

Impact of different growth regulators, chemical and wax coating on shelf-life of sapota fruits cv. 'Kalipatti'

P. D. PATEL¹ AND A. D. PATEL²

Krishi Vigyan Kendra,
Anand Agricultural University, Arnej - 382 230, Ta. Dholka, Dist. Ahmedabad (Gujarat)

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ABSTRACT

Studies were conducted to assess the effects of different growth regulators, chemical and wax coating to extend the shelf-life of sapota at ambient temperature. Sapota fruits were dipped in GA₃ @ 100, 200 ppm, NAA @ 100, 200 ppm and AgNO₃ @ 20, 40 ppm and then coated with wax 3 and 6 % under different treatments. Observations on various parameters were recorded at 6th, 9th, 12th and 15th days of storage period. Fruit firmness (Kgcm⁻²) was recorded at the end of the storage period. Results indicated that minimum PLW (2.64%) was recorded with treatment of AgNO₃ 40 ppm. Treatment combination of AgNO₃ 40 ppm treated fruits coated with wax 6 % recorded minimum PLW (3.68 and 6.35 %) on 9th and 12th day of storage period, respectively. Maximum marketable fruits (92.50, 66.67 and 45.83 %) was recorded with GA₃ 100 ppm on 6th, 9th and 12th day of storage periods, respectively. The treatment of GA₃ 100 ppm and NAA 100 ppm could significantly minimized spoilage of the fruits during storage. Minimum spoilage of the fruits (22.08 %) on 6th day of storage and 52.92 and 63.75 % on 9th and 12th day of storage period was recorded with GA₃ 100 ppm and NAA 100 ppm, respectively. Maximum shelf-life (9.17 days) was recorded with GA₃ 200 ppm and coating of fruits with wax 6 % (7.92 %). Maximum fruit firmness (0.53 Kgcm⁻²) was recorded with treatment of NAA 200 ppm.

Key words : Growth regulator, sapota, wax coating

Sapota [(*Manilkara achras* (Mill.) Fosberg] is fifth popular fruit in both production and consumption next to mango, banana, citrus and grapes. In India, it is cultivated under area of 1.56 lakh ha. with a total production of 13.07 lakh M.T. (Anonymous 2008-09). The major sapota growing states are Maharashtra, Gujarat, Tamilnadu, Andhra Pradesh, Karnataka, West Bengal, Uttar Pradesh, Punjab and Haryana. Being climacteric in nature, the fruit needs ripening treatments after full maturity. Storage and ripening of sapota are beset with a number of problems under tropical conditions. Fruits ripen within 2 or 3 days and become overripe and spoiled within 5 days after harvest.

The short post-harvest life of horticultural crops is due to their perishable nature and physiological break

down during handling, transport, storage and these losses are further enhanced by infection of post-harvest disease. Various viable technologies for improving shelf-life and storage of horticultural commodities like use of fungicides, cold storage, controlled atmosphere storage, anti-transparent, wax coating, growth regulators, irradiation and different type of packing materials, etc., were evolved during the past decades. The technology aim to preserve quality, nutritional and economic value and assure food safety and regulated supply of commodities for processing, domestic markets and export.

MATERIALS AND METHODS

The experiment was conducted at Department of Horticulture, B.A.C.A., AAU, Anand during 2007-08 and 2008-09. The handpicked, firm and healthy sapota cv. 'Kalipatti' fruits of uniform size and maturity, free from pest and diseases, injuries,

¹ Subject Matter Specialist (Hort.), ² Research Scientist, Regional Research Station, AAU, Anand

