AATCC Review

23 March 2023: Received
16 July 2023: Revised
18 September 2023: Accepted
21 November 2023: Available Online

www.aatcc.peerjournals.net

Research Article Open Access

Effect of Salicylic acid as post-harvest treatment on shelf life and quality of Guava (*psidium guajava* L.) Cv. Lucknow 49

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ABSTRACT

An experiment was conducted to study the effect of salicylic acid as dipping at two different concentrations (100 and 200ppm) on-shelf life and biochemical parameters of Guava cv. Lucknow 49 fruits (preharvest spray with Ca (No_3) 2 at 1 and 2 per cent) at two different color maturity stages of Green Mature (MG) and Color Turning stage (CT) and stored the fruits at room temperature (28± 2°c & 60 ± 10 % RH). Pre-harvest spray with calcium nitrate (2%) and postharvest treatment of SA at 200ppm at mature green stage recorded the minimum PLW of 13.65 percent on 9th day after storage with maximum fruit firmness of 4.93 Kg/cm^2 and fruit biochemical quality parameters viz TSS (9.01 ◦Brix), Ascorbic Acid (189.93 mg 100g^{-1}) Total sugars (6.95 %) with minimum total fruit skin and flesh color difference ΔE= 3.44 and 1.68

Keywords: *: Guava, Postharvest, Salicylic acid, Mature green (MG) Color turning (CT), Shelf life, Color difference, PLW*

Introduction

Guava (*Psidium guajava* L.), belonging to the Myrtaceae family, is an important fruit crop of the subtropical and tropical regions of the world. In India, the total area, production, and productivity of guava is about 264.85 (000 Ha) with 4053.51 (000 MT) and 15.30 MT /ha respectively. Tamil Nadu has total area production and productivity of guava are 9.69 (000 Ha), 155.06 (000MT), and 16.00MT /ha respectively (Hort. Stat 2018) The fruit is highly nutritional because its vitamin C content (50-300 mg/100g of fresh fruit) is 3-6 times higher than an orange[21].carbohydrates (13%) and minerals (Calcium-29 mg, Phosphorus-10 mg and Iron-0.5 mg 100 mg-1 fresh fruits). Guava is a very perishable fruit with a high respiration rate at 21 °C (2.24-mmol CO2 kg_1 h_1) and ethylene production rate (0.20-µmol C2H4 kg_1 h_1, after 156 h of storage) Guava is a climacteric fruit with a relatively short shelf life of about 3 to 5 days at ambient conditions due to its intense metabolism during ripening. This limits the time available for marketing and long-distance transport from the production area. Therefore extending the postharvest lifespan of guava fruit becomes fundamental to reducing its losses during the supply chain and increasing the commercialization as well.

Storage of guava fruits by using chemicals like GA3[15], Salicylic acid[2] and NAA[6] as postharvest treatment is commercially acceptable and economically feasible. Salicylic acid (SA) is a simple phenolic compound [20] also it plays a good role in post-harvest decay and disease resistance [1] and increases the plant defense against oxidative stress, delaying fruit ripening[1].

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DOI: https://doi.org/10.58321/AATCCReview.2023.11.04.365

Hence, salicylic acid treatments are used to control fruit ripening during shelf-life by which decreases successfully ethylene production in different fruits such as Kiwi [1], apple, and pear The inhibition of ethylene production in fruit may be through inhibition of ethylene by decreasing both of amino cyclopropane-1-carboxylic acid synthase (ACS) and oxidase (ACO) production and activity during early stage of fruit ripening since, ethylene plays a key role in fruit ripening and senescence.

Materials and Methods

The experiment was conducted to study the effect of postharvest treatment of salicylic acid at 100 and 200 ppm on the physico-chemical characteristics of guava cv. Lucknow 49 fruits stored at room temperature (28± 2°c & 60 ± 10 % RH) at Dept of Postharvest Technology, HC&RI, TNAU, Periyakulam from 2020 to 2022. The experimental fruits harvested from the tree were preharvest sprayed with $Ca(NO_3)_2$ at 1.0 and 2.0 per cent on one month before harvest at two different colour maturities of the green mature stage (MG), and colour turning stage (green yellow-CT).Thereafter, the fruits were treated with salicylic acid at 100 and 200 ppm and studied. its effect on the shelf life and quality of guava under ambient storage conditions. The treated fruits were then taken out and air dried and were analyzed for physico-chemical parameters and then stored at room temperature. Samples were taken at-two-day intervals until complete decay. All the observations were taken in triplicates.

