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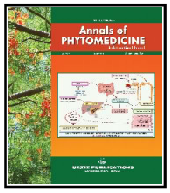

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Impact of salicylic acid and ascorbic acid post-harvest dipping on phytochemical compounds of Allahabad Safeda guava fruits

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Abstract

Guava (*Psidium guajava* L.) is one of the highly valued fruit crops. The fruit has many medicinal benefits for managing high blood pressure and is rich in a variety of bioactive compounds. However, after harvest, the fruit deteriorates quickly and can only be stored for a few days at room temperature. The current study aims to improve fruit's storability and preserve quality in guava when it is stored at room temperature. Completely ripe guava fruits were immersed in solutions containing salicylic acid (500, 1000, and 1500 µmol) and ascorbic acid (250, 500, and 750 ppm) alone and in combinations. As control fruits were submerged in distilled water. After being dried, fruits were placed in plastic bins. Guava fruits treated with treatment salicylic acid @ 1000 µmol + ascorbic acid @ 500 ppm (T5) exhibited excellent preservation of fruit quality and delayed senescence. This treatment maintained higher sugars (total sugar, reducing sugar, and TSS; 7.81%, 2.70%, and 7.18%, respectively), titratable acidity (0.52%), ascorbic acid content (224.92 mg/100 g pulp), and total phenol content (121.61 mg/100 g pulp) compared to the control. Simultaneously in treatment T5 observed the lowest drop of PME (1.44). All things considered, guava cv. "Allahabad Safeda" dipping with salicylic acid @ 1000 µmol + ascorbic acid @ 500 ppm (T5), significantly increased the fruits shelf-life and maintained its freshness for up to 12 days stored under ambient conditions. The findings of the study will enable long-distance transportation of guava fruit and ease its subsequent marketing.

1. Introduction

Guava (*Psidium guajava* L.) is one of the major fruits cultivated in tropical and subtropical countries. It belongs to the family Myrtaceae (Pandhi *et al*., 2022). It is a sturdy, long-lasting variety of trees that bears abundantly and has great commercial relevance; as a result, it needs less maintenance and is more profitable. Fruits of guava are highly cherished due to their richness in ascorbic acid, vitamin A and vitamin B. Well-known for its traditional therapeutic properties, guava is used in many traditional medical systems (Jayakumari *et al*., 2023). It is a rich in nutritional fibre, ascorbic acid, carotenoids, polyphenols, and sweet taste (Lakashmi *et al*., 2022). It also has a great flavour, Besides that, its fruits are also an excellent source of pectin and play a significant role in the reduction of cholesterol decreasing the risk of ulcers and cardiovascular diseases (Kumar *et al*., 2021). Guava fruits have low storage potential under ambient storage conditions, and therefore require certain post-harvest interventions to extend the storage potential under ambient storage conditions.

Guava is a climacteric fruit that ripens fast and has a shelf-life of 2-3 days under typical conditions (Madhav *et al*., 2016). Besides these properties, fruit also contains a higher content of ascorbic acid, phenolics carotenoids, and antioxidants (Adeoye *et al*., 2011; Tavassoli-Krafani *et al*., 2016). As it is a climacteric fruit with a short post-harvest life and a respiratory and ethylene peak during ripening, it is suffering substantial post-harvest losses (Gill *et al*., 2016). As a consequence, post-harvest treatments are the sole viable option for increasing storage life and decreasing spoilage. One of these treatments is the application of edible coatings (Sharma *et al*., 2023). These coatings take the place of polymers that are used to extend shelf-life. The food does not acquire any undesirable qualities from these films. The main benefit of these coats is that they cover the stomata, which encourages less transpiration and, as a result, lessens weight loss, as several research on different fruits have shown (Sharma *et al*., 2023). Antioxidants, such as salicylic acid along with ascorbic acid, are used in a variety of post-harvest applications.

Salicylic acid (SA), an endogenous plant growth regulator, slows post-harvest ripening in horticulture crops. It is a safe and natural chemical component for post-harvest treatment on fruits and has been utilized to delay ripening and softening while also reducing lipid peroxidation and chilling damage (Zhang *et al*., 2003; Barman and Asrey, 2014). Therefore, we studied the effect of post-harvest administration of salicylic acid and 5-sulfosalicylic acid (SSA), a derivative of SA, on the physiological and qualitative aspects of guava fruits. Ascorbic acid (AA), a natural antioxidant with anti-pathogenic effects, assists in the preservation of post-harvest quality in horticulture crops (Jayachandran *et al*., 2007). Ascorbic acid is a water-soluble antioxidant that functions as a ROS scavenger, potentially protecting cells from the negative effects of “oxidizing products” (Branduardi *et al*., 2007). Ascorbic acid has been used to prevent browning in mango (Loay and Ameer, 2019), mung bean sprouts (Sikora and Swieca, 2018), lotus root slices (Ali *et al*., 2020), and longan fruit (Khan *et al*., 2020).

