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Efficacy of different composite edible coatings on postharvest quality attributes of guava (*Psidium guajava* L.) cv. Lalit at ambient storage conditions

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Abstract
The aim of the study was to investigate the effects of different composite edible coating treatments like olive oil, *Aloe vera* gel, xanthan gum, sodium alginate and carboxymethyl cellulose as a base coatings with calcium gluconate (texture enhancer) and ascorbic acid (antioxidant) at varying concentrations on physico-chemical characteristics of guava cv. Lalit. The trial was carried out in winter seasons of 2017 and 2018. Olive oil composite edible coatings (olive oil 100% + texture enhancer 0.5%) were most effective in reducing weight loss (13.62 and 12.17%), fruit decay (5.41 and 6.80%) in 2017 and 2018, respectively. Higher mean total soluble solids and ascorbic acid were recorded in fruits coated with olive oil 100% + texture enhancer 0.5% and olive oil 100% + texture enhancer 0.5% + antioxidant 0.1% treatments. Hence, it can be concluded that olive oil composite coatings coated fruits retained more postharvest quality attributes under ambient storage conditions.

Keywords: Guava, efficacy, composite edible coatings, lalit

Introduction
Guava belongs to the genus *Psidium* of the family Myrtaceae and contains about 150 species (Hayes, 1970) [6] out of which only 20 species produce edible fruits and rest are wild with inferior quality fruits. It is termed as a common man's fruit and "Apple of the Tropics" as well. Guava fruit is consumed at both green and ripe stage. It is rich in vitamin C and contains a fair source of minerals such as phosphorus, calcium, iron as well as vitamin A. Due to highly perishable nature; guava fruits undergo rapid postharvest ripening in few days under ambient conditions (Hashem and Alamri, 2009) [4]. Guava being a climacteric fruit ripens rapidly after the harvest therefore has short shelf life. Once it is fully ripe, the fruit becomes soggy and consumer preference and marketing quality deteriorate rapidly. Composite coatings consist of xanthan gum (0.3%) and olive oil (0.1%) enriched with antioxidants enhanced the postharvest storability and nutritional quality of table grapes (Baraiya *et al*., 2016) [3]. The sodium alginate edible coating on the pear fruits reduced increase in the TSS value during the storage when compared to that of control fruits by slowing down the polysaccharide degradation (Kessiane *et al*., 2012) [8]. Calcium dips were effective in decreasing surface damage and delaying the decay of fruits compared to untreated fruits (Munoz *et al*., 2006) [12]. Othman *et al*., 2017 [13] found that sodium alginate based edible films enhanced the physico-chemical quality of coated guava fruits contained essential oil. Hashemi *et al*., 2018 [5] revealed that coated samples of fresh pistachio (*Pistacia vera* L.) fruits with 1.5% (w/v) carboxymethyl cellulose (CMC) with the combination of essential oil had lowest weight loss per cent. So many studies have been conducted by researchers to enhance the production but little work has been conducted to reduce postharvest losses of guava fruits. However, it is important to reduce the postharvest losses of guava fruits after harvesting. Therefore, the present study was undertaken to determine the effectiveness of postharvest application of composite edible coatings like *Aloe vera* gel, olive oil, xanthan gum, carboxymethyl cellulose and sodium alginate with food additives (Texture enhancer and antioxidant) for maintaining the quality and enhancing the shelf life of guava fruits.

