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The effect of edible coating materials to enhance storage life of guava (*Psidium guajava* L.) cv. L-49

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Abstract

The present investigation was to study the suitable edible coating material and their concentration and shelf-life evaluation of guava fruits. The experiment was conducted in Completely Randomized Design (CRD), comprising of 7 treatments with two replications. Consisting of post-harvest treatments of Chitosan (2%), $Cacl_2$ (1%), Aloe vera (75%), Bee wax (15%), Pectin (6%), Gaur gum (12%), Control. Average day temperature during the period of experiment was 20±2 °C and night temperature is 5±2 °C. Fruits were washed and dried before applying treatments. The boxes were kept at ambient temperature and relative humidity in post-harvest laboratory. Result of experimentation revealed that T_1 chitosan (2%) proved to be the good minimizing physiological loss in weight (9.87%) along with Fruit firmness (2.66). After (chitosan at 2%) maximum TSS content (10.73 oBrix) on 6 days of storage and highest acidity (0.60 to 0.45%) was recorded treatment T_1 (Chitosan at 2%) on Initial to 12th days of storage. The treatment T_1 (Chitosan at 2%) 193.17, 178.29, 165.36, 146.79 and 133.38 mg/100g showed highest ascorbic acid and Reducing sugars (5.85) and non- reducing sugars (3.05) and value was recorded over storage period 0 to 12th day.

Keywords: Guava (*Psidium guajava* L), edible coating, chitosan, cacl2, bee wax, pectin, gaur gum and shelf life

Introduction

Guava (*Psidium guajava* L.) is a tropical fruit crop that has adapted to life in the subtropics. It has chromosome 2n=22 and belongs to the Myrtaceous family. Guava is a tropical American fruit that was brought to India in the seventeenth century. It belongs to the Myrtaceae family and is known as "the apple of the tropics." It is endemic to tropical America, from Mexico to Peru, and the Portuguese introduced it to India in the 17th century (Mitra and Bose, 2001) [3]. According to a FAO (2017) report, India is the world's largest producer. Pakistan, China, Brazil, and Indonesia are four of the most populous countries on the planet. Guava is grown on 265 thousand hectares, with a production of 4054 thousand MT, according to the National Horticulture Board's (2017) fig. Madhya Pradesh produces the most guava, contributing for 23.8 percent of total production. The fruit is an excellent source of ascorbic acid and but has low energy (66 cal/100 g), Protein content (1%), about 17% dry matter and 83% moisture. The fruit is also rich in minerals like phosphorus (23.37 mg/100 g), Calcium (14-30 mg/100 g), lron (0.6-1.4 mg/100 g) as well as vitamins like Niacin, Pantothenic acid, Thiamine, Riboflavin and Vitamin A. The guava, being a climacteric fruit crop, during maturing exhibits peaks of respiratory and ethylene (Yamanur *et al.*, 2021) [20].

Guava fruits have a shelf life of just 3-5 days in ambient conditions; in the winter, rainy season mature fruits have a shelf life of 6-9 days and 2-4 days, respectively. Water quickly evaporates from fruits after harvesting, causing shriveling, degradation, and a short shelf life. Pre- and post-harvest interventions to increase the shelf life of guava fruits have been the subject of a variety of studies. It has been established that treating guava fruits; (Gangle *et al*., 2019) [8] demonstrated that treating of guava fruits cv. Allahabad Safadi containing 2%calcium nitrate and 0.1 percent carbendazim is the most effective method for ensuring safe storage, maximal fruit size retention, little physiological weight loss, minimal decay, maximum TSS. During storage at room temperature for up to 12 days, acidity, ascorbic acid, and sugars were measured.

Packing takes second place to the technology used to maintain fruit quality and ensure safe shipping. This packaging reduces spoilage and aids in increased marketing by functioning as a barrier against disease infestations. Selecting adequate packaging and cushioning material is crucial to minimizing harmful (adverse) effects on human health. There are a number of packing materials 3 to choose from to reduce post-harvest losses (Caleb, 2013) [4].

Materials and Methods

The present investigation entitled "The effect of edible coatings to enhance storage life of guava (*Psidium guajava* L.) cv. L-49" is being conducted at post-harvest laboratory, Department of Horticulture, Lovely Professional University, Punjab during the academic year 2021-2022. The experiment was conducted in Completely Randomized Design (CRD), comprising of 7 treatments with two replications.

