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Effect of Oil and Starch Based Edible Coating on Shelf Life of Guava *Psidium guajava* L. (cv Lucknow-49)

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ABSTRACT: Guava is popular with a wide range of people because it is cheaper, more nutritious and tastier than other fruits but the post harvest losses of guava around 46% because of high respiration rate, making it perishable while being stored. For minimize the post harvest losses and extend the shelf life of fresh guava the present study was conducted to using an edible coating made from edible oil such as rice bran, safflower and sunflower, beeswax and cornstarch. The treatment (Cornstarch 2% + safflower oil (1%) + beeswax (1%) has been proved to be the best oil and cornstarch based edible coating for shelf life of guava cv. L - 49 in respect to maximum - total soluble solids TSS (14.32 °Brix), acidity % (0.67%), ascorbic acid (199.66mg/100g), total, sugars 9.49%. The treatment (Cornstarch (2%) + rice bran oil (1%) + bees wax (1%) found next best treatment in improving the shelf life and quality of fruit up to 12th days of storage.

Keywords: Guava, Cornstarch, Edible coating, TSS, Vitamin C.

INTRODUCTION

Guava (*Psidium guajava* L.), known as the "apple of the tropics, is a plant in the Myrtaceae family. It is one of the most widespread fruit crops in India's tropical and subtropical regions, providing delicious fruits with high nutritional value and processing potential in the summer, rainy and winter season. In terms of area and production, guava is India's fourth-largest fruit crop, behind mango, banana, and citrus. In India, guavas are grown on about 2.60 million hectares, yielding 3826 and 15.93 metric tonnes per hectare, respectively. In Madhya Pradesh, guava is produced and grown on a total area basis of 28,44000 hectares, 990,000,000 tonnes, and 34.81 metric tonnes ha^{-1}, respectively (Anonymous, 2017).

Guava has a delicious flavour, high palatability, excellent nutritional and digestive qualities, and is widely accessible and reasonably priced. Guava fruits are popular with consumers and the food sector for many different reasons. It swiftly ripens after harvest, giving it a short shelf life. Fruit that is going to be shipped to distant markets needs to be fully mature, full size, and firm in texture, but it shouldn't have a distinct colour break on the surface. Fruits might be gathered at a more advanced state of maturity for the local market (Singh and Jain 2007). However, picking guava fruits at the proper stage of ripeness is essential for retaining their post-harvest quality. Six days after harvest, it soon starts to decay. After the fruit have been harvested at optimum maturity the important post-harvest need is the retention of quality for a longer period as possible so that it can be marketed.

The post-harvest losses can be minimized by extension of shelf life through checking the rate of transpiration and respiration, microbial infection and protecting membranes from disorganization. During storage, physico-chemical and biological changes affect the final texture and quality of fruits. Fruits' shelf life is extended by post-harvest dipping treatments that keep the fruit firm and the decomposing organism under control in nectarine (*Prunus persica* L. Batch cv 'Arctic Snow') fruit. Borah, (2016) reported that after harvesting of mature unripe tomato fruit coated with edible Aloe vera gel combined with bagging extending the shelf life and marketability.

Post-harvest practices dramatically enhance fruit quality and storage life (Azzolini *et al*., 2004; Patel *et al*., 2015). When covered with edible materials, fruits and vegetables retain their freshness for a longer period of time. When taken with the product, these are safe to eat and do not change the food's nutritional value. Thanks to edible coatings or films, fruits and vegetables have a longer shelf life and are more environmentally friendly. Therefore the aim of the present investigation was to extent shelf of guava with the use of edible coating.

Formiga *et al*. (2022) studied the impact of edible coatings made of hydroxypropyl methylcellulose (HPMC) and beeswax (BW) that were applied to guavas that were collected green and preserved for eight days at 22 °C. Guavas were coated with Control-uncoated, HPMC + 10% BW, HPMC + 20% BW, and HPMC + 40% BW. The coatings slowed the ripening process, prevented ethylene synthesis, and decreased respiration rate. The key advantages were the prevention of mass loss, preservation of green colour, and retention of stiffness. The HPMC + 20% BW treatment was the most effective in preserving fruit quality, lowering PG enzyme activity, and delaying the ripening of "Pedro Sato" guavas without increasing ADH enzyme activity and, as a result, fruit fermentation with HPMC + 20% CA.

