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Aloe vera Gel Coating For Post Harvest Quality Maintenance of Fresh Fig Fruits

Sai Lakshmi Marpudi, Pushkala Ramachandran and N Srividya*

Food Science and Technology Division, Department of Home Science, Sri Sathya Sai Institute of Higher Learning, Anantapur-515001, Andhra Pradesh, India.

ABSTRACT

The present investigation was undertaken to evaluate the effect of Aloe gel on the post harvest quality characteristics of fig fruits. One set of fruits were coated with *Aloe vera* gel and other set served as control (dipped in distilled water). The figs were stored at room temperature (29 ± 3^0C) and analysis was carried out every second day. The results revealed Aloe gel coating to be very beneficial in reducing the weight loss, minimizing changes in physico-chemical parameters (pH, titrable acidity and total soluble solids) of the fresh fruits and also in reducing fruit decay. The sensory characteristics of the coated fruits were also found to be better than the control as evidenced by lesser shriveling and browning of the fruit peel. The study thus indicates the potential of using an economical and eco-friendly biopolymer for maintaining the quality characteristics and extending the shelf life of fig fruits. The positive results obtained in the present study could further confirmed in larger market simulated experiments and extended to other tropical/subtropical fruits and vegetables.

Keywords: *Aloe vera* gel, figs, edible coating, post harvest, quality maintenance, shelf life

Corresponding author

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INTRODUCTION

Ficus carica, the fig fruit, is one of the most ancient fruits known to mankind. It is reported to be under cultivation from 3000-2000 BC in the eastern Mediterranean region. The fruit is credited with laxative and medicinal properties such as application on boils and treating other skin infections. It is considered to be an alkaline fruit helpful for liver health. Fresh figs are delicious and nutritious, rich in protein, calcium, potassium and iron. It is also a good source of fruit fibre [1]. Fig has a nutritive index of 11, as against 9 for apple and 6 for raisin. Fig is moderately important world crop with an estimated annual production of one million tons of fruit of which about 30% is produced by Turkey. The other major producers are Egypt, Morocco, Greece, California, Italy, Algeria, Syria and Tunisia.
In India, fig is considered to be a minor fruit crop and the commercial cultivation of common (edible) fig is mostly confined to Western parts of Maharashtra, Gujarat, Uttar Pradesh (Lucknow and Saharanpur), Karnataka (Bellary, Chitradurga and Srirangapatna) and Tamil Nadu (Coimbatore) [2].

There are about 20 popular varieties of fig that are being grown in different parts of the World. In India, "POONA FIG" is the most popular cultivar grown for consumption as fresh fruit. Most of the Fig grown in Mangalore, Bellary, Coimbatore, Daulatabad, Ganjam, Lucknow and Saharanpur resembles in plant and fruit morphology to that of Poona Fig. Recently a variety "Dinkar", an improvement over Daulatabad variety for yield and fruit quality is gaining commercial importance [3].

Fruits are consumed fresh or dried. The bulk of the fruit (about 80%) is consumed as dried fruits. But figs produced in India are mostly sold as fresh. Fig is classified as a climacteric fruit, and to a little extent ripening continues once the fruit is harvested. Fresh market figs must be harvested when almost fully ripe to be of good eating quality. Owing to perishable nature of fruits, growers prefer to sell their produce in local or nearby markets. Figs can be held only for a short period (7-10 days), at 0`C and 85-90 % relative humidity. There is a growing interest to consume fresh figs in many countries. Also the local farmers and sellers incur a high post harvest loss of fresh fig fruits due to its perishable nature.

Fresh figs' skin color and flesh firmness are related to their quality and postharvest-life. Flavor is influenced by stage of ripeness and overripe figs can become undesirable due to fermentative products. Shriveling of the skin and decay are other post harvest problems.

Various chemical treatments such as chlorine [4] and sulphur dioxide [5] have been used to improve the shelf life and to arrest the decay of figs. However there is growing demand for environment friendly and safer alternatives. Controlled atmospheric storage has been also explored as alternative storage method [6]. But, this is not always feasible for small farmers to use and also results in development of off flavours due to ethanol accumulation [6].

