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Effect of Gum Arabic Blended with Selected Leaf Extracts for Edible Coating on Shelf-life of Guava Fruits (*Psidium guajava*)

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ABSTRACT

The present investigation was aimed at assessing the effect of gum arabic blended with selected leaf extracts for edible coating on shelf-life of guava. Coatings were formulated from the leaf extract of tulsi (TLE), moringa (MLE) and guava (GLE) in concentrations of 3, 6 and 9% with gum arabic solution (10%) as base. The guava fruits were studied at an interval of five days and studied till 20 days of storage period. Twenty treatments viz., Control (T_1), TLE 3% (T_2), TLE 6% (T_3), TLE 9% (T_4), MLE 3% (T_5), MLE 6% (T_6), MLE 9% (T_7), GLE 3% (T_8), GLE 6% (T_9), GLE 9% (T_{10}), GA (T_{11}), GA+TLE 3% (T_{12}), GA+TLE 6% (T_{13}), GA+TLE 9% (T_{14}), GA+MLE 3% (T_{15}), GA+MLE 6% (T_{16}), AG+MLE 9% (T_{17}), GA+GLE 3% (T_{18}), GA + GLE 6% (T_{19}) and GA+GLE 9% (T_{20}) were analyzed for morphological and biochemical attributes. Leaf extracts with gum arabic noted significantly positive effect with respect to physiological weight loss, pH, titratable acidity and total soluble solid during the storage period. However, leaf extract without gum arabic had positive effect on firmness.

Key words: Storage, plant leaf extract, edible coating, gum arabic

INTRODUCTION

Guava (*Psidium guajava* L.) is an important tropical fruit coming under Myrtaceae family, also known as apple of tropics (Shehabudheen *et al.,* 2020). It is one of the popular fruits in India due to its delight taste, flavour and availability for a long period of time in a year and its moderate price.

Guava fruit is rich in antioxidant and vitamin C. It is also abundant in vitamins, minerals, carbohydrates, protein and other nutrients like high levels of folic acid, dietary fibre and potassium. The guava fruits are consumed at mature stage. It over-ripens within three to four days after the harvest and leads to physiology disorder at ambient condition (El-Gioushy et al., 2022). Coating is a substance applied to fruits and vegetables to prevent harvest loss and to extend shelf life (Shabir *et al.,* 2021). It increases a barrier among the end result and its surroundings and prevents the access of microorganisms. It facilitates shelf-life which minimizes weight reduction by reducing moisture loss via evaporation and maintains the freshness by protecting outside elements which boost up the ripening method (Pham *et al.,* 2023). The edible coatings with antimicrobial ingredients such as organic acids, plant essential oils and plant leaf extract may help in reduction of oxidative browning and inhibit microbial activity as well retard respiration thereby slowing down the physiological and biochemical changes (Duguma, 2022).

Polysaccharide-based coating is a fit eaten coating as it prevents not only the dehydration but also inhibits the ethylene manufacturing (Ali *et al.*, 2019). Leaf extract like moringa leaf extract (MLE), Tulsi leaf extract (TLE) and guava leaves extract (GLE) contains various antioxidants like alkaloids, tannins, saponins and glycosides, etc. (Gituma and Njue, 2019). These leaf extracts when incorporated with gum arabic may help in increasing shelf-life of the fruits and vegetables. Keeping all this in view, the present study was planned to study the effect of selected leaf extracts with gum

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arabic based edible coating on shelf-life of guava fruits.

MATERIALS AND METHODS

The present investigation was carried out during May, 2023 at Postharvest Management Laboratory, School of Agriculture, ITM University, Gwalior. Local varieties of guava fruits were procured from local orchard at Gwalior and transported within 24 h to Postharvest Research Laboratory. All the fruits were sorted for shape, size, colour and free from any mechanical and physiological damage.

