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Postharvest Application of Different Coatings to Improve the Quality and Storage Stability of Papaya Fruit (*Carica papaya* L.) Cv. Red Lady

Arunesh Kumar Verma [a++], Sanjay Kumar Tripathi [a#], Arvind Kumar [a#], Suresh Chandra [b#], Satya Prakash [c#], Manoj Kumar Singh [c#], Amit Kumar [a†*], Saurabh Kumar Singh [d‡], Satyam Singh [a++] and Prashant Chauhan [a++]

[a] Department of Fruit Science, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, India.
[b] Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (Uttar Pradesh), India.
[c] Department of Vegetable Science, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, India.
[d] Department of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors reviewed and approved the manuscript. This collaborative effort demonstrates the authors' commitment to producing a high-quality manuscript that accurately represents the research findings and contributes to the scientific community. All authors read and approved the final manuscript.

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[++] PG Research Scholar;
[#] Professor;
[†] Ph.D. Research Scholar;
[‡] Ph.D. Scholar;
**Corresponding author: E-mail: amitworld701@gmail.com;*

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ABSTRACT

The Present investigation was carried out on title “Study on different post-harvest treatment for improving shelf life and quality of Papaya fruit (*Carica papaya* L.) cv. Red lady”. The Experiment was conducted in a Completely Randomized Design with 10 treatments viz. T_0-Control, T1- Ethrel 500 ppm, T2- Ethrel 700 ppm, T3- Aloevera gel 1.0%, T4- Aloevera gel 1.5%, T5- Corn Starch 1.0%, T6- Corn Starch 1.5%, T7- Cassava Starch 1.0%, T8- Cassava Starch 1.5%, T9- (Corn Starch 1.5% + Cassava Starch 1.5%) and their three replications, during the year 2023. Aloevera gel 1.5% treated fruits showed the better results followed by the Aloevera gel 1.0%. This coating reduced the transpiration rate and slowed down the ethylene production and formed a layer on the surface of papaya fruits which helped in protection from microorganisms, fungus resulting in the increase in shelf life of fruits and storage quality. The Papaya fruits treated with Corn Starch 1.5% was also found to be significantly good treatments over the Control in respect of storage quality and shelf life of Papaya fruits during the storage. Based on the results obtained, it can be concluded that Aloevera gel 1.5% was found to be most appropriate treatment in papaya cv. Red Lady. Therefore, it can be used in Papaya cv. Red Lady for physiochemical traits *ie.,* Physiological loss in weight, Decay percent, Fruit Firmness, Sensory Evaluation, Visual Appearance, TSS.

Keywords: Papaya; shelf life; aloevera gel; post-harvest treatment; storage quality.

1. INTRODUCTION

Papaya (*Carica papaya* L.) is a tropical fruit having commercial importance because of its high nutritive and medicinal value. Around the world, people eat the fruit raw or processed, or as a vegetable. In addition to being tasty and healthful, the entire plant including the fruit, pulp, peel, seeds, bark and root is also believed to have therapeutic qualities. The high concentration of vitamins A (2020 IU/100g), B, and C as well as proteolytic enzymes with antiviral, antifungal and antibacterial qualities, such as papain and chymopapain, are responsible for papaya's numerous health advantages. The production of papaya in India was 5341000 MT across a cultivated area of 150000 hectares [1]. Contribution of Uttar Pradesh in papaya production is 111.85 thousand tonnes which has share of 1.95% of total production in the country [2]. Red Lady variety of papaya introduced from Taiwan. The papaya is trioecious and has three sex forms, including male, female and hermaphrodite (self-pollinating). Red Lady variety produce female and hermaphroditic plants. For instance, the primary factors limiting the retail quality of "Red Lady" papaya fruits exposed to temperature fluctuations (too warm or too cold) during simulated transportation and handling were loss of firmness and chilling injury.

