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Effects of Grape Seed Oil on Postharvest Life and Quality of Some Grape Cultivars

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Abstract**—**Table grapes (*Vitis vinifera* L.) are an important crop worldwide. Postharvest problems like berry shattering, decay and stem dehydration are some of the important factors that limit the marketing of table grapes. Edible coatings are an alternative for increasing shelf-life of fruits, protecting fruits from humidity and oxygen effects, thus retarding their deterioration. This study aimed to compare different grape seed oil applications (GSO, 0.5 g L^{-1}, 1 g L^{-1}, 2 g L^{-1}) and SO_2 generating pads effects (SO_2-1, SO_2-2). Treated grapes with GSO and generating pads were packaged into polyethylene trays and stored at 0 ± 1°C and 85-95% moisture. Effects of the applications were investigated by some quality and sensory evaluations with intervals of 15 days. SO_2 applications were determined the most effective treatments for minimizing weight loss and changes in TA, pH, color and appearance value. Grape seed oil applications were determined as a good alternative for grape preservation, improving weight losses and °Brix, TA, the color values and sensory analysis. Commercially, 'Alphonse Lavallée' clusters were stored for 75 days and 'Antep Karası' clusters for 60 days. The data obtained from GSO indicated that it had a similar quality result to SO_2 for up to 40 days storage.

Keywords**—**Postharvest, quality, sensory analyses, *Vitis vinifera* L.

I. Introduction

GRAPEVINE (*Vitis vinifera* L.) is one of the most important fruit crops cultivated worldwide with a production of 74.276.583 tons in 2017 [1]. Table grape production is approximately 36% of world production [2]. Turkey is one of the major grapes producing countries with 4 million tons production [1].

The table grape is a non-climatic fruit and is sensitive to changes in temperature and humidity [3]. Postharvest quality of the table grape is limited by many factors. Fungal decay is the major problem during postharvest storage [4] and gray mold (*Botrytis cinerea*) is the most important postharvest disease of table grapes [5]. It's generally controlled by use of chemicals such as sulfur dioxide (SO_2) [6], [7]. Slow release Sculpture dioxide (SO_2) generator pads are a successful alternative to SO_2 fumigation worldwide. Generator pads contain sodium metabisulfite ($Na_2S_2O_5$) and moisture within the polyethylene trays of grapes is absorbed by the pads, and it reacts with the sulfite to release SO_2 [8]. Although SO_2 is helpful for storage there are many disadvantages. That causes injury to grape berries, bleached and sunken areas on berries. Furthermore, SO_2 residues are dangerous to people possess health risk [9], [10]. Therefore, there must be applied some treatments to foods in order to extend shelf life. Many studies have been carried out to determine the effect of solutions on prolonging the storage time. Hot water immersion treatments [11], [12], storage with high CO_2 [13], and ozone are among the widely used treatments.

Use of natural products such as chitosan [14], propolis [15], essential oils [4], [16], thymol [17], instead of SO_2 can be used to extend shelf life and may help to sustain human health.

GSO represents a promising storage time enhancer due to having high phenol content and antioxidant capacity. Several compounds such as vitamin E, flavonoids, linoleic acid, and procyanidins are present in grape seed with highly concentrated levels [18], [19]. This study aimed to compare different grape seed oil applications (GSO, 0.5 g L^{-1}, 1 g L^{-1}, 2 g L^{-1}) and SO_2 generating pads effects (SO_2-1, SO_2-2).

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II. Material and Methods

A. Plant Materials

'Alphonse Lavallée' and 'Antep Karası' (*Vitis vinifera* L. cv.) clusters were harvested at commercial maturity stage from a commercial vineyard in Konya, Turkey.

