Research Article

Aloe vera gel coating along with calcium chloride treatment enhance guava (*Psidium guajava* L.) fruit quality during storage

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Abstract

Guava (*Psidium guajava* L.) is one of the commercially important fruit having a perishable nature. In this study, the effectiveness of various concentrations of *Aloe vera* gel as an edible coating and Calcium Chloride were examined on post-harvest quality of guava fruit stored at $5\pm 1^{\circ}\text{C}$ for 35 days. Treated guava fruit samples were studied for physicochemical properties (Fruit firmness, phenol content, physiological weight loss, respiration rate, decay index, pH, TSS, titratable acidity, ascorbic acid content, sugar acid-ratio) and sensory attributes (colour and flavour score). All the quality attributes were significantly affected by both treatment and storage intervals. The interaction effect of both treatment and storage duration also significantly affected all quality parameters. Edible coating and low temperature storage had reduced decay and enhanced shelf life of guava fruit. Guava coated with 2% CaCl_2 and 10% *Aloe vera* gel (labelled as GCA₄) promisingly retained physico-chemical characteristics and also maintained the sensory attributes than all the other treatments performed and was found to be most effective treatment in maintaining the fruit quality attributes along with the shelf life extension for 35 day.

Keywords *Aloe vera* gel; Calcium Chloride; Edible coating; Guava; Post-harvest quality; Shelf life

Introduction

Fruit surface coating is used as one of the best treatment to control the post-harvest losses and to extend the shelf life of fruits. Recently edible coating also known as bio preservation have been developed for preserving and improving the appearance of fruit. Such coating have beneficial effects on fruits like color improvement, prevent moisture loss percentage, delay weight loss, extending shelf-life reducing rate of respiration and protection against

microbial decay [1]. Bio preservation is innovative method of preservation that has the ability to extend and enhance shelf life and safety of foods by the use of natural or controlled antimicrobial compounds.

The use of bio preservation strategies instead of chemical preservation is user-friendly and has great potential if production and application techniques are fully investigated. Among the various biopreservative plants, the *Aloe vera* plant has a medicinal history due to its extensive

disease and fruit preservation. It can prevent the loss of water and hardness, control the respiration rate and maturation, delay oxidative browning, reduce microbial reproduction and other parameters such as titratable acidity, soluble solids content, ascorbic acid content, firmness and decay rate [2]. In postharvest technology, bio preservation use plant based products used in food engineering to prolong shelf life of fruits and vegetables. Gel of Aloe vera depicted promising results and potential to be used as bio preservative for fruits and vegetables [3] and is widely used as consumable coating for increasing shelf-life and delay ripening [4].

It has been also broadly reported that salts of calcium used in fruits help in keeping postharvest quality in order to reduce the problem of softening thus, reducing the ripening, respiration processes and the senescence [5-9]. In recent works 0.5–3% calcium salts concentrations are used by Bico *et al.* [10]. Calcium as a firming agent and preservative in fruits and vegetable sector is used for quite long time [11]. Also it plays a significant role in maintaining cell membrane and turgour pressure. Moreover it reduces browning as it minimizes the leakage of polyphenyl oxidase (PPO) on the exposed surfaces of the fruits or vegetables [12]. When fruits are dipped in CaCl_2 then their storage span is enhanced and firmness is also slow down [13].

Guava (*Psidium guajava* L.) is most attractive and tasteful fruit. As a desert fruit it is very sweet and fresh and can be consumed along with skin. Furthermore, it has the ability to produce best quality products like candies, concentrates puree, squash, paste, jams, juice, and jellies. Due to its commercial and nutritional importance the guava fruit is well thought-out a man's fruit and called "apple of the tropics" [14]. Softening is one factor which eventually reduces its shelf-life because of climacteric characteristic and higher metabolic process [15]. Guava grown in Pakistan has shorter shelf life because of high moisture content present in it. Its shelf

life cannot be extended easily with different techniques even when stored at cold environment. The main problems due to rapid ripening and softening is its sensitivity to fruit decay, low temperature and perishability, therefore effects the handling, storage and transport potential [16]. According to Toivonen and Deel [17], storage life of fresh fruits and post-cut quality it's totally dependent on cultivar, ripeness stage at harvest, processing technologies and storage environment. Though the use of calcium salts and *Aloe vera* gel has been widely used for keeping the quality of fruits during storage but very little is known about using *Aloe vera* gel along with the calcium salts as a post-harvest reagent for keeping the quality of guava fruits. In the current study, guava fruit harvested at physiological maturity stage were stored for 35 days and the individual as well as combined effects of Aloe-Vera gel coating and CaCl_2 were studied for the physicochemical and sensory attributes of guava fruit and their respective results for minimizing the post-harvest losses.

