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The effect of edible coating material on physical parameters for enhancement of the lifespan of guava (*Psidium guajava* L.) cv. L-49

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Abstract
The present study was undertaken to monitor post harvest effect on edible coatings of Guava in Punjab at Lovely Professional University from March to April of 2021-22. There are well-known challenges in the storage of this crop in the present day, including post harvest losses, lower shelf life and marketing losses. As a result, edible coatings are primarily used to boost shelf life of Guava. Various edible coatings were used in the experiment, including Rice Bran Oil, Sunflower oil, Aloe vera juice, Bees wax, Bees wax+ Rice Bran Oil, Sunflower oil+ Rice Bran Oil, Citric Acid were taken for the treatment. The experiment was set up with 8 treatment combinations and two replications in CRD. On the 9th day of storage, it was found that the sunflower oil coating produced longer shelf life, weight of the fruit (105.12gms), the length of the fruit (5.7cm), breadth of the fruit (6.1 cm), firmness of the fruit (6.8kg/cm2), spoilage percentage (40%), palatability rating (8.3 marks), physiological loss in weight (5.06%) compared with the individual fruit.

Keywords: Guava, coatings, rice bran oil, sunflower oil, aloe vera juice, bees wax, citric acid

Introduction
Guava (*Psidium guajava* L.) belongs to family Myrtaceae has attained business significance in tropics and subtropics due to its huge adaptability to various soil and climatic situations and as prolific bearer. Guava is thought to be originated in tropical America (Mexico to Peru). At present, it's far especially produced in South Asian countries, the Hawaiian Island, Cuba, Brazil, Pakistan and India. In Pakistan, it's far grown in all of the provinces over a place of 58.5 thousand hectares with manufacturing of 468.3 thousand tones. The primary guava developing regions encompass Shariqpur, Kasur, Lahore, Sheikhupura, Sangla Hills, Gujranwala with inside the Punjab; Kohat, Haripur and Bannu withinside the North West Frontier Province and Larkana and Hyderabad in Sindh. Presently guavas are grown nearly absolutely for sparkling consumption. However, worldwide marketplace for sparkling guavas is small. Nevertheless, greater alternate is carried on processed guava merchandise like Juices and nectars, Jam and Jellies, fruit paste, canned full and halves in syrup. Some investors consider that there is a great worldwide marketplace ability for sparkling guavas and that call for will develop as greater customers come to be familiar with this fruit. (Sravani, 2016) [39].
Guava is correctly grown beneath tropical and subtropical climatic zones. In regions having wonderful winter weather season, the yield has a tendency to growth and quality improves. It may be grown from sea degree to an altitude of approximately 1515 m. Young Guavas are liable to drought and cold situations. Dry environment on the time of flowering and fruit putting is good while excessive temperature at fruit improvement reasons fruit drop. Soil: The guava does grow properly on heavy clay, to mild sandy, gravel bars close to streams, or on limestone and tolerates a pH variety from 4.5 to 9.5 It is somewhat resistant to salinity. Good drainage is usually recommended. However, guavas are visible developing on land with excessive water table. (Ullasa and Kabir, 2012) [40].
Guava is propagated normally via seed however, cuttings, air layering, grafting and budding is likewise practiced. Although guava is tough to root, investigations imply that it is able to be correctly propagated from cuttings beneath mist. Leafy shoot-tip cuttings of contemporary season boom (10-12 cm long) handled with Indole butyric acid deliver greater that 80% rooting after six weeks when planted in soil beneath mist in greenhouse at some point July-August. (Sheetal, 2009) [36].

Commercial Varieties are Safeda with medium length, with very pale skin, thick white flesh, few seeds. Allahabad with large white fleshed with few pretty tough seeds. Karela with medium large, pear formed furrowed, tough skinned with gentle granular white flesh. Poor bearer. Seed less with medium to large, pear form to avoid, with thick white flesh, firm to gentle, mild bearer. Red fleshed with medium length with many pretty gentle seeds, excessive in pectin and precisely for jelly. Apple color with medium length, barely oblate deep purple skin, creamy white flesh, less seeds, very candy flavour. Heavy bearer. (Masood and Pooja, 2018) [20].

Guava bushes are planted at a distance of 5 to 6 meters. Trees develop unexpectedly and fruit in 2 to 4 years. They stay 30 to 40 years however productiveness declines after the fifteenth year. Orchard can be rejuvenated with the aid of drastic pruning. In guava, culmination is borne on contemporary season's boom. Manuring and fertilization encourage vegetative bloom and fruiting. A balanced delivery of NPK offers accelerated yield with great fruit. NPK on the ratio of 2:1:1 in similarly split doses in January and again in August is usually recommended in keeping with plant age and soil situations. Guava at times suffers from deficiency of zinc and iron. Spraying the plants with 7g/lit of ZnSo4 and 46.5 grams of FeSo4 improves quality and yield. (Amanullah and Kumar, 2017) [2].