B. Experimental Procedure

Harvested clusters of cultivars were immediately transported to the laboratory, where the main morphological values were measured. Clusters were chosen based on their size, color and general appearance in order to maintain uniformity. SO_2 generating pads (SO_2-1, SO_2-2) of 97.5% Sodium metabisulfite plus 2.5% inert ingredient, are produced by Himso Denizli Turkey. Clusters are packed with two SO_2 generating pad (SO_2-1 upside and SO_2-2 upside-downside polyethylene tray) and different grape seed oil GSO (0.5 g L^{-1}, 1 g L^{-1}, 2 g L^{-1}) concentrations were diluted in 1 L distilled water and sprayed on the clusters. GSO was obtained from 'Antep Karası' cv. with ether extraction method [20]. The GSO used in the current experiment contains 7.74% free acid, 66.8% linoleic acid, 21.3% oleic acid, 10.2% palmitic acid and 0.9% stearic acid. The control group was sprayed with distilled water. Samples were stored at 1°C and 85-95% moisture. Effects of the applications were investigated by some quality and sensory evaluations at intervals of 15 days for 120 days.

C. Weight Loss

Weight loss was determined according to the following expression: $\%ML(t) = [(M_0-M(t))/M_0] \times 100$ where $\%ML(t)$ is the percentage mass loss at time t, M_0 is the initial sample mass and $M(t)$ is the sample mass at time t [21].

D. Determination of pH, ºBrix and Titratable Acidity

pH of berries was determined on the grape juice by HI-2211 Bench Top pH meter, while ºBrix was measured on filtered grape juice by a refractometer (Atago) and expressed as Brix. Acidity (TA) was determined by potentiometric titration with 0.1 N NaOH of up to pH 8.1. Results were expressed as g of tartaric acid per 100 g of sample [21], [22].

E. Sensory Analysis (Berry Appearance)

Sensory analysis and berry appearance were carried out by a panel of 10 assessors in order to evaluate taste, general appearance with a numerical scale from 1 (very low) to 9 (maximum) [23].

F. Berry Color

The color of berry skin was measured using a chronometer Minolta® (CR-400). Then the values were calculated hue (h=artg [b^*/a^*]) [22].

G. Decay Rate

Percentages of decayed berries were calculated separately by dividing the number of grapes in each package showing visible decay symptoms by the total number of grapes in that package and multiplying the dividend by 100 [24].

H. Statistical Analysis

The experimental design was completely randomized, consisting of two factor factorial. The dose and time applications were compared with the Tukey test in the JMP 13.0 statistical program at p <0.05 significance level [25].

III. Results and Discussion

A. Weight Loss (%)

Weight loss of grape fruit in storage is shown in Figs. 1 and 2. The weight loss was not significant statistically in the experiment. Weight loss values of 1 g L^{-1} application generally showed fluctuations on 'Alphonse Lavallée' grape cultivar. It increased from 6.06% to 13.19% on day 75 and reached the highest value (21.48%) on day 120 compared to other applications. It has been determined that 'Alphonse Lavallée' grapes can be store for 45 days. It was determined that 1 g of L^{-1} application was effective in postharvest storage of 'Antep Karası' cultivar for 60 days.

Weight loss is one of the important quality criteria. Berry skin membrane has a considerable importance due to constituting a protective barrier, preventing water loss, controlling gaseous conductivity and maintaining transpiration [26]. Weight loss of a berry is related with the skin membrane that takes an important role in protection against water loss and manages gaseous exchange. Elevation in weight loss can be related with alterations of berry cuticle [26], [27]. The effects of GSO treatment on berry weight loss are very evident, which provide a good barrier to water permeation, and thus lead to less weight loss.

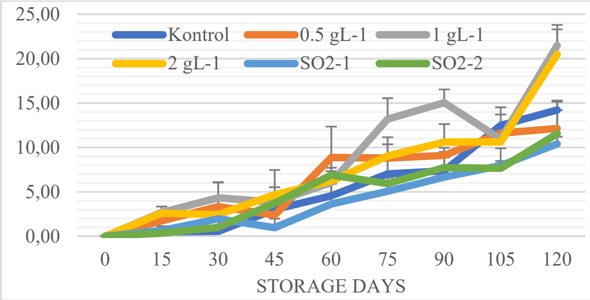

Fig. 1 Effects of applications on weight loss (%) values of 'Alphonse Lavallée'

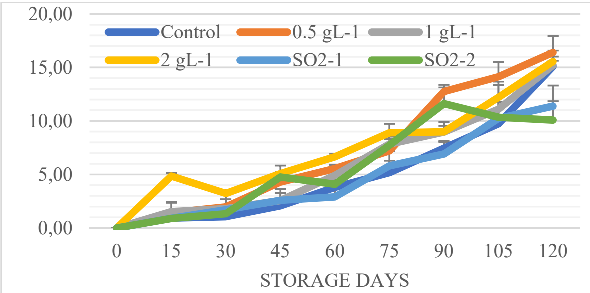

Fig. 2 Effects of applications on weight loss (%) values of 'Antep Karası'

B. Determination of pH, ºBrix and Titratable Acidity

1. pH

pH values of grape fruit in storage are shown in Figs. 2 and 3. pH values of 1 g L^{-1}, 2 g L^{-1} and SO_2-2 applications were parallel to their initial values.