Materials and Methods

The experiment was conducted at Postharvest Laboratory, Department of Horticulture, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand) during two winter seasons of 2017 and 2018. The guava fruits of winter season crops were harvested at 80% maturity (colour break stage) and collected in plastic crates covered with a thick layer of guava leaves and brought to the laboratory. Fruits with uniform size and colour were selected whereas blemished and diseased fruit were discarded. Prior to the post-harvest treatment, the fruits were washed in potable water. The fruits were then allowed to dry in shade. Composite coatings were prepared by taking the distilled water in a beaker and calculation of each chemical needed for one litre solvent was done except olive oil (100 ml) coatings and accordingly, coatings were prepared for dip treatment of guava. The composite coatings were prepared from base coatings of olive oil, *Aloe vera* gel, sodium alginate, xanthan gum, carboxymethyl cellulose with composite coating materials *viz*., calcium gluconate as a texture enhancer (TE) and ascorbic acid as a antioxidant (AO) of the required concentrations for each treatment. The detail of the treatments include, LT_1: Olive oil (100%) + TE (0.5%), LT_2: Olive oil (100%) + TE (0.5%) + AO (0.1%), LT_3: *Aloe vera* (1:1) + TE (0.5%), LT_4: *Aloe vera* (1:1) + TE (0.5%) + AO (0.1%), LT_5: Xanthan gum (0.5%) + TE (0.5%), LT_6: Xanthan gum (0.5%) + TE (0.5%) + AO (0.1%), LT_7: Sodium Alginate (2%) + TE (0.5%), LT_8: Sodium Alginate (2%) + TE (0.5%) + AO (0.1%), LT_9: CMC (1%) + TE (0.5%), LT_{10}: CMC (1%) + TE (0.5%) + AO (0.1%), LT_{11}: Control (without coating), the fruits were kept at ambient temperature conditions. Twenty fruits were dipped in each solution for 10 minutes and then air dried except olive oil. In case of olive oil coating, fruits were coated 3-4 times with the help of brush and left for air drying. The trial was carried out in three replicates. The treated fruits were kept at ambient temperature. The observations on physical and quality parameters were recorded at an interval of 3 days. Physiological loss in weight was recorded by weighing the sample on electronic balance and expressed in grams (g) from which the physiological loss in weight (PLW) was calculated and expressed in per cent. On the basis of number of spoiled fruits (unfit for human consumption) observed at every three days interval, the percentage decay was worked out and the spoiled fruits were removed. Guava samples were selected randomly and evaluated for their sensory characteristics using sensory panel consisting of 5 judges. The evaluation was taken at every 3 days interval. The judges were requested to record their degree of liking and disliking on a sensory score card using 9 point Hedonic scale ranging from 1 to 9 and data were expressed as the mean of all scores. The quality parameter, TSS of the fruit juice was recorded at room temperature using hand refractometer whereas, the ascorbic acid were estimated according to the standard method described by Ranganna (1986) [14]. The data was statistically analyzed in factorial completely randomized design (FCRD) for analysis of variance.

Results and discussion

The data regarding effect of different composite edible coatings on physiological loss in weight and decay per cent of guava cv. Lalit under ambient storage conditions are presented in Tables 1. It shows that all the treatments exerted a significant influence on physiological loss in weight and decay per cent. Maximum physiological loss (22.62%) was found in control (LT_{11}) followed by LT_9 (19.95%) while minimum physiological loss (13.62%) was recorded in LT_1 followed by LT_2 (13.86%) and LT_8 (16.00%) during the year 2017. In the year 2018, the maximum physiological loss (18.73%) was found in control (LT_{11}) followed by LT_{10} (16.06%) while minimum physiological loss (12.17%) was recorded in LT_1 followed by LT_2 and LT_5 i.e. 13.15% each. In *Aloe vera*, xanthan gum and sodium alginate composite coatings physiological loss in weight ranged from 13.15-14.23% which was statistically superior from control. Coating the guava fruits with olive oil with calcium gluconate and ascorbic acid was clearly effective in conferring a physical barrier to moisture loss; therefore, a decreased weight loss in the olive oil coated fruits was observed during evaluation in this study because it forms a film on the top of the skin acting as an additional barrier to moisture loss (Togrul and Arslan 2004) [17]. There was no visible sign of decay was observed in coated or control fruits up to 3rd days of the storage period. However, decay was observed in most of the coating treatments from 6th day of storage interval except olive oil coatings which exhibited no decay symptoms in fruits up to 6th day of storage. Thereafter, the coatings significantly reduced decay compared with the control. Data tabulated in Table 1 shows that maximum decay per cent (21.49 and 22.92 per cent) was recorded in control (LT_{11} each) in year 2017 and 2018, respectively. In olive oil composite coatings treatments fruits decay started from 9th day of storage period with minimum decay per cent (5.41 and 6.80 per cent) in LT_1 (olive oil 100% + TE 0.5%) both winter seasons of 2017 and 2018. Storage days affected fruit decay percentage significantly which increased gradually irrespective of the treatment as the storage period increased. Fruits respire even after harvest which may lead to deterioration mainly due to exhaustion of sugars. Storage life and spoilage of fruits was observed directly related to the rate of respiration (Srivastava *et al.*, 1961) [16].

