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Using Some Postharvest Treatments to Improve the Storage Life and Marketing of "Ruby Seedless" Grapes

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Abstract

Table grapes are facing postharvest problems such as weight loss, shattering, decay, stem browning, etc and they are major factors that restrict of the storage period and to distant markets. Therefore, this study aimed to find out suitable methods to solve the postharvest problems and improve the storage life of "Ruby seedless" grapes whether during cold storage or in marketing condition. This experiment was conducted during two successive seasons (2014-2015) to study the effect of dipping in salicylic acid at 4mM/l, paraffin oil and wrapping with polyethylene stretch on some physical and chemical properties of clusters and berries during storage life under cold storage at 5 °C in refrigerator with 85-90% R.H for 30 days or at 20± 5°C to estimate as marketing condition for 10 days. Results proved that all treatments gave positive effect on storage life and maintain the quality of cluster for the longest period possible under different storage conditions compared with untreated fruits (control), by reduced both of shattering %, weight loss % and retention the juice content of berries as long as possible, increased TSS, prevent the reduction of acidity, enhanced the total anthocyanin in berry skin. As for the total phenol, of treated clusters with salicylic acid had the highest significant effect on increasing the total phenol in berries compared with the other treatments and control.

Keywords: *salicylic acid, paraffin oil, polyethylene stretch, total phenol, anthocyanin.*

Introduction

Table grapes are belonged to a non-climacteric fruits which has a low rate of physiological activity and relatively short period of postharvest storage due to the chemical and physical changes which occur such as losses in nutritional quality, water loss, rachis dehydration and browning, berry shatter, and fungal decay. The use of chemicals such as SO_2, carbon dioxide, fungicides and growth regulators, is necessary to maintain the fruit quality during a long distance transport and a long storage period but they have detrimentally affecting on the safety of fruits and vegetables so to prevent these adverse effects. The researcher are trying to find out an alternative methods of chemicals materials and the scientifically ways to decrease their applications and use of environmentally friendly technologies which was recommended by (Zoffoli *et al.,* 2009, Asghari and Aghdam, 2010).

It is known that, the low temperature is one of the most effective methods to prolong the postharvest life of fresh food product and decreasing the loss of their quality and the temperature at 5°C proven effectiveness on maintaining the shelf life of fruits for as long as possible (Shein

et al., 2008). As a result of high costs of the product storage in low temperature and the lack of cold storage facilities during the transport at farmer level and the produced fresh fruit distribution in non-refrigerated trucks which led to a rapid deterioration for them for all these situations, the local traders encourage to find out cheaper methods to prolong the shelf-life of fresh produce (Baldwin, 1995).

Salicylic acid (SA), or ortho-hydroxyl benzoic acid which found in horticultural crops with various concentrations, is a simple phenolic compound with a phytohormone–like function in plant growth and development (Scotter *et al.,* 2007, Hayat *et al.,* 2010). There are many important functions of SA such as inhibiting ethylene biosynthesis and action (Zhang *et al.,* 2003), delayed ripening and senescence of fruits, prolonging storage life of fruits, reducing fruit softening rate, increasing the resistance of chilling injury and accumulation of phenolic compounds (Srivastava and Dwivedi, 2000, Zhang *et al.,* 2003, Chen *et al.,* 2006). SA has the mechanism to delay the ripening and senescence of different products by stimulating the accumulation of biologically active compounds and antioxidant enzymes such as catalase (CAT), peroxidase (POD) and superoxide dismutase (SOD) leading to a reduce in free radical levels and lipid peroxidation (Huang *et al.,* 2008). The DPPH scavenging activity, total phenols, flavonoids, anthocyanins and ascorbic acid contents of the fruits, were significantly increased by SA treatment might be due to the stimulation enzyme activity of Phenylalanine ammonia-lyase (PAL) and thus triggering the phenylpropanoid–flavonoids pathways therefore, these demonstrated that SA as a safe signaling molecule could enhance nutritional quality and improved health promoting and properties of fruits and vegetables (Tareen *et al.,* 2012, Dokhanieh *et al.,* 2013). Salicylates that happen naturally in plants and which added to drinks, food and oral care products as preservatives and flavorings have clinical importance (Scotter *et al*., 2007).

