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Response of different edible coatings on shelf life and quality of guava (*Psidium guajava* L.) cv. Sardar (L-49)

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Abstract

Guava is a highly perishable climacteric fruit, and its marketable life under ambient conditions is short. This study evaluated the effects of edible coatings on the storage behaviour and quality of guava cv. Sardar (L-49). Eleven treatments were compared: an untreated control, coconut oil, sesame oil, linseed oil, chitosan (2%), and six combinations of oils with one another or with chitosan. The experiment followed a completely randomized design with three replications of five fruits each. Fruits were stored for nine days under ambient laboratory conditions, and observations were recorded at 0, 3, 6 and 9 days. Parameters included physiological loss in weight (PLW), fruit dimensions, decay, total soluble solids (TSS), titratable acidity, total and reducing sugars, ascorbic acid and overall acceptability. All coatings performed better than the untreated control for several postharvest quality attributes, and oil–chitosan combinations generally performed better than single coatings. Linseed oil + chitosan (2%) (T_{11}) was the most effective treatment overall. At nine days, T_{11} recorded the lowest PLW (3.253%, compared with 9.007% in the control) and decay (15.40%, compared with 21.20%), the largest equatorial diameter (7.280 cm, compared with 6.520 cm), higher titratable acidity (0.483%, compared with 0.396%), higher ascorbic acid (237.0 mg/100 g, compared with 220.233 mg/100 g) and the highest overall acceptability score (7.667, compared with 4.333). These results indicate that linseed oil + 2% chitosan may be a promising postharvest coating for maintaining the quality of Sardar guava during short-term ambient storage. Further validation under commercial conditions is required.

Keywords: Edible coating, Chitosan, Linseed oil, Guava, Shelf life, Postharvest quality, Coconut Oil, *Sesamum* oil

1. Introduction

Guava (*Psidium guajava* L., family Myrtaceae) is an important fruit crop of tropical and subtropical regions, valued for its adaptability, regular bearing and nutritional quality. Sardar (L-49), also known as Lucknow-49, is a widely grown table cultivar, particularly in Maharashtra and Andhra Pradesh.

Despite its importance, guava is highly perishable. Its high respiration rate and climacteric ripening, together with moisture loss, softening and microbial infection, shorten its marketable life under ambient conditions. Although cold storage can extend storage life, cold-chain facilities are often unavailable to small growers and traders operating through short supply chains. Simple and economical postharvest treatments are therefore needed.

Edible coatings form a thin, semi-permeable film on the fruit surface that can restrict water loss and modify gas exchange, potentially slowing respiration and ripening. Chitosan is a biodegradable, film-forming biopolymer with reported antimicrobial activity, and chitosan coatings have reduced weight loss and delayed quality loss in guava (Hong *et al.*, 2012; Kumar *et al.*, 2017; Chawla *et al.*, 2018; Fekry, 2018; Nair *et al.*, 2021) [2, 3, 1, 4, 5]. However, coating concentration can affect the response; 2% chitosan alone was associated with uneven ripening and poor colour development in Allahabad Safeda guava, possibly due to CO_2 injury (Krishna *et al.*, 2014) [6].

Vegetable oils are hydrophobic and may act as moisture barriers. Olive-oil coatings have been investigated for guava shelf life (Kamboj *et al.*, 2018; Kohli *et al.*, 2019) [7, 8], and sesame oil has also been assessed for guava (Kabbashi *et al.*, 2018) [9]. Coconut-oil coatings have been reported to preserve quality in mandarin (Nasrin *et al.*, 2018; Kaur *et al.*, 2020) [11, 10]. Oil–polysaccharide combinations have also been investigated in other fruits, including chitosan with olive oil on fig and sodium alginate with olive oil on ber (Rao *et al.*, 2016; Vieira *et al.*, 2021) [12, 13].

Combining a hydrophobic oil with chitosan may provide complementary effects: the oil may limit water-vapour loss, while chitosan contributes film formation and antimicrobial activity. The present study compared coconut, sesame and linseed oils and chitosan, individually and in combinations, for their effects on

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weight loss, decay, physicochemical quality and sensory acceptability of Sardar guava stored under ambient conditions.

