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Effect of Coating of *Aloe Vera* Gel on Shelf Life of Grapes

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ABSTRACT

The present study had been conducted to study the shelf life of grapes with coatings of *Aloe Vera* suspended in water with concentrations of 0, 10, 20 and 30 per cent *Aloe vera* and was stored in poly packaging and open plates under different temperatures of 0^0C and 30^0C in refrigerator and incubator. The data was compared with the original shelf life of grapes to determine the efficiency of the Aloe Vera coating. *Aloe Vera* based coatings provided good gloss and 20 per cent coating concentration gave the best visual and physicochemical results. It was found that 20 per cent coating concentration of *Aloe Vera* is the most effective and appropriate for the extension of shelf life of grapes. It was also found that the use of low temperature storage in combination with edible coating and packaging extends marketability by reducing moisture loss.In short, the shelf life of grapes can be increased by using *Aloe Vera* gel coating and the spoilage due to fungal infection of grapes can be reduced.

Key words: Edible coating, Aloe Vera, Shelf life, Grapes, Food safety, Packaging, Storage.

INTRODUCTION

Grapes belonging to Family *Vitaceae* are commercially important fruit crop of India. It is a temperate crop which has got adapted to sub-tropical climate of peninsular India. India is among the first ten countries in the world in the production of grape. This crop occupies fifth position amongst fruit crops in India with a production of 1.21 million tones (around 2% of world's production of 57.40 million tons).

Grapes are highly perishable non climacteric fruits with reduced shelf-life due to decay, weight loss, and nutrient degradation during the storage time. Grapes can be decay during pre-harvest and post-harvest and post-harvest decay of grapes can be due to physical, physiological, or pathological factors. Rachis dehydration is a main decay factor (physical deterioration) of grapes during the pre or postharvest[23,24]. Skin browning of grapes is another main physiological problem associated with mature table grape cultivar[79]. Major cause for grape spoilage is fungal infection, which decreases the production of fruit[75]. Fungicides spray prevent decay of grapes but because of health hazard effects with the application of fungicides, have become restrictive, there is a necessity of natural substitutes, such as the application of essential oils of plants which shows higher effectiveness in preventing decay of table grapes[79, 52].

Aloe vera has medicinal properties, is a tropical and subtropical plant that has been used from ancient time[29]. The gel of *Aloe vera* leaves is the colorless mucilaginous, obtained from the parenchymatous cells. The usage of A*loe vera* gel in the food industry is increasing day by day as resource

of drinks, beverages and ice creams[29].*Aloe vera* is a stem less and very short-stemmed succulent plant belongs to family *Liliaceae*[74,53]. The medical uses of the gel juice (orally) are against skin diseases, constipation, radiation injury gastrointestinal, kidney and cardiovascular problems; reduce the cholesterol and triglyceride levels in blood. Recently other important property of *Aloe vera* has been reported such as anti-inflammatory and antibiotic activities against some diseases like diabetics, cancer, allergy and AIDS[28,60]. A*loe vera* gel is also used in the cosmetic industry, including treatment of burns and scars and in wound healing[1]. The antifungal activity of *aloe vera* gel has observed against several pathogenic fungi including *Botrytis cinerea,* main causative agent to decay grape fruit[42,63].

Edible coatings create a modified atmosphere around the fruit by providing a semi permeable barrier to water vapour and gases, and their use offers an attractive alternative to film packaging due to their environmentally friendly characteristic. They have been used since ancient time to protect perishable food stuffs from deterioration by retarding dehydration, suppressing respiration, improving textural quality to retain volatile flavor compounds, and reducing microbial growth[25,54].

Due to increased consumer's demand for food without chemical preservatives has resulted in application of natural antimicrobials preservatives and antimicrobial films and fungicide application can be reduced. To avoid fruit spoilage it is essential to preserve fruits and it has been estimated that around 25 to 80 per cent of harvested fresh fruits are wasted due to spoilage[58].

