EVALUATION OF POTASSIUM SILICATE, GUM ARABIC AND MODIFIED ATMOSPHERE ON BERRIES QUALITY OF EARLY SWEE.T GRAPE UNDER DIFFERENT STORAGE TEMPERATURE

[7]

Abdel – Hamid, N.[1]; Aly, M. K. [1]; Tourky, M. N.[2]
and Abdel – Maksoud, Magda, M.[2]

1) Faculty of Agriculture, Ain Shams University 2) Horticulture Research Institute, Agriculture Research Center

ABSTRACT

The effect of different pre storage treatments (Arabic gum and potassium silicate combined with modified atmosphere packing (MAP) on polyethylene bags at 40 or 80 mu and heat shrinkable) on berries quality and extending the storage life of Early sweet grape under two different storage temperature (0 and 7 ± 1^{o}C) have been investigated. Results clearly indicated that, potassium silicate and Arabic gum with heat shrinkable under temperature (0 ± 1 ^{o}C) maintaining the discarded berries, reduced weight loss throughout, reducing respiration rate and total acidity and recorded the high values of soluble solids contain and sensory evaluation of samples, flowed by the same substance with polyethylene bag at 40 mu which give moderate values while the least significant was obtained by wrapped fruit with polyethylene bags at 80 mu were given a value near untreated clusters (control).

Key words: Early sweet grapes, Arabic gum, Potassium silicate, Modified atmosphere packing (MAP), Heat shrinkable, Cold storage.

INTRODUCTION

Table grapes are one of the most wide grown fruit crops in Egypt. It's considered to be the second most important fruit crop after citrus. Table grapes are grown from Alexandria in the north of Egypt to Aswan in the south. There are many varieties of table grapes produced in Egypt, like early sweet, Superior, Thompson, Flame seedless, Crimson, and Red globe. Competition among Egyptian growers is tough. There's always more competition every year because of the new grape plantations coming into production every year, so the only thing that keeps one ahead of others in the market is the ability to produce high quality grapes. Egyptian's geographical spread of production enables fresh sweet grapes to be available from May to July for the main export destinations such as the European Union (UK, Netherlands, and Italy), Russia, and Gulf region (Emirates). Grapes can be picked, packed and air freighted to markets within 60-72 hours of harvest. Shipping to the Middle East countries takes almost 48-60 hours. Egypt exports around 7% from the total volume of produced grape. In 2013, the total volume of the exported grape was around 80,000 tones (AGQ 2014).

Storage methods used to protect the freshness of grapes are chemical protect, controlled atmosphere storage and cold storage. Cooling is the most active method to control maturity of vegetables and fruits in practice. The maturity of vegetables and fruits are the decaying caused by changing of chemical changing in organic matters. Enzymes can cause chemical changing in organic matters. The chemical reaction is too slow at below $0^{o}C$ (Selcuk and Serap 2004).

Storage affected the change of different parameters in a different way as well as the change of the quality of evaluated samples. Sensory traits like taste scent and texture decreased during storage. The storage reduced also the quality of instrumentally measured physical parameters fixing ability of grape berries and firmness of grape skin (Minarovska, and Horcin, 2000).

However, despite good temperature control during postharvest storage, table grapes continue to lose mass mainly due to the micro-climatic conditions that were created within the enclosed fruit packages. Ngcobo *et al.* (2012) reported that there were significant differences in mass loss of table grapes packed in different multi-packages, where the perforated liners films resulted in a higher mass loss than the non-perforated liner films during the cold storage period. The table grape is not exempt from issues of degrading quality, and many problems have been detected during postharvest storage and shelf life.

Quality losses include weight loss, color change, berry softening and rachis browning, leading to reduced shelf life and overall quality (Valverde *et al*, 2005). Packaging and handling systems have been developed in many countries to move products from farm to consumer expeditiously in order to minimize quality degradation. Procedures include lowering temperature to slow respiration and senescence, maintaining optimal relative humidity to reduce water loss without accelerating decay, adding chemical preservatives to reduce physiological and microbial losses, and maintaining an optimal gaseous environment to slow respiration and senescence (Wills *et al*. 1989;Workneh *et al*. 2011). It is widely accepted that modified atmosphere packaging (MAP) helps to retard tissue senescence and consequently extends storage life of produces (Ahvenainen 1996; Soylemezoglu 2001; Lurie *et al.* 2006). However, reliable knowledge about the practical use of MAP on the quality of minimally processed grapes is still limited. Kader (2002) recommended the use of MAP as a supplement to avoid skin browning incident which is a significant problem occurring in the storage of perishable produces like grapes.

In the absence of cold storage, deterioration is often faster because of the production of vital heat and carbon dioxide release from respiration. Thus, cold storage is mainly used to decrease the respiratory rate, reducing losses, and retaining the product features that are associated with quality. However, the metabolic rate should remain at minimum rate needed to keep the product cells alive while maintaining the sensory quality during storage (Fonseca *et al.*, 2002).

Modified atmosphere packing (MAP) leads to a reduction in the fruit respiration rate because the combination of fruit respiration and the gas permeability of the plastic film increases the CO_2 levels and decreases the oxygen (O_2) inside the package. Thus, there is a change in the metabolic processes (Hertog *et al*., 2001; Rocha *et al*., 2004) that slows fruit ripening, microbial growth (Cantwell, 1992; Caleb *et al*., 2012), moisture loss (Sabir *et al*., 2011), and enzymatic browning (Guan and Dou, 2010). Indeed, depending on the levels of fruit respiration and the film permeability, there may be an increase in the CO_2 levels that leads to anaerobic respiration, ethanol accumulation and physiological injuries to the product (Ares *et al.*, 2007).

Recently dipping in solutions of natural compounds in combination with modified atmosphere packaging (MAP) was proven as promising means for postharvest control decay (Valero *et al*., 2006). Obviously, film selection is important to the system of MAP, because proper matching of the commodity characteristics with the film results in the passive evolution of an appropriate atmosphere within the sealed package (Zanderighi, 2001). The principal advantage of shrink wrapping is reduced weight loss, minimized fruit deformation, reduced chilling injury and reduced decay by preventing secondary infection.

Sudhakar Rao *et al*. (2000) studied the effect of MAP and shrink wrapping on the shelf life of cucumber and reported that shrink wrapping with Polyethylene (PE) film can extend the shelf life of cucumber up to 24 days at 10 °C. The individual shrink wrap packaging extends the marketing life by preventing the maintaining firmness and reducing the respiration rate. It also delays the physiological deterioration of fruit some time even better than the low temperature storage. Edible sucrose polyesters (SPE) have been applied successfully as coatings to extend the postharvest life of fresh fruits such as apples, banana limes, mangoes, oranges, pomegranate and Peach (Santerre *et al* 1989; Nanda, *et al* 2001). On pomegranates Nazmy, *et al* (2012) found significant reduction on weight loss and respiration when using shrink film warping, possibly due to the low permeability of the films used for wrapping. While in peach Mahajan, *et al* (2015) reported that shrink film helped in reducing the loss in weight, firmness, decay incidence and maintained the various qualities attributes like total soluble solids, sugars, acidity and ascorbic acid content of the fruits during shelf life better than unwrapped control fruits

Despite not being considered as an essential nutrient for most plants to complete their life cycles, it has been widely reported that silicon (Si) reduces the effects of biotic and abiotic stresses (Epstein, 2009). Silicon applications might become an alternative to currently used fungicides. Silicon has been used to minimize the adverse effects of biotic and abiotic stresses on various fruit crops by stimulating defense reaction mechanisms (Brecht *et al*., 2003). Depositions of Si into epidermal cells may from an affective mechanical barrier against fungal penetration. Plants harden physically as a result of Si accumulation resulting in additional protection, preventing fungi from entering plant cells (Bosse *et al*., 2011).