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2. Materials and Methods

2.1 Material and treatment

An experiment was conducted at Lovely Professional University in Phagwara, India, using a factorial randomized block design with 3 applications, totaling 7 treatments to investigate the effect of post-harvest dipping in salicylic acid and ascorbic acid on the storage life and quality of guava fruit cv. Allahabad Safeda under ambient storage conditions. Guava fruits were transported from the orchard to the laboratory around the middle of February. At the time, the fruits were resilient and fresh, with consistent sizes. They were first rinsed by running tap water. The fruits were then treated with dipping method for 1 min with different concentrations of salicylic acid and ascorbic acid alone and in combination: T_1 (SA @ 500 µmol) and T_2 (SA @ 1000 µmol), T_3 (SA 1500 @ µmol), T_4 (SA @ 500 µmol + AA 250 ppm) T_5 (SA @1000 µmol + AA @ 500 ppm); T_6 (SA @ 1500 µmol + AA @ 750 ppm). The treated fruits were estimated for quality characteristics on the 4th, 6thand 12th day.

2.2 Estimation of TSS (°Brix)

The final results were presented as percentages after temperature adjustment at 20°C, and TSS was estimated using a hand refractometer (AOAC, 2005; Mohammadi *et al*., 2020).

2.3 Estimation of reducing sugars (%)

Fresh fruit pulp (5.0 g) was used to determine the RS, and following maceration, distilled water was added to produce the volume 50 ml. Later, 2.0 ml of lead acetate solution (45%) was added to precipitate the unwanted component. To remove excess lead, after 10 min, 5.0 ml of potassium oxalate (22%) was added to the solution, which was then raised to 100 ml with pure water (Gill, 2014).

2.4 Estimation of total sugars (%)

In order to identify fehling A + B, the filtrate was collected and titrated with methylene blue (2.5 ml each). The final target was determined to be brick red, and the results were expressed as percentages (Gill, 2014). A 100 ml volumetric flask was filled with 25 ml of the filtrate that had been previously prepared to estimate RS to estimate TS. After adding 20 milliliters of 60 per cent HCL to this solution, it was left to hydrolyze for the entire night. A saturated NaOH solution was used to neutralize the remaining HCL, and distilled water was added to bring the amount up to 100 ml. Using methylene blue as an indicator, the hydrolyzed filtrate was titrated against a boiling mixture containing 2.5 ml of fehling A and B each until it turned brick red, which was the amount of total sugar.

2.5 Estimation of titratable acidity (%)

To determine TA fresh fruit pulp (5.0 g) was macerated in distilled water to create a volume of 50 ml to calculate the TA. The aliquot was titrated using a phenolphthalein indicator against NaOH (0.1 N). The computation was done utilizing the (Gill *et al*., 2016) formula and the results were expressed as percentages.

2.6 Estimation of ascorbic acid content (mg/100 g pulp)

A few modest modifications were made to Ranganna's (1994) techniques to determine the fruit pulp's ascorbic acid concentration. Thus, 5.0 g of fresh fruit pulp that had been macerated was treated with 95 ml of 0.4 per cent oxalic acid. A 10-milliliter aliquot was taken from this prepared solution and titrated against 0.4 per cent DPCIP dye until the endpoint (pink 1 hue) was visible. According to Gill *et al*. (2016), the output was expressed in milligrams per 100 g of pulp.

2.7 Estimation of total phenol content (mg/100 g pulp)

To find the total phenol content in the apple pulp, the methods outlined by Bray and Thorpe (1954) were used with a few small modifications. Consequently, 10 milliliters of ethanol were mixed with 1.0 g of fresh fruit pulp (80%). After filtering, 0.2 ml of the filtrate was put in a 25 ml test tube together with 2.0 ml of 20% Na_2CO_3 and 1 ml of FC reagent (1 N). After the mixture was thoroughly blended, it was heated for one minute in a boiling water bath before being cooled under running water. The generated solution was brought to a final volume of 25 milliliters using distilled water. The absorbance was measured at 650 nm using a microplate spectrophotometer (Epoch Biotech, USA) after 30 min. The gallic acid standard curve was used to quantify the total phenol concentration, and the results were expressed in milligrams per 100 g of pulp (Gill *et al*., 2016).