MATERIAL AND METHODS

The present study was carried out in the Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, (M.P.) during 2019-20. Fresh, fully mature, uniform sized and free from any injury/infection, guava fruits were harvested at the colour break stage taken from ten year old trees of guava (*Psidium guajava* L.) cv. Lucknow-49 for this study from the Fruit Research Station Imaliya, Department of Horticulture, JNKVV, Jabalpur (M.P.). The solutions of various treatments of cornstarch and different oils along with beeswax at different concentrations were prepared in the Department of Horticulture, J.N.K.V.V., Jabalpur. The experiment consisted of 16 treatments *viz.,* cornstarch (0%, 2%, 4%, 6%) with oil [sunflower (1%), rice bran (1%), safflower (1%) +beeswax (1%)] and control. Post-harvest dipping of guava fruits was done in December 2019.

Preparation of chemical solutions for dipping. 20 gm, 40 gm, and 60 gm are needed to prepare solutions of cornstarch that are 2 percent, 4 percent, and 6 percent. In 1 litres of distilled water, cornstarch was dissolved. For the preparation of 1% sunflower oil + 1% beeswax + 1%, 1% rice bran + 1% beeswax + 1%, and 1% safflower oil + 1% beeswax solution, respectively, 10 g of each oil (sunflower, rice bran, and safflower) + 10 g of beeswax were combined with 0%, 2%, 4% and 6% cornstarch solution.

Fruits were washed under running water from the faucet after harvesting, and then air dried. Prior to dipping in the solutions, the initial parameters were recorded. Then, the fruits were treated-style dipped in the solution and kept at room temperature. The fruits were then exposed to several physico-chemical tests, as described in more detail. The treated fruits were stored in ambient conditions and analyses after 7 days for physical and chemical parameters. The TSS were recorded with hand refractometer and results were expressed as ^{0}Brix. The percent acidity was analyzed by titrating the fruit juice pulp with N/10 NaOH using phenolphthalein as an indicator. The ascorbic acid contents were determined by using 2,6 dichlorophenol indophenol dye (Ranganna, 2001). The total sugars were determined by slandered methods (AOAC, 1975) Reducing sugar % estimated by the method as suggested by Nelson (1994). Non reducing sugars(%) calculated difference in percent between total sugars and reducing sugars. The results were statistically analyzed using factorial completely randomized design (Panse and Sukhatme 1978).

RESULTS AND DISCUSSION

TSS (°Brix). The data presented in Table 1 revealed that TSS (°Brix) was significantly influenced by various post-harvest treatments. Data shows that TSS (°Brix) increased in all the treatments with the increase in storage period. It was found to have increased maximum [10.18, 10.69, 11.22, 11.96 and 12.40] under treatment [sunflower oil (1%) + Beeswax(1%)], whereas minimum (9.91, 10.10, 10.31, 10.70, 10.89) observed under control (water) during 3 to 12 days of storage. Total sugar (%) was significantly influenced by various post-harvest treatments. It was found to have a maximum (9.13) under treatment [sunflower oil (1%)+ Beeswax (1%)], whereas maximum (8.33) observed under control (water) at the 12th day of storage. In the case of concentration of cornstarch, (2% cornstarch) was found to have a maximum increase in total sugar (8.57) whereas, minimum increase in Total sugar (8.32) occurred in (0% cornstarch) i.e. water. There was an increase in total soluble solids content up to 12th day of storage in all the treatments including control. Among treatments TSS of T_7(14.32ºBrix) [Cornstarch (2%) + safflower oil (1%) + beeswax (1%)], whereas minimum (10.26ºBrix) under T_0 (control) at the end of storage period. The increase in TSS during the initial stage may be attributed to the conversion of starches and other polysaccharides into soluble forms of sugars. Tasdelen and Bayindirli (1998) in coated tomatoes and Dashora *et al.* (1999) in oil coated ber.

