Original Research Article

Effect of Calcium and Coating Materials on Quality and Shelf Life of Guava (*Psidium Guajava* L.) Cv. Allahabad Safeda Under Cold Storage Condition

ABSTRACT

An experiment was conducted to study the effect of calcium and coating materials on quality and shelf life of guava (*Psidium guajava* L.) cv. Allahabad Safeda under cold storage condition. The experiment conducted during the *Rabi*-2020 at cold storage, Horticultural Research Farm and P. G. Laboratory, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. Freshly harvested at physiological maturity of uniform size selected fruits were subject to comprising of different chemical concentration *viz*., $CaCl_2$ 1%, $CaNO_3$ 2% and No chemical and with different coating materials (Coconut oil, Arabic gum, Olive oil and No coating). Total numbers of treatments are twelve with CRD factorial design. Periodic observations on 4^{th}, 8^{th}, 12^{th}, 16^{th} and 20^{th} day of storage periods were taken. The study results revealed that fruits treated with $CaCl_2$ 1.0 % when coated with coconut oil coating resulted in prolonging shelf life up to 20 days with minimizing physiological loss in weight, spoilage, TSS and firmness with maintaining higher level of acidity, ascorbic acid, total sugar, reducing sugar and non-reducing sugar as compared to the control (No chemical and No coating).

Key words: *Guava, Shelf-life, $CaCl_2$, $CaNO_3$, Coating materials and Physiological loss in weight*

1. INTRODUCTION

Guava (*Psidium guajava*) is one of the most important fruits and it is considered as 'apple of tropics' and 'poor man's apple' which belong to Myrtaceae family. Guava originated, along with a number of other fruits, in Tropical America. Guava is now grown in India, Brazil, Mexico, Florida, Peru, South Africa, Egypt, West Indies, China and Malaysia. In India guava cultivated in Uttar Pradesh, Madhya Pradesh, Gujarat, Karnataka, Odisha, Bihar, Kerala, Rajasthan, Andhra Pradesh and Maharashtra. Allahabad district is major producer of guava. In Gujarat it is grown in Bhavnagar, Amreli, Kutch, Junagadh, Anand, Dahod, Surat and Gandhinagar.

India produces large quantity of fruit production, a great proportion of it is lost due to inadequate post-harvest management practices and extremely low level of processing in the country. There

are a number of factors behind low level of processing in India. Poor domestic demand is one of the reasons for inadequate development of processing sector, since Indians are more habitual of fresh consumption of fruits. Moreover, there is a huge gap between the prices of fresh fruits and processed products, so latter are thought to be costly affair. This sector, due to lack of proper infrastructure facilities, equipment, hygienic conditions and latest know how, is unable to produce good quality of product, resulting into low demand of processed items in the market.

Use of the various post-harvest treatment that should be used for maintain fresh-like quality and nutrional value. There are various types of post-harvest treatment like physical, chemical and gaseous treatment should be used. Shelf life of fresh fruits can be extended through low temperature storage, edible coating and treatments with chemicals. Estimated that at least 60 percent of Ca^{+2} in plant associated with cell wall fraction. Calcium is essential for structure integrity of both the cell wall and plasma membrane (Rosssingal *et al*., 1977). The use of coconut oil coating was found significantly effective in increased post-harvest shelf life, reduce PLW %, loss of moisture and retained better quality for long time (Pandya *et al.,* 2010).

2. MATERIAL AND METHODS

The research experiment was carried out during *Rabi*-2020 at Horticultural Research Farm and P. G. Laboratory, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. Uniform sized fruits of Allahabad Safeda cultivar were selected at physiological maturity. The fruits were dipped for 15 minutes in calcium chemical and after dry in shade condition for 5 to 10 minute and then it's coated with used of spongy material. Treated fruits were then placed in CFB boxes then after in cold storage. The experiment was laid out in Completely Randomized Design with Factorial concept (FCRD) having twelve treatments combination comprising of $CaCl_2$ 1.0 %, $CaNO_3$ 2 %, different coating (coconut oil, Arabic gum olive oil) and with control three replications.

Fruit samples were analysed for physio-biochemical changes like physiological loss in weight (%), spoilage (%), firmness ($Kgcm^{-2}$), total soluble solids (^{0}Brix), acidity (%), ascorbic acid (mg/100g pulp), total sugar (%), reducing sugar (%) and non-reducing sugar (%). Observations recorded at every four (4) days intervals (i.e., 4^{th}, 8^{th}, 12^{th}, 16^{th} and 20^{th} days) up to 20^{th} days during storage.