Gum Arabic (GA) is a dried gummy exudate from the stems and branches of *Acacia senegal* and related species of *Acacia* (Ali *et al*., 2010). Gum arabic (GA) is a common polysaccharide frequently used in industry as a food additive (Motlagh *et al*., 2006). The joint FAO/WHO Expert Committee on Food Additives has approved GA as a safe compound (Anderson and Eastwood, 1989) Use of Arabic gum as a postharvest covering of fruits cause reduce water loss and weight of fruits and delay fruits ripening (Creel, 2006). Quality change during postharvest was investigated through the effect of potassium silicate and Arabic gum combination with (MAP) using polyethylene bags in (40 mu and 80 mu) and shrink film on berries quality and extending the storage life of Early sweet grape under two different temperature.

MATERIALS AND METHODS

Plant material and experimental design:

This study was conducted during two successful season of 2013 and 2014 season to improve fruit quality of Early sweet grapes (*Vitis vinifera L*.,) as affected by Arabic gum, potassium silicate and modified atmosphere packing (MAP).

Early sweet grapes were harvest from a private orchard on Cairo - Alexandria desert road, Giza Governorate, Egypt. The grapevines cultivar early sweet were five years old, grown in sandy soil under drip irrigation system and planted at 1.5 X 30 meter.

Cultural practices were done according to general field recommendation including fertilization, pruning as well as pest diseases control.

Clusters were picked in the early morning at the ripening stage in the middle of June during both seasons. Ripening stage (TSS ≈ 14 – 15 %) and (0.4 – 0.5 %) acidity and complete yellow color of berries skin clusters hand harvest Kader (2002). Healthy clusters free from any visible physiological and pathological were chosen. Moreover, uniformity clusters size, color and firmness were selected. Clusters were harvested in bags cartons, and then immediately transported from the orchard to the postharvest laboratory at the Department of Horticulture, Ain Shames University and treated on the same day. Clusters were washed with tap water containing color x 1% (0.05% sodium hypochlorite) and air dried, then divided into 15 similar groups each group was 3 kg cluster and treated with following treatments.

1. Control treatment

Clusters were without any treatment.

2. Potassium silicate treatment

The clusters were dipped on potassium silicate (PS) at 1.5 % for 4 min and air dried at room temperature before storage.

3. Gum Arabic treatment

The clusters were dipped on pure concentrated (25% w/v) Gum Arabic solution (GA) was prepared by dissolving Gum Arabic in distilled warm water (60^{o}C). Sugar was added (5% w/v) and the solution was then purified for 4 min**.**

The treated fruits (PS or GA) were wrapped using:

- **a.** Heat shrinkable films (SH) BDF-2001 (a multi-layered co-extruded polyolefin film), film 25 mm thick.
- **b.** Modified atmosphere packaging (MAP) by using 40 mu of perforated polyethylene (PPE) bags.
- **c.** Modified atmosphere packaging (MAP) by using 80 mu of perforated polyethylene (PPE) bags.

The used treatments were

1. Clusters treated with 1.5 % potassium silicate (PS) were wrapped using heat shrinkable films (SH) (PS + SH).
2. Clusters treated with 1.5 % potassium silicate (PS) were packaged in modified atmosphere packaging (MAP) by using 40 mu (PS + MAP 40 mu).
3. Clusters treated with 1.5 % potassium silicate (PS) were packaged in modified atmosphere packaging (MAP) by using 80 mu (PS + MAP 80 mu).
4. Clusters treated with Gum Arabic (GA) (25% w/v) were wrapped using heat shrinkable film (SH) (GA + SH).

5. Clusters treated with Gum Arabic (GA) (25% w/v) were packaged in modified atmosphere packaging (MAP) by using 40 mu (GA + MAP 40 mu)

6. Clusters treated with Gum Arabic (GA) (25% w/v) were packaged in modified atmosphere packaging (MAP) by using 80 mu (GA + MAP 80 mu)

7. Control clusters: clusters were without any treatment.

Treated clusters were rapidly and carefully were placed in three perforated cartoon boxes (30×40×20 cm) for each treatment. Each box contained 2 kg was replicated three times and the experiment was repeated twice (2013 and 2014 seasons). Boxes of all treatments were subjected randomly to one of the pervious treatments and stored at

1. Refrigerator at O ± 1 C^{o} with 90 ± 5% for 28 days.

2. Refrigerator at 7 ± 1 Co with 90 ± 5% for 28 days.

A sample of randomly selected fruits at the beginning of cold storage duration (0 day) and weekly (7 days) intervals was collected from each replication for all treatments during the storage period. The experiment was arranged in complete randomized blocks design. Data on the following parameters was recorded.

Measurements:

1. Weight Loss Percentage:

The difference between the initial weight of the clusters and that recorded at the date of sampling was translated as weight loss percentage according to the following equation:

$$\textbf{Loss in weight \%} = \frac{A - B}{A} \times 100$$

Where:

A = The initial weight of the box.

B = Weight at inspecting day.

2. Discarded fruit percentage:

Berries showed any sign of decay or visual disorders were counted. The percentage of discarded berries was calculated on the bases of cluster weight using the flowing formula:

$$\textbf{Discarded fruit \%} = \frac{\text{weight of discarded berries at each sampling date}}{\text{Total cluster weight}} \times 100$$

3. Berry adherence strength (g/cm3)

was mustered by using Shatilonّs instrument.

4. Total Soluble Solids (TSS %):

Total soluble solids were determined in the berries using a digital refractometer (Model PR-32, Atago, Japan) by squeezing the fruit. (A. O. A. C., 1990).

5. Total Acidity (TA %):

Total acidity was determined by titration with a standard solution of sodium hydroxide (0.1N), using phenolphthalein as an indicator

(A. O. A. C., 1990). The results were expressed as percentages of anhydrous tartaric acid according to the following equation:

$$\textbf{Total acidity (\%)} = \frac{\text{ml of NaOH} \times 0.0074}{\text{ml juice used}} \times 100$$

Respiration rate (mg Co2/ kg fruit/hr):

Carbon dioxide produced by grape was determined after 10 hrs finished from treatments and then every 7 days during cold storage. The air flow was passed through concentrated NaOH, to insure that air flow is CO free, before passing into 1-liter jar fruit container (fruit ambient) one fruit/ jar was considered one replicate. The out coming air flow was then passed into 100 ml. NaOH of 0.1 N for 1 hr. Such solution was then titrated against 0.1 N HCl and CO levels produced by the fruits were then calculated as mg CO /kg fruits/h **(A. O. A. C., 1990).**

Statistical analysis:

The obtained data throughout the two seasons were subjected to analysis of **SAS Computer Program (1998)** according to Duncan's multiple ranges. This test was used for comparison between means. Different alphabetical letters in the column are significantly at the level of 5% of significance.

