

## Determining the Effect of post-harvest treatments on the shelf life of Guava Fruit (*Psidium guajava* L.) cv.

### ABSTRACT

The present investigation was carried out at Post harvest Laboratory, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, India. The study was conducted in a completely randomized design with 11 treatments viz. T<sub>0</sub>- Control, T<sub>1</sub>- Aloe vera gel 1%, T<sub>2</sub>- Aloe vera gel 2%, T<sub>3</sub>- Corn starch (0.5%), T<sub>4</sub>- Corn starch 1%, T<sub>5</sub>- Cassava starch 1% with sunflower oil, T<sub>6</sub>- Cassava starch 2% with sunflower oil, T<sub>7</sub>- Cassava starch 3% with sunflower oil, T<sub>8</sub>- CaNO<sub>3</sub> (0.5%), T<sub>9</sub>- CaNO<sub>3</sub> 1%, T<sub>10</sub>- Cassava starch 1% with sunflower oil and bee wax all of which were triplicated was conducted during the year 2023. The study faces several challenges, one of the primary difficulties being the need to ensure uniformity in applying the various physico-chemical treatments to the guava fruits in order to obtain reliable and comparable results. Additionally, controlling external factors like temperature and humidity during the postharvest period poses a significant challenge, as these factors must be managed carefully to accurately evaluate the impact of the treatments on the fruit's quality and shelf life. Out of 11 treatments applied the fruits treated with Corn starch (1%) and Corn starch (0.5%) had significantly better fruit quality over other treatments in respect of parameters i.e., Physiological loss in weight, Decay percent, Fruit firmness, Sensory evaluation test, T.S.S., pH, Titrability acidity and reducing sugar. The Aloe vera gel were also found to be significantly superior treatments over the control in respect of storage quality and shelf- life. Based on results obtained in the present study, it can be concluded that Corn starch 1% was found to be the most appropriate treatment in Guava cv. Dhawal on account of better shelf- life. Therefore, Corn starch 1% can be adopted with great success in Guava cv. Dhawal for physico-chemical traits, storage, quality and shelf-life on commercial scale.

**Key words:** Post-harvest treatments, Guava fruit, Corn starch, Aloe vera gel, Shelf life

### INTRODUCTION

Guava (*Psidium guajava* L.) is a tropical fruit belonging to the Myrtaceae family, native to Central America, Mexico, and northern South America. It has been cultivated for centuries and is now grown widely in tropical and subtropical regions around the world. Guava is valued for its unique flavor, nutritional benefits, and versatility in culinary uses. According to the report of **Anonymous (2021)**, India leads the world in guava production, followed by neighbouring countries such as China, Pakistan, and Indonesia. "Uttar Pradesh is the top guava-producing state in India, followed

by Madhya Pradesh and Bihar. India commercially cultivates a variety of guava types, with popular varieties including Sardar guava, Shweta, Allahabad Safeda, Arka Mridula, Chittidar, Lalit, and Pant Prabhat. In Punjab, guava is a significant crop, second only to citrus” (Singh et al., 2023). It is grown extensively across nearly all districts, covering an area of 2.5 lakh hectares and producing 195.60 thousand metric tons, which accounts for 3.97% of the area and 4.42% of the state's production. Guava is also highly nutritious, with every 100 grams containing 228.3 mg of Vitamin C, 80.80 g of water, 68 kcal of energy, 2.55 g of protein, 0.95 g of total lipid (fat), 14.32 g of carbohydrates, 5.4 g of fiber, 8.92 g of sugars, 18 mg of calcium, 0.26 mg of iron, 22 mg of magnesium, 40 mg of phosphorus, 417 mg of potassium, 2 mg of sodium, 0.23 mg of zinc, and other nutrients.