Materials and Methods

Guava fruits selection and treatment preparation

Guava fruits having identical size, shape and free from defects were harvested at physiological maturity from Malakandair farm, University of Agriculture Peshawar, Pakistan. The fruits were thoroughly washed with tap water and then air dried keeping under air fan overnight. The fruits were then cleaned with soft cotton cloth before treatment. For *Aloe vera* gel preparation, *Aloe vera* plant leaves were taken from ornamental nursery, Department of Horticulture, The University of Agriculture Peshawar, Pakistan and extraction of gel was done at Food Science and Technology Laboratory, University of Agriculture Peshawar, Pakistan. *Aloe vera* gel was extracted from aloe leaves following the method as described by Marpudi *et al.* [18]; Adetunji *et al.* [19]; Jalal and Ahmad [2] and the prepared gel

was stored in pre-sterilized brown colored paper covered glass jars at 5 °C to avoid any deterioration before use. Various concentrations of the aloe gel and solutions of calcium chloride provided by Food Science and Technology Laboratory, University of Agriculture Peshawar, Pakistan according to experimental plan (Table 1).

Treating guava fruits with aloe gel and CaCl₂

The guava fruits were treated with different concentrations of aloe gel and CaCl₂ solution as prescribed in (Table 1) using Dip technique [20]. The guava fruits were divided into six lots symbolically expressed as GA₀, GA₁, GA₂, GC₃, GCA₄ and GCA₅ (Table 1). Guava fruit of the treatment GA₁ were immersed in 10% *Aloe vera* gel while GA₂ were dipped in 20% *Aloe vera* gel for 30 mins and GC₃ were immersed in 2% CaCl₂ for 3 minutes. Similarly, guava of treatment GCA₄ were first dipped in 2% calcium chloride solution and then coated with concentration of 10% *Aloe vera* Gel for 30 mins respectively. Whereas GCA₅ were treated with same concentration of 2% CaCl₂ solution and addition of 20% *Aloe*

vera Gel for about 30 minute. The treatment (GCA₀) was left as a control without CaCl₂ and *Aloe vera* coating treatment. Guava fruits after treating with different coating materials were dried with a fan blower. All the samples were then stored in refrigerator at around 0 to 5±1°C. The process of data recording and lab analysis of guava fruit was carried out after each 7 days of interval for maximum of 35 days of storage period.

Analysis of physico-chemical properties

The treated stored guava fruits were characterized for various physicochemical properties on weekly basis.

Fruit firmness and phenol content

Fruit Firmness (kg/cm²) of guava fruits was measured from the two opposite sides of the fruits using hand Penetrometer following the standard method as prescribed in AOAC [21]. Phenol content (mg/100 g) was predicted by the method followed by Rana *et al.* [22].

Physiological weight loss and respiration rate

Physiological Weight loss (%) was measured by using the weighing digital balance using the formulae given below;

$$\text{Weight loss (\%)} = \frac{\text{Weight of fresh fruit} - \text{weight after duration}}{\text{Weight of fresh fruit}} \times 100$$

The respiration rate was measured in μ mole of CO₂ evolved/hour/ kilogram of fruit as described by Rana *et al.* [22].

pH, TSS, titratable acidity, ascorbic acid, sugar acid ratio

pH was measured with Digital pH meter, Total soluble solids (TSS) (°Brix) by digital refractometer, Percent or titratable acidity via titrating the prepared fruit juice solution against NaOH normal solution, Sugar/ acid

ratio dividing TSS by percent acidity, and Ascorbic acid (mg/100g) by titrating the fruit juice solution against 2, 6-dichlorophenol indophenol dye solution using the standard procedures as prescribed in AOAC [21].

Decay index

Decay index (%) was measured by using the following formulae;

$$\text{Decay index (\%)} = \frac{(1 \times N_1) + (2 \times N_2) + (3 \times N_3)}{3 \times N} \times 100$$

Where, 0 = No decay, 1 = ¼ decay, 2 = ½ decay, 3 = ¾ decay, N = Total number of fruits, N₁, N₂, N₃ = Number of fruits indicated decay regions.

