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

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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 $CaCl_2$ (5000 and 10000 mg/l) followed by plant growth regulators, Gibbrellic acid (GA_3) (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. $CaCl_2$ (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 Gibbrellic acid (GA_3) (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-harvestdip improves the fruit firmness, shelf life and ripening period of the sapota upto 12 days of storage.

Keywords: Sapota; Post-harvest; Calcium chloride; Gibbrellic acid (GA_3); 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 [*Manilkaraachras*(Mill) Forseberg.] 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), GA_3 (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 repetitions. Fruits were than air dried and packed in Corrugated Fibre Board (CFB) boxes and kept at room storage. The fruits were assessed at 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} day of storage for physiological loss in weight, spoilage, fruit firmness, shelf life and days taken to ripening.

Physiological loss in weight (PLW%)

The initial weight of fruits was recorded at the time just before giving post-harvest treatments. To assess the loss in weight, observations were recorded at 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} day and were subtracted from initial weight. The loss in weight was calculated and expressed in percentage. It was calculated by following formula.

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

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 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} 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 (kgcm^{-2})

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.

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Results and Discussion

The physiological loss in weight was significantly diminished by post-harvest $CaCl_2$ treatments (Table 1 and Figure 1). The fruits treated with $CaCl_2$ (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 $CaCl_2$ (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, $CaCl_2$ 10000 (11.25 days) and 5000 ppm (10.50 days) followed by GA_3 300 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 $CaCl_2$ 10000 ppm (8.5 days) and 5000 ppm (8.0 days) and GA_3 300 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.

Sr. No.	Treatments	Physiological loss in weight (%)				
		No. of days (Storage period)				
		4th	6th	8th	10th	12th
1	GA_3 150 mg/l	5.97	7.91	8.48	11.90	14.52
2	GA_3 300 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	$CaCl_2$ 5000 mg/l	2.71	4.53	6.96	8.26	13.23
8	$CaCl_2$ 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	0.40	0.44	0.49
C.D. (0.05%)		0.62	0.94	1.17	1.28	1.42
C.V. %		6.49	7.71	8.23	7.39	6.14

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.

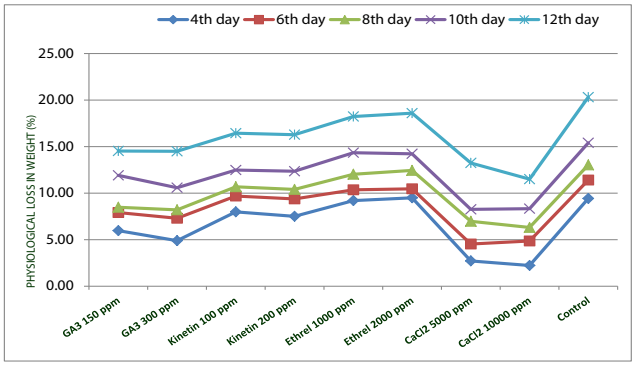

Figure 1: Effect of post-harvest treatments of chemical and growth regulators on physiological loss.

Sr. No.	Treatments	Shelf life (days)	Days taken to ripening (days)	Fruit firmness ($kgcm^{-2}$)
1	GA_3 150 mg/l	8.25	7.25	0.54
2	GA_3 300 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	$CaCl_2$ 5000 mg/l	10.50	8.00	0.64
8	$CaCl_2$ 10,000 mg/l	11.25	8.50	0.66
9	Control	6.25	6.25	0.30
S.Em. ±		0.36	0.33	0.02
C.D. (0.05%)		1.03	0.95	0.06
C.V. %		9.08	10.30	8.05

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.

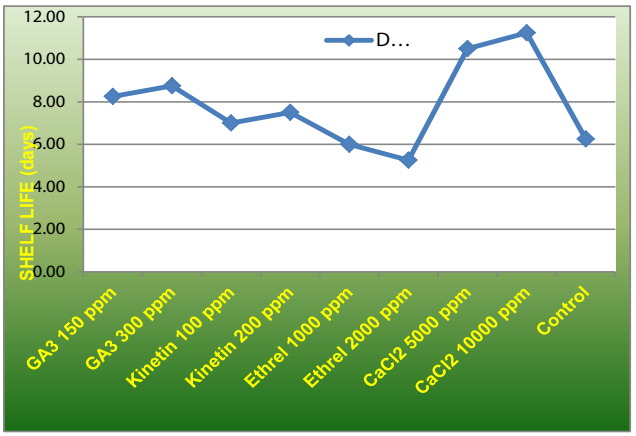

Figure 2: Effect of post-harvest treatments of chemical and growth regulators on Shelf life (days) of sapota fruits cv. Kalipattiin weight (%) of sapota fruits cv. Kalipatti.

