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Application of *Aloe vera* gel on shelf-life of grape (*Vitis vinifera* L. var. Shindokhani)

R. KAZIMI[1*] AND D. SAXENA[2]

[1]*Department of Horticulture, Faculty of Agriculture, Daikundi of Higher Education Institution, Afghanistan*
[2]*Department of Horticulture, Faculty of Agriculture, Lovely Professional University, Phagwara, Punjab, India.*

[*]*rahmatullah.12000758@lpu.in*

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ABSTRACT

Grape 'Shindokhani' variety is the most extensively produced, local and commercial table grape in Afghanistan. This variety is mostly demanded which is used for export, raising and table grape but this cultivar's short postharvest life is one of the main concerns. A study was conducted at Kabul University's Laboratory of Horticulture Department to determine how *Aloe vera* gel edible coating influenced the shelf life of cv 'Shindokhani' table grapes after harvest. This study used a completely randomized design to conduct a single factor experiment with five treatments and three replications. The initial step involved dipping grape clusters in five different *Aloe vera* (AV) gel coating 0%, 5%, 10%, 15%, 20%, drying and storing the bunches, and collecting data over a 3-day period. The proportion of weight loss (WL%), berry decay (DP%), berry total soluble solid (TSS), and berry pH were all measured. The findings, applying *Aloe vera* gel coating reduced WL%, DP%, as well as increase the amount of TSS, and pH. The coated grapes had the least weight loss as well as the lowest DP% and the maximum TSS%. As a result, enhancing the quality and shelf life of grape cv 'Shindokhani' by applying postharvest *Aloe vera* gel coating in a 5% and 15% concentration are recommended.

Key words: *Aloe vera*, edible coating, fruit quality, post-harvest quality, table grape

INTRODUCTION

Grapes (*Vitis vinifera* L.) are prized temperate fruit plants adapted to tropical and subtropical agro-climatic conditions. The fruit is a fleshy globose to oblong berry. The fruit can be white, green, purple, or red in color and can grow to reach 3 cm long (Urbi et al., 2014). Grape is one of the most important small fruits in the world, both as a fresh fruit (table grape) and as a processed product (grape juice, molasses, and raisins). As a fresh fruit, grapes are quite delicate, and there is a significant amount of loss between harvest and distribution. Weight loss, cluster and berry color changes, softness and fungal degradation during storage, and a lack of linked processing industries are all key issues with table grapes (Farahi, 2015). The grapefruit contains like water 82%, carbs 12-18%, proteins 0.5-0.6%, and fat 0.3-0.4%. Grapes are also a good source of other nutrients, such as boron, which may help with bone health (Yadav et al., 2009). In addition, Grape is a popular fruit that are high in phytochemical such phenolic acid, flavonoid, tannins, anthocyanin, cyanidin, ellagic acid, and proanthocyanidins, all of which have health advantages. Fever, diarrhea, and ulcers could all be treated with different components of the plants (Karthikeyan et al., 2020).

There are over 100 grape varieties in Afghanistan, but commercial production is focused on three varieties, i.e., Shindokhani, Kishmishi, and Taifi. Shindokhani is a local grape variety in Afghanistan that has a high commercial return and is in high demand both in the country and around the world. This grape variety is seedless, has a light-yellow color, and matures in September. It is used for table grapes, raisins, and export, but the short postharvest quality is the main issue with this variety (Roots of Peace and Ministry of Irrigation, 2016).

Grape production was estimated to be around 74.5 million tons, based on a 7.12 million hectares of growing area. China, Italy, the United States, Spain, France, Turkey, India, and Iran are the top grape producers (Pahi et al., 2021). Agriculture is the main source of the Afghan economy, accounting for 23% of the country's gross domestic product (GDP) in 2017, with 61.6 per cent of the working force employed in this industry. Afghanistan produces organic fruits, nuts, and grains, vegetables, and livestock goods such as cashmere, skin, and wool, with a substantial portion of these commodities destined for export. Horticulture is a significant element of the Afghan agricultural industry, accounting for around 360,000 ha or 14% of the total irrigated land area, and employs over 2 million people. Many rural households rely on horticultural products, such as grape cultivation, to supplement their income. Grapes play a significant role in horticultural production and business in Afghanistan, accounting for 48 percent of all farmland allocated to fruit farming. In 2015, grapes were the most popular export commodity, accounting for 19.5% of Afghanistan's total exports (Safi et al., 2018). Grape output in Afghanistan climbed from 3,60,000 MT in 2007 to 8,74,541 MT in 2016. In 2016, the province of Kandahar produced the majority of grapes. In 2015, Afghanistan was the world's eighth largest producer of raisins (dried grapes), accounting for 2.54% of global production (Atif et al., 2020)