2. Materials and methods

2.1. Experimental site and plant material

The study was conducted during 2025–2026 at the Post Graduate Laboratory, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, Maharashtra, India. Mature, healthy fruits of guava cv. Sardar (L-49), uniform in size, shape, colour and maturity, were collected from a commercial orchard and transported to the laboratory. Damaged, diseased, cracked or insect-infested fruits were discarded. Selected fruits were washed with clean tap water and air-dried in the shade.

2.2. Experimental design and treatments

The experiment was laid out in a completely randomized design (CRD) with 11 treatments, three replications per treatment and five fruits per replication. Coconut, sesame and linseed oils were used in food-grade form, and oil–oil combinations were mixed in equal proportions. Chitosan solution (2%) was prepared by dissolving chitosan powder in dilute acetic acid under continuous magnetic stirring and filtering through muslin cloth. For oil–chitosan combinations, the oil and chitosan solution were mixed with continuous stirring immediately before use.

Fruits were dipped individually in the respective coating for 3–5 min and placed on clean absorbent paper at room temperature until the film had dried. Control fruits were left uncoated. Fruits were stored in a single layer on trays under ambient laboratory conditions for nine days, from 17 to 26 January 2026. Storage temperature and relative humidity were not specified in the source manuscript and should be added if recorded.

Table 1. Treatment details

Treatment	Description
T_1	Control (uncoated)
T_2	Coconut oil
T_3	Sesame oil
T_4	Linseed oil
T_5	Chitosan 2%
T_6	Coconut oil + sesame oil
T_7	Coconut oil + linseed oil
T_8	Coconut oil + chitosan 2%
T_9	Sesame oil + linseed oil
T_{10}	Sesame oil + chitosan 2%
T_{11}	Linseed oil + chitosan 2%

2.3. Observations and analytical methods

Observations were recorded at 0, 3, 6 and 9 days of storage. Physiological loss in weight (PLW) was calculated as the percentage of initial fruit weight lost. Equatorial diameter was measured at the widest part of the fruit, and polar diameter from the stem end to the blossom end, using a digital vernier caliper. Decay was expressed as the percentage of the weight of fruits showing fungal growth or tissue breakdown relative to the total fruit weight.

Total soluble solids (TSS) were measured using a hand refractometer and expressed as °Brix. Titratable acidity was determined by titrating juice against 0.1 N NaOH using phenolphthalein and expressed as citric acid percentage. Total and reducing sugars were estimated by the Lane and Eynon method.

$$\text{Non-reducing sugars} = (\text{total sugars} - \text{reducing sugars}) \times 0.95.$$

Ascorbic acid was determined by titration with 2,6-dichlorophenol indophenol after extraction in metaphosphoric acid and expressed as mg/100 g pulp. The TSS:acid ratio was calculated by dividing mean TSS by mean titratable acidity. Sensory quality was assessed by a panel of judges using a 10-point hedonic scale; the overall acceptability score is reported.

2.4. Statistical analysis

Data were analysed under a completely randomized design using OPSTAT. Treatment effects were tested by analysis of variance, and means were compared using the standard error of the mean (SEm±) and critical difference (CD) at the 5% probability level, following Panse *et al.* (1985) [14]. Treatment means differing from the best treatment by less than the CD were considered statistically at par. The source manuscript does not report panel size or the detailed sensory-analysis procedure.

3. Results

At day 0, all treatments were reported as identical, and treatment differences were non-significant. Differences among treatments were reported at 3, 6 and 9 days for the measured parameters.

3.1. Physiological loss in weight and decay

PLW increased progressively during storage in all treatments (Table 2). Every coating reduced weight loss relative to the control. Among single coatings, chitosan (T_5; 6.240% at day 9) performed better than linseed oil (6.917%), sesame oil (7.590%) and coconut oil (8.313%). Oil–chitosan combinations generally reduced PLW further. T_{11} recorded the lowest PLW at each assessment: 0.903%, 2.257% and 3.253% at days 3, 6 and 9, respectively, compared with 2.707%, 5.967% and 9.007% in the control. This represents an approximately 63.9% reduction in PLW relative to the control at day 9. At days 3 and 6, T_{11} was statistically at par with T_{10}; at day 9, T_{11} was reported as significantly superior to the other treatments (CD = 0.2026).