Under normal ambient conditions, guava has a shelf life of approximately 3-4 days (Sudhir Pratap, 2021). The fruit is climacteric, with a thin exocarp layer, making it difficult for the fruit to retain moisture. Post-harvest treatments can help preserve the fruit's quality and extend its shelf life. Chemical treatments are primarily used to reduce quality degradation and prolong the shelf life of guava. Besides fungicides, other compounds can be utilized to delay ripening and senescence, thereby extending the storage life of the fruit. Ethylene scavengers are employed to keep ethylene levels below the threshold. Additionally, plant growth regulators, also known as phytochemicals, have been shown to prolong the post-harvest life and enhance the value of guava when used at various concentrations. With 5.42MT produced year, India leads the world's guava production rankings, followed by China, Indonesia, Pakistan, Mexico, Brazil, Malawi, Thailand, Bangladesh and Vietnam. Compared to the previous year, when it exported 12,301.63 tonnes of guava valued at Rs. 6714.61 lakhs in 2022–2023–India exported 11,740.67 tonnes in 2023–2024 according to Anon, (2022).

Dhawal, an improved variety. It is seedling selection, heavy bearer (about 20% higher than Allahabad safeda. Mature fruits develop a light-yellow color on ripening. Fruits are soft seeded, pulp white, taste sweet with muskiness. Average yield should be 384q/ha.

Edible coatings have emerged as an innovative solution to fruit quality concerns by slowing down metabolism and reducing ethylene production, thereby delaying the ripening process. Post-harvest treatments are essential for maintaining the quality and extending the shelf life of fruits like guava. Chemical treatments are primarily used to minimize quality deterioration and prolong shelf life.

Along with fungicides, other compounds can be employed to delay ripening, slow down senescence, and extend the storage duration of the fruit. Ethylene scavengers are used to keep ethylene levels below the threshold. Additionally, plant growth regulators, or phytochemicals, have been found to enhance the shelf life and value of guava when applied at different concentrations during storage, as reported by Baldwin *et al.* (1995). The use of edible coatings has become a valuable method for protecting the nutrients in food, particularly fruits and vegetables, while also enhancing their durability. These coatings consist of a thin layer of edible material that limits water loss, oxygen exposure, and the transfer of other soluble materials in food. Aloe vera gel, well-known for its ability to heal injured or irritated skin, shows potential as a nutritious addition for fruits and vegetables. The gel possesses antifungal properties and acts as a barrier to moisture, CO<sub>2</sub>, and O<sub>2</sub>, helping to reduce weight loss, browning, softening, and the growth of mold and yeast. An edible coating, which is a thin layer applied to the surface of fruit and consumed along with it, serves to extend shelf life, reduce moisture loss, improve handling characteristics, and decrease the need for additional packaging materials. This layer functions as a barrier against moisture and vapor transmission, thereby extending the shelf life of the product. Due to the polymers' ability to form hydrogen bonds effectively, the edible coating provides a robust lipid and oxygen barrier, especially at low to intermediate relative humidity (RH). The findings of such studies can lead to enhanced post-harvest handling techniques, prolonged shelf life, and optimized post-harvest quality processes for fruits like guava, benefiting both producers and consumers. With these considerations in mind, the present study focused on examining the post-harvest quality of guava (*Psidium guajava* L.) cv. Dhawal fruit as influenced by various physico-chemical treatments.

## **MATERIAL AND METHODS**

The present investigation was carried out at the Postharvest lab, College of Horticulture and Agro processing Centre (CoPHT & FP) of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut U.P. India, during the year 2022. Geographically, the Meerut is situated between 29°04' N L, 77°42' E L and at an altitude of 237.75 meters above the mean sea level. The variety Dhawal was selected for the study and periodically observed. The fruits were obtained from 06 years old orchard of guava cultivar “Dhawal” planted at a distance of 6×6 m. Observation taken during the period of storage, Physiological loss in weight, decay %, fruit firmness, sensory