Edible coatings are made up of edible components including lipids, proteins, and polysaccharides, and they can be eaten. By purifying the internal atmosphere of food products, these coatings extend their shelf life. These act as a semipermeable barrier, slowing respiration and transpiration and so delaying aging (Qamar et al., 2018). *Aloe vera* L. is a succulent plant of the Asphodelaceae family of the genus *Aloe* that has been used for centuries as a medicinal herb. (Nicolau-Lapeña et al., 2021). *Aloe vera* seems to be a cactus because of its thick, thorn-edged leaves that kept changing from gray to brilliant green, but it is basically a lily (Asphodelaceae). A regular *Aloe vera* plant blooms on and off throughout the year, producing two or three yellow tubular blossoms that imitate Easter lily petals. Its thick leaves keep the plant's water supply contained, allowing it to survive long periods of drought. Because the leaves have a high capacity for retaining water, this plant can live in settings when most other flora has died, even in extremely hot and dry climates (Misir et al., 2014). *Aloe* gel coating was found to be effective in lowering weight loss, eliminating changes in Physicochemical parameters of fresh fig fruits (such as: pH, titratable acidity and total soluble solids), and reducing fruit degradation (Farahi, 2015)

MATERIALS AND METHODS

Plant Material

Table grape (*Vitis vinifera* L. cv. Shindokhani) have been bought at the level of ripe from the local farmer, Shaker Dara district of Kabul, Afghanistan during the month of October in 2021 and has been transmitted instantly to Horticulture Department, Faculty of Agriculture, Kabul University. At the laboratory, clusters have been chosen to obtain homogenous bunches based on color, size, and absence of injuries. *Aloe vera* plants were collected from Shopkeeper, Kota Singe, Kabul city, and have been shifted to Laboratory of Horticulture Department.

Fruit coating

Clusters of grapes have been covered with *Aloe vera* gel at levels of 0 %, 5%, 10%, 15% and 20%. Treatment have been performed by immersing for 15 minutes in indicated treatments. The covered and uncovered bunches of the fruits have been air dried, placed in plastic box which having holes and maintained at room temperature and relative humidity 21% for 22 days. During storage, at 3 days' interval, clusters of each treatment have been taken for evaluation of qualities and following analysis:

Table 1. Treatment Details

Treatment	Description	Concentration (%)
T1	Water	0
T2	*Aloe vera* Gel Coating	5
T3	*Aloe vera* Gel Coating	10
T4	*Aloe vera* Gel Coating	15
T5	*Aloe vera* Gel Coating	20

Weight loss

The percentage of Weight Loss (WL, %) was determined according to the bellowing equation:

Weight Loss %=(Initial weight - weight sample)/(initial weight) × 100

Fruit decay

Fruit decay (%) was determined by the below equation:

Berry decay (%)=(Weight of Decayed Berries)/(Initial Cluster Weight) × 100

Fruit pH

Primarily, at 3 days' interval about 28 mL from each treatment have been taken for making the juice and transferred to glass flask and the pH for pH meter was controlled by the distilled water, in consequence, this parameter has been taken and calculated by the digital pH meter

Total soluble solids

Primarily, at 3 days' interval the 28 mL of grape juice from each treatment have been taken for making ready the juice, in consequence the total soluble solids (TSS) have been calculated and measured by the hand refractometer and have been shown in Degree Brix.