Edible coating using natural biomaterials is being explored as a safer alternative to extend the shelf life of perishable food crops. *Aloe vera* gel has been identified as a novel

coating agent with good antimicrobial properties [7, 8]. Studies in our laboratory had showed good results of using Aloe gel coating on papaya fruits [9]. Literature search revealed absence of studies in this direction for fresh figs. Hence, studies were carried out to evaluate the efficacy of *Aloe vera* gel as an edible coating to extent the shelf life of fresh figs.

MATERIAL AND METHODS

Plant material

Figs (*Ficus carica* L.) were purchased in one lot from the local market of Anantapur. The fruits were selected on the basis of size, color and absence of external injuries.

Preparation of edible coating solution

Aloe vera gel matrix was separated from the outer cortex of *Aloe vera* leaf and this colorless *hydroparenchyma* was ground in a blender. The resulting mixture was filtered to remove the fibres. The liquid obtained constituted fresh *Aloe vera* gel. The gel matrix was heated at 70^0C for 45 minutes. Immediately, it was cooled to an ambient temperature and ascorbic acid was added in the range of 1.9-2.0g per litre. This gel was cooled to about 23^0C in less than 15 minutes. Citric acid (4.5 – 4.6g/L) was added to this gel to maintain the pH at 4. The viscosity of the stabilized *Aloe* gel obtained was improved by using 1% of a commercial gelling agent to improve coating efficiency.

Application of the edible coating solutions

The fresh fig fruits were dipped in the coating solutions at room temperature for 5 min. At regular intervals, the fruits were rotated to increase the coating efficiency. They were allowed to drain for 2 min and then dried at room temperature under fan, to increase drying rate. Weights of the coated fruits were taken. One set of 25 fruits was taken for coating treatment. Another set of 25 uncoated fruits were used as control. The fruits were stored at room temperature (29 ± 3^0C) and at 45-55% RH.

Physico chemical analysis of coated fruits

The following physical and chemical analysis was carried out for the fruits to assess the effect of edible coating on the fruit quality:

Physiological loss in weight (PLW)

Fruits were weighed from both the coated and uncoated groups every 2 days for figs to determine water loss during storage. Water loss was calculated by the following equation:

$$\text{PLW/Water loss (\%)} = \frac{W_o - W_f}{W_o} \times 100$$

Where, W_o is the initial weight of fruits (0 days)
W_f is the final weight of fruits.

pH, titrable acidity and TSS

pH and titrable acidity of both control and coated fruits were determined after every two days of storage for room temperature stored figs.

Fruits were homogenized and the resultant pulp was filtered. The pH value of the fruit juice was determined using a pH meter. Ten ml of squeezed fruit juice was diluted to 50ml with distilled water and titrated against 0.1N NaOH by using phenolpthalein as indicator. The results were expressed as % total acids (titrable acidity).

Total soluble solids were determined for both control and coated fruits by using Abbe hand refractometer after every two days for the stored figs.

Sensory analysis for evaluating fruit quality

Sensory analysis was carried out by ten selected panelists. The fruits were randomly selected from each batch and served on white plates. The sensory quality of each batch of fruits was evaluated visually in terms of colour of the peel, fruit firmness, appearance and marketability. Sensory evaluation was carried out after every four days. The various quality parameters assessed and the scoring used is given below:

Colour

5 – Bright green
4 – Slight browning of the skin
3 – Moderate browning of the skin.
2 – Severe browning of the skin
1 – Blackening of the skin.

Appearance

4 – Smooth skin
3 – Slight Shriveling
2 – Moderate shriveling
1 – Severe shriveling

Firmness

5 – Very firm
4 – Firm
3 – Moderately firm
2 – Soft
1 – Very soft

Marketability for fig fruits:

4-Highly marketable
3-Marketable with slight defects
2-Fair and moderate defects
1-Marketability limited
0-Not marketable

Eating quality

Eating quality was judged periodically using fruits from each treatment by tasting the peeled / skinned fruits. The fruits were rated using a 5 point hedonic scale (5-sweet to 1-bland).

