Plant Archives Volume 21, No 1, 2021 pp. 534-539 *e-ISSN:2581-6063 (online), ISSN:0972-5210*

Plant Archives

Journal home page: www.plantarchives.org

DOI Url: https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no1.075

INFLUENCE OF HERBAL EDIBLE COATINGS ON PHYTOCHEMICAL CONTENT OF GUAVA DURING STORAGE

Monika Sood*, Julie D. Bandral and Neeraj Gupta

Division of Food Science and Technology, Faculty of Agriculture, SK University of Agricultural Sciences and Technology of Jammu, India

*E-mail: monikasoodfst@gmail.com

(Date of Receiving-09-11-2020; Date of Acceptance-02-02-2021)

ABSTRACT

Guava is a climacteric fruit ripens rapidly after harvest and therefore has short shelf life. The fruits are required to be managed appropriately to get a regulated market supply through judicious use of post-harvest treatments. Therefore, the main aim of the study was to assess the suitability of different edible coating treatments like *Aloe vera* gel and papaya leaf extract at varying concentrations (5, 10, 15 and 20%) on the phytochemical content of guava fruits (cultivar 'Lucknow-49'). After treatment, fruits were kept under ambient conditions and analyzed for various phytochemical parameters while the uncoated fruits served as control. Among all the treatments, minimum mean ascorbic acid content (198.99 mg/100g), total flavonoids (68.96), total antioxidants (235.44 µmol. trolex eq./100g) and total phenols (446.58 mg GAE/100g) were recorded in control guava fruits whereas, maximum mean ascorbic acid content of 237.01 mg/100g, total flavonoids of 81.43 mg/100g and total phenol content of 481.36 mg GAE/100g were observed in 20% *Aloe vera* gel coated guava fruits. Thus it can be concluded from the study that guava fruits can be safely stored up to 21 days at ambient storage without much deterioration in quality after treating with *Aloe vera* gel

Keywords: Guava, herbal coating, phtytochemical content, ambient storage, antioxidant, ascorbic acid

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most nutritious and delicious fruit, liked by the consumer for its pleasant flavour and refreshing taste. It is a major fruit crop of India, which belongs to the family *Myrtaceae*. The edible portion in guava is approximately 93% (Haque *et al*., 2009). It is a crop of important nutritional significance because of its high nutritional value due to carotenoids, ascorbic acid and polyphenols (Thaipong *et al*., 2006). The fruit is also rich in minerals like calcium (14-30 mg/100 g) and phosphorus (23.37 mg/100 g), as well as vitamins like pantothenic acid, niacin, riboflavin, thiamine and vitamin A. (Bose *et al.,* 1999). However, guava is a highly perishable fruit that presents accelerated physiological processes. Its perishing effects are aggravated by storage conditions during postharvest processes (Lima *et al*., 2002). Therefore, during post-harvest period, these fruits rapidly start senescence, a fact which prevents them from being stored for long periods. This is a very serious problem, because it hinders or even prevents the commerce of these fruits with distant markets, due to losses during transportation. Therefore, application of postharvest management is essential for guava market.

An edible coating is a thin layer that is deposited on the surface of a fruit and can be co-consumed. It is used to improve prevent moisture loss, handling properties, to increase the shelf life and to reduce the need of packaging material during transportation. The mechanism by which edible coatings preserve fruits and vegetables is the establishment of a modified atmosphere around the product, which serves as a partial barrier to water vapour and aroma compounds, O_2 and CO_2, decreasing the respiration rate of the fruit and water loss and thus preserving texture and flavour (Olivas *et al.,* 2008). Edible coatings act as oil and moisture barrier at low to intermediate RH because the polymers make effective hydrogen bonds. Ideal edible coatings have acceptable colour, good eating properties, taste, odour, texture, flavour and also act as barrier for microbes. The use of coating has gained importance in reducing the moisture loss and maintaining firmness (Chouhan *et al*., 2005).