analysis, total soluble solid, pH of guava pulp, total titratable acidity percentage and reducing sugar. The trial was laid out in a Completely Randomized Design (CRD) and the number of treatments was 11, i.e. are T0- control, T1- Aloe vera gel 1%, T2- Aloe vera gel 2%, T3- Corn starch (0.5%), T4- Corn starch 1%, T5- Cassava starch 1% with sunflower oil 1%, T6- Cassava starch 2% with sunflower oil 1%, T7- Cassava starch 3% with sunflower oil 1%, T8-  $\text{CaNO}_3$ (0.5%), T9-  $\text{CaNO}_3$ (1%), T10- Cassava starch 1% with sunflower oil 1% and beeswax 1% each replicated thrice. The present observations were carried out at days 0, 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> during storage. The physiological loss in weight (PLW) was manually calculated during the trial period using a formula provided by Srivastava and Tandon (1968). Data on decay and spoilage were recorded throughout storage, with percentages based on the visible symptoms of spoilage and unmarketable fruit. The firmness of the guava fruit was measured using a penetrometer during the trial period, expressed in  $\text{kg/cm}^2$ . Sensory analysis of the fruit, assessing organoleptic taste, flavor, aroma, freshness, and overall acceptability, was conducted using the Hedonic scale (0-9). A panel of eight judges, aged 21-50 years, was selected based on the consistency and reliability of their judgments. The total soluble solids (TSS) in the fruit juice were determined with a hand refractometer (0-32 range) and recorded in degrees Brix. Freshly collected clear juice from each guava treatment was used to measure the pH of the pulp with a pH meter. The reducing sugar content was determined using titrimetric methods, while the total titratable acidity (%) was calculated by titrating the extracted juice with 0.01N NaOH, following the standard procedure with phenolphthalein as the indicator. Statistical test applied, and process of doing analysis of the data was performed using standard procedure as described by **Gomez and Gomez (1996)**.

## RESULTS AND DISCUSSION

The present guava data in Table 1 showed that the (PLW %) of stored fruits treated with corn starch (1%) was found statistically superior over rest of the treatments with minimum percent physiological loss in weight during 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day of the storage (3.17%, 7.22%, 10.34%) respectively followed by Corn starch (0.5%) (3.74%, 8.06% and 10.42%). A similar trend was also observed by **Jagdeesh et al. (2006)**. No decay percent was recorded in all the treatments on the 3<sup>rd</sup> day after storage, while on 6<sup>th</sup> day Corn starch (0.5%) fruits remain no decay and Corn starch (1%) was found to be minimum decay of (1.00). On 9<sup>th</sup> day of storage, the minimum decay percentage was recorded in Corn starch (0.5%) and Corn starch (1%) are (5.10 and 5.73) respectively and the

maximum percent of decay were recorded in control (0.0, 6.00 and 14.00). Similar trend was also observed by **Wang et al. (2019)**. “On the initial day fruit firmness were recorded (4.70kg/cm<sup>2</sup>). On the 3<sup>rd</sup> day of storage, the treatment with Corn starch (1%) was the most effective in retaining fruit firmness, followed by Corn starch (0.5%) (5.39kg/cm<sup>2</sup> and 5.24kg/cm<sup>2</sup>) respectively. By the 6<sup>th</sup> day of storage, the most effective treatments for preserving fruit firmness were Corn starch 1% and Corn starch (0.5%) are (4.65kg/cm<sup>2</sup>, 4.48kg/cm<sup>2</sup>). On the 9<sup>th</sup> day of storage, the treatments with Corn starch 1%, Corn starch (0.5%) were effective in slowing down the decline in fruit firmness (3.38, 3.10) kg/cm<sup>2</sup> respectively. In general, the firmness decreases as fruits become more mature and decreases rapidly as they ripe. The firmness (kg/cm<sup>2</sup>) of guava fruits decreased continuously throughout the storage period which probably due to enzymatic degradation” **Chitarra et al. (2002)**. Sensory evaluation test on the 3<sup>rd</sup> day obtained maximum mean 7.83 value when fruit was treated with Corn starch 1% followed by Corn starch (0.5%) 7.42 respectively, while on 6<sup>th</sup> and 9<sup>th</sup> day, sensory evaluation tests were conducted in which Corn starch (0.5%) and Corn starch (0.5%) obtained highest Sensory evaluation score (8.48, 8.09) respectively. While the minimum sensory score (5.98 and 5.77) on 3<sup>rd</sup> day of storage were recorded when fruit treated with Cassava starch 1% with Sunflower oil 1% and Beewax 1% and the control. On the 6<sup>th</sup> and 9<sup>th</sup> day of storage lowest sensory evaluation scores (6.52, 7.21) and (5.97, 6.81) were obtained by Cassava starch 1% with Sunflower oil 1% and Beewax and Control respectively. A similar trend was followed by **Chauhan et al. (2008)** in their experiment Aloe vera 5% and Aloe vera 10% found best sensory evaluation scores.