Acidity (%). Table 1 and reveals that there was a significant interaction effect of oil and starch in all treated fruits at 3 to 12 days of storage. A gradual decrease in total titratable acidity was observed during the storage period. The maximum acidity percentage 0.74, 0.73, 0.71, 0.69 and 0.67% was recorded in T7 [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)] whereas, the minimum acidity percentage 0.73, 0.68, 0.61, 0.52 and 0.46 % were recorded under T_0 (control) at 0, 3, 6, 9 and 12 days of storage, respectively under ambient storage condition. Gradual and progressive decrease in acidity was observed under all the treatments during storage and this progressive decline might be due to utilization of acid in metabolism. The maximum (0.67%) acidity during storage was observed in fruits treated in T_7[(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)] followed by T_6 [(Cornstarch (2%) + rice bran (1%) + beeswax (1%)] against the minimum (0.46%) under control. A gradual decrease in acidity has also been reported by Josan *et al.* (1983); Wijewardane and Guleria (2009) in potato starch coated apples.

Ascorbic acid (mg/ 100gm pulp). The data presented in Table 2 revealed that ascorbic acid was significantly influenced by various post-harvest treatments. Data shows that ascorbic acid decreased in all the treatments with the increase in storage period. It was found to have decreased minimum (182.75) under treatment [sunflower oil (1%) + Beeswax (1%)], whereas maximum (149.83) observed under control (water) at the 12th day of storage. The ascorbic acid content decreased under all the treatments with the advancement of storage period. At the end of storage period the maximum (199.66 mg/100 g) ascorbic acid significantly decreased by the treatment T7 [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)] and the minimum (110.33 mg/100 g) ascorbic acid was observed in T_0 (control). This might be due to conversion of L-ascorbic acid into dehydro ascorbic acid. Similar results have been well supported by Mahajan *et al.* (2011) in coated kinnow fruits, Jagdeesh (1994) in cornstarch coated guava fruits.

Total sugar (%). The data presented in Table 2 revealed that Total sugar (%) sugar was significantly influenced by various post-harvest treatments. Data shows that Total sugar (%) increased in all the treatments with the increase in storage period. It was found to have maximum (7.52, 8.26, 8.60, 8.84 and 9.13) under treatment [sunflower oil (1%) + Beeswax (1%)], whereas maximum (7.44, 7.86, 8.10, 8.23 and 8.33) observed under control (water) during 3rd to 12th days of storage.

Total sugar increased with the highest on the 12th day of storage. This trend was seen in all the treated fruits of guava cv. Lucknow-49 and control also. Fruits treated with T_7 [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)] recorded the highest total sugar content (9.49%) and lower total sugar content (7.55 %) observed in T_0 (control) at the 12th day of storage. These findings are supported by observations of Singh and Mohammad (1997) in wax coated guava, Das and Medhi (1996) in cornstarch coated fruits and Dashora *et al.* (1999) in edible oil coated ber.

Reducing sugar (%). The data presented in Table 2 revealed that Reducing sugar(%) was significantly influenced by various post-harvest treatments. Data shows that Reducing sugar (%) increased in all the treatments with the increase in storage period. It was found to have maximum (4.25, 4.40, 4.54, 4.67 and 4.88) under treatment [sunflower oil (1%) + Beeswax(1%)], whereas maximum (4.24, 4.25, 4.35, 4.44 and 4.53) observed under control (water) during 3 to 12 days of storage.

In case of concentration of corn starch, (2% corn starch) was found to have a maximum increase in Reducing sugar (4.23, 4.33, 4.45, 4.56 and 4.68) whereas, minimum increase in Reducing sugar (4.26, 4.30, 4.41, 4.50 and 4.60) occurred in (0% cornstarch) i.e. water.

It was observed that the interaction effect of oil and starch based edible coating was having a significant increase in Reducing sugar percentage with increase in duration of storage up to 6 days and after that declined up to 9th to 12th day of storage (Table 2). The maximum percentage of reducing sugar was recorded 4.25, 4.45, 4.64, 4.81, 5.11 in T_7 [(Corn starch (2%) + safflower oil (1%) + beeswax (1%)]. Whereas, the minimum reducing sugar percentage 4.27, 4.15, 4.21, 4.26, 4.31 were recorded under T_0 (control) at 0, 3, 6, 9 and 12 days of storage, respectively. This might be due to the hydrolysis of polysaccharides and conversion of non-reducing sugar into reducing sugar. The results are well supported by Jagdeesh (1994) in corn starch coated fruits, Singh and Mohammad (1997) in wax coated

guava.

