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Aloe vera and chitosan edible coatings for postharvest shelf-life enhancement and quality retention of strawberries at ambient storage conditions

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Abstract

The strawberry is a highly perishable fruit and post harvest shelf life of strawberry is minimum at room temperature and post harvest losses in strawberry is a major challenge may lead to rotting and decay of fruits. The present experiment aims to study the effect of aloe vera and chitosan in improving shelf life and biochemical parameters of strawberry. The combination aloe vera 20% and chitosan 1% lowered physiological loss in weight, showed maximum firmness, higher total soluble solids, ascorbic acid content, anthocyanin content, sensory attributes and lower fungal decay compared to alone treating of alovera gel and chitosan.

Keywords: Strawberry, post-harvest treatment, aloe vera gel, chitosan, shelf life

Introduction

Strawberry (*Fragaria × ananassa*) belongs to the softest, delicate, and perishable fruit products and has a short postharvest life due to active metabolism, soft texture, and sensitivity to fungal pathogens (Priyadarshi *et al.*, 2024) ^[1]. The strawberries kept at room temperature, the fruits will deteriorate quickly because of the promotion of respiration processes and the development of decay, which can be attributed to the action of *Botrytis cinerea* and *Rhizopus stolonifera* mold (Feliziani, Eand Romanazzi, G. 2016) ^[2].

Although low storage temperatures, as well as synthetic fungicides, can be used extensively for slowing down the process of decay, such practices may often be hindered by economic factors, energy requirements, as well as increasing considerations regarding residues (Schirraet *al.*, 2011) ^[3]. Natural edible biopolymer-based coatings have been considered environmentally friendly alternatives in retarding post-harvest senescence by acting as gas and water-selective diffusion barriers, thereby inhibiting microbial growth (Pillaiet *al.*2024) ^[4].

The polysaccharides and phenolic compounds in Aloe vera gel are responsible for its antioxidant and antimicrobial properties, which increase the stability of the fruit (Kahramanoğlu *et al.*, 2019) ^[5]. The biodegradable polymer chitosan, which has film-forming properties and strong antifungal action, originates from the polysaccharide chitin (Aidat, O.and Amor, A. B. 2025) ^[6]. The combination of Aloe vera and chitosan individually may have synergistic effects on enhancing shelf life of fruits. This paper investigates the use of aloe vera-chitosan coatings on strawberries to retain quality at room temperature.

Materials and Methods

The present investigation was conducted during the year 2021-22 at the Post-Harvest Laboratory, College of Horticulture, Rajendranagar, to study the effect of postharvest treatments on shelf life and quality parameters of strawberry fruits under ambient storage conditions.

Fruit Sample Preparation

Strawberries with commercial maturity stage were obtained. Fruits that were of equal size, color, and degree of ripening and were not injured or infected were considered. Fruits were thoroughly rinsed in a filtered water system and dried in normal conditions and were used promptly.

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Preparations of Coating Formulations

Fresh aloe vera leaves were cleaned, peeled, and the inner part separated manually. The separated gels were mixed, filtered, and then prepared as 10% and 20% aloe vera solutions by adding distilled water.

Chitosan solution (concentration of 1%, w/v) was prepared by dissolving the chitosan powder in 1% v/v acetic acid solution under constant stirring until a solution was formed. In the combined treatments, the solution of the aloe vera gel was mixed with the chitosan solution at concentrations of 0.5% and 1%, w/v to form the mixture solution.

There were six treatments in the experiment: Uncoated Control (T₁), aloe vera gel at 10% (T₂) and 20% (T₃), Chitosan at 1% (T₄), aloe vera gel 10% + Chitosan 0.5% (T₅), and aloe vera gel 20% + Chitosan 1% (T₆). The fruits were treated by immersing them in the respective coating solutions for about 2-3 minutes; after that, they were drained and dried in air at room temperature for coating formation. The control fruits were treated with immersion in distilled water.

Experimental Design and Storage

The experimental design followed was the Completely Randomized Design (CRD) with six treatments and four replications. An equal number of fruits were maintained in each replication. The fruits were packed and stored in a normal temperature atmosphere of 25° to 30 °C after treatment. They were inspected occasionally until the end of their market life.