Table 1: Observations of PLW, Decay percent, Firmness and Sensory evaluation of guava cv. Dhawal.

Treatments		Day of storage (at ambient room temperature)														
		Physiological weight in loss (PLW)				Decay percentage				Firmness of guava fruit				Sensory evaluation test		
		0	3	6	9	0	3	6	9	0	3	6	9	3	6	9
T0	Control	0	5.14	12.62	14.46	0	0	6.00	14.00	4.70	5.09	4.10	2.30	5.77	6.52	5.97
T1	Aloe vera gel 1%	0	5.46	11.33	13.23	0	0	5.20	11.23	4.70	4.50	3.80	2.25	7.14	7.26	7.25
T2	Aloe vera gel 2%	0	4.44	13.33	13.30	0	0	5.23	12.00	4.70	4.70	3.97	2.28	7.17	7.30	7.17
T3	Corn starch (0.5%)	0	3.74	8.06	10.42	0	0	0.00	5.10	4.70	5.24	4.48	3.10	7.42	8.48	8.09
T4	Corn starch 1%	0	3.17	7.22	10.34	0	0	1.00	5.73	4.70	5.39	4.65	3.38	7.83	8.31	8.00
T5	Cassava starch 1%+ Sunflower oil 1%	0	4.04	7.80	11.10	0	0	5.08	12.00	4.70	5.15	4.27	3.03	7.09	7.23	6.92
T6	Cassava starch 2%+ Sunflower oil 1%	0	3.46	8.68	11.85	0	0	5.16	12.01	4.70	5.20	4.35	3.14	7.08	7.21	6.96
T7	Cassava starch 3%+ Sunflower oil 1%	0	3.98	8.70	9.44	0	0	5.01	11.10	4.70	5.28	4.42	3.22	7.09	7.23	6.99
T8	CaNO <sub>3</sub> (0.5%)	0	3.65	7.83	9.33	0	0	5.53	8.16	4.70	5.22	4.50	3.45	6.99	7.34	6.99
T9	CaNO <sub>3</sub> (1%)	0	4.31	8.03	9.68	0	0	5.66	8.66	4.70	5.35	4.70	3.88	7.00	7.35	6.98
T10	Cassava starch 1%+ Sunflower oil 1%+Beewax 1%	0	4.68	7.24	10.84	0	0	5.10	12.04	4.70	5.12	4.28	3.15	5.98	7.34	6.81
	Mean		4.18	9.16	10.32			4.63	10.18		5.11	4.32	3.016			
	SE(m)		0.286	0.47	0.426			0.447	0.416		0.191	0.61	1.069			
	C.D at 5%		0.843	0.98	1.242			1.319	1.227		0.27	0.23	0.352			
	C.V. (%)		11.24	6.266	6.498			17.01	7.069		5.497	6.477	6.852			