RESULTS AND DISCUSSION

Weight loss percentage:

It is clear from Table 1 that weight loss increased gradually during the storage period of early sweet grape stored either at 0 or 7^{o}C. The present data reveal that**,** control treatment suggested the highest weight loss were flowed by clusters which were dipped in potassium silicate (PS) or in gum Arabic (GA) and wrapped by perforated polyethylene (PPE) bags 80 mu with no significant differences between them and best rustles which reduced weight loss for clusters which dipped in potassium silicate or dipped in gum Arabic and wrapped by shrink film (SH).

The lowest significant percentage of fruit weight loss which recorded for dipping in gum Arabic or potassium silicate and wrapped by heat shrink (0.97, 1.08, 1.54 and 1.72) respectively in both storage degree in the first season after 7 days of storage to reach (8.30, 8.33, 9.34 and 9.79) at the end of storage (28 days). While, in the second season after 7 days storage were recorded (0.93, 1.02, 1.54 and 1.66) respectively to reach (8.44, 8.46, 8.69 and 8.88) respectively in the end of storage period as compared with the control which gave the highest significant percentage of weight loss (1.44, 2.21, 1.34 and 2.38) in both degree in two seasons after 7 days storage meanwhile, reached (11.56, 11.73, 10.82 and 11.80) respectively after 28 days storage in two seasons under both degree storage. This rustle is agree with (Seymour *et al*.1993) whose suggested that softening of fruit is due to deterioration in the cell structure, cell wall composition and intracellular materials and is a biochemical process involving the hydrolysis of pectin and starch by enzymes e.g. wall hydrolyses.

The basic mechanism of weight loss from fresh fruit and vegetables is by vapor pressure at different locations, as the process of fruit ripening progresses, depolymerisation or shortening of chain length of pectin substances occurs with an increase in pectin esterase and polygalacturonase activities (Yaman and Bayoindirli, 2002), although respiration also causes a weight reduction (Pan and Bhowmilk, 1992). This reduction in weight loss was probably due to the effects of the coating as a semi - permeable barrier against O_2, CO_2, moisture and solute movement, thereby reducing respiration, water loss and oxidation reaction rates (Baldwin *et al*., 1999)

Table 1: Effect of different treatments on weight loss percentage of Early sweet grape on cold storage during 2013 – 2014 seasons.

Weight Loss (%)								
Season 2013								
Days in cold storage								
	0 C°±1				**7C°±1**			
Days / Treatments	**7**	**14**	**21**	**28**	**7**	**14**	**21**	**28**
T_1	1.08**cd**	2.50**d**	4.62**d**	8.33**e**	1.72**d**	3.14**d**	5.38**d**	9.34**e**
T_2	1.33**abc**	4.07**b**	6.55**b**	11.00**c**	2.11**c**	4.96**b**	7.83**b**	11.27**c**
T_3	1.50**a**	4.52**a**	7.00**a**	11.90**a**	2.28**a**	5.25**a**	8.90**a**	12.75**a**
T_4	0.97**d**	2.40**d**	4.56**d**	8.30**e**	1.54**e**	3.08**e**	5.35**e**	9.79**d**
T_5	1.16**bcd**	3.55**c**	5.83**c**	10.72**d**	2.07**c**	4.62**c**	7.33**c**	11.12**cd**
T_6	1.56**a**	4.57**a**	7.03**a**	11.96**a**	2.33**a**	5.20**a**	8.95**a**	12.77**a**
T_7	1.44**ab**	4.37**a**	6.90**a**	11.56**b**	2.21**b**	5.07**a**	8.87**a**	11.73**b**
Season 2014								
T_1	1.02**d**	2.54**d**	4.74**c**	8.46**d**	1.66**c**	2.54**c**	5.00**e**	8.88**e**
T_2	1.26**bc**	3.96**b**	6.86**b**	10.35**b**	2.07**b**	4.36**b**	7.56**c**	10.98**c**
T_3	1.63**a**	4.20**a**	7.30**a**	11.18**a**	2.44**a**	5.23**a**	8.89**a**	12.71**a**
T_4	0.93**d**	2.36**d**	4.34**d**	8.44**c**	1.54**c**	2.36**d**	4.94**e**	8.69**e**
T_5	1.13**c**	3.23**c**	5.83**b**	10.23**b**	2.04**b**	4.23**bc**	6.84**d**	10.78**d**
T_6	1.70a	4.28a	7.37a	11.25a	2.50a	5.27a	9.00a	12.81a
T_7	1.34**b**	4.07**a**	7.24**a**	10.82**a**	2.38**a**	5.20**a**	8.84**a**	11.80**b**

T1 = PS + SH T2 = PS + PPE 40 mu T3 = PS + PPE 80 mu T4 = GA + SH

T5= GA + PPE 40 mu T6 = GA + PPE 80 mu T7 = control

Discarded berries percentage:

Discarded berries percentage was mainly due to the loss in berry weight, berry shatter and berry decay percentages. In this respect data showed from Table 2 that the discarded berries percentage was gradually increased by storage period advanced. It is clear from this table that dipping Early sweet grape in potassium silicate (PS) and wrapped with shrink film (SH) significantly reduced the percentage of discarded berries percentage in two seasons and both degree storage than the other treatments or the control. Meanwhile clusters were dipped in gum Arabic (GA) and covered by shrink film (SH) was given near value to potassium silicate (PS) Since, gum Arabic and potassium silicate were presented about (18.13, 18.16, 20.41 and 19.92) respectively, in both storage degree after 28 days of cold storage in the first season whereas, in the second season values were (18.72, 18.97, 19.34 and 19.62) respectively. Since control treatment was about (23.74 and 24.79) respectively, in the first season and (26.50 and 27.94) respectively in the second season. Similarly (Babalar *et al*.1998) presented that the amount of decay, weight loss and shattering of seedless grape were increased by storage harvest till 135 days. . (Tarabih *et al* 2014) declared that the percentage of total loss in weight was gradually increased during cold storage or at marketing as storage period advanced. Moreover, dipping Anna apple in potassium silicate at 0.3% significantly reduced the percentage of total loss in fruit weight than the other treatments.

Table 2: Effect of different treatments on discarded berries percentage of early sweet grape on cold storage during 2013 – 2014 seasons.

