The Impact of *Aloe vera* Gel as Postharvest Treatment on the Quality and Shelf Life of Table Grape cv. 'Askari'

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**ABSTRACT**
'The Askari' grape cultivar is the most extensively cultivated table grape in Iran. One of the main concerns that growers are facing is the poor postharvest life of this cultivar. Therefore a study was conducted to investigate the effects of *Aloe vera* gel on the postharvest quality and decay of table grape cv 'Askari'. In this study, a factorial experiment base on randomize completely design was conducted with twenty treatments and three replication. The first factor was dipping treatment of grape clusters in four ratios of *Aloe vera* (AV) gel: distil water (DW) (0:1, 1:1, 2:1 and 3:1 v/v) and second factor was storage duration of five times (0, 15, 30, 45 and 60 days) at the condition of 4°C and 85±5% RH. Traits such as weight loss percentage (WL %), berry browning percentage (BB %), berry shivering percentage (BSH %) and berry decay percentage (BD %) were measured. Results showed that application of AV gel reduced WL%, BD %, BSH% and BB%. The highest WL%, BD % and BB% were observed in uncoated grapes (control) in 60 days after storage period. Therefore, application of postharvest AV gel in the ratio of 2:1 is recommended for improving quality and shelf life of grape cv 'Askari'.

**Keywords:** Berry, browning, decay, fruit quality, storage, weight loss.

**Abbreviations:**

**INTRODUCTION**
Grape is one of the most important small fruits in the world both as fresh fruit (table grape) and processed in grape juice, molassa and raisins. As fresh fruit, grapes are very delicate and the loss at harvest and during the distribution is very high (Mencarelli and Bellincontro, 2005). Short life, fast putrescible, reducing firmness, berry shattering during harvest, large wastage, loss weight of berry and lack of related processing industries are the major problems of table grape cultivar 'Askari'. Weight loss, change in colour of the clusters and berries, softening and fungal decay during storage, cause reduce of grapes economic value (Vesaltalab et al., 2012).

Edible coatings have useful effects in fruits such as bright appearance, colour improvement, delay of water loss percentage, extending of shelf life and protection against microbial decay (Dang et al., 2008). Edible coatings create a modified atmosphere around the fruit by providing a semipermeable barrier to water vapour and gases, and their use offers an attractive alternative to film packaging due to their environmentally friendly characteristic (Rojas-Argudo et al., 2005).

Different compounds have mainly been used as edible coatings. *Aloe vera* gel is a novel edible coating for organic fruit storage technology. *Aloe vera* gel which has been known for its therapeutic, antibacterial and antifungal properties is used as an edible coating to prolong the storage life of tropical and sub-tropical fruits, which would be an innovative and interesting means for commercial application as a means of preservation (Padmaja and John Don Bosco, 2014). *Aloe vera* is a tropical and subtropical plant that has been used for centuries for its medicinal and therapeutic properties (Eshun and He, 2004). *Aloe vera* leaves are rich in bioactive compounds some of which are antioxidants those are broadly used in food engineering as preservation (King et al., 1995; Eshun and He, 2004). Considering health benefits of functional and beneficial effects to humans, the use of *Aloe Vera* in fruits after harvest continuously increased (Miranda et al., 2009).

*Aloe vera* gel is applied to fruits as an edible coating, which has been widely used for most fruits...
and vegetables. Edible coatings have a various favourable effect on fruits such as imparting a glossy appearance and better colour, retarding weight loss, or prolonging storage/shelf life by preventing microbial spoilage. The performance of Aloe vera gel as edible coating is dependent on its composition (Dang et al., 2008). Aloe vera gel has been used as an edible coating in fruits (Valverde et al., 2005; Martinez-Romero et al., 2006; Maria et al., 2008; Cheng et al., 2010), which would be an innovative and interesting means for commercial application and an alternative to the use of postharvest treatments.

Recently, use of Aloe vera gel as an edible coating for pro longevity and senescence delay in grape has been reported by Martinez-Romero et al. (2006). Aloe vera gel used widely for a lot of fruits and vegetables. Increasing shelf life and ripening delay has been reported by some researchers such as Serrano et al. (2006), Martinez-Romero et al. (2006) and Ahamed et al. (2009). Aloe vera contains active compounds such as vitamins, enzymes, mineral elements, lignins, saponins, salicylic acid and acid amine (Surjushe et al., 2008). Asghari et al. (2013) reported that Aloe vera gel is effective on shelf life extending and improvement of grape fruits quality. Marpudi et al. (2013) reported that Aloe gel coating to be very beneficial in reducing weight loss, minimizing changes in physicochemical parameters (such as: pH, titrable acidity and total soluble solids) of the fresh fig fruits and also in reducing fruit decay. The objective of this study was to investigate the effectiveness of postharvest Aloe vera gel treatments on improving and maintaining postharvest quality of table grape cv ‘Askari’.