Paraffin oil is the most edible coating which was recommended to apply on the surface of food product due to it can give more advantages than synthetic materials like edibility, biocompatibility, non-toxic and low cost. Paraffin, has a main role on fruit preservation and prolongation the storage life and marketing because, it can modify the storage atmosphere around the fruit surface by reducing the availability of oxygen and enhances the concentration of internal carbon dioxide therefore, inhibits the deterioration of fruit by decreasing of respiration rates, preserving the textural quality, decreasing dehydration, reducing decay and retention of firmness, and therefore delays senescence (Kaplan, 1986, Park, 1999).

Modified atmosphere packaging as polyethylene stretch, is a dynamic process to modify the gaseous component inside a package via the interaction between the natural process of produce respiration and permeation of gas over the packaging film (Caleb *et al.,* 2012). Moreover, atmospheres in MAP prolong shelf-life of fresh produce by reduction the metabolic activities such as ethylene biosynthesis and respiration whereas this slows

down biological and physiological changes of produce like softening, decay, senescence and the rate of changes in texture, flavor, color and nutritional quality attributes (Mangaraj *et al.,* 2011).

Material and Methods

The experimental was conducted during two successive seasons 2014 and 2015, using mature clusters harvested from grapevines on ten years old, uniform, "Ruby seedless" cultivated at the experimental vineyard, Pomology Department, Faculty of Agriculture, Assuit University. The clusters were carefully harvested at the time of commercial maturity when berries reached full color and TSS/acid ratio in berry juice were about 43.42, from vines received the standard agricultural practices that are used in the vineyard including soil fertilization, irrigation and pest control. Clusters were selected to obtain homogeneous batches based on color, size, and the existence of healthy greenish rachis and remove any infected and damaged berries, then directly transported to the laboratory in the same college.

At the starting of the experiment, all clusters were washed by distilled water and then dried at room temperature for 2 h. The clusters were randomly divided into four groups, each one was treated with the following treatments:-

1. Clusters were immersed in distilled water as control (T_1).
2. Clusters were immersed for two minutes in solutions of salicylic acid at 4 mM/l supplemented with 0.05 % tween–20 as a surfactant (T_2).
3. Clusters were individually placed in dishes Flynn and wrapped with stretch polyethylene (T_3).
4. Clusters were immersed in Paraffin oil for two minutes (T_4).

*(SA concentration of 4 mM/l was prepared, by dissolving SA powder in hot distilled water or ethanol alcohol then completed to liter of distilled water).

Twenty clusters of each treatment, were used to determine the weight loss. Clusters were left for 2h at room temperature to dry thereafter each group divided into two categories the first one, clusters stored at 5 °C in refrigerator 85-90% R.H for 30 days and the second, were stored at 20±5°C for 10 days, estimate as marketing condition . Samples of clusters(3 replicate with 2 clusters of each) were taken every 10 days from cold storage and every 5 days from marketing condition to determine the following parameters:-

1-**Weight loss (%):**

$$\frac{\text{Weight of fresh cluster (g)} - \text{Weight every interval (g)}}{\text{Weight of fresh cluster (g)}} \times 100$$

*Interval = 10 days for cold storage and 5days for marketing condition during the storage period.

2-Berry shattering%:

$$\frac{\text{Weight of berry shatter}}{\text{Initial weight}} \times 100$$

*berry shatter which detached from cap stem after moderate shaking (Cantin *et al*., 2007).

3-Weight of 100 berries was determined in grams by using analytical balance**.**

4-Juice volume of 100 berries was determined in ml by Graduated cylinder.

5-Fruit juice content %:

$$\frac{\text{Weight of extracted juice from 100 berries}}{\text{Weight of 100 berries}} \times 100$$

6-Total soluble solids in the juice were determined by using a hand refractmeter.