Experimental design and statistical analysis

This experiment has been undertaken as a single factor experiment. Data have been subjected to analysis of variance. The experimental data has been carried out in Completely Randomized Design with five treatments and three replications of grapes. Data have been analyzed by using Statistical Package for the Social Sciences. Means have been compared by the Least Significant Differences test at significant level of 0.05.

RESULTS AND DISCUSSION

Weight loss

Table grapes, like many other fruits, experience a variety of physical, chemical, and biological changes during storage that trigger and hasten the ripening process. Due to weight losses and the incidence of decay brought on by fungal plant diseases, these changes are accompanied by economical postharvest effects. *Aloe vera* treatment considerably decreased weight loss, which is regarded appropriate for retailing reasons, and this weight loss was synchronized with a decrease in respiratory rate. Weight loss rose while the grapes were being stored, although it was substantially more pronounced in the control than in the berries treated with *Aloe vera* gel. It is clear that the T1 treatment resulted in the fruit shedding the most weight (10.37). Even though the fruit losing weight was the lowest in Treatment 2 (7.59), (Fig. 1) it was also lowest in Treatment T4 (8.60) and T3 (8.96) (Fig. 1). In addition, when T2, T3, and T4 therapies are compared to T1 treatments, there was a favorable association.

Unexpectedly, coatings containing 20% *Aloe vera* did not include any greater gloss to grapes than coatings containing lower concentrations of *Aloe vera*. This could be directly attributable to the translucent nature of coating preparations, which could be enhanced by increasing lipid content, making the coating seem so less shiny. Moisture may have escaped from the grapes because of a lack of coating integrity and conformity, as well as possibly the type of variety. As a result, this agrees with the experiment of Ali et al. (2016).

Table 2. Effects of *Aloe vera* edible coatings on weight loss (%) of grapes (Shindokhani) in various treatments

Treatment	Storage Days							Mean
	4	7	10	13	16	19	22	
T1	0	10.2	6.92	9.3	10.06	16.03	20.13	10.37
T2	0	7.15	6.53	8.73	7.7	9.56	13.48	7.59
T3	0	9.1	7.22	9.15	9.83	12.16	15.3	8.96
T4	0	7.53	6.76	8.7	9.43	11.66	16.13	8.60
T5	0	8.16	7.53	9.73	12.16	17.36	20.43	10.25
Mean	0	8.428	6.992	9.122	9.836	13.354	17.094	
SD	0	1.1048	0.350	0.3831	1.4267	2.8947	2.7406	

Omero and Errano (2005) reported similar results, claiming that *Aloe vera* gel coating prevented weight loss, quality loss, color changes, and prolonged the storability of table grapes, this is due to edible coatings' hygroscopic qualities, which allow for the creation of a water barrier between the fruit and the environment, preventing external transmission of moisture. Without the addition of lipids, *Aloe vera* gel, which is primarily composed of polysaccharides, was an excellent moisture barrier. According to Peyro et al. (2017), in the table grape Shahroudi 15% *Aloe vera* gel coating had the highest amount of TSS, and reduction in weight loss as well as improving the grape's shelf life and postharvest quality. This is because of *Aloe vera* gel functions as an O_2 and CO_2 barrier as well as a moisture barrier, reducing weight loss. Furthermore, when compared to uncoated berries, Chauhan et al. (2014) found that 5% and 10% *Aloe vera* gel caused lesser weight loss, minor browning, and reduced the number of bacterial and fungal population. Similarly, Shahkoomahally and Ramezanian (2014) found that *Aloe vera* gel coating on grape fruit reduced browning and dehydration while also lowering the weight loss. In addition, Ozturk et al. (2019) reported that weight of cherry fruit and firmness losses were postponed throughout storage. Relhan et al. (2021) also shown that application of *Aloe vera* gel coating could effectively reduce the losing of weight in Ber fruit.

