



## Influence of pre-harvest application of chemicals on the shelf life of guava under cold storage

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### Abstract

Various chemicals and plant growth substances have proved useful in checking respiration and transpiration etc. that are responsible for spoilage of fruits along with improvement in physico-chemical aspects and post-harvest life. Therefore, the fruits of guava cv. Allahabad Safeda was given a pre-harvest ten treatments with spray of NAA and SA each @ 100,200 and 300 ppm and ascorbic acid 75, 150 and 300 ppm on winter season crop firstly four weeks before harvest and again spray was superimposed on the same trees two weeks before harvest to enhance shelf life. Treated fruits were harvested 15 days after second spray, then packed in CFB boxes of 4 kg capacity and kept in cold room. As the storage advanced fruit size and weight were declined after the 7<sup>th</sup> day followed by a further decrease in the 14<sup>th</sup> day and 21<sup>st</sup> day. The average fruit size was found the highest in NAA 200 ppm and fruit weight in SA 200 ppm at the end of the storage period. Color development of fruits was found best with SA treatments. Fruit firmness was retained maximum in SA 200 ppm and palatability rating value noted higher in NAA 200 ppm. TSS of fruits gradually declined with the storage time, however, sustained to an appreciable level with 200 ppm NAA. Total sugars and vitamin C content were estimated higher and acidity lower in NAA 200 ppm treatment during storage. It was concluded that pre-harvest application of either NAA 200 ppm or SA 200 ppm applied twice effectively improve physico-chemical traits and maintained shelf life for up to two weeks in cold storage.

**Keywords:** Allahabad Safeda, NAA, salicylic acid, ascorbic acid, cold storage

### 1. Introduction

Guava (*Psidium guajava* L.) is a tropical fruit, belongs to the family Myrtaceae is an excellent source of vitamin C. Being a fruit of perishable nature, it is difficult to store for long periods (Sanjay, 2000) [13]. Globally India, Pakistan and Brazil are the principal producers of commercial guava cultivars. In India the production of guava is the highest in Madhya Pradesh which accounts for 23.8 per cent followed by Uttar Pradesh (21.2 %) and Bihar (9.26 %). However, the best of guava is produced in Uttar Pradesh. The area under guava in India is 2.54 lakh ha yielding 40.5 lakh metric tons accounted for 3.97 per cent of area and 4.42 per cent of production. The average productivity of guava is 15.9 mt/ha (Bal, 2018) [3]. Post-harvest losses are estimated at 20 to 40 percent in developing countries and 10 to 15 per cent in developed countries, depending on the crop and the season (Madrid, 2011) [9]. Pre-harvest sprays of growth regulators are one of the most important practices of the new strategies applied in the integrated fruit production systems, improving fruit quality (El-hilali *et al.* 2003) [6]. The primary purpose of storage is to control the rate of transpiration, respiration, ripening and delay any undesirable biochemical changes and also to check the disease infection in the guava fruits and consequently extends the period of availability in the market. The various measures for reduction of post-harvest losses like low-temperature storage, use of growth regulators/chemicals, irradiation, and processing of fully ripened guava fruits, are adopted so that the surplus horticultural produce may be available. During the storage period, deterioration of guava is attributed to adverse physico-chemical changes, namely loss of weight due to respiration and transpiration, softening of the flesh, loss due to microbial attack and change in sugar and acid content.

Plant bio-regulators can hasten or delay the growth or maturation rate or otherwise alter the behavior of plants or their products (Olaiya and Osonubi, 2009) [11] and are very useful in improving physico-chemical aspects of fruits (Karole and Tiwari, 2016) [7].