Sample Treatment. Fruits were dipped in salicylic acid at 100 and 200 ppm for 1-2 minutes, drained and surface dried [13]. The physiological loss in weight (PLW) of fruit was calculated on an initial weight basis and expressed in percent. Flesh firmness was measured by hand-held fruit pressure tester penetrometer. The Firmness of three fruits per treatment was measured

(Pressure Tester Model FR 5120 , MakeLutron Taiwan)and it was expressed in Kg cm^{-2}. The total soluble solids of juice were measured with the help of a hand refract meter (0-32 ºBrix) and expressed as per cent soluble solids.

The titrable acidity was estimated by titrating against 0.1 N NaOH using phenolphthalein as an indicator [18]. The Appearance of pink colour was observed. From the volume of alkali used, acidity was calculated and expressed as g citric acid /100 g fruit pulp. Total sugars were estimated by the method of [19]. The color developed by the anthrone reagent was measured at 625 nm against a reagent blank and concentration was calculated by preparing a standard curve of glucose solution.

Color value: Color Changes during the storage of fruits were observed using a portable digital colorimeter(Brand Name: CTI Model: CTI 10HSN:9027 Display precision 0.01). Results were obtained as L* (lightness (51-100) and darkness (0-50), a* (a+ve indicates red whereas a-ve indicates green), b* (b+ve indicates yellow and b-ve indicates blue). Using these values, total color change (ΔE) was calculated using the formula [34].

Statistical Analysis

The experiment was carried out in a completely randomized design (CRD) with six treatments and four replications. The results obtained were subjected to analysis of variance (ANOVA) at $P< 0.05$ level of significance using AGRES software (Panse and Sukhatme, 1967)[14].

Effect of pre-harvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on physiological loss in weight of guava cv.Lucknow 49 fruits at mature green stage (MG) and color turning stage (CT) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Physiological loss in weight (PLW) was increased in advance of the storage period. The treatment T_4MG recorded the minimum PLW of 0.92 *percent* on the 1st DAS, it was gradually increased to4.66, 8.20 and 13.65 percent on 3rd, 6th and 9th DAS followed by the treatment T_2MG recorded 1.33, 4.98, 8.55 and 13.94 *per cen*t respectively. The treatment T_1 MG and T_3 ($CaNo_3$ 1&2% + SA 100 and 200 ppm) recorded the PLW of 1.41&1.56 on 1st DAS to 14.18 and 14.45 on 9th DAS whereas the control T_5 MG (No postharvest dip) recorded maximum PLW 6.26 percent on 3rd after storage and it was increased up to 17.33%. The T_6 MG (EFF) at 2% recorded PLW of 1.21, 4.56, 8.23 and 12.32% on 3rd, 6th and 9th DAS. The fruits treated with EFF at 2 percent recorded PLW of 1.21,4.56,8.23 and 12.32 per cent on 1st ,3rd,6th and 9th DAS respectively Physiological loss in weight of postharvest treatment of salicylic acid at two different concentrations recorded significant differences in mean weight loss of 1.88 percent on 1st day after storage to 14.64 percent on 9th day after storage. The treatment T_4 CT recorded PLW of 1.26, 5.86, 9.75 and 17.02 percent on 1st , 3rd, 6th and 9th DAS followed by T_2 CT ($CaNo_3$ 1% + SA 200 ppm) recorded 1.57, 5.98, 9.97 and 17.49 per cent on 1st , 3rd, 6th and 9th DAS whereas the treatment T_3 CT and T_1 CT recorded the PLW of 1.70,6.09, 10.07, 17.98 and 1.84, 6.20, 10.22 and 18.14 percent on 1st , 3rd, 6th and 9th DAS whereas the fruit treated with EFF at 2% recorded gradual weight loss of 1.46, 5.16, 9.53 and 17.23 percent on 1st , 3rd, 6th and 9th DAS. The control treatment T_5CT recorded 3.48, 5.22, 7.04, 8.75, and 10.06 percent from the first day to the fifth DAS. (Table 1&2)

Calcium plays an effective role in membrane functionality and integrity maintenance by binding to the polar head group of the phospholipids. Hence the lower loss of phospholipids with reduced ion leakage could be responsible for the lower weight loss in calcium-treated fruits [12]. In the cell walls, calcium serves as a binding agent in the form of calcium pectates. Calcium has received considerable attention in the recent past due to its ripening and senescence, increased firmness, vitamin "C" and phenolic contents, reduced respiration, incidence of physiological disorders and storage rots, and extended storage life [3]. and in papaya.[16].