The mature and uniform sizes of guava var. L-49 were procured from the Instructional cum Research Fruit Orchard and solutions prepared as per treatments for completing the experiments. Prior to the post-harvest treatment, the fruits were washed in potable water. The fruits allowed to dry in shade prior to imposition of treatments. The details of the treatments include T_1 (Chitosan 2%), T_2 ($Cacl_2$ 1%), T_3 Aloe vera (75%), T_4 (Bee wax 15%), T_5 (Pectin 6%), T_6 (Gaur gum 12%), T_7 Control, each treatment was replicated twice with 10 fruits in each replication. The observations on physical and quality parameters were recorded at an interval of 3 days.

Result and Discussion

Physiological loss of the weight

The table indicated that a gradually increased in weight loss was shown towards the end of storage period. Different edible coating materials effect on the physiological weight loss. Minimum weight loss recorded in T_1 chitosan (9.87%) followed by T_2 $CaCl_2$ (11.99%), T_4 Bee wax (12.04%), T_6 Gaur gum (12.18%), T_5 Pectin (12.19%) and T_3 Aloe Vera (12.52%) and maximum physiological weight loss in untreated fruit *i.e*., T_7 control (15.42%). Chitosan coating closed the opening of stomata and lenticels thereby, slow down the transpiration and respiration rates and also reduced microbial activity. These results reflect the findings of previous researchers (Pandey *et al*., 2010) [16] in guava fruits and (Nasrin *et al*., 2018) [13] in Mandarin fruits, (Sarmin *et al*., 2018) [17] in mangoes, (Kamboj and Kaur, 2018) [12], (Christian *et al*., 2017) [6] table 1.

Fruit firmness

Changes in flesh firmness between control and coated fruit samples during 12 days of storage. With regard to coated samples, 2.0% chitosan coating was more effective in preventing decrease of fruit firmness than the other treatments. The guava fruit starts decreasing its firmness after the harvesting up to storage period. However, the reduction in fruit firmness of guava was significantly affected due to various treatments. The result indicated the firmness of guava fruit recorded higher firmness value (4.08, 3.65, 3.05 and 2.66) on 0^{th}, 3^{rd}, 6^{th}, 9^{th} and 12^{th} days respectively, in T_1 (chitosan at 2%) over T_7 (control) followed by T_3 (aloe-vera75%), T_5 (pectin at 6%) and T_2 ($Cacl_2$ at 1%) whereas, minimum fruit firmness was observed in treatment control table1. The Chitosan inhibits the respiration rate and transpiration rate, resulting in better fruit firmness during storage. The result supported by (Bisen *et al*. 2012) [2] (Nasrin *et al*. 2018) [13] in Kagzi lime and mandarin fruits respectively.

Total soluble solids (Brix) and Titrable Acidity (%)

Total solids value (TSS) value of guava fruits was found to increase initially during storage up to 6th days and later on decreased gradually as the storage increased i.e., 9th and 12th days of storage period. However, the TSS content of guava fruits was significantly affected by various post-harvest treatment recorded that treatment T_1 (chitosan at 2%) maximum TSS content (10.73^0 Brix) on 6 days of storage and this treatment was found to be significantly better as compared to other treatment followed by T_2 ($Cacl_2$ at 1%), T_4 (Bee wax), T_5 (Pectin at 6%) and T_6 (Gaur gum at 12%). The lowest value of TSS was recorded in treatment T_7 (Control) respectively. Excess loss of water from the fruiting tissues may also be a valid reason behind this increment (Javed *et al*., 2016). Similar results were observed by (Deshmukh *et al*., 2020) [7] concluded that fruits of Nagpur mandarin coated with 20% neem leaf extract maintained the maximum total soluble solids (14.08 ^{0}Brix) over uncoated fruits. Similar results were noticed by (Ghosh *et al*., 2017) [9], (Kamboj and Kaur, 2018) [12].

Titrable acidity (TA) it was revealed from the trait, acidity of guava fruit experienced a linear decline during storage period up to 12^{th} day. However, the loss of acidity during storage period was more rapid and faster in control. The highest acidity (0.60 to 0.45%) was recorded treatment T_1 (Chitosan at 2%) on Initial to 12^{th} days of storage. The lowest (0.46 to 0.27%) acidity of guava fruits was showed in T_7 Control, respectively. The chitosan coating at 2.0% was probably able to modify the internal atmosphere of the fruit to prevent the decrease in TA contents. (Han *et al*., 2004) also observed lower acidity loss during storage in strawberry, peach, tomato and litchi coated with chitosan table 2.

Total sugars (%)

The total sugar content of the guava fruit increased slowly but steadily up to the sixth day of storage and then gradually decreased. In addition, the analyzed data showed that the higher total sugar in treatment T_1 (chitosan at 2%) 8.79, 8.80, 8.89, 8.66 and 8.35% on 0^{th}, 6^{th}, 9^{th} and 12^{th} days, respectively followed by T_3 (Aloe Vera at 75%), T_2 ($CaCl_2$ at 1%) and T_5 (Pectin at 6%). At treatment T_7 (control) 6.20, 6.60, 6.80, 6.64 and 6.15%, the lowest value of total sugars was observed on 0, 3th, 6th, 9th and 12th storage days, respectively table 4. These outcomes are in accordance with work of (Deshmukh *et al.*, 2020) [7], (Oliverira *et al.*, 2018) [15].