Decay increased during storage. At day 9, decay was lowest in T_{11} (15.40%), followed by T_{10} (16.207%) and T_9 (16.900%); the source reports T_{10} and T_9 as statistically at par with T_{11}. The control had the highest decay (21.200%). At day 6, decay was 6.190% in T_{11} compared with 16.190% in the control. Decay increased markedly between days 6 and 9 in all treatments, indicating that coating benefits did not prevent deterioration entirely.

3.2. Fruit dimensions and total soluble solids

Equatorial diameter declined from 7.70 cm at day 0 in all treatments. T_{11} retained the largest diameter at days 3, 6 and 9 (7.630, 7.563 and 7.280 cm, respectively), while the control declined to 6.520 cm at day 9. The source reports T_{11} as statistically at par with T_8 and T_{10} at day 9 (CD = 0.3647). Polar-diameter data are presented in Table 7; these values require verification because the control shows an increase from day 3 to day 6, rather than a consistent decline.

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Table 2. Effect of edible coatings on physiological loss in weight (PLW, %) and decay (%) of guava

Treatment	PLW 3 d	PLW 6 d	PLW 9 d	Decay 3 d	Decay 6 d	Decay 9 d
T_1	2.707	5.967	9.007	1.700	16.190	21.200
T_2	2.477	5.490	8.313	1.543	15.640	20.013
T_3	2.253	5.063	7.590	1.430	14.410	19.780
T_4	2.040	4.650	6.917	1.650	15.880	20.630
T_5	1.843	4.193	6.240	1.320	13.940	19.203
T_6	1.663	3.777	5.577	0.890	11.087	18.230
T_7	1.490	3.370	5.010	1.010	11.990	18.750
T_8	1.270	2.863	4.267	0.620	9.190	17.513
T_9	1.370	3.100	4.690	0.520	8.390	16.900
T_{10}	1.070	2.500	3.760	0.420	7.340	16.207
T_{11}	0.903	2.257	3.253	0.250	6.190	15.400
SEm±	0.0601	0.1096	0.0691	0.0245	0.4431	0.6679
CD (5%)	0.1761	0.3214	0.2026	0.0717	1.2995	1.9590

Note: At day 0, PLW and decay were reported as 0 in all treatments. Values are treatment means from three replications. CD = critical difference at $P = 0.05$.

TSS increased during storage in all treatments. At day 9, T_{11} had the highest TSS (10.690 °Brix), compared with 9.217 °Brix in the control. The source reports T_{11} as statistically at par with T_8, T_9 and T_{10} at day 9 (CD = 0.7987).

Table 3. Effect of edible coatings on equatorial diameter (cm) and TSS (°Brix) of guava

Treatment	Diameter 3 d	Diameter 6 d	Diameter 9 d	TSS 3 d	TSS 6 d	TSS 9 d
T_1	7.103	6.770	6.520	9.020	9.180	9.217
T_2	7.247	6.950	6.643	9.047	9.327	9.393
T_3	7.297	7.010	6.720	9.167	9.460	9.560
T_4	7.217	6.930	6.610	9.217	9.603	9.720
T_5	7.337	7.080	6.790	9.270	9.730	9.870
T_6	7.387	7.140	6.870	9.330	9.857	10.010
T_7	7.400	7.110	6.830	9.397	9.990	10.147
T_8	7.447	7.210	6.950	9.457	10.123	10.283
T_9	7.407	7.170	6.910	9.507	10.223	10.393
T_{10}	7.437	7.190	6.963	9.540	10.307	10.503
T_{11}	7.630	7.563	7.280	9.703	10.503	10.690
SEm±	0.0907	0.1136	0.1243	0.1253	0.2532	0.2723
CD (5%)	0.2810	0.3333	0.3647	0.3675	0.7427	0.7987

Note: At day 0, equatorial diameter was 7.70 cm and TSS was 9.00 °Brix in all treatments.

3.3. Titratable acidity and TSS:acid ratio

Titratable acidity increased slightly up to day 3 and then declined, according to the source manuscript. At day 9, T_{11} retained 0.483% acidity compared with 0.396% in the control; the difference exceeded the reported CD of 0.0488. The TSS:acid ratio declined at day 3 and subsequently increased. Coated fruit generally had a lower ratio than the control, with T_{11} recording 16.70, 19.24 and 22.13 at days 3, 6 and 9, respectively, compared with 18.71, 20.86 and 23.28 in the control. These ratios were calculated from treatment means and were not statistically analysed.