3. RESULTS AND DISCUSSION

3.1 Physiological parameters

3.1.1 Physiological loss in weight (PLW) (%)

The data present in Table 1 indicated that the physiological loss in weight during storage is increased day by day due to loss of moisture through transpiration and respiration rate. In this experiment minimum PLW % (0, 0.66, 1.35, 2.08 and 3.46 %) was recorded in T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) on 4^{th}, 8^{th}, 12^{th}, 16^{th} and 20^{th} as compared to control. This calcium content might had been associated with reduction of softening and improved storage life of fruits reported by Naik *et al.* (1997). Fruits coated with pure coconut oil recorded the minimum weight loss in mandarin. This may be due to anti senescence property present in pure coconut oil help to slow storage break down associated with slow respiration rate, transpiration rate and binding of the ethylene biosynthesis process reported by Bisen *et al*. (2008).

3.1.2 Spoilage

Data in Table 1 showed that there was no spoilage in all the treatments up to 4^{th} and 8^{th} days of storage. Then after fast spoilage observed in all the treatments with advancement of storage regardless of the treatments. Among the all treatment minimum spoilage % was observed in (4.33, 5.55 and 10.02 %) T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) on 12^{th}, 16^{th} and 20^{th} day of storage as compared to control. which was at par with treatments C_1M_3 ($CaCl_2$ 1% with olive oil) on 12^{th} day and C_2M_1 ($CaNO_3$ 2% with coconut oil coating) on 12^{th} and 16^{th} day of storage. This might be due to calcium controlled transpiration and respiration rates which delayed the disintegration of ripening of calcium treated fruits. The similar finding was reported by Yadav *et al.* (2006) in mandarin, Patel *et al.* (2011) in custard apple. Also, coconut oil coated fruit reduction of metabolic reaction by decreasing of respiration rates and thus delay the senescence of fruits. Coating slowed down the respiration rate, reduced the colour change of flesh and skin reported by Iqbal *et al.* (2017) in sweet orange.

3.1.3 Firmness ($Kgcm^{-2}$)

Data in Table 1 revealed that all the treatments exhibited non-significant effect for fruit firmness up to 4^{th} and 8^{th} day of storage. The maximum firmness (7.54, 6.95, 5.85, 4.53 and 3.96 $Kgcm^{-2}$) was recorded in treatment T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) on 12^{th}, 16^{th} and 20^{th} as compare to control, which was at par with treatment C_3M_1. The retention of firmness in calcium treated calcium is binding to free carboxyl group of polygalacturonate polymer, stabilizing and strengthening the cell wall (Conway and Sams, 1983.). Also, edible oil coatings preserve the quality of fruits, retard ethylene emission and enhance texture. These results corroborate the findings of Dashora *et al.* (1999) in ber fruits.

3.2 Bio-chemical parameters

3.2.1 Total soluble solids (^{0}Brix)

The data presented in Table 2 indicated that TSS content up to 12th days of storage was increase after that decline at end of storage period. The maximum TSS (11.85, 12.06, 12.39, 11.55, 10.54, 8.06 and 5.36 ^{0}Brix) was recorded with the treatment T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating), which were at par with treatment T_5 (C_2M_1) on 8thday of storage. The increase in TSS may be due to hydrolysis of starch into monosaccharaides or di-saccharides and end after that decrease might be due to reduction of sugar used in metabolic activities like respiration and senescence reported by Singh *et al.* (2012). Coconut oil coated fruit have controlled opening of pore/stomata, dehydration and transpiration process the reported by Kulkarni *et al*. (2010).

3.2.2 Acidity (%)

The data presented in Table 2 indicated there was decrease in acidity day to day of storage period. On 4th day of storage found maximum acidity was founded in T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) treated fruits. Which was at par with treatment C_1M_2 and C_1M_3 on 4th day of storage. The decreased in acidity during storage may be due to the use of organic acid as respiratory substrate during storage and conversion of acid into sugar because of ripening process noticed by Jawandha *et al.* (2008). The higher acidity in fruits treated with calcium might be due to decreased hydrolysis of organic acids and subsequent accumulation of these acids which are oxidized at a slower rate because of decreased respiration noticed by Gupta *et al*. (2011) in guava.

3.2.3 Ascorbic acid (mg/100g pulp)

Data pertaining to ascorbic acid in the fruit are presented in Table 2. Ascorbic acid content is decrease at the end of storage period. The maximum value of ascorbic acid was founded in T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) (237.50, 226.52, 201.50, 187.56, 170.55mg/100 g pulp) on 4th, 8th, 12th, 16th and 20th day of storage respectively, which was at par with C_2M_1 on 12th day of storage. Guava fruits treated with calcium nitrate and calcium chloride were significantly better in the retention of ascorbic acid compared to control, might be attributed to the slow rate of oxidation in the respiration process. The results are in similarity with the findings of Jain and Mukherjee (2011) in mango. In coconut oil coating helped in reducing the rate of respiration and ripening, which resulted in dissipation of ascorbic acid into dehydro ascorbic acid during storage. The present findings are in conformity with Nagar *et al.* (2004) in Kagzi lime fruits.