Sensory evaluation of stored guava fruits

The stored samples were organoleptically evaluated for colour and flavour by applying nine point Hedonic Scale described by Larmond [23]. Three

experienced and trained judges from the department of Food Science and Technology, University of Agriculture Peshawar, Pakistan judged the different treated fruit samples and marked according to the scale in comparison with the control. The questionnaire and grading scale used for the sensory evaluation of stored Guava fruits (Table 2).

Statistical analysis

All the data were taken in three replicates and statistically analyzed with the use of CRD complete randomized design with 2 factorial (Factor 1: Different treatment solutions labeled as GA₀, GA₁, GA₂, GC₃, GCA₄ and GCA₅; Factor 2: Storage duration i.e. 0, 7, 14, 21, 28, 35 days) and means were compared by LSD test (LSD value 0.05) as described by Steel and Torrie, [24] using Statistix software version 8.1, MS-Excel 2013 and Sigma plot software version 14.

Results and Discussion

Physico-chemical analysis

Results for the Physico-chemical analysis for all the studied parameters of stored guava fruits were significantly influenced by both treatment (GA₀, GA₁, GA₂, GC₃, GCA₄ and GCA₅) and storage intervals (0, 7, 14, 21, 28, 35 days). Means were separated by $p < 0.05$ followed by different alphabetic letters (Table 3a, b).

Guava fruit firmness (kg/cm²) and phenol content (mg/100g)

Fruit firmness is the promising and important parameter in the post-harvest study to test the maturity level and softening of fruits. Correspondingly, Phenol content decrease during storage leading to the softening of the fruit and affects the fruit firmness. These could be an important quality variables having a direct association with ripeness of the fruits. In the present study, statistical analysis of data indicated that firmness of guava fruit was significantly ($p < 0.05$) influenced by both treatment and storage intervals. Fruit firmness (2.87 - 2.89 kg/cm²) and phenol content (60.1 mg/100g) was noted in fresh fruits at 0 days of storage which were

reduced throughout storage time period. The maximum reduction in fruit firmness (0.71 kg/cm²) and phenol content (15.9 mg/100g) was recorded in control fruits while the minimum reduction in fruit firmness (0.99 kg/cm²) and phenol content (32.2 mg/100g) was recorded in fruits treated with 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) at 35 days of storage. This indicates that the fruit firmness (Fig. 1) has been significantly retained by GCA₄ with minimum reduction in phenol content (Fig. 2), up to 35 days of storage having less reduction as compared with the control and other treatments.

As observed in the present study, it was also reported in previous studies that during ripening process the firmness of fruits declined. The reason behind it is the conversion of insoluble proto pectins to much soluble pectin as well as the chain length of pectin material is shortened which ultimately increase the pectin esterase and polygalacturonase. The prominent activities of these enzymes that hydrolyze cell wall was declined by maximum level of CO₂ and minimum level of oxygen which leads to keep the firmness in post-harvest storage duration. It was also reported previously that coating materials acts as a firming agent which delays the changes occur in structural polysaccharide like pectin and maintained the firmness of fruit for a long period during storage [25]. Oms-Oliu *et al.* [26] reported that coating of fruit retain the firmness for longer time and act as a barrier to prevent loss of nutrient and moisture. The results regarding the prevention of fruit firmness are in line with the findings of Akhtar *et al.* [27] worked on the shelf life extension of loquat fruit using CaCl₂, and with Arowora *et al.* [28] studying the shelf life of oranges using *Aloe vera* gel as a coating material but CaCl₂ with the combination of *Aloe vera* gel used in the present study appeared to be the best coating material for the retention of fruit firmness which is directly an indication of preventing fruits from ripening during storage.