3.4. Sugars and ascorbic acid

Total and reducing sugars increased during storage. T_{11} had the highest total sugar values at days 3, 6 and 9 (9.580%, 10.143% and 10.563%, respectively) and the highest reducing sugar values reported in the source (5.087%, 5.777% and 6.343%). At day 9, reducing sugars in T_{11} exceeded the control value of 5.110% by more than the reported CD (0.6388). Non-reducing sugars were calculated from total and reducing sugar means and were not subjected to analysis of variance. The source table reports 4.01% for T_{11} at day 9, compared with 4.29% for the control.

Ascorbic acid was reported as 240.5 mg/100 g at day 0 and declined during storage. T_{11} retained 237.0 mg/100 g at day 9, while the control declined to 220.233 mg/100 g. The reported CD was 8.7704 mg/100 g.

3.5. Overall acceptability

Overall acceptability declined in all treatments. At day 9, T_{11} had the highest score (7.667), followed by T_8 and T_{10} (6.667 each), whereas the control had the lowest score (4.333). The source does not provide a CD or other inferential statistical test for sensory scores.

Table 4. Effect of edible coatings on selected quality attributes of guava after 9 days of storage

Treatment	Titratable acidity (%)	Total sugars (%)	Reducing sugars (%)	Ascorbic acid (mg/100 g)	Overall acceptability
T_1	0.396	9.630	5.110	220.233	4.333
T_2	0.404	9.123	5.200	222.133	5.333

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Treatment	Titratable acidity (%)	Total sugars (%)	Reducing sugars (%)	Ascorbic acid (mg/100 g)	Overall acceptability
T_3	0.412	9.283	5.290	223.700	5.333
T_4	0.421	9.443	5.370	225.400	5.000
T_5	0.429	9.603	5.470	226.933	5.667
T_6	0.438	9.763	5.560	228.000	6.333
T_7	0.447	9.923	5.650	230.033	5.667
T_8	0.456	10.083	5.740	231.667	6.667
T_9	0.465	10.243	5.830	233.233	6.333
T_{10}	0.474	10.403	5.920	234.767	6.667
T_{11}	0.483	10.563	6.343	237.000	7.667
SEm±	0.0166	0.2691	0.2178	2.9904	—
CD (5%)	0.0488	0.7891	0.6388	8.7704	—

Note: Day-0 values reported in the source were 0.42% titratable acidity, 7.55% total sugars, 4.05% reducing sugars, 240.5 mg/100 g ascorbic acid and an overall acceptability score of 10.0 for all treatments. No CD was reported for overall acceptability.

Table 5. Effect of edible coatings on TSS:acid ratio of guava

Treatment	3 d	6 d	9 d
T_1	18.71	20.86	23.28
T_2	18.39	20.87	23.25
T_3	18.30	20.75	23.20
T_4	18.07	20.61	23.09
T_5	17.97	20.61	23.01
T_6	17.84	20.45	22.85
T_7	17.70	20.35	22.70
T_8	17.58	20.33	22.55
T_9	17.41	20.01	22.35
T_{10}	17.25	19.82	22.16
T_{11}	16.70	19.24	22.13

Note: At day 0, the ratio was 21.43 for all treatments. Ratios were calculated as mean TSS divided by mean titratable acidity and were not statistically analysed.

Table 6. Effect of edible coatings on non-reducing sugars (%) of guava

Treatment	3 d	6 d	9 d
T_1	3.31	3.61	4.29
T_2	3.37	3.80	3.73
T_3	3.43	3.75	3.79
T_4	3.49	3.81	3.87
T_5	3.55	3.88	3.93
T_6	3.61	3.94	3.99
T_7	3.67	4.01	4.06
T_8	3.72	4.08	4.13
T_9	3.78	4.14	4.19
T_{10}	3.84	4.08	4.26
T_{11}	4.27	4.15	4.01

Note: Calculated as (total sugars − reducing sugars) × 0.95 from treatment means. The day-0 value was 3.32% in all treatments. These values were not statistically analysed.