Degree and rate of fruit spoilage

The differently coated fruits were visually observed for fungal spoilage and fruit rots. The number of fruits affected or spoiled were recorded periodically to assess the effect of the different coating on fruit spoilage and reported in percentage as total fruit decay.

RESULTS

Physiological loss in weight (PLW)

The effect of AG coating on physiological weight loss (%) of fig fruits during storage at room temperatures is shown in Figure 1. The weight loss of coated fruits was significantly ($p<0.05$) lower than that of non-coated fruits at both the temperatures. Weight loss increased progressively with storage time. At the end of 6 days of storage, PLW of control figs was observed to be 60.42±0.28%, whereas AG coated figs recorded significantly lower ($P<0.05$) PLW of 22.25±0.73%.

Water loss by transpiration occurs due to difference in the vapor pressure of water between the atmosphere and fruit surface [10]. Respiration of fruits causes weight reduction, because carbon atoms in the form of CO_2 molecules leave the fruits. It was observed that there is a significant effect of AG coating on preventing weight loss. *Aloe vera* coating has also been reported to reduce the weight loss on table grapes stored at 1^0C [7].

pH, TA and TSS

Chemical parameters like pH, titrable acidity and total soluble solids were analysed for fresh figs and the values are shown in Table-1. The mean values of AG coated fruits were significantly ($p<0.05$) different from uncoated fruits at the end of 6 days of storage.

The initial pH of the fruits was found to be 4.2 which increased to 4.53±0.02 and 4.38±0 for control and AG coated fruits, respectively, after 6 days at room temperature. Correspondingly, the titrable acidity of the fruits showed a decreasing trend with the acidity values being 0.2% for control and 0.24% for AG coated fruits after 6 days, from an initial value of 0.3%. Decrease in acidity was found to be more in control than in treated fruits. Commonly, organic acids are substrates for the enzymatic reactions of respiration, so a reduction in acidity and an increase in pH are expected. Since the reduction was more in control fruits, it can be inferred that the control fruits had a higher respiration rate which could have caused a greater reduction in acidity compared to AG coated fruits.

The acidity values correlated with the total soluble solids which were found to increase during storage from an initial value of 6.9^0Brix. At the end of 6 days storage total soluble solids were observed to be 8 ± 0^0Brix for the control fruits whereas the TSS of AG coated fruits were significantly lower (7.65 ± 01^0Brix). An increase in TSS is associated with accelerated ripening, due to which starch gets converted to sugars. From the results, it can be inferred that AG coating delayed the ripening process thereby improving the shelf life of the fig fruits.

Sensory Characteristics

Sensory attributes like appearance, color of the peel, firmness and taste were judged by the panel members periodically. The mean scores are shown in Table-3. The mean values of the AG coated fruits were found to be significantly different ($p<0.05$) from uncoated fruits, showing the beneficial effects of coating on the sensory properties of figs. Fig is a fruit that while it is decaying turns from an attractive bright green color to darker brown or black color. During storage fruit shrivels and softens, which affects consumer acceptance.

From the analysis, it was found that less darkening was observed on AG coated fruits than the control fruits. Color values were recorded as 2 for control and 3 for AG coated fruits after 6 days of storage.

The score for appearance were observed to be 1.5 and 2.7 for control and AG coated fruits, respectively, after storage for 6 days at room temperature. Firmness values after 6 days of storage were found to be 2 for control fruits and 3.87 for AG coated fruits. Taste values were recorded as 4.5 for control fruits whereas for the AG coated fruits the values were found to be 4.12 at the end of 6 days storage indicating greater ripening in control fruits.

From the above analysis, it can be inferred that AG coating had delayed the ripening process, color development, and also controlled shriveling and softening of the fruits. Since, the

ripening process was delayed, the AG coated fruits had lower scores for taste in terms of sweetness.

