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# Effects of post-harvest treatments and packaging materials on physico-chemical properties and shelf-life of guava (*Psidium guajava*)

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## Abstract

The study was undertaken to find out efficacy of different post-harvest treatments and packaging materials on improving the quality and shelf-life of guava fruits variety Allahabad Safeda at post-harvest laboratory, Department of Horticulture, SKN College of Agriculture, Jobner, during 2022-23 and 2023-24. The fruits were subject to dipping in tap water for 3 minutes, oxalic acid (OA) 10 mM 3 min., salicylic acid (SA) 2.0 mM 3min., calcium chloride at 1.5% 3min., with different packaging material, polythene bag (LDPE 25 Micron), corrugated boxes, gunny bag and untreated fruits without packing. The fruits were stored at ambient storage conditions for $12^{th}$ days. Fruits were analyzed for various physico-chemical characteristics, viz., PLW, decay percentage, shelf life, TSS, acidity, ascorbic acid, reducing, non-reducing and total sugars at an interval of 0, 4, 8 and 12 days. The results revealed that perforated calcium chloride 1.5% with polythene bag was the most effective in reducing weight loss and decay as compared to other treatments. Total soluble solids, reducing sugars, total sugars and ascorbic acid content were higher in fruits stored in perforated calcium chloride with polythene bag and it was also effective in extending the shelf -life of guava fruits to 13 days. Thus, it can be concluded that perforated calcium chloride 1.5 % with polythene bag can be recommended for extending storage period of guava fruits.

**Key words:** Oxalic acid, physiological loss in weight (PLW), shelf-life, storage, polythene bag (LDPE 25 Micron)

Guava (*Psidium guajava* L.), belonging to Myrtaceae family. It is mostly grown in Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Bihar, Chhattisgarh, West Bangal, Maharashtra, and Gujarat, covering an area of 352.49 thousand ha. yielding 5428.73 tonnes of production**.** In Rajasthan, it is grown in 12.45 thousand ha. with total production of 150.50 tonnes and a productivity of 12.09 tonnes/ ha in Sawai Madhopur, Tonk, Dholpur, Bharatpur and Kota districts of Rajasthan (MAFW, 2022).

There are many post-harvest treatments which maintain quality and enhance shelf-life of its fruits. Oxalic acid reduces production of polygalacturonase (PG) and pectin methyl esterase (PME), which is responsible for cell wall degradation, so that treated fruits maintain the firmness (Wu *et al.*, 2011). Salicylic acid is an endogenous plant hormone which plays an important role in enhancing fruit quality and positively effects on reducing respiration and ethylene biosynthesis rates, weight loss, decay and softening of fruits (Shafiee *et al.,* 2010).

## MATERIALS AND METHODS

The study was carried out at Department of Horticulture, SKN College of Agriculture, Jobner, during 2022-23 and 2023-24. Physiologically mature fruits of guava cv. Allahabad Safeda were harvested from progressive farmer's field, in tonk district. Healthy fruits of uniform size were selected. The fruits were subject to dipping in oxalic acid (OA) 10 mM for 3 minutes ($T_1$) salicylic acid (SA) 2.0 mM for 3 minutes ($T_2$), calcium chloride at 1.5% for 3 minutes ($T_3$), tap water for 3 minutes ($T_4$), with different polythene bags, (LDPE 25 micron) ($P_1$), corrugated boxes ($P_2$), gunny bags ($P_3$) and untreated fruits without packing ($P_4$). They were stored at ambient storage conditions for 12 days. The data on physiological loss in weight (PLW), decay percentage, shelf-life, TSS, acidity, ascorbic acid, reducing, non-reducing and total sugars were recorded at an interval of 0, 4, 8 and 12 days.

The PLW was calculated by subtracting the weight of fruit on the day of observation from the initial fresh weight and expressed as percentage loss in reference to initial fruit weight. Fruit decay was worked out by counting the number of spoiled fruits against total number of fruits on the day of observation and was expressed in percentage. The TSS was measured at room temperature with Huwaki hand refractometer having 0-32 % range. Sugars, titratable acidity and ascorbic acid were estimated by the methods described by Ranganna (1986). Shelf-life of fruits was determined by counting the number of days till the fruits retained optimum marketing and eating qualities. The experimental data was analysed with two factorial Completely Randomised Design (CRD) given by Snedecor and Cochran (1987) at 5 % level of significance.