bruises and blemishes were plucked from Horticulture Research cum Demonstration Farm, AAU, Anand. Out of these fruits, two kg. fruits were randomly selected and dipped in two growth regulators solution each at two levels i.e., GA₃ 100, 200 ppm, NAA 100, 200 ppm, a chemical at two levels i.e., AgNO₃ 20, 40 ppm solution for ten minutes. Treated fruits then surface dried up to sufficient cool and coated with wax (58-60 °C) 3 and 6 % for a minute. The experiment was laid out in Factorial Completely Randomized Block Design comprising thirteen treatment combinations, i.e. GA₃ 100 ppm + Wax 3 % (T₁), GA₃ 200 ppm + Wax 3 % (T₂), NAA 100 ppm + Wax 3 % (T₃), NAA 200 ppm + Wax 3 % (T₄), AgNO₃ 20 ppm + Wax 3 % (T₅), AgNO₃ 40 ppm + Wax 3 % (T₆), GA₃ 100 ppm + Wax 6 % (T₇), GA₃ 200 ppm + Wax 6 % (T₈), NAA 100 ppm + Wax 6 % (T₉), NAA 200 ppm + Wax 6 % (T₁₀), AgNO₃ 20 ppm + Wax 6 % (T₁₁), AgNO₃ 40 ppm + Wax 6 % (T₁₂) and control (T₁₃). The treated fruits then surface dried up to sufficient cool and then packed in card board carton of 30 x 30 x 30 cm size with 6 vents of 3 cm diameter, 3 each on opposite sides and stored in the laboratory at ambient temperature. The mean temperature and relative humidity prevailed during storage at both the season ranges from 25.7 to 31.2 °C, 39-72 % and 28.4 to 32.5 °C, 17-55 %, respectively. Observations on PLW (%), marketable fruits (%), spoilage of fruits (%), number of days taken to ripening, fruit firmness (Kg cm⁻²). Firmness of fruit was measured by means of pocket penetrometer in terms of pressure required for piercing through the fruits and expressed in kg cm⁻². For recording all these parameters, five fruits were randomly selected from a single lot and replicated thrice. The data obtained were statistically analyzed.

RESULTS AND DISCUSSION

The data presented in Table 1 showed increasing trend in PLW during the storage periods. All the treatments significantly exerted for PLW of fruits during the storage periods. On 6th 9th and 12th day of storage, minimum PLW (2.64, 3.73 and 6.55 % respectively) was recorded with AgNO₃ 40 ppm. On 9th and 12th day of storage, various treatments and their interaction also influenced PLW of sapota fruits. On 9th and 12th day of storage, minimum PLW

(3.68 and 6.35 %) was recorded with AgNO₃ 40 ppm + wax 6 %), followed by AgNO₃ 20 ppm + wax 6 %, respectively. This reduction in PLW by AgNO₃ 40 ppm and their combinations with wax 6 %, could be due to reduced metabolism and reduced rate of transpiration that resulted in slow release of free water. Silver nitrate (AgNO₃) is known to be the anti-ethylene compound, as the silver ion plays a vital role in the regulation of ethylene bio-synthesis showing a pronounced effect on the ethylene release during climacteric fruit ripening. The results are in conformity with the findings as reported by Gautam and Chundawat (1990) in sapota cv. 'Kalipatti', Gautam *et al.* (1990) in sapota cvs. 'Kalipatti' and 'Cricket Ball'. Attri and Singh (1996) in sapota cv. 'Cricket Ball', Bairwa and Dashora (1999) in banana and Kahlon and Uppal (2005) in mango cv. 'Chausa'.

Various growth regulators and chemical treatment significantly influenced marketable fruits of sapota during all the day of storage (Table 2). On 6th and 9th day of storage, maximum marketable fruits (92.50 and 66.67% respectively) were recorded with GA₃ 100 ppm. On 12th and 15th day of storage, maximum marketable fruits were recorded with GA₃ 100, 200 ppm (45.83 %) and GA₃ 200 ppm (15 %), respectively. The increase in marketable fruits might be due to gibberellic acid which controlled the ethylene production as well as enzymatic activity. The results are in conformity with findings as reported by Kumar and Nagpal (1996) in mango cv. 'Dashehari'.

Different growth regulators and chemical exerted significant effects on spoilage of fruits during 6th, 9th and 12th day of storage periods (Table 3). On 6th day of storage, minimum (22.08 %) spoilage of fruits was recorded with GA₃ 100 ppm. On 9th and 12th day of storage, minimum (52.92 and 63.75 % respectively) spoilage of fruits was recorded with NAA 100 ppm. GA₃ and NAA dipped fruits showed the least spoilage percentage during the storage period. This might be due to GA₃ treated fruits having thick skin, which prevented the entry of microbes and maintained low rate of various metabolic processes which in turn increased the resistance to microbial entry. The results are in conformity with the findings as reported

Table 1 Effects of different growth regulators, chemical and wax coating on PLW(%) of sapota cv. 'Kalipatti' during different storage periods.