Gum arabic (GA) was used as base coating agent. Powdered gum arabic was dissolved in distilled water in 1:10 (w/v) ratio. The solutions were stirred at low heat (40°C) for 60 min on a magnetic stirrer. This solution was filtered to remove dissolved impurities and to obtain uniform solution. Leaf extracts were prepared from fresh tulsi (TLE), moringa (MLE) and guava leaves (GLE) with water 1:1 in (w/v) and strained by using muslin cloth. Leaves extracts were added at 3, 6 and 9% in gum arabic followed by glycerol. The pH of the solutions was maintained at 5.6 using 1N NaOH/glacial acetic acid. The experiment was laid out in the completely randomized design with three replications. A total of 20 treatments viz., Control (T_1), TLE 3% (T_2), TLE 6% (T_3), TLE 9% (T_4), MLE 3% (T_5), MLE 6% (T_6), MLE 9% (T_7), GLE 3% (T_8), GLE 6% (T_9), GLE 9% (T_{10}), GA (T_{11}), GA + TLE 3% (T_{12}), GA + TLE 6% (T_{13}), GA + TLE 9% (T_{14}), GA + MLE 3% (T_{15}), GA + MLE 6% (T_{16}), AG + MLE 9% (T_{17}), GA + GLE 3% (T_{18}), GA + GLE 6% (T_{19}) and GA + GLE 9% (T_{20}) were analyzed for morphological and biochemical attributes. Selected guava fruits were dipped in coating agents for 1-2 min in all the treatments. The coated guava was left to dry for half an hour until it was dried. The data recorded for various parameters were assessed at an interval of 05 days i.e. 0, 5, 10, 15 and 20th day during the period of experimentation. Fruit weight (g) and fruit firmness (kg/cm^2) were analyzed at each interval. The physiological weight loss was analyzed following Shabir *et al.* (2021) as:

$$\text{PLW (\%)} = \frac{\text{(Initial weight - Final weight)}}{\text{Initial weight}} \times 100$$

The qualitative parameters viz., pH, titratable acidity (%), TSS (°B) and TSS: acid ratio were analyzed following (Shehabudheen *et al.*, 2020). The results obtained during the investigation were statistically analyzed through analysis of variance at 5% level of significance.

RESULTS AND DISCUSSION

Weight loss (%) gradually increased in the storage period for all treatments (Table 1). Maximum loss in weight happened in control. T_7 showed maximum loss in weight followed by T_5 and T_6. Minimum weight loss was shown in the treatment T_8, whereas minimum weight loss was noted in T_{19}. Initially significant differences were noted for polar and equatorial diameter of guava fruits. However, with decreasing trend non-significant difference was noted with advancement of the storage period. Fruit firmness showed significant differences among all the treatments during storage at ambient conditions (Table 2). The firmness of sample significantly decreased with storage period as depicted in table. Least changes for firmness were recorded for T_4 followed by T_2 and T_{13}. Minimum per cent physiological weight was noted for T_6 and T_5 whereas T_8 had maximum per cent physiological weight during the stored fruits.

Table 3 depicts pH and acidity in the fruits during storage period on 20th day. Overall increase in pH was noted. This may be due to breakdown of organic acid leading into increase in pH of the fruits. Whereas decreasing trend was noted for total titratable acidity. The decrease in titratable acidity throughout ripening was significant since it made the fruits less acidic. While organic acids such as citric acid and malic acid are required for respiration. By respiring, fruits and vegetables are meant to decrease in acidity (Murmu and Mishra, 2017). Highest TSS was noted in T_{12} followed by T_{11} and least in T_{15} followed by T_7.

The increase in fruit TSS with increasing storage time can be attributed to a number of factors, including an increase in the activity of the enzymes responsible for starch hydrolysis into sugars (Chawla *et al.,* 2018), the hydrolysis of cell wall polysaccharides and hemicelluloses, acid to sugar conversion (Chulaki *et al.,* 2017)

Table 1. Fruit weight (g), polar and equatorial diameter (mm) during storage period

