Effect of Post-harvest Treatments of Chemical and Plant Growth Regulators on Physical Parameters of Sapota Fruit cv. Kalipatti

Tsomu T* and Patel HC

Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand 388110, Gujarat, India

Abstract

Investigation was conducted to study the effect of post-harvest treatment of chemical and plant growth regulators on physical characteristics sapota fruit cv. Kalipatti. Fruits were treated with CaCl₂ (5000 and 10000 mg/l) followed by plant growth regulators, Gibberellic acid (GA₃) (150 and 300 mg/l), kinetin (100 and 200 mg/l), ethrel (1000 and 2000 mg/l) and control (untreated fruit) and stored at room temperature. CaCl₂ (5000 and 10000 mg/l) was proved very effective in reducing loss in weight, spoilage and registered high fruit firmness, increase shelf life and ripening period. There was a significant increase in Physiological loss in weight (PLW), with enhanced storage period irrespective of calcium chloride (5000 and 10000 mg/l) and Gibberellic acid (GA₃) (150 and 300 mg/l) treatments. On the other hand, Physiological loss in weight (PLW), spoilage was increase throughout the storage. However, minimum Physiological loss in weight (PLW) and, total spoilage were noticed under CaCl₂ 5000 mg/l and 10000 mg/l treated fruits. The study suggests that calcium chloride (5000 mg/l) as post-harvest dip improves the fruit firmness, shelf life and ripening period of the sapota upto 12 days of storage.

Keywords: Sapota; Post-harvest; Calcium chloride; Gibberellic acid (GA₃); Kinetin; Ethrel; Storage

Introduction

Sapota, popularly known in India as chiku, is native to tropical America, belongs to family Sapotaceae. Being climacteric in nature, sapota fruits need ripening treatments after full maturity. During ripening fruit passes through a series of changes in colour, texture and flavor indication that compositional changes are taking place. The ripe fruits have pleasant aroma and are excellent in sweetness without any astringency due to decrease in polyphenols with concurrent increase in sugars, production of ethylene, rate of respiration and catalase activity [1]. The post-harvest losses are very high in tropical countries. Various chemicals have been used to hasten or delay ripening, to reduce losses and to improve and maintain color and quality by slowing down the metabolic activities of fruit. These chemicals arrest the growth and spread of microorganism by reducing the shriveling which ultimately leads to an increased shelf life and maintain the marketability of the fruit for a longer period. Therefore the present investigation is carried out to evaluate the “Effect of post-harvest treatments of plant growth regulators and chemicals on physico-chemical characteristics and shelf life of sapota [Manilkara achras (Mill) Fosberg] fruit cv. Kalipatti.”

Materials and Methods

Present investigations were carried out at Anand Agricultural University, Anand. The fruit of sapota cv. Kalipatti were harvested at optimum stage of maturity. The fruits were dipped for 5 min. in solution of calcium chloride (5000 and 10000 mg/l) and ethrel (1000 and 2000 mg/l), GA₃ (150 and 300 mg/l) for 10 minutes, kinetin (100 and 200 mg/l) for 20 minutes and the fruits kept under control were dipped in distilled water for 5 minutes.

The experimental data was analyzed in Completely Randomized Design (CRD) with four replications. Fruits were than air dried and packed in Corrugated Fibre Board (CFB) boxes and kept at room temperature. The number of visibly diseased, rotten, over ripe fruits were counted and expressed as percentage over the total number of fruits at 4th, 6th, 8th, 10th and 12th day and were subtracted from initial weight. The loss in weight was calculated and expressed in percentage. It was calculated by following formula.

\[
\text{PLW} \, (\%) = \frac{\text{Initial weight} - \text{Final weight} \times 100}{\text{Initial weight} \, (g)}
\]

Shelf life (days)

The shelf life of fruits was noted by keeping the fruits at room temperature and the days taken from harvesting to optimum eating stage.

Spoilage of fruits (%)

The number of visibly diseased, rotten, over ripe fruits were counted and expressed as percentage over the total number of fruits at 4th, 6th, 8th, 10th and 12th days of storage period.

Number of days taken to ripening (day)

The number of days taken by each treatment to attain eating ripeness by more than 90 percent fruits present in a lot was considered as days taken to ripening.

Fruit firmness (kg/cm²)

Sapota fruit firmness (fruit’s pressure) was measured by means of a pocket Penetrometer in terms of pressure required by piercing through the fruit. The pressure required was recorded in kilogram per square centimeter.

