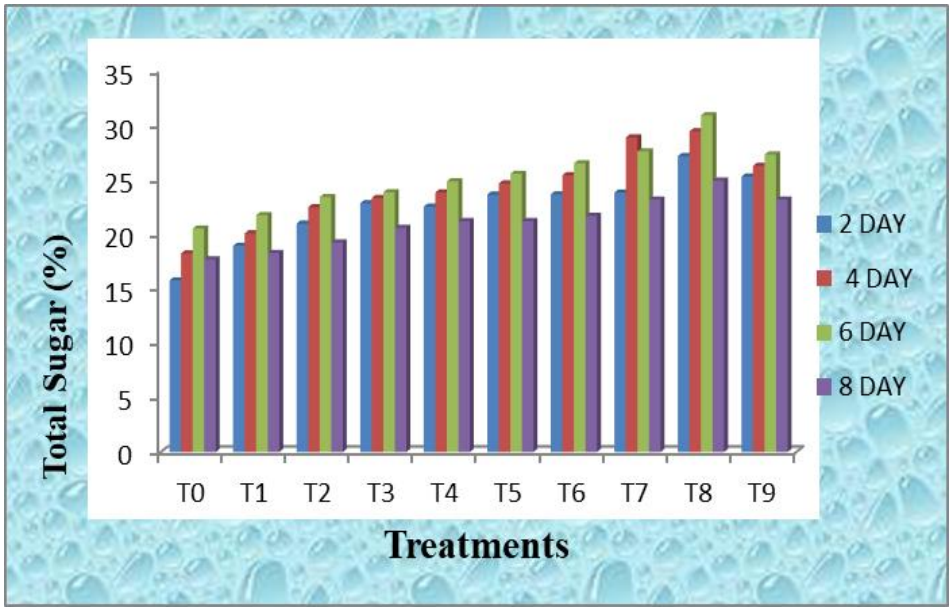


Fig 5: Effects of post-harvest treatment on total sugar (%) of custard apple

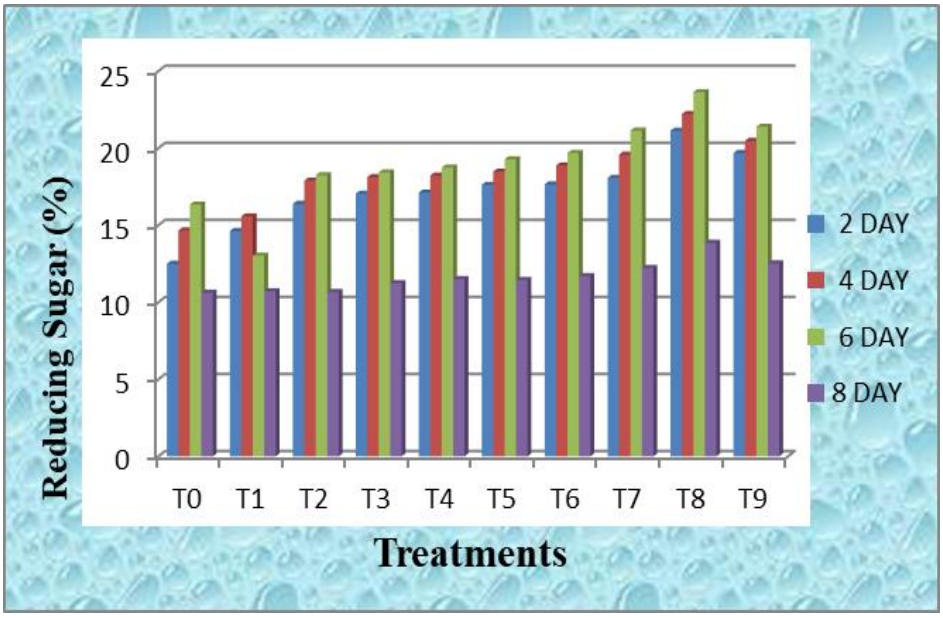


Fig 6: Effects of post-harvest treatment on reducing sugar (%) of custard apple

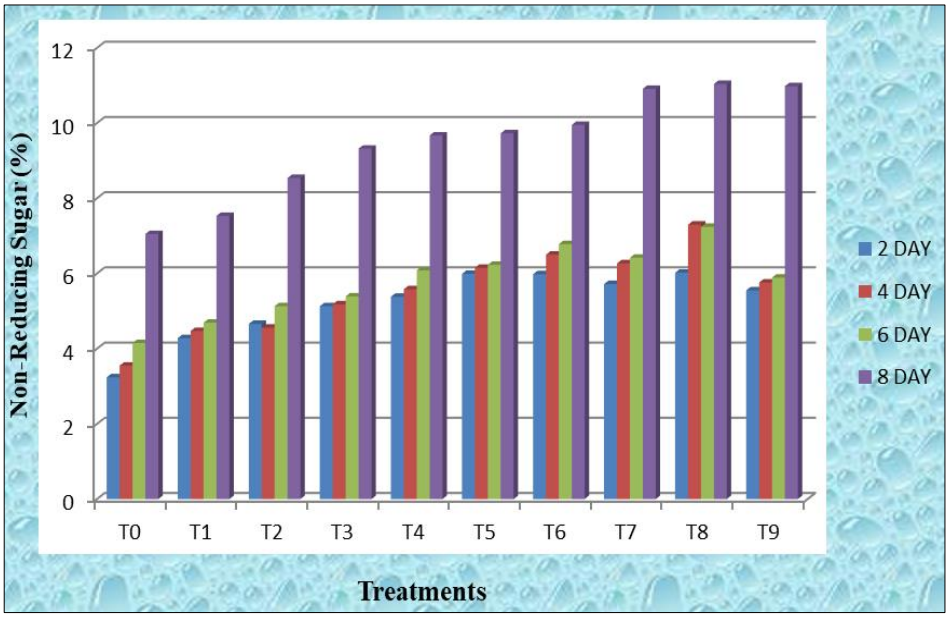


Fig 7: Effects of post-harvest treatment on non-reducing sugar (%) of custard apple

4. Conclusion

Paraffin wax emulsion (10%) + $KMnO_4$ (0.1%) + polythene wrap was found superior among all other post-harvest treatments. The paraffin wax emulsion (10%) along with $KMnO_4$ (0.1%) and polythene wrapping was found effective for enhancing chemical composition of custard apple fruit during storage period at ambient condition. Paraffin wax emulsion (10%) coating along with $KMnO_4$ (0.1%) and polythene wrapping delayed the ripening process and prolonged shelf-life and storability of custard apple fruits up to 8 days of storage without affecting their physical composition.

5. Suggestion

- Custard apple can be further analysed under various agro-climatic conditions stable yield and quality condition.
- Custard apple Fruit reaction to similar treatments varies among species and cultivars and physiological status of fruit. Hence, the experiment should be carried out on other fruit cultivars for extend their shelf life and boost demand in the industry.
- Relatable findings, on the effect of chemicals from anti-ethylene, packaging products, vapours preservation and modified atmosphere storage should be performed with this combination to determine their economic effectiveness and standardized fruit shelf-life techniques.

6. References

1. Ahlawat VP, Yamdagni R, Jindal PC. Studies on the effect of post-harvest treatments on storage behaviour of guava (*Pisidium guajava* L.) cv. Sardar. Haryana Agric. Univ. J Res. 1980;10(2):242-247.
2. Bisen A, Pandey SK, Patel N. Effect of skin coatings on prolonging shelf life of kagzi lime fruits (*Citrus aurantifolia* Swingle). J food Sci. and Technol. 2012;49(6):753-759.
3. Cheng Z, Zhou W, Gong X, Wei X, Li J, Peng Z. Physico-chemical changes of custard apple at different storage temperatures. In IOP Conference Series: Materials Science and Engineering; c2018, 392.
