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

DD Parekh
College of Horticulture, Anand Agricultural University, Anand, Gujarat, India

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

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

Corresponding Author:
BD Patel
Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

Influence of different chemicals on biochemical parameters of sapota (*Manilkara achras* (Mill.) Fosberg) cv. Kalipatti under cold storage condition

BD Patel, DD Parekh, AO Thakor and HL Chaudhary

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Abstract
An investigation held on "Influence of different chemicals on biochemical parameters of sapota cv. Kalipatti under cold storage condition" was conducted during May, 2019. The fruits were treated with Menadione (1000 and 2000 mg/l), Cycocel (0.250 and 0.500 ml/l) and Calcium Chloride (10000 and 20000 mg/l). The present investigation obtained results that the post-harvest dip treatment with $CaCl_2$ 20000 mg/l showed significantly maximum bio-chemical parameters *viz*., total soluble solid, ascorbic acid, total sugar, reducing sugar and non-reducing sugar, while slower decrease rate in acidity percent up to 24 days of storage under cold storage. The calcium chloride 10000 to 20000 mg/l were found best or maintain the quality of sapota fruits up to 24 days.

Keywords: Sapota, biochemical, calcium chloride

Introduction
Sapota (*Manilkara achras* (Mill.) Fosberg) is one of the most important fruit in southern and western part of the country due to its wide range of adaptability, low production cost and reasonable economic returns with very low pest and disease susceptibility. Sapota fruit has rusty brown scurfy skin and the pulp is soft, sweet and crumbling with a granular structure having particular aroma and high nutritive value. The fruit is a good source of digestible sugar (12-18%) and has appreciable quantities of protein (0.44 g), fat (1.10 g), dietary fibers (5.3 g) and minerals like calcium (21 mg), phosphorus (12 mg) and iron (0.80 mg). In India sapota is mainly cultivated for its fruits, whereas in other countries for chickle production, which is used in the preparation of chewing gum. Phytochemical screening of the crude ethanol extracts of sapota revealed the presence of some bioactive components like tannins, glycosides, alkaloids, saponins, carboxylic acids. The presence of alkaloids is interesting, as significant quantities are used as antimalarials, analgesics and stimulants. Herbs that have tannins as their components are astringent in nature and are used for treating intestinal disorders such as diarrhea and dysentery thus exhibiting antibacterial activity. The root extract of sapota showed antimicrobial activity against both gram positive and gram-negative bacteria (Sakala *et al.*, 2013) [6].

Materials and Methods
Present investigation was carried out at Anand Agricultural University, Anand. The handpicked, uniform size and optimum stage of mturity develops sapota cv. Kalipatti fruits are collected. The fruits were dipped for 5 minutes in solution of menadione (1000 and 2000 mg/l), cycocel (0.250 and 0.500 ml/l) and calcium chloride (10000 and 20000 mg/l) and the fruits under control were dipped in distilled water. After dipping, fruits surface eas air dried in open air for 30 minutes, then treated fruits were stored in the cold storage. The experimental data was analysed in CRD (Completely Randomized Design) with three repetitions. The five fruits were selected randomly from each repetition and used for chemical analysis. The biochemical parameters like total soluble solids (°Brix), acidity (%), ascorbic acid (mg/100 g), total sugars (%), reducing sugar (%) and nonreducing sugar (%) were recorded on 6th, 9th, 12th, 15th, 18th, 21st and 24th days of storage period.

Results and Discussion

The treatment with $CaCl_2$ 20000 mg/l recorded the maximum TSS which was at par with rest of the treatments except control at 12th day of storage respectively. Based on mean data, the sapota fruits treated with $CaCl_2$ 20000 mg/l was recorded the maximum TSS at 15th, 18th, 21st and 24th days of storage. The TSS content of fruits in any treatment increased up to certain period to reach maximum and declined thereafter to a minimum towards the end of their shelf life. The highest TSS was found in $CaCl_2$ 20000 mg/l. This might be due to the increase in soluble solids content and total soluble sugars caused by hydrolysis of polysaccharides (starch, pectin and cellulose) substances into simpler substances. Similar results obtained by Tsomu *et al.*, (2015) [10] and Gondaliya (2016) [2] in sapota and Barot (2014) [1] and Ramesh *et al.*, (2014) [5] in papaya. Among the different chemical treatment, $CaCl_2$ 20000 mg/l was observed significantly maximum acidity (%), while control treatment recorded lowest acidity at 6th, 9th and 12th day of storage. Based on mean data, the sapota fruits treated with $CaCl_2$ 20000 mg/l showed maximum acidity at 15th, 18th, 21st and 24th days of storage respectively. In different chemical treatments the slow decrease in acidity was observed in $CaCl_2$ 20000 mg/l and most rapid decrease in control. It may be due to conversion of organic acids into sugar and their derivatives or their utilization in respiration. The present study also conforms the results of Shivpuje (1998) [7] and Tsomu *et al.* (2015) [10] in sapota, Barot (2014) [1] and Ramesh *et al.*, (2014) [5] in papaya, Goswami (2014) [3] in mango and singh *et al.*, (2010) [9] in ber.

