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# EFFECT OF BUDS REMOVAL, GIBBERELLIC ACID FOLIAR SPRAY, LIMBS INJECTION WITH ASCORBIC ACID, CALCIUM LACTATE AND GLUCOSE ON CONTROL OF FRUIT BROWNING IN DESERT RED PEACH FRUITS DURING COLD STORAGE

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## ABSTRACT

This study was carried out during 2005 and 2006 seasons on mature Desert Red peach trees grown in a private orchard at El-Nobaria region. The aim of study was to evaluate the effect of buds removal at 20% & 40 % from the original shoots, foliar application of $GA_3$ at 70 and 140 ppm, limbs injection with ascorbic acid at (0.5 & 1.0%), calcium lactate at (0.2 & 0.4 %), Glucose at (1.0 & 2.0%) and control (spray with tap water) on yield, fruit drop percentage, fruit weight and quality, browning percentage, PPO enzyme activity, $CO_2$, $C_2H_4$ production, weight loss percentage, firmness and water soluble pectin and fruit decay percentage during cold storage as well as leaf and fruit $Ca^{++}$ content. The obtained results indicated that all treatments reduced yield as numbers of fruits/tree, however, when the yield was expressed as kg/tree, all treatments increased yield and average fruit weight .All treatments caused an increment in the fruit drop percentage. Calcium injection treatments significantly increased leaf and fruit $Ca^{++}$ content. All treatments significantly, reduced fruit decay percentage, browning percentage, PPO activity and total phenolic compounds content and increased fruit TSS and V.C. percentage. $GA_3$ foliar spray, calcium lactate and ascorbic acid injection treatments increased fruit firmness and reduced their soluble pectin content. $GA_3$ foliar spray glucose ascorbic acid and calcium lactate injection treatments significantly reduced weight loss percentage. Buds removal (2.0, 4.0%), glucose injection treatments reduced fruit acidity. $GA_3$ foliar spray at (70, 40 ppm), calcium lactate (0.2, 0.4%) injection treatments increased acidity and reduced fruit $CO_2$ and ethylene production, while, bud removal (20, 40%) increased them.

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**Key words:** Peach fruits browning and quality, limbs injection of Ca, $GA_3$, Ascorbic acid and Glucose.

## INTRODUCTION

The peach trees are widely grown through the world s north and south temperate zones. and its fruits are quite popular in many countries, including, Egypt. Recently, a large increase in the production of the new cultivars has occurred potential opportunities for export marketing accompanied with desire to extend the marketing seasons have increased producers interest to extend postharvest life. Moisture is easily lost from peaches because their skins lack a substantial waxy layer (Crisosto and Mitchell, 2002). Peach fruits are markedly subjected to various postharvest disorders during marketing, transit and storage, with a very short shelf life, it is highly susceptible to browning and discolouration problems giving the fruits unpleasant appearance and off-quality characters. Kahn (1975) reported that fruit browning is mainly caused by the oxidation of polyphenols and their subsequent polymerization to o-quinines. She added that the enzyme initiating this sequence of reactions is the polyphenol oxidase (PPO). Recently, Augustin *et al.* (1985) and Rofael (1985) showed that PPO present in fruits might be associated with fruit browning. Although there are tremendous volume of work on the different methods controlling enzymatic and non-enzymatic browning reactions in processed or manufactured foods, only few has been concerned with preventing browning in fresh fruits.

Therefore, this investigation was carried out, as a preliminary study, in order to evaluate the effect of some preharvest treatments on browning development, the activity of PPO enzyme, quality and storage ability of one of the most browning susceptible fruits, peaches.

## MATERIALS AND METHODS

The present investigation was conducted during 2005 and 2006 seasons on mature healthy Desert Red peach trees. Forty four uniform trees of 7 years old budded on Nemagard rootstock and spaced 3 × 4 meters apart in a private orchard in El-Nobaria region; El-Behera Governorate were used. During January of each experimental season, the trees were fertilized by 15 cubic meters of organic manure/ feddan besides, ammonium sulphate at rate of 3 kg per tree in two doses in mid February and mid April and calcium supper phosphate at rate of 1.3 kg per tree in mid February and irrigated with drip irrigation. The selected trees were divided into 11 groups, each group received one of the following treatments during both experimental seasons.

$T_1$: Control (Trees sprayed with water).

$T_2$: Buds removal (buds were removed by 20% (12–13 buds) of the original shoot at mid January.

$T_3$: Buds removal (buds were removed by 40% (24–26 buds) of the original shoot) at mid January.

$T_4$: Foliar spray with 70 ppm of gibberellic acid at the pre-bloom stage (mid January).

$T_5$: Foliar spray with 140 ppm of gibberellic acid at the pre-bloom stage (mid January).

$T_6$: Limbs injection with ascorbic acid at 0.5% (40 days before harvest).

$T_7$: Limbs injection with ascorbic acid at 1.0% (40 days before harvest).

$T_8$: Limbs injection with calcium lactated at 0.2% (40 days before harvest).

$T_9$: Limbs injection with calcium lactate at 0.4% (40 day before harvest)

$T_{10}$: Limbs injection with glucose at 1% (40 days before harvest).

$T_{11}$: Limbs injection with glucose at 2% (40 days before harvest).

The injections was made by gravity into limbs about 4 inches in diameters with taking care to exclude air from the injection holes.

For limbs injection, 8 holes, 2 cm depth, 1.1 cm width and an angle of 45°C were drilled in the limbs of the trees in different directions (4 limbs). The different solutions were injected through a brass tubing which fitted perfectly into the drilled holes, to prevent the leakage of injected solution. A 75 cm rub tubing was slided over the brass tube then, a 100 ml. syringe was filled with solution and pressed into the rubber tubing; which formed a bubble full with the solution. Then the free end of the rubber tubing was tied with a clamp and raised above the hole (Fig. 1). After the solution had been absorbed, the equipments were removed and the holes were sealed with paraffin wax. The injection operation of 100 ml solution took usually from 12 to 14 hours. Each injected tree was received (1600 ml from any tested solution).

Fruits were harvested on $5^{th}$ and $2^{nd}$ of June in 2005 and 2006, respectively. The fruits were sorted well to discard defective fruits due to mechanical damage or pathological disorders. Uniform fruits in size and color were washed, allowed to dry for physical and chemical determinations, a sample consisting of 30 fruits were taken randomly from each replicate (tree) within each treatment. Then, 200 fruit were taken randomly from each tree (replicate) and packed in a wood tray at the dimensions of 70, 40, 8 cm as length, width and depth, respectively, and stored at 0°C and 90–95% RH in the exporters union refrigerator in Abis Alexandria for one month and fruit samples were taken at 10 days intervals from cold storage for physical and chemical determinations. Firmness was determined using the Effegi pressure tester with on eight mm. Plunger (Effegi, 48011 Al Fonsine, Italy). The total soluble solids (TSS) and acidity percentages were determined in the fruit juice TSS% were directly estimated by a hand refractometer while acidity was determined by titration against 0.1. N NaOH. vitamin C. was determined using 2,6–dichlorophenol indophenol dye according to the A.O.A.C (1980). For assaying the activity of polyphenol oxidase enzyme (PPO), the method described by Augustin *et al.* (1985) was used, the enzyme activity was expressed as changes in the optical density at 420 nm per gram fresh weight per hour. Total soluble pectin percentage was determined according to McComb and McCready (1952) and total phenols compounds were extracted according a method described by Mapson *et al.* (1963), total phenolics were determined according to the methods described by Weurman and Swain (1955). The optical density of solution was measured at 725 nm and total phenolics was calculated from standard curve of tannic acid. The phenolic content were expressed as mg of tannic acid/ 100 g fresh weight of each replicate. For respiration (expressed as $CO_2$ production) and ethylene determination, 16 fruits of each replicate were weighted and placed in 1.4 liter jars at 20°C. The jars were sealed for 2 hr each day with a cap and rubber septum. Gas samples were removed with syringe and injected into a gas chromatography Ethylene was determined using a FID detector and aluminum column. and $CO_2$ on a TCD. Detector with a poropak N column (in the Central

Laboratory, Faculty of Agriculture, Alexandria Univ.). For calculating the percentage of fruit weight loss, 28 fruits from each replicate were labeled and periodically weighted and the loss in weight was calculated. In addition on each sampling date fruits showing browning or decay were counted and discarded. Then the percentages of disordered or decayed fruits were estimated on total fruit number basis.