Aloe vera gel is a novel edible coating for organic fruit storage technology. Application of aloe vera gel coating has been reported to extend shelf life by delaying post-harvest loss of quality in fruits and vegetables. There are natural preservatives which are used as edible surface coatings for vegetables and fruits such as waxes but these coatings commonly contain ingredients such as polyethylene, carnauba and candelilla[39,25,3]. Amarante *et al.* (2001); Jeong *et al.*, (2003) have studied wax coating as fruits preservatives and increase the shelf life, slows down ripening, retards water loss, reduces decay and enhances visual quality.

The *Aloe gel* is composed of water, amino acids, vitamins, lipids, sterols, tannins, and enzymes[64] and contains phenol, saponin, anthraquinones components, have anti-bacterial, antiviral and antifungal properties. Aloe vera has shown antibacterial property against gram positive and gram negative pathogens[2]. *Aspergillus*, *Fusarium* and *Penicillium* are fungal species which are responsible for oxidation and spoilage of food (A. Babaei et al., 2013). *Aloe vera* can be applied as edible coatings for fruits as its biological activities prevent loss of moisture, firmness, control respiration rate and maturation development, delay oxidative browning, and reduce microorganism proliferation[79,52].

MATERIALS AND METHODS

The present study was conducted in the Department of Post-harvest Process and Food Engineering. Chlorine for pre-treatment and cleaning of grapes was taken from the chemical store. A BOD automatic incubator and a refrigerator were used for storage of grapes after coating. The temperature range of incubator is 5^0C to 50^0C and sensitivity ranges up to 0.5^0C. Temperature range of refrigerator was 4^0C to 18^0C. A magnetic stirrer was used to mix thoroughly mix the *Aloe vera* with water. Digital Pocket pH test meter was used for estimation of pH.

Plant Material

Fresh healthy Indian Grapes "Thompson Seedless green colour grapes were purchased from the Main Market, Pantnagar, Uttarakhand.

Surface Preparation of Grapes

The primary purpose of surface preparation was to remove all the contaminants that would hinder proper coating adhesion and to render a sound, clean substrate, suitable for firm bonding. The grapes were washed with chlorine for blanching.

Preparation of *Aloe Vera* Coating

The *Aloe vera* was purchased from the Main Market, Pantnagar, manufactured by

PatanjaliAyurved Ltd. The *Aloe vera* was heated at 70^{0}C and then was immediately cooled for stabilization and ascorbic acid (1.9-2.0g, L^{-1}) and citric acid (4.5-4.6g, L^{-1}) was added to maintain the pH at 4. The solution was stored in darkness to to prevent oxidation of solution[2].

Coating Application

After washing the grapes were air dried and divided in to 16 groups (100gm ±1gm), which corresponded to 4 coating treatments (0% control), 10%, 20%, 30% then grapes were dipped in to the gel for 5 minutes and were then air dried for 30 minutes. Eight groups were stored in refrigerator at 4^{0}C in which 4 groups were poly packed and 4 groups were stored in open plates. Remaining 8 groups were stored in incubator at 30^{0}C and 4 groups were poly packed and 4 were stored in open plates. Physiciological parameters were carried out weekly in triplicates.

Grape Quality Assessment

Groups of each treatment were visually examined for the rachis appearance, incidence of cracked and shattered berries, decay, browning, and assessed acceptability by a panel of 5 persons. The visual characteristics were scored in daylight. So the quality of grapes was assessed at the end of storage by evaluation of berry, incidence of cracked, brown, and shatters berries, berry color and weight loss.

pH Assessment

Fruit juice was obtained by extraction of berries and filtered through cheese cloth for the