Reducing sugars (%) and non-Reducing sugars (%)

The highest reducing sugar obtain from the treatment T_1 (chitosan at 2%) 4.98, 5.46, 5.84, 4.65 and 4.53% on 0^{th}, 6^{th}, 9^{th} and 12^{th} days, respectively followed by T_3 (Aloe vera at 75%), T_2 ($Cacl_2$) and T_6 Gaur gum at 12% respectively. The lowest reducing sugars value observed in T_7 (control) 3.81, 4.11, 4.59, 3.61 and 3.22% from 0 to 12^{th} day of storage period. The total and reducing sugars were increased in all treatments. The raise in sugars maybe due to conversion of starch into sugars during storage. Similar observation was reported by (Siddiqui *et al*., 2018) in bananas, (Oliverira *et al*., (2018) [15], (Christian *et al*., 2017) [6]

All the different treatments significantly influenced the non-reducing sugars level of guava fruits, under storage condition the maximum non-reducing sugar content was registered in treatment T_1 (chitosan at 2%) 3.82, 3.86, 4.14, 3.20 and 3.05 from 0 to 12th day of storage. Likewise, the minimum value obtained from untreated fruit i.e., T_7 control with 3.01, 3.07, 3.13, 2.95 and 2.93 on 0, 3rd, 6th, 9th and 12th days respectively table 3. Result noted by (Oliverira *et al*., 2018) [15], (Christian *et al*., 2017) [6], (Singh *et al*., 2018) [19] and (Bhooriya *et al*., 2018) [1].

Ascorbic acid (mg/100g)

Although the loss of ascorbic acid content during the storage period was higher and higher at control (T_7) 171.26, 156.28, 136.47, 112.61 and 92.58 mg/100g compared to other treatments during the storage period i.e., 0th, 3rd, 6th, 9th and 12th days respectively. The Treatment T_1 (Chitosan at 2%) 193.17, 178.29, 165.36, 146.79 and 133.38 mg/100g showed highest ascorbic acid value was recorded over storage period 0th to 12th day, followed by T_3 (Aloe vera), T_2 ($CaCl_2$) and T_6 (Gaur gum at 12%) in table 4. This finding is in agreement with (Sharmin *et al.*, 2015) [18], (Singh *et al.*, 2018) [19] and (Chawla *et al.*, 2018) [5] papaya and in guava fruits.

Table 1: Effect of post-harvest treatments on Physiological loss in weight (%) and fruit firmness of guava cv. L- 49 during storage

Treatments	Physiological loss in weight (%) Storage period (day)					Mean	Fruit firmness Storage period (day)					Mean
	0th	3rd	6th	9th	12th		0th	3rd	6th	9th	12th	
T_1	5.41	5.64	7.20	8.58	9.87	7.34	4.56	4.08	3.65	3.05	2.66	3.6
T_2	5.60	5.70	7.30	10.16	11.99	8.15	4.15	3.71	3.64	2.80	2.55	3.37
T_3	5.57	5.87	8.02	10.05	12.52	8.406	4.22	3.76	3.52	2.72	2.31	3.306
T_4	6.14	6.54	7.26	10.48	12.04	8.492	3.95	3.63	3.51	2.90	2.65	3.328
T_5	5.49	5.98	7.82	10.11	12.19	8.318	4.18	3.63	3.51	2.90	2.61	3.366
T_6	5.98	6.15	8.51	10.31	12.18	8.626	4.03	3.61	3.53	2.81	2.51	3.298
T_7	8.87	8.74	11.24	13.09	15.42	11.472	3.64	3.32	2.68	1.54	0.70	2.376
S.Em±	0.11	0.127	0.087	0.185	0.163		0.067	0.075	0.062	0.069	0.047	
C.D @ 5%	0.368	0.427	0.291	0.62	0.547		0.223	0.252	0.209	0.23	0.158	

Table 2: Effect of post-harvest treatments on Total soluble solids (oBrix) and Titrable Acidity (%) of guava cv. L- 49 during storage