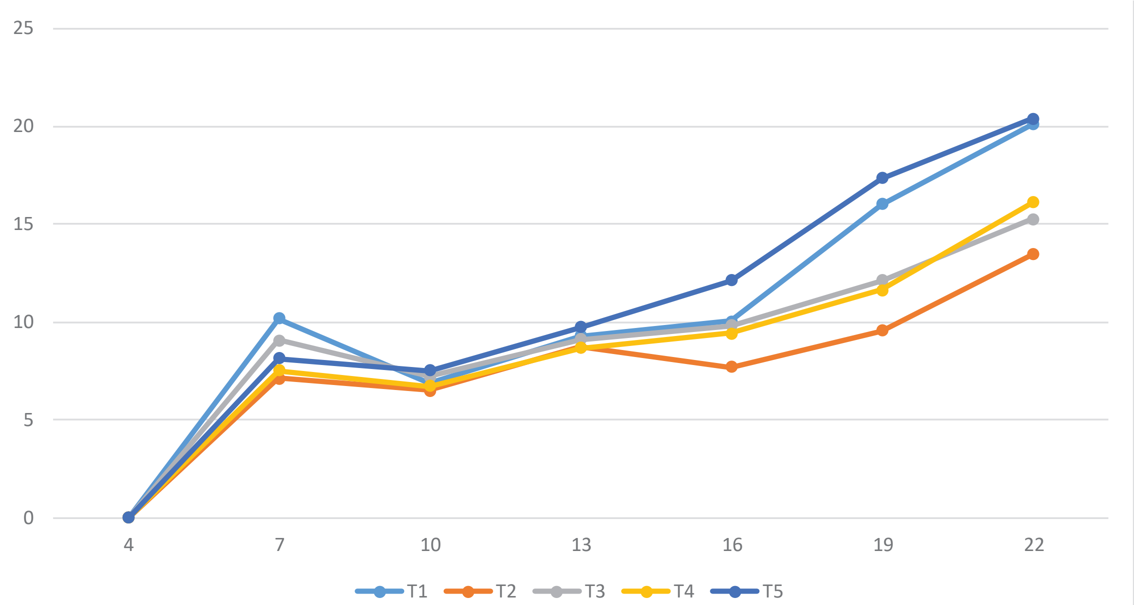

Fig. 1. Effects of edible coatings on weight loss (%) of Grape (Shindokhani) in different treatments

Ergun and Satici (2012) showed that the *Aloe vera* gel coating reduced weight loss significantly on Apple cv Granny smith, significantly. Khan et al. (2019) had shown that *Aloe vera* gel coating at level of 10% is very effective for extension lifespan of Apple fruits.

Fruit decay

One of the most important postharvest factors affecting horticulture crop quality is decay. *Aloe vera* gel coating has previously been shown to have antifungal effect against several pathogens found in harvested crops. The results of this study revealed that the applied treatment had a consistent effect on the berry decay percentage of "Shindokhani" grapes. The proportion of berry degradation was much lower in the *Aloe vera* gel-coated bunches. Clusters coated with T2 (4.51%) of *Aloe vera* gel coating had the lowest decay percentage when compared to others (Table 3). The highest percentage of berry decay was seen at 22 days, (20.2%). But according to treatment 7.13% for the T1 treatment, T2 therapies, as well as T3 and T4, have a favorable link with plant fruit deterioration. It is due to the beneficial effects of *Aloe vera* gel coating on the chemical parameters of plants.

Table 3. Effects of edible coating on fruit decay (%) of grape (Shindokhani) in different treatments

Treatment	Storage days							Mean
	4	7	10	13	16	19	22	
T1	3.1	4.66	3.73	3.76	3.56	3.76	3.9	3.78
T2	3.1	4.23	3.93	4.46	4.13	4.2	4.4	4.06
T3	3.1	4.53	3.92	4.46	4.43	4.16	4.1	4.10
T4	3.1	4.9	3.96	4.53	4.26	4.16	3.7	4.08
T5	3.1	4.66	4.04	4.56	4.26	4.3	3.86	4.11
Mean	3.1	4.59	3.92	4.35	4.12	4.11	3.99	
SD	0	0.218	0.107	0.299	0.299	0.185	0.240	

According to Karunarathna et al. (2021), *Aloe vera* gel showed the best efficacy against a disease called Pestalotiopsis sp. and Phomopsis sp. ripening red. Tarabih (2020) showed that all natural extracts, such as *Aloe vera* gel coating, had a positive effect on pathogen development. According to Farahi (2015), employing *Aloe vera* gel coating reduced the proportion of berry decays, resulting in weight loss in grapes.