MATERIAL AND METHODS

Plant Material:
Table grape (Vitis vinifera L. cv. ‘Askari’) were harvested at the ripe stage from a commercial vineyard in Cisakht, located in Kohgiloyeh va Boyerahmad province (Southwest of Iran) during August 2013 and were immediately transferred to postharvest laboratory of Islamic Azad University, Yasouj Branch. At the laboratory, clusters were selected to obtain homogeneous bunches based on colour, size, and absence of injuries, washed and dried.

Fruit Coating:
Grape clusters were coated with Aloe vera gel at 0:1, 1:1, 1:2 and 1:3 v/v. Treatment were performed by dipping clusters for 5 min in the mentioned treatments. Coated and uncoated clusters, were air-dried, put in plastic box with 10 holes and were kept in the refrigerator at 4°C and 85 ± 5 % relative humidity (RH) for 60 days. After storage, at 15, 30, 45 and 60 days, clusters of each treatment were taken for quality evaluation and following analysis.

Weight Loss:
The percentage of WL% was determined according to the below equation:

\[ \text{Weight Loss} = \left(\frac{\text{Initial cluster weight} - \text{Sample weight}}{\text{Initial cluster weight}}\right) \times 100 \]

Berry Decay:
It was determined by the below equation (Samra et al., 2014):

\[ \text{Berry Decay} = \left(\frac{\text{No of decayed berries}}{\text{No of Initial cluster's berry}}\right) \times 100 \]

Berry Browning:
This parameter was calculated based on a 5 score scale as: 1- without browning; 2- low browning; 3- medium browning; 4- severe browning and 5- very severe.

Experimental Design and Statistical Analysis:
The experiment was conducted as a factorial experiment by using a completely randomized design with twenty treatments and three replications. Data were subjected to analysis of variance. All analyses were performed with MSTATC software. Sources of variation were duration of storage and treatments, and the interaction of treatment × duration of storage. Mean comparisons were calculated using the Duncan’s Multiple Range Test at P < 0.05 and charts were draw with Excel software.

RESULTS AND DISSCUSSION

Weight Loss:
The result of treatments on WL % are shown in Fig. 1. Uncoated clusters exhibited a significant increase in WL %. AV coating treatment significantly decreased WL %. In fact, the highest WL percent was obtained in uncoated clusters. The lowest WL percent was observed in coated clusters with a 2:1 ratio of AV:DW (Fig. 1a). The effect of storage time on WL % is shown in Fig. 1b. WL percentage increased progressively with storage time. The highest fruit WL percent (18.02%) was observed at 60 days of storage as compared to initial day. Interaction of AV gel and storage time showed the most WL % was observed in uncoated cluster after 60 days in refrigeration (Fig. 1c). This positive effect of edible coatings is based on their hygroscopic properties, which enables formation of a water barrier between the fruit and the environment, and thus avoiding its external transference (Morillon et al., 2002). As other edible coatings, AV gel prevented moisture loss and controlled respiratory gases exchange (Valverde et al., 2005). Fruit weight loss is mainly related to the
moisture out of the surface of the fruit. Thin-surface of strawberry is susceptible to rapid water loss that is due to drying of the fruit surface. Rate of water loss is related to difference of vapour pressure between the fruit texture and the atmosphere air temperature. Additionally, evaporation from the mechanically damaged fruit surface that is increasing. Edibles coating act as a preservative agent, therefore it restricts water evaporation and transmission. By protection against mechanical damage and blocking of very small wounds in fruit surface, it delays dehydration (Hernadz-Mounz et al., 2008). Martinez-Romero et al. (2005) reported that AV gel coating acts like an edible coating and reduced weight loss of cherry and improves fruit firmness by increasing the cell wall-degrading enzyme activity like polygalacturonase (PG) of pectin methyl esterase (PME). Similar results have been reported by several researchers, including ‘Arctic Snow’ nectarines (Ahmed et al., 2009), ‘StarkKing’ cherries (Martinez-Romero et al., 2006), ‘Autumn Royal’ table grapes (Castillo et al., 2010).

