J. Plant Production, Mansoura Univ., Vol. 10 (2): 217 - 222, 2019

Effect of Pre-Harvest Treatments of Peach Trees on Fruits Quality Characters during Cold Storage

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ABSTRACT

This research was carried out during two successive seasons of 2016 and 2017 to study the effect of pre-harvest treatments on peach trees on fruits quality at harvest time and during cold storage at 5±1°C and 80-85% RH. The selected trees for this study were chosen from locally Mit-Ghamer peach trees(cv. Medium Sultani), grown in a private orchard at Fesha-Bana village, Aga Center, Dakahllia governorate, Egypt. The selected trees of peach (cv. Medium Sultani) were sprayed Pre-harvest (1.5 month after full bloom) with one of the followings: tap water (control), 1.5% potassium sulphate (K_2SO_4), 2% calcium chloride ($CaCl_2$) and the combination of them. The harvested mature fruits were cold stored at 5 ± 1°C and 80-85% relative humidity (RH) for a storage period of 24 days. Some physical and chemical quality characteristics were measured on the intact treated fruits at harvest date and at 6-day-intervals during cold storage up to 24 days. The obtained results showed that the peach fruits sprayed with 1.5% K_2SO_4 recorded the highest values of firmness, Vitamin C content and TSS% after 6, 12 and 18 days during The cold storage in both seasons. While, peach trees sprayed with 2% $CaCl_2$ gave the highest values of fruit firmness at harvest time and after 24 days of cold storage, and the lowest value of fruits decay incidence%, TSS% and anthocyanin content in fruit skin in all storage periods of both seasons. Applying the combination treatment of 1.5 % K_2SO_4 and 2% $CaCl_2$ showed the highest values of vitamin C, acidity and total sugars%, anthocyanin and pectic substances contents as well as the lowest value of TSS/acid ratio and weight loss% of fruit at 18 and 24 days of cold storage in both seasons. However, the opposite trends were true for the control treatment. Finally, it can be recommended applying the combination spray of 1.5 % K2SO4 and 2 % CaCl2 on peach trees at pre-harvest (1.5 month after full bloom) to improve maintaining physical and chemical qualities of peach fruits during cold storage up to 24 days.

Keywords: Peach, *Prunus persica*, pre-harvest treatments, potassium sulphate, calcium chloride, quality characters, cold storage.

INTRODUCTION

The peach, *Prunus persica* L. (Bastch) is one of the most preferred fruits for consumers in the world wide because of its high nutrient level and pleasant flavor. The fruit may be consumed fresh or processed into jelly and jam. Peach is considered one of the most important deciduous fruit that greatly success and widespread in the newly reclaimed areas in Egypt. The total cultivated area of peach in 2017 season was about 58803 feddans with total production of 360723 tons fruits, according to Food and Agriculture Organization (FAO, 2019).

Peach is a climacteric fruit, which undergoes rapid ripening. This is responsible for its short shelf-life and represents a serious constraint for its efficient handling and transportation (Hussain *et al*., 2008). So, there is a great role of pre-harvest horticultural applications to improve of fruits quality.

Potassium (K) is thought to plays an important role in metabolic reactions related to the maturity and senescence of fruits. It was reported that the foliar applications of potassium (K_2SO_4) increased cherry fruit firmness (Matzner and Maurer, 1975) and improved fruit quality in "Royal Glory" peach include soluble solids content and fruit appearance (Ben *et al*., 2009). Applying three sprays with 1.5% potassium nitrate significantly improved the fruit size of pear as compared to control (Gill *et al*,.2012). Pre-harvest spraying peach trees with potassium nitrate at 2% by Kaur *et al.* (2012) increased fruit weight, TSS and TSS: acid ratio, but reduced firmness and acidity of fruits. Jumaa and Ali (2016) showed that foliar application pomegranate trees with potassium sulfate at the rate of 3000 mg L^{-1} significantly decreased fruit cracking by18.7%, which led to increasing in fruit weight and fruit yield and some of the physical qualities of fruits. Kumar *et al*. (2017) revealed that the foliar spraying of potassium sulphate improved quality parameters over the control. Where, the highest fruit firmness, total soluble solids, total sugars, pectin content and ascorbic acid content and lowest acidity were recorded in guava plants sprayed with potassium sulphate at 3%.