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## RESULTS AND DISCUSSION

The post-harvest life of fruits is significantly affected by the rate of water loss from the fruits. The number of storage days affected the physiological loss in weight (PLW) significantly, which increased gradually as the storage period progressed, irrespective of the treatment applied (Table 1). Fruits packed in perforated white calcium chloride 1.5 % with polythene bag ($T_3P_1$) recorded lowest PLW (19.81%). The highest PLW (28.58 %) was registered in the control fruits. Interactions between treatments and storage period was also found to be significant with maximum PLW (43.60%) in fruits under the control on 12th day of storage. These observations were similar to those of Ismail *et al.* (2010). The main reason of loss the weight in fruits may be due to loss of water caused by transpiration and respiration processes (Zhu *et al.* 2008). Packaging in polythene bags might have increased the $CO_2$ concentration and decreased the $O_2$ which eventually lowered the respiration rate of fruits (Thompson, 2010).

Decay percen0tage of fruits directly contributes to post-harvest losses. The maximum decay (23.14%) was observed in the control ($T_4$), while it was minimum (10.73%) in fruits treated with calcium chloride (1.5%) with polythene bag ($T_3P_1$). There was no fruit decay on initial day of storage. All the treatments exerted significant positive influence in reducing the decay percentage. The symptoms of decay started from 4th day onward in various treatments. However, fruits stored in perforated calcium chloride 1.5% with polythene bag ($T_3P_1$), started decaying from 8th day onward. Highest decay (23.08 %) was recorded on 12th day of storage, while it was lowest (0.49 %) on 4th day of storage. The decay in guava was maximum in the control and it increased during storage period (Ismail *et al.*, 2010). As storage period advanced, there was gradual softening of fruits in all the treatments. In fruits where no treatment was applied (control), maximum softening of fruits was observed facilitating entrance for decay causing microbes. In the fruits kept in calcium chloride 1.5% with polythene bag ($T_3P_1$), rate of softening was slow and also the product was not in direct contact with the external environment which might have resulted in lower decay percentage.

The longest shelf-life (13.12 days) and shortest (9.87 days) were observed in fruits packed in perforated calcium chloride 1.5% with polythene bag ($T_3P_1$) and the control fruits, respectively. The increase in shelf-life of fruits in calcium chloride (1.5%) with polythene bag ($T_3P_1$) may be due to lesser permeability of moisture along with reduced level of $O_2$ and increased level of $CO_2$ gas as compared to other treatments which might have modified the microclimate and preserved fruit quality. Better isolation of fruits in calcium chloride (1.5%) with polythene bag might have extended shelf-life of fruits due to lesser exposure to pathogens and contaminants (Beaudry, 2000).

Total soluble solids (TSS) content of fruits increased initially up to 8th days and thereafter declined as the storage period progressed (Table 2). Highest TSS (11.78 °B) was

