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Effects of Some Pre- and Post-Harvest Treatments on Physical and Chemical Properties of Flame Seedless Grapevines during Cold Storage

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Abstract

Grapes are susceptible to various challenges after harvest and during marketing, primarily including water loss, disease and fungal infection, berry shattering, and stem browning. These factors significantly limit the storage life of grapes. Therefore, this research studied the effect of some treatments to overcome these problems as much as possible. This study was carried out in two consecutive seasons, 2021 and 2022, on Flame seedless grapevines. Three weeks prior to harvest, the clusters were sprayed with either salicylic acid (SA) at 200 ppm or gibberellic acid (GA3) at 30 ppm, each in a separate application. After collecting the clusters, they were divided into groups and immersed in separate or combined solutions of salicylic acid (200 ppm), GA_3 (30 ppm), and chitosan (1%), Subsequently, the clusters were stored at 5±1°C in a refrigerator at 85-90% R.H., and measurements of select physical and chemical properties were taken on a weekly basis until the storage period concluded. The results demonstrated that compared to other treatments, the control group could not maintain storage for more than three weeks. Conversely, the other treatments managed to preserve good quality up to the fourth week to the best extent possible. Notably, the most effective treatments included pre-harvest spraying with salicylic acid or GA3, as well as post-harvest dipping in chitosan, which maintained relatively good quality until the fifth week to some extent.

Keywords*:* Salicylic acid, Gibberellic acids, Flame seedless, pre- and post-harvest treatments, Cold storage.

Introduction

Grapes (*Vitis vinifera L.*) from the genus Vitis rank first among fruit crops in the world in terms of both production and economic importance (**Vivier and Pretorius, 2002**). In Egypt, grapes rank third among fruit crops, while citrus taking the first and second positions. The cultivated area has expanded significantly, been overgrown, especially on the reclaimed lands. reaching approximately 184410 feddans, the area dedicated to fruitful vines is about 157380 feddans, and the total annual production attained 1472418 tons, according to the statistics of the **M.A.L.R., (2021)**. Grapes are rich in bioactive antioxidants such as phenolic compounds (phenolic acids, flavonoids, anthocyanins and stilbenes) and vitamins. These compounds contribute significantly to both fruit quality and human health when consumed (**Xia *et al.,* 2010; Zhou and Raffoul, 2012**). However, grapes are highly perishable, non-climacteric fruits, and their fruit quality (size and color) is influenced by many factors, such as temperature. The desired appearance-the uniformity of the red hue, the size and shape of the cluster, and the berry-determines its market worth. The quality and nutrient composition of grapes can vary depending on agronomical management practices, agrochemical treatments, viticultural and biotechnological techniques, growth stage, and environmental changes, as well as combinations of leaf removal and crop load treatments. Generally, fruit quality refers to a combination of traits that determine whether the fruit is suitable for consumption while still fresh or for storage for an appropriate amount of time without deterioration and provides advice on its worth in terms of customer acceptance. (**Al-Saif *et al.,* 2022)**

Flame seedless grapes are highly sought-after due to their delightful flavor and crisp taste. This red seedless variety has medium-sized, loose, elongated clusters of dark red flowers that look just as lovely hanging on the vine as they do on the table. It is considered a well-liked table grape cultivar that was recently brought to Egypt, and because of its favorable characteristics for both the local and international markets, it is a promising variety (**Hegazi and Sallam, 2003**). Therefore, many efforts could be made to maintain berries with high-quality characteristics in berry size, firmness, color intensity, and cluster uniformity after harvest and during marketing, which would be very important for the Flame seedless producers to obtain better marketing quality. e (**Korkutal *et al.,* 2008**)

Most fresh fruits and vegetables contain 65%–95% water when harvested. However, even a slight loss of 5% or 10% of their fresh weight can lead to wilting and render the produce unusable. To minimize water loss, it is essential to maintain a moist atmosphere around the harvested produce (**Elazar, 2004**). Unfortunately, about 35–40% of fruits and vegetables are lost during postharvest conditions (**Kumar and Bhatnagar, 2014**). The post-harvest loss of fruits is a serious problem due to rapid deterioration during harvesting, transportation, handling, and storage conditions, especially in tropical regions (**Terry and Joyce, 2004; Gatto *et al.,* 2011**). To address these challenges, edible coatings are used on vegetables and fruits to improve appearance, modify the atmosphere around the fruit's surface to reduce fruit respiration rate, and improve environmental conditions like humidity and temperature (**Baldwin *et al.,* 1995**). These coating materials create semi-permeable berries that facilitate optimal carbon dioxide rates while reducing oxygen rates. Consequently, they minimize respiration, slow down ripening, decrease decay and water loss, lower oxidation reaction rates, and reduce metabolic activities, particularly transpiration and respiration. Therefore, coating fruits makes them more resistant to pathogens, promoting their marketing and storage abilities (**Petracek *et al.,* 1998**, **Park, 1999**, and **Chitarra and Chitarra, 2005**).

Salicylic acid (SA) is a phenolic acid that functions as a plant hormone and plays a crucial role in plant responses to abiotic stress and the regulation of plant growth and development (**Raskin, 1992**). Several studies have shown that the application of SA, either pre- or post-harvest can induce systemic acquired resistance (SAR) to pathogens and reduces decay in peaches and strawberries (**Wang *et al.,* 2006**; **Babalar *et al.,* 2007**), sweet cherries (**Xu and Tian, 2008**), grapes (**Champa *et al*., 2015)**.