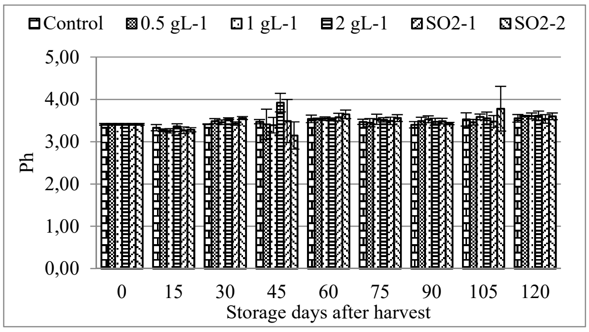

Fig. 3 Effects of applications on pH values of 'Alphonse Lavallée'

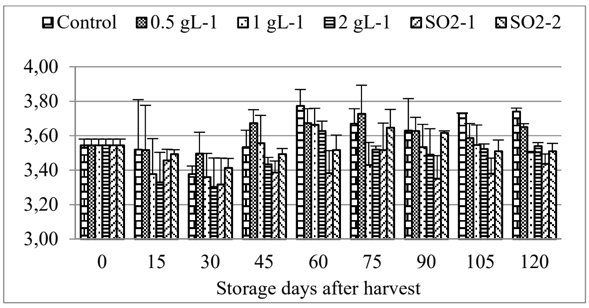

Fig. 4 Effects of applications on pH values of 'Antep Karası'

Compared to other applications, the pH value of 2 g L^{-1} application (3.54) was found to be more stable in 'Antep Karası'. pH values were significant among treatments; however, there were no important differences on 'Alphonse Lavallée'. A study mentioned that pH value does not change considerably and remains fairly stable during storage [28].

2. *ºBrix*

ºBrix increased gradually with maturity of the 'Alphonse Lavallée' grape fruit, SO_2-2 treatment significantly increased the level of *ºBrix* as compared to the control at harvest time ($p < 0.05$) (Figs. 5 and 6). The effects of SO_2-1 and SO_2-2 applications were found to be significant ($p<0.05$) on 'Antep Karası'. *ºBrix* values of SO_2-1 application decreased towards the end of the storage period. In other studies, it was found that ºBrix values of grapes increased during the storage period [29].

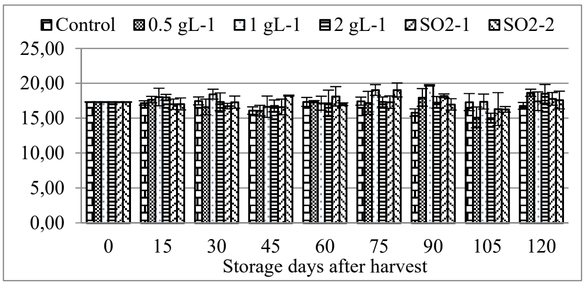

Fig. 5 Effects of applications on ºBrix values of 'Alphonse Lavallée'

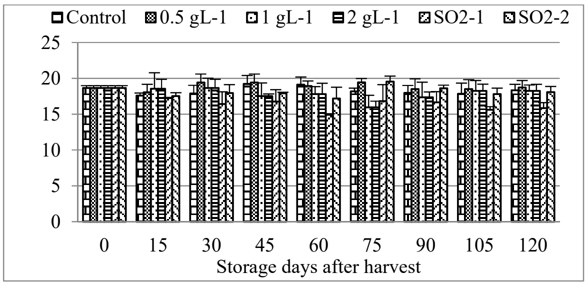

Fig. 6 Effects of applications on ºBrix values of 'Antep Karası'

3. Titratable Acidity (TA)

The effects of applications on TA were found to be statistically significant during storage of 'Alphonse Lavallée' grape cultivar ($p<0.05$). TA values of the applications showed fluctuations in the first 45 days. At the end of the storage period, the results were found to be parallel to the initial value (Fig. 7).