“The physiological changes in fruits occur immediately after harvest. Fruits begin to lose moisture very soon as when harvested and quickly lose market value if held under hot, dry conditions. In developing countries like India, the infrastructure facilities for processing are not optimum for majority of the growers and thus indulging them to have low market return because of glut in market. Due to poor keeping quality of papaya and difficulties of long distance transportation and preservation facilities, a large amount of this nutritious fruits have been wasted and spoiled. Reports claim that about 30-50% of the harvested papaya never reach the consumers mainly because of postharvest spoilage [3]. This necessitates the development of suitable technology for extension of their post-harvest life and quality. Extension of shelf-life may be possible by checking the transpiration rate, respiration rate and microbial infection. By protecting against moisture loss, bruising, mould growth and contamination, different coatings help in longer freshness of fruits”.

“The use of different types of films based on a variety of single biopolymers, or on their

combinations, results to be extremely advantageous even though all data obtained so far indicate that the coatings need to be tailored and optimized for each kind of foods" [4,5]. "Edible coatings based on cellulose gums effectively delay ripening in some climacteric fruits like mangoes, papayas, and bananas. Coating with *Aloe vera* gel reduces stem browning and dehydration of fruits during storage without loss of taste, aroma and favours" (Martynez-Romero et al*.* 2006).

"Addressing the major difficulties and challenges under the influence of different physico-chemical treatments one of the main challenges was ensuring uniformity among the papaya used for the different treatments. Papaya fruits can vary in size and maturity, which could introduce bias into the results. Thus, careful randomization and selection of papaya fruits was necessary to obtain reliable data. Managing the various treatments was another difficulty. Each treatment required specific conditions such as different concentrations of Ethrel, Aloevera gel, Corn Starch, Cassava Starch. This demanded precise execution and monitoring to avoid unintentional variations in the results. Monitoring the ripening process and post-harvest life of papaya was also labor-intensive and time-consuming. Regular assessment of various quality parameters, such as firmness, color, weight loss, and sugar content, was necessary for each treatment. Environmental factors, such as temperature and humidity, could also impact the outcomes of the study. Maintaining consistent environmental conditions for all treatments was crucial to obtaining accurate results". Considering the above facts, the present study was carried out on: we examined the postharvest quality of papaya (*Carica papaya* L.) cv. Red Lady fruit as affected by different physico-chemical treatments.

2. MATERIALS AND METHODS

The present investigation was conducted at Post-harvest Laboratory (Department of Horticulture) and Laboratories of Agro Processing Centre (CoPHT&FP), Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) from 22-30 September 2023. Geographically, Meerut is situated between 29.010^{o} latitude in the North and 77.750^{o} longitudes in the East at an altitude of 297 meters above the mean sea level.

The variety Red lady was selected for the study. Observation taken during the period of storage, Physiological loss in weight (PLW), Decay percentage, Fruit firmness, Sensory analysis, Total Soluble Solid (TSS), pH of papaya, Total titratable acidity percentage and Reducing sugar. The trial was laid out in a Complete Randomized Design (CRD) and the number of treatments was 10, each replicated three times.

The present observations was carried out 2nd, 4th, 6th and 8th day during storage. Physiological loss in weight (PLW) was calculated manually during the trial period and its value was calculated by using a formula which was given by Srivastava and Tandon [6]. Data on the Decay/spoilage were recorded during storage and expressed as percentages based on the appearance of visible symptoms of spoilage and unmarketable. The firmness of papaya fruit was measured by penetrometer during the trial period and expressed as kg/cm^{2}. Sensory analysis of fruit for organoleptic taste, flavour, aroma and fruit freshness for all the samples was done using the Hedonic scale. A panel of eight judges was made on their consistency and reliability of judgment. The total soluble solid in fruit juice was determined with the help of hand refractometer (0-32 range) and TSS was recorded in degree Brix. Freshly collected clear juice from each papaya fruit treatment was taken separately and the pH pulp was measured using a pH meter. The reducing sugar content was determined using titrimetric procedures, while the total titratable acidity (%) was calculated by titrating the extracted juice with 0.01N NaOH, following the standard method with phenolphthalein as the indicator. Statistical analysis of the data was performed using standard procedure as described by Gomez and Gomez [7].