The perusal of data on effect of various composite coating treatments on appearance and taste of guava cv. Lalit under ambient storage conditions are summarized in Tables 2 Maximum appearance score (7.16) was recorded in LT_1 (Olive oil 100% + TE 0.5%) followed by LT_2 (7.15) and minimum (5.89) was found in control (LT_{11}) followed by LT_{10} (6.57) during winter season of 2017. Similar trend was observed in 2018, maximum appearance score (7.08) was recorded in LT_1 followed by LT_2 (7.06) and minimum (5.83) was observed in control. The *Aloe vera* composite coating coated fruits score 6.94 which were statistically *at par* with xanthan gum and sodium alginate composite edible coatings. Coating acts as a semi-permeable obstacle against carbon dioxide, oxygen, moisture and solute movement, thereby decreasing the respiration rate, water loss and alternatively oxidation reaction due to which fruit appearance is acceptable (Kumar *et al*., 2017) [9]. The present results are in accordance with the findings of Mahajan *et al*., 2009 [10] in kinnow, Akhtar and Rab, 2014 [2] in strawberry and Kumar *et al*., 2017 [9] in guava who observed that composite edible coated samples scored higher in sensory attributes. In winter season of 2017, fruit taste score ranged from 6.17 to 7.18 (Table 2). Olive oil composite coatings (LT_1) was score maximum fruit taste value (7.18) followed by LT_2 (7.16) and minimum (6.17) was found in control (LT_{11}) followed by 6.73 in LT_{10} during winter season of 2017. While in winter season 2018, maximum taste score (7.09) was noticed in olive oil composite coatings (LT_1) followed by LT_2 (7.07) and minimum score (6.33) was recorded in control. Fruit taste

significantly differed during storage intervals which reduced gradually, irrespective of the treatment as the storage period progressed. Maximum acceptable taste of fruits (8.00 each) was observed on initial days during both seasons and it gradually decreased and found minimum (5.42 and 5.36) on 15th day of storage during winter seasons of 2017 and 2018, respectively. The results revealed that fruit taste decreased significantly with increase in storage intervals. It might be due to fluctuations in pH, acids and sugar/acid ratio. Olive oil and *Aloe vera* coatings maintained taste and retained the quality of fruits during storage. The present results are supported by the findings of Marpudi *et al*. (2011) [11] in papaya, Akhtar and Rab, 2014 [2] in strawberry and Kumar *et al*., 2017 [9] in guava who also observed that coated samples taste better and retained their quality during storage.

The data compiled on effect of composite coatings and storage periods and their interactions on fruit total soluble solids and ascorbic acid of guava cv. Lalit under ambient condition are presented in Table 3. The mean TSS ranged from 9.27 to 10.65°Brix in all the treatments. Maximum TSS (11.67ºBrix) was found in LT_6 during 12th day of storage. However with subsequent storage intervals, the quality deteriorated. During 15th day of storage, maximum TSS (11.36ºBrix) was noticed in LT_2 followed by 11.34°Brix in LT_1 and minimum (5.16ºBrix) was recorded in control (LT_{11}) followed by 8.23°Brix in LT_{10} during winter season of 2017. During 2018, maximum TSS (10.99ºBrix) was recorded in LT_2 followed by 10.92°Brix in LT_1 and minimum (5.31ºBrix) was recorded in control (LT_{11}) followed by 7.24°Brix in LT_9 on 15th day of storage period. LT_1 and LT_8 had similar content of TSS (10.32°Brix) which was statistically superior to *Aloe vera*, CMC composite coating treatments and control. Increase in TSS content during storage might be due to the moisture loss, hydrolysis of polysaccharides and concentration of juice as a result of degradation. The above results might be attributed to the reason that coating of olive oil retarded the ripening and senescence processes and simultaneously reduced the conversion of starch into sugars. Kamboj and Kaur, 2018 [7] reported that olive oil coated guava fruits retained significantly higher TSS during storage intervals. Perusal of the data (Table 3) in winter season of 2017, shows that maximum fruit ascorbic acid (253.80 mg/100 g) was recorded in LT_2 followed by 253.70 mg/100 g in LT_1 and minimum (214.66 mg/100 g) was found in control while sodium alginate composite coated treatment (LT_8) retained 248.08 mg/100 g ascorbic acid which was superior from the CMC composite coatings and control. During winter season 2018, maximum ascorbic acid (247.62 mg/100 g) was recorded in LT_1 followed by LT_2 (247.56 mg/100 g) and minimum (206.51 mg/100 g) was recorded in control. Sodium alginate composite coating treatments had higher level of ascorbic acid 243.55 and 243.09 mg/100 g in ST_7 and ST_8, respectively which was statistically superior over *Aloe vera* and xanthan gum composite coating treatments. The coated fruits had higher level of ascorbic acid and it gradually decreased over course of storage. The higher level of ascorbic acid in composite coated treatments might reflect the low oxygen permeability, slowing down the respiration rates, which delayed the deteriorative oxidation reaction of ascorbic acid of fruits. Akhtar and Rab, 2014 [2] reported that ascorbic acid was higher in calcium gluconate coated strawberry due to delaying the ripening process. Similar results were also revealed by Singh *et al*., 2018 [15] and Abraham and Banerjee, 2018 [1] in guava who found that coated fruits had retained higher level of ascorbic acid content.