**Table 1:** Effect of post-harvest treatments on physiological loss in weight of guava under ambient storage condition

| | Physiological loss in weight (%) (DAS) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022-23 | | | | 2023-24 | | | | Pooled | | | |
| | 0 day | 4th | 8th | 12th | 0 day | 4th | 8th | 12th | 0 day | 4th | 8th | 12th |
| **Factor A: Chemical treatments** | | | | | | | | | | | | |
| $T_1$ | 0.00 | 7.05 | 11.72 | 21.91 | 0.00 | 6.71 | 11.43 | 21.65 | 0.00 | 6.88 | 11.57 | 21.78 |
| $T_2$ | 0.00 | 6.69 | 11.02 | 21.12 | 0.00 | 6.36 | 10.67 | 20.81 | 0.00 | 6.52 | 10.84 | 20.97 |
| $T_3$ | 0.00 | 6.43 | 10.23 | 19.97 | 0.00 | 6.09 | 9.87 | 19.65 | 0.00 | 6.26 | 10.05 | 19.81 |
| $T_4$ | 0.00 | 8.77 | 15.38 | 28.82 | 0.00 | 8.45 | 15.12 | 28.34 | 0.00 | 8.61 | 15.25 | 28.58 |
| **SEm±** | - | 0.11 | 0.18 | 0.36 | - | 0.10 | 0.18 | 0.35 | - | 0.11 | 0.18 | 0.35 |
| **CD (5%)** | - | 0.32 | 0.53 | 1.02 | - | 0.30 | 0.51 | 1.01 | - | 0.31 | 0.52 | 1.01 |
| **Factor B: Packaging material** | | | | | | | | | | | | |
| $P_1$ | 0.00 | 6.44 | 10.36 | 20.15 | 0.00 | 6.12 | 10.01 | 19.84 | 0.00 | 6.28 | 10.18 | 19.99 |
| $P_2$ | 0.00 | 6.69 | 10.86 | 20.88 | 0.00 | 6.35 | 10.55 | 20.58 | 0.00 | 6.52 | 10.70 | 20.73 |
| $P_3$ | 0.00 | 7.21 | 12.03 | 22.42 | 0.00 | 6.87 | 11.69 | 22.13 | 0.00 | 7.04 | 11.86 | 22.27 |
| $P_4$ | 0.00 | 8.60 | 15.09 | 28.38 | 0.00 | 8.27 | 14.83 | 27.90 | 0.00 | 8.43 | 14.96 | 28.14 |
| **SEm±** | - | 0.11 | 0.18 | 0.36 | - | 0.10 | 0.18 | 0.35 | - | 0.11 | 0.18 | 0.35 |
| **CD (5%)** | - | 0.32 | 0.53 | 1.02 | - | 0.30 | 0.51 | 1.01 | - | 0.31 | 0.52 | 1.01 |
| **Interaction A×B** | | | | | | | | | | | | |
| **SEm±** | - | 0.22 | 0.37 | 0.71 | - | 0.21 | 0.36 | 0.70 | - | 0.21 | 0.36 | 0.70 |
| **CD (5%)** | - | 0.63 | 1.05 | 2.05 | - | 0.60 | 1.02 | 2.01 | - | 0.62 | 1.04 | 2.03 |

**Table 2:** Effect of post-harvest treatments on decay loss of guava under ambient storage condition

| | Decay loss (%) (DAS) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022-23 | | | | 2023-24 | | | | Pooled | | | |
| | 0 day | 4th | 8th | 12th | 0 day | 4th | 8th | 12th | 0 day | 4th | 8th | 12th |
| **Factor A: Chemical treatments** | | | | | | | | | | | | |
| $T_1$ | 0.00 | 0.14 | 8.29 | 12.17 | 0.00 | 0.12 | 7.61 | 11.51 | 0.00 | 0.13 | 7.95 | 11.84 |
| $T_2$ | 0.00 | 0.10 | 7.19 | 11.47 | 0.00 | 0.08 | 6.53 | 10.80 | 0.00 | 0.09 | 6.86 | 11.14 |
| $T_3$ | 0.00 | 0.04 | 6.15 | 11.08 | 0.00 | 0.03 | 5.49 | 10.39 | 0.00 | 0.03 | 5.82 | 10.73 |
| $T_4$ | 0.00 | 0.54 | 13.51 | 23.61 | 0.00 | 0.49 | 12.56 | 22.67 | 0.00 | 0.52 | 13.04 | 23.14 |
| **SEm±** | - | 0.00 | 0.13 | 0.25 | - | 0.00 | 0.12 | 0.24 | - | 0.00 | 0.13 | 0.24 |
| **CD (5%)** | - | 0.01 | 0.38 | 0.71 | - | 0.01 | 0.34 | 0.68 | - | 0.01 | 0.36 | 0.70 |
| **Factor B: Packaging material** | | | | | | | | | | | | |
| $P_1$ | 0.00 | 0.04 | 6.20 | 10.91 | 0.00 | 0.04 | 5.54 | 10.25 | 0.00 | 0.04 | 5.87 | 10.58 |
| $P_2$ | 0.00 | 0.08 | 7.08 | 11.42 | 0.00 | 0.07 | 6.42 | 10.74 | 0.00 | 0.08 | 6.75 | 11.08 |
| $P_3$ | 0.00 | 0.17 | 8.62 | 12.44 | 0.00 | 0.16 | 7.95 | 11.78 | 0.00 | 0.16 | 8.28 | 12.11 |
| $P_4$ | 0.00 | 0.52 | 13.25 | 23.56 | 0.00 | 0.46 | 12.30 | 22.61 | 0.00 | 0.49 | 12.77 | 23.08 |
| **SEm±** | - | 0.00 | 0.13 | 0.25 | - | 0.00 | 0.12 | 0.24 | - | 0.00 | 0.13 | 0.24 |
| **CD (5%)** | - | 0.01 | 0.38 | 0.71 | - | 0.01 | 0.34 | 0.68 | - | 0.01 | 0.36 | 0.70 |
| **Interaction A×B** | | | | | | | | | | | | |
| **SEm±** | - | 0.01 | 0.26 | 0.50 | - | 0.01 | 0.24 | 0.47 | - | 0.01 | 0.25 | 0.48 |
| **CD (5%)** | - | 0.02 | 0.75 | 1.43 | - | 0.02 | 0.69 | 1.36 | - | 0.02 | 0.72 | 1.40 |