3. RESULTS AND DISCUSSION

The present papaya fruit data in Table 1 showed that the physiological loss in weight (PLW) of stored fruits treated with Aloevera gel 1.0% were found statistically superior over rest of the treatments with minimum (4.94, 11.29, 13.9 and 23.51) per cent physiological loss in weight during 2nd, 4th, 6th and 8th day of storage. While maximum physiological loss (27.59 and 29.18) per cent moisture loss was recorded at 8th day of storage when the fruits were treated with Ethrel 700 ppm and control. Similar trends was observed by Sharmin et al*.* [8].

No decay percent was recorded in all the treatments on 2nd and 4th day of Storage. On

8th day of storage maximum decay percentage was recorded (27.64 and 26.14) in Control and Ethrel 700 ppm respectively. While good results was seen in the treatments Aloevera gel 1.5% and Corn starch 1.5% with minimum decay percent of (19.32 and 19.90) respectively. The same findings with papaya fruits was also documented by Marpudi et al. [9].

The results showed that on the second day of storage, Aloevera gel 1.0% was the most effective treatment for maintaining fruit firmness, with a firmness measurement of 5.63 kg/cm^2. cassava starch 1.5% and control had the least effective firmness measurements, at 5.3 kg/cm^2 and 5.2 kg/cm^2, respectively. The most successful therapy on the 8th day of storage was Aloevera gel 1.5%, which had a firmness of 2.52 kg/cm^2. Brishti et al. [10] similarly demonstrated similar outcomes. the firmness decreases as fruits become more mature and decreases rapidly as they ripe. Each cultivar has specific firmness which is related to its sensory attributes [11]. Best treatment in terms of sensory evaluation scores on the 2nd day was Aloevera gel 1.5%, which obtained a mean score of 5.6 and treatment with (Corn Starch 1.5% + Cassava Starch 1.5%) and the Control had the lowest scores, with mean values of 4.79 and 4.81, respectively. on 4th day of storage, Aloevera gel 1.5% was found to be the best treatment, with a mean score of 7.71. On 6th day of storage as Aloevera gel 1.5% with mean score of 8.13. The lowest mean scores was obtained by Cassava starch 1.0% and the control, with scores of 7.55 and 6.98, respectively. On the 8th day of storage highest mean scores was received by Aloevera gel 1.5%, Aloevera gel 1.0% and Corn starch 1.0%, with scores of (8.36, 8.10, and 7.81) and the lowest ratings were obtained by Ethrel 500 ppm and the control, with scores of 7.61 and 6.3. Similar results are in confirmation of findings by Nataraju [12] in banana.

The present Papaya fruit data in Table 2 showed that the fruits treated with Ethrel 700 ppm showed superior results statistically, with the highest TSS levels of (7, 9.9, 11.68 and 12.27) Brix on the 2nd, 4th , 6th and 8th day of storage, respectively. on the 2nd day of storage was observed in the fruits treated with the Aloevera gel 1.5% treatment. Similar findings were reported by Sharmin et al. [8]. On the 4th day of storage TSS was recorded as 9.9 ^{o}Brix for the fruits treated with Ethrel 700 ppm. On the 8th day of storage highest TSS was recorded as (12.27 and 12.1) ^{o}Brix for the fruits treated with Ethrel 700 ppm and Corn starch 1.5% + Cassava starch 1.5% respectively. Similar trend was also observed by Timilsina et al. [13].