The use of gibberellic acids (GA_3) is quite common in table grape production, where the impacts on grape quality are mentioned. Gibberellins affect postharvest grape physical and chemical deterioration, especially berry dehydration, because of vapor pressure deficits, skin browning, and changes in carbohydrates and phenol concentrations (**Vial *et al.,* 2005).** Gibberellic acid (GA_3) as a pre-harvest treatment reached the highest improved berry firmness and delayed the decrease of soluble solids content (SSC) and vitamin C after storage at 0°C in 95% relative humidity for 60 days (**Deng *et al.,* 2006**), had the lowest weight loss, and was effective in reducing decay percentage up to the third week of storage of grapes (**Meena *et al.,* 2012**).

Chitosan, a unique polysaccharide derived from the deacetylation of chitin, has gained significant attention in the field of fresh-keeping due to its favorable characteristics such as biocompatibility, biodegradability, antibacterial activity, and capacity to form membranes (**Chien *et al.,* 2007**). Due to their unique physicochemical properties, chitosan's have been successfully used as food wraps and to maintain the quality of postharvest fruits and vegetables (**Devlieghere *et al.,* 2004**; **Ducamp-Collin *et al.,* 2008**). Previous studies indicated that chitosan coating had the potential to prolong storage life and control the decay of many fruits, such as strawberries, peaches, table grapes, apples, and mango. Previous studies indicated that chitosan coating had the potential to prolong storage life and control the decay of many fruits, such as strawberries, peaches, table grapes, apples, and mangoes (**Romanazzi *et al.,* 2002; Dong *et al.,* 2004; Chien *et al.,* 2007; Ducamp-Collin *et al.,* 2008; Zhu *et al*., 2008).** This research specifically focuses on investigating the effects of chitosan, salicylic acid, and gibberellic acid coatings on Flame seedless grape clusters during cold storage, while assessing changes in physical and chemical properties.

The aims of this research:

- Facing the post-harvest problems and overcoming them as possible.
- Extended the grape storage season while maintaining the best marketing quality, and least expensive.
- Illustrated the effect of salicylic acid, GA_3, and chitosan on physical and chemical properties and storage quality of grapes.

Materials and Methods

This experiment was carried out in two consecutive seasons, 2021 and 2022, on Flame seedless grapevines. The grapevines were cultivated at Afak Farm, located in Balat district, New Valley Governorate, Egypt. The clusters were sprayed with salicylic acid at 200 ppm and gibberellic acid at 30 ppm, in a separate form, three weeks before harvest. The harvest date was set when the TSS reaching approximately 18.1 and the TA at 0.75, the clusters collected and selected as uniform in shape and size as possible, and there were no visible defects, and were directly transferred to the laboratory of the Horticulture Department, Faculty of Agriculture New Valley University.

The clusters were divided into three main groups; and each one was divided into three subgroups except the control, which was divided into two subgroups only. The clusters were washed with distilled water and their surface was disinfected with a 1% sodium hypochlorite solution, and then air-dried before use, for two hours. Each sub-group was subjected to one of the following treatments:

1. Clusters were sprayed with salicylic acid at 200ppm pre-harvest **(T1)**.
2. Clusters were sprayed with salicylic acid (200ppm) pre-harvest and immersed in SA at 200ppm (**T2**)
3. Clusters were sprayed with salicylic acid (200ppm) pre-harvest and immersed in chitosan 1% (**T3**).
4. Clusters were sprayed with GA_3 30 ppm pre-harvest (**T4**).
5. Clusters were sprayed with GA_3 30 ppm pre-harvest and immersed in chitosan 1% (**T5**).

6. Clusters were sprayed with GA_3 30 ppm pre-harvest and immersed in GA_3 30 ppm (**T6**).

7. The control clusters were sprayed with distilled water and immersed in distilled water (**T7**).

8. The control clusters were sprayed with distilled water and immersed in chitosan 1% (**T8**).

The clusters of all treatments were dipped for 60 seconds in the solution of each treatment, dried, and then stored at 5±1°C in the refrigerator at 85-90% R.H until the end of storage period.

Chitosan preparation:

A stock solution of chitosan with a concentration of 1% (w/v), was prepared by dissolving purified chitosan (low molecular weight chitosan was purchased from Sigma Chemical Co.) in 0.5% (v/v) glacial acetic acid, under continuous stirring, and the pH was adjusted to 5.6 using 1 N NaOH. The stock solution was sterilized at 121°C for 20 min., and then lower concentrations (2%) were made by appropriate dilution with distilled water (**Du *et al.*, 1997**).

GA_3 preparation: A stock solution (1000 ppm) of GA_3 was prepared by dissolving purified GA_3 in 1 g/L water and taking 30 ml from the stock, then continuing to one liter for 30 ppm concentration**.**

SA preparation: A stock solution (200 ppm) of SA was prepared by dissolving purified SA in 0.2 g/L of ethyl alcohol.

The clusters of each treatment were placed carefully in ventilated polyethylene bags each containing 3 clusters, to determine both weight loss and decay percentage, and at weekly intervals during the storage period. Each treatment was replicated 3 times (3 clusters of each).

Physical properties

1- Cluster weight loss percentage**:** weight loss % = $\frac{(Wi-Ws)}{Wi}\times 100$

WI: The initial weight of the cluster before storage.

Ws: The weight of cluster at a period of sampling (Interval one week).