Discarded berries (%)								
Season 2013								
Days in cold storage								
	0 C°±1				**7C°±1**			
Days / Treatments	**7**	**14**	**21**	**28**	**7**	**14**	**21**	**28**
T_1	1.39**d**	3.78**e**	8.98**e**	18.16**e**	2.17**d**	5.00**e**	10.46**e**	19.92**f**
T_2	2.36**b**	6.68**b**	14.19**b**	26.36**b**	3.23**ab**	7.72**b**	17.39**b**	27.35**b**
T_3	2.62**a**	7.17**a**	15.17**a**	27.32**a**	3.39**a**	8.25**a**	18.48**a**	28.74**a**
T_4	1.26**d**	3.84**e**	8.84**e**	18.13**e**	1.99**d**	5.06**e**	10.31**e**	20.41**e**
T_5	2.21**b**	6.20**c**	13.69**c**	24.95**c**	3.07**b**	7.39**c**	15.97**c**	26.44**c**
T_6	2.74**a**	7.23**a**	15.28**a**	27.38**a**	3.45**a**	8.33**a**	18.61**a**	28.88**a**
T_7	1.61**c**	5.31**d**	11.60**d**	23.74**d**	2.80**c**	6.91**d**	14.46**d**	24.79**d**
Season 2014								
T_1	1.29**cd**	3.92**e**	10.29**d**	18.97**e**	2.04**d**	4.39**e**	10.36**e**	19.62**e**
T_2	2.11**bc**	5.85**c**	15.01**b**	24.59**c**	3.05**b**	6.64**c**	16.02**c**	26.37**c**
T_3	2.56**a**	6.66**a**	15.74**a**	26.83**a**	3.55**a**	8.10**a**	18.01**a**	29.71**a**
T_4	1.17**d**	3.77**e**	9.87**e**	18.72**f**	1.95**d**	4.20**e**	10.30**e**	19.34**f**
T_5	1.48**c**	4.90**d**	12.53**c**	23.86**d**	2.81**c**	6.28**d**	13.86**d**	24.86**d**
T_6	2.63**a**	6.71**a**	15.80**a**	26.91**a**	3.61**a**	8.21**a**	18.12**a**	29.83**a**
T_7	2.23**b**	6.13**b**	15.58**ab**	26.50**b**	3.44**a**	7.64**b**	17.44**b**	27.94**b**

T1 = PS + SH   T2 = PS + PPE 40 mu   T3 = PS + PPE 80 mu   T4 = GA + SH

T5= GA + PPE 40 mu   T6 = GA + PPE 80 mu   T7 = control

Berry adherence strength:

Berry adherence strength is an important parameter because a lower adherence is related to shattering or berry drops. The higher berry adherence found in grapes dipping in gum Arabic and wrapped by shrink film (GA + SH) so also potassium silicate with shrink film (PS + SH). From table 3 it is clear that berry adherence strength was gradually reduced by storage period advanced till 28 days. Potassium silicate with shrink film (PS+SH) reduced berry adherence strength from harvest day to end storage in both degrees for two seasons about (15%) while, Gum Arabic with shrink film (GA+SH) reduced about (17%) in end storage period. The highest level record suggested for control (30 %) nearly using gum Arabic with perforated polyethylene 80 mu (GA + PPE 80 mu) with no significant value. The effects of these treatments on berry adherence were unpronounced. Likewise Fatih and Metin (2014) who suggested that berry removal force is an important parameter because a lower removal force is related to shattering or berry drops. Then higher berry removal force found in grapes covered with MG showed that the risk of berry drop levels would decrease. No berry drop is preferred during the marketing phase when the grape clusters are picked up from the package. Dropping implies a negative impression to the consumer, as it is accepted as a sign of the fruit not being fresh. Decreased berry removal force is understood to be a result of aging (Crisosto *et al*., 2001).

Table 3: Effect of different treatments on berry adherence strength of Early sweet grape on cold storage during 2013 – 2014 seasons.

Berry Adherence strength (gf)

Season 2013

Days in cold storage

Days / Treatments	0C°±1 H	0C°±1 7	0C°±1 14	0C°±1 21	0C°±1 28	7C°±1 H	7C°±1 7	7C°±1 14	7C°±1 21	7C°±1 28
T_1	1250a	1238a	1195a	1153a	1055a	1252a	1221ab	1171a	1112b	1053a
T_2	1250a	1222b	1170b	1143b	1028b	1250a	1214b	1151b	1103c	997c
T_3	1250a	1188d	1084d	962f	829f	1252a	1178d	1061e	947f	820f
T_4	1251a	1238a	1200a	1151a	1038a	1251a	1225a	1176a	1119a	1033b
T_5	1250a	1201c	1106c	1015d	917d	1250a	1195c	1104c	1011d	913d
T_6	1250a	1180d	1078d	956f	820f	1252a	1168d	1055e	938f	825f
T_7	1252a	1196c	1100c	979e	875e	1252a	1180d	1090d	973e	870e
Season 2014										
T_1	1252a	1235a	1183a	1111a	1057a	1252a	1227a	1185a	1125a	1050a
T_2	1252a	1223b	1156b	1103b	1025b	1251a	1206c	1166b	1114b	1028b
T_3	1251a	1186d	1105d	973d	867e	1251a	1174e	1086d	997e	859e
T_4	1251a	1233a	1178a	1113a	1037b	1252a	1220b	1181a	1123a	1035a
T_5	1252a	1217b	1151b	1098b	990c	1252a	1200c	1173ab	1087c	993c
T_6	1251a	1180d	1102d	986e	825f	1251a	1152f	1081d	987f	834f
T_7	1251a	1208c	1135c	1007c	920d	1252a	1196d	1150c	1054d	910d

T1 = PS + SH T2 = PS + PPE 80 mu T3 = PS + PPE 40 mu T4 = GA + SH

T5= GA + PPE 40 mu T6 = GA + PPE 80 mu T7 = control

Total Soluble Solids (T.S.S):

Total soluble solids content of stored fruits as shown in Table 4 were gradually and increased with extend of storage period during 2013 and 2014 seasons. On the end of storage days, the untreated clusters and treated clusters with potassium silicate and gum Arabic plus profited polyethylene 40 and 80 mu give the lowest values of T.S.S without significant different between them during 2013 and 2014 seasons. In this respect gum Arabic with profited polyethylene in 80 mu (GA + PPE 80 mu) treatment gave the lowest values followed by gum Arabic with profited polyethylene in 40 mu (GA + PPE 40 mu), potassium silicate with profited polyethylene in 40 mu (GA + PPE 40 mu) and potassium silicate with profited polyethylene 80 mu (PS + PPE 80 mu), potassium silicate with heat shrink (PS + SH) to reach the highest value to gum Arabic with heat shrink (GA + SH) as compared with the control treatment. It was suggested (16.6, 16.7, 16.8, 17.5, 17.6 and 18) under 0C^{o} in the first season and (16.2, 16.3, 16.3, 16.7, 18 and 18.2) in second season under the same degree. While under 7C^{o} TSS were suggested for same treatments (16.5, 16.5, 16.6, 16.8, 18.2 and 18.6) respectively in the first season and in the second season were suggested (16.3, 16.7, 16.8, 17.3, 18.6 and 18.). In general, these results agree with (Sabir *et al*, 2010) who suggested that SSC levels in all treatments progressively increased along with the prolonged storage, probably due to water loss and the slow ripening process occur in berries although the grape is a nonclimacteric fruit. After 4 week storage, effects of treatments on SSC change was found significant ($P<0.0025$).

