

Studies to Enhance the Shelf Life of Fruits Using *Aloe Vera* Based Herbal Coatings: A Review

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Abstract

Postharvest losses of fruits are a serious problem because of rapid deterioration during handling, transport and storage. Use of edible coatings over fruits is used to improve their quality and self life. These can be also safely eaten as part of the product and do not add unfavourable properties to the foodstuff. Recently there has been increased interest in using *Aloe Vera* gel as an edible coating material for fruits and vegetables driven by its antifungal activity. *Aloe Vera* gel based edible coating have been shown to prevent loss of moisture and firmness, control respiratory rate and maturation development, delay oxidative browning and reduce microorganism proliferation in fruits such as Oranges, grapes, sweet cherries and Papaya. In case of Papaya, the *Aloe vera* coated fruits survived the storage period of 15 days at low temperature whereas all the uncoated controls decayed within 10 days. Marketability was also found to be better for coated fruits. When studies were done of Grapes, it was found that the storability could be extended up to 35 days at 1 °C. Oranges have also been used for study and it was found that *Aloe Vera* coating in oranges resulted in decrease in weight loss, increase in titrability of acids and higher TSS. Thus, *Aloe Vera* gel is being increasingly studied as edible coating in fruits, which would be an innovative and interesting means for commercial application and an alternative to the use of postharvest chemical treatments leading to the enhancement of shelf life of fruits.

Keywords: *Aloe Vera*; Storage; Weight loss; Total soluble solids, Titrable Acidity; Firmness; Shelf Life

Introduction

Post Harvest Losses

Post harvest losses of fruits are serious problem because of rapid deterioration during handling, transport and storage in tropical regions (Yahia, 1998). The Indian fruits and vegetable market is one of the largest in the world. It has certain unique characteristics viz. high wastage in value chain, weak transportation and storage infrastructure, low tech harvestings, low usage in food processing and relatively low exports. As a result large volumes of fruits and vegetables are wasted every year. The post-harvest losses — between 35 and 40% and valued at about \$800 million annually — affect the livelihoods of nearly one-third of the population, the majority of whom are smallholder farmers. Reducing these losses can not only improve farmers' incomes but could also encourage more consumption of this highly nutritious fruit in a region where per capita consumption is only half of the recommended level. Table grapes show severe problems during postharvest storage and retailing. The losses of quality are based on weight loss, color changes, accelerated softening and rachis browning, and high incidence of berry decay, which lead to a reduction of shelf life.

Past research to increase post-harvest shelf life has yet to produce methods that are affordable, technologically viable, and can be scaled-up. Several of these methods are primarily designed to keep fruits like apples and pears firm. Thus, need for new solutions for reducing post harvest losses by increasing the shelf life of fruits and vegetables during transportation and storage has become very important.

Edible Coatings for increasing shelf life

In order to overcome the above constrains, coatings for extension of life of fruits and vegetables (without refrigeration) are being developed. Edible coatings are thin films that improve product quality and can be safely eaten as part of the product and do not add unfavorable properties to the foodstuff (Baldwin, 1994; Ahvenainen, 1996). Edible coatings provide a barrier against external elements and therefore increase shelf life (Guilbert et al., 1996) by reducing gas exchange, loss of water, flavors and aroma and solute migration towards the cuticle (Saltveit, 2001). The first kind of edible coatings were water-wax micro emulsions, used since the 1930s to increase brightness and colour in fruits, as well as fungicide carriers. Water loss is another problem that can be controlled with edible wax coatings (Debeaufort et al., 1998). Edible waxes can also offer protection against cold damage under storage (Nussinovitch & Lurie, 1995).

Importance of *Aloe Vera*

Aloe Vera, commonly referred to as a "medicinal plant", is known for its wide range of therapeutic properties. The most common species are *Aloe barbadensis* and *Aloe arborescens*. This semi-tropical plant, *Aloe Vera*, has a long and illustrious history dating from biblical times. It has been mentioned throughout recorded history and given a high ranking as an all-purpose herbal plant. The two major liquid components of *Aloe Vera* are a yellow latex (exudate) and clear gel (mucilage), which proceeds from the large leaf parenchymatic cells (Ni et al., 2004).

Aloe Vera is a plant made up of many complex ingredients including polysaccharides, glycoproteins, phenolic compounds, salicylic acid, lignins, hormones, amino acids, vitamins, saponins and enzymes which give *Aloe Vera* its many beneficial properties. *Aloe vera* gel is used as an antibacterial, antifungal and anti-inflammatory gel. The main use of *Aloe vera* gel is in the cosmetic industry including treatment of burns and scars and wound healing (Serrano et al., 2006). Recently, the use of *Aloe Vera* gel as an edible coating has been reported to prolong the shelf life and delay senescence in sweet cherry and table grapes (Martinez-Romero et al., 2006; Serrano et al., 2006). *Aloe Vera*. gel based edible coatings have been shown to prevent moisture loss and softening decrease, control respiration and senescence rate, delay oxidative browning and reduce microorganism proliferation in fruits such as sweet cherries, table grapes, nectarines and papaya (Ahmad et al., 2009; Valverde et al., 2005; Martinez- Romero et al., 2006; Marpudi et al., 2011).