Treatment	Weight (g)					Polar diameter (mm)					Equatorial diameter (mm)				
	Day 0	Day 5	Day 10	D 15	Day 20	Day 0	Day 5	Day 10	Day 15	Day 20	Day 0	Day 5	Day 10	Day 15	Day 20
T_1	116.22	95.91	87.53	69.94	60.32	56.29	54.94	51.89	48.78	44.5	62.04	59.01	55.45	52.89	48.5
T_2	118.73	113.01	103.13	89.69	73.1	58.52	56.36	53.92	51.43	47.08	60.73	58.43	56.97	55.19	50.49
T_3	117.01	109.73	97.45	83.19	73.54	58.92	55.19	54.92	49.59	45.59	60.7	60.08	57.2	53.03	48.21
T_4	115.91	107.2	98.13	88.83	73.4	57.32	53.79	52.21	48.16	43.05	57.76	55.12	52.89	50.76	47.39
T_5	116.61	110.92	100.49	88.66	67.66	59.1	57.38	54.13	50.24	46.93	60.14	58.68	56.24	53.35	50.17
T_6	117.17	112.16	101.17	83.97	68.38	60.51	59.57	56.09	52.58	50.61	61.97	57.58	56.3	54.41	50.64
T_7	117.27	111.14	99.94	86.51	67.75	59.28	56.1	52.62	50.17	46.39	62.5	58.18	56.84	52.92	47.53
T_8	114.3	104.89	93.73	95.66	85.51	57.23	54.2	51.43	48.39	46.11	58.06	55.14	52.84	50.91	46.57
T_9	119.22	109.89	97.81	86.95	74.73	55.31	52.03	49.94	48.33	45.38	59.41	57.63	54.18	51.64	46.79
T_{10}	110.22	104.16	93.78	81.29	64.31	60.91	55.35	52.76	49.32	44.53	61.73	56.58	53.81	51.72	47.12
T_{11}	119.25	109.27	97.09	85.71	76.51	54.03	52.89	50.01	49.26	44.46	57.07	54.99	52.77	50.64	45.97
T_{12}	118	108.27	97.55	85.43	71.73	61.29	59.02	55.57	54.29	49.77	64.54	62.81	56.91	55.81	52.06
T_{13}	120.9	114.33	103.97	91.3	75.05	58.96	56.11	54.17	50.79	47.5	63.33	59.1	55.83	54.65	49.46
T_{14}	110.65	99.41	87.42	74.78	66.66	54.62	53.55	51.94	49.11	45.07	57.35	55.6	53.25	49.38	44.88
T_{15}	120.81	111.22	100.34	83.15	76.68	52.73	53.05	52.32	48.48	45.44	56.98	55.95	53.11	51.32	45.35
T_{16}	119.61	109.62	97.14	88.01	78.77	52.73	51.58	47.5	44.57	39.34	57.17	55.82	53.4	50.01	44.99
T_{17}	116.2	109.31	98.49	88.21	74.11	61.11	56.06	54.27	51.07	47.03	55.99	56.23	53.69	50.59	46.64
T_{18}	117.03	104.95	98.81	89.84	75.62	55.62	54.14	52.08	49.03	45.18	60.26	58.53	56.2	54.08	49.72
T_{19}	115.36	106.63	95.81	87.45	78.1	54.99	53.17	49.65	45.82	40.59	55.21	54.15	50.38	47.02	42.48
T_{20}	118.33	109.73	99.6	91.31	79.02	56.83	54.99	49.05	46.35	41.5	62.47	55.22	53.95	51.67	45.29
S. Em±	1.73	1.77	1.71	1.94	1.16	2.42	2.31	2.25	2.11	2.44	1.84	1.71	1.82	1.92	2.06
C. D. (P=0.05)	4.96	5.05	4.9	5.55	3.31	NS	NS	NS	NS	NS	5.25	NS	NS	NS	NS

NS–Not Significant.

Table 2. Fruit firmness (kg/cm^2) and per cent physiological weight loss (PLW) during storage period