When compared to uncoated fruits in a study on Ber fruit, *Aloe vera* gel coating was effective in retaining the attributes for at least 15 days, hence *Aloe vera* coating exhibited the least physiological weight loss and shrinkage percentage (Mani et al., 2017). According to Pinzon et al. (2019), *Aloe vera* gel coating reduced fungal deterioration and increased the shelf life of strawberries by up to 15 days. Furthermore, *Aloe vera* gel coating with a 10% level of *Aloe vera* showed promise in keeping Physio-chemical features as well as sensory attributes for Guava fruits (Shabir et al., 2021). An addition, Saharika et al. (2021) reported that application of *Aloe vera* gel coating could prolong the shelf life Guava fruits. Moreover, Marpudi et al. (2013) has reported that application of *Aloe vera* gel coating can partially bring changes in Physiochemical characteristics in Fig fruits and preventing from fruit degradation.

Fruit pH

All treatments improved the pH value of coated and uncoated fruits, however *Aloe vera* gel considerably enhanced the pH value of coated fruits. The greatest pH of the fruits was found in T5 (4.11), while the lowest was found in T1 (3.78) (Table 4). The metabolic changes in the fruit, such as the breakdown of organic acids to sugars and participation in the respiratory cycle, account for this. Edible coverings like *Aloe vera* gel coating efficiently delay the ripening and degeneration of the fruit by slowing down the pH changes. The pH of grapefruit increases as storage time increases, however, in T4 it appears to slow down and then increase again (Fig. 3).

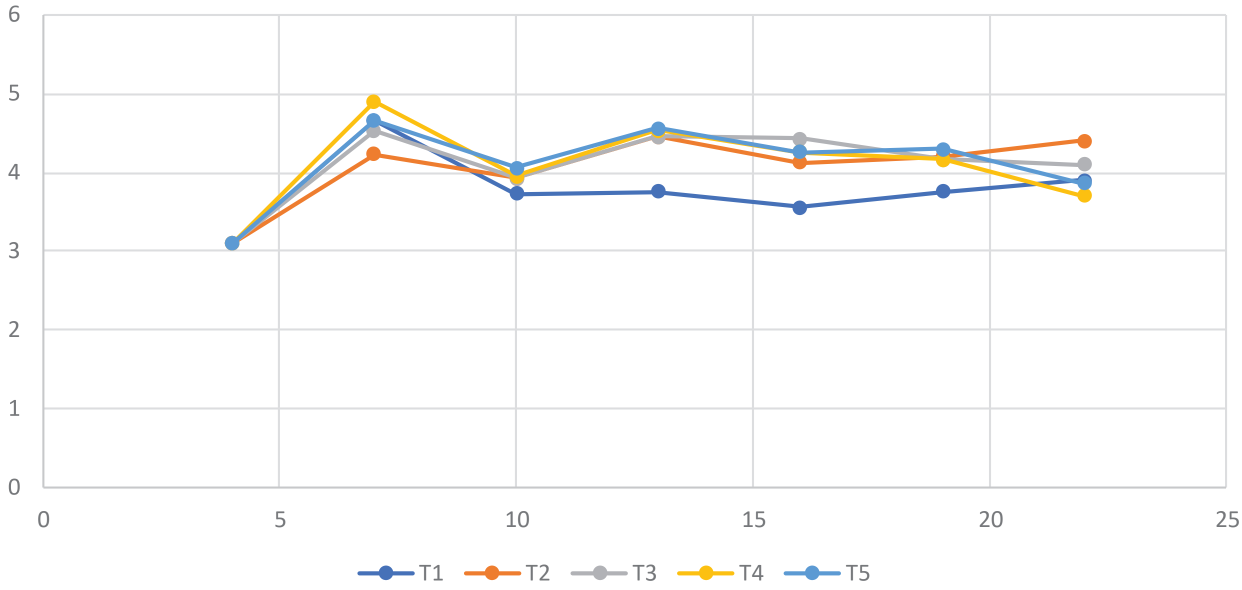

Fig. 2. Effects of edible coatings on PH of Grape (Shindokhani) in different treatments