Aloe vera, commonly referred to as a "medicinal plant", is known for its wide range of therapeutic properties. *Aloe vera* based edible coatings have been shown to prevent loss of moisture and firmness, control respiration rate and maturation development, delay oxidative browning, and reduce microorganism proliferation in fruits such as sweet cherry and table grapes (Valverde *et al*., 2005). In addition to the traditional role of edible coatings as a barrier to water loss and delaying fruit senescence, the new generation coatings are being designed for incorporation and/or for controlled release of chemical additives, antioxidants, nutraceuticals and natural antimicrobial agents (Vargas *et al*., 2008). It has also been reported that the *Aloe vera* extracts possessed antimicrobial activity against bacterial pathogens from gram negative and gram positive (Adetunji, 2008).

On the other hand, plant extracts (neem, onion, garlic etc.) are widely popular as a postharvest treatment (Anjum *et al*., 2016). The antimicrobial activity of many plants against post-harvest pathogens has been demonstrated in papaya and mango (Banos *et al*., 2002). Furthermore,

Table 1: Effect of herbal edible coatings on Ascorbic acid content of stored guava fruits

Treatment	Ascorbic acid (mg/100g)				
	Storage period (days)				
	0	7	14	21	Mean
T1 (Control)	249.36	216.17	175.62	154.81	198.99
T2 (5% AG)	249.36	227.42	209.36	189.57	218.93
T3 (10% AG)	249.36	234.61	217.49	196.84	224.57
T4 (15% AG)	249.36	241.41	223.76	205.60	230.03
T5 (20% AG)	249.36	247.67	234.48	216.53	237.01
T6 (5% PLE)	249.36	219.20	184.73	167.56	205.21
T7 (10% PLE)	249.36	221.47	190.36	172.88	208.52
T8 (15% PLE)	249.36	232.78	212.11	181.00	218.81
T9 (20% PLE)	249.36	239.19	220.19	203.15	227.97
Mean	249.36	231.1	207.57	187.55	

AG *Aloe vera* Gel PLE Papaya Leaf Extract

Effect	$CD_{0.05}$
Treatment	0.03
Storage	0.02
Treatment x Storage	0.07

Table 2: Effect of herbal edible coatings on total flavonoids of guava fruits stored under ambient conditions

Treatment	Total Flavonoids (mg/100g)				
	Storage period (days)				
	0	7	14	21	Mean
T1 (Control)	90.63	73.40	66.13	45.70	68.96
T2 (5% AG)	90.63	80.21	72.11	58.78	75.43
T3 (10% AG)	90.63	83.68	74.46	60.80	77.39
T4 (15% AG)	90.63	85.76	76.53	63.77	79.17
T5 (20% AG)	90.63	88.34	79.85	66.89	81.43
T6 (5% PLE)	90.63	76.20	70.42	54.30	72.89
T7 (10% PLE)	90.63	78.16	72.29	58.76	74.96
T8 (15% PLE)	90.63	81.35	75.11	61.84	77.23
T9 (20% PLE)	90.63	86.60	78.25	64.39	79.97
Mean	90.63	81.52	73.9	59.47	

AG *Aloe vera* Gel PLE Papaya Leaf Extract

Effect	$CD_{0.05}$
Treatment	0.04
Storage	0.03
Treatment x Storage	0.09

papaya leaf contains bioactive compounds which have antimicrobial activity against fungal pathogen (Abirami, 2013). Moreover, plant extracts have the ability to decompose rapidly and do not cause any negative hazards to the environment unlike chemical pesticides (Fokialakis *et al*., 2006). Therefore, the objectives of this work were to develop an edible coating of *Aloe vera* gel and papaya leaves extract to be used on the surface of guava and to evaluate its preservation efficiency through bioactive component analysis.