Non-reducing sugar (%). The data presented in Table 2 revealed that Non-Reducing sugar (%) was significantly influenced by various post-harvest treatments. Data shows that Non - Reducing sugar (%) increased in all the treatments with the increase in storage period. It was found to have maximum (3.27, 3.86, 4.07, 4.16 and 4.24) under treatment [sunflower oil (1%) + Beeswax(1%)], whereas maximum (3.22, 3.60, 3.75, 3.79 and 3.80) observed under control (water) during 3 to 12 days of storage. In case of concentration of corn starch (2% corn starch) was found to have a maximum increase in Non - Reducing sugar (3.16, 3.70, 3.85, 3.88 and 3.89) whereas, minimum increase in Non - Reducing sugar (3.11, 3.52, 3.66, 3.71 and 3.72) occurred in (0% cornstarch) i.e. water.

Interaction effect of oil and starch based edible coating on non reducing sugar percentage of guava was significantly influenced by different post-harvest treatments. The maximum non reducing sugar 3.22, 3.60, 3.75, 3.79 and 3.80 % were recorded under treatment T7 (Corn starch (2%) + safflower oil (1%) + beeswax (1%)]. On the other hand, minimum non reducing sugar percentage 3.10, 3.25, 3.24, 3.24 and 3.01 were recorded under T_0 (control) at 0, 3, 6, 9 and 12 days of storage, respectively. The increase in non-reducing sugar during storage was due to the conversion of starch into sugar. The findings obtained in the present investigation can be compared to those obtained by Agrawal and Jaiswal (2012); Jatinder & Singh (2017).

Table 1: Effect of edible coating on the chemical properties of guava (cv. Lucknow-49) during storage.

Treatments	TSS (°Brix)			Acidity(%)			Ascorbic Acid (mg/100gms)		
Oil	**Day 0**	**Day 6**	**Day 12**	**Day 0**	**Day 6**	**Day 12**	**Day 0**	**Day 6**	**Day 12**
Water (control)	9.91	10.31	10.89	0.73	0.63	0.51	243.41	208.91	149.83
Sunflower oil (1%) + beeswax (1%)	10.18	11.22	12.40	0.74	0.67	0.60	243.75	226.33	182.75
Rice bran oil (1%) + beeswax (1%)	10.21	10.61	11.34	0.74	0.65	0.54	244.41	213.58	166.58
Safflower oil (1%) + beeswax (1%)	10.02	10.47	10.92	0.74	0.65	0.54	244.50	215.16	160.33
SE(m)±	0.032	0.029	0.048	0.001	0.001	0.001	0.167	0.187	0.672
C.D at 5% level	0.094	0.084	0.138	0.003	0.003	0.002	0.484	0.542	1.950