For determination leaves and fruits mineral composition, 30–50 leaves and 25 fruits were collected from each tree (replicate). The leaf samples were collected during the first week of June in both seasons. The leaf and fruit samples was washed with tap water, then with distilled water and then oven dried at 65–75°C to a constant weight, 0.3 gram of the ground dried material of each sample was digested by $H_2O_2$ according to Evenhuis and Dewaard (1980). The calcium content of each sample was determined by Perkin Elmer Atomic absorption spectrophotometer model 2380.

The experimental design was R.C.B.D. with 11 treatments and 4 replicates including control. The obtained data were statistically analyzed using the analysis of variance as described by Snedecor and Cochran (1990). The L.S.D. method (at 0.05 level) was used to compare the effect of treatments (T), date of sampling by days (D) and their interaction (T × D).

## RESULTS AND DISCUSSION

**Fruit yield and quality evaluation**

**1– Yield**

The data of the present study indicated that all examined treatments reduced yield expressed as fruits number per tree in both experimental seasons compared with untreated ones (control) (Table 1). In the meantime, the differences were not significant between buds removal at (20%), ascorbic acid injection at 0.5% and control in the first season. However, in the second season the difference was not significant between bud removal at 20% and control only.

Main while, when the yield was expressed as kilograms per tree, the data in Table (1) indicated that, all treatments increased yield. However, the differences were significant between control, buds removal at 20%, $GA_3$ spray at 140 ppm, ascorbic acid injection at 0.5%, 1.0% glucose injection at 1% and 2% in the first season. In the second season, the differences were significant between control and buds removal at 20%, 40% and ascorbic acid injection at 0.5% only.

The obtained results agreed with those previously reported by, Sourour (1993), Southwick *et al.* (1996) and Taylor and Taylor (1998) working on Florda Prince, Early Grand, Loadel and Redhaven and Cresthaven Peach cvs. respectively, Saperas and Ziolkowski (1987) on apples. Visai *et al* (1980) on pears.

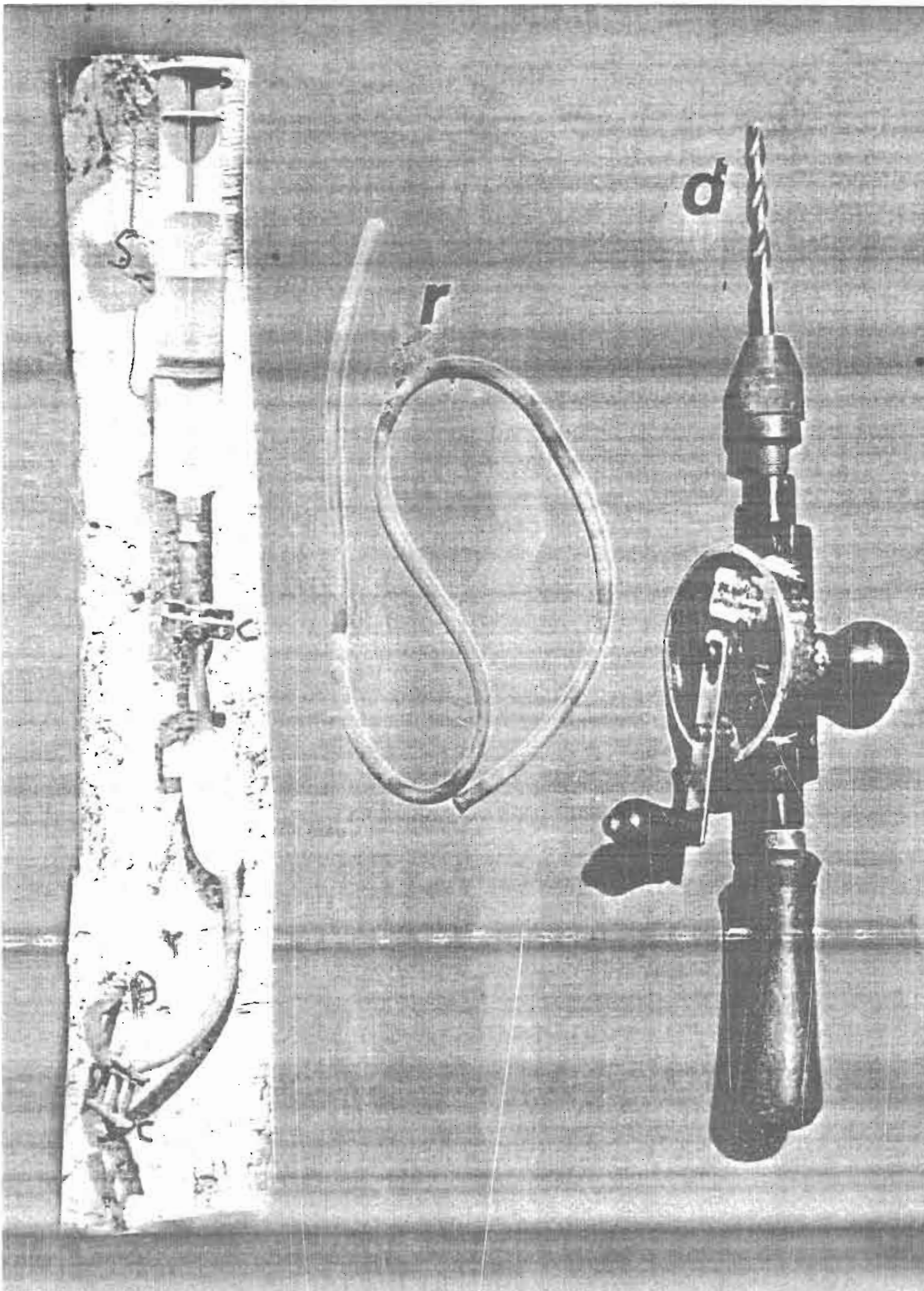


Fig. (1): Injection instrument:

d. Drill — s. Syring.

c. Clamps — b. Brass tubing.

r. Rubber tubing

**Table (1): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on yield, fruit drop % and leaf and fruit calcium content of Desert Red peach at harvest time in 2005 and 2006 seasons**

| Treatments | No. of fruit/tree | | Yield/tree (kg) | | Average fruit weight (g) | | Pulp weight (g) | | Fruit drop (%) | | Fruit Ca (%) | | Leaf Ca (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| Control | 430 | 450 | 30.10 | 31.14 | 70.00 | 69.20 | 61.90 | 62.30 | 10.10 | 12.35 | 0.395 | 0.420 | 1.66 | 1.81 |
| Buds removable 20% | 418 | 438 | 34.32 | 36.80 | 82.11 | 84.01 | 73.10 | 72.60 | 17.20 | 16.95 | 0.401 | 0.438 | 1.78 | 1.91 |
| Buds removable 40% | 389 | 390 | 33.10 | 34.52 | 85.10 | 88.50 | 73.50 | 73.00 | 18.35 | 19.10 | 0.430 | 0.459 | 1.83 | 1.96 |
| $GA_3$ spray (70 ppm) | 380 | 396 | 33.08 | 34.18 | 87.06 | 86.32 | 74.40 | 73.90 | 23.95 | 22.88 | 0.398 | 0.423 | 1.64 | 1.83 |
| $GA_3$ spray (140 ppm) | 385 | 390 | 33.91 | 33.31 | 88.08 | 85.40 | 75.00 | 74.21 | 28.10 | 29.18 | 0.399 | 0.429 | 1.68 | 1.81 |
| Ascorbic acid injection 0.5% | 400 | 397 | 35.86 | 34.28 | 89.66 | 86.35 | 72.00 | 71.11 | 20.15 | 22.16 | 0.394 | 0.421 | 1.66 | 1.82 |
| Ascorbic acid injection 1.0% | 383 | 380 | 33.86 | 33.18 | 88.40 | 87.31 | 72.60 | 71.80 | 21.00 | 22.33 | 0.393 | 0.418 | 1.67 | 1.84 |
| Calcium lactate injection 0.2% | 382 | 386 | 31.24 | 32.00 | 81.79 | 82.90 | 69.10 | 70.11 | 21.41 | 22.10 | 0.915 | 0.980 | 3.80 | 3.96 |
| Calcium lactate injection 0.4% | 380 | 389 | 31.73 | 33.11 | 83.50 | 85.11 | 69.50 | 68.71 | 22.11 | 23.61 | 0.960 | 0.996 | 3.95 | 4.66 |
| Glucose injection 1.0% | 384 | 388 | 34.30 | 33.97 | 89.31 | 86.51 | 71.30 | 71.70 | 20.33 | 21.51 | 0.398 | 0.418 | 1.68 | 1.82 |
| Glucose injection 2.0% | 385 | 390 | 34.15 | 34.03 | 88.71 | 87.25 | 72.90 | 72.00 | 20.41 | 22.00 | 0.396 | 0.422 | 1.66 | 1.81 |
| L.S.D.0.05 | 40.1 | 46.2 | 3.30 | 3.09 | 7.96 | 8.88 | 6.11 | 5.55 | 4.01 | 4.20 | 0.081 | 0.085 | 0.19 | 0.22 |

