International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(1): 39-42
www.biochemjournal.com
Received: 29-11-2025
Accepted: 31-12-2025

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Effect of post harvest edible coatings on biochemical parameters of dragon fruit (*Selenicereus monacanthus*)

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DOI: https://www.doi.org/10.33545/26174693.2026.v10.i1Sa.6880

Abstract
The research entitled "Effect of post harvest edible coatings on biochemical parameters of dragon fruit (*Selenicereus monacanthus*)" was carried out at Department of Fruit Science Laboratory, Dr. YSRHU-College of Horticulture, Venkataramannagudem, West Godavari district, Andhra Pradesh during the year 2023-24. In the experiment, the design followed was Completely Randomized Design with seven treatments and three replications. Dragon fruits were coated with different edible coatings i.e., T_1: *Aloe vera* gel extract- 50%, T_2: *Aloe vera* gel extract- 75%, T_3: Gum arabic- 10%, T_4: Gum arabic- 15%, T_5: Cellulose gum -1%, T_6: Cellulose gum -2%, T_7 was taken as control and stored at ambient temperature. Fruits coated with *Aloe vera* gel 75% (T_2) recorded significantly highest TSS (13.70°Brix), total sugars (10.29%) and reducing sugars (7.13%) at 9th day of storage. Hence, the research findings concluded that *Aloe vera* gel 75% (T_2) found to be best in retaining biochemical parameters of dragon fruits at ambient temperature.

Keywords: Dragon fruit, edible coatings, *Aloe vera* gel, biochemical parameters

Introduction

Dragon fruit, also known as pitaya, strawberry pear, or *Kamalam*, is an exotic tropical fruit belonging to the family *Cactaceae* and the genus *Selenicereus*, with a chromosome number of 2n = 22. Botanically, it is a climbing cactus vine. The commercially cultivated species of *Selenicereus* include *S. undatus*, *S. monacanthus*, *S. costaricensis*, and *S. megalanthus* (Korotkova *et al*., 2017) [8]. Among these, *S. monacanthus* and *S. costaricensis* produce fruits with red peel and red pulp, whereas *S. undatus* bears fruits with red peel and white pulp. The crop is indigenous to southern Mexico but has since spread across Central America, tropical South America, Southeast Asia, and China (Wichienchot *et al*., 2010) [19].

In recent years, dragon fruit cultivation has expanded rapidly in India, with production exceeding 24,000 tons from an area of approximately 3,000 hectares in 2023. The red-fleshed dragon fruit (*S. monacanthus*) has gained particular popularity in Indian markets due to its attractive color and superior nutritional profile. Owing to its health-promoting properties and growing demand among health-conscious consumers, it is increasingly recognized as a "superfruit" (Lorith & Kanlayavattanakul, 2013) [10].

Despite its rising popularity and commercial importance, the shelf life and economic value of dragon fruit are constrained by its high perishability and rapid post-harvest deterioration, especially during long-distance transportation and export. Although several post-harvest technologies are available to maintain fruit quality, many of these methods rely on chemical treatments. Such chemical-based approaches raise concerns related to residual toxicity, environmental pollution, and potential adverse effects on human health. Consequently, there is increasing interest in safe and eco-friendly alternatives. Edible coatings derived from natural plant extracts offer a promising solution, as they are biodegradable, non-toxic, and environmentally friendly. In recent years, plant-based extracts have gained considerable scientific attention due to their effective antibacterial and antifungal properties, making them suitable candidates for sustainable post-harvest management of dragon fruit.

Edible coatings are prepared from environmentally friendly and consumable materials and are considered safe for human health (Galus & Kadzinska, 2015) [4]. These coatings are typically formulated using lipids, proteins, polysaccharides such as gums, or their combinations, along with herbal extracts such as *Aloe vera* gel (Hassan *et al*., 2018) [5]. Edible coatings act as semi-permeable barriers on the fruit surface, regulating the exchange of gases and moisture. By limiting oxygen and water vapor transfer, they help delay fruit deterioration and maintain quality by reducing microbial spoilage, respiration rate, and transpiration losses (Kahramanoglu *et al*., 2020) [6].

Materials and methods

The experiment was conducted at Department of Fruit Science Laboratory, Dr. YSRHU-College of Horticulture, Venkataramannagudem, West Godavari district, Andhra Pradesh during the year 2023-24. The design adopted for the experiment was completely randomized design (CRD), with 7 treatments each having 3 replicates as per the procedure out lined by Panse and Sukhatme (1967) [14].