7- Acidity in the juice 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.,1985).

$$\text{Acidity (\%)} = \frac{\text{standard solution (N) x base solution (ml) x 0.075}}{\text{Total juice (ml)}} \times 100$$

*The equivalent weight of Tartaric acid = 0.075.

*Total juice= 5ml

8- TSS to acidity was reported as a ratio from the results recorded from juice SSC and titratable acidity

9-Total anthocyanin content:

The determination of the total anthocyanin was realized by the method proposed by (Di Stefano *et al*., 1989) The samples were diluted with a solution consisting of 70/30/1 (v/v/v) ethanol/water/HCl (concentrated) and the absorbance was measured at 540 nm. Due to the lack of a malvidin-3-glucoside standard, the total anthocyanin contents are expressed as malvidin-3-glucoside equivalents and calculated using the following equation purposed by (Di Stefano *et al*., 1989).

$$TA_{540\text{ nm}}\ (\text{mg/L}) = A_{540\text{ nm}} 16.7 d$$

Where A540 nm is the absorbance at 540 nm and d is the dilution.

10-Total phenol:

The Folin–Ciocalteu method (Slinkard and Singleton, 1977) was used for the determination of the total phenol. In brief, an aliquot (1 ml) of the appropriate diluted extracts was added to a 10 ml volumetric flask, containing 5 ml of distilled water. Then, 0.5 ml of Folin-Ciocalteu reagent was added and the contents mixed. After 3 min, 1.5 ml Na_2CO_3 solution of concentration 5 g/L was added and made up to the total volume of 10 ml distilled water. After keeping the samples at 50°C (water bath) for 16 min in sealed flasks and subsequent cooling, their absorbencies were read at 765 nm against distilled water as the blank. A calibration curve was constructed using Gallic acid standard solutions (0–100 mg/L). The concentration of total phenol is expressed as the Gallic acid equivalent (GAE) per 1 g of fresh sample. All samples were prepared in triplicate.

*Total phenol and β-carotene (mg/kg):- were determined by using Apparatus: Spectrophotometer double beam, Labomed, INC. Model: UVD-2950, Glass Cell.

Result and Discussion

In this study, the results illustrated that, the storage duration in marketing condition was 10 days and 30 days in cold storage. The results demonstrated that, all treatments prolonged the storage period of grape with maintained their quality. The evaluation of the storage life was depending on the changes of physical and chemical grape properties therefore, when results described the increased damage in properties of grapes so the storage should be stopped.

A- Physical parameters:

1-**Shattering%:**

The results in Table 1 demonstrated that, the shattering % was gradually increased as storage period advanced in the two different conditions during two seasons. During cold storage, all treatments had signifi-

cantly effect on reduction of shattering % compared with control and there insignificant difference between treatments while at the end of cold storage, T_2 (2.187, 2.48 %) and T_3 (2.747, 1.88 %) treatments, gave the best significant values compared with T_4 (6.32, 6.237 %) in the two investigated seasons, respectively.

As for the marketing condition, all treatments gave positive effect to reduce shattering % during storage life compared with control in two seasons. The highest reduction of shattering % was noted in T_3 (0.2533, 0.6267%) followed by T_4 (0.6200, 0.7333%) compared with T_1 (6.7767, 6.8467) % in the two seasons, respectively

Regarding these results, salicylic acid and polyethylene gave the best effect more than paraffin oil on this parameter during cold storage and marketing condition in the two successive seasons.

Concluded from that, polyethylene was the best treatment in both different conditions in two successive seasons.

Table 1. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on shattering % during cold storage at 5°C and marketing condition at (20± 5°C)on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	Days of cold storage						Marketing condition			
	2014			2015			2014		2015	
	10	20	30	10	20	30	5	10	5	10
Control (T_1)	3.0167A	6.5200 A	9.3967 A	2.7467A	6.5200A	9.3967 A	3.3767 A	6.7767 A	3.3767A	6.8467A
Salicylic acid (T_2)	0.1567 B	1.5133 B	2.1867 C	0.1567B	1.4833 B	2.4833 C	0.1500 B	2.2300 B	0.1700 B	2.4100B
Polyethylene stretch (T_3)	0.0000 B	1.2933B	2.7467 C	0.0000B	1.4367 B	1.8800 C	0.0000 B	0.2533 C	0.0000 B	0.6267C
Paraffin oil (T_4)	0.1467 B	2.3933B	6.3233 B	0.1467B	2.3933 B	6.2367 B	0.0667 B	0.6200 C	0.0667 B	0.7333C