Treatment	Firmness (kg/cm^2)					PLW (%)			
	Day 0	Day 5	Day 10	Day 15	Day 20	Day 5	Day 10	Day 15	Day 20
T_1	14.9	13.43	12.8	11.17	3	17.45	24.66	39.79	48.08
T_2	14.97	12.27	10.47	10.6	7.6	4.84	13.17	24.51	38.38
T_3	15	9.83	6.7	5.23	3.27	6.23	16.74	28.9	37.09
T_4	14.93	13.23	11.23	9.2	8.73	7.47	15.29	23.35	36.66
T_5	14.2	10.97	10	7.73	3.13	4.89	13.84	24.02	41.97
T_6	14.2	14.8	8.97	8	5.2	4.25	13.64	28.31	41.62
T_7	14.87	12.73	10.47	8.27	5.43	5.23	14.78	26.25	42.22
T_8	14.93	14.47	12.73	3.2	3.27	8.14	17.92	16.3	25.16
T_9	14.9	14.6	11.67	4.53	3.03	7.81	17.97	27.06	37.32
T_{10}	14.9	14.8	13.93	13.5	3.87	5.5	14.91	26.24	41.61
T_{11}	14.83	14.77	13.63	7.7	3	8.37	18.58	28.14	35.83
T_{12}	14.83	13.97	14.87	5.5	5.87	8.2	17.27	27.55	39.17
T_{13}	14.17	14.77	14.7	6.23	6.23	5.43	13.99	24.47	37.91
T_{14}	14.77	8.13	7.87	6.97	3.37	10.15	21	32.43	39.78
T_{15}	14.93	14.63	14.63	11.83	4.47	7.95	16.93	31.15	36.53
T_{16}	14.83	10.8	6.2	5.13	2.93	8.34	18.77	26.41	34.13
T_{17}	14.9	14.6	5.8	5	3.43	5.93	15.2	24.07	36.22
T_{18}	14.93	13.23	14.17	7.23	5.33	10.31	15.51	23.17	35.35
T_{19}	14.53	14.77	14.67	7.7	3.47	7.58	16.92	24.16	32.28
T_{20}	14.9	14.77	11.03	10.67	6.13	7.27	15.8	22.84	33.17
S. Em±	0.18	0.23	0.26	0.4	0.25	1.22	1.41	1.43	1.19
C. D. (P=0.05)	0.52	0.66	0.73	1.15	0.71	3.48	4.04	4.09	3.41

and a higher proportion of dry matter as a result of fruit water loss (Nandaniya *et al.,* 2017). The coating materials around the fruits during storage produced a semi-permeable covering that delayed fruit ripening and slowed down respiration with a decrease in acid ingestion (Table 4). It may be the acids losses by organic acids, in the respiratory system as well as the creation of novel molecules during the process of maturing. Weight loss was due to respiration, transpiration and some processes of oxidation, which influenced post-harvest treatment and storage temperature (Verma *et al.,* 2023). Edible-coating with leaf extracts helped in decreased respiration rates and delayed the softening by maintaining stiffness during the

Table 3. Fruit pH and titratable acidity (%) during storage period

Treatment	pH					Titratable acidity (%)				
	Day 0	Day 5	Day 10	Day 15	Day 20	Day 0	Day 5	Day 10	Day 15	Day 20
T_1	4.15	4.4	4.5	4.77	5.41	0.03	0.02	0.02	0.02	0.01
T_2	4.53	4.17	4.02	3.93	3.94	0.03	0.03	0.04	0.02	0.02
T_3	4.37	4.01	4.06	3.93	4.27	0.05	0.02	0.02	0.02	0.02
T_4	4.23	3.71	4.27	3.91	4.15	0.03	0.03	0.03	0.03	0.02
T_5	4.42	3.86	3.89	3.82	4.16	0.04	0.04	0.03	0.02	0.02
T_6	4.42	4.14	3.99	3.65	4.16	0.03	0.04	0.04	0.03	0.03
T_7	4.45	4.08	4.11	4.05	3.74	0.03	0.03	0.03	0.03	0.03
T_8	4.29	3.78	4.03	3.93	3.83	0.02	0.03	0.02	0.02	0.04
T_9	4.65	4.07	3.8	3.97	4.06	0.02	0.03	0.02	0.03	0.02
T_{10}	4.63	3.81	4.01	3.83	4.11	0.03	0.03	0.03	0.03	0.03
T_{11}	4.73	3.97	4.02	4.11	4.1	0.04	0.03	0.03	0.03	0.02
T_{12}	4.79	4.03	3.98	3.9	4.07	0.04	0.03	0.03	0.03	0.03
T_{13}	4.29	3.82	4.22	4.1	4.1	0.04	0.05	0.03	0.03	0.02
T_{14}	4.32	4.09	4.27	4.11	3.99	0.03	0.02	0.03	0.02	0.04
T_{15}	4.2	4.09	3.73	4.09	4.05	0.04	0.03	0.03	0.02	0.03
T_{16}	4.17	3.75	4.15	3.93	4.01	0.05	0.05	0.03	0.03	0.04
T_{17}	4.12	4.65	3.88	4.11	4.36	0.03	0.03	0.03	0.02	0.06
T_{18}	4.2	3.82	4.04	4.1	4.17	0.03	0.05	0.03	0.03	0.05
T_{19}	4.28	4.05	3.77	3.89	4.29	0.02	0.04	0.03	0.03	0.03
T_{20}	4.12	4.08	4.04	3.79	4.36	0.03	0.03	0.03	0.03	0.03
S. Em±	0.26	0.23	0.29	0.23	0.32	0.003	0.002	0.002	0.003	0.002
C. D. (P=0.05)	NS	NS	NS	NS	NS	0.01	0.01	0.01	0.01	0.01