Treatments	Total soluble solids (°Brix) Storage period (Day)					Mean	Titrable Acidity (%) Storage period (Day)					Mean
	0th	3rd	6th	9th	12th		0th	3rd	6th	9th	12th	
T_1	9.14	9.31	10.73	10.24	10.19	9.922	0.60	0.55	0.52	0.48	0.45	0.52
T_2	9.21	9.78	10.51	10.5	10.04	10.008	0.48	0.43	0.37	0.34	0.29	0.382
T_3	9.16	9.84	10.39	10.04	10	9.886	0.55	0.47	0.45	0.40	0.38	0.45
T_4	9.16	9.75	10.50	10.29	10.1	9.96	0.50	0.42	0.36	0.35	0.30	0.386
T_5	9.21	9.93	10.45	10.12	9.94	9.93	0.49	0.44	0.38	0.35	0.31	0.394
T_6	9.17	9.88	10.44	10.1	9.91	9.9	0.48	0.42	0.36	0.35	0.30	0.682
T_7	8.42	8.65	10.32	9.15	9.04	9.116	0.46	0.42	0.36	0.34	0.27	0.37
S.Em±	0.121	0.201	0.154	0.115	0.105		0.013	0.007	0.007	0.005	0.004	
C.D @5%	0.405	0.672	NS	0.385	0.350		0.042	0.024	0.023	0.017	0.014	

Table 3: Effect of post-harvest treatments on reducing sugars (%) and non-Reducing sugars (%) of guava cv. L- 49 during storage

Treatments	Reducing sugars (%) Storage period (Day)					Mean	Non- Reducing sugars (%) Storage period (Day)					Mean
	0th	3rd	6th	9th	12th		0th	3rd	6th	9th	12th	
T_1	4.98	5.46	5.84	4.65	4.53	5.092	3.82	3.86	4.14	3.2	3.05	3.614
T_2	4.40	4.82	5.14	4.24	3.99	4.518	3.59	3.72	3.95	3.19	3.07	3.504
T_3	4.65	4.77	4.95	4.28	4.19	4.568	3.53	3.67	3.96	3.08	2.79	3.406
T_4	4.32	4.78	5.37	4.18	3.87	4.504	3.43	3.57	3.8	3.12	2.9	3.364
T_5	4.31	4.85	5.21	4.19	3.93	4.498	3.49	3.59	3.76	3.21	3.13	3.436
T_6	4.42	4.75	5.18	4.23	3.83	4.482	3.42	3.52	3.76	3.17	3.01	3.376
T_7	3.81	4.11	4.59	3.61	3.22	3.868	3.01	3.07	3.13	2.95	2.93	3.018
S.Em±	0.066	0.059	0.09	0.062	0.069		0.043	0.064	0.065	0.038	0.058	
C.D @5%	0.22	0.199	0.302	0.207	0.232		0.142	0.213	0.217	0.126	0.194	

Table 4: Effect of post-harvest treatments on Total sugars (%) and Ascorbic acid (mg\100g) of guava cv. L- 49 during storage

Treatments	Total sugars (%) Storage period (Day)					Mean	Ascorbic acid (mg\100g) Storage period (Day)					Mean
	0th	3rd	6th	9th	12th		0th	3rd	6th	9th	12th	
T_1	8.79	8.80	8.89	8.66	8.35	8.698	193.17	178.29	165.36	146.79	133.38	163.39
T_2	7.85	7.86	8.34	7.96	7.58	7.918	184.36	176.77	158.92	133.08	113.24	153.27
T_3	8.07	8.22	8.61	7.81	7.74	8.09	191.13	178.68	160.19	139.29	120.76	158.01
T_4	7.90	8.12	8.27	7.62	7.44	7.87	180.39	168.91	156.52	136.65	119.40	152.37
T_5	8.06	8.07	8.34	7.79	7.42	7.936	180.60	168.25	157.62	134.05	120.51	152.20
T_6	7.92	8.18	8.19	7.65	7.35	7.858	183.58	168.34	152.83	135.65	119.87	151.964
T_7	6.20	6.60	6.80	6.64	6.15	6.478	171.26	156.28	136.47	112.61	92.58	133.84
S.Em±	0.124	0.105	0.187	0.075	0.113		2.093	3.779	1.333	1.919	1.302	
C.D @5%	0.416	0.352	0.624	0.252	0.377		6.999	12.636	4.457	6.418	4.355	

Conclusion

On the basis of result observed from this experiment it was conclude that Chitosan (2%) coating was found most effective postharvest treatment followed by Gur gum (12%) and Aloe vera (75%), Bee wax (15%), $CaCl_2$ (1%) and Pectin (6%) coating which enhanced the shelf life and consumer acceptability of the stored guava fruits. The Chitosan (2%) treated fruits has more overall acceptability because this coating helped in improving the colour, taste, appearance and quality of fruits. Hence this technology could be more useful for increase shelf life of fruits, low cost and reduce the post-harvest loss of fruits it also helps to reduce the use of harmful chemicals by growers and traders.

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