Physiological Assessments

Physiological Loss in Weight (%)

Fruit weight was recorded at the beginning of storage and at each observation interval. Physiological loss in weight was expressed as a percentage using the following equation:

$$PLW (\%) = \frac{W_0 - W_t}{W_0} \times 100$$

where W_0 represents the initial fruit weight and W_t denotes the weight at a given storage interval.

Firmness (Kg/cm²)

The firmness of the fruits was determined by a digital penetrometer with a 10 mm diameter flat end plunger and is measured in kg/cm². Firmness was evaluated at three separate stages of the equatorial region, and the average recorded value was. The firmness loss measured was expressed as a percentage of the initial value.

Shelf Life (days)

Shelf life was determined as the number of days the fruits retained acceptable visual quality, firmness, and freedom from decay under ambient storage conditions.

Chemical and Biochemical Analysis

Chemical attributes were analyzed using standard laboratory procedures. Total soluble solids (TSS) were measured using a digital refractometer and expressed as °Brix. Titratable acidity was determined by acid-base titration and expressed as percent citric acid. The TSS to acidity ratio was calculated accordingly. Ascorbic acid content was estimated by a dye titration method and expressed as mg per 100 g fresh weight. Total and reducing sugars were determined using standard colorimetric techniques (optional). Anthocyanin content was quantified using the pH differential method and expressed as mg per 100 g fresh weight

(AOAC).

Statistical Analysis

Experimental data were analyzed using analysis of variance (ANOVA), suitable for a Completely Randomized Design. Differences among treatment means were assessed at the 5% level of significance using appropriate statistical test

Results and Discussion

Physiological Loss in Weight (PLW) %

The physiological loss in weight of strawberry fruits increased steadily during ambient storage across all treatments (Fig. 1). Uncoated control fruits had the highest PLW throughout storage, reaching about 10.5% by day 4. This indicated rapid moisture loss and aging. All edible coating treatments significantly reduced PLW compared to the control. Among the single coatings, chitosan 1% was more effective than aloe vera alone. Aloe vera 20% was more effective at reducing weight loss than aloe vera 10%, showing a response that depended on concentration. The lowest PLW was consistently found in fruits treated with aloe vera 20% and chitosan 1%, followed by aloe vera 10% and chitosan 0.5%. At the end of storage, the combined coating cut PLW by over 50% compared to the control. The reduced weight loss in coated fruits is likely due to the formation of a semipermeable barrier that limits transpiration and respiration (Baldwin *et al.* 1995, Alemu *et al.*, 2025) [7, 17]. These results show that aloe vera and chitosan composite coatings effectively minimize physiological weight loss and improve the postharvest performance of strawberries during ambient storage. The findings are in close conformity with findings of Vieira *et al.* (2016) [8] in blue berry.

Fruit Firmness (kg/cm²)

The firmness of fruits reduced in storage in all treatments (Fig. 2), with maximum reduction in the case of uncoated control fruits. The decrease in firmness of the fruits in the control was noticeable, from 1.7 kg cm² to 0.4 kg cm², on day 4. The firmness of fruits in all coated treatments was significantly better than that of the control fruits. Of the single coatings, the better ones were chitosan 1% and aloe vera 20%, compared with aloe vera 10%. The maximum firmness was preserved in fruits treated with aloe vera 20% + chitosan 1%, which retained about 1.15 kg cm² by the end of storage. The better retention of firmness could be due to reduced water loss and slowed-down degradation of cell walls because of the formation of a semi-permeable coating layer. The results are in close association with findings of Gboyimde *et al.* (2019) [9] in Tomato and Terefe, G. (2021) [10] in Sweet orange.

Total soluble solids (°Brix)

Total soluble solids were found to increase in all the treatment groups when stored at room temperature (Fig. 3). Control fruits recorded the highest increase in TSS concentration from 6.0 to 7.8 °Brix in four days. Slowing down of TSS increase in the coated fruits is attributed to the inhibition of gas exchange, thus lower respiration rates and consequently ripening of the fruits during room temperature storage. Based on the highest TSS content, the least values were recorded in fruits coated with aloe vera 20% + chitosan 1% compared to those coated with aloe vera 10% + chitosan 0.5%. An increase in TSS concentration in control fruits shows the natural ripening of the fruits. The findings are in close conformity with Hajebi Seyedet *et al.* (2021) [12] in Mango.