4. Chouksey S, Singh A, Singh R, Deshmukh R. Influence of gamma irradiation and benzyl adenine on keeping quality of custard apple fruits during storage. J Food Sci. and Technol. 2013;50(5):934-941.
5. Gautam KS, Dwivedi H, Deepa KP, Singh N. Efficiency of application of wax, mustard oil and benzyl adenine (BA) for prolonging shelf life of guava (*Psidium guajava* L.) cv. CISH G-1 during ambient storage. Trends in Biosci. 2015;8(1):17-22.
6. Hiwale SS, Singh SP. Prolonging the shelf life of guava (*Psidium guajava* L.). Indian J Hort. 2003;60:1-9.
7. Jawadagi SR, Patil RD, Peerajade AD, Shreedhar D, Achari R. Studies on effect of post-harvest treatments on quality and shelf life of custard apple (*Annona squamosa* L.) cv. Balanagar. Asian J Hort. 2013;8(2):494-497.
8. Jholgiker P, Reddy BS. Effect of different surface coating material on post-harvest physiology of (*Annona squamosa* L.) fruits under ambient and zero energy cool chamber storage. Indian J Hort. 2007;64(1):41-44.
9. Kamble KJ, Soni SB. Effect of steam blanching on quality of custard apple pulp. J Hort. and Forestry. 2010;2(5):104-107.
10. Masalkar DS, Garande KV. Effect of post-harvest treatments and packaging materials on shelf life and quality of custard apple fruits. 5th International Post-harvest Symposium; c2004, 682.
11. Nelson N. A photoelectric adaptation of the Somogyi's method for the determination of glucose. J Biol. Chem. 1994;15:375-80.
12. Pandey SK, Joshua JE, Bisen A. Influence of gamma-irradiation, growth retardants and coatings on the shelf life of winter guava fruits (*Psidium guajava* L.). J. food sci. and Technol. 2010;471:124-127.
13. Patel N, Naik AG, Arbat SS. Response of post-harvest chemical treatments on shelf life and quality of custard apple cv. Balanagar. Indian J Hort. 2011;68(4):547-550.
14. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products. Tata Mc Graw Hills Pub., New Delhi. 1986;32(1):323-369.
15. Singh D, Sharma RR. Post-harvest wax coating of Kinnow fruits to retain quality during storage. Agricultural Engineering Today. 2007;31(2):1517.