*Corresponding author: Tsomu T, Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand 388110, Gujarat, India, Tel: 912692 261076; E-mail: thupten.tsomu@gmail.com

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Results and Discussion

The physiological loss in weight was significantly diminished by post-harvest CaCl₂ treatments (Table 1 and Figure 1). The fruits treated with CaCl₂ (5000 and 10000 mg/l) recorded the lowest loss in weight. The reduction in weight loss might be due to the maintenance of firmness of fruits by calcium as it decreased the enzyme activity responsible for disintegration of cellular structure, which decreases the gaseous exchange [2]. The loss in weight during the storage was significant regardless of CaCl₂ (5000 and 10000 mg/l) treatment.

The shelf life of fruits was significantly prolonged due to calcium chloride and plant growth regulator treatments over control or untreated fruits. Among the different treatments tried, CaCl₂ 10000 ppm (11.25 days) and 5000 ppm (10.50 days) followed by GA₃ 300 ppm (8.75 days) were found most effective to extend the shelf life of sapota fruits over control (Table 2 and Figure 2).

The sapota fruits under treatments of calcium chloride were found to have better quality with extended shelf life. Calcium helps in structural integrity of both the cell wall and plasma membrane thus delaying ripening and extending storage life [3].

The fruits treated with CaCl₂ 10000 ppm (8.5 days) and 5000 ppm (8.0 days) and GA₃ 300 ppm (7.50 days) and 150 ppm (7.25 days) took significantly maximum days for ripening. The untreated fruits ripened in six days and ethrel 2000 ppm treated fruits ripened almost in 4 days earlier than rest of the treatments.

The delay in ripening of the fruits was due to the fact that it slowed down the process of ripening by retarding the pre-climacteric respiration rate and ethylene production and through postponement of their climacteric peak a vis a vis control (Table 2 and Figure 3). These changes lead to reduced degradative metabolism in terms of catalase and PME activities and thus helpful in extending shelf-life of the fruits.

The present investigation is in conformity with the results reported by Gautam and Chundawat [4] in sapota cv. ‘Kalipatti’, Attri and Singh [5] in sapota cv. ‘Cricket Ball’ Damodaran et al. [6] in sapota cv. ‘Cricket Ball’ and Sudha et al. [7] in sapota cvs. ‘PKM-1’ and ‘CO-2’.

Fruit firmness during the storage is associated with acceleration of hydrolytic enzymes. Post-harvest treatments assisted sapota fruits to maintain firmness up to the end of storage period. Fruits treated with CaCl₂ 10000 ppm (0.66 kgcm⁻²) and 5000 ppm (0.64 kgcm⁻²) showed the highest firmness. The fruits treated with CaCl₂ retained more firmness in comparison to control (Table 2 and Figure 4). Firmness in many fruits is an important characteristic that is used to determine stability and it is predominantly determined by cell wall composition and structure. Calcium treatments have been known to delay the softening and improve the fruit quality [3].

The spoilage percent of sapota fruits was increased as the storage

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Table 1: Physiological loss in weight due to the effect of different levels of post-harvest treatments of chemical and plant growth regulators on sapota fruits cv. Kalipatti.

| Sr. No. | Treatments       | Physiological loss in weight (%) | No. of days (Storage period) |
|--------|------------------|----------------------------------|-----------------------------|
|        |                  |                                  | 4th | 6th | 8th | 10th | 12th |
| 1      | GA 150 mg/l      | 5.97                            | 7.91 | 8.48 | 11.90 | 14.52 |
| 2      | GA 300 mg/l      | 4.89                            | 7.30 | 8.19 | 10.57 | 14.50 |
| 3      | Kinetin 100 mg/l | 7.98                            | 9.68 | 10.67 | 12.48 | 16.44 |
| 4      | Kinetin 200 mg/l | 7.50                            | 9.37 | 10.4  | 12.35 | 16.27 |
| 5      | Ethrel 1000 mg/l | 9.20                            | 10.36 | 12.02 | 14.34 | 18.22 |
| 6      | Ethrel 2000 mg/l | 9.50                            | 10.46 | 12.44 | 14.22 | 18.58 |
| 7      | CaCl₂ 5000 mg/l  | 2.71                            | 4.53  | 6.96  | 8.26 | 13.23 |
| 8      | CaCl₂ 10,000 mg/l| 2.23                            | 4.85  | 6.30  | 8.32 | 11.49 |
| 9      | Control          | 9.42                            | 11.40 | 13.00 | 15.40 | 20.31 |
| S.Em. ±|                  | 0.21                            | 0.33 | 0.36 | 1.03 | 2.71 |
| C.D.  (0.05%) |                | 0.02                            | 0.03 | 0.04 | 0.44 | 0.49 |
| C.V. % |                  | 6.49                            | 7.71  | 8.23 | 7.39 | 6.14 |