The treatment with calcium chloride 20000 mg/l observed maximum ascorbic acid at 6th, 9th and 12th day of storage. Based on mean data, the sapota fruits treated with $CaCl_2$ 20000 mg/l recorded maximum ascorbic acid at 15th, 18th, 21st and 24th days of storage. Among the different chemical treatments had beneficial effect at on ascorbic acid content in $CaCl_2$ 20000 mg/l. Because of the higher concentration of $CaCl_2$ hindered the rapid oxidation of ascorbic acid. These results elucidate the findings of Tsomu *et al.*, (2015) [10] and Gondaliya (2016) [2] in sapota, Barot (2014) [1] in papaya, Goswami (2014) [3] in mango and Singh *et al.*, (2010) [9] in ber. The fruits treated with calcium chloride 20000 mg/l recorded maximum total sugars at 12th days of storage. Based on mean data, the sapota fruits treated with $CaCl_2$ 20000 mg/l recorded the maximum total sugars at 15th, 18th, 21st and 24th days of storage respectively. The total sugars increase in response to $CaCl_2$ 20000 mg/l might be due to slowed the rate of starch hydrolysis and later stage reduction due to utilization of sugar in the process of respiration. These observations are in close agreement with the reports of Tsomu *et al.*, (2015) [10] and Gondaliya (2016) [2] in sapota, Barot (2014) [1], Rajkumar *et al.*, (2005) [4] in papaya and Singh (2013) [8] in mango.

Whereas, 6th and 9th days of storage control treatment was showed significantly maximum reducing sugar respectively. The treatment $CaCl_2$ 20000 mg/l recorded the maximum reducing sugar at 12th day of storage, respectively. Based on mean data, the fruits treated with $CaCl_2$ 20000 mg/l was recorded the maximum reducing sugar at 15th, 18th, 21st and 24th days of storage respectively. The beneficial impact of $CaCl_2$ 20000 mg/l in increasing reducing sugar might be due to the starch converted in sugar as a result of decrease in acidity by physiological change during storage and later on reduction could possibly due to utilization of sugar in the process of respiration. These results are elaborate in the findings of Tsomu *et al.*, (2015) [10] and Gondaliya (2016) [2] in sapota, and Barot (2014) [1] and Rajkumar *et al.*, (2005) [4] in papaya.

The treatment with $CaCl_2$ 20000 mg/l recorded the maximum non-reducing sugar at 12th day of storage. Based on mean data, the sapota fruits treated with $CaCl_2$ 20000 mg/l recorded the maximum non-reducing sugar at 15th, 18th, 21st and 24th days of storage respectively. The application of $CaCl_2$ 20000 mg/l may have the hydrolysis of starch and pectin substances converted from water insoluble to water soluble fractions. In conformity of these findings Tsomu *et al.*, (2015) [10] in sapota, and Barot (2014) [1] and Rajkumar *et al.*, (2005) [4] in papaya

Table 1: Effect of different chemicals on total soluble solids (°Brix) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Total soluble solids (°Brix)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	20.68	22.09	18.74	-	-	-	-
T_2	Menadione (1000 mg/l)	19.67	21.04	23.32	21.45	18.24	-	-
T_3	Menadione (2000 mg/l)	20.36	22.02	24.05	21.79	19.30	-	-
T_4	Cycocel (0.250 ml/l)	19.80	21.33	23.22	19.22	-	-	-
T_5	Cycocel (0.500 ml/l)	20.55	21.82	23.72	19.92	-	-	-
T_6	Calcium chloride (10000mg/l)	20.09	21.11	23.16	24.31	21.71	19.25	-
T_7	Calcium chloride (20000mg/l)	19.33	21.63	24.35	25.08	23.94	21.84	19.84
S.Em. +		0.55	0.49	0.69				
C.D. at 5%		NS	NS	2.09				
C.V. %		4.71	3.90	5.21				

Table 2: Effect of different chemicals on acidity (%) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Acidity (%)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	0.165	0.129	0.088	-	-	-	-
T_2	Menadione (1000 mg/l)	0.185	0.167	0.144	0.130	0.093	-	-
T_3	Menadione (2000 mg/l)	0.198	0.187	0.153	0.134	0.109	-	-
T_4	Cycocel (0.250 ml/l)	0.181	0.150	0.128	0.093	-	-	-
T_5	Cycocel (0.500 ml/l)	0.184	0.165	0.143	0.113	-	-	-
T_6	Calcium chloride (10000 mg/l)	0.204	0.181	0.169	0.141	0.128	0.101	-
T_7	Calcium chloride (20000 mg/l)	0.217	0.196	0.178	0.162	0.151	0.132	0.119
S.Em. +		0.005	0.006	0.005				
C.D. at 5%		0.014	0.017	0.014				
C.V. %		4.269	5.827	5.618				