Ascorbic acid content (mg/100g)

The ascorbic acid level in strawberries had been significantly affected during storage at ambient temperature (Fig. 4). The control strawberries had initially high ascorbic acid levels, which significantly decreased from 65 to 45 mg/100 g on day 4, reflecting increased oxidative decomposition. The aloe vera and chitosan-coated strawberries had slower decomposition of ascorbic acid, and chitosan 1% performed better compared to only aloe vera. However, the combination of coatings had better ascorbic acid retention and even increased levels in strawberries, especially in aloe vera 20% + chitosan 1%, which had increased to 80 mg/100 g on day four. The findings of Qamaret *et al.* (2018)^[13] in strawberries also showed edible coating conserved ascorbic acid content.

Anthocyanin content (mg/100g)

The content of anthocyanin in all coated fruits was increasing, while in the other fruits reduced at a later period (Fig. 5). The control fruits had reached a maximum on day 2, followed by a drastic drop in content by about 18 mg/100g on day 4, showing decomposition of pigments in accordance with the development of senescence. The coated fruits showed an incessant rise in the content of anthocyanin. The reduced oxidation and ripening of fruits could be attributed to the semi-permeable layer of the coating. Al-Hilifiet *et al.* (2022)^[15] also showed similar reports in Fig.

Sensory attributes of edible coated strawberry fruits

Strawberry sensory properties such as color, texture, taste, freshness, and overall acceptability were significantly affected by the application of edible coatings (Fig. 6). Uncoated fruits maintained the lowest scores for sensory acceptability because of faster deterioration during storage at room conditions. Fruits coated with either aloe vera or chitosan had enhanced sensory acceptability compared to the other two. In all sensory parameters, the fruits coated with the combination of 20% aloe vera + 1% chitosan had the best scores, followed by the formulation of 10% aloe vera + 0.5% chitosan. Higher sensory acceptability of the coated fruits can be contributed to the reduced loss of water, slower development of softness, and lower development of decay, which makes the fruits more desirable. The findings are in close conformity with reports of Gboyimde, P. M. (2019)^[9] in tomato, orange and cucumber. Abdollahi *et al.* (2022)^[16] also proved sensory parameters in fresh cut orange.

Fungal decay

Fungal decay was on the increase in all treatments during storage at room temperatures (Fig. 7), with the highest percentages of decay being in the control fruits. At the end of day four, controls had an average decay of about 42%, showing accelerated microbial decay. All the coated treatments reduced decay significantly compared to the control. Of the mono-coated treatments, decay was highest in aloe vera compared to chitosan 1%. The decay was least in aloe vera 20% + chitosan 1%, followed by aloe vera 10% + chitosan 0.5% treatments. Lower decay in fruits coated with material is because of the antimicrobial activity of chitosan and aloe vera as well as the physical barrier they impart on the fruit surface. Kaur *et al.* (2024)^[14] also showed similar findings in Fig

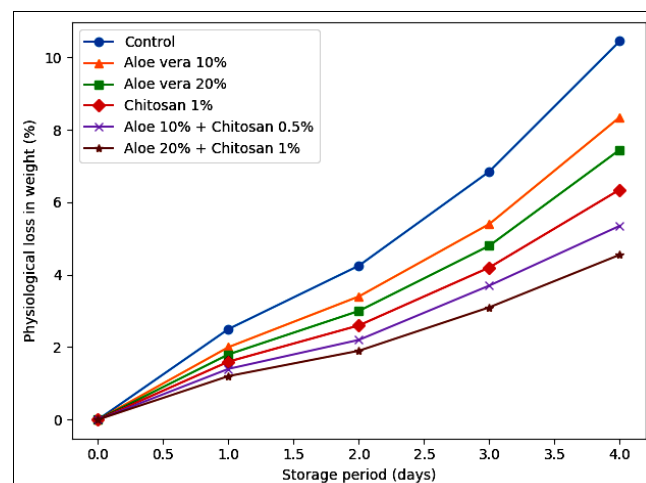


Fig 1: Effect of edible coatings on the physiological loss in weight (%) of strawberry fruits during storage at ambient conditions ($25 \pm 2^\circ\text{C}$ and 55-60% RH)