MATERIAL AND METHODS

Preparation of herbal coatings

Aloe vera gel coating

Aloe vera gel was prepared according to the method of Ramachandra and Rao (2008). Whole leaves were washed with water and the base and tips of the leaves along with its spikes were removed. *Aloe vera* leaves must be processed within 2 hours of harvesting to prevent oxidation of the gel due to their exposure to air. Next, the skin was carefully separated from parenchyma to obtain *Aloe vera* flesh. The flesh was then washed and blanched in hot water at 100ºC for 4 minutes. The blanched flesh was then blended and the *Aloe vera* gel obtained was filtered through activated carbon to remove anthraquinones that have a laxative effect. Before pasteurization, the pH of the gel was adjusted to 3.0 by addition of citric acid to stabilize and prevent browning. The process was then continued with pasteurization at 85ºC for 1 minute. After pasteurization,

Table 3: Effect of herbal edible coatings on total antioxidant activity of stored guava fruits

Treatment	Total antioxidants (µmol. trolex eq. /100g)				
	Storage period (days)				
	0	7	14	21	Mean
T1 (Control)	270.31	243.88	220.00	207.58	235.44
T2 (5% AG)	270.31	250.20	240.26	236.79	249.39
T3 (10% AG)	270.31	255.63	247.00	240.83	253.44
T4 (15% AG)	270.31	260.70	253.76	246.48	257.81
T5 (20% AG)	270.31	265.57	256.91	249.60	260.6
T6 (5% PLE)	270.31	247.36	235.19	220.80	243.41
T7 (10% PLE)	270.31	249.51	242.66	231.34	248.45
T8 (15% PLE)	270.31	252.84	248.73	240.60	253.12
T9 (20% PLE)	270.31	254.90	250.11	245.85	255.29
Mean	270.31	253.4	243.85	235.54	

AG *Aloe vera* Gel	PLE	Papaya Leaf Extract
Effect	$CD_{0.05}$	
Treatment	0.06	
Storage	0.04	
Treatment x Storage	0.011	

Table 4: Effect of herbal edible coatings on total phenolic content of guava fruits stored under ambient conditions

Treatment	Total phenols (mg GAE/100g)				
	Storage period (days)				
	0	7	14	21	Mean
T1 (Control)	491.67	448.31	423.52	404.25	441.94
T2 (5% AG)	491.67	468.87	445.62	428.36	458.63
T3 (10% AG)	491.67	475.76	461.88	441.93	467.81
T4 (15% AG)	491.67	482.24	473.27	458.59	476.44
T5 (20% AG)	491.67	488.75	479.67	465.35	481.36
T6 (5% PLE)	491.67	450.70	432.51	411.46	446.58
T7 (10% PLE)	491.67	460.52	437.60	416.11	451.48
T8 (15% PLE)	491.67	476.91	466.95	430.26	466.45
T9 (20% PLE)	491.67	480.29	472.28	453.15	474.35
Mean	491.67	470.26	454.81	434.38	

AG *Aloe vera* Gel	PLE	Papaya Leaf Extract
Effect	$CD_{0.05}$	
Treatment	0.04	
Storage	0.03	
Treatment x Storage	0.09	

the gel was quickly cooled to 5ºC or below. Finally, the *Aloe vera* gel was filled into pre-sterilized, opaque glass bottles for storage in a chiller at 5ºC and 75-80% relative humidity.

Papaya leaves extract coating

For preparation of papaya leaf extract, 500 g papaya leaves were washed with running water. After that the leaf surface was sterilized using 0.1% mercuric chloride for 10 min. (El-Kadder and Hammad, 2012) and again washed thoroughly with sterile distilled water. Filtration was carried out to remove fibre.

Coating of guava fruits

Fresh and fully mature uniform sized and disease free guava variety Lucknow-49 was procured from RHRSS, Raya. The fruits were washed with tap water to remove the dirt and dust particles and dried at room temperature. The guava fruits were divided into requisite lots for different coatings. Accordingly, coatings of aloe vera gel and papaya leaf extract were made in 5, 10, 15, 20% with water. The treated and non-treated fruits were divided into different lots and were placed in ambient conditions in the laboratory. Fruits were dipped in these solutions for 1-2 minutes, drained and surface dried by using procedure according to Hong *et al*. (2012). The observations on various bioactive components were studied on same day of harvest and after 7, 14 and 21 days of storage at ambient conditions (27-29ºC and 70-75% RH).

Ascorbic acid (mg/100g)

The ascorbic acid was expressed in terms of mg ascorbic acid/100g was determined as per method of Ranganna (2001).