2.8 Estimation of pectin methyl esterase (PME) activity (micro equi. acid produced/min/g pulp)

To extract the enzyme, 10 ml of guava fruit pulp was filtered through two layers of cheesecloth, mixed with 60 - 100 ml of a 0.15 M NaCl solution, then centrifuged at 2000 g for 30 min at 4°C. Since the amount of salt used and pH are directly correlated, the pH of the NaCl solution (0.15 M) was continuously maintained at 7.0 to increase PME activity. An enzyme source was isolated from the supernatant. A 50 ml beaker was filled with 10 ml of the supernatant solution to bring the pH of the enzyme assay to 7.0. In this case, time seemed to be zero. After 15 min after being kept at 30°C in a water bath, the beaker's pH was checked and brought to 7.0 by adding 0.02 N NaOH and swirling the contents. The amount of NaOH used at each storage interval was also noted. To gauge PME activity, the micro equivalent acid generated/min/gm pulp was utilized (Hagerman and Austin, 1986).

3. Results

3.1 Ascorbic acid (mg/100 g pulp)

The data revealed that the ascorbic acid levels in untreated and treated fruits were not significantly different until the 8th day of storage (Table 1). The minimum ascorbic acid (147.87 mg/100 g pulp) was found in control on the 12th day of storage. Guava fruits treated with SA @ 1000 µmol + AA @ 500 ppm (T_5) had the maximum ascorbic acid retention (224.92 mg/100 g pulp), followed by treatment T_4 (SA @ 500 µmol + AA @ 250 ppm).

3.2 Total soluble solids (mg/100 g pulp)

In this investigation, TSS was reduced during storage in both treated and control fruits (Table 2). On the 12th day of storage, treatment T_5 (SA @ 1000 µmol + AA @ 500 µmol) had the highest TSS (8.18 mg/ 100 g pulp), while T_4 (SA @ 500 µmol + AA @ 250 ppm) was statistically comparable.

Table 1: Effect of salicylic acid and ascorbic acid on ascorbic acid (mg/100 g pulp)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	256.10^{a}	229.13^{b}	210.42^{d}	159.88^{h}	213.88^{de}
T_2	256.10^{a}	230.50^{b}	213.83^{cd}	167.23^{gh}	216.91^{cd}
T_3	256.10^{a}	231.62^{b}	212.90^{cd}	163.45^{h}	216.02^{cde}
T_4	256.10^{a}	232.74^{b}	219.21^{c}	184.42^{f}	223.12^{ab}
T_5	256.10^{a}	233.82^{b}	217.00^{cd}	192.76^{e}	224.92^{a}
T_6	256.10^{a}	234.30^{b}	215.11^{cd}	171.90^{g}	219.35^{bc}
Control	256.10^{a}	235.41^{b}	209.83^{d}	147.87^{i}	212.30^{e}
Mean	256.10^{a}	232.50^{b}	214.04^{c}	169.64^{d}	
LSD ($p \leq 0.05$)	Treatment (T) = 3.87	Days (D) = 2.92	D × T = 3.74		

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

Table 2: Effect of salicylic acid and ascorbic acid on total soluble solids (mg/100 g pulp)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	5.79^{d}	6.38^{c}	8.40^{a}	7.21^{b}	6.95^{bc}
T_2	5.79^{d}	6.20^{c}	8.21^{a}	8.08^{a}	7.07^{abc}
T_3	5.79^{d}	6.42^{c}	8.44^{a}	7.24^{b}	6.97^{bc}
T_4	5.79^{d}	6.27^{c}	8.30^{a}	8.11^{a}	7.12^{ab}
T_5	5.79^{d}	6.36^{c}	8.39^{a}	8.18^{a}	7.18^{a}
T_6	5.79^{d}	6.24^{c}	8.18^{a}	8.17^{a}	7.10^{ab}
Control	5.79^{d}	6.30^{c}	8.33^{a}	7.14^{b}	6.89^{c}
Mean	5.79^{d}	6.31^{c}	8.32^{a}	7.73^{b}	
LSD ($p \leq 0.05$)	Treatment (T) = 0.19	Days (D) = 0.14	D x T = 0.38		

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

3.3 Titrable acidity (%)

The data showed that the titratable acidity content of the fruits decreased during storage. Guava fruits treated with SA @ 1000 ìmol + AA @ 500 ppm (T_5) had the highest titratable acidity (0.41%) at the end of storage, whereas the control had a minimum (0.23%) titratable acidity. All treatments were shown to have significant differences from each other.