TA values were determined statistically significant during the storage of 'Antep Karası' grape cultivar ($p<0.05$) (Fig. 8). Although there were fluctuations in the TA values of the applications during the storage period, it was determined that there was an increase compared to the initial data from the day 45. Organic acids can be converted into organic sugars as hydrolysis during storage [30], and depending on this transformation, decreases in the titratable acid content can be observed in grape syrup.

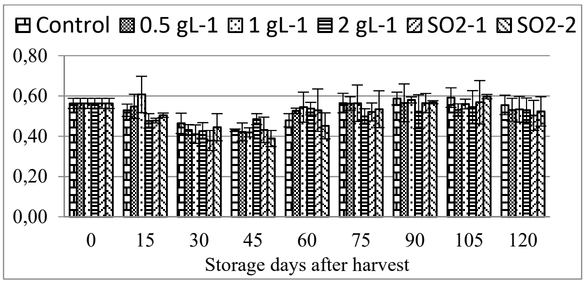

Fig. 7 Effects of applications on TA values of 'Alphonse Lavallée'

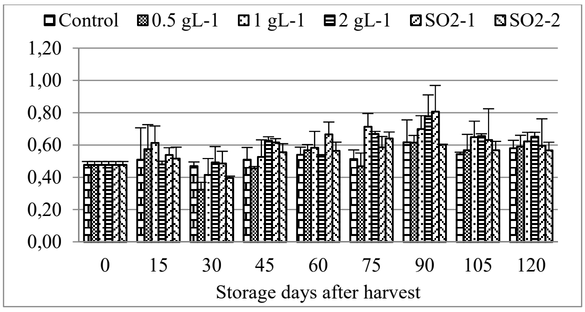

Fig. 8 Effects of applications on TA values of 'Antep Karası'

C. Sensory Analysis (Berry Appearance)

The panelist score values (1-9) of 2 g L^{-1} GSO applications did not fall below the marketable value at day 75 and day 90 for 'Alphonse Lavallée' grape fruit (Fig. 9).

Panelist scores after 60 days storage were below that of marketable taste, and panelist score values of SO_2 and GSO applications were similar at 90 storage days for 'Antep Karası' grape berries (Fig. 10).

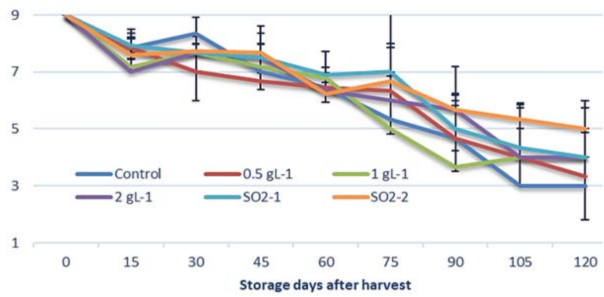

Fig. 9 Effects of applications on berry appearance values of 'Alphonse Lavallée'

ºBrix and acidity changes can cause changes in berry taste quality in grapes [31]. Loss in skin color and browning are affected by polyphenol oxidase enzyme as a deleterious result of storage [32]. GSO delayed browning and skin color loss that may be ascribed to inhibiting this enzyme for a while. Furthermore, grape seed extracts possess polyphenol rich compounds that may affect the color and sensory characteristics [33].

D. Berry Color

The Hue (h°) value of berries were similar during 75 days of storage period for both cultivars ($p<0.05$) (Figs. 11 and 12).