Delay the increase in concentrations of total soluble solids during storage showed in treated clusters with combination treatments, this is may be due to slowing down metabolism activity respiration and delay in the ripening process and senescence, the lower TSS due to the slower change from carbohydrates to sugars (Hara, *et al*, 2004). Dragon fruit, being a non-climacteric fruit, showed a slight increase in SSC contents (Ali *et al*. 2013). The increased SSC in control fruit was a direct consequence of the hydrolysis of pectic materials into simple compounds (Maqbool *et al*. 2011).

(Khan *et al.* 2012) confirmed that increase in TSS may be related to enzymes which are presented when amino acids enhanced the synthesis of different proteins, acids and sugars.

Table 4: Effect of different treatments on total soluble solids percentage of Early sweet grape on cold storage during 2013 - 2014 seasons.

T.S.S										
Season 2013										
Days in cold storage										
	0C°±1					**7C°±1**				
Days / Treatments	**H**	**7**	**14**	**21**	**28**	**H**	**7**	**14**	**21**	**28**
T_1	17.0**a**	16.7**c**	16.9**a**	17.1**a**	17.6**a**	17.0**a**	17.3**a**	17.5**ab**	17.9**a**	18.2**b**
T_2	17.2**a**	17.3**ab**	17.2**a**	17.0**a**	16.8**b**	17.0**a**	17.3**a**	17.3**b**	17.0**a**	16.6**d**
T_3	17.0**a**	17.2**ab**	17.5**a**	17.8**a**	17.5**a**	17.2**a**	17.3**a**	17.5**ab**	17.2**a**	16.8**c**
T_4	17.0**a**	16.8**bc**	17.2**a**	17.5**a**	18.0**a**	17.2**a**	17.4**a**	17.8**a**	18.1**a**	18.6**a**
T_5	17.2**a**	17.4**a**	17.3**a**	17.0**a**	16.7**b**	17.2**a**	17.5**a**	17.2**b**	17.0**a**	16.5**d**
T_6	17.0**a**	17.3**ab**	17.3**a**	17.0**a**	16.6**b**	17.3**a**	17.6**a**	17.2**b**	16.8**a**	16.5**d**
T_7	17.0**a**	17.2**ab**	17.4**a**	17.0**a**	16.8**b**	17.3**a**	17.6**a**	17.3**b**	16.9**a**	16.5**d**
Season 2014										
T_1	17.0**a**	17.3**a**	17.5**a**	17.8**a**	18.2**a**	17.3**a**	17.6**a**	18.0**ab**	18.3**a**	18.6**a**
T_2	17.0**a**	17.3**a**	17.2**bc**	16.9**b**	16.3**c**	17.3**a**	17.8**a**	17.5**c**	17.2**b**	16.8**c**
T_3	17.3**a**	17.4**a**	17.3**ab**	17.0**b**	16.7**b**	17.0**a**	17.5**a**	17.8**ab**	17.6**b**	17.3**b**
T_4	17.0**a**	17.3**a**	17.7**a**	17.8**a**	18.0**a**	17.3**a**	17.7**a**	18.2**a**	18.5**a**	18.8**a**
T_5	17.2**a**	17.3**a**	16.9**c**	16.8**b**	16.3**c**	17.0**a**	18.0**a**	17.8**ab**	17.3**b**	16.7**c**
T_6	17.3**a**	17.2**a**	16.8**c**	16.7**b**	16.2**d**	17.2**a**	18.0**a**	17.7**bc**	17.2**b**	16.3**c**
T_7	17.3**a**	17.2**a**	16.8**c**	16.6**b**	16.**d**	17.0**a**	17.6**a**	17.6**bc**	17.3**b**	16.7**c**

T1 = PS + SH T2 = PS + PPE 40 mu T3 = PS + PPE 80 mu T4 = GA + SH

T5= GA + PPE 40 mu T6 = GA + PPE 80 mu T7 = control

Total Acidity Percentage:

It is obvious from table data in Table 5 that total acidity in berry juice tended to fluctuate, but some increment was found as a storage period prolonged till 28 days of cold storage. Thus, all treatments produced a lower acidity in berry juice compared with the control after 28 days of cold storage. This is in general agreement with the results of various studies conducted on different cultivars such as Sultanina (Athanasopoulos and Thanos, 1998), Thompson seedless (Crisosto *et al*., 2002) and Superior seedless (Artes-Hernandez *et al.*, 2006). The gradual decrease in acid level during the storage may physiologically be attributed to increase in membrane permeability allowing acids stored in cell vacuoles to be respired and transformation of acids to sugars (Winkler *et al.*, 1974; Sabir *et al.*, 2010) besides certain other processes occur inside the cells. Therefore, reduction in tartaric acid level might influence solely the activity of many enzymes involved in respiratory metabolism, ethylene biosynthesis and compositional changes of berries. Respiration rises and appears to provoke consuming organic acids and to reduce TA of the fruits. SO2 effects in reducing respiration rate may reduce the need for sugar consumption leading to less conversion of organic acids to sugars (Nelson, 1985).

Table 5: Effect of different treatments on total acidity percentage of Early sweet grape on cold storage during 2013 – 2014 seasons.

Acidity (%)										
Season 2013										
Days in cold storage										
	0C°±1					**7C°±1**				
Days / Treatments	**H**	**7**	**14**	**21**	**28**	**H**	**7**	**14**	**21**	**28**
T_1	0.47**a**	0.47**a**	0.43**b**	0.40**d**	0.36**d**	0.48**a**	0.46**b**	0.50**b**	0.54**c**	0.65**cd**
T_2	0.48**a**	0.46**a**	0.42**b**	0.47**c**	0.51**c**	0.49**a**	0.46**b**	0.51**b**	0.59**b**	0.69**bc**
T_3	0.48**a**	0.45**ab**	0.49**a**	0.56**b**	0.63**b**	0.48**a**	0.51**a**	0.58**a**	0.67**a**	0.75**a**
T_4	0.48**a**	0.47**a**	0.43**b**	0.39**e**	0.35**d**	0.48**a**	0.46**b**	0.50**b**	0.55**c**	0.64**d**
T_5	0.48**a**	0.46**a**	0.44**b**	0.48**c**	0.52**c**	0.48**a**	0.46**b**	0.50**b**	0.60**b**	0.70**bc**
T_6	0.47**a**	0.43**b**	0.51**a**	0.62**a**	0.71**a**	0.48**a**	0.51**a**	0.59**a**	0.66**a**	0.77**a**
T_7	0.48**a**	0.44**ab**	0.50**a**	0.61**a**	0.70**a**	0.48**a**	0.50**a**	0.58**a**	0.65**a**	0.74**ab**
Season 2014										
T_1	0.48**a**	0.46**a**	0.43**b**	0.39**d**	0.35**e**	0.48**a**	0.45**b**	0.51**b**	0.56**c**	0.67**b**
T_2	0.49**a**	0.46**a**	0.41**b**	0.48**c**	0.54**c**	0.49**a**	0.45**b**	0.53**b**	0.62**b**	0.71**b**
T_3	0.49**a**	0.44**a**	0.51**a**	0.61**ab**	0.72**a**	0.48**a**	0.54**a**	0.65**a**	0.73**a**	0.82**a**
T_4	0.48**a**	0.46**a**	0.43**b**	0.38**d**	0.34**e**	0.48**a**	0.44**b**	0.50**b**	0.56**c**	0.66**b**
T_5	0.48**a**	0.44**a**	0.41**b**	0.46**c**	0.55**c**	0.48**a**	0.45**b**	0.55**b**	0.64b	0.73**b**
T_6	0.48**a**	0.44**a**	0.52**a**	0.63**a**	0.73**a**	0.48**a**	0.58**a**	0.68**a**	0.75**a**	0.83**a**
T_7	0.48**a**	0.44**a**	0.50**a**	0.58**b**	0.68**b**	0.49**a**	0.53**a**	0.62**a**	0.70**a**	0.79**a**