Total Flavonoids (mg Catechin/100 g)

Total flavonoids content was estimated using aluminium chloride method (Zhishen *et al*., 1999). 1 ml of guava extract in methanol was taken in 4 ml of distilled water, 0.3 ml of 5% sodium nitrite ($NaNO_2$) and 0.3 ml of 10% aluminium chloride ($AlCl_3 \cdot 6H_2O$). The mixture was allowed to stand for 6 minutes at room temperature. Then, after adding 2 ml of 1 N NaOH, the solution was diluted to 10 ml with distilled water. Finally, the absorbance of the solution was recorded at 510 nm in a spectrophotometer against a reagent blank.

Total Phenolics (mg GAE/100 g)

Total phenolics content in the edible portion of fruit was determined using Folin-Ciocalteu reagent (Singleton *et al*., 1999). 2.9 ml of distilled water, 0.5 ml of Folin-Ciocalteu reagent and 2.0 ml of 20% Na_2CO_3 solution was added to 100 µl of sample extract (in 80% ethanol). Mixture was allowed to stand for 90 minutes and absorbance was recorded in a spectrophotometer at 760 nm wavelength.

Total Antioxidants (µmol. trolex eq. /100g)

Total antioxidants capacity was determined following CUPRAC (Cupric reducing antioxidant capacity) assay (Apak *et al*., 2008). 0.1 ml of sample extract (in 80% ethanol) was added to 1 ml each of copper (II) chloride solution, neocuproine solution, ammonium acetate buffer solution and distilled water in a test tube. The mixture was then allowed to stand for 30 minutes and the absorbance was recorded at 450 nm in a spectrophotometer.

Statistical analysis

The data were analysed according to the procedure for analysis of two factorial completely randomized designs. The overall significance of differences among the treatments was tested, using critical difference (C.D.) at 5% level of significance.

RESULTS AND DISCUSSION

Ascorbic acid: Effect of storage period on edible coated guava indicated that ascorbic acid content decreased in all the treatment during storage (Table 1). Maximum ascorbic acid content (237.01 mg/100g) was recorded in 20% *Aloe vera* gel coated guava fruits followed by T_4 (15% *Aloe vera* gel coated) guava fruits having value as 230.03 mg/100g whereas, minimum ascorbic acid content (198.99 mg/100g) was recorded in control guava fruits. Loss of ascorbic acid was observed in all treatments during storage. This might be due to conversion of L-ascorbic acid into dehydro ascorbic acid.

Total Flavonoids content

Treatments exerted a significant influence on fruit total flavonoids content (Table 2). Maximum total flavonoids content (81.43 mg/100g) was recorded in 20% aloe vera gel coated fruits (T_5) followed by T_4 (15 % *Aloe vera* gel) having value as 79.17 mg/100g and minimum (68.96 mg/100g) was recorded in control (T_1). Storage period significantly affected total flavonoids content of guava fruits. The total flavonoids content decreased gradually during storage irrespective of treatments. The loss of total flavonoids content in treated fruits occurred more slowly than control. Flavonoids are the secondary plant phenolic compounds having significant chelating and antioxidant properties. It has numerous beneficial effects on human body such as antimicrobial activities, anti-inflammatory, inhibition of platelet aggregation and inhibition of mast cell histamine release (Koley *et al*., 2011). Slower reduction of total flavonoids in *Aloe vera* and papaya leaf extract treated fruits might be attributed to anti-senescence properties of *Aloe vera* and papaya leaf extract (Wisniewska and Chelcowski, 1999).

Total Antioxidants activity

Treatments exerted a significant influence on total antioxidants capacity (Table 3). The highest total antioxidants activity (260.60) was recorded in 20% *Aloe vera* gel coated fruits (T_5) followed by (257.81) in 15% *Aloe vera* gel coated fruits (T_4) and lowest (235.44) was recorded in T_1 (Control) followed by (243.41) in 5% papaya leaf extract treated fruits (T_6). Antioxidant activity of guava fruits decreased significantly during storage period. Antioxidant activity of fruit is contributed by several bioactive compounds like flavonoids, ascorbic acid and phenolics. In the present study, *Aloe vera* and papaya leaf extract treated fruits maintained significantly higher total antioxidant activity compared to control which might be attributed to higher content of phenolics, flavonoids and ascorbic acid in the treated fruits, owing to delayed senescence. Antioxidant contributing property of phenolic compounds and ascorbic acid has also been reported earlier in mango by Asrey *et al*. (2013).