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

2-Weight loss %:

It is known that, the weight loss percentage increased with the advancement in storage period in two different conditions during two seasons. The results in Table 2 illustrated that, after 10 days of cold storage period, there were insignificant difference between the values of control (T_1) and salicylic acid (T_2) and paraffin oil (T_4). Moreover, polyethylene stretch (T_3) gave the lowest value of decrement and this reduction was continued during the storage period. The same trend was found at the end of the cold storage period, data illustrated that, the lowest reduction of weight loss was found in T_3 (12.533, 11.367%) and the highest value in T_1 (40.9, 42%) in two successive seasons, respectively.

Regarding, the results of weight loss% in marketing condition proved that, the best effect of reducion the weight loss% was obtained by T_3 (11.72, 11.83%) and the highest value of weight loss was in T_1 (40.37, 41.40%) in two seasons, respectively.

Concluded from that, polyethylene was the best treatment in both different conditions during two seasons.

Table 2. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on weight loss % during cold storage at 5°C and marketing condition at (20± 5°C) on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	Days of cold storage						Marketing condition			
	2014			2015			2014		2015	
	10	20	30	10	20	30	5	10	5	10
Control (T_1)	13.59 A	24.50 A	40.90 A	13.33 A	25.16 A	42.00 A	22.56 A	40.37 A	23.17 A	41.40 A
Salicylic acid (T_2)	13.01 A	18.07 B	25.83 B	13.43 A	17.76 B	25.73 B	20.31 A	37.31 A	20.60 A	37.76 B
Polyethylene stretch(T_3)	1.12 B	1.78 C	12.53 D	1.78 B	3.07 C	11.36 D	4.72 C	11.72 C	5.13 C	11.83 D
Paraffin oil (T_4)	11.33 A	16.64 B	23.60 C	12.33 A	18.16 B	23.46 C	17.00 AB	32.96 B	17.33 B	33.20 C

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

3- Juice content %:

The results in Table 3 revealed that, the juice content % of berries was gradually reduced with storage period advanced in both conditions during 2014 and 2015 seasons. There were significant differences between the treatments and control. At the end of storage period, polyethylene had the highest value of juice content% and followed by salicylic acid and paraffin while the untreated fruits had the lowest one in both different conditions during investigation seasons.

Resulting that, wrapping with polyethylene stretch gave the positive effect to prevent the reduction of juice content % of berries in both different conditions and in the two successive seasons.

Table 3. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on juice content % during cold storage at 5°C and marketing condition at (20± 5°C) on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	55.340 A	45.117 B	40.413 B	35.430 C	38.390 B	27.150 C
Salicylic acid (T_2)	55.340 A	52.287 A	50.550 A	46.347 B	41.037 B	38.533 B
Polyethylene stretch (T_3)	55.340 A	53.423 A	51.403 A	48.650 A	57.423 A	59.543 A
Paraffin oil (T_4)	55.340 A	52.617 A	50.550 A	47.710 AB	41.380 B	41.663 B
Period(days) / Treatment	0 date	Season 2015				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	57.340 A	47.377 C	42.440 C	37.653 C	39.963 B	29.587 C
Salicylic acid (T_2)	57.340 A	53.370 AB	50.493 B	47.377 B	44.720 B	43.420 B
Polyethylene stretch (T_3)	57.340 A	54.403 A	53.397 A	51.480 A	60.270 A	60.463 A
Paraffin oil (T_4)	57.340 A	52.437 B	50.297 B	48.317 B	47.160 B	47.570 B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

B- Chemical properties:

It is known that, the changing happened in chemical properties of berries whenever the storage period prolonged such as an increase in each of TSS, total phenol and anthocyanin while acidity decreased (Shwartz *et al,* 2009).