The present guava data in Table 2. Showed, there was a gradual increase in TSS from the 3<sup>rd</sup> to the 6<sup>th</sup> day of storage, followed by a notable decline. The fruits treated with Corn starch (1%) consistently exhibited statistically superior results over the other treatments, showing the highest TSS levels on the 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day of storage (10.74, 11.62 and 12.10) °Brix respectively. Corn starch (0.5%) (10.70, 11.48 and 11.96) °Brix also performed well, yielding superior TSS levels on the respective days. Similar trend was also observed by **Martinez-Romero et al. (2006)** found that “guava fruits treated with corn starch and aloe vera gel had higher levels of TSS. On the 3<sup>rd</sup> day of storage, the fruits treated with Corn starch 1% exhibited higher pH (3.87) values compared to other treatments, followed by Corn starch (0.5%) (3.85) and Cassava starch 1% with sunflower oil 1% and beeswax 1% also exhibited pH (3.86). The treatments with Cassava starch 2% with sunflower oil 1% resulted in the lowest pH values on the 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day (3.72, 3.80 and 3.94) respectively. On the 6<sup>th</sup> day of storage, the maximum pH values were observed when fruits were treated with Corn starch 1% and Corn starch (0.5%) were (4.17 and 4.12) respectively”. “During the 9<sup>th</sup> day of storage, the maximum pH values were recorded when fruit was treated with Corn starch 1% (4.36). An increasing trend in pH value was recorded during storage period. This fluctuation in pH due might be due to the variations in titrable acidity or temperature or storage” (**Hames and Hooper 2000**).

On the 3<sup>rd</sup> day of storage, the treatments with Corn starch (0.5%), Corn starch 1% and CaNO<sub>3</sub> resulted in higher titrable acidity levels (0.47, 0.45 and 0.46) respectively. Conversely, the Cassava starch 2% with Sunflower oil 1% and Cassava starch 1% and 3% with Sunflower oil 1% treatments exhibited the lowest titrable acidity levels (0.34, 0.37, 0.37) on the 3<sup>rd</sup> day of storage. On the 6<sup>th</sup> day of storage, the highest titrable acidity levels were observed in the Corn starch 1% treatment (0.44), followed by the Corn starch (0.5%) treatment (0.42). The lowest titrable acidity (0.30) levels were recorded in the treatment the Cassava starch 2% with Sunflower oil 1% and the Cassava starch 3% with Sunflower oil 1% are same. Moving on to the 9<sup>th</sup> day of storage, the treatments with Corn starch (0.5%) and CaNO<sub>3</sub> (1%) resulted in the highest titrable acidity levels 0.36 and 0.35 respectively. Overall, the best treatment for titrable acidity percentage throughout the study was found to be Corn starch (0.5%). The decrease in total acidity in guava during ripening is probably due to decrease in citric acid. **Garg et al. (2015)** reported that “Corn starch with waxol found minimum titrable acidity during storage of guava fruits. The reducing sugar of guava was recorded on the 3<sup>rd</sup> day of storage, Control, Cassava starch 3% with Sunflower oil 1% and Cassava starch 2% with Sunflower oil 1% were found to minimum reducing sugar (2.62, 2.70 and 2.84) on the other hand maximum reducing sugar will be recorded on Corn starch 1% and Corn starch (0.5%) were the (3.84, 3.78) respectively. while on 6<sup>th</sup> day of storage Cassava starch

1% with Sunflower oil 1% and beeswax 1%, Cassava starch 3% with Sunflower oil 1% and Cassava starch 2% with Sunflower oil 1% found minimum reducing sugar (3.10, 3.11 and 3.15) respectively and maximum were recorded on Corn starch 1% and Corn starch (0.5%) are (4.35 and 4.29) respectively. On 9<sup>th</sup> day of storage, the lowest reducing sugar (3.01, 3.07 and 3.11) were recorded when fruit were treated with Cassava starch 1% with Sunflower oil 1% and bee wax 1%, Cassava starch 2% with Sunflower oil 1%, Cassava starch 3% with Sunflower oil 1% respectively and maximum were be Corn starch 1% and Corn starch (0.5%) are (4.29, 4.26) respectively. Reducing sugar increased with increasing in storage period". This might be due to the hydrolysis of polysaccharides and conversion of non- reducing sugar into reducing sugar. The Results are well supported by **Jagdeesh (1994)** in corn starch coated fruits, **Singh and Mohammad (1993)** in wax coated guava.

Table 2: Observations of TSS, Ph, Titrability acidity and Reducing sugar of guava cv. Dhawal.