Table 3: Effect of salicylic acid and ascorbic acid on titrable acidity (%)

Treatments	Storage days				
0	4	8	12	Mean	
T_1	0.65^{a}	0.40^{fg}	0.33^{ij}	0.25^{lm}	0.46^{f}
T_2	0.65^{a}	0.46^{d}	0.39^{fgh}	0.32^{jk}	0.45^{d}
T_3	0.65^{a}	0.42^{e}	0.37^{h}	0.27^{l}	0.43^{e}
T_4	0.65^{a}	0.51^{c}	0.46^{d}	0.38^{gh}	0.50^{b}
T_5	0.65^{a}	0.54^{b}	0.49^{c}	0.41^{ef}	0.52^{a}
T_6	0.65^{a}	0.49^{c}	0.41^{ef}	0.35^{i}	0.47^{c}
Control	0.65^{a}	0.38^{gh}	0.30^{k}	0.23^{m}	0.39^{g}
Mean	0.65^{a}	0.46^{b}	0.39^{c}	0.31^{d}	
LSD ($p \leq 0.05$)	Treatment (T) = 0.01	Days (D) = 7.64	D × T = 0.02		

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

3.4 Total sugar and reducing sugar (%)

The results showed that the total and reducing sugars were seen to increase up to the 8th day and then decreased until the 12th day of storage (Table 4, 5). At the end of storage, control fruits had the greatest drop (4.97%) of total sugar compared to treated fruits. The T_5 treatment (SA @ 1000 µmol + AA @ 500 ppm) resulted in the lowest reduction (6.78 %) of total sugars. Guava fruits treated with SA @ 1000 µmol + AA @ 500 ppm (T_5) had more reducing sugars (3.19 %) than the control (2.13 %) by the 12th day.

Table 4: Effect of salicylic acid and ascorbic acid on total sugar (%)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	5.79^{d}	6.38^{c}	8.40^{a}	7.21^{b}	6.95^{bc}
T_2	5.79^{d}	6.20^{c}	8.21^{a}	8.08^{a}	7.07^{abc}
T_3	5.79^{d}	6.42^{c}	8.44^{a}	7.24^{b}	6.97^{bc}
T_4	5.79^{d}	6.27^{c}	8.30^{a}	8.11^{a}	7.11^{ab}
T_5	5.79^{d}	6.36^{c}	8.39^{a}	8.18^{a}	7.18^{a}
T_6	5.79^{d}	6.24^{c}	8.18^{a}	8.17^{a}	7.09^{ab}
Control	5.79^{d}	6.30^{c}	8.33^{a}	7.14^{b}	6.89^{c}
Mean	5.79^{d}	6.31^{c}	7.73^{bb}	8.32^{a}	
LSD ($p \leq 0.05$)	Treatment (T) = 0.19		Days (D) = 0.14	D × T = 0.38	

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

Table 5: Effect of salicylic acid and ascorbic acid on reducing sugar (%)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	1.83^{j}	2.39^{ef}	3.41^{a}	2.20^{hi}	2.46^{cd}
T_2	1.83^{j}	2.21^{hi}	3.22^{bcd}	3.09^{d}	2.59^{b}
T_3	1.83^{j}	2.43^{e}	3.45^{a}	2.25^{ghi}	2.49^{c}
T_4	1.83^{j}	2.29^{fgh}	3.32^{abc}	3.10^{d}	2.63^{ab}
T_5	1.83^{j}	2.37^{efg}	3.40^{a}	3.19^{cd}	2.70^{a}
T_6	1.83^{j}	2.25^{ghi}	3.18^{d}	3.19^{cd}	2.61^{b}
Control	1.83^{j}	2.32^{efgh}	3.34^{ab}	2.13^{i}	2.41^{d}
Mean	1.83^{d}	2.32^{c}	3.33^{a}	2.73^{b}	
LSD ($p \leq 0.05$)	Treatment (T) = 0.07		Days (D) = 0.05	D × T = 0.13	

Note: At P≤0.05, data with identical alphabets are statistically similar (n = 12).