1-TSS:

Data in Table 4 showed that, the increment of TSS was occoured parallel with advancing the storage period in the two different conditions during two seasons. The highest and significant values were noted in control (T_1) compared with the other treatments and there were no significant differences between the used

treatments in both different conditions and in the two successive seasons while in the first season under cold storage, T_3 and T_4 gave the lowest values of T.S.S content (19.66, 19%), respectively compared with paraffin oil (20%) and control (21.3%)

2-Acidity:

The results in Table 5 proved that, the acidity% decreased with the progress of the storage period in two different conditions during the two investigation seasons. Concerning storage period, the significant reduction of acidity % was recorded in control compared with the other treatments and the highest value of acidity % was recorded in polyethylene stretch in both storage conditions during two seasons. At the end of the first season in cold storage there was no significant difference between T_3 and T_4 while at the end of the second season there were significant values between all treatments beginning with the highest values of T_3, followed by, T_4. In marketing condition, the highest value was found in T_3 (0.4500 and 0.4567%) in the two tested seasons, respectively followed by, T_2 and T_4.

Table 4. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on TSS % during cold storage at 5°C and marketing condition at (20± 5°C) on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	18 A	19.333 A	20.333 A	21.333A	20.0A	21.67 A
Salicylic acid (T_2)	18 A	18.000 B	18.667 B	19.66BC	19.33AB	19.67 B
Polyethylene stretch(T_3)	18 A	18.000 B	18.667 B	19.000C	19.00B	19.3 B
Paraffin oil (T_4)	18 A	18.333 B	19.33AB	20.000 B	19.67AB	20.33 B
Period(days) / Treatment	0 date	Season 2015				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	18 A	19.333 A	20.000 A	21.333 A	20.00 A	21.67 A
Salicylic acid (T_2)	18 A	18.000 B	19.000 B	19.667 B	19.33 AB	19.67 B
Polyethylene stretch(T_3)	18 A	18.000 B	19.000 B	19.333 B	19.00 B	19.33 B
Paraffin oil (T_4)	18 A	18.660 AB	19.333 B	20.330 AB	19.67 AB	20.33 B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within Columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

Table 5. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on acidity % during cold storage at 5°C and marketing condition at (20± 5°C)on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	0.4950 A	0.4303 C	0.3680 C	0.3298 C	0.4267 D	0.3667 C
Salicylic acid (T_2)	0.4950 A	0.4510 B	0.4287 B	0.4023 B	0.4600 B	0.4267 B
Polyethylene stretch(T_3)	0.4950 A	0.4620 AB	0.4440 A	0.4350 A	0.4733 A	0.4500 A
Paraffin oil (T_4)	0.4950 A	0.4700 A	0.4370 AB	0.4237 A	0.4500 C	0.4100 B
Period(days) / Treatment	0 date	Season 2015				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	0.4990 A	0.4337 B	0.3640 C	0.3203 D	0.4367 C	0.3467 C
Salicylic acid (T_2)	0.4990 A	0.4377 B	0.4363 B	0.4023 C	0.4700 A	0.4233 B
Polyethylene stretch(T_3)	0.4990 A	0.4717A	0.4523 A	0.4363 A	0.4800 A	0.4567 A
Paraffin oil (T_4)	0.4990 A	0.4633 A	0.4360 B	0.4223 B	0.4567 B	0.4100 B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

3-TSS/acid ratio:

It is clear that, with advancing of storage period, the percentage of TSS increased whenever the acidity % decreased therefore, the TSS/ acid ratio increased and this indicator to, ending the storage period.

The results in Table 6 proved that, there were significant differences between control and the other treatments whereas, at the end of storage, the highest value of TSS/ acid ratio was noted in T_1 (64.707, 66.607) in cold storage and (59.660, 63.137) in marketing condition in two successive seasons, respectively while, the lowest values of ratio was noted in T_3 (43.703, 44.32) in cold storage and (43.160, 42.523) in marketing condition during two seasons.