Minimum Titrable acidity on 2nd day of storage was recorded (0.31 and 0.33) when fruits were treated with Ethrel 500 ppm and Corn starch 1.0% and maximum was recorded in Aloevera gel 1.5% was 0.43. On 4th day of storage maximum Titrability acidity was recorded in Aloevera gel 1.5% was 0.35 while minimum Titrability acidity percent was recorded in treatment Cassava starch 1.0% was 0.26. On 6th day of storage maximum Titrability acidity was recorded Aloevera gel 1.0% (0.40) while minimum Titrability acidity percent was recorded when fruit treated with cassava starch 1.5% was (0.21). Titrability acidity came down slowly to its minimum level (0.18%) on the 8th day of storage in both corn starch 1.5% and Cassava starch 1.0%. Similar observations was shown by Sharmin et al. [8] that the papaya fruits treated with Aloevera gel 1.5% gave the maximum titrable acidity at 12 days of storage.

On the 2nd day of storage the maximum reducing sugar percentages were observed as 5.36% and 5.32% in fruits treated with aloevera gel 1.5% and aloevera gel 1.0% respectively. The highest reducing sugar percentage of 7% was recorded on the 4th day of storage in fruits treated with Aloevera gel 1.5%. On the 6th day of storage the highest reducing sugar percentage of 7.59% was found in fruits treated with Cassava starch 1.5% followed by Aloevera gel 1.5% (7.31%). On the 8th day of storage, the maximum reducing sugar percentage of 7.16% was recorded in fruits treated with Cassava starch 1.5%, while the minimum reducing sugar percentage of 6.07% was observed in fruits treated with Aloevera gel 1.0%. Baviskar et al. [14] suggested that the rise in sugars during the first six days of storage and the subsequent, steady drop could be attributed to metabolic change in soluble molecules and increased conversion of organic acid into sugars.

On the 2nd day of storage, the fruits treated with Aloevera gel 1.5% exhibited the highest pH value of 5.89. On the 4th day of storage, the highest pH values of 5.92 and 5.88 was observed when fruits were treated with Aloevera gel 1.5% and Corn starch 1.5%, respectively. On the 6th day of storage, the highest pH value of 5.94 was recorded when fruit was treated with Aloevera gel 1.5% and lowest pH value of 5.26 was recorded in control. On the 8th day of storage, the

Table 1. Observations of PLW, decay percent, firmness and sensory of papaya fruit cv. red lady

Treatments	Day of Storage (at ambient room temperature)															
	Physiological loss in weight (PLW)				Decay percentage				Firmness of Papaya fruits (kg/cm^2)				Overall acceptability			
	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS
Control	5.73	13.91	22.07	29.18	0	0	24.3	27.64	5.2	4.24	3.31	1.87	4.81	6.84	6.98	6.3
Ethrel 500 ppm	4.91	12.71	19.25	24.82	0	0	22.5	25.55	5.22	4.38	3.72	2.05	5.03	7.1	7.59	7.61
Ethrel 700 ppm	5.76	12.77	20.14	27.59	0	0	23.98	26.14	5.25	4.33	3.68	2.09	5.03	7.33	7.88	7.75
Aloevera gel 1.0%	4.94	11.29	13.9	23.51	0	0	18.47	19.77	5.63	5.02	4.09	2.28	5.25	7.4	8.12	8.1
Aloevera gel 1.5%	5.47	12.07	18.83	23.58	0	0	17.62	19.32	5.61	5.19	4.34	2.52	5.6	7.71	8.13	8.36
Corn Starch 1.0%	6.18	13.24	20.74	25.86	0	0	19.91	21.81	5.41	4.94	3.35	2.36	4.95	7.05	7.71	7.81
Corn Starch 1.5%	6.03	12.87	20.08	25.32	0	0	18.63	19.9	5.37	4.76	3.26	2.32	5.25	7.54	7.98	7.79
Cassava Starch 1.0%	5.53	14.02	21.13	26.04	0	0	20.7	21.91	5.3	4.41	3.14	2.14	4.91	6.92	7.55	7.64
Cassava Starch 1.5%	5.95	14.51	22.06	26.39	0	0	20.96	22.54	5.13	4.62	3.28	2.07	4.94	7.08	7.62	7.37
Corn Starch 1.5%+ Cassava Starch 1.5%	7.05	15.2	21.13	27.52	0	0	21.71	23.66	5.26	4.57	3.42	1.94	4.9	7.17	7.79	7.63
Mean	5.75	13.26	19.93	25.96	0	0	20.88	22.82	5.33	4.64	3.55	2.16				
SE(m)	0.310	0.565	0.586	0.739			0.624	0.757	0.049	0.099	0.104	0.101				
CD @ 5%	0.92	1.67	1.74	2.19			1.854	2.248	0.144	0.293	0.308	0.299				
CV	9.34	7.38	5.08	4.92			5.176	5.742	1.574	3.674	5.050	8.062				