### 2. Materials and Methods

Present research studies were planned with aim to study the pre-harvest application of chemicals on the shelf life of guava under cold storage temperature on ripening and storage life of winter season guava cv. Allahabad Safeda. Investigations were conducted on 6 years old guava orchard of progressive farmer under Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara during the year 2017-18. The trees of guava were sprayed with NAA @100 ppm, 200 ppm and 300 ppm, SA @100 ppm, 200 ppm and 300 ppm and ascorbic acid @ 75ppm, 150 ppm and 300 ppm, twice (firstly in the first week of November at color break stage and second at 15<sup>th</sup> November). After attaining uniform color and size, the fruits were harvested, and were analyzed after their storage at cold store (4-6°C and RH 85-90%). Sprayed fruits were harvested after 15 days of second spray and packed in CFB boxes (4 kg capacity) and kept in cold storage. The fruits were analyzed for physico-chemical properties after interval of 7 days viz. 0, 7, 14 and 21 days. Physical characters like fruit diameter, weight, fruit firmness (with Pressure Tester 'Penetrometer' after removing skin, in units of lbs/cm<sup>2</sup>), fruit color by matching the fruits with Royal Horticultural Colour Chart a (Wilson 1938), palatability rating score (out of 20). TSS, acidity, vitamin C and total sugars were recorded as per standard methods of A.O.A.C (2010). Data were analyzed statistically according to completely

randomized block design with factorial arrangement.

### 3. Results and Discussion

#### 3.1 Physical traits

Effect of pre-harvest treatments on fruit breadth, weight and firmness of guava cv. Allahabad Safeda under cold storage is given in Table 1.

**3.1.1 Fruit diameter:** The highest fruit breadth value (6.67 cm) was noted in 200 ppm NAA during first day of cold storage. Fruit breadth goes on decreasing after 7<sup>th</sup> day followed by further declined value on 14<sup>th</sup> day. This trend of reduction continued, and fruit breadth was 6.24 cm on 21<sup>st</sup> day. At the end of cold storage period the average fruit breadth was recorded highest in NAA 200 ppm treatment. However, the interaction was found non-significant between the storage days and treatments. The fruit size in terms of breadth may be attributed to the increase in cell elongation and cell division caused by NAA is proved by several research workers. Arora and Singh (2014) recorded significant increase in ber fruit size traits i.e. fruit length, breadth and volume with treatment of NAA 30 ppm.

**3.1.2 Fruit weight:** The weight of guava fruits continuously decreased with advancement of storage period and it was observed that the highest values were in salicylic acid 200 ppm treatment and during initial stage of cold storage period. As the storage advanced, fruit weight was decreased after 7<sup>th</sup> day followed by further declined on 14<sup>th</sup> day. This trend of reduction continued and fruit weight was noted 172.35 g on 21<sup>st</sup> day. Application of NAA proved useful for quality retaining is due to its stimulatory effect on metabolism process of the plant and could be accompanying with decrease or disruption in rate of respiration by NAA, thus reduced the loss of water which is the measure of guava fruit weight (Singh *et al.* 2017).

**3.1.3 Fruit firmness:** The maximum fruit firmness along with declining trend was observed in salicylic acid 200 ppm under cold storage conditions. The firmness was recorded 17.50 lbs/cm<sup>2</sup> on storage day, while on 7<sup>th</sup> day it was noted as 16.75 lbs/cm<sup>2</sup>. Corresponding lower values were recorded on 14<sup>th</sup> day and 21<sup>st</sup> day i.e. 16.41 lbs/cm<sup>2</sup> and 16.16 lbs/cm<sup>2</sup>, respectively. Mandal *et al.* (2012) reported that treatment of guava fruits with NAA 100 ppm resulted in highest mean fruit firmness within the specified storage period. Higher firmness in fruits due to NAA might be due to postponing senescence, conserving cellular organization and delaying respiration process rate. The results of current

study are in agreement with that of Selvan and Bal (2005) [4] in guava.

#### 3.2 Quality traits

Effect of pre-harvest treatments on palatability rating, fruit color and TSS of guava under cold storage is detailed in Table 2.