T1 = PS + SH T2 = PS + PPE 40 mu T3 = PS + PPE 80 mu T4 = GA + SH

T5= GA + PPE 80 mu T6 = GA + PPE 40 mu T7 = control

Respiration Rate:

It can see from Table 6 that there was noticeable decrease in values of rates of respiration as mg CO_2/kg fruit /hr at end of cold storage period compared with the initial respiration rate values at harvest day in all postharvest treatments during the two seasons of investigation. Dipping in Gum Arabic or potassium silicate and wrapped by shrink film tend to have the effective role in reducing the rate of respiration of grape clusters (1.68, 1.66, 2.37 and 2.4) respectively in the first season at both storage degree and (1.69, 1.71, 2.46 and 2.5) respectively in the second season in both storage degree. These results agree with (Hammash and El Assi, 2007) who reported that fruit mesocarp tissue was able to absorb Si from the treatment solution. Additionally, Si solution deposition between the cell wall and cell membrane were visualized by TEM. This deposition of Si has been reported to cause impregnation of the intercellular parts of fruit peel. As Si treatment covers fruit stomata with a Si layer, it reduces fruit respiration and concomitantly results in decreased weight loss Si treatments, therefore, could positively be associated with delaying fruit weight loss by maintaining fruit moisture. So on this way (Tesfay *et al*., 2011) suggested that plants utilize energy to maintain cell metabolism and the amount of energy used can be estimated by the rate of CO_2 production. Fruit stored at 5.5 ◦C followed a similar trend of CO_2 production in all treatments. Although the respiration rate increased after cold storage, the trend remained the same. Fruit firmness also showed a similar trend in all treatments over time. Furthermore, CO_2 production rate and firmness were negatively correlated after removal from storage. Fruit mass loss measured over time was not significantly different among treatments. However, treatments had a significant effect on mass loss. Fruit treated with Si lost less mass compared with control ones. Therefore, Si possibly played a role in maintaining fruit moisture. (Abeer, T. Mohsen 2011) Potassium in diminishing the respiration rate, reducing the sugar consumption, maintaining the berry quality and retarding the senescence phase. Such delay in weight loss may be attributed to the effect of MAP on decreasing the respiration rate of fruits (Kader, 2002) and on restriction of malate dehydrogenase (MDH) activity (Ke *et al*., 1995), one of the most active enzymes involved in certain metabolic pathways face.

Table 6: Effect of different treatments on respiration rate (mgCO_2/kgfruit/hr) of Early sweet grape on cold storage during 2013 – 2014 seasons.

Respiration Rate (mgCO2/kgfruit/hr)										
Season 2013										
Days in cold storage										
	0C°±1					7C°±1				
Days / Treatments	H	7	14	21	28	H	7	14	21	28
T_1	3.85a	0.77b	0.90c	1.16e	1.66d	3.82a	0.73cd	0.91c	1.53d	2.40d
T_2	3.93a	0.76b	1.03b	1.35d	2.04c	3.87a	0.79b	1.08b	1.69c	3.18c
T_3	3.90a	0.87a	1.14ab	1.73a	3.00b	3.88a	0.83a	1.27a	2.20a	3.87a
T_4	3.88a	0.77b	0.90c	1.14e	1.68d	3.85a	0.72d	0.89c	1.53d	2.37d
T_5	3.90a	0.80ab	1.08b	1.52c	2.87b	3.88a	0.77bc	1.23a	2.00b	3.60b
T_6	3.87a	0.87a	1.21a	1.80a	3.18a	3.88a	0.85a	1.33a	2.24a	3.93a
T_7	**3.88a**	**0.87a**	**1.12ab**	**1.63b**	**2.88b**	**3.88a**	**0.85a**	**1.28a**	**2.15ab**	**3.80a**
Season 2014										
T_1	3.85a	0.75b	0.90a	1.17e	1.71d	3.85a	0.74d	0.96c	1.53e	2.50d
T_2	3.87a	0.77b	0.98a	1.35d	2.03c	3.87a	0.78cd	1.13b	1.77d	3.07c
T_3	3.83a	0.87a	1.17a	1.73a	2.91a	3.87a	0.88ab	1.38a	2.33a	3.81a
T_4	3.85a	0.77b	0.90a	1.14e	1.69d	3.85a	0.75d	0.95c	1.50e	2.46d
T_5	3.85a	0.83a	1.07a	1.48c	2.12c	3.88a	0.80cd	1.22b	2.07c	3.58b
T_6	3.87a	0.88a	1.22a	1.80a	3.00a	3.85a	0.90a	1.42a	2.37a	3.85a
T_7	3.87a	0.80a	**0.95a**	**1.60b**	2.78b	**3.85a**	**0.83bc**	**1.37a**	**2.27b**	**3.53b**

T1 = PS + SH T2 = PS + PPE 80 mu T3 = PS + PPE 40 mu T4 = GA + SH
T5= GA + PPE 40 mu T6 = GA + PPE 80 mu T7 = control

Acknowledgment:

This study was supported by Department of Horticulture, Ain Shams University with great effort from Dr. Samah Nasr Assistant prof of Pomology. Higher institute for Agriculture Co - Operation, Ain Shams University

REFERENCES

Abeer, T. Mohsen (2011): Attempts to Improve the Berry Quality and Storability of grape Crimson Seedless with Potassium Compounds under Desert Conditions. J. Hort. Sci. & Ornamen. Plants, 3 (1): 75 – 85.

AGQ, Lab and Technological services 2014

Ahvenainen R. (1996): New approaches in improving the shelf life of minimally processed fruits and vegetables. Trends in Food Sci Tech 7:179–186

Ali, A., M. Maqbool, S. Ramachandran, and P.G. Alderson (2010): Gum arabic as a novel edible coating for enhancing shelf-life and improving postharvest quality of tomato (*Solanum lycopersicum* L.) fruit. Postharvest Biology and Technology 58: 42–47.

Ali, A., M. Maqbool, P.G. Alderson, and N. Zahid (2013): Effect of gum arabic as an edible coating on antioxidant capacity of tomato (Solanum lycopersicum L.) fruit during storage. Postharvest Biol. Technol. 76, 119–124.