Physiological weight loss (%), respiration rate (μ mole CO₂ release/hr/kg fruit) and decay index (%)

Fruits start losing moisture contents soon after harvest due to higher respiration rate during storage and thus rapidly lose their weight and deteriorate. Results demonstrated that weight loss (Fig. 3), respiration rate (Fig. 4) and decay index (Fig. 5) in guava fruit was significantly affected ($p < 0.05$) by both treatment and storage intervals and there is a significant difference exists among coated and uncoated fruits. The physiological weight loss and decay index of Guava fruits having the respiration rate ($4.9 - 5.5 \mu$ mole of CO₂ evolved/hour/ kilogram of fruit) at 0 days of storage continuously rose with increase in storage period. None of the guava fruit experienced any sign of decay during first 7 days having lowest physiological weight loss ($3.4 - 6.13 \%$) and respiration rate ($7.7 - 9.8 \mu$ mole of CO₂ evolved/hour/ kilogram of fruit), however the fruits start deteriorating after 7 days of storage. At 35 days of storage, the fruits treated with 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) retained the maximum weight loss (8.21%) having lesser respiration rate (17.7μ mole of CO₂ evolved/hour/ kilogram of fruit) having lesser fruit deterioration (25.27%) while the maximum loss in physiological weight (15.9%) having maximum respiration rate (25.3μ mole of CO₂ evolved/hour/ kilogram of fruit) with maximum decay index (47.56%) was found in control fruits.

The higher value of weight loss in control fruit when compared with treated fruit might be due to beneficial role of edible coating of *Aloe vera* gel and calcium application. Similar results for physiological weight loss (%) were found by Akhtar *et al.* [27]; Laster and Grusak [29]; Hayat *et al.* [30]. Loss in physiological weight is due to higher respiration rate during storage [22]. In consistence, analysis of data pointed that decay index of guava was significantly ($p < 0.05$) impacted by both treatment and

storage period. The lower value of decay index in treated guava as compared with untreated guava might be due to the reason that calcium dipping and edible coating slow down senescence. Similar results were revealed by El-Anany *et al.* [31] for Anna apple and Sohail *et al.* [32] for peach fruit.

pH, TSS, titratable acidity, ascorbic acid, sugar acid ratio

During preservation period of fruits, the post-harvest parameters like pH, total soluble solids (TSS), Titratable acidity, Ascorbic acid has a greater contribution in preserving the fruits from deterioration and early ripening and has a great relation among them. During the post-harvest life, pH and TSS increases whereas, the titratable acidity and ascorbic acids decreases. pH value increase due to the development of pectin and free acids [33] and TSS due to losses in water through respiration and evaporation and also hydrolysis of starch in storage duration [34]. Similarly, Titratable/ percent acidity and Ascorbic Acid/ Vitamin C content decreases in post-harvest storage due to metabolic activity organic acids and oxidation of Ascorbic Acid into dehydro ascorbic acid by enzyme ascorbic acid oxidase [35, 36]. During storage, the coating materials forms a semipermeable layer around the fruits due to which it delayed ripening of fruit and slow down the respiration rate with reduction of consumption of acids. The losses in acids are greatly because organic acids are used as a substrate for respiratory metabolism and also as a carbon skeleton for the synthesis of new compounds during process of ripening. In addition, accumulation of sugars at the time of ripening contributes to decrease of acidity as a result of rise in TSS acid ratio [37].

In present study, pH (Fig. 6), TSS (Fig. 7), Ascorbic Acid (Fig. 8), Acidity (Fig. 9) and sugar acid ratio (Fig. 10) was significantly ($p < 0.05$) influenced by both treatment and storage intervals. At the initial day of storage, in Guava fruits, TSS ($7.81 - 7.85$ °Brix) and pH ($4.28 - 4.87$) was found in

coated and uncoated fruits which increased during storage period while Ascorbic acid (187.51 – 198.27 mg/100g) and Titratable Acidity (0.92 – 0.98 %) was found in coated and uncoated fruits which decreased with the increase in storage period. Similarly sugar acid ratio was found (8.01 – 8.49) in all coated and uncoated fruits at 0 days of storage which also showed an increased trend during storage period. Maximum TSS (9.36 °Brix) and pH (4.61) was retained by 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) while maximum increased in TSS (11.05) and pH (6.74) was noted in controlled fruits at 35 days of storage. Similarly, the minimum decrease in ascorbic acid (155.8 mg/100g) and titratable acidity (0.74 %) was found in guava fruits treated with 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) as compared with the controlled fruits with maximum decrease in ascorbic acid (109.11 mg/100g) and titratable acidity (0.47 %) at 35 days of storage. Correspondingly the minimum increase in sugar acid ratio (12.65) was noted in maximum fruits treated with 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) and maximum increase in sugar acid ratio (23.51) in control fruits at 35 days of storage.