Total Phenolics content

Maximum fruit total phenolics (Table 4) content (481.36 mg GAE/100g) was recorded in 20% aloe vera gel coated fruits (T_5) followed by T_4 (15 % aloe vera gel) having value as 476.44 mg GAE/100g and minimum (441.94 mg GAE/100g) was recorded in control (T_1) followed by (446.58 mg GAE/100g) in 5 % papaya leaf extract treated samples (T_6). During storage the total phenolic content of guava fruits decreased significantly irrespective of the treatment. Control fruits showed faster decrease in total phenolics than other treatments. This may be ascribed to higher activity of polyphenol oxidase and peroxidase enzymes in control fruits which caused rapid decrease in total phenolics in fruit. On the other hand, higher retention of phenolics in *Aloe vera* treated fruits might be due to lower activities of peroxidise and polyphenol oxidase enzymes, there by delaying oxidation of phenolic compounds.

Furthermore, due to formation of protective *Aloe vera* layer over the fruit surface, there was less moisture loss from the fruit which reduced the loss of assortment between polyphenol oxidase and peroxidase enzymes and phenolic compounds present in the vacuole there by decreased its breakdown (Awad and De Jager, 2000). This finding is in accordance with the previous findings of Lu *et al*. (2011) in pineapple, who also reported that application of edible coating maintained higher phenolics content in fruits during storage by reducing polyphenol oxidase activity.

CONCLUSION

Edible coatings containing natural extracts are being used widely to enhance the overall quality of fruits and vegetables along with extended shelf life. The present study confirmed that the use of natural plant extract such as *Aloe vera* gel and papaya leaf extract could enhance the quality of the guava fruit. On the basis of results, it may be concluded that 20% *Aloe vera* treatment was found effective in extending the shelf life up to 21 days as it retained higher phytochemical content. Therefore, herbal edible coatings are a promising concept because of their eco-friendly nature and non-toxic.

REFERENCES

Abirami, L.S.S. (2009). Efficacy of chitosan and natural plant extracts on the growth of selected fungal pathogens and control of anthracnose disease of papaya. Masters' Thesis, Sri Sathya Sai Univ. Prashanthi Nilayam, India.

Adetunji, C.O. (2008). The antibacterial activities and preliminary phytochemical screening of vernonia amygdalina and Aloe vera against some selected bacteria. Masters' Thesis University of Ilorin.

Anjum, M.A., A. Naseer, C. Babita, Harmeet and P. Gupta (2016). Plant extracts in postharvest disease management of fruits and vegetables- A review. *J. Fd. Process. Technol.*, **7**(6): 2-5

Apak, R., K. Guclu, M, Ozyurek and S.E. Celik (2008). Mechanism of antioxidant capacity assays and the CUPRAC (cupric ion reducing antioxidant capacity) assay. *Microchimica Acta*., 160: 413-419.

Asrey, R., V.B. Patel, K. Barman and R.K. Pal (2013). Pruning affects fruit yield and postharvest quality in mango (*Mangifera indica* L.) cv. Amrapali. *Fruits,* 68(5): 367-381.

Awad, M.A. and A. De Jager (2000). Flavonoid and chlorogenic acid concentrations in skin of Jonagold and Elstar apples during and after regular and ultra-low oxygen storage. *Postharvest Biol. Technol.,* 20: 15-24.

Banos, S.B., L.L.B. Necha, L.B. Luna and K.B. Torres (2002). Antifungal activity of leaf and stem extracts from various plant species on the incidence of *Colletotrichum gloeosporioides* of papaya and mango fruit after storage. *Mexican J. Phytopath*., 20: 8-12.

Bose, T.K., S.K. Mitra, A.A. Farooqui and M.K. Sandhu (1999). *Tropical Horticulture*. 1st Ed. Nava Prokash Publication, Kolkata.