Table 6. **Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on TSS/acid ratio during cold storage at 5°C and marketing condition at (20± 5°C) on "Ruby seedless "grapes during 2014 & 2015 seasons**

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	36.360 A	44.960 A	55.290 A	64.707 A	46.843 A	59.660 A
Salicylic acid (T_2)	36.36 A	39.917 B	43.540 B	48.890 B	42.217 B	46.317 C
Polyethylene stretch (T_3)	36.36 A	39.010 B	42.067 B	43.703 C	40.317 C	43.160 D
Paraffin oil (T_4)	36.36 A	39.000 B	44.170 B	47.213 B	43.930 B	49.870 B
Period(days) / Treatment	**0 date**	**Season 2015**				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	36.100 A	44.587 A	54.960A	66.607 A	45.770 A	63.137 A
Salicylic acid (T_2)	36.100 A	41.130 B	43.547 B	48.923 B	41.320 C	46.760 BC
Polyethylene stretch (T_3)	36.100 A	38.183 C	42.007 C	44.327 C	39.760 C	42.523 C
Paraffin oil (T_4)	36.100 A	40.320 BC	44.340 B	48.140 B	43.280 B	49.927 B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

4-Total phenol content:

The presented results in Table 7 showed the accumulation of total phenol with the progress of the storage period in both storage conditions and during the two successive seasons. Data showed that, the highest values of phenol content were recorded in T_2 (salicylic acid) in both conditions in 2014 and 2015 seasons while there were insignificant differences between T_1, T_3 and T_4 in two different conditions and during the investigated seasons. In this respect, salicylic acid had an obvious effect on the phenol accumulation compared with the other treatments and control.

5-Total anthocyanin:

Data in Table 8 illustrated that, the anthocyanin pigment content increased with the progress of storage period until the end, but it reduced with the end stage of storage and this was clearly in control (T_1) in cold storage during the two seasons. The results proved that, there were significant values between all treatments compared with control in both condition and two seasons. At the end of cold storage the highest value of anthocyanin was registed in T_2 (0.7457, 0.7430) followed by T_4 (0.7070, 0.7033) and then T_3 (0.6867, 0.6817) in both seasons, respectively. At the end of marketing condition storage the significant score was noted in T_2 (0.7350, 0.7357) followed by T_4

(0.7157, 0.7137) in the two seasons, respectively and there was no significant differences between T_3 and T_1. Consequence with before that, the salicylic acid treated gave the best effect on anthocyanin in all conditions.

Table 7. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on Total phenol (mg/kg) during cold storage at 5°C and marketing condition at (20+ 5°C)on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	43.550 A	49.937 C	56.370 B	62.970 B	59.003 C	62.593 C
Salicylic acid (T_2)	43.550 A	55.563 A	65.660 A	74.403 A	63.507 A	75.610 A
Polyethylene stretch(T_3)	43.550 A	51.567 C	58.283 B	63.677 B	59.690 BC	65.560 B
Paraffin oil (T_4)	43.550 A	53.370 B	58.643 B	65.273 B	61.560 AB	66.667B
Period(days) / Treatment	0 date	Season 2015				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	45.710 A	50.490 C	55.953 C	62.650 C	59.770 B	63.577C
Salicylic acid (T_2)	45.710 A	55.577 A	65.743 A	74.257 A	64.180 A	76.357A
Polyethylene stretch(T_3)	45.710 A	51.363 C	58.277 B	64.350 BC	59.580 B	66.360BC
Paraffin oil (T_4)	45.710 A	53.087 B	58.443 B	65.870 B	60.810 B	66.813B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within Columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

Table 8. Effect of salicylic acid (4 mM), polyethylene stretch and paraffin oil on anthocyanin (O.D at 540 nm) during cold storage at 5°C and marketing condition at (20+ 5°C)on "Ruby seedless "grapes during 2014 & 2015 seasons