**2- Fruit drop (%)**

Data presented in Table (1) obviously clarified that in both experimental seasons, all treatments caused a significant increment in the fruit drop percentages compared with control. However, the differences were not significant with buds removal treatments at (20% and 40%). It can be noticed that $GA_3$ spray treatment at 140 ppm caused significantly highest drop percentage compared with other treatments. These results are in agreement with those reported by Southwick *et al.* (1995) using gribberllic acid on Loadel peach cv. as well as Smock and Gross (1950) working on different apple cvs. They found that injection treatments with ascorbic acid and other materials increased drop percentage in treated trees.

**3- Fruit and flesh weight**

Data of both seasons of study (Table 1) revealed that all treatments significantly increased the average fruit and pulp (flesh) weight, the differences between treatments were not great enough to be significant. These results are in line with those of Muhammed *et al.* (1996), ZhiGuo *et al.* (2001), Crisosto and Labavitc. (2002), on peach, Plich and Wojcik (2002)on plums

**4- Leaf and fruit calcium content:**

The data of the present study indicated that all calcium treatments significantly increased leaf and fruit calcium content during both experimental seasons compared with control and other tratments (Table 1). The positive influence of Ca treatment on leaf and fruit Ca content seemed to be in complete agreement with the results observed by numerous other investigators such as Smock and Gross (1950) on apple and Plich and Wojcik (2002) on plums as they found that calcium limbs injection or foliar spray treatments increased leaf and fruit Ca content.

**5- Fruit browning and PPO activity during cold storage:**

The effect of the different treatments on the fruit browning percentage, activity of PPO enzyme and total phenolic compounds of the Desert Red Peach fruits are shown in Table (2, a,b and c). The data indicated that all treatments significantly reduced fruit browning percentage, PPO activity and total phenolic compounds content comparing with control. As for the fruit browning percentage, the data revealed that ascorbic acid injection treatments (at 0.5 and 1.0%) significantly had lowest fruit browning percentage comparing with other tested treatments. In the meantime, $GA_3$ foliar spray treatments at 140 ppm, Ca - lactate at 0.4% and glucose at 1.0 % injection treatments were significantly had lower fruit browning percentage than buds removal at (20% and 40%), $GA_3$ foliar spray at 70 ppm, Ca lactate at 0.2% and glucose injection treatments at 2%, respectively in the first season of study during and at the end of the storage period.

At the second season, the data indicated that $GA_3$ foliar spray treatment at 140 ppm had lowest browning percentage comparing with all other tested treatments. In the meantime, ascorbic acid injection (at 0.5 and1.0%) treatments significantly had lower browning percentage than Ca- lactate injection at (0.2% and 0.4%), buds removal at (20 and 40%), $GA_3$ foliar spray at 70 ppm and glucose injection at (1 and 2%) treatments.

**Table (2 a): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit browning %, PPO activity and total phenolic content in Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Fruit browning | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.00 | 2.60 | 4.10 | 18.50 | 6.30 |
| Buds removable 20% | 0.00 | 1.95 | 2.30 | 5.19 | 2.36 |
| Buds removable 40% | 0.00 | 1.90 | 2.18 | 5.04 | 2.28 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.80 | 2.25 | 5.31 | 2.34 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.65 | 2.09 | 4.06 | 1.95 |
| Ascorbic acid injection 0.5% | 0.00 | 1.50 | 1.80 | 3.10 | 1.60 |
| Ascorbic acid injection 1.0% | 0.00 | 1.45 | 1.72 | 2.88 | 1.51 |
| Calcium lactate injection 0.2% | 0.00 | 1.91 | 2.28 | 5.42 | 2.40 |
| Calcium lactate injection 0.4% | 0.00 | 1.73 | 2.15 | 4.16 | 2.01 |
| Glucose injection 1.0% | 0.00 | 1.95 | 2.49 | 4.51 | 2.24 |
| Glucose injection 2.0% | 0.00 | 1.95 | 2.50 | 5.65 | 2.53 |
| Mean | 0.00 | 1.85 | 2.35 | 5.81 | |
| L.S.D.0.05 | T: 0.83 | | D: 0.390 | T × D :4.26 | |
| | 2006 | | | | |
| Control | 0.00 | 3.00 | 5.00 | 19.10 | 6.75 |
| Buds removable 20% | 0.00 | 1.99 | 2.60 | 5.22 | 2.45 |
| Buds removable 40% | 0.00 | 1.88 | 2.50 | 5.03 | 2.35 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.74 | 2.61 | 5.24 | 2.40 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.54 | 2.00 | 2.06 | 1.40 |
| Ascorbic acid injection 0.5% | 0.00 | 1.60 | 1.78 | 3.58 | 1.74 |
| Ascorbic acid injection 1.0% | 0.00 | 1.41 | 1.81 | 3.68 | 1.73 |
| Calcium lactate injection 0.2% | 0.00 | 1.95 | 2.35 | 4.74 | 2.26 |
| Calcium lactate injection 0.4% | 0.00 | 1.69 | 2.48 | 4.99 | 2.29 |
| Glucose injection 1.0% | 0.00 | 1.89 | 2.62 | 5.26 | 2.44 |
| Glucose injection 2.0% | 0.00 | 1.92 | 2.48 | 5.69 | 2.52 |
| Mean | 0.00 | 1.87 | 2.57 | 5.87 | |
| L.S.D.0.05 | T: 0.980 | | D: 0.449 | T × D :5.00 | |

As for the fruit PPO activity and total phenolic compounds content the data shown that in both experimental seasons during and at the end of the storage period the differences between treatments were not great enough to be significant. These results confirmed those of Visai *et al.* (1980), Medhi and Singh (1983), Rensburg and Engelbrecht (1986) and Sourour and El Deep (2004), Paulson *et al.* (1980) that $GA_3$ is capable of inducing multiple changes in the PPO enzyme forms, its offinity towards specific substrates as well as its pH optima might provide a reasonable explanation to the observed decrease of PPO activity in fruits treated with $GA_3$. In the meantime, the role played by Ca in maintaining membrane integrity and cellular compartmentalization (Conway and Sams, 1987) would probably keep the normal spatial separation between PPO and its substrate. Moreover, the relatively high ascorbic acid content in GA and $CaCl_2$ treated fruits might also account for the low browning potentiality of such fruits. Augustin *et al.* (1985), stated that ascorbic acid acts by reducing the quinines formed by PPO action back into colorless compounds, while ascorbic acid itself being oxidized. They added that the effect of ascorbic acid on preventing browning is, therefore, only temporary. This might explain the lateness of browning development in $GA_3$ and Ca treated fruits. The results found by Sapers *et al.* (1989), that ascorbic acid caused a longer lag phase before the onset of browning might also support this conclusion.