Growth regulators & Chemical(GC)	Physiological Loss in Weight (%)								
	6 th day			9 th day			12 th day		
	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)
Control			6.33			9.78			12.97
GA ₃ 100 ppm	4.49	3.93	4.21	8.82	8.12	8.47	13.35	12.33	12.84
GA ₃ 200 ppm	4.48	3.80	4.15	8.48	7.50	7.99	13.98	13.05	13.52
NAA 100 ppm	4.49	4.22	4.36	7.55	6.93	7.24	8.98	8.00	8.49
NAA 200 ppm	4.40	3.90	4.16	6.55	6.11	6.33	8.48	8.18	8.33
AgNO ₃ 20 ppm	2.87	2.52	2.69	4.50	4.20	4.35	6.92	6.38	6.65
AgNO ₃ 40 ppm	2.90	2.37	2.64	3.78	3.68	3.73	6.76	6.35	6.55
Mean(W)	3.94	3.46	3.70	6.61	6.09	6.35	9.75	9.05	9.40
F-test CD at 5 %									
Grs. & Chemical(GC)			0.42			0.41			0.60
Wax (W)			0.24			0.24			0.35
Interaction (GC x W)			NS			0.268			0.339
									NS

Table 2 Effects of different growth regulators, chemical and wax coating on marketable fruits(%) of sapota cv. 'Kalipatti' during different storage periods.

Growth regulators & Chemical(GC)	Marketable fruits (%)								
	6 th day			9 th day			12 th day		
	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)
Control			74.17			50.83			31.67
GA ₃ 100 ppm	94.17	90.83	92.50	66.67	66.67	66.67	45.00	46.67	45.83
GA ₃ 200 ppm	93.33	93.33	93.33	60.00	65.00	62.50	45.83	45.83	45.83
NAA 100 ppm	80.83	82.50	81.67	59.17	60.00	59.58	40.83	41.67	41.25
NAA 200 ppm	81.67	83.33	82.50	60.00	58.33	59.17	42.50	40.83	41.67
AgNO ₃ 20 ppm	79.16	79.17	79.17	56.67	56.67	57.08	37.50	38.33	37.92
AgNO ₃ 40 ppm	81.67	80.00	80.83	55.83	53.33	55.83	37.50	38.33	37.92
Mean (W)	85.14	84.86	85.00	59.72	60.56	60.14	41.53	41.94	41.74
F-test CD at 5 %									
Grs. & Chemical(GC)			7.24			7.36			6.30
Wax (W)			NS			NS			NS
Interaction (GC x W)			NS			NS			NS
									NS

Table 3 Effects of different growth regulators, chemical and wax coating on spoilage of sapota cv. 'Kalipatti' fruits during different storage periods.

Growth regulators & Chemical (GC)	Spoilage of fruits (%)											
	6 th day			9 th day			12 th day			15 th day		
	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)	Wax 3 %	Wax 6 %	Mean (GC)
Control			37.50			72.50			94.17			95.83
GA ₃ 100 ppm	25.00	19.17	22.08	65.00	64.17	64.58	81.67	78.33	80.00	90.00	86.67	88.33
GA ₃ 200 ppm	29.17	22.50	25.83	62.50	62.50	62.50	90.83	81.67	86.25	95.00	89.16	92.08
NAA 100 ppm	29.17	26.67	27.92	55.00	50.83	52.92	65.83	61.67	63.75	91.67	90.00	90.83
NAA 200 ppm	25.83	21.67	23.75	61.67	51.67	56.67	72.50	58.33	65.42	91.67	89.17	90.42
AgNO ₃ 20 ppm	35.00	28.33	31.67	77.50	75.00	76.25	90.00	90.00	90.00	92.50	91.67	92.08
AgNO ₃ 40 ppm	37.50	31.67	34.58	78.33	76.67	77.50	90.83	89.17	90.00	93.33	91.67	92.50
Mean(W)	30.28	25.00	27.64	66.67	63.47	65.07	81.94	76.53	79.24	92.36	89.72	91.04
F-test CD at 5 %												
Grs. & Chemical(GC)			7.11			9.92			8.76			NS
Wax (W)			4.11			NS			5.06			3.29
Interaction (GC x W)			NS			NS			6.116			NS

Table 4 Effects of different growth regulators, chemical and wax coating on number of days taken for ripening of sapota cv. 'Kalipatti' fruits during different storage periods.