Table 6: Effect of salicylic acid and ascorbic acid on total phenols (mg/100 g pulp)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	170.22^{a}	142.03^{bcd}	100.86^{i}	54.87^{kl}	116.99^{bc}
T_2	170.22^{a}	139.23^{cde}	101.34^{i}	51.22^{l}	115.50^{c}
T_3	170.22^{a}	134.44^{e}	106.77^{ghi}	55.24^{kl}	116.67^{bc}
T_4	170.22^{a}	144.71^{bc}	110.22^{g}	50.18^{l}	118.83^{ab}
T_5	170.22^{a}	146.11^{b}	109.78^{gh}	60.33^{k}	121.61^{a}
T_6	170.22^{a}	136.78^{de}	103.75^{hi}	52.44^{l}	115.80^{bc}
Control	170.22^{a}	125.22^{f}	79.34^{j}	30.20^{m}	101.24^{d}
Mean	170.22^{a}	138.36^{b}	101.72^{c}	50.64^{d}	
LSD ($p \leq 0.05$)	Treatment (T) = 3.12		Days (D) = 2.36	D x T = 6.24	

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

Table 7: Effect of salicylic acid and ascorbic acid on pectin methylesterase activity (micro equi. acid produced/min/gm pulp)

Treatments	Storage days				
	0	4	8	12	Mean
T_1	2.30^{h}	2.60^{e}	3.21^{c}	1.80^{i}	2.48^{b}
T_2	2.30^{h}	2.43^{fgh}	3.19^{c}	1.77^{ij}	2.42^{bc}
T_3	2.30^{h}	2.39^{gh}	3.10^{c}	1.65^{j}	2.36^{c}
T_4	2.30^{h}	2.55^{ef}	2.78^{d}	1.48^{k}	2.28^{d}
T_5	2.30^{h}	2.45^{fg}	2.81^{d}	1.44^{k}	2.25^{d}
T_6	2.30^{h}	2.48^{efg}	3.22^{c}	1.90^{i}	2.48^{b}
Control	2.30^{h}	3.78^{b}	4.20^{a}	0.80^{l}	2.77^{a}
Mean	2.30^{c}	2.67^{b}	3.22^{a}	1.55^{b}	
LSD ($p \leq 0.05$)	Treatment (T) = 0.07		Days (D) = 0.05	D x T = 0.14	

Note: At $p \leq 0.05$, data with identical alphabets are statistically similar (n = 12).

3.5 Total phenols (mg/100 g pulp)

In our investigation, total phenols in untreated fruit decreased faster than in treated fruits after storage (Table 6). Guava treated with SA @ 1000 µmol and AA @ 500 ppm (T_5) retained the most total phenolics (60.33 mg/100 g pulp) on the 12th day of storage, whereas untreated guava had the lowest (30.20 mg/100 g pulp).

3.6 Pectin methylesterase activity (micro equi. acid produced/ min/gm pulp)

It is evident from Table 7 that the significant effect of SA and AA treatments on PME activity in guava fruits was observed throughout the experiment. The control fruits had the lowest PME content (0.80 micro equi. acid produced/min/gm pulp), whereas guava fruits treated with (SA @ 1000 µmol + AA @ 500 ppm) (T_5) had the lowest drop in PME activity (1.44 micro equi. acid produced/min/gm pulp).

4. Discussion

Studies have found that ascorbic acid levels in guava decline during post-harvest storage (Barman and Asrey, 2014; Siddiqui *et al*., 2015). Guava treated with SA @ 1000 µmol + AA @ 500 ppm (T_5) had the maximum ascorbic acid retention (224.92 mg/100 g pulp) as ascorbic acid levels in untreated fruits fell quicker from the 8th day of storage, reaching a minimum of 147.87 mg/100 g pulp on the 12th day. Ascorbic acid is degraded during fruit senescence (Ali *et al*., 2021). Oxidative degradation of AA causes a decrease in its content during storage. The postharvest duration of AA reduction is restricted by the inhibition of oxidation caused by SA and AA treatment. The ascorbic acid level was higher in all treated fruits as a result of this treatment's restriction on O_2 availability for oxidative breakdown, which decreased fruit senescence and deterioration.

The treated guava fruits showed a progressive increase in TSS concentration till the 8th day, which then decreased until the 12th day of storage. Treatments involving SA + AA showed a progressive rise in TSS until the end of the experiment, suggesting that they had reduced the guava fruits' respiration rate during storage. Out of the treatments, T_5 (SA @ 1000 µmol + AA @ 500 µmol) had the highest TSS (8.18 mg/100 g pulp) on the 12th day out of all. The rise in TSS is due to the conversion of starch to sugar during guava ripening. After hydrolysis, no additional rise occurred, and the TSS level decreased as the sugars were converted to organic acids during respiration (Wills *et al*., 2007). Hydrolytic enzymes broke down complex polymers into simple chemicals, causing a rise in TSS up to the 8th day of storage. These compounds were subsequently utilized during respiration throughout the following storage periods (Bhooriya *et al*., 2018). Because SA may have slowed catabolic processes such as respiration rate and ethylene formation in treated guava fruits, TSS levels increased gradually (Madhav *et al*., 2016).