2- Cluster decay percentage:

All damaged cluster produced by rots, fungus, bacteria, and pathogens were accounted for by the percentage of disordered cluster, and the decay % were calculated in the following way:

$$\text{Cluster decay \%} = \frac{\text{Total number of decayed clusters}}{\text{Initial number of stored clusters}} \times 100$$

2- The weight of 100 berries was determined in grams**.**

Chemical properties

1-Total soluble solids (TSS) of berries were measured using a refractometer.

2- Total acidity: was calculated as ml based on tartaric acid per 100 ml of juice through titration against 0.1 normal sodium chloride using phenolphthalein as an indicator as outlined in the (**A.O.A.C.,1990**).

$$\frac{\text{standard solution (N) x base solution (ml) x 0.075}}{\text{Total juice (ml)}} \text{ X } 100$$

*The equivalent weight of Tartaric acid= 0.075.

*Total juice= 5ml

3- Total sugar %: The concentration was computed as g glucose per 100 g and was determined calorimetrically using phenol and sulphuric acid, described by **(Malik and Singh, 1980)**.

Statistical analysis: The results were examined statistically using Analysis of Variance ANOVA in a Randomized Complete Block Design (RCBD)., and the means of the three treatments were compared using the LSD test based on the guidelines provided by **Gomez and Gomez (1984)**.

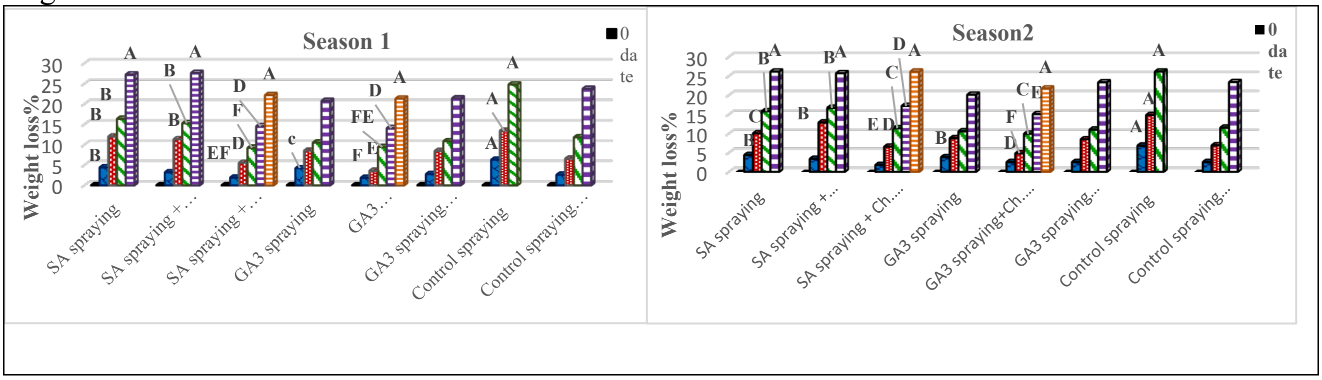
Results

The results of the experiment illustrated the effect of salicylic acid and GA_3 treatments, whether spraying pre-harvest or dipping post-harvest, and chitosan post-harvest treatment over a storage period of five weeks.

The study included physical and chemical measurements to assess the effects of these treatments on the quality of the stored clusters. The findings revealed that the control group, which did not receive any treatment, exhibited a decrease in quality starting from the third week of the storage period. In contrast, all other treatments maintained their quality until the fourth week. Notably, two treatments, namely salicylic acid spraying with chitosan dipping and GA3 spraying with chitosan dipping, were able to maintain their quality until the fifth week of the storage period. The results in detail came in the next histograms.

Cluster weight loss%

The data in **Fig. (1)** illustrate that the weight loss percentage in the two successive seasons increased as the storage period lengthened. The storage period of the control did not exceed three weeks, whereas the other treatments extended beyond that. During the first three weeks of the storage period, the control group experienced the highest weight loss percentage, followed by **T1** and **T4** with significant differences between them in the first week, and **T1** and **T2** in both the second and third weeks with significant differences, and the lowest percentage was in **T5** and **T3**, with significant differences compared with the other treatments in two successive seasons. In the fourth week, the highest percentage was in **T1** and **T2** with insignificant differences in both seasons, while the lowest percentage was in **T3** and **T5** with insignificant differences in the first season, but in the second season, the lowest percentage of the weight loss was in **T5** only. The fifth week was the end of the storage period, and **T3** and **T5** only continued to the end of the storage, and there was an insignificant difference between them in the two study seasons.



**Means separation by LSD multiple range tests at P <0.05. The same letters within columns are not significantly different. The ascending order starts with (A), which means the highest value, until it reaches the letter that has the lowest value.*

Fig (1): Effects of some pre- and post-harvest treatments on weight loss percentage (%) of the Flame seedless cluster during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons

Cluster decay %

The data in **Fig. (2)** Demonstrate the effect of bacterial, viral, and other factors on clusters during the storage period. The control group failed to survive beyond three weeks of storage, while treatments involving chitosan had a positive effect compared with other treatments in both seasons. On the other hand, **T3** and **T5** clusters continued the storage period until the fifth week with as good properties as possible, in two successive seasons. In the third week, the highest percentage of decay was observed in the control group (66.1, 73.8%) and followed by **T4** (25.5, 28.1%) with significant differences, while the lowest percentage was observed in **T3** (6.7, 6.1%) and **T5** (2.2, 6.6%) with significant differences, respectively, in both study seasons. In the fourth week, the data showed the comparative effects of the treatments. In the first season, the highest percentage was found in **T1** and **T4** (78, 70.8%), respectively, while the lowest percentage was found in **T3** and **T5** (15, 20.1%), respectively. In the second season, the highest percentage was found in **T4** and **T6** (71, 67.4%), and the lowest percentage was found in **T3** and **T5** (14.3, 15.5%), respectively. At the end of the storage period in the fifth week, only two treatments reached this stage: T3 and T5. In the first season, the highest percentage was observed in **T5** (78.9%), and **T3** recorded 54.1% with significant differences between **T3** and **T5**, while in the second season, there were insignificant differences between both of which recorded, which recorded **T3** and **T5** (26.1, 21.7%), respectively.