Identical outcomes for the impact of edible coating were described by Ali *et al.* [38] on pH of peach fruit, Lara *et al.* [12] on strawberry fruit and, Ergun and Satıcı [33] on Granny Smith's Apples. Regarding the TSS the same pattern of change was previously shown by Ahmad *et al.* [39] working on 'Arctic Snow' nectarine. Similarly, it was also reported that edible coating is promising tool for retaining the percent acidity in fruits during storage and the work is greatly related with Ahmed *et al.* [39]; Caro and Joas [40]; Apai *et al.*

[41]; Ergun and Satıcı. [33]; Zhou *et al.* [42]. Fruit coating slow down the respiration rate in fruits after harvest and therefore helps in maintaining Vitamin C for long duration [43]. The outcomes of the present study are also relevant to this study of El-Alakmy [44].

Sensory evaluation

Results for the Sensory evaluation of stored guava fruits were significantly influenced by both treatment (GA₀, GA₁, GA₂, GC₃, GCA₄ and GCA₅) and storage intervals (0, 7, 14, 21, 28, 35 days). Judges score for the target parameters i.e. color and flavor were statistically analyzed. To confirm the scores for both color and flavor, the scoring for overall acceptability of the fruits were also counted and their means were separated by $p < 0.05$ followed by different alphabetic letters (Table 4).

Colour and flavor score

Data analysis revealed that color and flavor score of guava fruit was significantly ($p < 0.05$) influenced by different treatments and storage intervals. Judges score for colour and flavour was (8.53 – 8.81) at the initial day of storage which is considerably decreased during storage period. The final score for colour and flavour of stored guava fruits (3.81) was significantly retained by treatment of 2% CaCl₂ and 10% *Aloe vera* gel (labelled as GCA₄) while the lowest colour and flavour score (2.17) was recorded in control fruits at 35 days of storage (Fig. 11).

Similar results for color flavor and overall acceptability were also reported by Hayat *et al.* [30]; Mirdeghan *et al.* [45]; Marpudi *et al.* [18]; Valverde *et al.* [46]; Martinez-Romero *et al.* [4]; Ahmed *et al.* [39]; Navarro *et al.* [47]; Carillo *et al.* [48]; Mahmud *et al.* [49]; Guillen *et al.* [50]; El-Anany *et al.* [31].

Table 1. Various concentrations of Aloe gel and CaCl₂ solution

Treatments	Calcium chloride (%)	<i>Aloe vera</i> gel (%)
GCA ₀	Nil	Nil
GA ₁	—	10
GA ₂	—	20
GC ₃	2	-
GCA ₄	2	10
GCA ₅	2	20

Where G= Guava, C= Calcium Chloride, A= *Aloe vera* gel

Table 2. 9-Point hedonic scale for Sensory evaluation of coated guava fruits with Aloevera gel and Calcium chloride

Treatments	Color (1-9)	Flavor (1-9)	Overall Acceptability (1-9)
GCA ₀			
GA ₁			
GA ₂			
GC ₃			
GCA ₄			
GCA ₅			

Points: Like/ Dislike; Scale: (9-Like Extremely), (8-Like very much), (7-Like moderately), (6-Like slightly), (5-Neither liked nor disliked), (4-Disliked slightly), (3-Disliked moderately), (2-Dislike very much), (1-Disliked extremely)

Table 3a. Physico-chemical analysis of Guava fruits treated with various concentrations of CaCl₂ and *Aloe vera* gel stored for 35 days after harvest

Treatments	Firmness (kg/cm ²)	Phenol content (mg/100g)	Weight loss (%)	Respiration rate (μ mole CO ₂ evolved/hr/ kg fruits)	Decay index (%)
GCA ₀	1.85d	38.75a	9.05a	15.40a	18.22a
GA ₁	1.97c	41.90d	6.21bc	13.22b	11.89c
GA ₂	1.95c	43.20b	6.29b	13.28b	13.90e
GC ₃	2.04ab	43.57b	5.08d	13.22b	8.89b
GCA ₄	2.14a	46.57c	4.89d	12.57c	8.32b
GCA ₅	2.02b	44.83bc	5.56c	13.88d	9.12d
Sig.	*	*	*	*	*
Storage Intervals					
Initial	2.93a	60.10a	0.00f	5.13a	0e
7 days	2.56b	53.68b	4.32e	8.82b	0e
14 days	2.24c	45.87c	5.77d	13.20c	3.54d
21 days	1.92d	38.98d	7.18c	16.60d	12.94c
28 days	1.51e	34.30e	9.47b	17.78e	21.43b
35 days	0.92f	25.88f	10.33a	20.03f	33.02a
Sig.	*	*	*	*	*

Table 3b. Physico-chemical analysis of Guava fruits treated with various concentrations of CaCl_2 and *Aloe vera* gel stored for 35 days after harvest.