Role of *Aloe vera* in Increasing Self life in Fruits

Grapes

Berry softening, berry drop, stem browning and its desiccation, and also by fungal decay shorten Postharvest life of table grapes and thus reduce market value. Effects of edible Coating *Aloe vera* gel on grapes fruits storage were investigated. Harvested clusters of Gizeh Uzum in Iran, were treated by *Aloe Vera* gel at two (1: 3), (1: 4) and salicylic acid at three (0, 1 and 2 mmolL⁻¹) concentrations for 45 days and then at 0±0.5 °C 90 days after first treatment in same temperature to estimate as their shelf life. The lowest PPO was observed in combination of treatment 2 mmolL⁻¹salicylic acid and 33% *Aloe Vera* gel. In addition, *Aloe Vera* gel used at concentration of 33% and 2 mmol/L-1salicylic acid treatment also retained the Soluble solid content, total phenolic, antioxidant, of berry juice after the shelf life period. These results demonstrate that the postharvest treatment of grape berries by salicylic acid and *Aloe Vera* gel and has potential for increasing storage life of table grapes and maintaining their quality.(Asghari et al.,2013)

Sweet Cherry

Because of the harmful effects of chemicals on human health and environment, the use of these compounds in postharvest technology of horticulture crops is highly restricted. In a study, effect of nitric oxide (at 0, 1, 5 and 10 µmol L⁻¹) and *Aloe vera* gel (at 25 and 33 %) on postharvest life and quality of Sweet Cherry (*Prunus avium* cv. Napoleon) fruit during 30 days of storage at 1± 0.5 °C with 85-95% RH was studied. Fruit marketability, total phenolics content, vitamin C, catalase enzyme activity, decay index, weight loss were evaluated after 15 and 30 days. Treatment of fruit with 5 and 10µmolL⁻¹ nitric oxide and 33% *Aloe vera* gel significantly maintained fruit quality during 30 days of cold storage. Combination treatment with nitric oxide and *Aloe vera* gel was effective than each treatment alone in retaining fruit quality attributes. Nitric oxide when applied before treatment with *Aloe vera* gel effectively preserved fruit marketability, total phenolics content, vitamin C, catalase enzyme activity and reduced decay index and weight loss. The results indicated that

the use of nitric oxide and *Aloe vera* gel may be introduced as an effective and successful strategy in postharvest technology of the Siahe mashhad sweet cherry fruit. (Mohamadreza Asghari et al;2013)

Oranges

Three hundred and twenty (320) oranges of Valencia variety were stored under cold conditions in the refrigerator for 8 weeks. The following parameters were carried out during the course of storage: Total soluble solids, titratable acidity, weight loss, firmness, pH, vitamin C and sugar/ acid ratio. The final value for firmness for coated oranges was found to be $1781.25 + 118.30N$, while that of uncoated oranges was $1531.25 + 185.53N$. The pH was gradually increasing during the course of storage in the two treatments, whereas vitamin C was found to be decreasing in storage. The total soluble solid for coated oranges was $9.79 + 1.14\%$ while that of uncoated oranges was found to be $9.34 + 0.06\%$ at the end of storage. There was a linear decrease in titratable acidity during the course of storage. It was found that the value obtained for coated oranges was higher than that of uncoated oranges which was obtained to be $1.14 + 0.07$ at the end of storage. Converse to this was obtained for % weight losses in the two treatments. The weight loss for coated oranges was $29.20 + 0.55\%$, while that of uncoated oranges was $53.30 + 1.17\%$ at the end of storage. A linear increase was observed in sugar/acid ratio in the two treatments during the course of storage with higher value being recorded for uncoated oranges as $8.90 + 0.87$, while lower value was gotten for coated oranges as $7.43 + 0.34\%$. (Arowara, K.A et al;2013).

Papaya

In case of Papaya, the *Aloe vera* coated fruits survived the storage period of 15 days at low temperature whereas all the uncoated controls decayed within 10 days. Marketability was also found to be better for coated fruits. (Marpudi et al; 2011)

Freshly harvested papaya fruits were coated with Aloe gel/AG (50%), papaya leaf extract/PLE incorporated Aloe gel (1:1) and 2.5% chitosan. The coated and uncoated (control) fruits were stored at $30 \pm 3^\circ C$ for 15 d. Physical (PLW, fruit size), chemical (pH, titratable acidity and TSS), and sensory characteristics (colour, taste & firmness); fruit disease index (FDI), and marketability were analyzed at regular intervals during the storage period. The coated fruits survived the storage period of 15 d, whereas, all the uncoated controls decayed within 10 d.