Pruning and Deblossoming: Light annual pruning is important to inspire new boom after each harvest. Guava plants two times a year, first in March to April for summer time season crop after which in August to September for winter weather crop. Blooming length varies from 25 to 45 days. Winter crop is typically desired because it yields better with fruit of higher quality. It is likewise feasible to achieve blooming in a preferred season. Some of the growers undertake the exercise of getting an excellent winter weather crop with the aid of retaining with water at some point of summer time season or deblossoming the summer time season crop. Research employees have cautioned 2,4-D@30mg/liter of water because it is the only chemical for deblossoming of summer time season plants. Guava fruit takes approximately 125 days to attain maturity after setting. (Nilesh and Hasan, 2015) [22].

Harvesting done when matured fruit turns from green color to oil green in color and at ripening creamy in color. Hand choosing of ripened guavas about twice or thrice per week is recommended. The harvesting season may remain for 8-10 weeks. Fruit is incredibly perishable therefore, it must be straight away marketed after harvest. (Amanullah and Kumar, 2017) [2].

Materials and Methods

The present investigation entitled "The Effect of edible coating material on physical parameters for enhancement of the lifespan 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 8 treatments with two replications.

The mature and uniform sizes of guava var. L-49 were taken from the Instructional cum research fruit orchard and coatings were prepared as per treatments to complete the experiments. Prior to the post-harvest treatment, the fruits were washed in distilled water. The fruits were kept to dry in shade before application of treatments. The details of the treatments are T_1: Rice bran oil (80%), T_2: Sunflower oil (80%), T_3: Aloe vera (75%), T_4: Bee wax (15%), T_5: Bees wax+ Rice Bran Oil (60%), T_6: Sunflower oil+ Rice Bran Oil (70%), T_7: Citric Acid (25%), T_8: 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.

Results and Discussion

The Effect of Edible coatings on the weight of Guava fruit

Fruit weight results showed significant differences among the treatments in 3, 6 and 9 days after storage of Guava in ambient conditions. On the 3rd day of storage, among various postharvest treatments, the maximum weight was noticed in fruits treated with T_2 (Sunflower oil) with the value of 110.19 grams followed by T_7 (Citric acid powder) with a value of 99.69 grams. Fruit weight was minimum in control fruits (49.52 grams). On the 9th day of storage maximum weight was seen in the same T_2 treatment to the range of 105.12 grams and followed by T_3 treatment where it was 86.24 grams. Fruit weight was minimum under control conditions (37.12 grams) during 8 days storage period.

These coatings will function a semi-permeable barrier to the passage of O2, CO2, moisture, and matter movements. As a result, they'll lower respiration, water loss, and oxidization reaction rates. Fruits take longer to lose water once the temperature is low. If they need a thick peel or are going to be keep for a restricted time, they will additionally need an extended length for water loss. On average, it takes four to eight days to lose around 3% of the burden of a Guava fruit. Sunflower oil and bees wax inhibits the transpiration and respiration rate, thus it did not effect fruit length during marketing and storage. This result is supported by Shri (2011) [37] in grapes, Xing (2015) [41] in jujube fruits.

The Effect of Edible coatings on the Length of Guava fruit

Fruit length results showed significant differences among the treatments in 3, 6 and 9 days after storage of Guava in ambient conditions. On 3rd day of storage among various postharvest treatments, the maximum length was noticed in fruits treated with T_1 (Rice bran oil) and T_5 (Beeswax + Sunflower oil) with the value of 5.8 cm followed by T_2 (Sunflower oil) with a value of 5.7 cm. Fruit length was minimum in control fruits (4.5cm).On the 9th day of storage maximum length was seen in the same T_5 (Beeswax + Sunflower oil) T_2 (Sunflower oil) treatment to the range of 5.2 cm and followed by treatment T_1 (Rice bran oil) and T_3 (Aloe vera juice) where it was only 5.1 cm. Fruit length was minimum under control conditions during 8 days (3.9 cm) storage period.

Sunflower oil and bees wax inhibits the transpiration and respiration rate, thus it did not effect fruit length during marketing and storage. This result is supported by Shri (2011) [37] in grapes, Xing (2015) [41] in jujube fruits.

The Effect of Edible coatings on the breadth of Guava fruit

Fruit breadth results showed significant differences among the treatments in 3, 6 and 9 days after storage of Guava in ambient conditions. On 3rd day of storage, among various postharvest treatments, the maximum breadth was noticed in

fruits treated with T2 (Sunflower oil) with the value of 6.1 cm followed by T_7 (Citric acid powder) with a value of 5.7 cm. Fruit breadth was minimum in control fruits (4.3 cm).On the 9th day of storage maximum breadth was seen in the same T_2 (Sunflower oil) treatment to the range of 5.8 cm and followed by T_7 treatment where it was only 5.2 cm. Fruit breadth was minimum under control conditions as it ranged to (3.9 cm) during 8 days storage period.