Berry Decay:
The results of this study showed that berry decay percentage of ‘Askari’ grape was consistently affected by the applied treatment. Bunches treated with AV coating significantly had a lower BD%. The lowest BD% was observed in cluster coated with 2:1 ratio of AV and DW as compare to others (Fig. 2a). The effect of storage time on BD% is shown in Fig. 2b. BD percentage increased progressively during storage time. The highest percentage of BD % (17.1%) was observed at 60 days after storage as compared to initial day. Interaction of AV gel and storage time showed the greatest BD% observed in uncoated cluster after 45 and 60 days in refrigerator (Fig. 2c).

Decay is one of the most important postharvest factor in reducing quality of horticultural crops. Anti-fungal activity of AV gel on some of pathogens in harvested crops has been previously recognized. Asghari et al. (2013) have reported AV gel as an germination inhibitor of fungi spore. Kazemini (2011) reported that use of edible coating on strawberry improved physical properties, fruit firmness and reduced fruit decay. In a research on cherry fruit, direct application of AV gel could reduce the microorganism especially Botrytis (Martinez-Romero et al, 2005). Control of fruits decay by pre-harvest (Castilo et al, 2010) and post-harvest (Mrtinez –Romero et al., 2006 and Vaverd et al., 2005) application of AV gel has also been reported. Navaro et al. (2010) reported that
application of AV gel increased shelf life of nectarine due to decrease of ethylene, respiration rate and fungi decay. Application of AV gel coating extended shelf life by delaying postharvest loss of quality and fruit quality improvement of some fruits such as Jujube (Padmaja and Bosco, 2014), Strawberry (Vahdat et al., 2012), Granny smith and Red Chief apples (Ergun and Satici, 2012), tomato (Athmaselv et al., 2013), Sweet cherries (Martinez-Romero et al., 2006), some stone fruits (Paladines et al., 2014), fig (Marpudi et al., 2013) and table grapes (Serrano et al., 2006; Chauhan et al., 2014; Shahkoomahally and Ramezanian, 2014) have been reported.

Berry Shrivelling:
Application of AV gel reduced BSH percentage in 'Askari' table grapes. The results presented in Fig. 3a showed that the utmost BSH% was obtained in clusters coated with 2:1 ratio of AV and DW as compare to other treatments. The effect of storage time on BSH % are shown in Fig. 3b. BSH percentage increased progressively with storage time. The highest BSH (13.58%) was observed at 60 days of storage as compared to initial day. Interaction of AV gel and storage time showed that the utmost BSH percentage occurred in uncoated cluster after 60 days of storage (Fig. 3c). Increasing and preservation of post-harvest fruits quality properties is one of the most important goals in food security besides reducing agricultural products spoilation. Edible coatings is one of the most important non-chemical agent that have a lot of use such maintenance of foods materials, antibacterial and antioxidant properties. On other hand, edible coating have a few influence on oxygen and moisture, so it’s is a good barrier to gases and vapour water that affected crop quality preservation (Sinoviky and Alkhatib, 2003). Obtained results of this study was similar to Vahdat et al. (2012) findings. They reported that strawberry cv 'Selva' coated with AV gel significantly showed less WL percent and their firmness was higher in coated fruits. In a research, Guillen et al. (2013) found that coating peach and plum fruits with AV gel significantly delays postharvest ripening related quality parameters changes.

Berry Browning:
The results of this experiment show that AV gel could be used as an inhibitor of BB%. The lowest of BB% (1.36%) was observed in clusters coated with 2:1 ratio of AV and DW (Fig4a). The effect of storage time on BB% is shown in Fig4a. BB% increased progressively with storage time. The highest BB% (8.55%) was observed in 60 days of storage as compared to initial day.
Fig. 3. a) Effect of AV gel treatment on BSH% of 'Askari' table grape. b) Effect of Storage time on BSH% of 'Askari' table grape. c) Interaction of AV gel and storage time on BSH percent in 'Askari' table grape.

Fig. 4. a) Effect of AV gel treatment on BB% of 'Askari' table grape. b) Effect of storage duration on BB percent in 'Askari' table grape. c) Interaction of AV gel and storage time on BB percent in 'Askari' table grape.
Interaction of AV gel and storage time showed the utmost BB% observed in uncoated cluster after 60 days in storage (Fig4c). Marpudi et al. (2013) reported the sensory characteristics of the coated fig fruits were also found to be better than the control as evidenced by lesser shrivelling and browning of the fruit peel.

CONCLUSION

From the obtained results, it can be concluded that application of AV gel affects fruit quality characteristics during storage of ‘Askari’ table grape by improving them. Application of AV gel with a ratio of 2:1 increases postharvest quality of table grape cv ‘Askari’ until 30 days after harvest.

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