Table 2: Effect of different levels of post-harvest treatments of chemical and plant growth regulators on shelf life, days taken to ripening and fruit firmness of sapota fruits cv. Kalipatti.

| Sr. No. | Treatments       | Shelf life (days) | Days taken to ripening (days) | Fruit firmness (kgcm⁻²) |
|--------|------------------|-------------------|-----------------------------|------------------------|
| 1      | GA 150 mg/l      | 8.25              | 7.25 | 0.54 |
| 2      | GA 300 mg/l      | 8.75              | 7.50 | 0.55 |
| 3      | Kinetin 100 mg/l | 7.00              | 6.00 | 0.41 |
| 4      | Kinetin 200 mg/l | 7.50              | 6.50 | 0.44 |
| 5      | Ethrel 1000 mg/l | 6.00              | 5.00 | 0.37 |
| 6      | Ethrel 2000 mg/l | 5.25              | 4.50 | 0.39 |
| 7      | CaCl₂ 5000 mg/l  | 10.50             | 8.00 | 0.64 |
| 8      | CaCl₂ 10,000 mg/l| 11.25             | 8.50 | 0.66 |
| 9      | Control          | 6.25              | 6.25 | 0.30 |

C.V. %: 9.08 10.30 8.05
C.D. (0.05%) ±: 0.36 0.33 0.02
S.Em. ±: 0.36 0.33 0.02

Figure 1: Effect of post-harvest treatments of chemical and growth regulators on physiological loss.

Figure 2: Effect of post-harvest treatments of chemical and growth regulators on Shelf life (days) of sapota fruits cv. Kalipattin weight (%) of sapota fruits cv. Kalipatti.

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period advanced irrespective of any treatment. Calcium treated fruits showed significantly lesser extent of rotting which may be due to the higher fruit flesh and skin calcium content, which resulted in stronger intracellular organization and rigidified cell wall. Similar findings were reported by Singh and Narayana [8] in mango (Table 3 and Figure 5).

Conclusion

The present study was conducted to investigate the effect of post-harvest treatments of chemical and plant growth regulators on physical parameters of sapota fruit cv. Kalipatti. The various post-harvest treatments included were fruit dip in CaCl₂, GA₃, kinetin, ethrel and control fruits were dipped in distilled water. Treated fruits were stored under room temperature. Fruits treated with CaCl₂ (5000 mg/l) helps in maintaining the highest fruit firmness, delayed ripening and shelf life. The least spoilage and PLW was again found in fruits treated with CaCl₂ (5000 and 10000 mg/l) followed by GA₃ (150 and 300 mg/l) as compared to other post-harvest treatments.

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| Sr. No. | Treatments       | Spoilage (%) | No. of days (Storage period) | 4th | 6th | 8th | 10th | 12th |
|--------|------------------|--------------|-----------------------------|-----|-----|-----|------|------|
| 1      | GA₃ 150 mg/l     | 6.00         | 21.70 41.33 61.13 88.50    |     |     |     |      |      |
| 2      | GA₃ 300 mg/l     | 5.50         | 20.87 40.83 65.92 85.75    |     |     |     |      |      |
| 3      | Kinetin 100 mg/l | 8.50         | 24.78 45.50 68.96 87.75    |     |     |     |      |      |
| 4      | Kinetin 200 mg/l | 7.00         | 22.44 42.24 67.67 90.25    |     |     |     |      |      |
| 5      | Ethrel 1000 mg/l | 10.25        | 26.14 50.90 76.25 100.00   |     |     |     |      |      |
| 6      | Ethrel 2000 mg/l | 11.25        | 28.90 52.32 75.00 100.00   |     |     |     |      |      |
| 7      | CaCl₂ 5000 mg/l  | 4.50         | 17.51 36.57 50.02 80.00    |     |     |     |      |      |
| 8      | CaCl₂ 10,000 mg/l| 4.00         | 15.02 34.69 50.71 75.00    |     |     |     |      |      |
| 9      | Control          | 10.00        | 25.03 48.55 73.27 100.00   |     |     |     |      |      |

Table 3: Effect of different levels of post-harvest treatments of chemical and growth regulators on spoilage of sapota fruits cv. Kalipatti.