Percent fruit decay

The fruits were visually observed for fungal spoilage and decay to give an account on the effect of AG coating on fruit spoilage. The total percentage fruit decay observed at different storage intervals are shown in figure 5. Control fruits stored at room temperature started showing decay from second day and by the fourth day more than half of the fruits had decayed. On the other hand, decay was controlled to a large extent in AG coated fruits and was found to be 55% at the end of 6th day of storage, as against the control fruits which completely decayed by the sixth day.

This could be attributed to the effect of Aloe gel on delaying the respiration rate and also antimicrobial activity which could have prevented the microbial growth and thereby prevented fruit decay. Earlier studies [7, 11] have reported *Aloe vera* gel based edible coatings to be effective in reducing proliferation of microorganisms in table grapes and sweet cherry.

Marketability

The mean values of marketability are depicted in figure for fruits. From the analysis it was found that the marketability of control figs reduced drastically by second day itself. At the end of 6 days storage marketability was found to be 1.16 for control fruits, whereas for AG coated fruits it was found to be significantly higher (2.87). The improved marketability of the AG coated fruits could be attributed to its effect on preventing loss of moisture, firmness, and maturation.

Table 1: Effect of edible coatings on pH, titrable acidity and total soluble solids of fig fruits stored at 29 ± 3˚C

Storage Period	pH		Titrable acidity (%)		Total soluble solids (^{0}Brix)	
	Control	AG coated	Control	AG coated	Control	AG coated
O day	4.2±0.01		0.3±0.01		6.9±0.04	
4th day	4.39±0.01	4.34±0.02	0.28±0.01	0.27±0.02	7.5±0.07	7.31±0.07
6th day	4.53±0.02a	4.38±0.01b	0.20±0.01a	0.24±0.01c	8.0±0.05a	7.65±0.02b
8th day	*	4.47±0.03	*	0.17±0.03	*	8.31±0.02

Values are mean ± standard error

* Indicates complete decay of fruits.

Significant test carried out at the end of storage period of control fruits. Values in a row followed by different letters are significantly ($p<0.05$) different (Duncan's multiple range test).

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Table 2: Effect of edible coatings on sensory qualities of fig fruits stored at 29 ± 3˚C

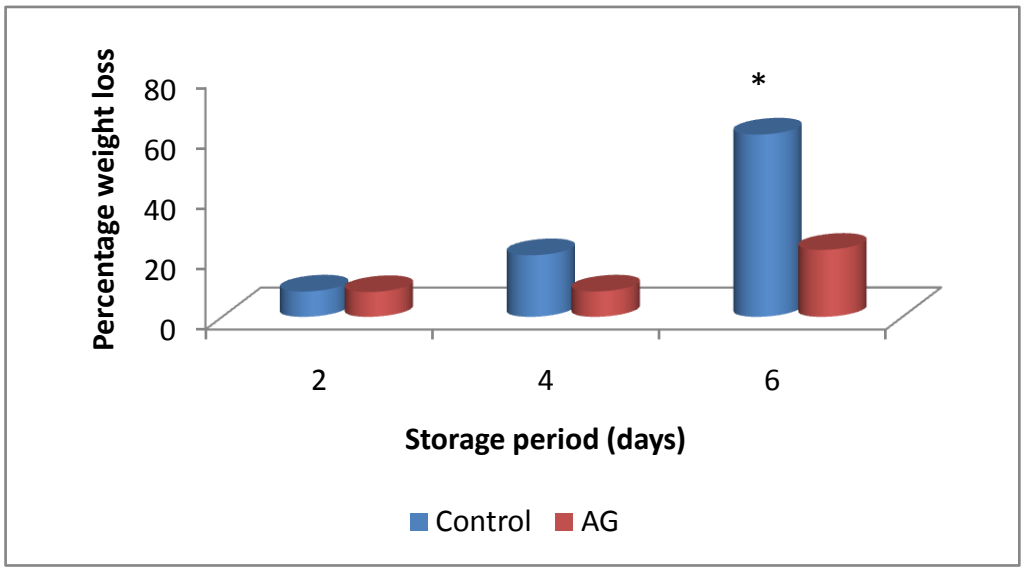
Type of coating	Appearance	Colour	Firmness	Taste
0 day	5 ± 0	5 ± 0	5 ± 0	2.45 ± 0.14
4 days storage Control AG	 1.7 ± 0.02 2.41 ± 0.04	 2.70 ± 0.02 3.29 ± 0.01	 2.12 ± 0.05 3.70 ± 0.08	 2.12 ± 0.29 4.08 ± 0.27
6 days storage # Control AG	 1.5 ± 0.02 a 2.70 ± 0.02 b	 2 ± 0.01 a 3 ± 0.02 b	 2 ± 0.02 a 3.87 ± 0.05 b	 4.5 ± 0.11 a 4.12 ± 0.41 b
8 days storage Control AG	 * 1.12 ± 0.09	 * 2 ± 0.01	 * 1.25 ± 0.09	 * 4.25 ± 0.35