Chouhan, S.K., K.S. Thakur and B.B.L. Kaushal (2005). Effect of post harvest coating treatments on the storage behaviour of starking delicious apple fruits under evaporative cool chamber. *Acta Hort*., 696 : 473-478.

El-Kadder, E. M. A. and H. Hammad (2012). In vitro propagation of dillenia indic. *Australian J. Basic Applied Sci.*, **6** (7): 452-457.

Fokialakis, N., C.L. Cantrell, S.O. Duke, A.L. Skaltsounis and D.E. Wedge (2006). Antifungal activity of thiophenes from Echinops ritro. *J. Agri. Fd .Chem.,* 54(5): 1651-55.

Haque, M.N., B.K. Saha, M.R. Karim and M.N.H. Bhuiyan (2009). Evaluation of nutritional and physico-chemical properties of several selected fruits in Bangladesh. *Bangladesh J. Sci Ind. Res*., 44(3): 353-358.

Hong, K., J. Xie, L. Zhang, D. Sun and D. Gong (2012). Effects of chitosan coating on postharvest life and quality of guava (*Psidium guajava* L.) fruit during cold storage. *Sci. Hort.*, 144: 172-178.

Koley, T.K., C. Kaur, S. Nagal, S. Walia, S. Jaggi and A. Sarik (2011). Antioxidant activity and phenolic content in genotypes of Indian jujube (*Zizyphus mauritiana* Lamk.). *Arab. J. Chem.*, doi:10.1016/j.arabjc.2011.11.005.

Lima, M.A.C., J.S. de. Assis, and N.L. Gonzaga (2002). Caracterização dos frutos de goiabeira e seleção de cultivares na Região do Submédio São Francisco. *Revista Brasileira de Fruticultura.*, 24 **(**1): 273-276.

LuX, D. Sun, Y. Li, W. Shi and G. Sun (2011). Pre and post-harvest salicylic acid treatments alleviate internal browning and maintain quality of winter pineapple fruit. *Sci. Hort.,* 130(1): 97-101.

Olivas, G.I., J.E. Davila-Avina, N.A. Salas-Salazar and F.J. Molina (2008). Use of edible coatings to preserve the quality of fruits and vegetables during storage. *Stewart Postharvest Rev.,* 4: 1-9.

Ramachandra, C.T. and P.S. Rao (2008). Processing of *Aloe vera* leaf gel: A review. *American J. Agril. Biol. Sci.,* 3: 502-510.

Ranganna, S. (2001). *Handbook of analysis and quality control for fruit and vegetable products.* 7th edition. Tata McGraw Hill Publishing Co. Ltd., New Delhi, pp 594-625.

Serrano, V.J.M., Guillen and D. Valero (2006). Coating of table grapes with Aloe vera gel. *J. Agri. Food Chem*., 54 (11): 3882-3886.

Singleton, V.L., R. Orthofer and R.M. Lamuela-Ranventos (1999). Analysis of total phenols other oxidation substrates and antioxidants by means of folin-ciocalteu reagent. *Meth. Enz.,* 299: 152-178.

Thaipong, K., U. Boonprakob, K. Crosby, L. Cisneros-Zevallos and D.H. Byrne (2006). Comparison of ABTS, DPPH, FRAP, and ORAC assays for estimating antioxidant activity from guava fruit extracts. *J. Food Comp. Anal.*, 19(6): 669-675.

Valverde, J.M., A. Valero, D. Martinez-Romero, F. Guileen and S. Castillo (2005). Novel edible coating based on Aloe vera gel to maintain table grape quality and safety. *J. Agric. Food Chem.,* 53: 7807-7813.

Vargas, M., C. Pastov, A. Chirau, M.C. Clements, D. Julian and M.C. Gunzales (2008). Recent advances in edible coatings for fresh and minimally processed fruits. *Crit. Rev. Food Sci. Nutr.*, 48: 496-511.

Wisniewska, H. and J. Chelcowski (1999). Influence of exogenic salicylic acid on *Fusarium* seedling blight reduction in barley. *Acta Phys. Plan*., 21(1): 63-66.

Zhishen, J., T. Mengcheng and W. Jianming (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Fd. Chem*., 64: 555-559.