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A study on biochemical changes of sapota vrieties in cold storage with application of GA_3

R.G. PATEL, **B.R. PARMAR** AND S.J. PATIL

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See end of the article for authors' affiliations

Correspondence to :

B.R. PARMAR
Department of Horticulture, N.M. College of Agriculture, Navsari Agricultural University, NAVSARI (GUJARAT) INDIA

ABSTRACT

Sapota (*Manilkara achras*) fruits of different varieties (Kalipattai, PKM-1, Co-2, Singapore and Kirthibarthi) dipped in GA_3 (150 mg L^{-1}) and then stored at three different cold storage temperatures: 5^0C, 12^0C, 15^0C and ambient condition evaluated for its effect on post storage fruit quality. Sapota fruits stored at 5^0C sustained chilling injury manifested as uneven ripening, pitting and hardened pulp. The rate of change of chemical constituents was found to be slower in fruit stored at 12^0C as compared to fruit stored at 15^0C and control (ambient condition). 'Kalipatti' variety was superior in terms of longer shelf life and required quality attributes. 'PKM-1' noted highest TSS (%), reducing sugars (%) and total sugars (%) although 'Kalipatti' and 'CO-2' variety exhibited good post harvest quality but Singapore and Kirthibarthi varieties had poor fruit quality. Thus, all varieties of sapota fruit can be stored at 12^0C temperature for a long period with edible acceptable quality.

Key words : Sapota, GA_3, Cold storage.

Sapota or sapodilla [*Manilkara achras* (Mill) Fosberg] commonly known as *chiku* is a delicious fruit and valued for its mellow and sweet pulp which mainly used for table purpose in India. South Gujarat and coastal Maharashtra are the principal areas where it is extensively cultivated and marketed to various parts of the country (Parmar, 2002). The fruits are highly perishable and cannot be stored for long as it becomes over ripe and spoiled within 5 days due to rapid degradative metabolism. Extension of post harvest life and quality may be possible by checking the rate of respiration, transpiration and also retard by microbial infection. These can be achieved to some extent by the use of growth regulators and low temperature storage of fruits (Banik *et al.*, 1988). Considering these facts, the present study was carried out.

MATERIALS AND METHODS

The present investigation was carried out for extending the post harvest life and to know the biochemical changes of sapota fruits at Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari in collaboration with Cold Storage Unit, Post Harvest Technology Centre, N.A.U., Navsari during the year 2008. The experiment was laid out in a Completely Randomized Block Design with factorial concept (FCRD) with three repetitions comprised cold storage temperature *viz.* fruits stored at C_1- (5^0C), C_2- (12^0C), C_3- (15^0C) and C_4- control (ambient temperature) and sapota varieties V_1- Kalipatti, V_2- PKM-1, V_3- CO-2, V_4- Singapore and V_5- Kirthibarthi with post harvest dipping of GA_3 (150mgL^{-1}) for 10 minutes. The data were recorded at alternate day. Statistical analysis of data was done by following the Fisher's analysis of variance techniques as given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under following heads:

Total soluble solids (%):

TSS (%) content was significantly affected by the various cold storage temperatures on all the days of storage period. The TSS (%) content of fruits gradually increased throughout the storage period (Table 1). The combination of post harvest dipping of fruits in GA_3 (150 mg L^{-1}) and cold storage temperature at 5^0C recorded minimum TSS (%) in fruits during all the days of storage. The minimum accumulation of TSS (%) might be due to reduced rate of hydrolysis of starch and delayed ripening in low temperature. In case of variety, PKM-1 obtained highest TSS (%) throughout the storage period due to hydrolysis of starch to sugars and dehydration of juice, minerals and acids. This is in line with findings of Rana (2006), Banik *et al*. (1988) and Balakrishnan (2003) in sapota.

Vitamin-C (mg/100 g of pulp):

A significant decrease in ascorbic acid at later

Table 1 : Effect of post harvest application of GA_3 on TSS (%) and vitamin-C (mg/100g pulp) of sapota varieties in cold storage