Table 1: Effect of composite coatings on fruit physiological loss in weight (%) and decay (%) of guava cv. Lalit (2017 and 2018)

Year	Physiological loss in weight (%) in 2017						Mean	Physiological loss in weight (%) in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	0.00	3.22	8.68	14.26	23.54	31.98	13.62	0.00	7.33	10.09	10.24	20.97	24.36	12.17
LT_2	0.00	1.41	9.01	16.06	21.06	35.61	13.86	0.00	6.21	10.43	13.12	22.19	26.94	13.15
LT_3	0.00	7.86	12.90	17.12	26.23	42.72	17.81	0.00	5.48	9.26	13.22	25.53	30.32	13.97
LT_4	0.00	7.14	12.67	16.85	24.29	38.40	16.56	0.00	6.04	8.23	13.88	24.19	32.49	14.14
LT_5	0.00	6.54	9.94	17.77	25.05	41.11	16.73	0.00	4.95	7.87	12.17	22.14	31.80	13.15
LT_6	0.00	8.16	13.51	20.54	27.29	43.28	18.80	0.00	4.48	8.54	14.41	22.22	30.71	13.39
LT_7	0.00	4.21	11.58	19.44	26.18	41.68	17.18	0.00	5.31	11.72	13.89	22.24	30.49	13.94
LT_8	0.00	3.19	9.45	16.96	24.47	41.91	16.00	0.00	5.84	12.10	14.19	22.85	30.41	14.23
LT_9	0.00	9.69	15.24	16.76	28.18	49.83	19.95	0.00	5.81	9.41	16.63	28.82	34.71	15.90
LT_{10}	0.00	6.29	13.33	19.24	23.56	48.03	18.41	0.00	5.72	9.41	17.41	28.71	35.13	16.06
LT_{11}	0.00	7.82	14.90	22.09	37.21	53.69	22.62	0.00	5.48	8.53	20.81	30.72	46.87	18.73
Mean	0.00	5.96	11.93	17.92	26.10	42.57		0.00	5.70	9.60	14.54	24.60	32.20	

Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.264	0.094
Treatments (T)	0.357	0.127
Interaction (S.I.×T)	0.874	0.312

Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.224	0.08
Treatments (T)	0.303	0.108
Interaction (S.I.×T)	0.742	0.265

Year	Decay (%) in 2017						Mean	Decay (%) in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	0.00	0.00	0.00	2.11	10.23	20.11	5.41	0.00	0.00	0.00	3.14	12.34	25.34	6.80
LT_2	0.00	0.00	0.00	2.45	10.22	22.23	5.82	0.00	0.00	0.00	3.33	12.65	28.63	7.43
LT_3	0.00	0.00	5.20	11.23	26.45	30.12	12.17	0.00	0.00	5.30	14.34	30.21	32.34	13.70
LT_4	0.00	0.00	5.20	12.55	26.47	31.24	12.58	0.00	0.00	5.40	13.77	30.44	33.45	13.84
LT_5	0.00	0.00	6.70	13.11	31.11	35.53	14.41	0.00	0.00	6.76	14.11	34.23	36.23	15.22
LT_6	0.00	0.00	6.80	13.14	31.24	35.47	14.44	0.00	0.00	6.99	14.23	34.27	36.57	15.34
LT_7	0.00	0.00	5.10	11.12	19.78	33.37	11.56	0.00	0.00	5.34	14.21	25.56	29.56	12.45
LT_8	0.00	0.00	5.00	11.34	19.87	33.89	11.68	0.00	0.00	5.10	11.87	24.62	31.34	12.16
LT_9	0.00	0.00	6.70	13.54	27.78	31.25	13.21	0.00	0.00	6.80	12.77	32.24	37.56	14.90