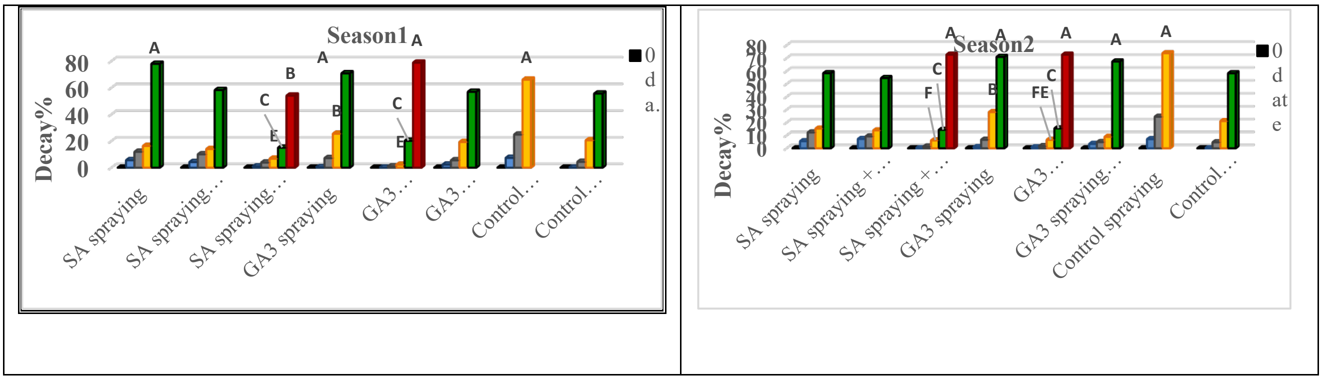


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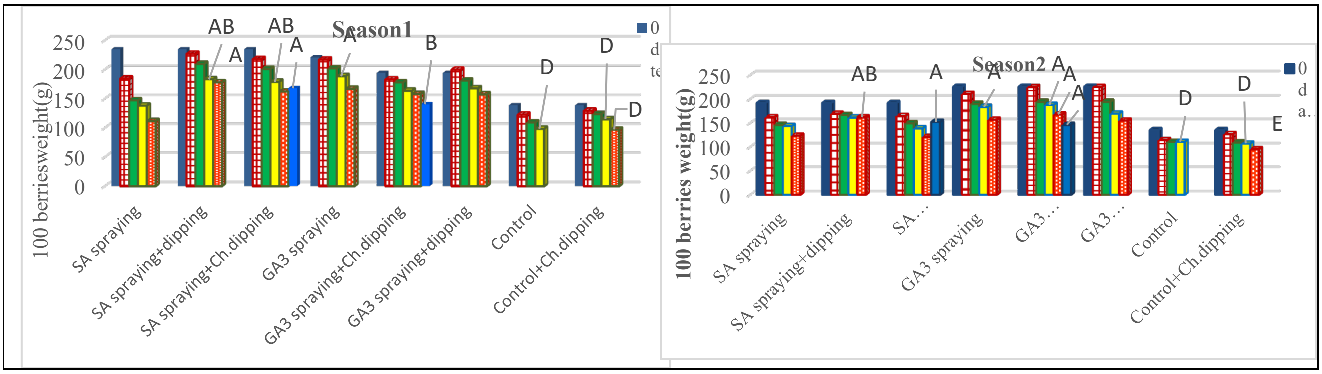
Fig. (2): Effects of some pre- and post-harvest treatments on decay percentage % of the Flame seedless cluster during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons

100 berries weight (g)

Based on findings from the current work, The data in **Fig. 3** demonstrates an inverse relationship between the berries weight and the storage period; when the storage period extended, the weight of berries decreased, and this did so in two successive seasons. Treatments were containing pre-harvest spraying with salicylic acid, or GA_3, exhibited higher values than the other treatments, including the control. The third week, which considers the last stage of the storage period of the control ones, made a comparison between the control, and other treatments. In the first season, the highest value of 100 berry weight was recorded in **T4** (188.7 g), followed by **T2** and **T3** (183.3 and 179 g), respectively, with trivial differences, and the lowest values were recorded in **T7** and **T8** (98.3 and 114.7 g), respectively, with trivial differences. In the second season, the highest values were recorded in **T4** and **T5** (183.7,188 g), respectively, with an insignificant difference, and the lowest values were in **T7** and **T8** (110.7,107 g), respectively, with insignificant differences.