Effect of the preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200ppm) in quality of Guava fruits *cv*. Lucknow 49 at mature green stage (MG) and at color turning stage (CT) after storage at ambient conditions (27± 2°c & 70 % RH 60± 10 %)as influenced by different treatments

Fruit firmness increases according to the increasing concentration of SA treatments. It was firm compared with control fruits. The maximum fruit firmness (4.93 kg/cm^2) was recorded in T_4 MG ($CaNo_3$ 2% + SA 200 ppm) The treatment T_1 MG and T_2 MG recorded the fruit firmness of 4.29 and 4.46 kg/cm^2. ($CaNo_3$ 1% + SA 100 and 200 ppm) Significant differences were observed among the treatments for TSS (^{0}Brix), ascorbic acid content (mg/100 g of fruit) and total sugar (%). The treatment T_4 MG recorded TSS of 9.01 ^{0}Brix, 189.93 mg/100 g ascorbic acid, and 6.95 *percent* total sugar followed by the treatment T_3 MG and T_2 MG recorded 9.63 & 9.25 ^{0}Brix TSS, 176.74 &169.58 mg/100g ascorbic acid and 7.38 & 7.18 *percent* total sugar respectively. The treatment T_5 MG recorded the highest TSS of 10.93 ^{0}Brix 143.86/100g ascorbic acid and 8.55 percent total sugar. Whereas the fruits treated with EFF at 2% recorded TSS 9.14 ^{0}Brix, 181.32 mg/100g ascorbic acid, and 7.08 *percent* total sugar respectively. The fruits harvested at the color turning stage (CT) revealed that among the treatments, maximum fruit firmness was recorded in T_4 CT (4.38 kg/cm^2) followed by T_3 CT (4.14 kg/cm2). The treatment T_2 CT and T_1 CT recorded 3.95 and 3.75 kg/cm2 fruit firmness whereas the control T_5 CT recorded 2.94 kg/cm^2 firmness and fruits treated with EFF at 2% recorded a the firmness of 3.96 kg/cm^2.Fruit biochemical parameters *viz.,* minimum TSS, Total sugar, and maximum ascorbic acid content was recorded in T_4 CT (10.48^{0}Brix, 7.99 percent total sugar and 173.05 mg/100g) and EFF at 2% treated fruits (9.32^{0}Brix, 8.14 *percent* total sugar and 168.60mg/100g ascorbic acid) followed by the treatment T_2 CT recorded TSS of 11.05 ^{0}Brix, 8.15 *percent* total sugar and 152.98 mg/100g ascorbic acid and T_3 CT recorded TSS of 11.40 ^{0}Brix , 8.35 *percent* total sugar and 161.75 mg/100g ascorbic acid respectively. The treatment T_1 CT recorded maximum TSS of 11.75^{0}Brix, 8.48 percent total sugar and 139.23 mg/100g ascorbic acid. The control treatment (T_5 CT) recorded minimum fruit firmness of 2.94kg/cm^2 maximum TSS 13 ^{0}Brix, 9.28% total sugar and 146.33 mg/100g ascorbic acid content respectively. (Table. 3&4).(The increasing fruit firmness with higher SA concentration may be related with the effect of SA on cell wall degradation enzymes such as cellulose, polygalacturonase and xylanase and also pectin degradation. So treating guava fruit with higher concentration of SA at 500 µM, could be decrease of cell wall degradation enzymes activities [22]. Ascorbic acid contents between different color maturities and SA concentrations during nine days of shelf-life might be related with the mechanism of SA in fruit tissue. It may preventing the destruction of vitamin C content of fruit were immersed in 500 µM than other treatments[20]. The higher level of ascorbic acid in

chitosan-treated fruit might reflect the low oxygen permeability, slowing down the respiration rate, which delays the deteriorative oxidation reaction of ascorbic acid of fruit. The present results of chitsoan- treatment are in conformity with the findings in mango [10], strawberries [24] and kiwifruit [17].

The increase in TSS content was delayed in the fruits preharvest spray with calcium nitrate and postharvest treatment with chitosan. The delay in the rise of TSS content could be due to the slowing down of respiration and metabolic activity[8]. A suppressing respiration rate also slows down the synthesis and the use of metabolites, resulting in lower TSS, due to the slower hydrolysis of carbohydrates to sugars [5]. The present experimental results are in close conformity with the findings of [11] and [13], where a slow rise in TSS was recorded in mango, banana and plums treated with chitosan. The effect of calcium treatment on delaying the increase in TSS are in harmony with those reported by [21]. in peach fruit.

Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on fruit skin and flesh color value of guava *cv*. Lucknow 49 fruits at mature green stage (MG) and at color turning stage (CT) during storage at ambient condition (27± 2°c & RH 60± 10 %)

The color value of the fruits treated with salicylic acid at 100 and 200 ppm stored under ambient conditions was recorded. The treatment T_1MG samples darker (L=42.30), green (a= -7.66) and more yellow (b=49.56). The delta values L, and b showed that darker (ΔL =-2.09) Δa is -1.12 (green color) and Δb = 3.96 (yellow color). The total color difference ΔE =4.62. The treatment T2 MG recorded darker (L=42.87) green color (a=-8.17) and yellow color (b=49.04). The differences in colour showed that darker (ΔL =-1.52) Δa is -0.61 (green color) and Δb = 3.44 (yellow color).The treatment T4MG recorded a minimum total color difference of ΔE =3.44 followed by T2 MG (ΔE =3.81) and T3 MG (ΔE =4.16). In T4MG sample recorded lighter (L=43.12), green color (a=-8.54), and yellow color (b=48.79). The color difference is darker ((ΔL =-1.27), Δa is -0.24 (green color) and Δb = 3.19 (yellow color).Fruits treated with EFF@ 2 per cent recorded that the color value is lighter (L=43.71),green color (a=-8.52) and yellow color (b=47.59) with the color difference is lighter ((ΔL0.68), Δa is -0.26 (green color) and Δb = (yellow color) and the total color difference ΔE =2.25 whereas the control treatment T6MG recorded maximum total color difference ΔE =10.16Table 6 showed that the postharvest treatment of SA at 100 and 200 ppm on guava fruit var Lucknow 49 fruit flesh color changes after storage in T4MG recorded minimum total color difference ΔE = 1.68 followed by T2MG (ΔE =1.94) T3MG (ΔE =2.52) and T1MG (ΔE =3.05) The control treatment T6MG recorded maximum total color difference ΔE =9.39. The treatment T1MG recorded lighter (L=47.88), green color (a= -3.2), and yellow color (b=24.07). The delta color differences are darker (ΔL =-1.22) Δa is -0.97 (green color) and Δb = -2.2 (blue color).The treatment T2MG recorded L,a,b value is L=48.32(lighter),a= -3.77 (green color) and b=25.8 (yellow color).The treatment T3MG and T4MG recorded lighter (L=48.13&48.65) green (a=-3.43 &-3.91) yellow(b=24.67 &25.67).Fruits treated with EFF at 2 per cent recorded the color value is L=47.82 (lighter),a=-3.84(green), and b=24.73(yellow color).The color differences indicated that the darker (ΔL =-1.28) Δa is -0.33 (green color) and Δb = 2.2 (yellow color). T3MG and T6MG (control treatments) recorded maximum total color difference of ΔE = 26.41 and 9.39 The treatment T4CT recorded lighter (L=45.31), green color (a=-12.09) and yellow color (b=46.03). The delta color differences L, a and b is darker (ΔL =-2.1) Δa is -0.75 (green color) and Δb = 3.05 (yellow color).The total color difference is minimum (ΔE =3.78) followed by T2CT recorded ΔE = 4.65 and with L,a,b value is L=44.32(lighter),a= -11.69 (green color) and b=46.26 (yellow color) and color difference is (ΔL =-4.21) Δa is -1.41 (green color) and Δb = 3.57(yellow color) The treatment T6CT (Control) recorded a maximum total colour difference of ΔE =11.14. Fruits treated with EFF at two percent recorded the color value is L=44.39(lighter),a= -11.85 (green) and b=43.73 (yellow color).The color differences indicated that the darker (ΔL =-3.01) Δa is -0.43 (green color) Δb = -3.75 (yellow color) and ΔE =4.82The guava fruit cv. Lucknow49 treated with SA at 100 and 200 ppm recorded fruit flesh color after storage showed that the treatment T4CT recorded lighter (L=50.34),green color (a=-7.13) and yellow color(b=25.90). The delta color differences L, a and b is darker (ΔL =-2.28) Δa is -0.30 (green color), and Δb = -0.75 (blue color) The total color difference is minimum (ΔE =2.42) followed by T2CT recorded ΔE = 2.83 and with L,a,b value is L=50.1 (lighter),a= -6.9 (green color) and b=26.35 (yellow color) and color difference is (ΔL =-2.52) Δa is -0.53 (green color) and Δb = -1.20 (blue color) The total color difference of ΔE =2.84 than the standard value (L=52.62,a=-7.43 and b=25.15). The treatment T6CT (Control) recorded maximum total color difference of ΔE =8.52 Fruits treated with EFF at two percent recorded the color value is L=50.12 (lighter),a= -7.21 (green) and b=26.17 (yellow color).The color differences indicated that the darker (ΔL =-2.55) Δa is -0.22 (green color) Δb = 1.02 (yellow color) and ΔE =2.78 (Table 5-8) The total colour difference was minimum in fruits dipped in S at 200 and 100 PPM might be due to reduction of PPO during ripening that reflects to increase fruit color quality The study was correlated with the findings of the fruits coated with chitosan (1% and 1.5%) treated fruits The rate of loss of greenness and development of yellowness was slow when compared to control fruits. This may be due to the reduction of respiration rate and lower metabolic activity in chitosan-treated fruits. The finding is agreed with the [23]stated that the ascorbic acid and calcium chloride treated minimally processed apples were found to maintain the lightness and chroma value during storage which is due to its radical scavenging activity and anti-browning property. [3]also reported that the ascorbic acid, calcium chloride and citric acid were found to inhibit color change in apple cubes during cold storage for 5-10 days. Fresh-cut pears treated with calcium chloride, calcium lactate and calcium propionate had maximum color retention than the control [12] Minimum total flesh color difference (ΔE=1.39) and skin-color difference (ΔE=2.72) was recorded in sapota var. PKM1 treated with EFF at 0.50 per cent [33]. Minimum (ΔE= 2.45 and 3.73) color change was observed in fruits treated with 1.0and ,0.5 % ascorbic acid and 1.0% calcium chloride in jack var palur 1 [7].

Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on of guava cv.Lucknow 49 fruits at mature green stage (MG) during storage at ambient condition (27± 2°c & RH 60± 10 %) on organoleptic qualities

Organoleptic tests were conducted for appearance, colour, texture, taste and overall acceptability using a 9point hedonic scale varying from like extremely to (rated as 9) to (0) dislike extremely. Among the different treatments, T4MG recorded the highest mean score of 7.20. The untreated fruits recorded the lowest mean values of 5.40 (Table 9)

Table 1 Effect of the pre-harvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on physiological loss in weight of guava cv.Lucknow 49 fruits at mature green stage (MG) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Treatments	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
T_1 MG - $CaNo_3$ 1% + SA 100ppm	1.41	3.32	5.33	6.77	7.53	8.80	10.24	12.09	14.18
T_2 MG - $CaNo_3$ 1% + SA 200ppm	1.33	3.12	4.98	6.56	7.22	8.55	10.10	11.61	13.94
T_3 MG- Control (Preharvest Spray 1%)	2.36	3.56	6.06	7.13	8.32	9.52	11.32	13.21	15.62
T_4 MG - $CaNo_3$ 2% + SA 100ppm	1.56	3.71	5.92	7.31	7.78	8.99	10.49	12.42	14.45
T_5 MG - $CaNo_3$ 2% + SA 200ppm	0.92	2.95	4.66	5.99	7.03	8.20	9.57	11.40	13.65
T_6 MG – Control **Preharvest Spray 2%)**	2.18	3.92	6.26	8.04	10.70	12.12	13.77	15.18	17.33
T_7EFF @2% (positive control)	**1.21**	**3.06**	**4.56**	**6.32**	**7.12**	**8.23**	**9.83**	**10.32**	**12.32**
SE (d)	0.059	0.053	0.087	0.063	0.073	0.061	0.130	0.153	0.109
CD (p=0.05)	0.157 *	0.130**	0.183**	0.174**	0.151**	0.135**	0.344**	0.296**	0.232**

Table 2 Effect of the preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200ppm) on physiological loss in weight of guava cv. Lucknow49fruits at color turning stage (CT) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Treatments	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9
T_1 CT - $CaNo_3$ 1% + SA 100ppm	1.84	3.90	6.20	7.78	9.10	10.22	12.36	15.39	18.14
T_2 CT - $CaNo_3$ 1% + SA 200ppm	1.57	3.79	5.98	7.14	8.80	9.97	12.00	14.96	17.49
T3 CT-**Control (Preharvest Spray 1%)**	2.16	4.89	5.34	7.16	8.21	9.05	0.00	0.00	0.00
T_4 CT - $CaNo_3$ 2% + SA 100ppm	1.70	3.49	6.09	7.30	8.99	10.07	12.18	15.18	17.98
T_5 CT - $CaNo_3$ 2% + SA 200ppm	1.26	3.36	5.86	6.90	8.47	9.75	11.65	13.99	17.02
T6 CT – Control **Preharvest Spray 1%)**	3.48	5.22	7.04	8.75	10.06	0.00	0.00	0.00	0.00
EFF @2% (positive control)	**1.46**	**3.52**	**5.16**	**7.05**	**8.42**	**9.53**	**11.65**	**14.60**	**17.23**
SE (d)	0.089	0.114	0.098	0.836	0.085	0.069	0.212	0.317	0.126
CD (p=0.05)	0.211**	0.258**	0.221**	0.280**	0.209**	0.143**	0.440**	0.789**	0.346**