LT_{10}	0.00	0.00	6.80	13.47	28.88	32.24	13.57	0.00	0.00	6.90	14.12	33.43	38.67	15.52
LT_{11}	0.00	0.00	8.90	24.78	38.78	56.47	21.49	0.00	0.00	10.12	28.75	40.31	58.34	22.92
Mean	0.00	0.00	5.13	11.71	24.62	32.90		0.00	0.00	5.34	13.15	28.21	35.28	

Factors	CD at 5%	SE(m)	Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.254	0.091	Storage Intervals (S)	0.234	0.084
Treatments (T)	0.344	0.123	Treatments (T)	0.317	0.113
Interaction (S.I.×T)	0.844	0.301	Interaction (S.I.×T)	0.776	0.277

Where LT_1: Olive oil (100%) + TE (0.5%), LT_2: Olive oil (100%) + TE (0.5%) + AO (0.1%), LT_3: *Aloe vera* (1:1) + TE (0.5%), LT_4: *Aloe vera* (1:1) + TE (0.5%) + AO (0.1%), LT_5: Xanthan gum (0.5%) + TE (0.5%), LT_6: Xanthan gum (0.5%) + TE (0.5%) + AO (0.1%), LT_7: Sodium Alginate (2%) + TE (0.5%), LT_8: Sodium Alginate (2%) + TE (0.5%) + AO (0.1%), LT_9: CMC (1%) + TE (0.5%), LT_{10}: CMC (1%) + TE (0.5%) + AO (0.1%), LT_{11}: Control (without coating), CMC - Carboxymethyl cellulose, TE- Texture enhancer (calcium gluconate) and AO- Antioxidant (ascorbic acid)

Table 2: Effect of composite coatings on appearance and taste of guava cv. Lalit (2017 and 2018)

Year	Appearance of fruits in 2017						Mean	Appearance of fruits in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	8.00	7.87	7.74	6.78	6.48	6.11	7.16	8.00	7.79	7.68	6.81	6.57	5.64	7.08
LT_2	8.00	7.86	7.72	6.77	6.47	6.09	7.15	8.00	7.77	7.64	6.79	6.54	5.63	7.06
LT_3	8.00	7.77	7.47	6.47	6.19	5.75	6.94	8.00	7.71	7.54	6.61	6.32	5.76	6.99
LT_4	8.00	7.65	7.48	6.44	6.11	5.77	6.91	8.00	7.76	7.53	6.00	6.33	5.67	6.88
LT_5	8.00	7.64	7.46	6.40	6.09	5.67	6.88	8.00	7.75	7.55	6.59	6.25	5.66	6.97
LT_6	8.00	7.66	7.47	6.51	5.70	5.62	6.83	8.00	7.69	7.50	6.58	6.28	5.59	6.94
LT_7	8.00	7.75	7.48	6.52	5.97	5.61	6.89	8.00	7.68	7.61	6.71	6.33	5.61	6.99
LT_8	8.00	7.75	7.46	6.55	6.00	5.64	6.90	8.00	7.74	7.63	6.72	6.31	5.60	7.00
LT_9	8.00	7.62	7.46	6.31	5.49	4.79	6.61	8.00	7.69	7.42	6.24	5.55	4.76	6.61
LT_{10}	8.00	7.62	7.39	6.30	5.31	4.77	6.57	8.00	7.68	7.41	6.29	5.45	4.77	6.60
LT_{11}	8.00	7.61	6.97	5.89	3.89	3.00	5.89	8.00	7.75	6.89	5.55	3.76	3.01	5.83
Mean	8.00	7.71	7.46	6.45	5.79	5.35		8.00	7.73	7.49	6.44	5.97	5.25	

Factors	CD at 5%	SE(m)	Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.099	0.035	Storage Intervals (S)	0.084	0.033
Treatments (T)	0.135	0.048	Treatments (T)	0.114	0.041
Interaction (S.I.×T)	0.33	0.118	Interaction (S.I.×T)	0.28	0.1