**Table (2 b): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit browning, PPO activity and total phenolic content in Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | PPO activity (Change in optical density /gm fresh weight / hour) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.185 | 0.270 | 0.320 | 0.391 | 0.292 |
| Buds removable 20% | 0.134 | 0.170 | 0.191 | 0.208 | 0.176 |
| Buds removable 40% | 0.133 | 0.171 | 0.191 | 0.207 | 0.176 |
| $GA_3$ spray (70 ppm) | 0.122 | 0.167 | 0.184 | 0.209 | 0.171 |
| $GA_3$ spray (140 ppm) | 0.120 | 0.162 | 0.176 | 0.200 | 0.165 |
| Ascorbic acid injection 0.5% | 0.118 | 0.160 | 0.170 | 0.192 | 0.160 |
| Ascorbic acid injection 1.0% | 0.116 | 0.155 | 0.165 | 0.180 | 0.154 |
| Calcium lactate injection 0.2% | 0.112 | 0.152 | 0.161 | 0.178 | 0.151 |
| Calcium lactate injection 0.4% | 0.115 | 0.154 | 0.162 | 0.176 | 0.152 |
| Glucose injection 1.0% | 0.130 | 0.173 | 0.190 | 0.206 | 0.175 |
| Glucose injection 2.0% | 0.131 | 0.172 | 0.191 | 0.205 | 0.175 |
| Mean | 0.129 | 0.173 | 0.191 | 0.213 | 0.177 |
| L.S.D.0.05 | T: 0.066 | | D: 0.030 | | T × D :0.33 |
| | 2006 | | | | |
| Control | 0.198 | 0.289 | 0.346 | 0.409 | 0.311 |
| Buds removable 20% | 0.146 | 0.191 | 0.228 | 0.264 | 0.207 |
| Buds removable 40% | 0.145 | 0.192 | 0.228 | 0.264 | 0.207 |
| $GA_3$ spray (70 ppm) | 0.128 | 0.177 | 0.195 | 0.229 | 0.182 |
| $GA_3$ spray (140 ppm) | 0.125 | 0.169 | 0.185 | 0.226 | 0.176 |
| Ascorbic acid injection 0.5% | 0.122 | 0.159 | 0.177 | 0.220 | 0.170 |
| Ascorbic acid injection 1.0% | 0.119 | 0.156 | 0.170 | 0.210 | 0.164 |
| Calcium lactate injection 0.2% | 0.116 | 0.158 | 0.168 | 0.206 | 0.162 |
| Calcium lactate injection 0.4% | 0.118 | 0.164 | 0.167 | 0.212 | 0.165 |
| Glucose injection 1.0% | 0.145 | 0.193 | 0.231 | 0.259 | 0.207 |
| Glucose injection 2.0% | 0.143 | 0.194 | 0.233 | 0.266 | 0.209 |
| Mean | 0.137 | 0.186 | 0.212 | 0.251 | 0.197 |
| L.S.D.0.05 | T: 0.080 | | D: 0.027 | | T × D :0.40 |

**Table (2 c): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit browning, PPO activity and total phenolic content in Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Total phenolics (%) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.998 | 0.986 | 0.974 | 0.967 | 0.981 |
| Buds removable 20% | 0.970 | 0.958 | 0.948 | 0.926 | 0.951 |
| Buds removable 40% | 0.969 | 0.956 | 0.947 | 0.925 | 0.949 |
| $GA_3$ spray (70 ppm) | 0.920 | 0.907 | 0.900 | 0.850 | 0.894 |
| $GA_3$ spray (140 ppm) | 0.900 | 0.880 | 0.819 | 0.781 | 0.845 |
| Ascorbic acid injection 0.5% | 0.883 | 0.851 | 0.817 | 0.760 | 0.828 |
| Ascorbic acid injection 1.0% | 0.872 | 0.831 | 0.800 | 0.751 | 0.814 |
| Calcium lactate injection 0.2% | 0.922 | 0.910 | 0.880 | 0.830 | 0.886 |
| Calcium lactate injection 0.4% | 0.910 | 0.879 | 0.831 | 0.780 | 0.850 |
| Glucose injection 1.0% | 0.966 | 0.950 | 0.941 | 0.920 | 0.944 |
| Glucose injection 2.0% | 0.963 | 0.947 | 0.934 | 0.916 | 0.940 |
| Mean | 0.934 | 0.914 | 0.890 | 0.855 | |
| L.S.D.0.05 | T: 0.190 | | D: 0.084 | T × D :0.890 | |
| | 2006 | | | | |
| Control | 0.981 | 0.961 | 0.945 | 0.915 | 0.951 |
| Buds removable 20% | 0.916 | 0.802 | 0.783 | 0.740 | 0.810 |
| Buds removable 40% | 0.913 | 0.801 | 0.780 | 0.739 | 0.808 |
| $GA_3$ spray (70 ppm) | 0.900 | 0.881 | 0.829 | 0.709 | 0.830 |
| $GA_3$ spray (140 ppm) | 0.879 | 0.829 | 0.768 | 0.715 | 0.798 |
| Ascorbic acid injection 0.5% | 0.850 | 0.812 | 0.751 | 0.706 | 0.780 |
| Ascorbic acid injection 1.0% | 0.821 | 0.800 | 0.720 | 0.669 | 0.753 |
| Calcium lactate injection 0.2% | 0.898 | 0.879 | 0.832 | 0.700 | 0.827 |
| Calcium lactate injection 0.4% | 0.880 | 0.835 | 0.728 | 0.672 | 0.779 |
| Glucose injection 1.0% | 0.910 | 0.800 | 0.775 | 0.700 | 0.796 |
| Glucose injection 2.0% | 0.906 | 0.876 | 0.768 | 0.693 | 0.811 |
| Mean | 0.896 | 0.843 | 0.789 | 0.723 | |
| L.S.D.0.05 | T: 0.180 | | D: 0.081 | T × D :0.92 | |

However, fruit browning % and PPO activity were increased, while fruit total phenolic content was decreased by increasing of storage period in both seasons.

**6- Fruit firmness and total soluble pectin percentage at harvest and during cold storage**

Data in Table (3, a and b) clearly showed that in both experimental seasons of study the differences between buds removal levels and glucose injection treatments (at 1% and 2%) had no significant effect on fruit firmness and total soluble pectin percentage. The obtained results are in harmony with those reported by Saeid and Khalil (1993), Southwick *et al.* (1998) and Sourour and El Deep (2004) working on different peach cvs. Meanwhile, calcium lactate (0.2 and 0.4%). Ascorbic acid (0.5

and 1%) injection and GA3 foliar spray (140 – 70 ppm) treatmens significantly increased fruits firmness and reduced their total soluble pectin percentage at harvest and after the end of the storage period comparing with control. In the meantime, both calcium lactate treatments had significantly the best effect comparing with other treatments. However, the differences were not significant between other treatments (GA3 foliar spray treatments, ascorbic acid and glucose injection treatments). These results are in line with those reported by Sourour and El Deep (2004), Genard and Souty (1996) on peaches and Smock and Gross (1950) on apples. However,fruit firmness was decreased, while fruit total soluble pectin content was increased by the increasing of storage period in both seasons .

**Table (3 a): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit firmness (Lb/ $in_2$) total soluble pectin and weight loss percentage of Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Fruit firmness ( Lb/ $in_2$) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 10.66 | 10.41 | 8.90 | 6.01 | 8.99 |
| Buds removable 20% | 10.72 | 10.48 | 8.92 | 6.11 | 9.06 |
| Buds removable 40% | 10.70 | 10.42 | 8.93 | 6.00 | 9.01 |
| $GA_3$ spray (70 ppm) | 11.09 | 10.78 | 9.32 | 8.60 | 9.95 |
| $GA_3$ spray (140 ppm) | 11.18 | 10.75 | 9.60 | 8.72 | 10.06 |
| Ascorbic acid injection 0.5% | 11.13 | 10.90 | 9.45 | 8.50 | 9.99 |
| Ascorbic acid injection 1.0% | 11.18 | 10.98 | 9.49 | 8.59 | 10.06 |
| Calcium lactate injection 0.2% | 11.88 | 11.50 | 11.20 | 9.89 | 11.12 |
| Calcium lactate injection 0.4% | 11.91 | 11.65 | 11.35 | 9.95 | 11.22 |
| Glucose injection 1.0% | 10.73 | 10.45 | 9.93 | 6.16 | 9.32 |
| Glucose injection 2.0% | 10.71 | 10.44 | 9.89 | 6.11 | 9.29 |
| Mean | 11.06 | 10.80 | 9.73 | 7.70 | |
| L.S.D.0.05 | T: 0.41 | | D: 0.41 | T × D :0.189 | |
| | 2006 | | | | |
| Control | 10.41 | 10.36 | 9.66 | 5.95 | 9.10 |
| Buds removable 20% | 10.63 | 10.38 | 9.70 | 6.00 | 9.18 |
| Buds removable 40% | 10.66 | 10.39 | 9.75 | 6.02 | 9.21 |
| $GA_3$ spray (70 ppm) | 11.20 | 10.88 | 10.33 | 8.34 | 10.19 |
| $GA_3$ spray (140 ppm) | 11.29 | 11.00 | 10.59 | 8.49 | 10.34 |
| Ascorbic acid injection 0.5% | 11.18 | 10.95 | 10.60 | 8.66 | 10.35 |
| Ascorbic acid injection 1.0% | 11.36 | 11.02 | 10.47 | 8.71 | 10.39 |
| Calcium lactate injection 0.2% | 11.82 | 11.47 | 11.10 | 9.86 | 11.06 |
| Calcium lactate injection 0.4% | 11.96 | 11.60 | 11.28 | 9.89 | 11.18 |
| Glucose injection 1.0% | 10.65 | 10.38 | 9.88 | 5.94 | 9.21 |
| Glucose injection 2.0% | 10.68 | 10.37 | 9.79 | 5.97 | 9.20 |
| Mean | 11.08 | 10.80 | 10.29 | 7.62 | |
| L.S.D.0.05 | T: 0.35 | | D: 0.150 | | T × D :1.79 |