Sunflower oil and bees wax inhibits the transpiration and respiration rate, thus it did not effect fruit length during marketing and storage. This result is supported by Shri (2011) [37] in grapes, Xing (2015) [41] in jujube fruits.

The Effect of Edible coatings on the Firmness of Guava fruit

Fruit firmness results showed significant differences among the treatments in 3, 6 and 9 days after storage of Guava in ambient conditions. On 3rd day of storage, among various postharvest treatments, the maximum firmness was noticed in fruits treated with T_2 (Sunflower oil) with the value of 6.8 kg/cm^2 followed by T_5 (Beeswax + Sunflower oil) with a value of 6.6 kg/cm^2 Fruit firmness was minimum in control fruits (2.2 kg/cm^2). on the 9th day of storage maximum firmness was seen in the same T_2 treatment to the range of 5.7 kg/cm^2 and followed by T_5 treatment where it was only 5.2 kg/cm^2. Fruit firmness was minimum under control conditions as it ranged from 0.8 kg/cm^2.

Sunflower oil inhibits the transpiration and respiration rate, That results in better fruit firmness during marketing and storage. This result is supported by Masood and Pooja (2018) [20] in Guava, Maqbool *et al*., (2011) [14] Guava and Banana.

The Effect of Edible coatings on the Spoilage percentage of Guava fruit

Spoilage percentage results showed significant differences among the treatments in 3,6 and 9 days after storage of Guava in ambient conditions. On 3rd day of storage, among various postharvest treatments, minimum spoilage percentage was observed in fruits treated with T_1 (Rice bran oil), T_2 (sunflower oil), T_4 (Beeswax), T_5 (Beeswax + Sunflower oil) to the tune of 10% followed by T_3 andT_6 with a value of 20% whereas maximum decay percentage was observed T_7 and T_8 with 30% and during 0th of storage no spoilage was seen in treatments. On the 9th day of storage decay percentage was highest in T_7, T_8 treatment to the range of 90% and followed by T_6 and T_3 with 80%, spoilage percentage was minimum under T_2 with 40% and followed by T_4 with 40%.

The reason behind the lowest spoilage percentage in the (T2) might be due to inhibition of the moisture and microbial agent particularly. Whereas oil at a low concentration act as a protection for storage of foods that inhibits the growth of postharvest disease like fruit rot. In all other treatments, the spoilage percentage in fruits gradually increased as the storage days increased. These research findings are further strengthened by the findings of Nilesh and Hasan *et al*., (2015) [22] in Guava, Deka (2006) [6] in Apple, and Ahmed *et al*., (2005) in Nagpur mandarin.

The Effect of Edible coatings on the Physiological loss in weight (%) of Guava fruit

Physiological loss in weight results showed significant differences among the treatments in 3,6 and 9 days after storage of Guava in ambient conditions. On 3rd day of storage, among various postharvest treatments, the lowest physiological loss in weight was noticed in fruits treated with T_2 (Sunflower oil) to the tune of 1.53% followed by T_6 (Rice bran oil + Sunflower oil) with a value of 1.64% whereas physiological loss in weight was highest in control fruits (2.85%). On the 9th day of storage lowest physiological loss in weight was seen in the same T_6 treatment to the range of 4.56% and followed by T_5 treatment where it was only 4.97%. Physiological loss in weight was maximum under control conditions as it ranged 9.42% during 8 days storage period.

Sunflower oil coating closed the opening of stomata nearby, thus slowed respiration and transpiration rates and also reduced microbial growth at once. These results reflect the findings of previous researchers Sravani (2016) [39] in Guava, Ali and Manisha (2015) [18] in Mandarin.

Table 1: Effect of post-harvest treatments on fruit weight (gm) and fruit length (cm) of guava cv. L- 49 during storage