Table 2. Observations of TSS, titrability, acidity, reducing sugar and PH of papaya fruit pulp cv. Red Lady

Treatments	Day of Storage (at ambient room temperature)															
	TSS (°Brix)				Titrable acidity%				Reducing Sugar				pH of Papaya fruits			
	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS	2 DAS	4 DAS	6 DAS	8 DAS
Control	6.14	9.07	11.33	12.02	0.35	0.27	0.23	0.19	4.79	6.45	7.09	7.01	5.16	5.24	5.26	5.22
Ethrel 500 ppm	6.73	9.7	11.25	12	0.31	0.29	0.24	0.2	4.04	5.67	6.5	6.21	5.47	5.56	5.68	5.6
Ethrel 700 ppm	7	9.9	11.68	12.27	0.35	0.28	0.25	0.22	4.39	5.94	6.54	6.15	5.55	5.61	5.62	5.56
Aloevera gel 1.0%	6.58	7.41	8.32	9.5	0.41	0.32	0.4	0.39	5.32	6.06	6.58	6.07	5.79	5.83	5.85	5.89
Aloevera gel 1.5%	5.95	6.98	7.62	9.14	0.43	0.35	0.36	0.34	5.36	7	7.31	6.86	5.89	5.92	5.94	5.96
Corn Starch 1.0%	5.99	7.55	9.5	10	0.33	0.27	0.24	0.19	4.32	6.7	7.15	6.48	5.36	5.41	5.47	5.46
Corn Starch 1.5%	6.15	7.7	8.9	10.2	0.36	0.28	0.23	0.18	4.35	6.34	6.83	6.39	5.8	5.88	5.92	5.9
Cassava Starch 1.0%	6.17	7.25	10.11	11.3	0.33	0.26	0.23	0.18	4.36	5.94	6.61	6.37	5.2	5.26	5.31	5.32
Cassava Starch 1.5%	6.2	8.56	10.5	11.9	0.34	0.27	0.21	0.19	4.37	6.27	7.59	7.16	5.26	5.3	5.34	5.33
Corn Starch 1.5%+ Cassava Starch 1.5%	6	8.66	11.1	12.1	0.35	0.27	0.23	0.21	5	6.45	7.08	7	5.21	5.24	5.3	5.29
Mean	6.29	8.27	10.03	11.04	0.356	0.286	0.262	0.229	4.63	6.282	6.928	6.57	5.47	5.525	5.569	5.56
SE(m)	0.202	0.444	0.595	0.601	0.017	0.013	0.019	0.016	0.10	0.14	0.184	0.238	0.051	0.039	0.038	0.04
CD @ 5%	0.599	1.32	1.77	1.785	0.051	0.039	0.057	0.05	0.29	0.405	0.546	0.71	0.152	0.117	0.112	0.12
CV	5.73	9.30	10.28	9.422	8.03	8.22	12.60	12.85	3.71	3.76	4.59	6.26	1.62	1.23	1.17	1.26