**Table (3 b): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit, total soluble pectin and weight loss percentage of Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Total soluble pectin % | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.992 | 1.088 | 1.185 | 1.282 | 1.137 |
| Buds removable 20% | 0.995 | 1.098 | 1.188 | 1.286 | 1.142 |
| Buds removable 40% | 0.993 | 1.089 | 1.186 | 1.285 | 1.138 |
| $GA_3$ spray (70 ppm) | 0.779 | 0.876 | 0.972 | 1.068 | 0.924 |
| $GA_3$ spray (140 ppm) | 0.777 | 0.877 | 0.971 | 1.069 | 0.924 |
| Ascorbic acid injection 0.5% | 0.778 | 0.878 | 0.976 | 1.070 | 0.926 |
| Ascorbic acid injection 1.0% | 0.776 | 0.880 | 0.978 | 1.067 | 0.924 |
| Calcium lactate injection 0.2% | 0.765 | 0.865 | 0.966 | 1.072 | 0.917 |
| Calcium lactate injection 0.4% | 0.760 | 0.859 | 0.956 | 1.054 | 0.907 |
| Glucose injection 1.0% | 0.990 | 1.091 | 1.250 | 1.285 | 1.154 |
| Glucose injection 2.0% | 0.995 | 1.096 | 1.195 | 1.350 | 1.159 |
| Mean | 0.873 | 0.972 | 1.074 | 1.172 | |
| L.S.D.0.05 | T: 0.21 | | D: 0.095 | T × D :1.05 | |
| | 2006 | | | | |
| Control | 0.836 | 0.925 | 1.071 | 1.161 | 0.998 |
| Buds removable 20% | 0.850 | 0.936 | 1.019 | 1.103 | 0.977 |
| Buds removable 40% | 0.846 | 0.933 | 1.013 | 1.100 | 0.973 |
| $GA_3$ spray (70 ppm) | 0.650 | 0.736 | 0.820 | 0.908 | 0.779 |
| $GA_3$ spray (140 ppm) | 0.652 | 0.739 | 0.823 | 0.910 | 0.781 |
| Ascorbic acid injection 0.5% | 0.626 | 0.712 | 0.797 | 0.881 | 0.754 |
| Ascorbic acid injection 1.0% | 0.628 | 0.715 | 0.799 | 0.878 | 0.755 |
| Calcium lactate injection 0.2% | 0.607 | 0.693 | 0.775 | 0.858 | 0.733 |
| Calcium lactate injection 0.4% | 0.600 | 0.686 | 0.769 | 0.855 | 0.728 |
| Glucose injection 1.0% | 0.828 | 0.916 | 0.999 | 1.083 | 0.957 |
| Glucose injection 2.0% | 0.825 | 0.911 | 0.995 | 1.079 | 0.953 |
| Mean | 0.723 | 0.809 | 0.898 | 0.983 | |
| L.S.D.0.05 | T: 0.18 | | D: 0.082 | T × D :0.900 | |

**7- Fruit weight loss percentage during cold storage**

During and at the end of cold storage period,the data in Table (3, c) indicated that in both seasons GA3 foliar spray treatments at (70 ppm and 140 ppm), glucose at (1% and 2%), ascorbic acid at (0.5% and 1%) and calcium lactate at (0.2% and 0.4%) injection treatments significantly reduced weight loss percentage comparing with control. These results confirmed those of Sourour and El Deep (2004). Mainwhile, buds removal at 20 and 40% treatments, caused significantly higher fruit weight loss than control and other tested treatments.

Such increment might be attributed to the fruit progress in the ripening process and the physiological activities, Khalil *et al.* (1990) and Muhammed *et al.* (1996) working on nectarines and Redhaven peach, respectively However, fruit weight loss % was increased by increasing of storage period in both seasons .

**Table (3 c): Effect of buds removal, gibberellic acid spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit, total soluble pectin and weight loss percentage of Desert Red peach during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Fruit weight loss (%) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.00 | 1.58 | 5.80 | 7.39 | 3.70 |
| Buds removable 20% | 0.00 | 1.64 | 6.52 | 8.42 | 4.15 |
| Buds removable 40% | 0.00 | 1.81 | 6.93 | 8.91 | 4.41 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.20 | 4.00 | 5.01 | 2.55 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.18 | 3.98 | 5.00 | 2.54 |
| Ascorbic acid injection 0.5% | 0.00 | 1.31 | 4.25 | 5.60 | 2.79 |
| Ascorbic acid injection 1.0% | 0.00 | 1.34 | 4.23 | 5.55 | 2.78 |
| Calcium lactate injection 0.2% | 0.00 | 1.30 | 4.26 | 5.61 | 2.80 |
| Calcium lactate injection 0.4% | 0.00 | 1.33 | 4.19 | 5.57 | 2.77 |
| Glucose injection 1.0% | 0.00 | 1.12 | 3.88 | 5.11 | 2.53 |
| Glucose injection 2.0% | 0.00 | 1.10 | 3.92 | 5.01 | 2.51 |
| Mean | 0.00 | 1.36 | 4.72 | 6.11 | |
| L.S.D.0.05 | T: 0.36 | | D: 0.160 | T × D :1.69 | |
| | 2006 | | | | |
| Control | 0.00 | 1.60 | 5.77 | 8.01 | 3.85 |
| Buds removable 20% | 0.00 | 1.80 | 6.87 | 8.51 | 4.30 |
| Buds removable 40% | 0.00 | 1.90 | 6.98 | 8.95 | 4.46 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.19 | 4.15 | 5.13 | 2.62 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.16 | 4.00 | 5.11 | 2.57 |
| Ascorbic acid injection 0.5% | 0.00 | 1.38 | 4.35 | 5.70 | 2.86 |
| Ascorbic acid injection 1.0% | 0.00 | 1.35 | 4.41 | 5.66 | 2.86 |
| Calcium lactate injection 0.2% | 0.00 | 1.26 | 4.21 | 5.76 | 2.81 |
| Calcium lactate injection 0.4% | 0.00 | 1.28 | 4.06 | 5.69 | 2.76 |
| Glucose injection 1.0% | 0.00 | 1.15 | 3.98 | 5.20 | 2.58 |
| Glucose injection 2.0% | 0.00 | 1.12 | 4.02 | 5.28 | 2.61 |
| Mean | 0.00 | 1.38 | 4.80 | 6.27 | |
| L.S.D.0.05 | T: 0.40 | | D: 0.16 | T × D :1.83 | |

**8- Peach fruit TSS and ascorbic acid content at harvest and during cold storage**

The results in Table (4,a and b) revealed that in both experimental seasons at harvest and at the end of storage period, all treatments significantly increased fruit total soluble solids and ascorbic acid content comparing with control. As for fruit TSS% the data indicated that both of glucose injection treatments at (2% and 1%) significantly had highest fruit TSS content comparing with other tested treatments and control. Regarding to the fruit ascorbic acid content, we can notice that ascorbic acid at 1%, glucose at 2%, ascorbic acid at 0.5% injection, GA3 foliar spray at 70–140 ppm and glucose at 1% injection treatments significantly had higher V.C. content respectively comparing with other tested treatments and control.