Table 3. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on quality of Guava fruits cv.Lucknow 49 at mature green stage (MG) after storage at ambient conditions (27± 2°c & 70 % RH 60± 10 %) as influenced by different treatments

(Initial: TSS- 7.90◦Brix, Firmness -6.34 Kg cm^{-2}, AA- 179mg 100g^{-1}, TS- 5.44%)

Treatments	Firmness (Kg cm^{-2})	Ascorbic Acid (mg 100g^{-1})	Total sugars (%)	TSS (◦ Brix)
T_1 MG - $CaNo_3$ 1% + SA 100ppm	4.29	162.91	7.90	9.75
T_2 MG - $CaNo_3$ 1% + SA 200ppm	4.46	169.58	7.18	9.25
T3 MG - Control (Preharvest Spray 1%)	4.32	156.92	7.42	9.81
T_4MG - $CaNo_3$ 2% + SA 100ppm	4.56	176.74	7.38	9.63
T_5MG - $CaNo_3$ 2% + SA 200ppm	4.93	189.93	6.95	9.01
T_6 MG – Control **Pre-harvest Spray 2%)**	3.69	143.86	8.55	10.93
EFF @2% (positive control)	4.26	181.32	7.08	9.14
SE (d)	0.076	3.012	0.173	0.102
CD (p=0.05)	0.169**	6.084**	0.368**	0.218**

Table 4. Effect of the preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on quality of Guava fruits cv.Lucknow 49 color turning stage (CT) after storage at ambient conditions (27± 2°c & 70 % RH 60± 10 %) as influenced by different treatments

(Initial: TSS- 9.70 Brix, Firmness – 5.45 Kg cm^{-2}, AA- 160mg 100g^{-1}, TS- 7.03%)

Treatments	Firmness (Kg cm^{-2})	Ascorbic Acid (mg 100g^{-1})	Total sugars (%)	TSS (◦ Brix)
T_1 CT - $CaNo_3$ 1% + SA 100ppm	3.75	139.23	8.48	11.75
T_2 CT - $CaNo_3$ 1% + SA 200ppm	3.95	152.98	8.15	11.05
T3 **CT- Control (Preharvest Spray 1%)**	3.76	143.51	9.21	9.12
T4CT - $CaNo_3$ 2% + SA 100ppm	4.14	161.75	8.35	11.40

T_5 CT - $CaNo_3$ 2% + SA 200ppm	4.38	173.05	7.99	10.48
$T_5$6 CT – Control **Preharvest Spray 2%)**	2.94	146.33	9.28	13.00
EFF @2% (positive control)	3.96	168.60	8.14	9.32
SE (d)	0.63	4.59	0.35	0.93
CD (p=0.05)	0.131**	9.781**	0.69**	2.32**

Table 5. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm)on fruit skin color value of guava cv. Lucknow 49 fruits at mature green stage (MG) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE*ab
T_1 MG - $CaNo_3$ 1% + SA 100ppm	42.30	-2.09	-7.66	-1.12	49.56	3.96	4.62
T_2 MG - $CaNo_3$ 1% + SA 200ppm	42.87	-1.52	-8.17	-0.61	49.04	3.44	3.81
T3 MG Control (Preharvest Spray 1%)	38.31	-15.02	-11.60	6.52	36.94	0.35	16.38
T_4 MG - $CaNo_3$ 2% + SA 100ppm	42.58	-1.81	-7.87	-0.91	49.23	3.63	4.16
T_5 MG - $CaNo_3$ 2% + SA 200ppm	43.12	-1.27	-8.54	-0.24	48.79	3.19	3.44
$T_5$6 MG – Control **(Preharvest Spray 2%)**	35.44	-8.95	-7.12	-1.66	50.12	4.52	10.16
EFF @2% (positive control)	43.41	0.68	-8.52	-0.67	47.59	1.99	2.25