Treatments	TSS (%)							Vitamin-C (mg/100g pulp)						
	Storage periods (days)							Storage periods (days)						
	2nd	4th	6th	8th	10th	12th	14th	2nd	4th	6th	8th	10th	12th	14th
Cold storage temperature														
C_1= 5^{0}C	19.58	19.81	19.91	19.99	20.09	20.18	20.26	10.12	9.96	9.68	9.38	9.07	8.74	8.48
C_2=12^{0}C	19.84	20.18	20.67	21.43	21.99	22.34	0.00	9.91	8.11	5.68	3.98	2.92	1.14	0.00
C_3=15^{0}C	20.23	20.72	21.30	21.90	22.20	0.00	0.00	9.71	7.13	4.32	2.08	1.10	0.00	0.00
C_4=Control	20.53	21.08	21.95	21.30	0.00	0.00	0.00	9.62	6.29	3.19	1.11	0.00	0.00	0.00
S.E. ±	0.20	0.22	0.23	0.25	0.21	0.23	0.13	0.09	0.11	0.11	0.12	0.10	0.09	0.04
C.D. (P=0.05)	0.59	0.62	0.67	0.72	0.60	0.68	0.37	0.25	0.31	0.33	0.36	0.31	0.25	0.13
Varieties														
V_1=Kalipatti	20.23	20.34	20.81	21.10	16.20	10.75	5.11	10.38	8.18	6.10	4.36	3.47	2.68	2.29
V_2=PKM-1	22.04	22.50	23.02	23.15	17.52	11.65	5.54	9.50	7.75	5.63	4.00	3.17	2.35	2.02
V_3=CO-2	19.19	19.81	20.38	20.45	15.46	10.14	4.81	10.83	8.47	6.26	4.54	3.57	2.76	2.31
V_4=Singapore	18.87	19.37	19.95	20.20	15.28	10.07	4.79	9.27	7.58	5.37	3.92	3.11	2.30	2.00
V_5=Kirthibarthi	19.89	20.24	20.64	20.89	15.89	10.53	5.05	9.20	7.38	5.23	3.87	3.04	2.25	1.97
S.E. ±	0.23	0.24	0.26	0.28	0.23	0.26	0.14	0.10	0.12	0.13	0.14	0.12	0.10	0.05
C.D. (P=0.05)	0.66	0.70	0.75	0.80	0.67	0.76	0.42	0.28	0.35	0.37	0.40	0.34	0.28	0.15
Interaction (CxV)														
S.E. ±	0.46	0.49	0.52	0.56	0.47	0.53	0.29	0.20	0.24	0.26	0.28	0.24	0.20	0.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	0.848	NS	NS	NS	NS	NS	0.577	0.308
CV %	4.03	4.16	4.37	4.62	5.12	8.68	10.13	3.52	5.38	7.91	11.90	12.85	14.14	8.78

NS = Non significant

ripening stage was noticed (Table 1), which could be due to oxidative destruction of vitamin-C in the presence of molecular oxygen by ascorbic oxidase (Mapson, 1970). The highest vitamin-C content was reported by 5^{0}C cold storage temperature and CO-2 variety but desirable quality was maintained by 12^{0}C. This might be due to slow down the rate of respiration and oxidation due to low temperature and therefore, higher level of ascorbic acid in treated fruits was observed. These findings are in close proximity with Kalaria (2005) and Balakrishnan (2003) in sapota.

Acidity (%):

The titrable acidity (%) showed a constant decrease during storage period due to conversion of acid to sugar (Table 2). The highest acidity (%) was noted when sapota fruits dipped in GA_3 (150 mg L^{-1}) and stored at 5^{0}C and in PKM-1 variety. This might be due to delayed ripening at low temperature and utilization of acids in respiratory process or due to suppression of ethylene formation which is responsible for ripening process. These findings are in close proximity with the findings of Patel and Katrodiya (1998), Sahoo and Munsi (2004) in sapota.

Reducing sugars (%):

The data given in the Table 3 show that the cold storage temperature had significant effect on reducing sugars (%) and lowest reducing sugars was noted in fruits treated with GA_3 (150 mg L^{-1}) and stored at 5^{0}C on all the days of storage. But the fruits of this treatment were not ripen up to the end of storage due to chilling injury. The sapota fruits stored at 12^{0}C also accumulated less sugars and maintained the good quality because of accumulation of reducing sugars is a function of starch metabolism which is slower in fruits stored at low temperature which resulted in lower reducing sugar (%) in the fruits. This finding is in line with Gautam and Chundawat (1990) in sapota. While in case of varieties, PKM-1 variety registered the highest reducing sugars (%) throughout the storage period. A corroborative results obtained by Balakrishnan (2003) in sapota.

Total sugars (%) :

Total sugar (%) was minimum in fruits treated with GA_3 (150 mg L^{-1}) and store at 5^{0}C as well as 12^{0}C temperatures (Table 3). The slower rate of acceleration of total sugars (%) in these treatments might be due to slower rate of hydrolysis and low rate of respiration and oxidation in treated fruits. The results are in close proximity of those obtained by Kalaria (2005), Rao and Chundawat (1988) in sapota. PKM-1 obtained highest total sugars (%) followed by Kalipatti. Corroborative results are in line with those reported

Table 2 : Effect of post harvest application of GA_3 on acidity (%) of sapota varieties in cold storage