During the fourth week, in the first season, the highest value was observed in **T2** (178g) and the lowest value was recorded in **T8** (97g), while in the second season, the highest values were found in **T5** (167.7g) followed by **T2** (161.7g) with trivial differences, and the lowest value found in **T8** (95g). At the end of the storage period, only **T3** and **T5** until the fifth week compared with other treatments. In the first season, **T3** (168g) was higher than **T5** (140.3g) with significant differences, while in the second season, there was an insignificant difference between them: **T3** was 152.3 g and **T5** was 146g.

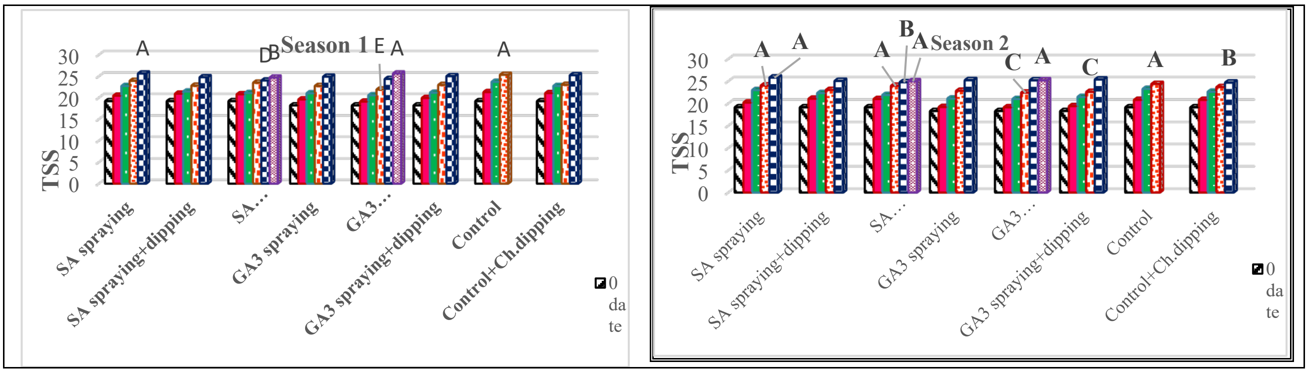


**Means separation by LSD multiple range tests at P <0.05. The same letters within columns are not significantly different. The ascending order starts with (A), which means the highest value, until it reaches the letter that has the lowest value.*

Fig (3): Effects of some pre- and post-harvest treatments on 100 berries weight (g) of the Flame seedless during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons

Total Soluble Solids (TSS): Basically, the total soluble solids increased when the storage period increased, and the results showed that in **Fig. (4)** With a comparison of the control with other treatments in both successive seasons, the data of the third week in the first season proved that the highest rate of TSS was in **T7** (25.3%) and the lowest rate was in **T5** (21.9%). In the second season, it was somewhat different; the highest rates were in **T1, T2**, and **T7** (24, 23.9, and 24.4%), with insignificant differences, and the lowest rates were in **T5** and **T6** (22.4, and 22.6%), respectively, with trivial differences between them.

In the fourth week of both successive seasons, the highest rate was recorded in **T1** (25.6 and 25.8%), respectively, in both seasons, and the lowest rate was observed in **T3** (24%) in the first season and **T3** and **T8** (24.7 and 24.8%), respectively, in the second season. At the end of the storage period, in the first season, **T5** (25.6%) was higher than **T3** (24.6%) with a significant difference, while in the second season, there was an insignificant between **T3**(25.2%), and **T5** (25%).

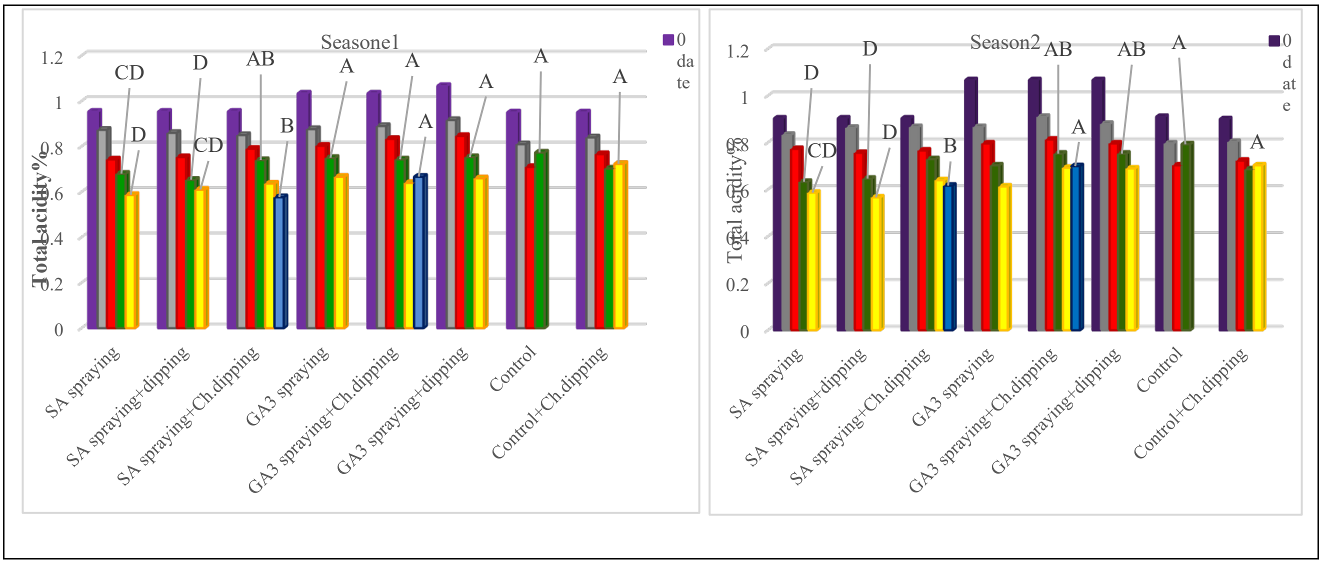


**Means separation by LSD multiple range tests at P <0.05. The same letters within columns are not significantly different. The ascending order starts with (A), which means the highest value, until it reaches the letter that has the lowest value.*