Mature red fleshed dragon fruits of uniform size, firm, free from blemishes, disease incidence and injuries were procured from a private orchard in Nabipeta, Nallajerla mandal, West Godavari district, Andhra Pradesh. Maturity index of dragon fruit is colour break stage from bright green to red colour or minimum of 31 days after flowering (DAF).

Preparation of post harvest edible coatings

Fresh *Aloe vera* leaves were collected from Medicinal and Aromatic block, College of Horticulture, Venkataramannagudem. They were washed to remove the dust, gel matrix was separated from outer cortex of leaves using knife and then colourless hydro parenchyma was grinded in a blender and strained through muslin cloth to remove fibres. The gel (100%) was diluted with distilled water to obtain the concentrations as treatments (50 and 75%) (v/v). Then, 1% glycerol was added to the solution to increase the plasticizing effect as followed by Pimsorn *et al*. (2022) [15]. To prepare 10 and 15% gum arabic solutions, required quantity of gum arabic powder was dissolved in distilled water and the solution was heated at 40^0C and stirred until it became clear using a magnetic stirrer as followed by Khaliq *et al*. (2015) [7]. Solutions of cellulose gum (1 and 2%) were prepared by dissolving required quantity of cellulose gum powder in distilled water and stirring at 60^0C. After dissolving completely, 0.3% glycerol (w/v), as a plasticizer, was added and stirred (Panahirad *et al*., 2019) [13].

Application of coating solutions

Dragon fruits were coated with different edible coatings i.e., T_1: *Aloe vera* gel extract- 50%, T_2: *Aloe vera* gel extract- 75%, T_3: Gum arabic- 10%, T_4: Gum arabic- 15%, T_5: Cellulose gum -1%, T_6: Cellulose gum -2%, T_7 was taken as control. Before coating, dragon fruits were washed with tap water and dried under shade. Then they were immersed in coating solutions as per the treatment and left to immerse for 5 minutes. Then they were dried under shade and kept at room temperature.

Observations recorded

The fruits were stored at ambient condition and were evaluated for biochemical parameters at three days interval during storage.

Total soluble solids (°Brix)

Fruits were cut and pulp was crushed for juice extraction. The total soluble solids in juice were determined by using digital refractometer with range 0-32 and expressed as °Brix (Ranganna, 1986) [17].

Total sugars (%)

Total sugars were determined following the method described by Lane and Eyon (AOAC, 1965) [9]. Fifty ml lead free filtrate was taken in a 100 ml volumetric flask and to it 5 ml of concentrate HCL was added, mixed well and then kept for 24 hours at room temperature. Acid was then neutralized with NaOH using a drop of phenolphthalein as an indicator till the pink colour persisted for at least few seconds. Then volume is made up to 100 ml. Total sugars were then estimated by taking this solution in a burette and titrating it against standard Fehling’s solution mixture of A and B (1:1) using methylene blue as an indicator till brick red colour is formed and noted as an end point.

$$\text{Total sugars (\%)} = \frac{\text{Factor} \times \text{Volume made up}}{\text{Titre value} \times \text{Weight of sample}} \times 100$$

Reducing sugars (%)

Reducing sugars were determined by the method of Lane and Eyon (AOAC, 1965) [9]. Ten grams of fruit pulp was taken, ground well and transferred to 250 ml volumetric flask. To this, 100 ml of distilled water was added. Two ml of lead acetate solution (45%) was added to flask for precipitation of colloidal matter and two ml of potassium oxalate (22%) was added in this solution to precipitate the lead and volume was made up to 250 ml using distilled water.

The contents were then filtered through Whatmann No. 1 filter paper after testing a little of filtrate for its freedom from lead by adding a drop of potassium oxalate. The lead free solution was taken in a burette and titrated against 10 ml of standard Fehling’s solution mixture of A and B (1:1) using methylene blue as an indicator till brick red colour is formed and noted as an end point. The titration was carried out by keeping the Fehling’s solution boiling on the heating mantle.

$$\text{Reducing sugars (\%)} = \frac{\text{Factor} \times \text{Volume made up}}{\text{Titre value} \times \text{Weight of sample}} \times 100$$

Results and discussion

Total soluble solids (°Brix)

The results regarding total soluble solids as influenced by different post harvest treatments during ambient storage presented in Table 1 and Figure 1 revealed significant differences. TSS increased with increase in storage period and later decreased. However, the increase had been at a slower rate in all the treated fruits compared to control. On 3rd day of storage, the maximum total soluble solids content of 13.20 °Brix was recorded in control (T_7) and minimum of 12.03 °Brix was recorded in fruits coated with *Aloe vera* gel @ 75% (T_2). Similar trend was noticed on 6th day of storage. On 9th day of storage, significantly the highest total soluble solids content of 13.70 °Brix was recorded in fruits coated with *Aloe vera* gel @ 75% (T_2), followed by gum arabic @ 10% (T_3) (13.55 °Brix) and the lowest of 11.27 °Brix was recorded in control (T_7).