Year	Taste of fruits in 2017						Mean	Taste of fruits in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	8.00	7.37	7.29	7.11	6.84	6.47	7.18	8.00	7.39	7.31	6.91	6.56	6.37	7.09
LT_2	8.00	7.38	7.25	7.09	6.82	6.44	7.16	8.00	7.36	7.31	6.87	6.52	6.35	7.07
LT_3	8.00	7.35	7.16	6.89	6.46	5.54	6.90	8.00	7.34	7.22	6.64	6.37	5.51	6.85
LT_4	8.00	7.35	7.15	6.88	6.47	5.51	6.89	8.00	7.32	7.21	6.62	6.37	5.49	6.84
LT_5	8.00	7.33	7.21	6.83	6.49	5.55	6.90	8.00	7.32	7.20	6.61	6.35	5.48	6.83
LT_6	8.00	7.32	7.22	6.87	6.45	5.52	6.90	8.00	7.33	7.20	6.63	6.32	5.46	6.82
LT_7	8.00	7.33	7.21	6.84	6.47	5.55	6.90	8.00	7.33	7.23	6.63	6.34	5.47	6.83
LT_8	8.00	7.35	7.21	6.88	6.48	5.56	6.91	8.00	7.34	7.24	6.63	6.39	5.49	6.85
LT_9	8.00	7.34	7.14	6.56	6.27	5.11	6.74	8.00	7.37	7.08	6.45	6.21	5.09	6.70
LT_{10}	8.00	7.33	7.11	6.55	6.28	5.13	6.73	8.00	7.33	7.09	6.44	6.22	5.09	6.70
LT_{11}	8.00	7.37	7.03	6.34	5.01	3.27	6.17	8.00	7.36	7.01	6.29	6.19	3.14	6.33
Mean	8.00	7.35	7.18	6.80	6.37	5.42		8.00	7.34	7.19	6.61	6.35	5.36	

Factors	CD at 5%	SE(m)	Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.086	0.031	Storage Intervals (S)	0.084	0.03
Treatments (T)	0.116	0.041	Treatments (T)	0.113	0.04
Interaction (S.I.×T)	0.284	0.101	Interaction (S.I.×T)	0.277	0.099

Where LT_1: Olive oil (100%) + TE (0.5%), LT_2: Olive oil (100%) + TE (0.5%) + AO (0.1%), LT_3: *Aloe vera* (1:1) + TE (0.5%), LT_4: *Aloe vera* (1:1) + TE (0.5%) + AO (0.1%), LT_5: Xanthan gum (0.5%) + TE (0.5%), LT_6: Xanthan gum (0.5%) + TE (0.5%) + AO (0.1%), LT_7: Sodium Alginate (2%) + TE (0.5%), LT_8: Sodium Alginate (2%) + TE (0.5%) + AO (0.1%), LT_9: CMC (1%) + TE (0.5%), LT_{10}: CMC (1%) + TE (0.5%) + AO (0.1%), LT_{11}: Control (without coating), CMC - Carboxymethyl cellulose, TE- Texture enhancer (calcium gluconate) and AO- Antioxidant (ascorbic acid)

Table 3: Effect of composite coatings on TSS (^{0}Brix) and ascorbic acid (mg/100 g) of guava cv. Lalit (2017 and 2018)

Year	TSS (^{0}Brix) in 2017						Mean	TSS (^{0}Brix) in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	9.80	10.12	10.53	10.62	11.23	11.34	10.61	9.60	9.80	10.23	10.52	10.86	10.92	10.32
LT_2	9.80	10.23	10.56	10.67	11.27	11.36	10.65	9.60	9.90	10.34	10.56	10.88	10.99	10.38
LT_3	9.80	10.35	10.64	11.12	11.43	10.01	10.56	9.60	9.70	10.56	11.12	11.13	10.01	10.35
LT_4	9.80	10.41	10.67	11.32	11.45	9.56	10.53	9.60	9.80	10.55	11.12	11.16	9.23	10.24
LT_5	9.80	10.41	10.67	11.54	11.62	9.46	10.58	9.60	9.70	10.71	11.07	11.16	9.56	10.30
LT_6	9.80	10.34	10.80	11.62	11.67	8.65	10.48	9.60	9.80	10.56	11.24	11.34	9.47	10.33

LT_7	9.80	10.47	10.61	10.89	11.34	8.46	10.26	9.60	9.90	10.46	10.89	11.11	9.78	10.29
LT_8	9.80	10.45	10.67	10.97	11.47	10.11	10.58	9.60	9.90	10.44	10.99	11.09	9.89	10.32
LT_9	9.80	10.42	10.87	11.54	10.01	8.56	10.20	9.60	10.10	10.67	11.56	10.01	7.24	9.86
LT_{10}	9.80	10.34	10.88	11.62	9.23	8.23	10.02	9.60	10.20	10.77	11.65	9.56	7.32	9.85
LT_{11}	9.80	10.53	10.92	11.97	7.26	5.16	9.27	9.60	10.50	10.97	11.78	6.56	5.31	9.12
Mean	9.80	10.37	10.71	11.26	10.73	9.17		9.60	9.94	10.57	11.14	10.44	9.07	

Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.124	0.044
Treatments (T)	0.168	0.06
Interaction (S.I.×T)	0.411	0.147

Factors	CD at 5%	SE(m)
Storage Intervals (S)	0.127	0.045
Treatments (T)	0.172	0.061
Interaction (S.I.×T)	0.422	0.151

Year	Ascorbic acid (mg/100 g) in 2017						Mean	Ascorbic acid (mg/100 g) in 2018						Mean
Treatments	Storage intervals (days)							Storage intervals (days)						
	0	3	6	9	12	15		0	3	6	9	12	15	
LT_1	276.45	275.60	266.70	247.60	234.56	221.30	253.70	267.44	266.56	256.67	243.56	231.23	220.23	247.62
LT_2	276.45	274.56	266.50	247.20	235.00	223.10	253.80	267.44	265.67	255.60	242.11	233.22	221.34	247.56
LT_3	276.45	275.00	260.23	233.40	220.10	214.56	246.62	267.44	266.50	255.12	230.12	221.23	213.42	242.31
LT_4	276.45	275.00	261.20	234.50	219.60	211.20	246.33	267.44	265.47	251.34	230.42	220.23	208.99	240.65
LT_5	276.45	275.40	261.30	223.00	213.60	213.70	243.91	267.44	266.78	245.65	226.56	211.23	205.64	237.22
LT_6	276.45	275.40	266.00	223.40	217.80	211.40	245.08	267.44	266.31	244.56	226.30	212.48	206.56	237.28
LT_7	276.45	275.40	264.20	225.40	213.70	211.45	244.43	267.44	265.34	255.20	240.11	223.41	209.78	243.55
LT_8	276.45	274.60	264.00	226.10	229.70	217.60	248.08	267.44	264.33	254.33	238.33	223.78	210.34	243.09
LT_9	276.45	275.00	253.40	223.10	214.67	211.20	242.30	267.44	266.40	243.33	221.23	209.56	200.01	234.66
LT_{10}	276.45	275.00	253.40	224.10	217.60	210.10	242.77	267.44	266.34	242.23	220.23	208.67	200.32	234.21
LT_{11}	276.45	275.60	243.70	189.78	167.56	134.89	214.66	267.44	266.78	240.11	173.56	157.68	133.46	206.51
Mean	276.45	275.14	260.06	227.05	216.72	207.32		267.44	266.04	249.47	226.59	213.88	202.74	

Factors	CD at 5%	SE(m)
Storage Intervals (S)	3.246	1.159
Treatments (T)	4.395	1.569
Interaction (S.I.×T)	10.767	3.844

Factors	CD at 5%	SE(m)
Storage Intervals (S)	3.085	1.101
Treatments (T)	4.176	1.491
Interaction (S.I.×T)	10.23	3.653

Where LT_1: Olive oil (100%) + TE (0.5%), LT_2: Olive oil (100%) + TE (0.5%) + AO (0.1%), LT_3: *Aloe vera* (1:1) + TE (0.5%), LT_4: *Aloe vera* (1:1) + TE (0.5%) + AO (0.1%), LT_5: Xanthan gum (0.5%) + TE (0.5%), LT_6: Xanthan gum (0.5%) + TE (0.5%) + AO (0.1%), LT_7: Sodium Alginate (2%) + TE (0.5%), LT_8: Sodium Alginate (2%) + TE (0.5%) + AO (0.1%), LT_9: CMC (1%) + TE (0.5%), LT_{10}: CMC (1%) + TE (0.5%) + AO (0.1%), LT_{11}: Control (without coating), CMC - Carboxymethyl cellulose, TE- Texture enhancer (calcium gluconate) and AO- Antioxidant (ascorbic acid)

Conclusion

According to above findings, it may be concluded that olive oil + calcium guconate 0.1% and olive oil + calcium guconate 0.1%+ ascorbic acid 0.1% were found quite effective in extending the shelf life as they retained greater sensory attributes and physico-chemical properties like ascorbic acid, TSS with minimum physiological loss in weight during storage days.

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