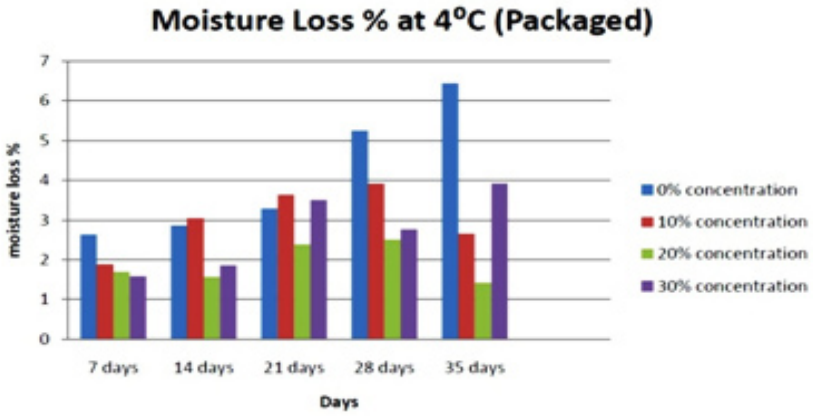

Fig. 3.1: Relationship between moisture loss (%) & time of storage of packaged grapes at 4°C

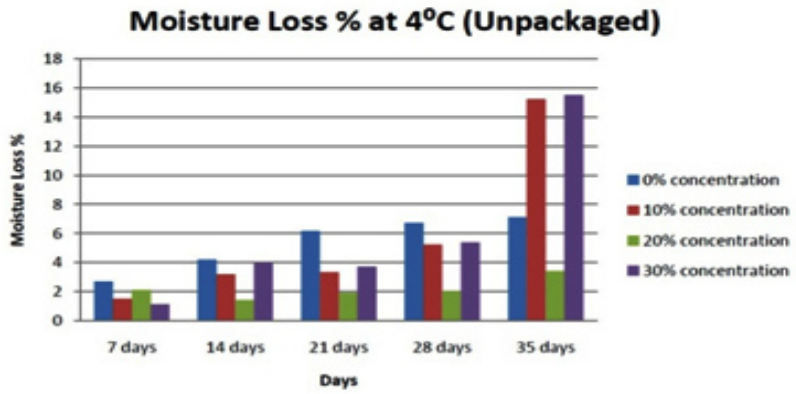

Fig. 3.2: Relationship between moisture loss (%) & time of storage of unpackaged grapes at 4°C

measurement of pH. pH was measured by digital pocket pH meter. The readings were taken in triplicate basis on the first day and after the different sampling dates.

Weight Loss Assessment

Weights of individual groups were recorded on the first day and after the different sampling dates. Weight losses were expressed by the following relationship:

$$\text{Weight loss(g/100g)}=\{(WWf)/W\} \times 100$$

Where

W - initial weight

W_f – final weight

Colour Analysis

In order to determine the effects of treatment and storage time on colour change of the grapes colour analysis was done. First of all, a photograph was taken using a DSLR camera, under a fluorescent illuminated state. Then the photograph was analyzed using a image processing software (like Adobe® Photoshop™) to determine the value of luminance (L*), parameter „a*" defined along the axis of red-green and parameter „b*" defined along the axis of yellow-blue. The net colour difference (ΔE) was calculated using the relation:

$$\Delta E = \text{“ } \sqrt{(L^*L^*)^2 + (a^*a^*)^2 + (b^*b^*)^2}\}$$

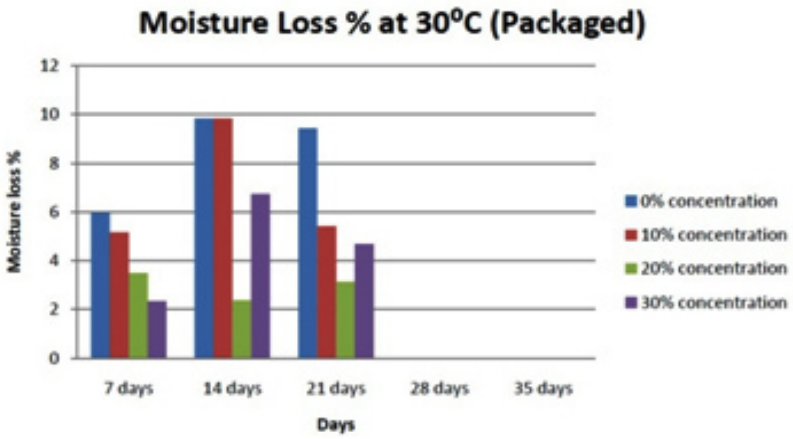

Fig. 3.3: Relationship between moisture loss (%) & time of storage of packaged grapes at 30°C