Growth regulators & Chemical (GC)	Number of days taken for ripening		
	Wax 3%	Wax 6%	Mean (GC)
Control			4.67
GA ₃ 100 ppm	7.50	7.83	7.67
GA ₃ 200 ppm	8.83	9.50	9.17
NAA 100 ppm	6.83	7.33	7.08
NAA 200 ppm	6.67	7.00	6.83
AgNO ₃ 20 ppm	7.33	7.67	7.50
AgNO ₃ 40 ppm	7.50	8.16	7.83
Mean(W)	7.44	7.92	7.68
F-test CD at 5 %			
Grs. & Chemical(GC)			0.93
Wax (W)			0.54
Interaction (GC x W)			NS

Table 5 Effects of different growth regulators, chemical and wax coating on fruit firmness of sapota cv. 'Kalipatti'.

Growth regulators & Chemical (GC)	Fruit firmness (Kg cm ⁻²)		
	Wax 3%	Wax 6%	Mean (GC)
Control			0.48
GA ₃ 100 ppm	0.37	0.38	0.38
GA ₃ 200 ppm	0.46	0.51	0.49
NAA 100 ppm	0.50	0.49	0.50
NAA 200 ppm	0.50	0.55	0.50
AgNO ₃ 20 ppm	0.45	0.46	0.46
AgNO ₃ 40 ppm	0.50	0.51	0.51
Mean (W)	0.47	0.49	0.48
F-test CD at 5 %			
Grs. & Chemical(GC)			0.11
Wax (W)			NS
Interaction (GC x W)			NS

by Avaiya and Singh (1989) in sapota cvs. 'Kalipatti', 'Cricket ball', Choudhary and Dhaka (2005) in Kinnow mandarin fruits, Kahlon and Uppal (2005) in mango

cv. 'Chausa', Rajkumar *et al.* (2005) in papaya cv. 'CO-2' and Sudha *et al.* (2007) in sapota cvs. 'PKM-1', 'Zumakhia', 'Calcutta special', 'Mohargootee' and 'Pilipatti'. Application of NAA helped to delay the ripening process and thus reduced spoilage. The results are in conformity with the finding as reported by Banik *et al.* (1988) in sapota, Gautam *et al.* (2003) in mango cv. 'Banganapalli'.

Various treatments significantly influenced number of days to reach ripening of sapota fruits (Table 4). Maximum number of days (9.17) for ripening of the fruits were recorded with GA₃ 200 ppm followed by AgNO₃ 40 ppm (7.83). Wax 6 % treatment showed maximum number of days (7.92) to reach ripening of sapota fruits. This delay in ripening of the fruits was due to the fact that GA₃ slowed down the process of ripening by reducing the respiration rate and ethylene production and through postponement of their climacteric peak *a vis a vis* control. These changes to reduced degradative metabolism in terms of catalase and PME activities and thus are helpful in extending shelf-life of the fruits. The results are in accordance with the findings of Gautam and Chundawat (1989) in sapota cv. 'Kalipatti', Attri and Singh (1996) in sapota cv. 'Cricket Ball', Damodaran *et al.* (2001) in sapota cv. 'Cricket Ball' and Sudha *et al.* (2007) in sapota cvs. 'PKM-1' and 'CO-2'.

Various growth regulators and chemical significantly influenced firmness of sapota fruits (Table 5). Maximum firmness (0.53 Kg cm⁻²) was recorded with NAA 200 ppm. Fruit firmness during the storage period is associated with the activity of acceleration of hydrolytic enzymes. Post-harvest treatments assisted sapota fruits to maintain firmness up to the end of storage period. Fruits treated with NAA showed the highest firmness. All other growth regulators also recorded higher fruit firmness than untreated. GA₃ that reduced the activities of softening enzymes i.e. polygalactouronase and pectin methyl esterase by protecting stiff pectin micro-molecules against demethylation or reduced depolymerization of polygalactouronase. The results of present investigation is in accordance with the results reported by Singh and Narayana (1999) in mango, Rajkumar *et al.* (2005) in papaya cv. 'CO-2' and Sudha *et al.* (2007) in sapota cv. 'PKM-1'.