3.2.4 Total sugar (%), Reducing sugar (%) and Non-reducing sugar (%)

The data presented in Table 3 revealed that effect of treatments on total sugar and reducing sugar was significant. The total sugar and reducing sugar were increasing up to 16th days of storage after it was decrease. The maximum total sugar and reducing sugar recorded in T_1 (C_1M_1-$CaCl_2$ 1.0 % with coconut oil coating) on 4th, 8th, 12th, 16th and 20th day of storage. This may be due to rapid conversion of polysaccharides into sugars in the earlier stage and later to utilization of sugars in respiration. Jawandha *et al*. (2008) concluded that total sugars showed a similar trend of increase up to 20 days from storage followed by a decrease.

Table.1 Effect of calcium and coating materials on Physiological loss in weight (%), Spoilage (%) and Firmness (Kgcm^{-2}) of guava (*Psidium guajava* L.) cv. Allahabad Safeda under cold storage condition

Treatment combinations	Physiological loss in weight (%)					Spoilage (%)					Firmness (Kgcm^{-2})				
	Storage period in days					Storage period in days					Storage period in days				
	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th
C_1M_1	0	0.66	1.35	2.08	3.46	0	0	4.33	5.55	10.02	8.73	7.72	7.54	6.95	5.85
C_1M_2	0	3.78	6.38	8.22	11.49	0	0	17.00	19.18	54.15	8.66	7.69	5.4	5.05	4.71
C_1M_3	0	1.11	1.75	2.83	6.21	0	0	5.33	12.34	26.90	8.64	7.66	7.10	6.11	5.18
C_1M_4	0	5.82	8.79	12.59	-	0	0	29.33	30.79	-	8.65	7.63	4.95	4.60	-
C_2M_1	0	0.90	1.64	3.45	5.21	0	0	5.00	6.72	22.38	8.65	7.63	7.21	6.36	5.32
C_2M_2	0	5.54	8.59	11.45	-	0	0	27.00	32.41	-	8.66	7.59	5.21	4.78	-
C_2M_3	0	1.60	2.13	3.69	8.79	0	0	12.66	16.57	26.90	8.68	7.55	6.21	5.46	4.93
C_2M_4	0	5.86	9.49	12.82	-	0	0	40.00	52.30	-	8.56	7.53	4.73	4.56	-
C_3M_1	0	2.01	3.02	3.72	9.14	0	0	14.66	17.00	40.42	8.63	7.53	6.10	5.30	4.88
C_3M_2	0	4.76	7.86	10.83	12.89	0	0	18.66	19.60	69.95	8.41	7.58	5.34	4.93	4.63
C_3M_3	0	3.63	3.26	5.24	9.19	0	0	14.00	18.29	45.49	8.50	7.55	5.95	5.19	4.78
C_3M_4	0	7.09	11.37	14.22	-	0	0	48.00	-	-	8.63	7.57	4.51	4.12	-
S.Em. ±		0.017	0.021	0.021	0.017	-	-	1.02	0.50	0.014	0.130	0.112	0.017	0.018	0.014
C.D. at 5 %		0.048	0.062	0.060	0.051	-	-	2.99	1.46	0.04	NS	NS	0.051	0.55	0.042
C.V. %		1.93	0.68	0.47	0.54	-	-	9.05	4.51	0.10	2.61	2.56	0.51	0.62	0.74

Table.2 Effect of calcium and coating materials on Total Soluble Solids (°Brix), Acidity (%) and Ascorbic acid (mg/100 g pulp) of guava (*Psidium guajava* L.) cv. Allahabad Safeda under cold storage condition