						Days of storage (At ambient room temperature)											
		T.S.S Brix				pH of guava fruits				Titrability acidity %				Reducing sugar of guava fruits			
	Treatments	0	3	6	9	0	3	6	9	0	3	6	9	0	3	6	9
T0	Control	9.15	9.19	10.33	9.24	3.60	3.76	4.02	4.10	0.40	0.38	0.32	0.22	3.20	2.62	3.30	3.15
T1	Aloe vera gel 1%	9.15	9.29	10.10	11.23	3.60	3.78	4.04	4.17	0.40	0.42	0.38	0.32	3.20	3.42	4.12	4.07
T2	Aloe vera gel 2%	9.15	9.16	10.22	10.96	3.60	3.75	3.96	4.16	0.40	0.41	0.36	0.31	3.20	3.45	4.20	4.22
T3	Corn starch (0.5%)	9.15	10.7	11.48	11.96	3.60	3.85	4.12	4.34	0.40	0.47	0.42	0.36	3.20	3.78	4.29	4.26
T4	Corn starch 1%	9.15	10.74	11.62	12.10	3.60	3.87	4.17	4.36	0.40	0.45	0.44	0.32	3.20	3.84	4.35	4.29
T5	Cassava starch 1%+ Sunflower oil 1%	9.15	9.72	10.02	9.82	3.60	3.75	3.82	4.00	0.40	0.37	0.32	0.3	3.20	3.14	3.18	3.14
T6	Cassava starch 2%+ Sunflower oil 1%	9.15	9.80	10.20	9.02	3.60	3.72	3.80	3.94	0.40	0.34	0.30	0.22	3.20	2.84	3.15	3.07
T7	Cassava starch 3%+ Sunflower oil 1%	9.15	9.15	10.14	9.00	3.60	3.74	3.79	4.00	0.40	0.37	0.30	0.23	3.20	2.70	3.11	3.11
T8	CaNO <sub>3</sub> (0.5%)	9.15	8.20	10.00	10.26	3.60	3.82	4.25	4.20	0.40	0.44	0.40	0.32	3.20	3.34	4.19	4.10
T9	CaNO <sub>3</sub> (1%)	9.15	8.13	10.13	10.96	3.60	3.84	4.30	4.32	0.40	0.46	0.38	0.35	3.20	3.40	4.25	4.11
T10	Cassava starch 1%+ Sunflower oil 1%+Beewax 1%	9.15	8.73	9.50	9.77	3.60	3.86	3.90	4.09	0.40	0.38	0.31	0.25	3.20	2.91	3.10	3.01
	Mean		9.34	10.25	10.40		3.79	4.00	4.15		0.41	0.35	0.29		3.22	3.74	3.68
	SE(m)		0.35	0.379	0.36		0.03	0.021	0.062		0.013	0.011	0.008		0.177	0.122	0.133
	C.D at 5%		1.015	1.092	0.987		0.088	0.064	N/A		0.038	0.034	0.032		0.344	0.359	0.393
	C.V. (%)		6.371	7.146	6.022		1.351	0.829	3.76		5.417	6.268	6.41		6.261	5.674	6.261



## **CONCLUSION**

Based on the findings of this study, it can be concluded that Corn starch at a concentration of (1%) showed the best treatment for the enhancing of shelf life of guava cv. Dhawal during the 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> day of storage to be found effective, followed by Corn starch (0.5%). Corn starch at 1% was observed to positively affect the post-harvest quality of guava fruits. Post-harvest life of guava fruits extended when fruit were treated with Corn starch (1%) during the storage period.

## **FUTURE SCOPE**

The future prospects of the study hold significant promise for the fruit industry and consumers. The insights gained from this research can pave the way for the development of advanced post-harvest handling techniques and storage methods that can extend the shelf life of guavas and maintain their quality during transportation. By optimizing the ripening process, it may be possible to offer consumers guavas with better taste, texture and nutritional value. Additionally, the findings could potentially lead to the formulation of eco-friendly and sustainable treatments to enhance post-harvest characteristics, reducing food waste and improving overall supply chain efficiency. The study's results could play a crucial role in shaping the guavas industry's practices, benefiting growers, exporters, retailers and consumers by ensuring a more reliable and enjoyable guava experience.

## **DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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