Table 3: Effect of different chemicals on ascorbic acid (mg/100 g pulp) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Ascorbic acid (mg/100 g pulp)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	16.48	13.17	10.37	-	-	-	-
T_2	Menadione (1000 mg/l)	19.98	17.45	13.99	11.24	9.11	-	-
T_3	Menadione (2000 mg/l)	20.46	18.14	14.68	12.17	9.82	-	-
T_4	Cycocel (0.250 ml/l)	18.79	15.15	11.17	8.70	-	-	-
T_5	Cycocel (0.500 ml/l)	19.56	16.09	12.13	9.15	-	-	-
T_6	Calcium chloride (10000 mg/l)	21.51	20.30	18.69	16.01	12.89	10.15	-
T_7	Calcium chloride (20000 mg/l)	21.92	20.89	19.17	16.94	14.12	12.17	10.25
S.Em. +		0.66	0.40	0.34				
C.D. at 5%		2.00	1.20	1.03				
C.V. %		5.77	3.95	4.12				

Table 4: Effect of different chemicals on total sugars (%) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Total sugars (%)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	14.95	16.79	13.64	-	-	-	-
T_2	Menadione (1000 mg/l)	13.32	15.19	16.37	14.86	12.37	-	-
T_3	Menadione (2000 mg/l)	14.12	15.92	16.48	15.14	13.14	-	-
T_4	Cycocel (0.250 ml/l)	14.33	16.19	14.88	12.53	-	-	-
T_5	Cycocel (0.500 ml/l)	14.83	16.70	15.51	13.67	-	-	-
T_6	Calcium chloride (10000 mg/l)	12.81	14.91	16.12	17.33	14.87	13.16	-
T_7	Calcium chloride (20000 mg/l)	13.13	15.05	17.24	17.73	16.63	15.86	13.99
S.Em. +		0.37	0.32	0.45				
C.D. at 5%		1.12	0.98	1.36				
C.V. %		4.58	3.55	4.94				

Table 5: Effect of different chemicals on reducing sugar (%) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Reducing sugar (%)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	6.48	7.65	5.70	-	-	-	-
T_2	Menadione (1000 mg/l)	5.79	6.78	6.91	6.35	5.03	-	-
T_3	Menadione (2000 mg/l)	6.35	7.32	7.09	6.59	5.74	-	-
T_4	Cycocel (0.250 ml/l)	5.92	7.49	5.96	5.41	-	-	-
T_5	Cycocel (0.500 ml/l)	6.40	7.60	6.50	5.59	-	-	-
T_6	Calcium chloride (10000 mg/l)	5.19	5.83	7.12	7.36	5.82	5.12	-
T_7	Calcium chloride (20000 mg/l)	5.45	5.92	7.58	7.65	6.83	6.46	5.37
S.Em. +		0.17	0.15	0.19				
C.D. at 5%		0.52	0.47	0.59				
C.V. %		4.98	3.84	5.00				

Table 6: Effect of different chemicals on non-reducing sugar (%) of sapota fruits cv. Kalipatti under cold storage condition

Treatment code	Treatments	Non-reducing sugar (%)						
		6th day	9th day	12th day	15th day	18th day	21st day	24th day
T_1	Control	8.47	9.14	7.94	-	-	-	-
T_2	Menadione (1000 mg/l)	7.54	8.40	9.45	8.51	7.35	-	-
T_3	Menadione (2000 mg/l)	7.77	8.60	9.39	8.55	7.40	-	-
T_4	Cycocel (0.250 ml/l)	8.40	8.70	8.92	7.12	-	-	-
T_5	Cycocel (0.500 ml/l)	8.43	9.10	9.01	8.08	-	-	-
T_6	Calcium chloride (10000 mg/l)	7.62	9.08	9.00	9.98	9.05	8.04	-
T_7	Calcium chloride (20000 mg/l)	7.67	9.13	9.66	10.09	9.80	9.41	8.61
S.Em. +		0.27	0.21	0.30				
C.D. at 5%		NS	NS	0.90				
C.V. %		5.81	4.14	5.66				

Conclusion

It is inferred from the present study that post-harvest 5-minute dip treatment of calcium chloride 10000 mg/l to 20000 mg/l was maintained different quality parameters such as TSS, acidity, ascorbic acid, total sugars, reducing sugars and nonreducing sugars content upto 24 days storage period of fruits as compared to untreated fruits.

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