Treatment combinations	Total Soluble Solids (°Brix)					Acidity (%)					Ascorbic acid (mg/100 g pulp)				
	Storage period in days					Storage period in days					Storage period in days				
	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th
C_1M_1	11.85	12.06	12.39	11.55	10.54	0.733	0.719	0.715	0.711	0.705	237.50	226.52	201.50	187.56	170.55
C_1M_2	10.5	10.58	10.71	9.80	6.21	0.716	0.688	0.682	0.675	0.668	216.50	194.93	159.40	134.54	135.45
C_1M_3	10.94	11.71	11.40	11.22	9.37	0.730	0.712	0.710	0.704	0.698	225.29	206.53	176.32	150.36	128.76
C_1M_4	9.94	10.30	10.18	7.17	-	0.693	0.671	0.665	0.657	-	213.71	183.52	148.49	122.73	-
C_2M_1	11.65	11.98	11.94	11.34	10.40	0.730	0.716	0.712	0.706	0.700	231.68	214.67	195.64	179.39	158.23
C_2M_2	10.21	10.49	10.42	7.98	-	0.7067	0.676	0.674	0.669	-	214.67	186.37	153.64	128.43	-
C_2M_3	10.91	11.29	11.01	10.36	8.38	0.693	0.698	0.695	0.688	0.682	221.69	201.01	167.39	141.66	120.53
C_2M_4	9.7	9.81	10.24	6.92	-	0.696	0.664	0.680	0.654	-	212.32	178.31	145.39	119.42	-
C_3M_1	10.57	10.87	10.89	10.13	7.95	0.720	0.694	0.691	0.706	0.678	219.57	200.27	164.64	139.39	117.23
C_3M_2	10.23	10.56	10.65	8.12	5.84	0.706	0.684	0.680	0.669	0.66	215.67	191.43	156.46	129.38	109.92
C_3M_3	10.43	10.69	10.75	9.95	6.25	0.720	0.690	0.686	0.688	0.671	217.67	196.09	161.40	136.40	115.43
C_3M_4	9.52	9.72	9.87	6.81	-	0.683	0.67	0.651	0.654	-	202.08	180.06	140.43	115.44	-
S.Em. ±	0.010	0.034	0.048	0.020	0.013	0.006	0.002	0.002	0.685	0.002	1.861	2.761	2.556	2.420	1.911
C.D. at 5 %	0.055	0.101	0.140	0.058	0.038	0.017	0.006	0.005	0.673	0.005	5.432	8.060	7.461	7.063	5.57
C.V. %	0.30	0.55	0.76	0.37	0.42	1.44	0.49	0.47	0.54	0.67	1.47	2.43	2.70	2.99	3.76

Table.3 Effect of calcium and coating materials on Total sugar (%), Reducing sugar (%) and Non- reducing sugar (%) of guava (*Psidium guajava* L.) cv. Allahabad Safeda under cold storage condition

Treatment combinations	Total sugar (%)					Reducing sugar (%)					Non- reducing sugar (%)				
	Storage period in days					Storage period in days					Storage period in days				
	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th	4th	8th	12th	16th	20th
C_1M_1	8.48	8.99	9.58	10.31	9.61	4.53	4.65	4.88	5.21	4.63	3.95	4.34	4.70	5.11	4.98
C_1M_2	7.83	8.16	8.59	9.31	8.77	4.30	4.41	4.66	4.76	4.39	3.51	3.75	3.93	4.55	4.38
C_1M_3	8.37	8.68	9.18	9.91	9.22	4.48	4.57	4.79	5.08	4.56	3.77	4.04	4.39	4.83	4.66
C_1M_4	7.54	7.68	8.03	8.33	-	4.08	4.14	4.45	4.58	-	3.46	3.54	3.58	3.75	-
C_2M_1	8.23	8.55	9.25	9.95	9.25	4.42	4.60	4.82	5.13	4.59	3.89	4.08	4.43	4.82	4.66
C_2M_2	7.65	7.88	8.24	8.85	-	4.32	4.24	4.56	4.62	-	3.46	3.64	3.68	3.93	-
C_2M_3	8.18	8.61	9.11	9.83	9.15	4.46	4.56	4.77	5.06	4.45	3.72	3.86	4.34	4.77	4.62
C_2M_4	7.39	7.61	7.93	8.14	-	4.03	4.11	4.38	4.42	-	3.34	3.50	3.55	3.72	-
C_3M_1	8.05	8.43	8.87	9.51	8.98	4.42	4.61	4.72	4.95	4.45	3.63	3.82	4.15	4.56	4.53
C_3M_2	7.80	8.12	8.56	9.26	8.75	4.19	4.38	4.63	4.73	4.54	3.50	3.74	4.04	4.53	4.21
C_3M_3	7.88	8.24	8.72	9.34	8.85	4.35	4.43	4.68	4.81	4.45	3.56	3.81	4.68	4.53	4.40
C_3M_4	7.21	7.39	7.71	7.89	-	4.05	4.08	4.16	4.22	-	3.18	3.31	3.55	3.67	-
S.Em. ±	0.054	0.022	0.020	0.021	0.012	0.021	0.022	0.019	0.019	0.015	0.021	0.020	0.018	0.016	0.011
C.D. at 5 %	0.157	0.065	0.059	0.060	0.036	0.062	0.064	0.057	0.056	0.043	0.062	0.059	0.053	0.47	0.033
C.V. %	1.18	0.47	0.40	0.39	0.35	0.85	0.86	0.73	0.69	0.85	1.02	0.93	0.77	0.64	0.64

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