Table 7. Effect of edible coatings on polar diameter (cm) of guava

Treatment	3 d	6 d	9 d
T_1	5.810	6.133	6.180
T_2	5.910	6.190	6.210
T_3	6.010	6.240	6.240
T_4	6.110	6.300	6.270
T_5	6.210	6.380	6.300
T_6	6.310	6.430	6.330
T_7	6.410	6.490	6.360
T_8	6.510	6.563	6.390
T_9	6.610	6.610	6.420
T_{10}	6.710	6.670	6.450
T_{11}	6.943	6.830	6.480
SEm±	0.2073	0.1256	0.0554
CD (5%)	0.6081	0.3684	0.1623

Note: Polar diameter was reported as 6.00 cm at day 0 for all treatments.

4. Discussion

The lower PLW and decay observed in coated fruit are consistent with the potential of semi-permeable films to restrict transpiration and modify gas exchange. Similar reductions in postharvest quality loss have been reported for chitosan-coated guava (Hong *et al.*, 2012;

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Kumar *et al.*, 2017; Nair *et al.*, 2021) [2, 3, 5]. In the present study, chitosan alone performed better than any single oil for PLW at day 9, while oil–chitosan combinations generally performed better than individual coatings. The combination of linseed oil and chitosan was the strongest treatment for several measured outcomes. This pattern is consistent with, but does not independently prove, complementary effects of the oil as a moisture barrier and chitosan as a film-forming coating.

Linseed oil alone did not produce the lowest decay at day 9, whereas its combination with chitosan did. This pattern suggests a possible combined-treatment benefit; however, a mechanistic or synergistic effect cannot be confirmed without additional experiments designed to test interaction effects. The smaller decline in equatorial diameter in T_{11} is consistent with its lower PLW, although fruit dimensions should be interpreted alongside the measurement protocol and any measurement variability.

The higher TSS and sugar values in coated fruit, together with higher acidity and lower TSS:acid ratios, require cautious interpretation. Changes in TSS can reflect ripening-related metabolism and concentration effects caused by water loss. Respiration rate, ethylene production, firmness and objective colour were not measured, so the coating effects on ripening rate cannot be established directly. The lower TSS:acid ratio in coated fruit is consistent with greater acidity retention, but the overall evidence does not establish a single ripening mechanism.

Retention of ascorbic acid in T_{11} is consistent with reports that chitosan and oil-based coatings can help maintain guava quality during storage (Chawla *et al.*, 2018; Fekry, 2018; Kamboj *et al.*, 2018) [1, 4, 7]. The sensory acceptability pattern also favoured oil–chitosan combinations, with T_{11} receiving the highest reported score at day 9. However, the sensory-panel size, assessor selection and statistical analysis were not supplied, and therefore the strength and generalisability of sensory differences should be interpreted cautiously.

The study was limited to one cultivar, one experimental period and nine days of ambient laboratory storage. No cold-storage comparison was included. Firmness, respiration, ethylene and objective colour were not measured, and only one chitosan concentration was tested. Further experiments across seasons and cultivars, with recorded temperature and relative humidity and under commercial handling conditions, are needed before a general recommendation can be made.

5. Conclusion

Under the conditions of this experiment, edible coatings reduced weight loss and decay and helped retain selected quality attributes of guava cv. Sardar (L-49) during nine days of ambient storage. Oil–chitosan combinations generally performed better than single coatings. Linseed oil + chitosan (2%) (T_{11}) was the most effective treatment overall, with the lowest PLW and decay and the highest reported overall acceptability at day 9. The treatment appears promising for short-term postharvest handling; however, commercial-scale validation and confirmation of the methodological and data queries listed separately are needed before making a broad recommendation.

Credit authorship contribution statement

Bhagyashri S. Tale: Investigation, data curation, formal analysis, writing – original draft. **Amol M. Bhosale:** Conceptualization, methodology, supervision, writing – review and editing. **Sachin B. Pavhane:** Validation, supervision, writing – review and editing. **Pallavi S. Khade:** Validation, investigation, writing – review and editing. **Kalpana B. Nagargoje:** Resources, validation, writing – review and editing. **Dipali S. Tale:** Investigation, data curation, writing – review and editing. **Vivek S. Tale:** Resources, supervision, writing – review and editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. [

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