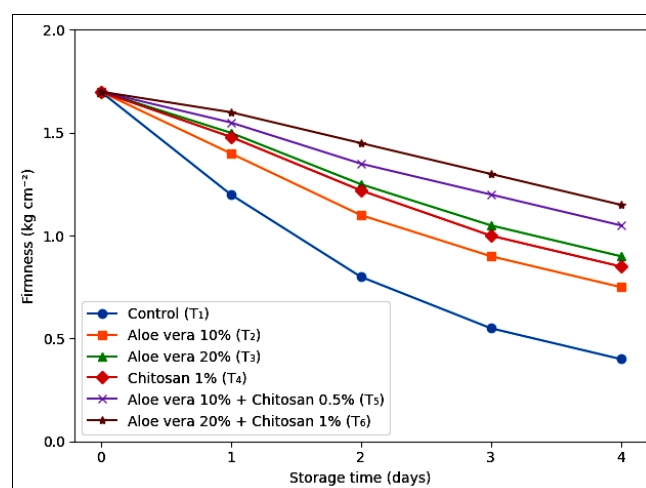


Fig 2: Effect of edible coatings on firmness of strawberry fruits during storage at ambient conditions ($25 \pm 2^\circ\text{C}$ and 55-60% RH)

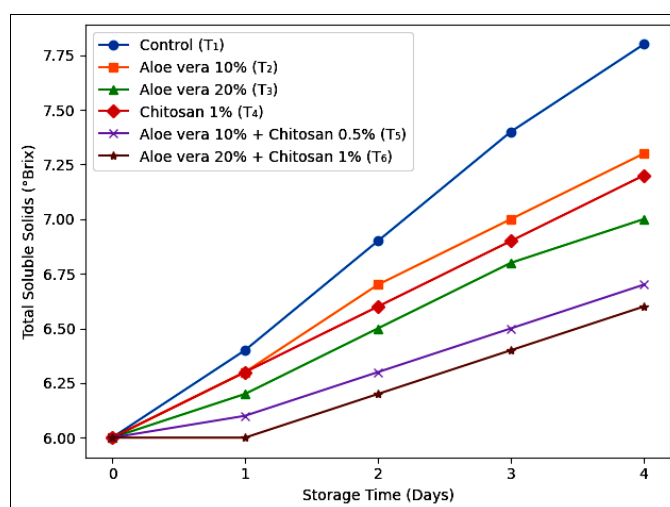


Fig 3: Effect of edible coatings on total soluble solids (TSS) of strawberry fruits during storage at ambient conditions ($25 \pm 2^\circ\text{C}$ and 55-60% RH)

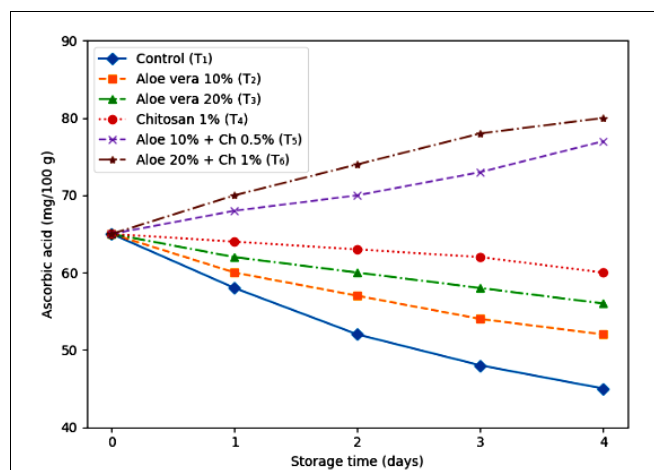


Fig 4: Effect of edible coatings on ascorbic acid content (mg/100 g) of strawberry fruits during storage at ambient conditions (25 ± 2 °C and 55-60% RH) for 4 days