**Table (4 a): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit quality of Desert Red peach fruits during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | TSS % | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 9.10 | 10.00 | 10.80 | 11.59 | 10.37 |
| Buds removable 20% | 9.88 | 10.82 | 11.91 | 12.20 | 11.20 |
| Buds removable 40% | 9.95 | 10.98 | 12.00 | 12.45 | 11.35 |
| $GA_3$ spray (70 ppm) | 9.79 | 10.90 | 11.97 | 12.15 | 11.20 |
| $GA_3$ spray (140 ppm) | 9.85 | 10.93 | 12.00 | 12.20 | 11.25 |
| Ascorbic acid injection 0.5% | 9.82 | 10.93 | 11.95 | 12.22 | 11.23 |
| Ascorbic acid injection 1.0% | 9.88 | 10.95 | 11.97 | 12.30 | 11.28 |
| Calcium lactate injection 0.2% | 9.85 | 10.90 | 11.93 | 12.25 | 11.23 |
| Calcium lactate injection 0.4% | 9.95 | 10.96 | 12.03 | 12.50 | 11.36 |
| Glucose injection 1.0% | 10.39 | 10.98 | 11.93 | 12.90 | 11.55 |
| Glucose injection 2.0% | 10.55 | 11.09 | 12.29 | 13.11 | 11.76 |
| Mean | 9.91 | 10.86 | 11.89 | 12.35 | |
| L.S.D.0.05 | T: 0.53 | | D: 0.235 | | T × D :2.61 |
| | 2006 | | | | |
| Control | 9.19 | 10.03 | 10.85 | 11.65 | 10.48 |
| Buds removable 20% | 9.90 | 10.90 | 11.96 | 12.35 | 11.28 |
| Buds removable 40% | 9.98 | 11.10 | 12.18 | 12.59 | 11.46 |
| $GA_3$ spray (70 ppm) | 9.83 | 10.98 | 12.00 | 12.26 | 11.27 |
| $GA_3$ spray (140 ppm) | 10.00 | 11.11 | 12.13 | 12.42 | 11.42 |
| Ascorbic acid injection 0.5% | 9.89 | 11.00 | 12.00 | 12.33 | 11.31 |
| Ascorbic acid injection 1.0% | 9.90 | 11.03 | 12.08 | 12.36 | 11.34 |
| Calcium lactate injection 0.2% | 9.87 | 10.98 | 11.99 | 12.35 | 11.30 |
| Calcium lactate injection 0.4% | 9.99 | 10.99 | 12.08 | 12.70 | 11.44 |
| Glucose injection 1.0% | 10.40 | 11.13 | 11.97 | 13.03 | 11.63 |
| Glucose injection 2.0% | 10.67 | 11.29 | 12.60 | 13.30 | 11.99 |
| Mean | 9.97 | 10.96 | 11.99 | 12.48 | |
| L.S.D.0.05 | T: 0.0.50 | | D: 0.225 | | T × D :2.41 |

**Table (4 b): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit quality of Desert Red peach fruits during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Acidity % | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 1.080 | 1.025 | 0.970 | 0.910 | 0.996 |
| Buds removable 20% | 0.930 | 0.871 | 0.818 | 0.792 | 0.853 |
| Buds removable 40% | 0.900 | 0.841 | 0.819 | 0.796 | 0.839 |
| $GA_3$ spray (70 ppm) | 1.223 | 1.166 | 1.110 | 1.055 | 1.139 |
| $GA_3$ spray (140 ppm) | 1.226 | 1.160 | 1.113 | 1.058 | 1.139 |
| Ascorbic acid injection 0.5% | 1.088 | 1.030 | 0.960 | 0.920 | 1.000 |
| Ascorbic acid injection 1.0% | 1.086 | 1.030 | 0.973 | 0.916 | 1.001 |
| Calcium lactate injection 0.2% | 1.225 | 1.068 | 1.112 | 1.058 | 1.141 |
| Calcium lactate injection 0.4% | 1.228 | 1.170 | 1.089 | 1.060 | 1.137 |
| Glucose injection 1.0% | 0.993 | 0.844 | 0.812 | 0.798 | 0.862 |
| Glucose injection 2.0% | 0.996 | 0.858 | 0.910 | 0.796 | 0.865 |
| Mean | 1.089 | 1.024 | 0.962 | 0.924 | |
| L.S.D.0.05 | T: 0.190 | | D: 0.089 | | T × D :0.99 |
| | 2006 | | | | |
| Control | 1.150 | 1.080 | 1.010 | 0.940 | 1.045 |
| Buds removable 20% | 1.080 | 0.880 | 0.820 | 0.799 | 0.995 |
| Buds removable 40% | 1.093 | 0.873 | 0.829 | 0.793 | 0.897 |
| $GA_3$ spray (70 ppm) | 1.260 | 1.200 | 1.140 | 1.050 | 1.163 |
| $GA_3$ spray (140 ppm) | 1.295 | 1.223 | 1.152 | 1.078 | 1.187 |
| Ascorbic acid injection 0.5% | 1.156 | 1.083 | 1.016 | 0.940 | 1.049 |
| Ascorbic acid injection 1.0% | 1.160 | 1.090 | 1.020 | 0.950 | 1.055 |
| Calcium lactate injection 0.2% | 1.300 | 1.230 | 1.160 | 1.110 | 1.200 |
| Calcium lactate injection 0.4% | 1.340 | 1.270 | 1.195 | 1.130 | 1.234 |
| Glucose injection 1.0% | 1.090 | 0.865 | 0.835 | 0.800 | 0.898 |
| Glucose injection 2.0% | 1.060 | 0.850 | 0.830 | 0.802 | 0.881 |
| Mean | 1.190 | 1.057 | 1.001 | 0.945 | |
| L.S.D.0.05 | T: 0.210 | | D: 0.097 | | T × D :1.98 |

The present study indicated that fruit total soluble solids (TSS), and ascorbic acid content were greatly affected the browning percentage in peach fruits. In general, tested treatments that reduced browning maintained higher fruit ascorbic acid. Gupta and Mukherjee (1980) found that the loss of ascorbic acid from fruits was closely associated with skin damage and browning during storage. In the meantime the relatively high ascorbic acid found in treated fruits might be attributed to the presence of copper as the prosthetic group in ascorbic acid oxidase enzyme (Epstein, 1978). The relatively high TSS and ascorbic acid values observed in treated fruits were due to delaying fruit ripening and respiration (McGlasson, 1970). In addition, Proebsting and Mills (1966) noticed that GA lessened fruit browning and delayed soluble solids development in Italian prunes. In line with these results those reported by Sourour and El-Deep (2004) on peaches and Ahmed and Ismail (2000) on guava However, fruit TSS % was increased, while ascorbic acid content was decreased by the increasing of storage period in both seasons .

**9- Fruit acidity at harvest and during cold storage**

The data presented in Table (4, c) revealed that in both seasons of study, at harvest and at the end of storage period both leaves of buds removal (20% and 40%) as well as glucose injection treatments at (1 and 2%) reduced fruit acidity % comparing with control. At the same time, $GA_3$ foliar spray treatments at (70 ppm and 140 ppm) as well as Ca-lactate injection treatments at (0.2 and 0.4%) increased fruit acidity but the differences were not great enough to be significant. In harmony with these results those reported by Ahmed and Ismail (2000) on guava fruits. However, ascorbic acid injection treatments at (0.5 and 1.0%) had no significant effect on fruit acidity %. These results seemed to be in line with those obtained by Smock and Gross (1950) working on apples and Sourour and El-Deep (2004) working on peaches However, fruit acidity was decreased, by the increasing of storage period in both seasons .

**10- Fruits production of $CO_2$ and $C_2H_4$ at harvest and during cold storage**:

The data in Table (5,a and b) indicated that in both experimental season at harvest and at the end of storage period, that calcium lactate at (0.2 and 0.4%), ascorbic acid at (0.5 and 1.0%) injection and $GA_3$ foliar spray treatments at (70 and 140 ppm) significantly reduced ethylene and $CO_2$ production of peach fruits, likewise, Smock and Gross (1950) and Ahmed (2000) on apples they found that Ca or ascorbic acid injection or foliar spray treatments reduced $C_2H_4$ and $CO_2$ production in apple fruits. However, buds removal at (20 and 40%) significantly increased $C_2H_4$ and $CO_2$ production comparing with control and other treatments. Main while, glucose injection treatments at (1and 2%) had no significant effect on fruit $CO_2$ and $C_2H_4$ production comparing with control and other treatments However, fruit $CO_2$ and $C_2H_4$ production were increased, by the increasing of storage period in both seasons .