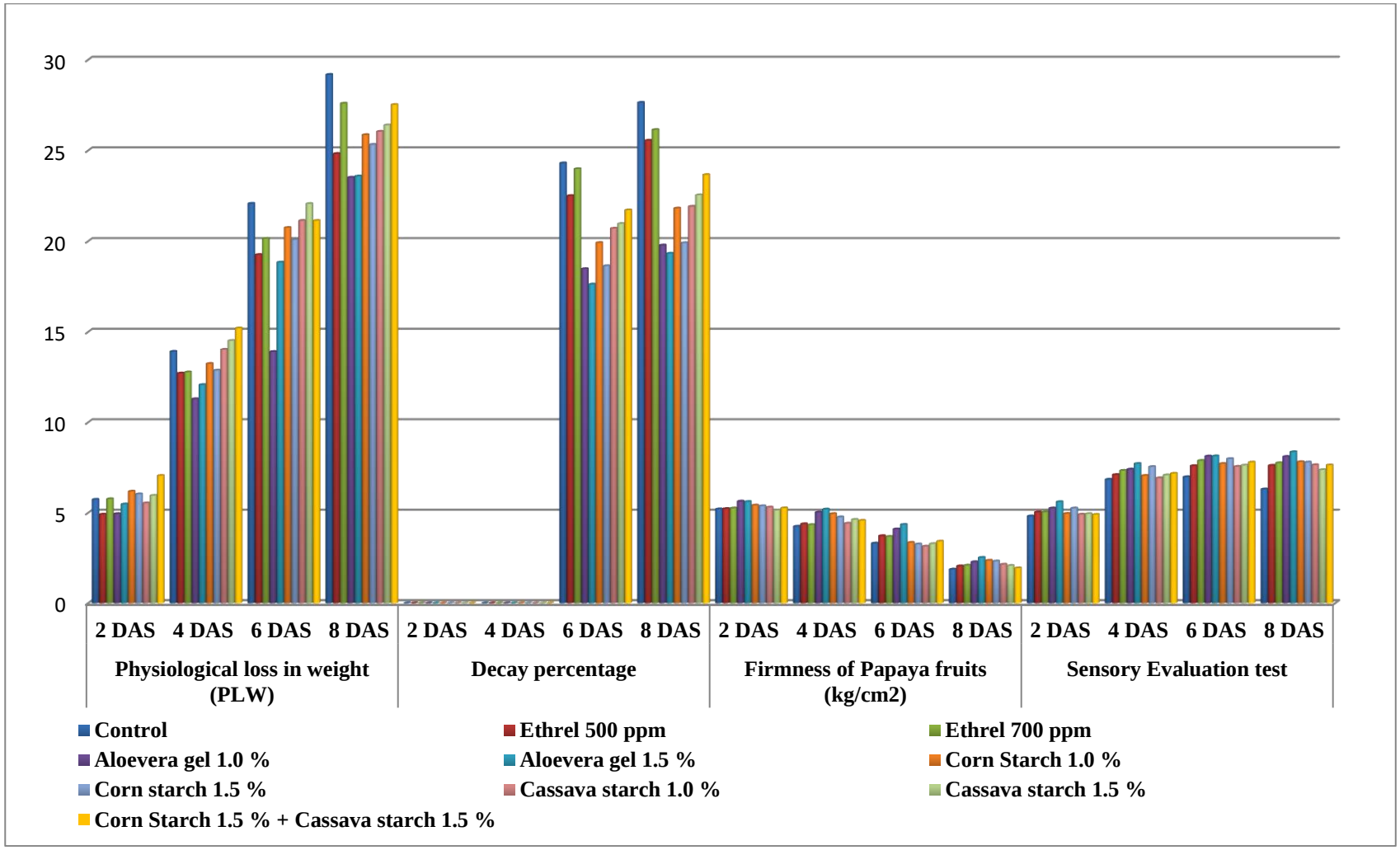

Fig. 1. Effect on PLW, decay percent, firmness and sensory of papaya fruit cv. red lady