Calcium sprays are applied universally during fruit development to maximize storage potential and minimize the risk of calcium-related storage disorders (Ernani *et al*., 2002). Many pre-harvest calcium treatments are effective in overcoming several physiological disorders and this fact is attributed to the ability and efficiency of calcium to maintain cell membrane and wall integrity and structure relating with pectin polymers and keeping cell cohesiveness (Glenn and Poovaiah, 1990). Pre-harvest Ca^{2+} treatments used to increase Ca^{2+} content of the cell wall were effective in delaying senescence, resulting in firmer fruits have a higher quality (Raese and Drake, 2006). The pear trees treated with calcium chloride at 2.0% concentration (Prasad *et al*., 2015) recorded the highest value of both titratable acidity (0.46 %) and ascorbic acid (6.42 mg/100 g) compared to other treatments. Gayed *et al.* (2017) showed that pre-harvest application with 2% $CaCl_2$ was most effective in minimizing decay% and weight loss% as well as in maintaining maximum firmness and lengthening shelf life. Singh *et al*. (2017) showed that peach fruits treated with $CaCl_2$ (0.6%) reduced the physiological loss in weight, maintained fruit firmness and content of acidity, TSS and ascorbic acid under both ambient and refrigerated conditions. Sharma and Pratima (2018) stated that foliar application of calcium nitrate (1%) was found to be superior over calcium chloride (2%) for improving peach fruit quality (TSS, acidity and firmness) and reducing fruit deterioration during shelf life.

Peach ripen and deteriorate quickly at ambient temperature. Therefore, cold storage has always been used as the main method to slow these processes as well as decay development, but chilling injury limits peach storage life at low temperatures (Wang *et al*., 2006). The weight loss, decay percentage and TSS/acid ratio of the peach fruits were gradually increased by increasing cold storage period. While, fruit pulp firmness, TSS and acidity were decreased (Gad *et al.*, 2016 and Kaur and Kaur, 2019).

Therefore, the main goal of this research is to study the effect of pre-harvest treating peach trees by the spraying with potassium sulphate or calcium chloride alone or in combination on the physical and chemical characteristics of peach fruits quality during cold storage (5± 1°C and 80-85% RH).

MATERIALS AND METHODS

The present study was carried out during two successive seasons of 2016 and 2017 on locally Mit-Ghamer peach trees (*Prunus persica* L.) Medium Sultani (Eliwa,2005) grown in aprivate orchard at Fesha-Bana vallage, Aga center, Dakahllia governorate, Egypt.The selected trees were about 35-years-old, almost uniform grown in clay soil, spaced at 5*4meters apart, received irrigation and fertilization programs along with other cultural practices according to recommendation of the Agriculture Ministry to clay soil conditions.

Twenty four trees were selected and randomly divided into four equal groups, 6 trees each. Every one group was sprayed pre-harvest (1.5 months after full bloom) by one of the following treatments: Tap water (control = T_1), Potassium sulphate at 1.5% (T_2), Calcium chloride at 2% (T_3) and a combination of the two salts (T_4).

At harvest date, 120 mature fruits were collected from each treatment and immediately transported to the laboratory of Pomology Department, Faculty of Agriculture, Damietta University, washed with tap water and soup, to remove impurities and microbial load on the fruit surfaces, and dried using electrical fan. These fruits were sorted for uniformity in size, shape, maturity and freedom from defects.

Fruits were refrigerated at low temperature (5±1°C) and 80-85% relative humidity (RH) for storage period of 24 days. The following physical and chemical characteristics of fruits quality at harvest date and during cold storage periods at 6-day-intervals were measured.

A- Physical characteristics

The physical characteristics were measured on the intact treated fruits in 3 replicates (40 fruits each) per treatments as follows:

1. Fruit firmness (lb. /in^2) was determined by Magness and Taylor (1925) pressure tester using a 5/16 plunger.

2. Fruit weight loss (%): The initial weight of each replicate was recorded at the starting of cold storage. Changes in fruits weight were measured by reweighting at 6-day-intervals during cold storage period up to 24th day. The weight loss percentage was calculated in relation to its initial weight according the following equation:

$$\text{Weight loss (\%)} = \frac{\text{Initial weight} - \text{Sample weight}}{\text{Initial weight}} \times 100$$

3. Fruits decay incidence (%): Percentage of decay incidence was obtained from the number of fruits that showed signs of decay over the initial number of fruits.