Treatments	pH	Total Soluble Solids	Titrateable Acidity %	Sugar acid Ratio	Ascorbic Acid
GCA ₀	5.49a	9.06a	0.71d	13.923a	154.81f
GA ₁	4.53bc	8.59bc	0.78c	11.393c	163.34d
GA ₂	4.56b	8.60b	0.77c	11.572b	159.66e
GC ₃	4.46d	8.53d	0.85ab	10.281e	169.14b
GCA ₄	4.41d	8.43e	0.94a	9.960f	180.22a
GCA ₅	4.52c	8.56cd	0.82b	10.630d	166.81c
Sig.	*	*	*	*	*
Storage Intervals					
Initial	4.43f	7.83f	0.95a	8.262f	192.33a
7 days	4.41e	7.97e	0.92b	8.654e	187.19b
14 days	4.56d	8.20d	0.81c	10.164d	174.91c
21 days	4.67c	8.51c	0.76d	11.365c	166.63d
28 days	4.84b	9.40b	0.71e	13.502b	142.44e
35 days	5.01a	9.86a	0.64f	15.823a	122.74f
Sig.	*	*	*	*	*

Figure 1. Fruit firmness of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$.

Figure 2. Phenol contents of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 3. Physiological weight loss of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 4. Respiration rate of Guava fruits affected by various concentrations of CaCl₂ and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at P ≥ 0.05

Figure 5. Decay Index of Guava fruits affected by various concentrations of CaCl₂ and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at P ≥ 0.05

Figure 6. pH of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 7. TSS of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 8. Titratable Acidity of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 9. Ascorbic Acid of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Figure 10. Sugar Acid Ratio of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Table 4. Sensory evaluation of Guava fruits treated with various concentrations of CaCl_2 and *Aloe vera* gel stored for 35 days after harvest

Sensory Evaluation			
Treatments	Color	Flavor	Overall Acceptability
GCA ₀	5.192d	5.052d	5.181d
GA ₁	5.843c	5.772c	5.831c
GA ₂	5.803c	5.701c	5.782c
GC ₃	6.124ab	6.063b	6.111b
GCA ₄	6.191a	6.134a	6.184a
GCA ₅	6.053ab	6.004b	6.043b
Sig.	*	*	*
Storage Intervals			
Initial	8.672a	8.441a	8.604a
7 days	7.383b	7.341b	7.384b
14 days	6.254c	6.203c	6.252c
21 days	5.295d	5.192d	5.211d
28 days	4.375e	4.302e	4.363e
35 days	3.324f	3.253f	3.332f
Sig.	*	*	*

Figure 11. Colour and Flavour score of Guava fruits affected by various concentrations of CaCl_2 and *Aloe vera* gel compared with the control during storage period up to 35 days. Error bars represent LSD at $P \geq 0.05$

Conclusion

Based on the obtained results from stored guava fruits at $5 \pm 1^\circ\text{C}$ for 35 days treated with various concentrations of *Aloe vera* gel CaCl_2 alone and in combination, it was concluded that both CaCl_2 treatment and edible coating *Aloe vera* gel showed significant impact on quality parameters. Edible coating and low temperature storage had reduced decay and enhanced shelf life of guava fruit. Guava coated with 2% CaCl_2 and 10% *Aloe vera* gel (labelled as GCA4) promisingly retained physico-chemical characteristics and also maintained the sensory attributes than all the other treatments performed and was found to be most effective treatment in maintaining the fruit quality attributes along with the shelf life extension for 35 days.

Authors' contributions

Conceived and designed the experiments: A Riaz & R Shabir, Performed the experiments: R Shabir, Analyzed the data: A Sohail & R Shabir, Contributed materials/ analysis/ tools: SM Shah, Wrote the paper: R Shabir.

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