Treatments	Storage periods (days)						
	2nd	4th	6th	8th	10th	12th	14th
Cold storage temperature							
C_1= 5^{0}C	0.144	0.128	0.108	0.098	0.088	0.080	0.082
C_2=12^{0}C	0.130	0.100	0.076	0.058	0.030	0.011	0.00
C_3=15^{0}C	0.128	0.084	0.056	0.026	0.013	0.00	0.00
C_4=Control	0.128	0.074	0.036	0.012	0.00	0.00	0.00
S.E. ±	0.004	0.004	0.003	0.003	0.003	0.002	0.002
C.D. (P=0.05)	NS	0.013	0.008	0.007	0.006	0.004	0.003
Varieties							
V_1=Kalipatti	0.133	0.098	0.068	0.046	0.033	0.023	0.020
V_2=PKM-1	0.143	0.100	0.075	0.054	0.036	0.025	0.023
V_3=CO-2	0.133	0.090	0.070	0.046	0.031	0.021	0.020
V_4=Singapore	0.123	0.098	0.070	0.051	0.031	0.023	0.020
V_5=Kirthibarthi	0.133	0.098	0.063	0.048	0.033	0.023	0.020
S.E. ±	0.005	0.004	0.004	0.003	0.003	0.002	0.002
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS
Interaction (CxV)							
S.E. ±	0.011	0.010	0.007	0.006	0.006	0.004	0.003
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV %	14.12	17.65	16.52	19.62	27.86	28.77	21.82

NS = Non significant

Table 3 : Effect of post harvest application of GA_3 on reducing sugars (%) and total sugars (%) of sapota varieties in cold storage

Treatments	Reducing sugars (%)							Total sugars (%)						
	Storage periods (days)							Storage periods (days)						
	2nd	4th	6th	8th	10th	12th	14th	2nd	4th	6th	8th	10th	12th	14th
Cold storage temperature														
C_1= 5^{0}C	2.38	2.48	2.62	2.75	2.87	3.03	3.30	10.12	10.33	10.48	10.89	11.12	11.43	11.60
C_2=12^{0}C	2.47	2.89	3.46	4.42	6.03	7.57	0.00	14.52	14.68	15.30	16.58	17.87	18.74	0.00
C_3=15^{0}C	2.56	3.04	3.71	4.98	7.53	0.00	0.00	15.41	15.58	16.77	18.20	18.46	0.00	0.00
C_4=Control	2.78	4.89	7.65	7.44	0.00	0.00	0.00	16.43	16.62	18.22	17.32	0.00	0.00	0.00
S.E. ±	0.06	0.08	0.10	0.13	0.14	0.08	0.04	0.18	0.19	0.24	0.25	0.17	0.12	0.11
C.D. (P=0.05)	0.19	0.23	0.29	0.39	0.40	0.24	0.12	0.51	0.55	0.69	0.73	0.49	0.35	0.32
Varieties														
V_1=Kalipatti	2.74	3.45	4.54	5.06	4.20	2.68	0.86	14.47	14.66	15.58	16.08	12.13	7.73	3.01
V_2=PKM-1	2.84	3.68	4.95	5.46	4.60	2.90	0.88	14.62	14.82	15.83	16.29	12.35	7.90	3.08
V_3=CO-2	2.37	3.14	4.06	4.63	3.88	2.54	0.79	13.76	13.93	14.76	15.39	11.60	7.29	2.73
V_4=Singapore	2.23	2.91	3.93	4.47	3.77	2.50	0.76	13.56	13.71	14.50	15.14	11.33	7.14	2.68
V_5=Kirthibarthi	2.56	3.37	4.32	4.87	4.09	2.62	0.81	14.20	14.40	15.30	15.83	11.91	7.65	2.99
S.E. ±	0.07	0.09	0.11	0.15	0.15	0.09	0.05	0.20	0.21	0.27	0.28	0.19	0.13	0.12
C.D. (P=0.05)	0.21	0.26	0.32	0.44	0.45	0.27	NS	0.574	0.615	0.781	0.823	0.549	0.393	NS
Interaction (CxV)														
S.E. ±	0.15	0.18	0.22	0.31	0.31	0.18	0.10	0.40	0.43	0.54	0.57	0.38	0.27	0.25
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	10.15	9.65	9.05	10.94	13.39	12.32	21.11	4.92	5.21	6.22	6.33	5.60	6.30	15.36

NS = Non significant

by Balakrishnan (2003) in sapota.

Conclusion :

The present study clearly indicates that, combined treatments of GA_3 (150 mg L^{-1}) dipping and fruits stored at 12^0C cold storage temperature found to be more effective for extending the post harvest life and required edible quality of sapota varieties up to long time storage. The PKM-1 and Kalipatti variety obtained desired quality parameters when stored at 12^0C cold storage temperature.

Authors' affiliations:
R.G. PATEL AND S.J. PATIL, Department of Pomology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, NAVSARI (GUJARAT) INDIA

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