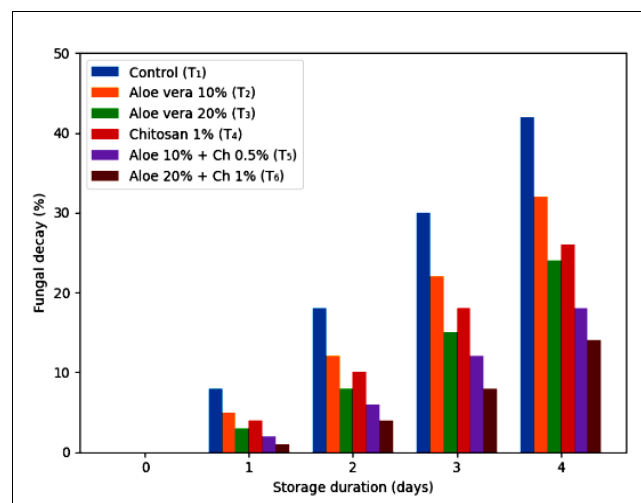


Fig 7: Effect of edible coatings on fungal decay (%) of strawberry fruits during storage at ambient conditions (25 ± 2 °C and 55-60% RH) for 4 days

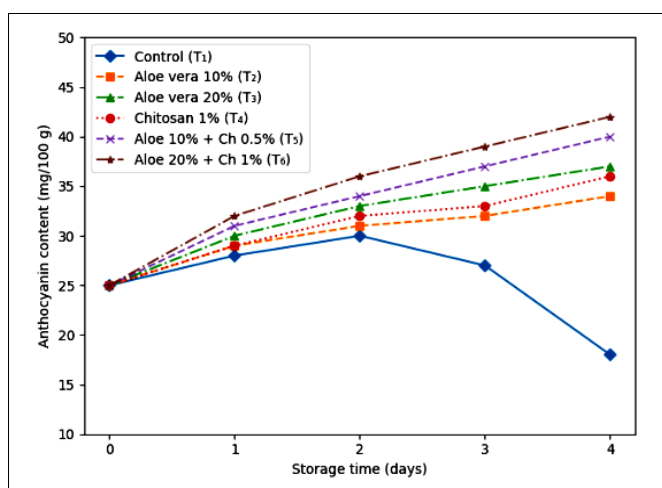


Fig 5: Effect of edible coatings on anthocyanin content (mg/100 g) of strawberry fruits during storage at ambient conditions (25 ± 2 °C and 55-60% RH) for 4 days

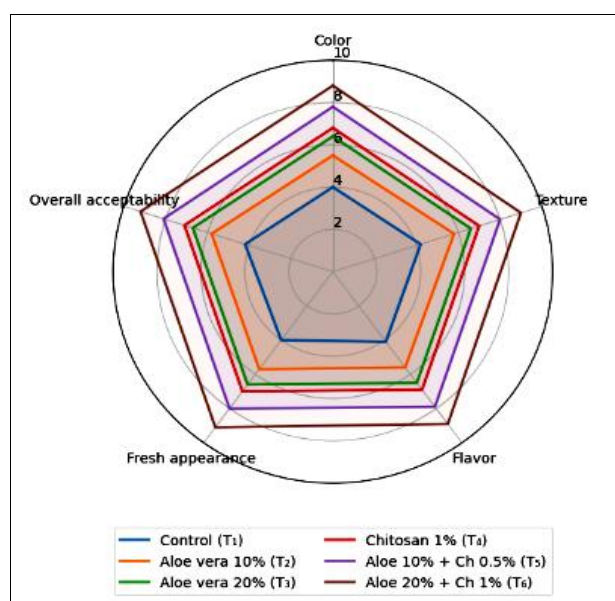


Fig 6: The sensory quality of strawberry fruits as affected by edible coatings during ambient storage (25 ± 2 °C and 55-60% RH)

Conclusion

The findings of the study indicates that strawberry fruits are highly perishable to postharvest loss at ambient temperature. The combined treatment with aloe vera gel (20%) and chitosan (1%) performed better than individual treatment methods in maintaining low loss in weight, increased firmness, high total soluble solids, ascorbic acid content, anthocyanin pigment, and overall quality. Hence, the combined treatment with the aloe vera-chitosan composite coating could be found to be very useful in maintaining the post-harvest quality of strawberry fruits stored at an ambient temperature.