CORNSTARCH									
Cornstarch (water) 0%	10.09	10.47	10.93	0.74	0.64	0.52	244.58	208.91	152.91
Cornstarch 2%	9.81	10.32	10.97	0.73	0.64	0.54	243.25	226.33	166.58
Cornstarch 4%	9.82	10.58	11.57	0.74	0.66	0.56	243.91	213.58	165.41
Cornstarch 6%	10.60	11.24	12.08	0.74	0.66	0.57	244.33	215.16	176.58
SE(m)±	0.032	0.029	0.048	0.001	0.001	0.001	0.167	0.187	0.672
C.D. at 5% level	0.094	0.084	0.138	0.003	0.003	0.002	0.484	0.582	1.950
T_0 Control	9.71	10.04	10.26	0.73	0.61	0.46	244.33	192.66	110.33
T_1 Cornstarch 0% + sunflower oil (1%) + beeswax (1%)	10.08	10.41	11.02	0.73	0.63	0.52	242.33	212.33	140.00
T_2 Cornstarch 0% + rice bran oil (1%) + beeswax (1%)	9.61	10.21	11.10	0.73	0.64	0.54	243.66	214.00	161.33
T_3 Cornstarch 0%+ safflower oil (1%) + beeswax (1%)	10.24	10.58	11.20	0.73	0.64	0.54	243.33	216.66	166.66
T_4 Cornstarch (2%) + Oil 0% + beewax 0%		10.57	11.30	0.75	0.65	0.55	244.33	219.33	171.00
T_5 Cornstarch (2%) + sunflower oil (1%) + beeswax (1%)	9.78	10.65	11.48	0.73	0.65	0.58	242.33	222.66	180.00
T_6 Cornstarch (2%) + rice bran oil (1%) + beeswax (1%)	9.59	11.10	12.53	0.75	0.7	0.64	244.33	229.66	180.33
T_7 Cornstarch (2%) + safflower oil(1%) + beeswax (1%)	10.98	12.58	14.32	0.74	0.71	0.67	244.00	233.66	199.66
T_8 Cornstarch (4%) + Oil 0% + beewax 0%	10.74	11.00	11.42	0.74	0.65	0.55	245.00	213.33	164.00
T_9 Cornstarch (4%) + sunflower oil (!%) + beeswax (1%)	9.78	10.21	10.95	0.73	0.64	0.54	245.66	218.00	168.33
T_{10} Cornstarch (4%)+ rice bran oil (1%) + beeswax (1%)	9.90	10.35	11.55	0.75	0.66	0.54	242.66	211.66	161.66
T_{11} Cornstarch(4%) + safflower oil (1%) + beeswax (1%)	10.44	10.88	11.45	0.74	0.66	0.55	244.33	211.33	172.33
T_{12} Cornstarch (6%) + Oil 0% + beewax 0%	9.63	10.28	10.73	0.75	0.66	0.55	244.66	216.66	166.33
T_{13} Cornstarch (6%) + sunflower (1%) + beeswax (1%)	9.54	10.00	10.45	0.75	0.66	0.56	242.66	210.33	156.66
T_{14} Cornstarch (6%) + rice bran oil (1%) + beeswax (1%)	10.17	10.65	11.13	0.74	0.66	0.55	245.00	218.00	158.66
T_{15} Cornstarch (6%) + safflower oil (1%) + beeswax (1%)	10.73	10.94	11.36	0.74	0.65	0.57	245.66	215.66	167.66
SE(m)±	0.064	0.058	0.095	0.002	0.002	0.002	0.333	0.373	1.344
C.D. at 5% level	0.186	0.168	0.276	0.006	0.006	0.005	0.937	0.183	3.900