B- Chemical characteristics

These characteristics were determined in 3 replicates per treatment. Four fruits per replicate were homogenized and the homogenate filtered through several layers of cheese cloth to obtain the clear juice. The procedures of determinations were as follows:

1. Vitamin C content (mg/100ml juice) was determined in fruit juice as described by Ranganna (1979).

2. Titratable acidity (%) was measured in 3.0 ml per replicate by titrating the fruit juice after diluting with distilled water, against 0.1N sodium hydroxide (NaOH) solution in the presence of phenolphthalein as an indicator to the end point (Ranganna, 1979).

3. Total soluble solids (TSS %) was measured in using an Abe hand refractometer**.**

4.Total soluble solids/acid ratio was calculated from the results recorder for TSS% and titratable acidity % determinations.

5. Total soluble sugars were determined according to the method described by Sadasivam and Manickam (1996) and the obtained result was represented as a percentage.

$$\text{Total anthocyanins (mg/100 g)} = \frac{\text{Absorbance at 535 nm} \times \text{Dilution factor}}{\text{Weight of sample} \times 55.9} \times 100$$

6. Anthocyanin content (mg/100g): Half gram of fresh skin of peach fruits was extracted in 10 ml of acidified ethanol alcohol solution, for 24 hr under laboratory temperature. The extract was measured at 535 nm using Spectrophotometer according to the methods of Husia *et al.*, (1965). The content of total anthocyanin in peach skin was calculated using the following equation as described by Francis and Chiriboga (1973):

7. Determination of pectic substances% was made according to Ranganna (1979).

C. Statistical analysis

The experiment was laid out in randomized complete blocks design. The differences among treatment means were compared with Duncan Multiple Range tests at a significant level of $P< 0.05$ using the Statistical Analysis System of SAS Package(1996).

RESULTS AND DISCUSSION

1. Physical characters:

Fruit firmness, weight loss and decay incidence percentages of peach fruits as affected by pre-harvest spraying treatments at 6-days intervals under cold storage up to 24days during 2016 and 2017 seasons were presented in Table (1).

The results showed that pre-harvest spraying of $CaCl_2$ spraying achieved the highest firmness of fruits compared to spraying with K_2SO_4 or control. Increasing the duration of cold storage gradually reduced fruit firmness. After 24 days of cold storage, the control fruit firmness was decreased to a minimum value of 2.35 lb/in^2 as an average of the two seasons of study, while the $CaCl_2$ treated fruits retained a higher firmness than the control by 40.4% followed by the K_2SO_4-treated fruits, which increased by 28.1% over control fruits. Such are in results agreement with the previous study indicated that fruit firmness was increased significantly with different potassium treatments as compared to firmness of control (non-treated pear fruits) (Gill, *et al.*, 2012). Applications of potassium increased osmoregulation of cell vacuoles and maintained the equilibria, resulting in firm fruits (Wani and Khajwall, 1997).

The improvement in the fruits firmness associated with pre - harvest spraying with $CaCl_2$ may be due to the role of calcium in maintaining cell wall structure in fruits by interacting with pectin in the cell wall to form calcium pectate which assists molecular bonding between constituent of the cell wall (Dong *et al*., 2000). Calcium is known to strengthen the structure of cells by maintaining the fibrous packaging in the cell walls, thus reinforcing contact of the cell to cell, which is related to the formation of calcium pectate and counteracts the pectin methyl esterase activity as observed in calcium treated pear fruits (Alandes *et al*., 2009).

Fruits of control showed the highest weight loss during cold storage periods of 6 to 24 days. The percentage of weight loss in stored fruits increased with the progress of cold storage period. Most effective treatment in reducing weight loss was the treatment of $CaCl_2$ spraying (22.4%) followed by the combination of $CaCl_2$ and K_2SO4 (22.9%) compared to control (26.5%) as an average of the two seasons of study at the last day of storage (24days).

Table 1. Fruit firmness, weight loss and decay incidence percentages of peach fruits as affected by pre-harvest spraying potassium sulphate, calcium chloride and their combination at 6-days intervals of cold storage during 2016 and 2017 seasons.