**11- Fruit decay percentage during cold storage:**

The data of the present study indicated that all tested treatments significantly reduced the decayed fruits percentage comparing with control. However, the differences between the examined treatments were not high enough to be significant during and the end of storage period in both seasons (Table 5 c). Similar results were reported by Ahmed (2000) on apples, Sourour and El-Deep (2004) on peaches and Gupta and Mukherjee (1980) on guava fruits However, fruit decay % was increased by the progress of storage period in both seasons .

**Table (4 c): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on fruit quality of Desert Red peach fruits during cold storage at 0°C in 2005and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | V.C. (mg/ 100 ml juice) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 15.98 | 15.62 | 15.28 | 14.81 | 15.42 |
| Buds removable 20% | 17.11 | 16.75 | 16.40 | 16.00 | 16.57 |
| Buds removable 40% | 17.15 | 16.80 | 16.43 | 16.07 | 16.61 |
| $GA_3$ spray (70 ppm) | 17.85 | 1752 | 17.19 | 16.85 | 17.36 |
| $GA_3$ spray (140 ppm) | 17.90 | 17.56 | 17.20 | 16.85 | 17.38 |
| Ascorbic acid injection 0.5% | 17.98 | 17.82 | 17.50 | 17.16 | 17.62 |
| Ascorbic acid injection 1.0% | 18.19 | 17.83 | 17.58 | 17.29 | 17.72 |
| Calcium lactate injection 0.2% | 16.99 | 16.62 | 16.30 | 15.95 | 16.47 |
| Calcium lactate injection 0.4% | 17.04 | 16.67 | 16.32 | 15.97 | 16.50 |
| Glucose injection 1.0% | 17.89 | 17.53 | 17.20 | 16.85 | 17.37 |
| Glucose injection 2.0% | 18.11 | 18.00 | 17.61 | 17.15 | 17.72 |
| Mean | 17.47 | 17.16 | 16.82 | 16.45 | |
| L.S.D.0.05 | T: 0.83 | | D: 0.33 | | T × D :3.38 |
| | 2006 | | | | |
| Control | 16.30 | 15.90 | 15.50 | 15.10 | 15.70 |
| Buds removable 20% | 17.22 | 16.80 | 16.46 | 16.08 | 16.63 |
| Buds removable 40% | 17.35 | 16.92 | 16.51 | 16.17 | 16.74 |
| $GA_3$ spray (70 ppm) | 18.13 | 17.90 | 17.50 | 17.01 | 17.64 |
| $GA_3$ spray (140 ppm) | 18.41 | 18.02 | 17.63 | 17.26 | 17.83 |
| Ascorbic acid injection 0.5% | 18.46 | 18.16 | 17.88 | 17.58 | 18.02 |
| Ascorbic acid injection 1.0% | 19.40 | 18.63 | 18.15 | 17.46 | 18.41 |
| Calcium lactate injection 0.2% | 17.15 | 17.10 | 16.70 | 16.30 | 16.75 |
| Calcium lactate injection 0.4% | 17.18 | 17.12 | 16.73 | 16.32 | 16.84 |
| Glucose injection 1.0% | 18.25 | 17.85 | 17.46 | 17.03 | 16.65 |
| Glucose injection 2.0% | 18.88 | 18.20 | 18.80 | 17.47 | 18.16 |
| Mean | 17.88 | 17.51 | 17.14 | 16.68 | |
| L.S.D.0.05 | T: 0.91 | | D: 0.38 | | T × D :3.68 |

During cold storage in general the data in Tables (2, 3, 4 and 5) showed that in 2005 and 2006 browning %, PPO activity, weight loss %, total soluble pectin %, TSS %, $CO_2$, $C_2H_4$ production and fruit decay percentage were increased as storage time proceeded. In the meantime fruit total pehnolic %, firmness, acid %, V.C. content were decreased. In line with these results those reported by Ahmed (2000) on apples and Sourour and El-Deep (2004) working on peach fruits

**Table (5 a): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on $CO_2$, $C_2H_4$ production and decay percentage of Desert Red peach fruits at harvest during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | $CO_2$ production (nl / kg / hr) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 26.30 | 33.00 | 36.60 | 38.76 | 33.67 |
| Buds removable 20% | 30.93 | 38.49 | 42.96 | 46.91 | 39.82 |
| Buds removable 40% | 31.97 | 39.95 | 43.89 | 47.61 | 40.86 |
| $GA_3$ spray (70 ppm) | 14.12 | 16.90 | 19.60 | 22.80 | 18.36 |
| $GA_3$ spray (140 ppm) | 13.19 | 15.00 | 18.12 | 22.11 | 17.11 |
| Ascorbic acid injection 0.5% | 12.18 | 14.60 | 17.91 | 22.00 | 16.67 |
| Ascorbic acid injection 1.0% | 12.00 | 14.62 | 17.88 | 22.16 | 16.67 |
| Calcium lactate injection 0.2% | 11.16 | 13.20 | 16.50 | 21.30 | 15.54 |
| Calcium lactate injection 0.4% | 10.60 | 12.11 | 15.33 | 20.00 | 14.51 |
| Glucose injection 1.0% | 25.91 | 32.69 | 36.20 | 38.96 | 33.44 |
| Glucose injection 2.0% | 26.11 | 32.67 | 36.40 | 38.90 | 33.52 |
| Mean | 19.50 | 23.93 | 27.40 | 31.05 | |
| L.S.D.0.05 | T: 3.6 | | D: 1.64 | T × D :16.01 | |
| | 2006 | | | | |
| Control | 23.96 | 31.11 | 35.00 | 37.88 | 31.00 |
| Buds removable 20% | 28.10 | 36.70 | 40.16 | 43.90 | 37.22 |
| Buds removable 40% | 30.00 | 37.18 | 42.00 | 46.20 | 38.85 |
| $GA_3$ spray (70 ppm) | 12.18 | 15.79 | 19.00 | 21.90 | 17.22 |
| $GA_3$ spray (140 ppm) | 12.00 | 14.00 | 17.10 | 20.16 | 15.82 |
| Ascorbic acid injection 0.5% | 11.91 | 13.30 | 16.50 | 21.12 | 15.71 |
| Ascorbic acid injection 1.0% | 11.20 | 13.91 | 16.98 | 20.85 | 15.74 |
| Calcium lactate injection 0.2% | 10.96 | 12.88 | 15.30 | 19.60 | 14.69 |
| Calcium lactate injection 0.4% | 10.20 | 12.13 | 15.00 | 21.43 | 14.69 |
| Glucose injection 1.0% | 23.79 | 30.99 | 34.96 | 37.76 | 31.88 |
| Glucose injection 2.0% | 23.82 | 31.10 | 34.92 | 37.72 | 31.89 |
| Mean | 18.01 | 22.64 | 26.08 | 29.87 | |
| L.S.D.0.05 | T: 2.90 | | D: 1.32 | T × D :12.01 | |

It can be concluded from the above results that foliar spray with $GA_3$ at (70 and 140 ppm), calcium lactate injection (0.4 and 0.2 %), ascorbic acid injection (1 and 0.5%), glucose injection treatments at (2 and 1%) and buds removal at 20 and 40% are good treatments for reducing fruit browning and improving fruit quality and storeability of Desert Red peachs.