The titratable acidity of the fruits decreased during storage. Guava fruits treated with SA @ 1000 µmol + AA @ 500 ppm (T_5) had the highest titratable acidity (0.41%) at the end of storage, whereas the control had a maximum (23%). The acid concentration decreased more quickly in untreated fruits, but the acidity level decreased gradually in treated fruits. The reduction in acid content of fruits with increasing storage might be ascribed to the utilization of organic acids in the respiratory process by fruit cells and the conversion of acids into total sugars (Gill *et al*., 2014). Fruits treated with ascorbic acid retained a greater acidity level throughout storage, presumably due to delayed ripening.

In the present study, the total and reducing sugars were increased up to the 8th day of storage and then decreased on the 12th day. The previous study reported that the reducing sugars and total sugars gradually increased up to a certain period of growth and then decreased until ripening (Madhav *et al*., 2016). Control fruits had the greatest drop compared to treated fruits (4.97%). The treatment T_5 (SA @ 1000 µmol + AA @ 500 ppm) resulted in the lowest reduction of total sugars (6.78%). According to Mahajan *et al.* (2017), the rapid decomposition of starch into sugar leads to a rise in total sugar, but no further increase, demonstrating that organics function as a substrate during respiration. Guava fruits treated with SA @ 1000 µmol + AA @ 500 ppm (T_5) had more reducing sugars (3.19 %) than the control (2.13%) by the 12th day. The decline in sugar might be due to sugar being consumed for respiration throughout the storage period. Similarly (Saleem *et al.,* 2021) found that the concentration of non-reducing sugars decreases with extended storage time. Similarly, AA can slow fruit ripening and prevent fast increases in sugar content, as shown in treated guava fruits.

Total phenolic was significantly high in guava fruits treated with SA @ 1000 µmol and AA @ 500 ppm (T_5) on 12th day of storage. On the

other hand, total phenolic content was found to be lowest in control fruits compared with other treatments. Total phenols in untreated fruit decreased faster than in treated fruits during storage. The activities of polyphenol oxidase and peroxidase enzymes lowered the phenolic compounds available in guava as the storage duration increased (Duan *et al*., 2007). Salicylic acid's beneficial effect in reducing phenolic component loss in this study might be ascribed to delayed phenolic oxidation caused by decreased enzyme activity (Lu *et al*., 2011). Furthermore, SA and chitosan may have boosted phenolic compound production in fruit by enhancing PAL enzyme activity, resulting in greater total phenolics retention (Ghasemnezhad *et al.,* 2013), (Wang *et al*., 2018).

The PME activity increased until the 8th day and then decreased until the 12th day of storage (Table 7) and the minimum PME activity in T_5 (SA @ 1000 µmol and AA @ 500 ppm) treatment was recorded while it was maximum in fruits of T_6 (SA @1500 µmol + AA @ 750 ppm) treatment on 9th day of storage. A reduction in pectin is associated with a decrease in molecular size and desertification of pectin during storage. PME removes the methyl group from pectin's galacturonic acid polymers. Desertification of the pectin chain by PME may render it more sensitive to polygalacturonase-mediated breakdown, Carpita and Gibeaut (1993), resulting in a fast loss of cell wall structure. The decrease in the activities of PME in response to post-harvest treatments inhibits fruit softening, which contributes to the increased shelf life of produce (Saleem *et al*., 2021).

5. Conclusion

The combination of ascorbic acid (500 ppm) and salicylic acid (1000 µmol) shows promise in maintaining guava fruit quality and reducing post-harvest losses. When kept at room temperature, guava fruit cultivar "Allahabad Safeda" can maintain its higher firmness, sugar content, titratable acidity, ascorbic acid content, total phenol content, and sensory attributes for up to 12 days. The treatments were significantly postponing weight loss and deterioration of guava fruits. The results of this study also assisted us in organizing future studies on the effects of dipping in salicylic acid and ascorbic acid on the dynamics of enzymes that break down cell walls, PME activity, and other bioactive components of guava cv. "Allahabad Safeda" under ambient storage conditions.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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