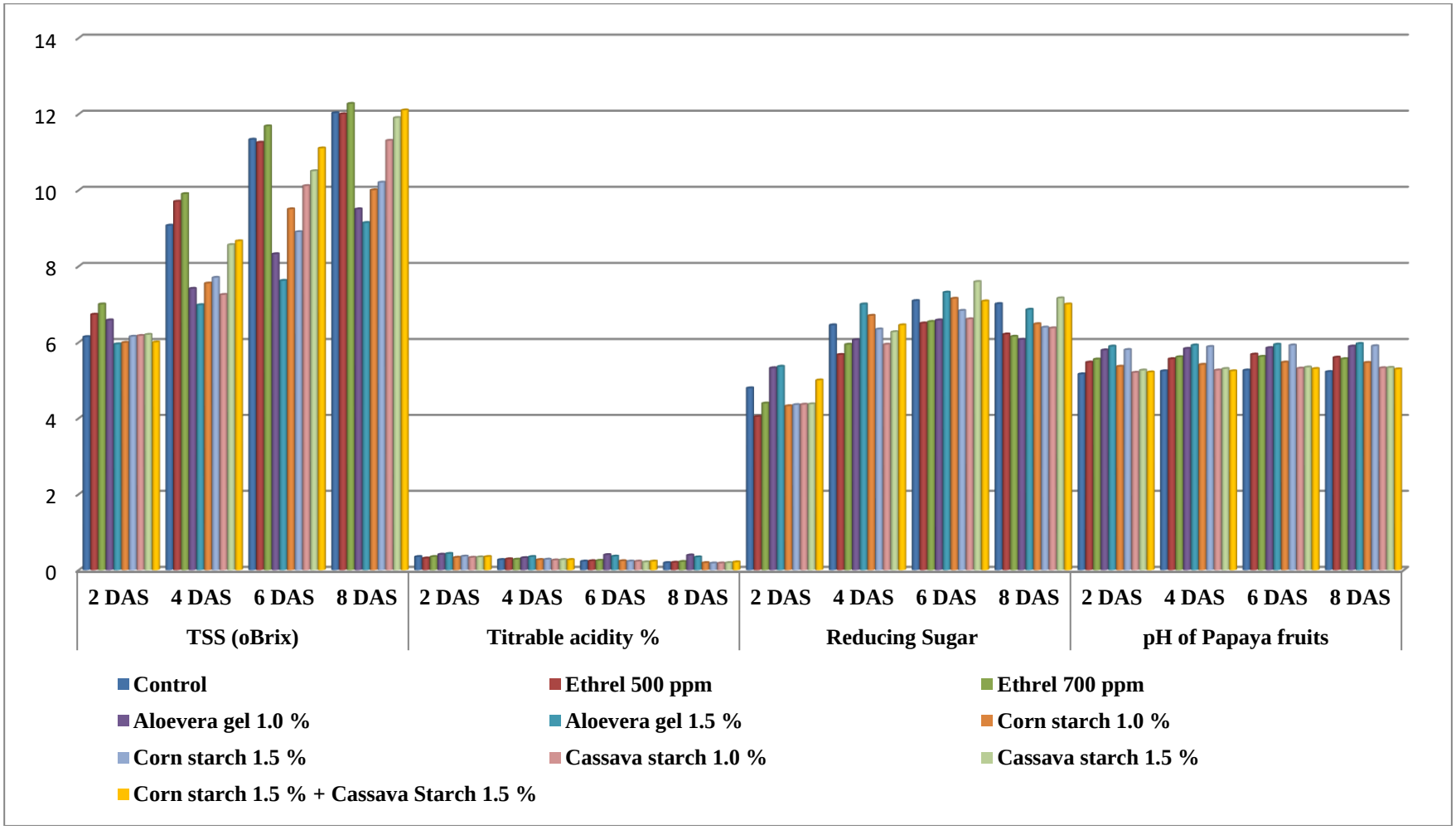

Fig. 2. Effect on TSS, Titrability acidity, Reducing sugar and , pH of papaya fruit pulp cv. Red Lady

highest pH value of 5.96 was recorded when the fruit was treated with Aloevera gel 1.5%. and lowest pH value of 5.24 was recorded in control. The pH increased and the titrable acidity decreased significantly along with increased storage time in both treated and untreated fruits. These results agreed with thus reported by El-Ghaouth et al. [15].