Values are mean ± standard error

* Indicates complete decay of fruits.

Significant test carried out at the end of storage period of control fruits. Values in a row followed by different letters are significantly ($p<0.05$) different (Duncan's multiple range test).

Figure 1: Effect of Aloe gel coating on physiological loss in weight (PLW) of fig fruits stored at 29 ± 3^{0}C



Values are mean ± Standard error of three replicates

* Indicates significant difference with respect to control

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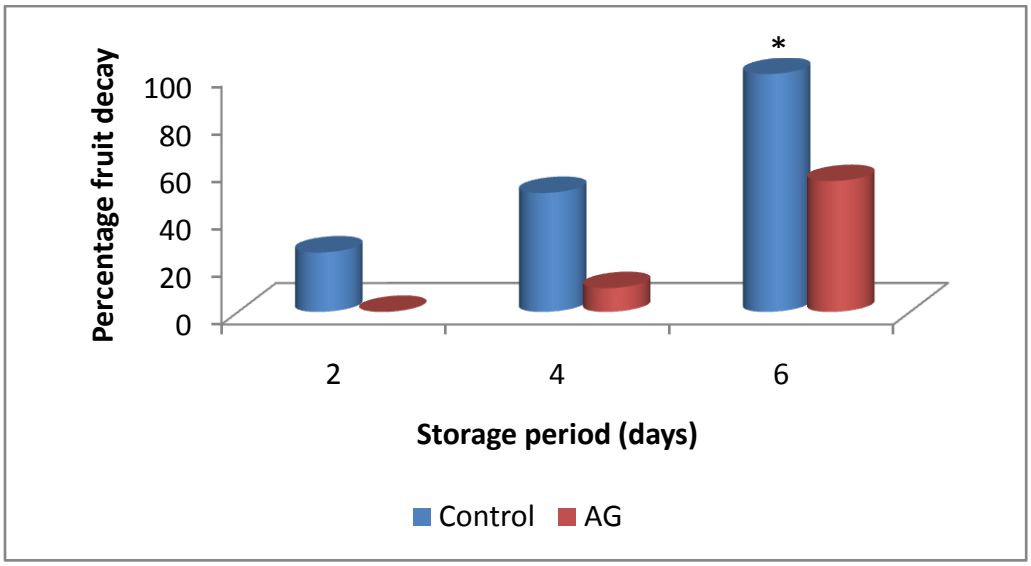
Figure 2: Effect of Aloe gel coating on fruit decay (%) of fig fruits stored at 29 ± 3^{0}C



Values are mean ± Standard error of three replicates
* Indicates significant difference with respect to control

CONCLUSION

The present study has demonstrated the efficacy of Aloe gel obtained from *Aloe vera*, as a source of cost effective and eco-friendly primary packing material for tropical and sub tropical fruits. It was found to extend shelf life of figs by delaying decay and ripening as reflected in lower weight loss, lesser changes in physico-chemical parameters, greater firmness, better sensory quality and marketability. This study is probably the initial one that has evaluated edible coatings to preserve the quality of fresh fig fruits with promising results. The present study further can be extended by designing new composite coatings with greater moisture – barrier properties. The encouraging results obtained with Aloe gel coating in the present study warrants their evaluation on other tropical fruits.

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