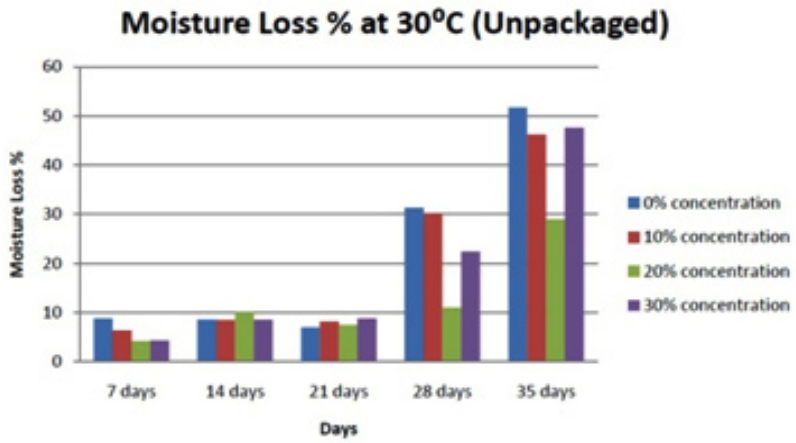

Fig. 3.4: Relationship between moisture loss (%) & time of storage of unpackaged grapes at 30°C

RESULTS AND DISCUSSION

Qualitative Characteristics of Coated Grapes

Fruit Gloss

In order to be of commercial value, any new coating formulation needs to meet the need of high gloss. On the visualization of all groups of grapes after 21 days of storage it was observed that the packaged group stored in incubation at 30^{0}C was unmarketable with a high incidence of decay and accelerated quality of deterioration. For this reason, the predicted sampling schedule of shelf life was stopped at this moment. However, the visual aspects of other 12 groups were considered to be acceptable and were stored for further experiments. The unpackaged groups stored at 30^{0}C in incubator after 21 days lost much of moisture and lost all moisture on 35th day of storage.

Under commercial storage conditions at 25^{0}C to 30^{0}C gloss of grapes faded with storage time of 7-14 days[79]. The differences between fruit gloss were much reduced as storage time increased, as were the differences between coatings having different conditions. These results most likely could be due to differences in humidity and temperature which probably affected the crystalline structure and light reflectance in the fruit surface.

Aloe vera based coatings also provided good gloss and coating with 20 per cent concentration gave the best visual and physicochemical results in contrast to the findings earlier reported by Valverde *et al*. 2005 who studied novel edible coating based on *Aloe vera* gel to maintain the quality and safety of Crimson Seedless table grapes during cold storage