Fig (4): Effects of some pre- and post-harvest treatments on TSS(%) of the Flame seedless berries during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons

Total acidity (%)

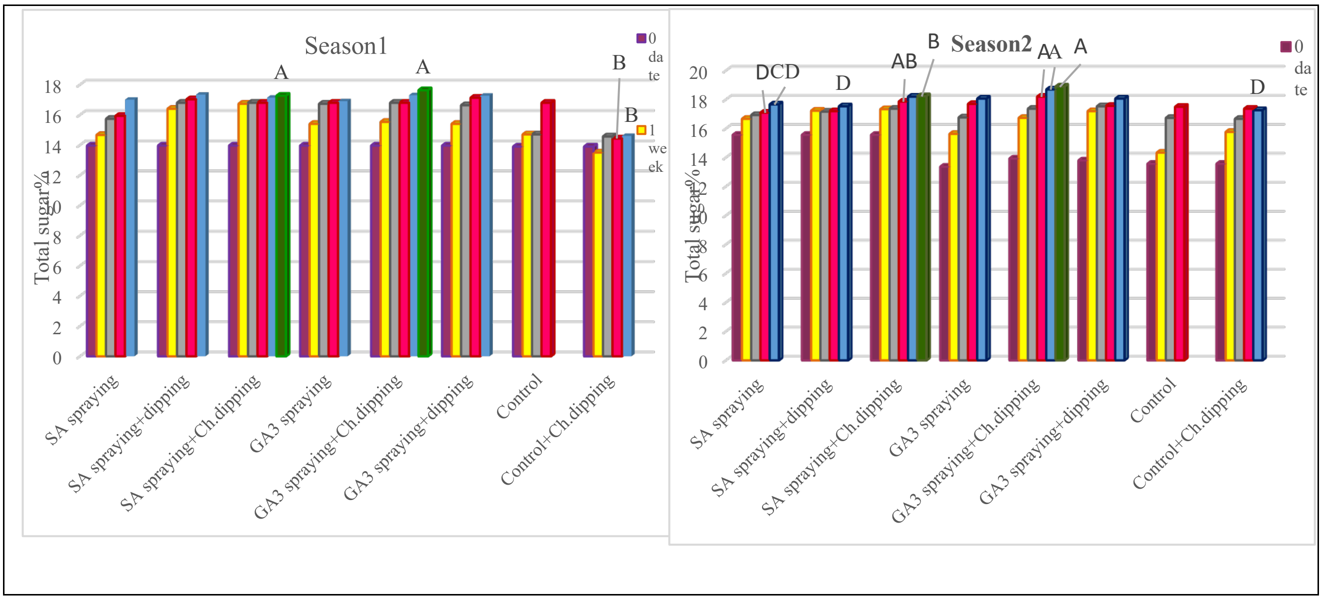
Knowingly, that with the long storage period, the total acidity decreased until a specific stage where the acidity was increased again. That was apparent from the obtained data in **Fig. (5)** The results in the third week in both seasons illustrated that there were trivial differences between most treatments except **T1** (0.68, 0.63%), and **T2** (0.65, 0.65%), respectively, that had the lowest rate of acidity with significant differences with other treatments. In the fourth week of two study seasons, the highest rate of acidity was in **T8** (0.72 and 0.70%), respectively, and the lowest rate was in **T1** (0.58, 0.58%), and **T2** (0.61, 0.56%), respectively, with an insignificant difference. At the end of the storage period of both study seasons, the highest value was in **T5**(0.66, 0.70%), and the lowest value was in **T3** (0.57, 0.61%), respectively, with a significant difference.



**Means separation by LSD multiple range tests at P <0.05. The same letters within columns are not significantly different. The ascending order starts with (A), which means the highest value, until it reaches the letter that has the lowest value.*

Fig (5): Effects of some pre- and post-harvest treatments on total acidity (%) of the Flame seedless berries during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons.

Total sugar (%): In the third week, the data showed that there were insignificant differences between most treatments except **T8**(14.4%) those that had the lowest value of total sugar and significant differences with the others. In the second season, the highest rate was found in **T5** and **T3** (18.2, and 17.8%), respectively, with negligible significance between them, and the lowest rate was recorded in **T1** (17.1%). In the fourth week of the first season, most treatments displayed the highest total sugar content, whereas **T8** (14.6%) exhibited the lowest value with a significant difference from the others. On the other hand, the highest value was recorded in **T5** (18.7%), while the lowest values were observed in **T1, T2,** and **T8** (17.6, 17.5, and 17.2%), respectively. At the end of the storage period, the data in the first season proved that there was an insignificant difference between **T5** (17.6%) and **T3** (17.2%), while in the second season, the data showed that there was a significant difference between **T5** (18.9%) and **T3** (18.2%).



Means separation by LSD multiple range tests at P <0.05. The same letters within columns are not significantly different. The ascending order starts with (A), which means the highest value, until it reaches the letter that has the lowest value.