Anderson, D. M. W., and M. A. Eastwood, (1989): The safety of gum Arabic as a food additive and its energy value as an ingredient: A brief review. Journal of Human Nutrition and Dietetics, 2, 137–144.

A.O.A.C (1990). Association of official Agriculture Chemistry. Official methods of Analysis. Benjamin Franklin Station Washington. 4 D. C. S.A.

Ares, G., C. Lareo, and P. Lema, (2007): Modified atmosphere packaging for postharvest storage of mushrooms: a review. Fresh Products *1*(1) 32-40.

Artes, H. F., B. F. Tomas, and F. Artes (2006): Modified atmosphere packaging preserves quality of SO_2 free 'Superior seedless' table grapes. Postharvest Biology and Technology; 39: 2, 146-154.

Athanasopoulos, P. and A. Thanos, (1998): Quality characteristics of Sultanina table grapes stored in a pilot plant scale. Fruits, 53: 199206.

Babalar M., A.Dolanti, H. Baneh and M.A. Asgari, (1998): The study of postharvest changes in quantitative and qualitative traits of Fakhry Shahroodi and seedless Keshmeshi grape cultivar. Iranian J. Agric. Sci.,29 (8): 483-490.

Baldwin E.A., J.K. Burns, W. Kazokas, J.K. Brecht, R.D. Hagenmaier, R.J. Bender and E. Pesis. (1999): Effect of two edible coatings with different permeability characteristics on mango (*Mangi feraindica* L.) ripening during storage. Postharvest Biol. Technol., 17: 215-226.

Bosse R. J., J. P. Bower and I. Bertling. (2011): Pre and post-harvest treatments on fuerte avocado to control anthracnose (colletotrichum gloeosporioides) during ripening. S. Afr. Avocado Grwers Assoc., 34: 65 – 69.

Brecht M., L. Datnoff, R. Nagata and T. Kucharek (2003): The Role of Silicon in Suppressing Tray Leaf Spot Development in St. Augustine Grass. University of Florida, Florida

Caleb, O. J., U. L. Opara, and C. R. Witthuhn (2012): Modified atmosphere packaging of pomegranate fruit and arils: a review. Food and Bioprocess Technology 5(1) 15-30

Cantwell, F. F. (1992): Postharvest handling systems: minimally processed fruits and vegetables. In A. A. Kadder (Ed.), Postharvest technology of horticultural crops (p 277-281). Oakland: University of California.

Chahal S. and J. S. Bal (2003): Effect of post harvest treatments and packaging on shelf-life of Umran ber at cool temperature. J Res Punjab Agric Univ 40:363–369

Creel, R. E. (2006): Effect of acacia gum on postharvest quality of cut flowers. Master of Science Thesis. Auburn, Alabama University. 70. P.

Crisosto, C. H., D. Garner and G. M. Crisosto, (2002): High carbon dioxide atmospheres affect stored 'Thompson seedless' table grapes. Hort. Science, 37: 10741078.

Crisosto, C.H., J.L. Smilanick, and N.K. Dokoozlian (2001): Table grapes suffer water loss, stem browning during cooling delays. California Agric., (1): 39-42. 16. El Ghaouth, A., Wilson.

Epstein E. (2009): Silicon: Its manifold roles in plants. Ann. Applied Biol., 155: 155-160.

Fatih S. and K. Metin (2014): Effect of different covering materials used during the pre-harvest stage on the quality and storage life of ‘Sultana Seedless’ grapes. Food sci. Technol, Campinas, 34(4): 787-792, Oct.-Dec.

Fonseca, S. C., F. A. R. Oliveira, and J. K. Brecht (2002): Modelling respiration rate of fresh fruits and vegetables for modified atmosphere packages: a review. Journal of Food Engineering 52(2) 99-119

Guan, J. F., and S. Dou (2010): The effect of MAP on quality and browning of cold-stored plum fruits. Journal of Food, Agriculture and Environment *8*(2) 113-116.

Hammash, F. and N. El Assi, (2007): The Influence of pre-storage waxing and wrapping on quality attributes of stored ‘Shamouti’ oranges. Acta Hortic. 741, 133–140.

Hara M., K. Oki, K. Hoshino and T. Kuboi, (2004): Effects of sucrose on anthocyanin production in hypocotyls of two radish (Raphanus sativus) hypocotyls of two radish (Raphanus sativus) varieties. Plant Biotechnology, 21(5): 401-405.

Hepler, P.K. and R.O. Wayne, (1985): Calicumand plant development. Annu. Rev. Plant Physiol., 36: 397-439.

Hertog, M. L, S. R. Nicholson, and N. H. Banks (2001): The effect of modified atmospheres on the rate of firmness change in 'Braeburn' apples. Postharvest Biology and Technology 23(3) 175-184.

Kader, A. A. (2002): Postharvest Technology of Horticultural Crops. University of California, Agriculture and Natural Resources, Publication 3311, Third Edition, 535 pp.

Ke, D., E. Yahia, B. Hess, L. Zhou and A. A. Kader, (1995): Regulation of fermentative metabolism in avocado fruit under oxygen and carbon dioxide stresses. Journal of American Society for Horticultural Science, 120: 481490

Khan, A.S., B. Ahmad, M.J. Jaskani, R. Ahmad and A. U. Malik, (2012): Foliar application of mixture of amino acids and seaweed *(Ascophlum nodosum*) extract improve growth and physic chemical properties of grapes, Int. J. Agric. Biol., 14: 383 – 388.

Lurie S, E. Pesis, O. Gadiyeva, O. Feygenberg, Ben-Arie R, T. Kaplunov, Y. Zutahy and A. Lichter. (2006): Modified ethanol atmosphere to control decay of table grapes during storage. Postharvest Biol Tech 42:222–227

Mahajan B.V., W.S. Dhillon, M. Kumar and B. Singh. (2015): Effect of different packaging films on shelf life and quality of peach under super and ordinary market conditions. J Food Sci Technol 52(6):3756-62.

Maqbool M, A. Ali, P.G. Alderson, M.T.M. Mohamed, Y. Siddiqui and N., Zahid (2011): Postharvest application of gum arabic and essential oils for controlling anthracnose and quality of banana and papaya during cold storage, Postharvest biology and technology., 62,71-76.

Minarovska, A. and V. Horcin, (2000): Qualitative properties of stored new breeds of table grapes. Zahradnties UZPI., 27: 91 – 94.

Motlagh, S., P. Ravines, K.A. Karamallah and Q. Ma, (2006): The analysis of Acacia gums using electrophoresis. Food Hydrocolloids 20, 848–854.

Nanda, S., D.V.S. Rau and S. Krishnamurthy, (2001): Effects of shrink film wrapping and storage temperature on the shelf life and quality of pomegranate fruits cv. Ganesh. Postharvest. Biol. Technol., 22: 61-69.

Nazmy A. A., I. N. Samah and H. M. Korkar. (2012): Effects of Polyolefin Film Wrapping and Calcium Chloride Treatments on Posthravest Quality of "Wonderful" Pomegranate Fruits. J. Hort. Sci. & Ornamen. Plants, 4 (1): 07-17.