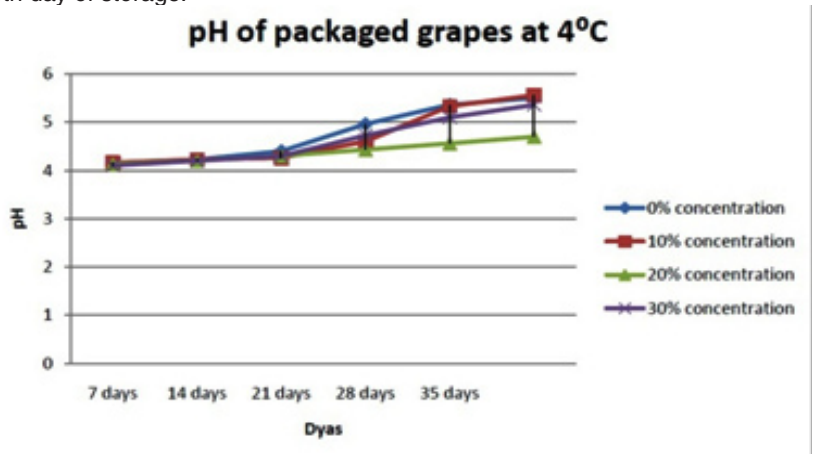

Fig. 3.5: Relationship between pH and time of storage of packaged grapes at 40˚C

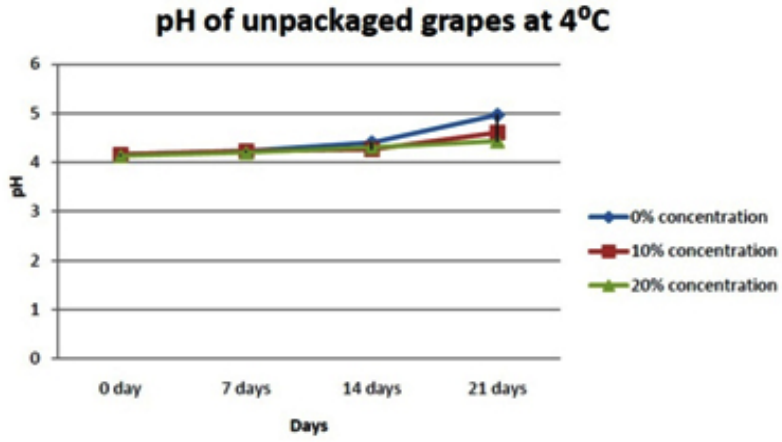

Fig. 3.6: Relationship between pH and time of storage of unpackaged grapes at 4˚C

and subsequent shelf life. *Aloe vera* gel prevented moisture loss and controlled respiratory exchange. It significantly reduced the firmness losses during cold storage and subsequent shelf life, whereas losses of >50 per cent were detected in control grapes after 21 days of cold storage plus 4 days at 20°C.

Surprisingly coatings with 30% Aloe Vera did not provide higher gloss to grapes then coatings with 20% Aloe Vera concentration, this could also be due to translucent character of coating formulations which could be accentuated by increasing lipid content thereby making the coating appear less glossy.

Grapes Weight Loss

Coating concentrations had a considerable effect on weight loss of coated grapes. The figure shows the effect of coating's concentration on weight loss of coated grapes. The uncoated grapes lost much weight than the coated grapes with due course of time.

The grapes which were stored at 4^{0}C with poly packaging and without coating lost tremendous weight at the end of the 35th day. The grapes which were stored at 30^{0}C in incubator with polypackaging showed browning and decayed due to microbial attacks and were not considered acceptable for commercial market use after 21 days and hence were dropped from the experiment.

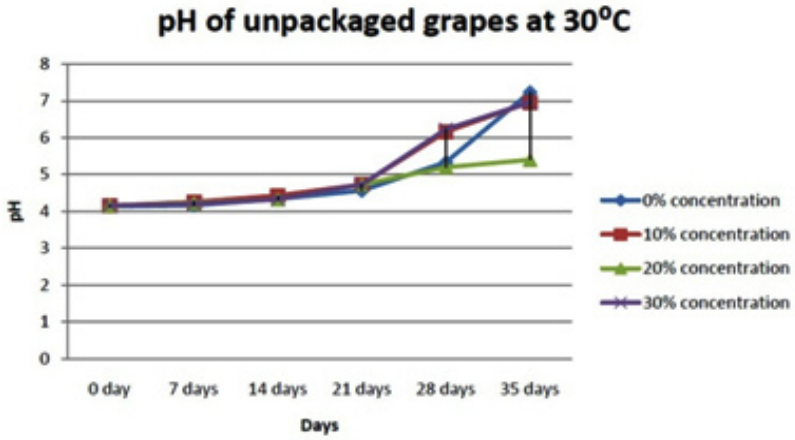

Fig. 3.7: Relationship between pH and time of storage of unpackaged grapes at 30°C