4. CONCLUSION

Based on the present study's findings, it can be concluded that during the 2nd, 4th, 6th and 8th day of storage, the 1.5% Aloevera gel treatments improved the various physiochemical characteristics of the papaya fruit cultivar Red Lady. It was also shown that applying 500 ppm of ethrel and 1.5% of corn starch had a good impact on the post-harvest quality of papaya fruits. Aloe vera gel-based coatings have gained attention in the food sector in recent years as a workable and secure means of successfully extending the shelf life of postharvest fruits and vegetables.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. Agricultural and Processed Food Products Export Development Authority; 2021. Available:https://agriexchange.apeda.gov.in/India%20Production/India_Productions.aspx?cat=fruit&
2. Anonymous. National Horticulture Board, Indian Horticulture Database. Ministry of Agriculture and Farmers Welfare, Government of India; 2021. DOI:www.agricoop.nic.in
3. Mondal MF, Bose SK. Physico-chemical changes in papaya fruits during storage. Journal of Bangladesh Society of Agricultural Science and Technology. 2007; 4:145-148.
4. Porta R, Mariniello L, Di Pierro P, Sorrentino A, Giosafatto CV. Transglutaminase crosslinked pectin- and chitosan-based edible films: A review. Critical Reviews in Food Science and Nutrition. 2011;51:223-238.
5. Rojas-Graü MA, Salvia-Trujillo L, Soliva-Fortuny R, Martín-Belloso. Edible films and coatings. In: Decontamination of Fresh and Minimally Processed Produce. John Wiley and Sons Inc., USA; 2012.
6. Srivastava MP, Tandon RN. Changes in ascorbic acid content of Mosambi fruit induced by Botryodiplodia theobromae. Canadian Journal of Plant Science. 1968; 48(3):337-338.
7. Gomez AK, Gomez AA. Statistical procedure for agricultural research. 2nd ed. John Wiley and Sons, New York; 1996.
8. Sharmin MR, Islam MN, Alim MA. Shelf-life enhancement of papaya with aloe vera gel coating at ambient temperature. Journal of the Bangladesh Agricultural University. 2015;13(1):131-136.
9. Marpudi S, Abirami L, Srividya N. Enhancement of storage life and quality maintenance of papaya fruits using Aloe vera based antimicrobial coating; 2011.
10. Brishti FH, Misir J, Sarker A. Effect of biopreservatives on storage life of papaya fruit (*Carica papaya* L.). International Journal of Food Studies. 2013;2(1):126-136.
11. Jarimopas B, Kitthawee U. Firmness properties of mangoes. International Journal of Food Properties. 2007;10(4): 899-909.
12. Nataraju MS. Effect of wax coating on the post-harvest behavior of banana cv. Yelakki. Mysore Journal of Agricultural Sciences. 2009;43(3):467-471.
13. Timilsina U, Shrestha AK. Effect of different concentration of ethephon on banana (cv. Malbhog) ripening and post-harvest life at laboratory condition. Archives of Agriculture and Environmental Science. 2022;7(1):20-25.

14. Baviskar MR, Waskar DP, Kaulgad SN. Effect of various post-harvest treatments on shelf-life and quality of ber fruits. Indian Journal of Horticulture. 1995;52: 37–45.

15. El Ghaouth A, Arul J, Ponnampalam R, Boulet M. Chitosan coating effect on storability and quality of fresh strawberries. Journal of Food Science. 1991;56(6):1618-1620.

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