Table 6. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on fruit flesh color value of guava cv.Lucknow 49 fruits at mature green stage (MG) during storage at ambient condition (27± 2°c & RH 60± 10 %) Mature green: Flesh Color

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE*ab
T_1 MG - $CaNo_3$ 1% + SA 100ppm	47.88	1.22	-3.2	-0.97	24.07	-2.22	3.05
T_2 MG - $CaNo_3$ 1% + SA 200ppm	48.32	0.78	-3.77	-0.40	25.80	-1.73	1.94
T3 MG **Control (Preharvest Spray 1%)**	45.12	-21.82	-3.81	-1.26	22.68	14.95	26.41
T_4 MG - $CaNo_3$ 2% + SA 100ppm	48.13	0.97	-3.43	-0.74	24.07	-2.23	2.52
T_5 MG - $CaNo_3$ 2% + SA 200ppm	48.65	0.45	-3.91	-0.26	24.67	-1.6	1.68
T_6 MG – Control **(Preharvest Spray 2%)**	40.33	8.77	-2.77	-1.4	27.12	-3.05	9.39
EFF @2% (positive control)	47.82	-1.28	-3,64	-0.33	24.73	-1.54	2.24

Table 7. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on fruit skin color value of guava cv.Lucknow 49 fruits at color turning stage (CT) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE*ab
T_1 CT - $CaNo_3$ 1% + SA 100ppm	41.13	6.28	-11.13	-1.71	46.7	-3.72	7.50
T_2 CT - $CaNo_3$ 1% + SA 200ppm	44.32	3.09	-11.69	-1.15	46.26	-3.28	4.65
T3 CT Control (Preharvest Spray 1%)	43.00	-19.70	-9.31	4.23	39.11	-1.81	20.24
T_3 CT- $CaNo_3$ 2% + SA 100ppm	43.20	4.21	-11.43	-1.41	46.55	-3.57	5.70
T_4 CT - $CaNo_3$ 2% + SA 200ppm	45.31	2.10	-12.09	-0.75	46.03	-3.05	3.78
T_5 CT- Control **(Preharvest Spray 1%)**	37.89	9.52	-9.78	-3.06	47.90	-4.92	11.14
EFF @2% (positive control**)**	44.39	-3.01	-11.85	-0.43	46.73	-3.75	4.82

Table 8. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on fruit flesh color value of guava cv.Lucknow 49 fruits at color turning (CT) during storage at ambient condition (27± 2°c & RH 60± 10 %)

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE*ab
T_1 CT - $CaNo_3$ 1% + SA 100ppm	49.38	-3.24	-6.31	-1.12	26.89	-1.74	3.84
T_2 CT- $CaNo_3$ 1% + SA 200ppm	50.10	-2.52	-6.90	-0.53	26.35	-1.20	2.84
T3 CT Control (Preharvest Spray 1%)	52.05	-6.75	4.14	-3.43	24.17	14.64	16.14
T_4 CT - $CaNo_3$ 2% + SA 100ppm	49.55	-3.07	-6.66	-0.77	26.57	-1.42	3.47
T_5 CT- $CaNo_3$ 2% + SA 200ppm	50.34	-2.28	-7.13	-0.30	25.90	-0.75	2.42
T_6 CT - Control	44.70	-7.92	-5.80	-1.63	27.84	-2.69	8.52
EFF @2% (positive control**)**	50.12	-2.50	-7.21	-0.22	26.17	1.02	2.78

Table 9. Effect of preharvest spray of calcium nitrate (1 & 2%) and postharvest treatment of salicylic acid (100 and 200 ppm) on physiological loss in weight of guava cv.Lucknow 49 fruits at mature green stage (MG) during storage at ambient condition (27± 2°c & RH 60± 10 %) on organoleptic qualities

Treatments	Appearance	Color	Texture	Taste	Overall Acceptability	Mean
T1¬ MG - CaNo3 1% + SA 100ppm	7	5	7	7	6	6.40
T2¬ MG- CaNo3 1% + SA 200ppm	7	6	7	7	6	6.60
T3 MG Control (Preharvest Spray 1%)	6	5	5	6	6	5.6
T4¬ MG - CaNo3 2% + SA 100ppm	7	6	8	8	7	6.40
T5 MG- CaNo3 2% + SA 200ppm	8	7	8	9	8	7.20
T6 MG Control (Preharvest Spray 2%)	6	5	6	5	5	5.40
EFF @2% (positive control)	7	6	7	6	6	6.40

References

1. Chung, H.D., Kang, K.Y., Yun, S.J. and Kim, B.Y. (1993). Effect of foliar application of calcium chloride on shelf-life and quality of strawberry. fruits. J. Korean. Soci. Hort. Sci., 34 (1) : 7-15

2. Das DK, Dutta H, Mahanta CL. Development of a rice starch-based coating with antioxidant and microbe-barrier properties and study of its effect on tomatoes stored at room temperature. LWT – Journal of Food Science and Technology. 2013; 50:272-278.