Treatments / Seasons	Intervals of cold storage in days									
	0		6		12		18		24	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Fruit firmness (lb/in^2)										
T_1. Control treatment	4.33c	4.47c	3.07c	3.12c	2.97c	3.08c	2.37d	2.47d	2.28c	2.42c
T_2. K_2SO_4 at 1.5%	6.23b	7.07ab	5.17a	5.68a	4.36b	4.66b	3.47b	3.74b	2.97ab	3.05b
T_3. $CaCl_2$ at 2.0%	7.97a	8.25a	5.64a	5.92a	5.03a	5.33a	4.20a	4.15a	3.25a	3.37a
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	6.20b	6.40b	4.66b	4.76b	3.00c	3.10c	2.78c	3.02c	2.37c	2.43c
Fruit weight loss (%)										
T_1. Control treatment	0.00	0.00	8.39a	6.99a	14.82a	12.22a	18.69a	19.00a	27.90a	25.17a
T_2. K_2SO_4 at 1.5%	0.00	0.00	6.00b	4.26b	12.11b	8.36b	16.75bc	15.17b	25.93b	22.98b
T_3. $CaCl_2$ at 2.0%	0.00	0.00	5.72b	5.44b	11.58bc	6.95c	17.52ab	17.59a	24.14c	20.64c
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	0.00	0.00	3.76c	4.46b	11.00c	6.89c	15.91c	13.62b	25.14b	20.58c
Fruits decay incidence (%)										
T_1. Control treatment	0.00	0.00	5.92a	0.00	21.71a	8.54a	37.17a	13.27b	63.29a	47.35a
T_2. K_2SO_4 at 1.5%	0.00	0.00	0.00b	0.00	10.90b	8.47a	14.04b	17.02a	34.31b	32.53b
T_3. $CaCl_2$ at 2.0%	0.00	0.00	0.00b	0.00	0.00c	4.59b	4.78c	10.68b	16.64c	14.53c
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	0.00	0.00	0.00b	0.00	0.00c	0.00c	7.54c	5.00c	19.04c	18.62c

Means followed by the same letter (s) in the same column don't significantly differ at 0.05 of probability according to Duncan's Multiple Range Test.

Pre-harvest spraying K_2SO_4 or $CaCl_2$ alone or together led to the prevention of any decay incidence after 6 days cold storage compared to control, and also showed a significant decrease in fruits decay incidence% compared to control in all periods of cold storage. Calcium chloride alone or in combination with K_2SO_4 caused the lowest percentage of fruit decay incidence%.

These results may be explained to the role of potassium on fruit quality by influencing size and firmness (Bhargava *et al*., 1993). While, the lowest values of fruit firmness and the highest weight loss and decay incidence percentages of peach fruits after 12, 18 and 24 days of cold storage were resulted from control in both seasons. These results came in the similar point of view with those reported by Gill *et al.* (2012), Jumaa and Ali (2016), Gayed *et al.* (2017), Kumar *et al.* (2017) and Sharma and Pratima (2018).

2. Chemical characters:

Means of ascorbic acid concentration (Vitamin C), titratable acidity and TSS%, TSS/acid ratio, total soluble sugars%, anthocyanin and pectic substances contents in peach fruit juice as affected by pre-harvest spraying treatments at 6-days intervals of cold storage during 2016 and 2017 seasons are recorded in Tables (2 and 3). Vitamin C content, acidity and total sugars percentages and pectic content in peach fruits were turn down gradually, while TSS %, total soluble solids/acid ratio and anthocyanin content in peach fruits were gradually increased by increasing storage period and the rates of decline were significantly differed between the tested pre-harvest treatments in both seasons.

Data tabulated in Table (2) proved that pre-harvest spraying of K_2SO_4 or $CaCl_2$ alone or in combination produced significantly higher fruits of vitamin C compared with control. The treated fruits were also preserved with higher vitamin C content than the control during periods of cold storage. Increasing the period of cold storage led to vitamin C decrease in stored fruits. The results of acidity content in fruits showed a similar trend to their vitamin C content.