References

1. Priyadarshi R, Jayakumar A, de Souza CK, Rhim JW, Kim JT. Advances in strawberry postharvest preservation and packaging: a comprehensive review. *Comprehensive Reviews in Food Science and Food Safety*. 2024;23(4):e13417.
2. Feliziani E, Romanazzi G. Postharvest decay of strawberry fruit: etiology, epidemiology, and disease management. *Journal of Berry Research*. 2016;6(1):47-63.
3. Schirra M, D'Aquino S, Cabras P, Angioni A. Control of postharvest diseases of fruit by heat and fungicides: efficacy, residue levels, and residue persistence. A review. *Journal of Agricultural and Food Chemistry*. 2011;59(16):8531-8542.
4. Pillai AR, Eapen AS, Zhang W, Roy S. Polysaccharide-based edible biopolymer coatings for fruit preservation: a review. *Foods*. 2024;13(10):1529.
5. Kahramanoğlu İ, Chen C, Chen J, Wan C. Chemical constituents, antimicrobial activity, and food preservative characteristics of *Aloe vera* gel. *Agronomy*. 2019;9(12):831.
6. Aboryia MS, El-Gioushy SF, Sami R, Aljumayi H, Alyamani A, Almasoudi A, Gawish MS. Synergistic effect of dipping in *Aloe vera* gel and mixing with chitosan and calcium chloride on the activities of antioxidant enzymes and cold storage potential of peach (*Prunus persica* L.) fruits. *Coatings*. 2022;12(4):498.
7. Baldwin EA, Nisperos-Carriedo MO, Baker RA. Edible coatings for lightly processed fruits and vegetables. *HortScience*. 1995;30(1):35-38.
8. Vieira JM, Flores-López ML, de Rodríguez DJ, Sousa MC, Vicente AA, Martins JT. Effect of chitosan-*Aloe vera*

- coating on postharvest quality of blueberry (*Vaccinium corymbosum*) fruit. *Postharvest Biology and Technology*. 2016;116:88-97.
9. Gboyimide PM. Synergistic effects of chitosan and *Aloe vera* gel coatings on tomato, orange and cucumber Malete (Nigeria): Kwara State University; 2019.
 10. Terefe G. The effect of *Aloe vera* gel coating in enhancing postharvest quality and shelf life of sweet orange (*Citrus sinensis* Osbeck) fruits Haramaya (Ethiopia): Haramaya University; 2021.
 11. Wei S, Mei J, Xie J. Effects of edible coating and modified atmosphere technology on the physiology and quality of mangoes after low-temperature transportation at 13 °C in vibration mitigation packaging. *Plants*. 2021;10(11):2432.
 12. Hajebi Seyed R, Rastegar S, Faramarzi S. Impact of edible coating derived from a combination of *Aloe vera* gel, chitosan and calcium chloride on maintaining the quality of mango fruit at ambient temperature. *Journal of Food Measurement and Characterization*. 2021;15(4):2932-2942.
 13. Qamar J, Ejaz S, Anjum MA, Nawaz A, Hussain S, Ali S, Saleem S. Effect of *Aloe vera* gel, chitosan and sodium alginate based edible coatings on postharvest quality of refrigerated strawberry fruits of cv. Chandler. *Journal of Horticultural Science and Technology*. 2018;1(8):1-8.
 14. Kaur N, Somasundram C, Razali Z, Ahmed ZFR. Sustainable *Aloe vera*/chitosan-based edible coatings reduce postharvest loss of stored fresh figs (*Ficus carica* L.). *Frontiers in Sustainable Food Systems*. 2024;8:1459600.
 15. Al-Hilifi SA, Al-Ali RM, Al-Ibresam OT, Kumar N, Paidari S, Trajkovska Petkoska A, Agarwal V. Physicochemical, morphological, and functional characterization of edible anthocyanin-enriched *Aloe vera* coatings on fresh figs (*Ficus carica* L.). *Gels*. 2022;8(10):645.
 16. Abdollahi M, Bazargani-Gilani B, Aghajani N, Daraei Garmakhany A. Response surface optimization of the effect of *Aloe vera* gel coating enriched with golpar essential oil on the shelf life, postharvest quality, color change and sensory attributes of fresh-cut orange fruit. *Journal of Food Processing and Preservation*. 2022;46(11):e17019.
 17. Alemu MY. The Redistributive Effects of Tax Reforms in Developing Countries: Comparative Evidence from Ethiopia and Mozambique. In *Forum for Social Economics* 2025 Sep 23 (pp. 1-31). Routledge.