Period(days) / Treatment	0 date	Season 2014				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	0.4670 A	0.5447 D	0.6520 BC	0.5873 D	0.5553 D	0.6827 C
Salicylic acid (T_2)	0.4670 A	0.6450 A	0.7080 A	0.7457 A	0.6853 A	0.7350 A
Polyethylene stretch (T_3)	0.4670 A	0.5947 C	0.6330 C	0.6867 C	0.6053 C	0.6927 C
Paraffin oil (T_4)	0.4670 A	0.6173 B	0.6670 B	0.7070 B	0.6553 B	0.7157 B
Period(days) / Treatment	0 date	Season 2015				
		Days of cold storage			Marketing condition	
		10	20	30	5	10
Control (T_1)	0.4780 A	0.5487 C	0.6500 BC	0.5903 D	0.6117 B	0.6803 C
Salicylic acid (T_2)	0.4780 A	0.6437 A	0.7070 A	0.7430 A	0.6840 A	0.7357 A
Polyethylene stretch(T_3)	0.4780 A	0.5963 B	0.6303 C	0.6817 C	0.6040 B	0.6910 C
Paraffin oil (T_4)	0.4780 A	0.6170 B	0.6737 B	0.7033 B	0.6530 AB	0.7137 B

*Means separation by Duncan's multiple range tests at P <0.05. The same letters within Columns are not significantly different. Ascending order starts from (A) means the highest value until reaches to the letter which has the lowest value.

Discussion

Water is the essential content of fresh fruits and it's represented about 80 to 90% of fresh weight. Fruits considered as the living organisms which still continuous in respiration process even after harvest. At harvest, the fruits start to lose the moisture from the processes of metabolic activity, respiration and transpiration (evaporation of water).This lead to, loss of both moisture content then weight of fruit, and this give a negative effect on the fruit quality, which is not suitable for marketing (Yaman and Bayindirli, 2002).

Salicylic acid prolongs the storage life of grape clusters by the reducing of ethylene biosynthesis, respiration and transpiration, water loss,

softened berry rate and decay infection by stomatal closing of fruit surface (Zheng and Zhang, 2004, Ehsan *et al.,* 2011) and maintains the firmness and delaying rachis browning by inhibiting the polyphenol oxidase activity. It is well known that, Polyphenol oxidase (PPO) and peroxidase (POD) are involved in browning of fruit (data not shown) (Peng and Jiang, 2006, Shafiee *et al.,* 2010, Khalil, 2014).

Salicylic acid has main effect on some climacteric fruits such as banana, is the reduction of ethylene production and its action so that, the application of SA on the climacteric fruits, gives positive effect in TSS reduction rate (Srivastava and Dwivedi, 2000). On the other hand, SA gives trivial effect on TSS for some fruits which belong to non-climacteric fruits during cold storage (Sayyari *et al.,* 2009).

Paraffin makes a modified atmosphere inside the fruit by reducing the oxygen content and enhancing the carbon dioxide and therefore, decreases the fruit's respiration rate and improves the postharvest life which permits to prolong the marketing and storage period for the fruits (Magashi and Bukar, 2006).

Polyethylene stretch can create a modifying atmosphere around the fruits by decreasing the oxygen and increasing CO_2 and thus, occur reduction in the rate of respiration and weight loss of fruit (Caleb *et al.,* 2012, Mangaraj *et al.,* 2011).

Shattering % is resulting by the infection with fungal during storage (Sandhu *et al.,* 1990). Whereas, SA has ability to decrease fungal decay of grapes because, it leads to stimulate the expression of many protection genes against pathogens (Khalil, 2014) (data not shown). In addition to, SA has ability to reduce the shattering %, which attributed to an inhibition of both ethylene production and its action in the abscission layer (Srivastava and Dwivedi, 2000, Ehsan *et al.,* 2011)

Grapes are belonged to the non-climacteric fruits which have a low respiration rates, therefore, they characterized by consuming small amounts of sugar for respiration process after harvest and storage at different conditions (Cirami *et al.,* 1992). However, the increasing of TSS in juice due to the loss of water from fruit, that leads to the increase of concentration of the soluble solids (Nanda *et al.,* 2001).During storage, TSS and soluble sugars may enhance due to the action of sucrose-phosphate synthase (SPS), a key enzyme in sucrose biosynthesis. This enzyme is catalyzed by ethylene (Asghari and Aghdam, 2010).