reported in fruits stored in perforated calcium chloride 1.5% with polythene bag ($T_3P_1$) whereas minimum TSS (11.46 °B) was recorded in control fruits. In case of ($T_3P_1$), TSS increased gradually till 8th day of storage (13.86 °B) while in the control fruits, TSS was highest on $8^{th}$ day, after which there was a sharp decline and lowest TSS was observed on $12^{th}$ day of storage (11.78 °B). Initial increase in TSS content and then gradual decrease later during storage was similar to there of Singh *et al.* (2018). Gradual increase in the TSS content with increasing storage period for all the treatments might be due to hydrolysis. of starch into sugar. The decrease in total soluble solids at advanced stage might be the result of increased rate of respiration in later stages of storage which led to its faster utilization in oxidation process through Kreb's cycle.

Fruits treated with calcium chloride (1.5%) with polythene bag ($T_3P_1$) recorded minimum titratable acidity (0.55%), while it was maximum (0.62%) in the control (Table 2). There was gradual decrease in acidity of fruits with advancing storage period. It was highest on $4^{th}$ day of storage (0.71%) and decreased to 0.62% on $12^{th}$ day of storage. The decline in titratable acidity in all treatments and the control during storage period might be due to oxidation of ascorbic acid. The decrease in titratable acidity may also be attributed to increased rate of metabolic activities and conversion of different organic compounds into sugars during storage period (Echeverria and Valich, 1989).

Highest ascorbic acid (122.28 mg/100g pulp) was found in fruits stored in perforated calcium chloride (1.5%) with polythene bag ($T_3P_1$). The minimum ascorbic acid content (110.48 mg/100 g pulp) was observed in the control ($T_4P_4$). This might be due to lower rate of oxidation of ascorbic acid inside perforated calcium chloride (1.5%) with polythene bag as compared to fruits kept in open (control). Storage days exerted significant influence on ascorbic acid of fruits, which decreased gradually with increase in storage period.

Maximum reducing sugars (8.24%) were reported in calcium chloride 1.5% with polythene bag ($T_3P_1$). Minimum reducing sugars (8.09%) were recorded in the control fruits ($T_4P_4$). An increase in reducing sugars in all treatments was observed with the advancement of storage period, but this increase was registered only up to $8^{th}$ day of storage (8.24%) and thereafter it declined as storage period advanced and minimum was registered on $12^{th}$ day of storage (6.78%). Non-reducing sugars increased initially up to $8^{th}$ day and later decreased gradually as the storage period progressed. total sugars content increased during storage period. The initial rise may be due to water loss from fruits through evapo-transpiration and inhibition of activities of enzymes responsible for degradation of sugars, while the subsequent decline may be due to utilization of sugars in respiration (Alsawmahi *et al.*, 2018).

## CONCLUSION

The physico-chemical changes during storage were slow in case of calcium chloride 1.5% with polythene bag ($T_3P_1$) as compared to other treatments and it can be used to extend the storage period, marketability and maintain the quality of fruits during storage in guava cv. Allahabad Safeda.

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