This looks a lot like (Atlaw, 2018), who discovered that the pH of a fruit such as mango increased during storage due to the use of *Aloe vera* gel coating, and it was also assumed that the increase in pH was due to acid breakup and respiration during storage, and it was also suggested that using *Aloe vera* gel coating with citric acid can significantly increase the value of pH. Similarly, Nia et al. (2021) found that employing *aloe* gel coating elevated the pH value of berries somewhat throughout storage period, with the rise attributed to biochemical changes in the fruit and organic acid breakdown. Similarly, Ali et al. (2016) discovered that the pH of grape fruit increased steadily during storage. Coated grapes had a better value at the conclusion of the storage time, owing to the semi-permeability formed by *Aloe vera* coatings on the fruit's surface.

Table 4. Effects of edible coating on the pH of grape (Shindokhani) in different treatments

Treatment	Storage days							Mean
	4	7	10	13	16	19	22	
T1	3.1	4.66	3.73	3.76	3.56	3.76	3.9	3.78
T2	3.1	4.23	3.93	4.46	4.13	4.2	4.4	4.06
T3	3.1	4.53	3.92	4.46	4.43	4.16	4.1	4.10
T4	3.1	4.9	3.96	4.53	4.26	4.16	3.7	4.08
T5	3.1	4.66	4.04	4.56	4.26	4.3	3.86	4.11
Mean	3.1	4.59	3.92	4.35	4.12	4.11	3.99	
SD	0	0.218	0.107	0.299	0.299	0.185	0.240	

Total soluble solid (TSS, Brix)

The total soluble solids of coated and uncoated grapefruit during storage are shown in (Table 5). During the storage period, the total soluble solids of coated and untreated grapes increased. T2 (26.81) had the greatest total soluble solid, followed by T4 and T3 (Fig. 3). Because the covering material acts as a semi-permeable barrier, respiration rates are reduced. The largest TSS was seen throughout a period of 22 days, compared to the lowest quantity on the first day. Edible coatings have been shown to affect not just water vapor permeability, but also O_2 and CO_2 permeability.