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 $CaCl_2$ 10000 ppm (0.66 $kgcm^{-2}$) and 5000 ppm (0.64 $kgcm^{-2}$) showed the highest firmness. The fruits treated with $CaCl_2$ 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

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 $CaCl_2$, GA_3, kinetin, ethrel and control fruits were dipped in distilled water. Treated fruits were stored under room temperature. Fruits treated with $CaCl_2$ (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 $CaCl_2$ (5000 and 10000 mg/l) followed by GA_3 (150 and 300 mg/l) as compared to other post-harvest treatments.

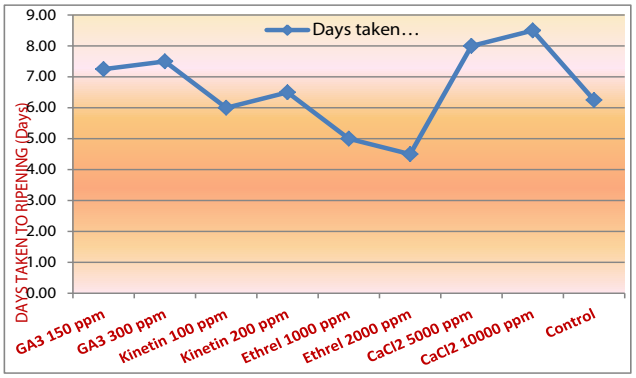

Figure 3: Effect of post-harvest treatments of chemical and growth regulators on days taken to ripeninig of sapota fruits cv. Kalipatti.

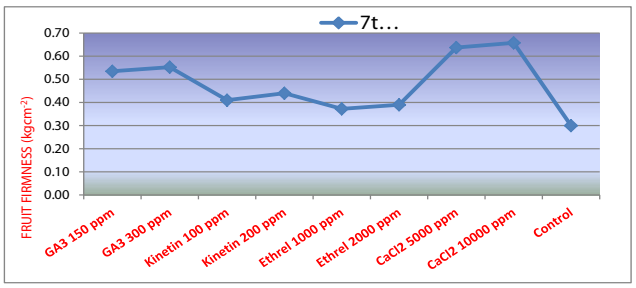

Figure 4: Effect of post-harvest treatments of chemical and growth regulators on fruit firmness ($Kgcm^{-2}$) of sapota fruits cv. Kalipatti.

Sr. No.	Treatments	Spoilage (%)				
		No. of days (Storage period)				
		4th	6th	8th	10th	12th
1	GA_3 150 mg/l	6.00	21.70	41.33	61.13	88.50
2	GA_3 300 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	$CaCl_2$ 5000 mg/l	4.50	17.51	36.57	50.02	80.00
8	$CaCl_2$ 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
S.Em. ±		0.37	0.96	1.65	2.94	1.78
C.D. (0.05%)		1.06	2.79	4.80	8.51	5.17
C.V. %		9.84	8.55	7.57	8.97	3.98

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

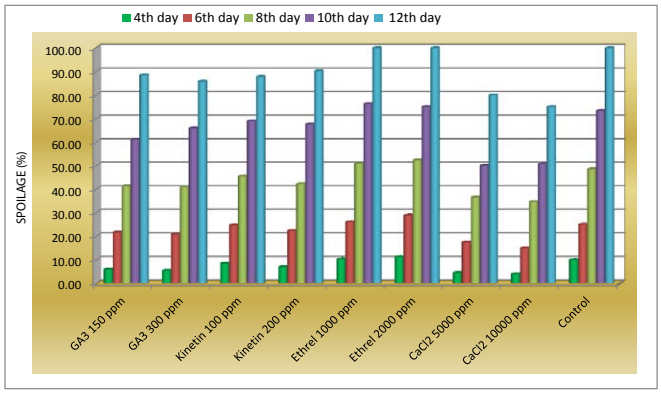

Figure 5: Effect of post-harvest treatments of chemical and growth regulators on spoilage (%) of sapota fruits cv. Kalipatti.

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