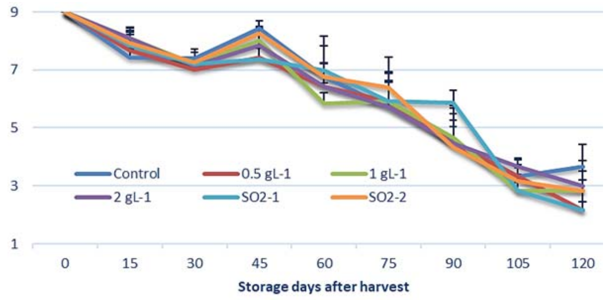

Fig. 10 Effects of applications on berry appearance values of 'Antep Karası'

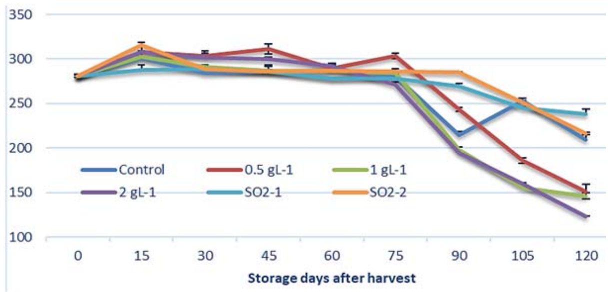

Fig. 11 Effects of applications on berry hue values of 'Alphonse Lavallée'

According to the findings of this study, the longer storage time resulted in reduced brightness value. As reported in previous studies, there is a steadily decreasing value of brightness towards the end of storage period and berries become opaque [23], [34].

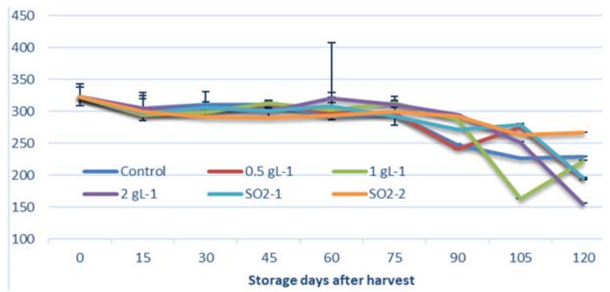

Fig. 12 Effects of applications on berry hue values of 'Antep Karası'

E. Decay Rate

The weight loss was not significant statistically in the experiment. The 0.5 g of L^{-1} GSO application was determined to be the most effective in control of decay on 'Alphonse Lavallée' grape cultivar. In all the applications, decay has been observed since day 30. Decay was observed from day 30 (2.33%) and the highest decay (13.75%) was determined on day 60 for the control samples (Fig. 13).

The 0.5 gL^{-1} GSO treatment had less berry decay compared to control that may be as a consequence of delay in enzymatic reactions such as polyphenol oxidase, a similar explanation was presented in a previous experiment [35].

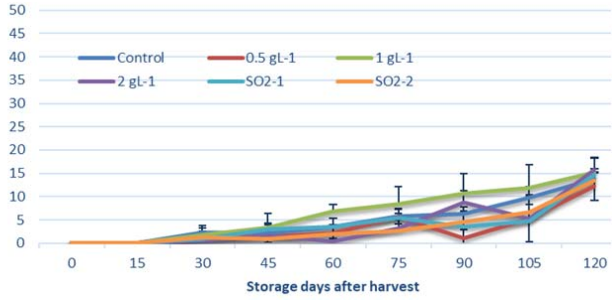

Fig. 13 Effects of applications on decay rate of 'Alphonse Lavallée'

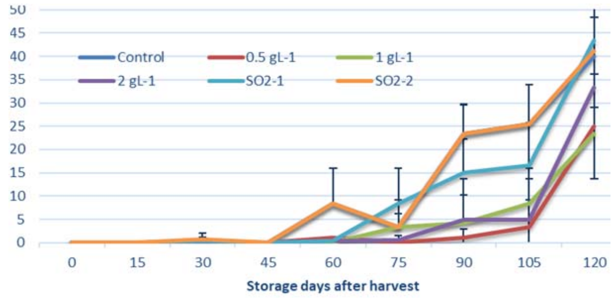

Fig. 14 Effects of applications on decay rate of 'Antep Karası'

IV. Conclusion

According to the results obtained from this study, SO_2 application was determined as the most effective application limiting weight loss and decay during the postharvest storage. It was determined that 0.5 g L^{-1} application had weight loss and decay limiting effects. Therefore, it is advisable to use 0.5 g of L^{-1} as an alternative to SO_2. However, GSO application and cultivars have different effects depending on the prolongation of storage period. For this reason, it is considered that it would be more beneficial to determine the effects of GSO application by examining different cultivars at different storage times.

Acknowledgment

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