REFERENCES

- Anonymous, 2008-09 *Indian Horticultural Database-2008*, National Horticulture Board, Director of Horticulture, Gujarat State, Gandhinagar.
- Attri, B. L. and Singh, D. B. 1996. Effect of GA₃ and silver nitrate on the physicochemical characteristics of sapota cv. 'Cricket Ball' during storage. *Progressive Horticulture*, **28** (3&4): 137-42.
- Avaiya, Y. V. and Singh, S. P. 1989. Studies on storage behaviour of sapota (*Achras sapota* L.) cultivars as influenced by ripening retardants. *Orissa Journal of Horticulture*, **17** (1&2): 55-60.
- Bairwa, L. N. and Dashora, L. K. 1999. Effect of KMnO₄ and AgNO₃ on post-harvest shelf-life of banana (*Musa paradisiaca* L.). *Advances in Horticulture and Forestry*, **7**: 9-15.
- Banik, D. Dhua, R. S. Ghosh, S. K. and Sen, S. K. 1988. Studies on extension of storage life of sapota (*Achras sapota* L.). *Indian Journal of Horticulture*, **45** (3&4) : 241-48.
- Choudhary, M.R. and Dhaka R.S. 2005. Effect of different post-harvest treatments on quality of Kinnow mandarin fruits during storage. *Haryana Journal of Horticultural Science*, **34** (1&2): 39-41.
- Damodaran, T. Attri, B. L. Medhi, R. P. Nair, S. A. and Alex, L. 2001. Studies on post-harvest management of sapota (*Achras zapota*) cv. 'Cricket Ball' during storage. *Indian Journal of Horticulture*, **58** (4): 342-45.
- Gautam, B. Sarkar, S. K. and Reddy, Y. N. 2003. Effect of post-harvest treatments on shelf-life and quality of 'Banganapalli' mango. *Indian Journal of Horticulture*, **60** (2): 135-39.
- Gautam, S. K. and Chundawat, B. S. 1989. Post-harvest changes in sapota cv. 'Kalipatti': I-Effect of various post-harvest treatments on biochemical changes. *Indian Journal of Horticulture*, **46**: 310-15.
- Gautam, S. K. and Chundawat, B. S. 1990. Post-harvest changes in sapota cv. 'Kalipatti': II-Effect of various post-harvest treatments on physico-chemical attributes. *Indian Journal of Horticulture*, **47** (3): 264-69.

- Gautam, S. K. Chundawat, B. S. Prakash, -J(ed.) and Pierik, R. L. M. 1990. Effects of prepacking treatments on storability and quality of sapota (*Achras sapota* L.) *Horticulture'-new technologies and applications'*. Proceedings of the International Seminar on *New Frontiers in Horticulture*, organised by Indo-American Hybrid Seeds, Bangalore, India, Nov.,25-28,1990. *Current Plant Science and Biotechnology in Agriculture*, **12**: 371-77.
- Kahlon, P. S. and Uppal, R. S. 2005. Effect of post-harvest treatments on shelf-life of mango cv. 'Chausa'. *Haryana Journal of Horticultural Science*, **34** (1&2): 51-53.
- Kumar, R. and Nagpal, R. 1996. Effect of post-harvest treatments on the storage behaviour of mango cv. 'Dashehari'. *Haryana Journal of Horticultural Science*, **25** (3): 101-08.
- Rajkumar, M., Karuppaiah, P. and Kandasamy, R. 2005. Effect of calcium and gibberellic acid on post-harvest behaviour of papaya cv. 'CO-2'. *Indian Journal of Horticulture*, **62** (4): 327-31.
- Singh, B. P. and Narayana, C. K. 1999. An integrated approach for storage of mango. *Indian Journal of Horticulture*, **56** (1): 5-9.
- Sudha, R. Amutha, R. Muthulaksmi, S. Baby Rani, W. Indira, K. and Mareeswari, P. 2007. Influence of pre and post-harvest chemical treatments on physical characteristics of sapota (*Achras sapota* L.) Var. 'PKM-1'. *Research Journal of Agricultural & Biological Science*, **3** (5): 450-52.