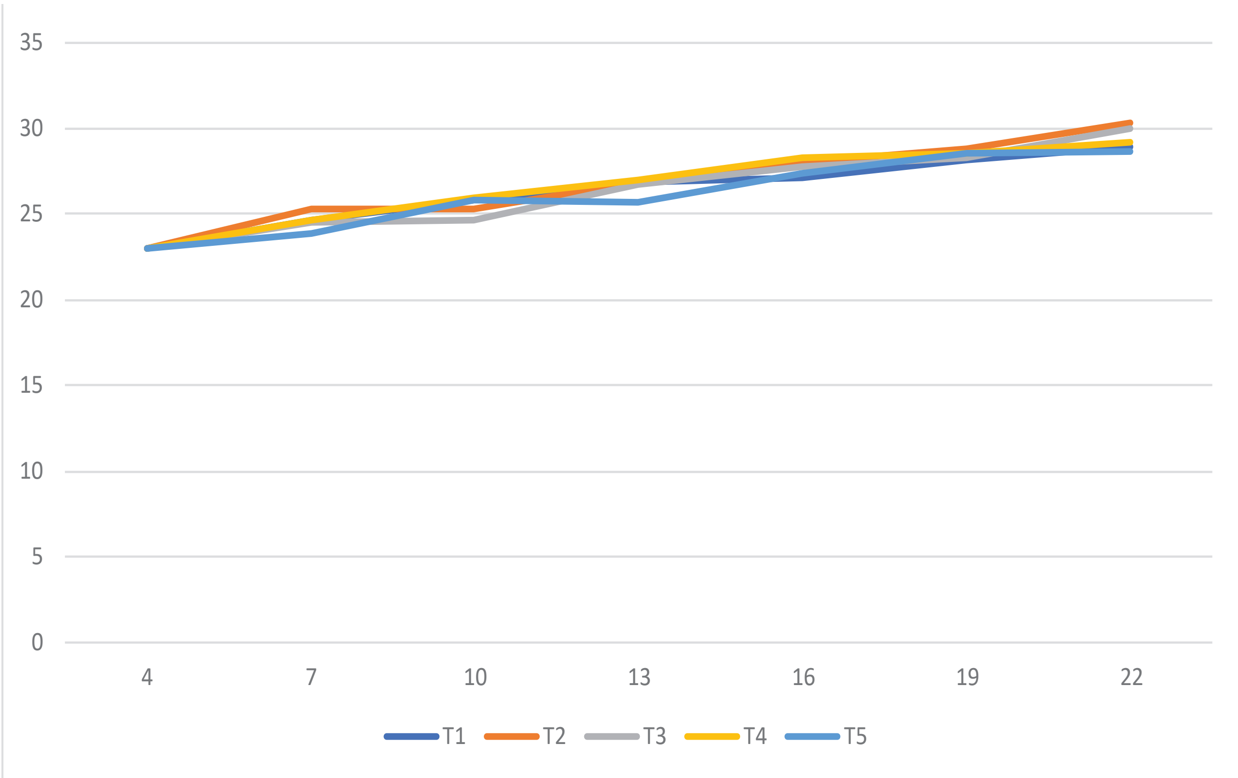

Fig. 3. Comparison of total soluble solids in coated and uncoated grapefruits in different treatments

This is consistent with the findings of (Pinzon et al., 2019) who found that *Aloe vera* gel coating increased TSS in both coated and untreated strawberry fruits during storage. Similarly, Nia et al. (2021) found that *Aloe vera* gel coating enhanced the TSS of berries during storage when compared to control. In addition, Mohammadi et al. (2021) reported that TSS increased during storage without a significant difference between treated and untreated strawberries, and flavor index (as a ratio of TSS/TA) is a major criterion of fruit taste related to increasing sweetness and decreasing sourness. This is also in line with the findings of (Peyro et al., 2017), who found that applying *Aloe vera* gel at a concentration of 15% enhanced total soluble solid content at the greatest rate in grape. According to Mani et al., (2018) the TSS content of various fruits coated and uncoated with various types of edible coating materials like *Aloe vera* coating can be enhanced, with the highest total soluble solid recorded at the 15th day of storage.

Table 5. Effects of edible coating on TSS (Degree Brix) of grape (Shindokhani) in different treatments

Treatment	Storage days							Mean
	4	7	10	13	16	19	22	
T1	23	24.6	25.83	26.93	27.16	28.16	28.93	26.38
T2	23	25.26	25.36	26.93	28	28.83	30.33	26.81
T3	23	24.56	24.66	26.7	27.76	28.33	30	26.43
T4	23	24.6	26	27	28.33	28.56	29.2	26.67
T5	23	23.83	25.76	25.7	27.33	28.5	28.66	26.11
Mean	23	24.58	25.52	26.65	27.71	28.47	29.42	
SD	0	0.454	0.479	0.486	0.428	0.225	0.637	

CONCLUSION

Coatings made from naturally accessible organic materials such as *Aloe vera* might be simply incorporated into the present fruit handling system, giving the produce an extended shelf life. All covered grapefruit in exception of T5 treatment exhibited dramatically reduced weight loss, decaying percentage, and increased total soluble solid, pH of the fruit when compared to the untreated grapefruits. This study confirms *Aloe vera* gel coating as an effective bio-preservative and a viable alternative to synthetic preservatives. *Aloe vera* gel-based coating as a reasonably easy and safe approach to successfully enhance the shelf life of postharvest crops. The *Aloe vera* based covering is completely non-toxic to the environment. In reality, it is a green alternative to synthetic coatings and other post harvest chemical treatments. Dipping grapes in an *Aloe vera* extract reduced the rate of losing of moisture, which was thought to be the cause of quality degradation and weight loss. In general, the potential of *Aloe vera* gel coating to preserve higher quality for at least 22 days was validated by a reduction in rotting, weight loss, and an increase in TSS and pH of the fruit as compared to uncoated grape fruits. Finally, *Aloe vera* gel coating to grape fruits @5-15 per cent are recommended for effective storage.

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