**Table (5 b): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on $Co_2$, $C_2H_4$ production and decay percentage of Desert Red peach fruits at harvest during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | $C_2H_4$ production (nl / kg / hr) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 25.10 | 30.00 | 37.14 | 44.19 | 34.11 |
| Buds removable 20% | 27.80 | 33.11 | 39.10 | 49.00 | 37.25 |
| Buds removable 40% | 28.00 | 34.13 | 39.60 | 49.30 | 37.76 |
| $GA_3$ spray (70 ppm) | 16.18 | 19.20 | 24.30 | 31.90 | 22.90 |
| $GA_3$ spray (140 ppm) | 16.00 | 19.00 | 24.16 | 31.95 | 22.78 |
| Ascorbic acid injection 0.5% | 16.11 | 19.01 | 24.20 | 33.10 | 23.11 |
| Ascorbic acid injection 1.0% | 16.15 | 19.18 | 24.25 | 33.59 | 23.50 |
| Calcium lactate injection 0.2% | 14.15 | 17.30 | 22.60 | 31.10 | 21.29 |
| Calcium lactate injection 0.4% | 14.00 | 17.06 | 22.39 | 31.00 | 21.11 |
| Glucose injection 1.0% | 24.96 | 30.10 | 37.28 | 44.20 | 34.14 |
| Glucose injection 2.0% | 24.91 | 30.15 | 37.50 | 44.90 | 34.37 |
| Mean | 20.31 | 24.46 | 30.23 | 38.57 | |
| L.S.D.0.05 | T: 2.70 | | D: 1.23 | T × D :11.40 | |
| | | | 2006 | | |
| Control | 23.90 | 28.93 | 35.88 | 42.65 | 32.84 |
| Buds removable 20% | 26.50 | 31.91 | 38.96 | 45.98 | 35.84 |
| Buds removable 40% | 27.11 | 32.60 | 39.70 | 46.42 | 36.46 |
| $GA_3$ spray (70 ppm) | 15.30 | 18.90 | 24.89 | 31.06 | 22.54 |
| $GA_3$ spray (140 ppm) | 15.13 | 18.36 | 24.60 | 3112 | 22.30 |
| Ascorbic acid injection 0.5% | 15.10 | 18.48 | 24.75 | 30.80 | 22.28 |
| Ascorbic acid injection 1.0% | 15.17 | 18.77 | 24.99 | 31.63 | 22.64 |
| Calcium lactate injection 0.2% | 13.21 | 16.80 | 22.11 | 29.60 | 20.43 |
| Calcium lactate injection 0.4% | 12.98 | 16.17 | 22.00 | 29.55 | 20.18 |
| Glucose injection 1.0% | 23.80 | 29.00 | 35.61 | 42.40 | 32.70 |
| Glucose injection 2.0% | 23.41 | 29.01 | 35.70 | 42.59 | 32.68 |
| Mean | 19.24 | 23.54 | 29.93 | 36.71 | |
| L.S.D.0.05 | T: 2.59 | | D: 1.19 | T × D :11.00 | |

**Table (5 c): Effect of buds removal, gibberellic acid foliar spray, limbs injection with ascorbic acid, calcium lactate and glucose on $Co_2$, $C_2H_4$ production and decay percentage of Desert Red peach fruits at harvest during cold storage at 0°C in 2005 and 2006 seasons**

| Treatment | Storage period (days) | | | | |
|---|---|---|---|---|---|
| | 2005 | | | | |
| | Decay (%) | | | | |
| | 0 | 10 | 20 | 30 | Mean |
| Control | 0.00 | 5.81 | 10.09 | 16.81 | 8.18 |
| Buds removable 20% | 0.00 | 1.80 | 3.10 | 6.23 | 2.78 |
| Buds removable 40% | 0.00 | 1.72 | 3.00 | 6.12 | 2.71 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.66 | 2.81 | 5.64 | 2.53 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.59 | 2.70 | 5.48 | 2.44 |
| Ascorbic acid injection 0.5% | 0.00 | 1.69 | 2.79 | 5.58 | 2.52 |
| Ascorbic acid injection 1.0% | 0.00 | 1.58 | 2.68 | 5.37 | 2.41 |
| Calcium lactate injection 0.2% | 0.00 | 1.41 | 2.48 | 5.08 | 2.24 |
| Calcium lactate injection 0.4% | 0.00 | 1.39 | 2.31 | 4.50 | 2.05 |
| Glucose injection 1.0% | 0.00 | 1.76 | 2.96 | 6.03 | 2.69 |
| Glucose injection 2.0% | 0.00 | 1.70 | 3.01 | 6.34 | 2.76 |
| Mean | 0.00 | 2.01 | 3.45 | 6.65 | |
| L.S.D.0.05 | T: 1.13 | | D: 0.56 | | T × D :4.70 |
| | 2006 | | | | |
| Control | 0.00 | 4.90 | 10.83 | 18.77 | 8.63 |
| Buds removable 20% | 0.00 | 1.77 | 3.65 | 6.41 | 2.96 |
| Buds removable 40% | 0.00 | 1.68 | 3.37 | 6.75 | 2.95 |
| $GA_3$ spray (70 ppm) | 0.00 | 1.56 | 3.24 | 6.89 | 2.87 |
| $GA_3$ spray (140 ppm) | 0.00 | 1.42 | 2.95 | 5.91 | 2.57 |
| Ascorbic acid injection 0.5% | 0.00 | 1.54 | 3.19 | 6.47 | 2.80 |
| Ascorbic acid injection 1.0% | 0.00 | 1.51 | 3.13 | 6.39 | 2.76 |
| Calcium lactate injection 0.2% | 0.00 | 1.29 | 2.59 | 5.17 | 2.26 |
| Calcium lactate injection 0.4% | 0.00 | 1.18 | 2.47 | 5.06 | 2.18 |
| Glucose injection 1.0% | 0.00 | 1.66 | 2.44 | 4.99 | 2.27 |
| Glucose injection 2.0% | 0.00 | 1.69 | 2.49 | 5.01 | 2.30 |
| Mean | 0.00 | 1.84 | 3.67 | 7.06 | |
| L.S.D.0.05 | T: 2.09 | | D: 0.90 | | T × D :8.1 |

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## تأثير إزالة البراعم والرش الورقي بحمض الجبريليك وحقن الأفرع بحمض الأسكوربيك والكالسيوم لاكتات والجلوكوزعلى السيطرة على التلون البني أثناء التخزين المبرد لثمار الخوخ صنف ديزرت رد

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** بحوث البساتين بالصبحية – الإسكندرية – مركز البحوث الزراعية – مصر.

أجريت هذه الدراسة خلال موسمي ٢٠٠٥، ٢٠٠٦ على أشجار الخوخ صنف ديزرت رد البالغة النامية في مزرعة خاصة بمنطقة النوبارية بهدف تقييم تأثير إزالة البراعم والرش الورقي باستخدام الـــ $GA_3$ (٧٠، ١٤٠ جزء في المليون)، حقن البراعم بحمض الأسكوربيك (٠,٥، ١,٠%) وكالسيوم لاكتات (٠,٢، ٠,٤%)، الجلوكوز (١,٠، ٢,٠%) والكنترول (رش بماء الصنبور) على المحصول ونسبة تساقط الثمار ووزنها وجودتها ونسبة تلون الثمار ونشاط إنزيم الـــ PPO، وإنتاج ثاني أكسيد الكربون والإيثلين ونسبة حدوث العفن ونسبة الفقد في الوزن اثناء التخزين المبرد. ومحتوى الأوراق والثمار من الكالسيوم. دلت البيانات على أن جميع المعاملات أدت إلى تقليل المحصول كعدد ثمار/ شجرة، بينما زاد المحصول على اساس ك جم/ شجرة وزاد متوسط وزن الثمرة وأدت إلى زيادة نسبة تساقط الثمار. أدت معاملات حقن الكالسيوم لاكتات إلى زيادة محتوى الأوراق والثمار من الكالسيوم. أدت جميع المعاملات إلى تقليل نسبة التلون البني للثمار و تقليل نسبة الحموضة وتقليل نشاط إنزيم الـــ PPO وتقليل الفينولات الكلية وأدت إلى زيادة محتوى الثمار من الـــ TSS والـــ V.C. معاملات الرش الورقي بحمض جبريليك ومعاملات الحقن بالكالسيوم لاكتات، وحمض الأسكوربيك أدت إلى زيادة صلابة الثمار وقللت من نسبة البكتين الذائب في الثمار. معاملات الحقن بالجلوكوز وحمض الأسكوربيك ولاكتات الكالسيوم ومعاملات الرش الورقي بحمض الجبريليك أدت إلى تقليل نسبة الفقد في الوزن. معاملات إزالة البراعم ومعاملات حقن الجلوكوز والكالسيوم قللت حموضة الثمار وإنتاجها الإيثلين وثاني أكسيد الكربون، لكن معاملة إزالة البراعم أدت إلى زيادة إنتاج ثاني أكسيد الكربون والإيثلين وزيادة الحموضة.