The increase in TSS during early storage is mainly due to the conversion of starches to sugars and the breakdown of organic acids. Decrease in TSS during later storage stages occurs as fruits begin to lose water, or enter the senescence phase, which involves the breakdown of sugars and the degradation of cellular structures. Additionally, microbial activity, excessive moisture loss, and enzymatic processes contribute to the decline in soluble solids. Similar trend was observed in dragon fruit by Prashanth *et al*. (2022) [16]. The fruits coated with *Aloe vera* gel @ 75% had showed a gradual increase in TSS content during storage as compared to other treatments. *Aloe vera* gel had slowed down ripening process, through reduced ethylene production, ethylene sensitivity thereby delaying starch-to-sugar conversion. The barrier forming property of *Aloe vera* gel had reduced the respiration rate, which limits sugar consumption for energy release and helps to retain higher TSS at the end of storage. Similar results were reported by Adetunji *et al*. (2012) [1] in orange, Benitez *et al*. (2013) [2] in kiwi, Chauhan *et al*. (2014) [3] in apple and Mani *et al*. (2017) [11] in ber.

Table 1: Effect of post-harvest edible coatings on total soluble solids (ºBrix) in dragon fruit pulp during storage.

Treatment	Total soluble solids (ºBrix)			
	3rd day	6th day	9th day	12th day
T_1 : *Aloe vera* gel 50%	12.37	13.23	13.13	*
T_2: *Aloe vera* gel 75%	12.03	12.90	13.70	13.17
T_3: Gum arabic 10%	12.23	13.17	13.55	12.80
T_4: Gum arabic 15%	12.40	13.33	13.07	*
T_5: Cellulose gum 1%	12.83	13.45	11.57	*
T_6: Cellulose gum 2%	12.57	13.37	11.93	*
T_7 : Control	13.20	13.60	11.27	*
Mean	12.52	13.29	12.60	12.98
SE m±	0.05	0.05	0.05	
CD at 5%	0.16	0.14	0.14	

*Indicates termination of storage

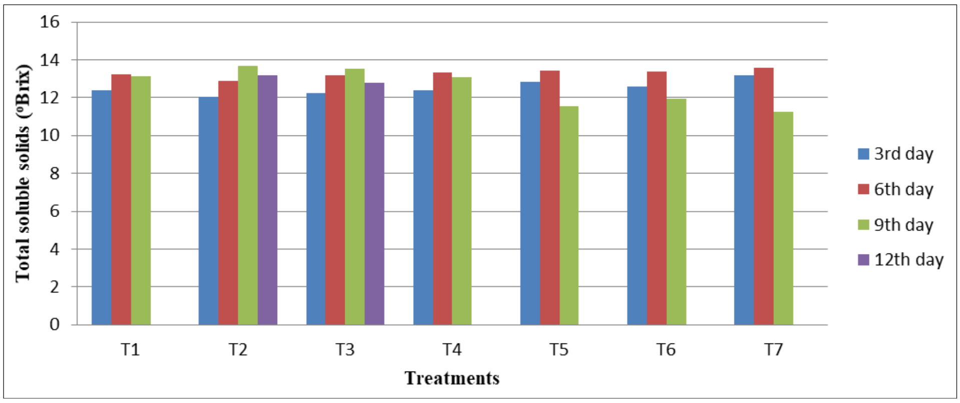

Fig 1: Effect of post harvest edible coatings on total soluble solids (ºBrix) in dragon fruit pulp during storage. T_1: *Aloe vera* gel 50%, T_2: *Aloe vera* gel 75%, T_3: Gum arabic 10%, T_4: Gum arabic 15%, T_5: Cellulose gum 1% T_6: Cellulose gum 2% T_7: Control

Total sugars (%)

The data (Table 2) pertaining to total sugars (%) content due to influence of post-harvest edible coatings showed a significant influence during storage. Total sugars increased in all treatments with increase in storage period and later decreased. However, the increase had been at a slower rate in all the treated fruits as compared to control. On 3rd day of storage, the highest total sugars content of 10.24% was recorded in control (T_7) and the lowest of 9.44% was registered in fruits coated with *Aloe vera* gel @ 75% (T_2). Similar trend was noticed on 6th day of storage. On 9th day of storage, significantly the highest total sugars content of 10.29% was registered in fruits coated with *Aloe vera* gel @ 75% (T_2), followed by gum arabic @ 10% (T_3) (10.17%) and the lowest of 7.07% was recorded in control (T_7).