Fig (6): Effects of some pre- and post-harvest treatments on total sugar (%) of the Flame seedless berries during cold storage at 5±1°C (85–90% R.H.) in the 2021 and 2022 seasons

Discussion

Fresh fruits are mostly composed of water, accounting for approximately 80 and 90 percent of their weight. Fruits are considered living things that continue to respire even after they harvest. This respiration process, along with transpiration (water evaporation) and ongoing metabolic activities, leads to moisture loss in harvested fruits. This causes the fruit to lose weight and moisture content, which has a detrimental impact on the fruit's quality and makes it unfit for commercialization (**Yaman and Bayindirli, 2002**).

Fruits susceptible to damage and quality lose during storage due to a significant issue with shrinkage and weight loss caused by water loss (**Ben-Yehoshua and Rodov 2003**). Fruit coatings have been widely used to delay fruit ripening, minimize fruit skin shrivelling, and reduce dehydration and water loss. By acting as a semi-permeable barrier against oxygen, carbon dioxide, and moisture, coatings can effectively reduce respiration rates, water loss, and oxidation reactions (**Park, 1999; Yaman and Bayoindirli, 2002**).

Recent studies shown that salicylic acid (SA) serves as a highly effective substitute for conventional insecticides in reducing post-harvest losses and delaying ripening process delay. SA is a plant hormone belonging to the phenolic chemical class that is widely found in plants. In plants, it controls a variety of physiological functions. Its effects on softening, reducing disease resistance, delaying ripening, and lowering disease incidence have all been the subject of several research (**Raskin, 1992**).

By controlling ethylene biosynthesis, respiration and transpiration, water loss, maintaining hardness, and decay infection by stomatal closure of fruit surface, salicylic acid increases the storage life of grape clusters. It also preserves the firmness of the fruit and delays rachis browning by blocking the activity of polyphenol oxidase (**Zheng and Zhang, 2004, Ranjbaran *et al.*, 2011**).

GA_3 significantly reduced rachis browning, berry shattering, and decay while delaying the decline in soluble solids content (SSC). It also preserved higher fruit detachment force and membrane integrity. In addition, GA_3 retarded the conversion of protopectin to water-soluble pectin and improved berry firmness, fewer berries shattering, and preserved the soluble solids content, total acidity, and protopectin as possible compared with those control ones, but did not markedly reduce rachis browning and membrane integrity loss. According to decay is reports, one of the main causes of grape losses at the market is decay (**Wu *et al.*, 1992**) Nevertheless, clusters treated with GA3 exhibited a comparatively low rate of decay. GA_3 has been widely used to manage various diseases of horticultural and agronomic crops, as well as to regulate certain functions and features. Because GA_3 can delay senescence and the subsequent breakdown of certain phytoalexins, it can prevent postharvest deterioration of celery and rose blossoms caused by *Botrytis cinerea* (**Afek *et al.,* 1995**). Treated with GA_3 induced a delay in ripening, and a decrease in total acidity and sugar, and that had a significant effect on grape quality after cold storage (**Avenant, 2017**).

Chitosan reduces the rate of transpiration without interfering with the ripening process, extending the grape's shelf life and maintaining its weight, color, taste, and texture. Due to its non-toxicity, this natural and ecologically benign molecule is also biodegradable, making it an excellent substitute for synthetic fungicides for treating postharvest fruits and vegetables. It is also a bioactive component found in medicinal and industrial applications. Possesses good substance and has the ability to cover the fruit with a semipermeable coating that alters the interior environment, prevents weight loss and transpiration-induced withering, and improves fruit quality overall. Mango, papaya, and citrus fruits have all been effectively coated with chitosan (**Abdel-Salam, 2021**).

Fruit coated with chitosan preserved fruit firmness as much as feasible (**Mongkon, 2005**). According to **Sakhale and Kapse (2012**) the alter gas spread and the exchange of O_2 and CO_2 between fruit cells and the external atmosphere, which lowers normal metabolic activity and preserves fruit moisture. As a result, they can both slow down textural changes and the ripening process in grapes.

Temperature control is one of the most environmental factors influencing fruit quality and is one of the most important methods for extending fruit's shelf life, alongside chitosan coating. Although chitosan is known to reduce fruit weight loss when compared to a control group, its effectiveness is not very high. Chitosan's poor water vapor barrier properties are one of its main drawbacks when applied to fresh fruit; however, these can be improved by mixing it with other substances (**Camatari *et al.,*2018**).

According to the findings of **Kumpoun *et al.* (2005),** all fruits treated with chitosan and aloe Vera exhibited resistance to rot and disease caused by bacteria, fungi, and other environmental factors.

The primary determinant of fruit acceptance and quality is its acidity. The quality of a fruit does not depend on its acidity, neither too high nor too low. The main acid present in grapes is tartaric acid. Respiration is the primary cause of fruits' decreased acidity during storage. On the other hand, organic acids were thought to be crucial for the enzymatic respiration processes, which are why the fruits' acidity rate dropped (**Yaman and Bayoindirli, 2002**) .Since fungi may use organic acids as a growth medium, an overabundance of fungi may be the cause of the fruit's sudden drop in acidity (**Vieira *et al.,* 2016**). Edible coatings provide a thin layer on the surface of fruits that limits gas exchange and lowers the rate of fruit respiration, according to **(Jiang and Li 2001) and Silva *et al.* (2017).**

Total sugar concentration is considered an important factor in fruit storage when determining whether the fruit is ready to mature. Since all treatments lowered respiration rate, transpiration, and other metabolic processes, all treatments except the control resulted in a significant increase in total sugars.