Control on 6th day

Control on 12th day

Treatment 7 on 6th day

Treatment 7 on 12th day

Table 2: Effect of oil and starch based edible coating on the Total sugar (%) and Ascorbic Acid (mg/100gm) of guava (cv. Lucknow-49) during storage.

Treatments	Total sugar(%)			Reducing Sugar (%)			Non Reducing Sugar (%)		
Oil	Day 0	Day 6	Day 12	Day 0	Day 6	Day 12	Day 0	Day 6	Day 12
Water (control)	7.44	8.10	8.33	4.24	4.35	4.53	3.22	3.75	3.80
Sunflower oil (1%) + beeswax (1%)	7.52	8.60	9.13	4.25	4.54	4.88	3.27	4.07	4.24
Rice bran oil (1%) + beeswax (1%)	7.48	8.33	8.59	4.23	4.45	4.66	3.24	3.88	3.92
Safflower oil (1%) + beeswax (1%)	7.28	8.02	8.25	4.25	4.48	4.69	3.11	3.53	3.56
SE(m)±	0.025	0.012	0.014	0.009	0.008	0.009	0.046	0.015	0.050
C.D at 5% level	0.071	0.035	0.040	N\A	0.023	0.025	N\A	0.044	0.146
CORNSTARCH									
Cornstarch (water) 0%	7.38	8.08	8.32	4.26	4.41	4.60	3.11	3.66	3.72
Cornstarch 2%	7.39	8.30	8.57	4.23	4.45	4.68	3.16	3.85	3.89
Cornstarch 4%	7.46	8.33	8.66	4.22	4.47	4.72	3.24	3.86	3.94
Cornstarch 6%	7.50	8.35	8.75	4.25	4.49	4.77	3.33	3.86	3.97
SE(m)±	0.025	0.012	0.014	0.009	0.008	0.009	0.046	0.015	0.050
C.D. at 5% level	0.071	0.035	0.040	0.027	0.023	0.0025	0.113	0.044	0.146
T_0 Control	7.37	7.45	7.55	4.27	4.21	4.31	3.10	3.24	3.01
T_1 Cornstarch 0% + sunflower oil (1%) + beeswax (1%)	7.42	8.31	8.54	4.23	4.38	5.18	3.22	3.93	3.36
T_2 Cornstarch 0% + rice bran oil (1%) + beeswax (1%)	7.44	8.32	8.61	4.21	4.41	4.62	3.23	3.91	3.99
T_3 Cornstarch 0% + safflower oil (1%) + beeswax (1%)	7.55	8.34	8.64	4.22	4.42	4.64	3.33	3.92	4.00
T_4 Cornstarch (2%) + Oil 0% + beewax 0%	7.52	8.47	8.81	4.26	4.43	4.67	3.26	4.04	4.14
T_5 Cornstarch (2%) + sunflower oil (1%) + beeswax (1%)	7.48	8.56	8.94	4.26	4.51	4.80	3.22	4.05	4.14
T_6 Cornstarch (2%) + rice bran oil (1%) + beeswax (1%)	7.51	8.67	9.27	4.31	4.57	4.91	3.20	4.10	4.36
T_7 Cornstarch (2%) + safflower oil (1%) + beeswax (1%)	7.58	8.70	9.49	4.25	4.60	5.10	3.33	4.08	4.38
T_8 Cornstarch (4%) + Oil 0% + beewax 0%	7.52	8.45	8.75	4.30	4.56	4.75	3.22	3.89	4.00
T_9 Cornstarch (4%) + sunflower oil (!%) + beeswax (1%)	7.48	8.34	8.60	4.27	4.42	4.64	3.21	3.92	3.96
T_{10} Cornstarch (4%)+ rice bran oil (1%) + beeswax (1%)	7.51	8.37	8.59	4.21	4.42	4.64	3.30	3.95	3.95
T_{11} Cornstarch (4%) + safflower oil (1%) + beeswax (1%)	7.58	8.19	8.44	4.33	4.42	4.65	3.25	3.77	3.79
T_{12} Cornstarch (6%) + Oil 0% + beewax 0%	7.13	7.95	8.19	4.27	4.48	4.70	2.86	3.47	3.49
T_{13} Cornstarch (6%) + sunflower (1%) + beeswax (1%)	7.24	7.99	8.22	4.24	4.48	4.70	3.00	3.51	3.52
T_{14} Cornstarch (6%) + rice bran oil (1%) + beeswax (1%)	7.39	7.98	8.19	4.23	4.46	4.61	3.16	3.52	3.58
T_{15} Cornstarch (6%) + safflower oil (1%) + beeswax (1%)	7.38	8.16	8.42	3.97	4.49	4.69	3.41	3.67	3.73
SE(m)±	0.049	0.024	0.027	0.0075	0.0081	0.0078	0.092	0.030	0.101
C.D. at 5% level	N\A	0.071	0.079	0.024	0.022	0.0200	N\A	0.080	0.292

CONCLUSIONS

The maximum total soluble solids (14.32°Brix) was recorded in T_7 treatment [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)], whereas the minimum (10.26 Brix) in control (T_0) treatment on 12th day of storage. The maximum acidity (0.67%) was recorded in T_7 treatment [(Cornstarch (2%) + safflower oil(1%) + beeswax (1%)], however the minimum (0.46%) in control (T0) treatment on 12th day of storage. The minimum TSS/acid ratio (19.38) was recorded in T_7 treatment [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)] whereas the maximum TSS/acid ratio (22.31) was recorded under control (water). The maximum ascorbic acid (199.66 mg/100g) was recorded in T_7 treatment [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%)], whereas the minimum (110.33mg/100g) in control (T0) treatment on 12th day of storage. The maximum total sugars (9.49%) was recorded in T_7 treatment [(Cornstarch (2%) + safflower oil (1%) + beeswax (1%))], whereas the minimum (7.55%) in control (T0) treatment on 12th day of storage.

FUTURE SCOPE

In future research should be done with other different starch, oils, antioxidant and organic compounds treatments with different concentration and other varieties of guava fruits for find out the best chemical/organic compounds/antioxidants for enhancing the quality and extending the shelf-life.

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Conflicts of Interest. None.

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