The increase of TSS and the loss of the TA are usually used to describe the ripening stage of the fruits as well as to assess the fruit taste which is represented mainly by the balance between sweetness and acidity. The major function of SA is delaying the fruit ripening during storage by reducing of ethylene production (Kazemi *et al.,* 2011) and also improving the fruit quality (Asghari and Aghdam, 2010). On the other hand, SA gives trivial effect on TSS for some fruits which belong to non-climacteric fruits during cold storage (Sayyari *et al.,* 2009).

(Sarikhani *et al.,* 2010) suggested that SA treatment enhanced

the increase of total phenol content in treated grape fruits and. SA treatment could be cause for accumulation of phenol compounds in grapes via increasing the activity of PAL, which considered the first key enzyme involved in the biosynthesis of phenols in fruits (Chen et al., 2006). In addition, the concentrations of catechin and quercetin were higher in SA–treated berries (Ehsan *et al.,* 2011).

Total anthocyanin content of grape berries which treated with SA showed an increasing trend up to 45 days of storage period and then gradually decreased (Harindra-Champa *et al.,* 2014) that may be due to decrease respiration which prevents fruit senescence during storage and prevents enzymatic activities which have a role in anthocyanin synthesis (Shafiee *et al.,* 2010).

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استخدام بعض المعاملات ما بعد الحصاد لتحسين وجوده عنب" الروبي سيدلس" خلال فترة التخزين والتسويق

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الملخص

من المعروف ان فترة التخزين والتسويق لعناقيد العنب تكون قصيرة جدا، وذلك راجع إلي أسباب عديده من اهمها عملية تنفس العناقيد التي تظل مستمرة حتي ما بعد عملية الحصاد. نتيجه عملية التنفس يواجه العنقود بعض المشاكل مثل فقد الماء (الرطوبه) من الحبات ومن المحور الزهري مما يتسبب في تكوين منطقة الإنفصال بين الحبات وبين العنقود وتسمي هذة العملية بفرط الحبات ، صغر حجم الحبات ، انخفاض نسبة العصير حتي تصل الي مرحلة الكرمشه ، فقد المحور الزهري حيويتة ويتحول الي اللون البني ونتيجه لهذه العمليات يصبح العنقود اكثر تعرضا لاصابة بالفطريات والامراض التي تجعل العنقود يصل الي مرحلة الأضمحلال. لذلك فان الهدف من هذا الدراسه هو إطالة فترة التخزين والتسويق باستخدام بعض المعاملات مثل حمض السلسيلك بتركيز ٤ ملمول/لتر وزيت البرافين وأيضا لف العناقيد بواسطة البولي إثيلين إستريتش والتي قد تقلل من عملية التنفس الي حد ما وبالتالي الحفاظ علي حيوية وجودة العناقيد لاطول فترة ممكنه ،ثم تخزينها في الثلاجات في درجة حراره ٥م° ورطوبة ٨٥ إلي٩٠ % وفي درجة حرارة ٢٠±٥ °م وهي ممثلة كالتخزين في الاسواق وتأثير هذة المعاملات علي الصفات الطبيعية والكيماويه للحبات مثل (نسبة فرط الحبات – نسبة الفقد في الوزن – نسبة محتوي العصير% – نسبة المواد الصلبة الذائبة الكلية – الحموضة – النسبة بين المواد الصلبة الذائبة الي الحموضة – الفينولات الكلية – الانثوسيانين الكلي). أثبتت النتائج ان جميع المعاملات تعمل علي الاحتفاظ بحيوية العناقيد لاطول فترة ممكنه مع الاحتفاظ بالقيمه الغذائية لها مقارنه بالثمار الغير معاملة (الكنترول) وان فترة التخزين في الثلاجه كانت أطول حيث تصل إلي ٣٠ يوم مقارنه بالتخزين في ظروف التسويق حيث وصلت إلي ١٠ ايام فقط.