The reduction of TSS in fruit has been related to decreased amounts of pectin and sugars, the breakdown of glycosides, and partial hydrolysis of protein into subunits during the respiration process (**Saranwong *et al.,* 2003).**

The TSS levels of coated fruit were greater than those of uncoated fruit. This is likely due to the protective barrier provided by the coating which, slowing down the ingress of oxygen and speeding up the ingress of CO2. As a result, the respiration rates become less active. Furthermore, delays ripening and reduces fluctuations in the amount of TA in the vacuole **(Du *et al.,* 1997; Yonemoto *et al.,* 2002).**

Scientific studies have demonstrated an inverse relationship between fruit acidity and storage duration; Fruit acidity gradually decreases with extended storage periods, and a fast decrease in acidity indicates senescence, even if this rise was only marginally noticeable during in cold storage **(Ali *et al.,* 2011).**

It is well known that as storage times lengthen, TSS rises as well. Furthermore, fruits' TSS concentration rises as a result of water loss, which might be mistaken for a real shift in fruit TSS (**Olivas and Barbosa-Cánovas 2005**). Increases in TSS and decreases in TA are typically used to characterize the stage of fruit ripening and evaluate their flavor, which is mostly determined by how well the fruit balances sweetness and acidity. The total sugar content of grapes, a non-climacteric fruit with a low respiration rate, slightly decreased while stored at various temperatures. On the other hand, the rise in juice TSS was described as fruit water loss, resulting in a higher soluble solids concentration. The results that were acquired conformed to the findings of **Koksal (1989) & Nanda *et al.* (2001).**

According to **Kazemi *et al.* (2011),** the primary purpose of SA is to delay fruit ripening during storage by decreasing ethylene production. **Asghari and Aghdam (2010)** also state that SA improves fruit quality.

However, SA has negligible effects on TSS for some fruits that are non-climacteric fruits during cold storage **(Sayyari *et al.,* 2009).**

Tartaric acid is the primary acid responsible for the extreme acidity of grape berries, however, there are other organic acids found in grapes as well, including citric, malic, acetic, fumaric, and lactic acids. Fruits continue to breathe while being stored, and this process consumes the majority of the fruit's acid content (tartaric acid). Because of this, during storage, the acidity dropped (**Melgarejo *et al.,* 2000**). The obtained results are in line with the findings of (**Waskar *et al.,* 1999, Artes *et al.,* 2000**).

Grapes, being non-climacteric fruits with a low respiration rate, require minimal amounts of sugar for the respiration process during post-harvest storage under various conditions **(Cirami *et al.,* 1992).**

Conclusion

In light of the current results, it can be concluded that the best treatments are pre-harvest spraying with salicylic acid or GA3 and covering with chitosan, and it has reached the fifth week with good quality.

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تاثير بعض معاملات ما قبل وبعد الحصاد علي الصفات الطبيعية والكيماوية للعنب الفليم عديم البذوراثناء التخزين البارد

طلعت رفعت كامل المهدى[1] ، مها محمد عبد السلام حسين[1] ، عصام محمد عبد الظاهر رضوان*[2] ، عاطف يعقوب حليم[3] ، الزهراء عبداللاه محمود عبدالعال[2]

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الملخص العربي

من المعروف أن العنب يواجه العديد من المشاكل بعد الحصاد وأثناء التسويق، أهمها: فقدان الماء، الإصابة بالأمراض والعدوى الفطرية، فرط الحبات، وتحول هيكل العنقود الي اللون البني. لذلك لا يتحمل العنب التسويق والتخزين لفترات طويلة. ولذلك فقد قام هذا البحث بدراسة تأثير بعض المعاملات للتغلب على هذه المشاكل قدر الإمكان.

أجريت هذه الدراسة خلال موسمين متتاليين 2021 و 2022 على أشجار العنب صنف الفليم بدون بذور. تم رش العناقيد بحامض الساليسيليك بتركيز 200 جزء في المليون وحمض الجبريليك بتركيز 30 جزء في المليون كل منهما علي حدي قبل الحصاد بثلاثة أسابيع.

بعد جمع العناقيد، تم تقسيمها إلى مجموعات وتغطيسها بحمض الساليسيليك (200 جزء في المليون)، والجبريلين (30 جزء في المليون)، والشيتوزان 1%، كل منهما علي حدي او الخليط بينهم.

تم تخزينها في الثلاجة بدرجة حرارة 5±1 درجة مئوية ونسبة رطوبة نسبية 85-90%، وتم قياس بعض الخواص الفيزيائية والكيميائية أسبوعياً حتى انتهاء فترة التخزين.

أثبتت النتائج أن:-

- معاملة الكنترول لم تستمر في التخزين لأكثر من ثلاثة أسابيع مقارنة بالمعاملات الأخرى.
- بينما وصلت المعاملات الأخرى إلى الأسبوع الرابع بجودة جيدة قدر الإمكان.
- في حين أن أفضل المعاملات التي شملت الرش قبل االجمع بحامض الساليسيليك أو الجبريلين والغمس بالشيتوزان وصلت للأسبوع الخامس بنوعية جيدة إلى حد ما.

الكلمات الدالة :حمض السالسيلك ، حمض الجبرلليك ، الفليم عديم البذور ، معاملات ما قبل وبعد الحصاد ، التخزين البارد .