Symbols	Treatments	Fruit Weight				Mean	Fruit Length				Mean
		Storage period (Day)					Storage period (Day)				
		0th	3rd	6th	9th		0th	3rd	6th	9th	
T_1	Rice Bran Oil	85.52	83.69	81.74	75.92	81.71	5.9	5.8	5.4	5.1	5.5
T_2	Sunflower Oil	115.62	110.19	107.92	105.12	109.72	5.8	5.7	5.5	5.2	5.5
T_3	Aloe Vera Juice	96.38	94.37	91.74	86.24	92.18	5.7	5.5	5.4	5.1	5.4
T_4	Bees Wax	85.34	82.97	80.35	75.12	80.94	5.1	4.9	4.6	4.2	4.7
T_5	Beeswax + Sunflower oil	93.63	90.55	87.54	83.24	88.74	5.9	5.8	5.5	5.2	5.6
T_6	Rice Bran + Sunflower oil	68.93	65.64	61.27	55.97	62.92	5.6	5.1	4.9	4.5	5
T_7	Citric Acid Powder	105.52	99.69	95.52	83.92	96.16	5.5	5.3	5.1	4.6	5.1
T_8	Control	56.58	49.52	46.12	37.12	61.69	5.1	4.5	4.1	3.9	4.4
S.Em+		0.059	0.062	0.102	0.083	0.076	0.013	0.012	0.015	0.016	0.014
C.D @5%		0.179	0.165	0.326	0.243	0.228	0.035	0.039	0.042	0.049	0.041

Table 2: Effect of post-harvest treatments on fruit breadth (cm) and fruit firmness (cm) of guava cv. L- 49 during storage

Symbols	Treatments	Fruit Breadth				Mean	Fruit Firmness				Mean
		Storage period (Day)					Storage period (Day)				
		0th	3rd	6th	9th		0th	3rd	6th	9th	
T_1	Rice Bran Oil	5.5	5.3	5.2	5.1	5.2	6.9	6.3	5.9	4.9	6
T_2	Sunflower Oil	6.2	6.1	6	5.8	6	7.2	6.8	6.4	5.7	6.5
T_3	Aloe Vera Juice	5.5	5.3	5.1	4.9	5.2	3.9	3.2	2.5	1.2	2.7
T_4	Bees Wax	5.3	5.2	5	4.8	5	6.3	5.8	5.1	4.5	5.4

T_5	Beeswax + Sunflower oil	5.6	5.4	5.1	4.8	5.2	6.9	6.6	5.7	5.2	6.1
T_6	Rice Bran + Sunflower oil	5	4.8	4.7	4.5	4.7	5.2	4.6	3.8	3.2	4.2
T_7	Citric Acid Powder	5.8	5.7	5.5	5.2	5.5	3.9	3.4	2.8	1.8	2.9
T_8	Control	4.5	4.3	4.1	3.9	4.2	3.9	2.2	1.6	0.8	2.1
S.Em+		0.021	0.032	0.051	0.053	0.039	0.014	0.016	0.019	0.018	0.016
C.D @5%		0.075	0.111	0.165	0.143	0.123	0.039	0.042	0.047	0.053	0.045

Table 3: Effect of post-harvest treatments on spoilage percentage (%) and physiological loss in weight (%) of guava cv. L- 49 during storage

Symbols	Treatments	Spoilage Percentage (%) Storage period (Day)				Mean	Physiological Loss in Weight (%) Storage period (Day)				Mean
		0th	3rd	6th	9th		0th	3rd	6th	9th	
T_1	Rice Bran Oil	0	10	30	60	33.33	0.00	1.67	2.98	4.98	3.21
T_2	Sunflower Oil	0	10	20	40	23.33	0.00	1.53	3.06	5.06	3.21
T_3	Aloe Vera Juice	0	20	40	80	46.66	0.00	2.21	5.26	7.26	4.91
T_4	Bees Wax	0	10	20	40	26.66	0.00	2.72	4.1	6.72	4.51
T_5	Beeswax + Sunflower oil	0	10	20	60	30	0.00	1.67	2.99	4.97	3.21
T_6	Rice Bran + Sunflower oil	0	20	40	80	46.66	0.00	1.64	2.64	4.56	2.94
T_7	Citric Acid Powder	0	30	60	90	60	0.00	2.68	4	7.92	4.86
T_8	Control	0	30	60	90	60	0.00	2.85	4.78	9.42	5.78
S.Em+		0	0.053	0.059	0.066	0.059	0.00	0.071	0.123	0.087	0.093
C.D @5%		0	0.165	0.339	0.365	0.240	0.00	0.201	0.216	0.211	0.209

Conclusion

On the basis of result observed from this experiment it was found that Treatment (T_2) Sunflower oil (100%) coating was found most effective postharvest edible coated treatment followed by Treatment (T_6) Rice bran oil + Sunflower oil (70%), Treatment (T_4) Bees wax (15%), Treatment (T_5) Beeswax +Sunflower oil (80%), Treatment (T_1) Rice bran oil (100%), Treatment (T_7) Citric acid (25%) and Aloe vera (75%), coating which enhanced the shelf life and consumer acceptance of the stored guava fruits. The Sunflower oil (100%) coated guavas has more overall acceptability because this coating helped in improving the quality, appearance, taste and color of fruits. Hence this technology could be more useful for increase shelf life of fruits at low cost, reduce the post-harvest loss and the use of harmful chemicals by growers and traders.

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