NS–Not Significant.

Table 4. Fruit TSS and TSS: acid ratio during storage period

Treatment	TSS					TSS: acid ratio				
	Day 0	Day 5	Day 10	Day 15	Day 20	Day 0	Day 5	Day 10	Day 15	Day 20
T_1	8.17	8.27	11.63	13.6	13.7	313.43	395.17	718.85	906.87	1431.01
T_2	7.97	8.1	9.25	10.68	13.33	241.95	269.99	266.15	479.54	639.91
T_3	8.07	8.2	7.91	8.18	12.37	179.18	346.44	326.31	398.18	754.23
T_4	6.97	8.4	9.04	9.91	12.22	217.24	282.08	267.6	379.7	595.03
T_5	7.6	8.13	8.17	9.86	9.65	200.28	220.5	259.83	410.35	542.98
T_6	8.07	8.72	9.04	10.42	10.51	253.99	242.53	257.79	319.74	333.24
T_7	7.77	8.83	10.79	11.48	13.37	335.9	294.9	327.8	416.67	431.9
T_8	7.23	7.91	7.9	11.23	12.25	303.86	237.69	371.01	487.47	305.15
T_9	7.57	7.88	9.77	9.93	12.2	343.37	264.61	456.56	314.6	548.61
T_{10}	7.97	6.58	10.12	11.23	10.66	322.82	190.86	320.98	448.64	316.62
T_{11}	8.03	7.83	9.1	10.5	9.78	207.52	295.75	353.79	382.7	456.84
T_{12}	7.03	7.78	10.72	8.77	7.31	175.33	302.83	314.09	336.47	231.73
T_{13}	8.07	8.06	11.27	8.25	10.53	209.18	150.66	342.8	270.27	571.68
T_{14}	7.83	8.16	9.59	9.83	11.63	234.07	345.21	320	455.13	289.57
T_{15}	6.83	7.78	8.95	11.24	12.75	184.27.	252.36	261.75	554.4	375.07
T_{16}	7.17	7.03	8.44	10	10.33	146.28	155.72	275.86	377.31	274.91
T_{17}	7.7	6.48	8.9	9.26	11.13	282.48	210.87	269.11	403.27	203.82
T_{18}	7.87	8.31	8.99	8.64	10.95	255.26	178.12	269.29	313.29	240.93
T_{19}	8.17	8.23	7.71	10.12	11.73	364.37	209.65	228.22	299.91	371
T_{20}	7.13	8.01	9.3	9.75	11.52	215.05	300.25	335.81	307.32	349.06
S. Em±	0.41	0.3	0.37	0.39	0.31	32.76	27.37	41.51	64.04	67.81
C. D. (P=0.05)	NS	0.84	1.05	1.12	0.89	93.64	78.23	118.65	183.03	193.82

NS–Not Significant.

course of storage (Shehabudheen *et al.*, 2020). Losses in firmness occurred as a result of increase in the activity of cell wall hydrolysis enzymes such as pectin-esterase, polygalacturonase, pectin methyl-esterase, and pectatelyases during ripening and cold storage.

CONCLUSION

No specific trend was noted with respect to the specific coating. However, it was noted that coating helped in overall improvement in shelf-life of the guava. Leaf extracts with gum

arabic showed better result in diameter, pH, titratable acidity and total soluble solid. Leaf extract without gum arabic showed good result in weight, physiological weight loss, firmness and TSS: acid ratio.

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