Nelson, K.E. (1985): Harvesting and handling California table grapes for market. Univ. Calif. Div. Agr. Natural Resources, Bul. 1913

Ngcobo, M. E. K., U. L. Opara, and G. D. Thiart (2012): Effects of packaging liners on cooling rate and quality attributes of table grape (cv. Regal seedless). Packaging Technology and Science, 25(2), 73e84

Pan, J.C. and S.R. Bhowmilk. (1992): Shelf life of mature green tomatoes stored in controlled atmosphere and high humidity. *J. Food Sci.*, 57: 948-953

Rocha, A. M., M. G. Barreira, and M. B. Morais (2004): Modified atmosphere package for apple 'Bravo de Esmolfe'. *Food Control 15*(1) 61-64

Sabir, A., F. K. Sabir, and Z. Kara (2011): Effects of modified atmosphere packing and honey dip treatments on quality maintenance of minimally processed grape cv. Razaki (V. vinifera L.) during cold storage. Journal of Food Science and Technology 48(3) 312-318.

Sabir, F. K., A. Sabir and Z. Kara (2010): Effects of modified atmosphere packing and ethanol treatmenton quality of minimally processed table grapes during cold storage. Bulg. J. Agric. Sci., 16: 678-686.

Salunkhe, D.K., H.R. Boun and N.R. Reddy.(1991): Storage, processing and nutritional quality of fruits and vegetables.CRC Press Inc., Boston, MA, USA.

Santerre, C.R., T.F. Leach and J.N. Cash, (1989). The influence of the sucrose polyester, Semperfresh™, on the storage of Michigan grown ‘McIntosh’ and ‘Golden delicious’ apples.

Selcuk Arin and Serap Akdemir.(2004): Quality properties changing of grape during storage period. J. Biol. Sci., 4 (2) : 253 – 257.

Seymour, G.B.. J.E. Taylor and G.A. Tucker.(1993): Biochemistry of Fruit Ripening. Chapman and Hall, London, UK.

Soylemezoglu G. (2001): Storage of table grapes. Ankara University, Faculty of Agriculture, Department of Horticulture, Ankara University Press, Ankara, 72p

Sudhakar R. D.V., R. K.P. Gopalakrishna, S. Krishnamurthy (2000): Extension of shelf life of cucumber by modified atmosphere packaging (MAP) and shrink wrapping. Indian Food Pack 54:65–71

Tanada- Palmu, P.S. and C.R.F. Grosso. (2005): Effect of edible wheat gluten-based films and coatings on refrigerated strawberry (*Fragaria ananassa*) quality. *Postharvest Biol. Technol.*, 36: 199-208.

Tarabih, M. E., E. E. EL-Eryan, and M. A. El-Metwally, (2014): Physiological and pathological impacts of potassium silicate on storability of Anna Apple fruits. American Journal of Plant physiology 9(2):52, 67.

Tesfay, S. Z. I. Bertling and J. P. Bower, (2011)**:** Effects of postharvest potassium silicate application on phenolic and other anti-oxidant systems aligned to avocado fruit quality. Postharvest Biology and Technology. 60; 92–99

Tournas V. and E. Katsoudas (2005): Mould and yeast flora in fresh berries, grapes and citrus fruits, International journal of Food Microbiology., 105:11-17.

Valero, D., J. M. Valverde, R. D. Martinez, F. Guillen, S. Castillo, and M. Serrano, (2006): The combination of modified atmosphere packaging with eugenol or thymol to maintain quality, safety and functional properties of table grapes. Postharvest Biology and Technology 41: 3, 317-327.

Valverde, J.M., F. Guillén, D. R. Martínez, S. Castillo, M. Serrano, and D. Valero. (2005): Improvement of table grapes quality and safety by the combination of modified atmosphere packaging (MAP) and eugenol, menthol, or thymol. Journal of Agricultural and Food Chemistry 53: 7458-7464.

Wei, G., Z. Zhu, J. Li and Q. Yao. (2004): Effect of silicon supply and sphaerotheca fuliginea inoculation on resistance of cucumber seedling against powdery mildew. Ying Yong Sheng Tai Xue Bao, 15; 2147- 2151.

Wills R. B., W. B. Mcglasson, D. Graham, H. Tlee and E. G. Hall (1989): Postharvest an introduction to the physiology and handling of fruit and vegetables, 3rd edn. Van Nostrand Reinhold, New York

Winkler A. J., J. A. Cook, W. M. Kliewer and L. A. Lider (1974): General Viticulture. Univ. California Press, Berkeley, USA, 710 pp.

Workneh T. S., G. Osthoff and M.S. Steyn, (2011): Influence of preharvest and postharvest treatments on stored tomato quality. Afr J Agric Res 6 (12):2725–2736.

Yaman, O. and L. Bayoindirli. (2002): Effects of an edible coating and cold storage on shelf-life and quality of cherries. *Lebnsm.-Wiss.Und.Technol*., 35: 46-150.

Zanderighi, L. (2001): How to design perforated polymeric films for modified atmosphere packs (MAP) Packaging Technol. Sci. 14:253–266

Zuhair, R. A., A. Aminah, A. M. Sahilah and H. M. Khalid (2013): Effect of Gum Arabic on Quality and Antioxidant Properties of Papaya Fruit during Cold Storage. International Journal of ChemTech Research.5,.(6) 2854-2862

تقييم سليكات البوتاسيوم والصمغ العربي والجو الهوائي المعدل علي حبات العنب الايرلي سويت اثناء التخزين تحت درجات حرارة مختلفة

[٧]

نظمي عبد الحميد[١]– مدحت كامل علي[١]– محمد ناجي تركي[٢]
ماجده محمود عبد المقصود[٢]
١) كلية الزراعة، جامعة عين شمس ٢) معهد بحوث الساتين، مركز البحوث الزراعية

المستخلص

تاثير معاملات مختلفة من الصمغ العربي وسليكات البوتاسيوم بالتفاعل مع او بدون اللف بالبولي اثيلين سمك ٤٠ او ٨٠ ميكرون او اللف الساخن

تم دراسة تلك المعاملات علي جودة حبات العنب بالإضافة الي محاولة زيادة فترة العمر التخزيني علي درجتي الحرارة المنخفضة وقد اظهرت النتائج ان معاملة حبات العنب بكل من الصمغ العربي وسليكات البوتاسيوم مع اللف الساخن و المخزنة علي درجة حرارة صفر ± ١م˚ قللت الفقد في الوزن وذلك خلال خفض معدل التنفس و الحموضة الكلية .

كما اعطت نفس المعاملات السابقة الذكر اعلي القيم للمواد الصلبة الذائبة الكلية كما ان نفس المعاملات السابقة مع اللف باكياس البولي اثيلين سمك ٤٠ ميكرون اعطت قيم متوسطة بينما اظهرت معاملة لف الثمار باكياس البولي اثيلين بسمك ٨٠ ميكرون اقل القيم معنوية وتكاد تقترب مع الحبات غير المعاملة.