**3.2.1 Palatability rating:** Taste and appearance (palatability rating) of guava fruits stored under cold storage was observed highest (18.91) in NAA 200 ppm treatment. When fruits were stored under cold condition, palatability rating was 19.20 on the day of storage. During 7<sup>th</sup> day of storage it was observed as 19.02 and decreased further during 14<sup>th</sup> day and 21<sup>st</sup> day to the tune of 18.82 and 18.61, respectively. With the advancement of storage, guava fruit palatability rating showed decreasing trend. The results of current study are in agreement with Singh *et al.* (2017) who reported that guava fruits treated with NAA at different days of storage get the highest score and considered 'excellent' with respect to palatability.

**3.2.2 Fruit color:** Promising results relating to guava fruit color were obtained in all concentrations of salicylic acid treatment. When fruits were harvest (at 0 day) fruits surface color was light-green and light-yellow green (GG135 A, YGG 145 A). After 7 days light green color (GG 135 A, B, D) were observed in fruits in salicylic acid treatments. But, it was recorded light yellow green (GG 145 B, YGG 145 A, B, respectively) on 14<sup>th</sup> day. Finally, at 21<sup>st</sup> days it was noted as light yellow green to yellow green (YGG 154 A, B) in different salicylic acid treatments. It may be due to preventing the degradation of chlorophyll and deferring the gathering of carotenoids or gibberellins possibly have a senescence postponing action by obstructing ethylene as reported by Selvin (2002). Madhav *et al.* (2016) also described that guava fruits treated with salicylic acid resulted in improved colour change.

**3.2.3 Total soluble solids:** The highest mean total soluble solids (11.45%) were recorded in NAA 200 ppm treatment. TSS content was noted 12.00 per cent at 0 day of storage but it showed declining trend and after 7<sup>th</sup> day and it was recorded as 11.70 per cent. This decreasing trend continued up to end of the storage and it was recorded 11.30 per cent on 14<sup>th</sup> day and 10.81 per cent on 21<sup>st</sup> day. Similar results were also observed by Selvan and Bal (2005) [13] in guava. However, Mandal *et al.* (2012) reported that TSS content of guava fruits increased initially up to 20 days of cold storage period and thereafter started diminishing gradually.

**Table 1:** Effect of pre-harvest treatments on fruit breadth, weight and firmness of guava cv. Allahabad Safeda under cold storage

Treatment	Fruit Breadth (cm) / Storage days					Fruit Weight (g) / Storage days					Fruit Firmness (lb/cm <sup>2</sup> ) / Storage days					
	0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean	
NAA	100 ppm	6.24	6.15	6.04	5.85	6.07	167.82	165.91	164.15	162.42	165.08	16.94	16.14	15.71	15.32	16.03
	200 ppm	6.67	6.57	6.45	6.24	6.48	168.38	166.48	164.73	163.00	165.65	17.08	16.29	15.87	15.49	16.18
	300 ppm	6.59	6.48	6.34	6.16	6.39	168.18	166.83	165.68	164.59	166.32	17.15	16.38	16.00	15.76	16.32
Salicylic acid	100 ppm	6.21	6.1	5.92	5.69	5.98	167.57	166.22	164.97	163.88	165.66	17.19	16.4	16.01	15.65	16.32
	200 ppm	6.45	6.32	6.14	5.91	6.21	175.38	174.12	173.20	172.35	173.76	17.50	16.75	16.41	16.16	16.71
	300 ppm	6.38	6.23	6.06	5.82	6.12	170.64	169.34	168.31	167.45	168.94	17.45	16.71	16.35	16.09	16.65
Ascorbic acid	75 ppm	6.17	6.01	5.81	5.55	5.89	167.49	165.54	163.78	162.03	164.71	16.89	16.08	15.60	15.25	15.96
	150 ppm	6.14	5.96	5.75	5.49	5.84	167.19	165.22	163.42	161.66	164.37	16.81	15.98	15.50	15.14	15.86
	300 ppm	6.07	5.9	5.68	5.39	5.76	166.67	164.67	162.85	161.02	163.80	16.76	15.91	15.43	15.06	15.79
Control		5.95	5.76	5.52	5.21	5.61	165.1	162.92	160.75	158.72	161.87	16.71	15.85	15.36	14.97	15.72
<b>Mean</b>		6.28	6.15	5.97	5.73	6.03	168.44	166.72	165.18	163.71	166.02	17.05	16.25	15.82	15.49	16.15