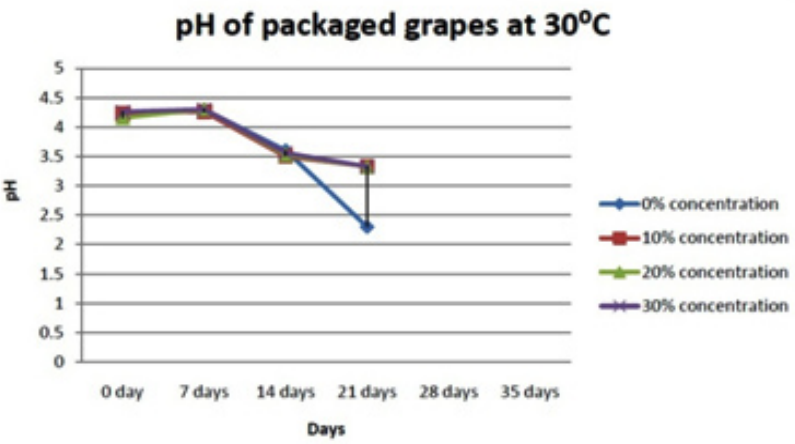

Fig. 3.8: Relationship between pH and time of storage of packaged grapes at 30°C

The grapes stored at 4^{0}C without packaging showed more loss of moisture content then those with poly packaging and the case in 30^{0}C storage was opposite there the openly stored grapes showed morelife then poly packaged grapes.

Effectiveness also depends upon storage conditions when all coating concentrations with moisture loss were examined it was concluded that the coating with 20%concentraton had the minimum moisture loss over all concentrations, packaging conditions and temperature differences. It was seen that the packaged grapes at 4^{0}C lost the minimum moisture over all conditions and the openly stored grapes in incubator at 30^{0}C lost maximum in the total storage period. So among all treatments 20% coating concentration was the most effective as a moisture barrier for prolonged storage. These results suggest that the use of low temperature storage in combination with edible coating and packaging extends marketability by reducing moisture loss.

Grapes pH

The pH of the grape juice was found to be gradually increasing during the course of storage as shown in graphs. The groups with packaging's and which were stored in 30^{0}C in incubator showed acidic behavior from 14th day to 21st day. This was due to the browning, decaying and microbial attack on the grapes due to packaging and due to high temperature. The final value of pH for uncoated grapes in 30^{0}C and unpackaged condition was 6.96. this was due to the fact that they lost all their moisture in the total storage time. Packaged grapes with storage in 4^{0}C gave the minimum pH. The pH of all the coating concentration did not gave very much difference except the 20% coating. There was no significant difference between the two treatments (10.0% and 30.0%). It was found that coated grapes had higher value at the end of storage period; this was due to the semi-permeability created by aloe vera coatings on the surface of the fruit, which might have modified the internal atmosphere i.e. endogenous O_2 and CO_2 concentrations in the fruit, thus retarding ripening.

CONCLUSION

Grapes were coated with *Aloe vera*gel suspended in water with concentrations 0, 10, 20 and 30 per cent and were stored in poly packaging and open plates under different temperatures of 0^{0}C and 30^{0}C in refrigerator and incubator. Initially the weights of grapes were taken and made 16 groups of 100 ±1gm. Grapes were stored for a period of 35 days and the readings were taken accordingly. Fruit gloss, decaying, rachis browning, weight loss and pH were evaluated during the storage period.

Coating concentrations, temperature and packaging had an effect on weight loss, fruit gloss, colour and pH. The weight losses of coated grapes have decreased with increasing concentrations of coating. 30% coating concentration gave more weight loss on the contrary. 20% coating concentration gave the least moisture loss on all the parameters taken. Weight loss over time was due to loss of moisture content of the grapes. The coating made a barrier in the surface and less moisture was lost in the coated grapes. A lack of coating integrity and uniformity may have allowed moisture to escape from the grapes. Normally grapes turn brown over time due to rachis browning and enzymatic changes and loss of water. Edible coating was hypothesized to help maintain firmness by sealing in moisture. The higher coating concentration of 20% makes these coatings more appropriate for extension of shelf life.

In the storage poly packaging and open plates were used to store the sample under different temperatures. The poly packaging made grapes brown, acidic and microbial activity increased in incubator at 30^{0}C so it was concluded that poly packaging can increase shelf life by 1-2 weeks under 30^{0}C storage conditions and upto 2-3 weeks at same temperature under open conditions. The poly packed grapes which were stored in refrigerator at 4^{0}C gave increase in shelf life for 35 days and those in open plates under refrigerator gave 3-4 weeks shelf life.

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