3. Chien PJ, Sheu F, Lin HR. Coating citrus (Murcotttang or) fruit with low molecular weight chitosan increases postharvest quality and shelf life. Food Chemistry. 2007; 100:1160-1164.

4. Gomathi V ,Premalakshmi, J Rajangam and K Venkatesan Effect of postharvest dipping on quality and shelf life of minimally processed jackfruit (*Artocarpus heterophyllus* Lam.) flakes during storage The Pharma Innovation Journal 2021; 10(11): 809-813

5. Hong K, Xie J, Zhang L, Sun D, Gong D. Effects of chitosan coating on postharvest life and quality of guava (*Psidium guajava* L.) fruit during cold storage. Scientia Horticulturae. 2012; 144:172-178.

6. Huang Z, Li J, Zhang J, Gao Y, Hui G. Physiochemical properties enchancement of Chinese kiwi fruit (*Actinidia chinensis* Planch) via chitosan coating enriched with salicylic acid treatment. Journal of Food Measurement and Characterization. 2016; 11(1):184-191

7. Jain SK, Mukherjee S. Enhancing keeping quality of fruits in mango cv. Langra. Indian Journal of Horticulture. 2011; 68(1):142-144.

8. Kittur FS, Saroja NS, Habibunnisa-Tharanathan RN. Polysaccharide-based composite coating formulations for shelf-life extension of fresh banana and mango. European Food Research and Technology. 2001; 213:306-311

9. Lester GE, Grusak MA. Post-harvest application of Calcium and Magnesium to honeydew and netted muskmelons: Effects on tissue ion concentrations, quality and senescence. Journal of the American Society for Horticultural Science. 1999; 124:545-552

10. Liu K, Yuan C, Chen Y, Li H, Liu J. Combined effects of ascorbic acid and chitosan on the quality maintenance and shelf life of plums. Scientia Horticulturae. 2014; 176:45–53.

11. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers. Edn 2, ICAR, New Delhi 381p

12. Ramakrishna, M., Haribabu, K., Reddy, Y.N. and Purushotham,K. (2001). Effect of Pre-harvest application of calcium on physiochemical changes during ripening and storage of Papaya. Indian J. Hort., 58 (1) : 228-231.)

13. Rama Krishna.K and D. V. Sudhakar Rao 2014 Effect of Chitosan Coating on the Physiochemical Characteristics of Guava (*Psidium guajava* L.) Fruits During Storage at Room Temperature Indian Journal of Science and Technology, Vol 7(5), 554–558

14. Ranganna S.2003 Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hills Publishing Co. Ltd., New Delhi.

15. Sadasivam,S and Manickam A.1996. Biochemical methods, Published by New Age International (P) Limited, Publishers, New Delhi.

16. Sohail M, Ayub M, Khalil SA, Zeb A, Ullah F, Afridi SR, et al. Effect of calcium chloride treatment on post-harvest quality of peach fruit during cold storage. International Food Research Journal. 2015; 22(6):2225- 2229

17. Srivastava, M. K. and Dwivedi, U. N. (2000). Delayed ripening of banana fruit by salivylic acid. Plant Science 158: 87-96.)

18. Shafiee, M., Taghavi, T. S. and Babalar, M. (2010). The addition of salicylic acid to the nutrient solution combined with postharvest treatments (hot water, salicylic acid, and calcium dipping) improved the postharvest fruit quality of the strawberry. Scientia Horticulturae 124: 40-45. doi: DOI: 10.1016/j.scienta.2009.12.004

19. Varela P, Salvador A, Fiszman SM. The use of calcium chloride in minimally processed apples: a sensory approach. European Food Research and Technology 2007;224:461-467

20. Wang SY, Gao H. Effect of chitosan-based edible coating on antioxidants, antioxidant enzyme system, and postharvest fruit quality of strawberries (*Fragaria x aranassa* Duch.). LWT - Food Science and Technology. 2013; 52:71-79

21. Mercadante, A. Z., Steck, A., & Pfander, H. (1999). Carotenoids from Guava (*Psidium guajava* L.): Isolation and structure Elucidation. *Journal of Agricultural and Food Chemistry*, *47*(1), 145-151.