C.D. (p $\geq$ 0.05) Storage days 0.21 Treatments 0.32 Storage days 1.28 Treatments 2.03 Storage days 0.20 Treatments 0.32

**Table 2:** Effect of pre-harvest treatments on fruit palatability (Out Of 20), color and TSS (%) of guava cv. Allahabad Safeda under cold storage

Treatment		Fruit Palatability / Storage days					Fruit color / Storage days					Fruit TSS (%) / Storage days				
		0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean
NAA	100 ppm	18.07	17.67	17.31	17.13	17.55	YG10A	YG12A	YG13C	YG10A	YG10A	10.83	10.28	9.72	9.12	9.99
	200 ppm	19.20	19.02	18.82	18.61	18.91	YG10B	YG11B	YG10C	YG12C	YG10B	12.00	11.70	11.30	10.81	11.45
	300 ppm	18.60	18.41	18.21	18.00	18.31	YG9C	YG11B	YG11C	YG12C	YG9C	11.73	11.21	10.67	10.10	10.93
Salicylic acid	100 ppm	18.10	17.70	17.32	17.07	17.55	GG135A	GG135B	GG145B	YGG154B	GG135A	10.76	10.19	9.61	8.76	9.83
	200 ppm	18.50	18.28	18.05	17.82	18.16	YGG145A	GG135A	YGG145A	YGG154A	YGG145A	11.50	10.97	10.42	9.68	10.64
	300 ppm	18.62	18.20	17.98	17.80	18.15	GG135A	GG135D	YGG145B	YGG154A	GG135A	11.28	10.74	10.18	9.43	10.41
Ascorbic acid	75 ppm	18.00	17.58	17.19	16.91	17.42	YG9C	YG9C	YG11B	YG11B	YG9C	10.59	10.01	9.41	8.46	9.62
	150 ppm	17.86	17.30	16.90	16.55	17.15	YG11A	YG12B	YG13C	YG10D	YG11A	10.37	9.75	9.12	8.22	9.37
	300 ppm	17.80	17.14	16.69	16.33	16.99	YG10A	YG10B	YG12B	YG12B	YG10A	10.28	9.65	9.02	8.11	9.27
Control		17.68	17.01	16.51	16.14	16.84	YGG145A	YGG145B	YG11A	YOG154A	YGG145A	10.19	9.54	8.87	7.94	9.14
Mean		18.24	17.83	17.50	17.24	17.70						10.95	10.40	9.83	9.06	10.06

C.D. (p>=0.05) Storage days 0.26 Treatments 0.42 Storage days 0.25 Treatments 0.39

**3.3.1 Biochemical traits**

The data given in table 3 showed changes in acidity, vitamin C and total sugars during storage of guava.

**3.3.1.1 Acidity:** The minimum acidity along with declining trend was observed in NAA 200 ppm treatment under cold storage conditions. On day of storage, fruit acidity was recorded 0.69 per cent. Likewise, lower values were recorded on 7<sup>th</sup>, 14<sup>th</sup> day and 21<sup>st</sup> day i.e. 0.60 per cent, 0.50 per cent and 0.40 per cent, respectively with average of 0.50 per cent. Pawar *et al.* (2005) and Singh *et al.* (1996) in winter guava also recorded that NAA treatment resulted in better quality in terms of lower acidity.