The effectiveness of AG coating was found to improve on incorporation of PLE. Shelf life could be further extended in low temperature storage. This is probably the first study on utilizing a natural alternative such as Aloe -gel and PLE to extend shelf life quality in papaya.

On the basis of the over all physiological changes, Aloe gel based antimicrobial coating has been identified as a suitable method to extend the shelf life of papaya fruits.

Table 1: Table Showing the Increase of Shelf Life Due to Edible Coating of Aloe Vera

Plant	Control	Treatment	Temperature	Time	Relative Humidity	Effects	References
Table Grapes		Treated with salicylic acid at concentrations (0,1 and 2 mmolL-1)	0±0.5°C	45-90 days of cold storage	95%	Control clusters were unmarketable, with a high incidence of decay and accelerated quality deterioration. Coated clusters showed encouraging results.	Asghari et al 2013
Table Grapes		Treatment with a solution of A.Vera diluted 1:3 with distilled water.	1°C	7,14,21,28,35 days storage	95%	Control clusters were unmarketable, with a high incidence of decay and accelerated quality deterioration.	Valverde et al 2005
				35 days at 1°C plus 4 days at 20°C.	90%	Treated clusters was considered to be acceptable after 35 days at 1°C plus 4 days at 20°C	
Papaya		Treatment with A.Vera gel along with ascorbic acid(1.9-2.0g/L-1) and citric acid(4.5-4.6g/L-1)	30±3°C	15 days	42-55%	Control started deteriorating before 5 days storage. Coated fruits showed shelf life upto 15 days .	Marpudi et al 2011
Oranges		Treatment with A.Vera gel along with ascorbic acid(1.9-2.0g/L-1) and citric acid(4.5-4.6g/L-1)	12°C.	8 weeks	96-98%	Coated fruits showed better results in terms of weight loss, TSS, Titrable acidity, firmness compared to control.	Arowora et al 2013
Sweet Cherries	Treated with distilled water	A.V. gel treatments fruit were immersed in gel solutions 0, 25% and 33% (diluted with distilled water) for 5 min. For combination treatments fruit were first treated with NO and then were dried at ambient temperature for 8 min and then treated with A. V. gel.	1-0.5°C.	30days	85-95%	Nitric oxide with A.Vera gel significantly maintained fruit quality than to Control.	Mohamadrazza Asghari et al 2013

Conclusion

Edible coatings are traditionally used to improve food appearance and conservation due to their environmentally friendly nature, because they are obtained from both animal and vegetable agricultural products (Petersen et al 1999). Generally, coatings can be divided into proteins, lipids, and polysaccharides, alone or in combination. They act as barriers to moisture and oxygen during processing, handling, and storage and do not solely retard food deterioration but also enhance its safety due to their natural biocide activity or the incorporation of antimicrobial compounds. Edible coatings, apart from acting as a gas barrier, may serve to improve food safety by inhibition or delay of the growth of microorganisms, giving a further step to the concept of active packaging.

Aloe Vera because of its ecofriendly nature and non-toxic properties is a promising candidate for niche applications such as in medical, dental and health care textiles. Due to the availability of the *Aloe Vera* in bulk quantity, easy process of extraction, purification and sterilization made it a standard product that can face the challenges and still can be a good area of innovation in the world of bioactive compounds.

There has thus been an increased interest in using *Aloe Vera* gel as an edible coating material for fruits driven by its antifungal activity. *Aloe Vera* gel based edible coatings have been shown to prevent loss of moisture and firmness, control respiratory rate and maturation development, delay oxidative browning, and reduce microorganism proliferation in fruits such as sweet cherry, table grapes and nectarines. 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 incorporating and/or for controlled release of antioxidants, nutraceuticals, chemical additives and natural antimicrobial agents. Extracts of papaya leaves have been reported to possess antimicrobial activity against fungal pathogens. There are no reports presently on the post-harvest application of Aloe gel coating on papaya fruits or the use of papaya leaf extracts as an antimicrobial agent in coatings. A study was, hence, conducted to evaluate the effect of Aloe gel and papaya leaf extract incorporated Aloe gel coatings on the storage life of papaya fruits in comparison to chitosan coating. Thus the various scientific data and reports show that using *A. Vera* gel based antimicrobial coating in tropical fruits such as papaya, oranges, grapes, cherry's etc provide promising results. The utilization of papaya leaf extracts as an antifungal natural additive in coatings has been also presented here for the first time. These are bio-based substances and are thereby eco-friendly.

Being available easily in the tropical regions, they could be used as a cost-effective simple method for extending the post harvest shelf life and quality of fruits.

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