Table 2: Effect of post-harvest edible coatings on total sugars (%) in dragon fruit pulp during storage.

Treatment	Total sugars (%)			
	3rd day	6th day	9th day	12th day
T_1 : *Aloe vera* gel 50%	9.68	9.96	9.56	*
T_2: *Aloe vera* gel 75%	9.44	9.83	10.29	9.53
T_3: Gum arabic 10%	9.59	9.93	10.17	9.12
T_4: Gum arabic 15%	9.72	10.01	8.74	*
T_5: Cellulose gum 1%	9.85	10.19	8.42	*
T_6: Cellulose gum 2%	9.79	10.16	8.58	*
T_7 : Control	10.24	10.34	7.07	*
Mean	9.76	10.06	8.97	9.32
SE m±	0.03	0.02	0.03	
CD at 5%	0.08	0.06	0.08	

*Indicates termination of storage

Reducing sugars (%)

The data (Table 3) showed significant differences in reducing sugars (%) as influenced by post harvest edible coatings on dragon fruit. Reducing sugars increased in all treatments with increase in storage period and later decreased. However, the increase had been at a slower rate in all the treated fruits compared to control. On 3rd day of storage, the highest reducing sugars content of 7.02% was recorded in control (T_7) and lowest of 6.37% was registered in fruits coated with *Aloe vera* gel @ 75% (T_2). Similar trend was noticed on 6th day of storage. On 9th day of storage, significantly the highest reducing sugars content of

7.13% was recorded in fruits coated with *Aloe vera* gel @ 75% (T_2) followed by gum arabic @ 10% (T_3) (7.03%) and the lowest of 5.06% was recorded in control (T_7).

The percent increase in sugars during early storage period was mainly due to conversion of starches to simple sugars (glucose, fructose and sucrose) and breakdown of organic acids through an enhanced enzymatic process. Decrease in sugars during later stages of storage occurs as they are used in respiration, converted to other compounds (e.g., alcohol during fermentation), or metabolized by deteriorating cells. Additionally, microbial activity and the breakdown of fruit tissues also contribute to the reduction in sugar levels. Similar trend was observed in dragon fruit by Prashanth *et al*. (2022) [16]. It could be evident from the data recorded that *Aloe vera* gel @ 75% coated fruits had showed a gradual increase in sugars. *Aloe vera* gel acts as a barrier that slows down the respiration rate and ripening process. It might be due to reduced gaseous exchange and ethylene production leading to a gradual increase and retention of higher sugar levels at end of storage period compared to uncoated fruits. Similar results were also earlier reported by Adetunji *et al*. (2012) [1] in orange, Singh *et al*. (2018) [18] in guava and Mani *et al*. (2018) [12] in ber.

Table 3: Effect of post-harvest edible coatings on reducing sugars (%) in dragon fruit pulp during storage.

Treatment	Reducing sugars (%)			
	3rd day	6th day	9th day	12th day
T_1 : *Aloe vera* gel 50%	6.52	6.79	6.60	*
T_2: *Aloe vera* gel 75%	6.37	6.72	7.13	6.61
T_3: Gum arabic 10%	6.47	6.78	7.03	6.27
T_4: Gum arabic 15%	6.53	6.84	6.36	*
T_5: Cellulose gum 1%	6.67	6.95	6.18	*
T_6: Cellulose gum 2%	6.58	6.94	6.27	*
T_7 : Control	7.02	7.11	5.06	*
Mean	6.59	6.87	6.37	6.44
SE m±	0.02	0.02	0.02	
CD at 5%	0.05	0.05	0.07	

*Indicates termination of storage

Conclusion

Results of the experiment revealed that different post harvest edible coatings significantly affected the biochemical parameters of dragon fruit. Among the different coatings used, *Aloe vera* gel @ 75% was best in terms of maintaining biochemical parameters without causing adverse effects, followed by gum arabic (10%) treatment.

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