**3.3.1.2 Vitamin C:** The vitamin C content of guava fruit decreased gradually with the advancement of storage period. A declining trend was observed with the advancement of storage time. It was found highest in NAA 200 ppm treatment (average 181.02 mg/100g). Further declined values of vitamin C on 7<sup>th</sup> day (196.04 mg/100g), 14<sup>th</sup> day (164.55 mg/100g) and 21<sup>st</sup> day (134.88 mg/100g) under cold

storage conditions also confirmed the same trend. NAA 200 was the best treatment followed by NAA 300 ppm with respect to vitamin C of guava fruit. Selvan and Bal (2005) [3] also observed similar results in winter guava.

**3.3.1.3 Total sugars:** The data regarding the total sugars reveals that its content increased significantly up to 14<sup>th</sup> days of cold storage. After steady increase in total sugars up to 7<sup>th</sup> day of storage an increase was observed slightly sharp up to 14<sup>th</sup> days and declining trend was noted afterward. Maximum mean total sugars (7.65%) were estimated in fruits treated with NAA 200 ppm. After 0 day of storage the value was recorded 7.57 per cent whereas it increased during 7<sup>th</sup> and 14<sup>th</sup> to the tune of 7.72 per cent and 8.22 per cent, respectively. Then a decline (7.10%) was noted on 21<sup>st</sup> day. The interaction between storage days and treatments was found non-significant during the course of investigation. The present investigation is in conformity with the results reported by Bisen *et al.* (2014) in guava and Bal (1982) [3] in ber.

**Table 3:** Effect of pre-harvest treatments on fruit acidity (%) vitamin C (mg/100g) and total sugars (%) of guava cv. Allahabad Safeda under cold storage

Treatment		Fruit acidity (%) / Storage days					Vitamin C (mg/100g) / Storage days					Total sugars (%) / Storage days				
		0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean	0 day	7 day	14 day	21 day	Mean
NAA	100 ppm	0.74	0.67	0.58	0.49	0.62	230.86	192.10	155.51	120.32	174.70	7.24	7.36	7.79	6.74	7.28
	200 ppm	0.69	0.60	0.50	0.40	0.50	228.60	196.04	164.55	134.88	181.02	7.57	7.72	8.22	7.10	7.65
	300 ppm	0.70	0.61	0.51	0.41	0.56	230.64	196.33	164.35	132.77	181.00	7.46	7.60	8.09	6.98	7.53
Salicylic acid	100 ppm	0.75	0.68	0.60	0.52	0.64	234.10	191.90	153.31	117.07	174.10	7.18	7.30	7.78	6.75	7.25
	200 ppm	0.71	0.63	0.54	0.44	0.58	231.00	195.29	161.82	128.18	179.07	7.33	7.46	7.96	6.87	7.41
	300 ppm	0.73	0.66	0.57	0.48	0.61	232.24	195.24	159.14	125.55	178.04	7.28	7.40	7.89	6.82	7.35
Ascorbic acid	75 ppm	0.76	0.70	0.63	0.56	0.66	229.83	186.19	147.58	110.47	168.52	7.03	7.14	7.61	6.59	7.09
	150 ppm	0.78	0.72	0.66	0.59	0.69	231.96	186.97	148.17	103.12	167.56	6.94	7.05	7.51	6.56	7.02
	300 ppm	0.8	0.75	0.69	0.62	0.72	228.00	182.08	138.07	94.01	160.54	6.83	6.95	7.40	6.47	6.91
Control		0.84	0.81	0.78	0.73	0.79	230.45	180.26	131.61	85.98	157.08	6.74	6.85	7.29	6.37	6.81
Mean		0.75	0.68	0.61	0.52	0.64	230.77	190.24	152.41	115.24	172.16	7.16	7.28	7.75	6.72	7.23

C.D. (p>=0.05) Storage days 0.02 Treatment 0.03 Storage 6.78 Treatment 10.72 Storage 0.23 Treatment 0.36

**4. Conclusion**

NAA 200 ppm was the finest treatment in relation to fruit size, palatability rating, TSS, acidity, vitamin C and total sugars of guava fruit but at the same time salicylic acid 200 ppm showed promising results regarding fruit weight and fruit firmness. The control treatment experienced lowest values concerning physico-chemical characteristics.

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