The peach trees sprayed with potassium sulphate at the rate of 1.5 % produced the highest vitamin C content at harvest time and after 6 and 12 days of cold in both seasons. These findings may be attributed to potassium is considered to be of most importance and is known to have profound effect on fruit quality by influencing size, color, soluble solids, acidity and vitamin content (Bhargava *et al*., 1993). Whilst, peach trees sprayed with calcium chloride at the rate of 2 % recorded the lowest percentages of TSS and anthocyanin content in peach fruit in all storage periods in both seasons. These results may be ascribed to pre-harvest calcium treatment increased Ca content of the cell wall, which more effective in delaying senescence, resulting in firmer fruits and have a higher chemical quality (Raese and Drake, 2006).

At harvest time (0 day of storage), TSS% was the highest in fruits treated with K_2SO_4 and the lowest in $CaCl_2$ -treated fruits (Table 2), which means that the fruit ripening was accelerated with the first one and delayed by the second one. Prolonging the cold storage period resulted in increasing the TSS content of the stored fruit. After 24 days of cold storage, the $CaCl_2$- treated fruits contained lower TSS%, while the fruits treated with K_2SO_4 had the higher value. This is explained by the fact that calcium chloride delays the biochemical decomposition in the fruits, unlike the potassium sulfate. Pre-harvest spraying $CaCl_2$ or K_2SO_4 alone or in combination resulted in a significant decrease in TSS / acid ratio in the treated fruits compared with control, at the harvest time and during cold storage periods up to 24 days (Table 2). The applying of $CaCl_2$ and K_2SO_4 interaction gave the lowest TSS / acid ratio, due to reducing acid content of treated fruits and increasing TSS content.

Table 2. Vitamin C, titratable acidity. TSS percentages and TSS/acid ratio in peach fruit juice as affected by pre-harvest spraying treatments potassium sulphate, calcium chloride and their combination at 6-days intervals of cold storage during 2016 and 2017 seasons.

Treatments	Intervals of cold storage in days									
	0		6		12		18		24	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
	Vitamin C (mg/100 ml juice)									
T_1. Control treatment	13.01b	13.54b	8.96c	9.14d	6.40b	6.70c	5.26b	5.29c	3.46b	3.56b
T_2. K_2SO_4 at 1.5%	14.98a	15.22a	12.14a	12.35a	9.30a	9.47a	6.66ab	6.80b	4.02b	5.09a
T_3. $CaCl_2$ at 2.0%	13.43ab	14.40a	9.92bc	10.02c	7.07b	7.25b	5.60b	5.84c	4.80a	4.99a
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	14.51ab	14.91a	10.77b	10.85b	7.04b	7.33b	7.54a	7.85a	5.01a	5.31a
	Titratable acidity (%)									
T_1. Control treatment	1.03c	1.07b	0.82c	0.87c	0.62c	0.67b	0.49c	0.49d	0.45d	0.32c
T_2. K_2SO_4 at 1.5%	1.33b	1.41a	1.04b	1.12b	0.74b	0.83b	0.78b	0.63c	0.61c	0.42b
T_3. $CaCl_2$ at 2.0%	1.31b	1.34ab	1.06b	1.08b	0.77b	0.83b	0.72b	0.78b	0.63b	0.43b
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	1.41a	1.45a	1.33a	1.36a	1.23a	1.27a	0.91a	0.91a	0.89a	0.56a
	TSS (%)									
T_1. Control treatment	8.13c	8.00c	8.77b	8.67a	9.67a	9.33a	10.27b	10.00c	11.13c	10.67b
T_2. K_2SO_4 at 1.5%	8.33a	8.20a	9.67a	9.33a	10.27a	10.00a	11.07a	11.00a	12.83a	12.67a
T_3. $CaCl_2$ at 2.0%	8.00d	7.87d	8.43b	8.00a	8.87b	8.33b	10.20b	10.00c	10.50d	10.17b
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	8.20b	8.07b	9.05ab	9.00a	9.97a	10.00a	10.93a	10.27b	12.07b	12.00a
	TSS/acid ratio									
T_1. Control treatment	7.95a	7.75a	10.30a	10.45a	15.53a	14.93a	24.48a	20.92a	42.99a	41.04a
T_2. K_2SO_4 at 1.5%	6.25b	5.89b	9.35ab	8.58ab	13.92a	12.44ab	15.40b	14.10c	30.07b	28.43b
T_3. $CaCl_2$ at 2.0%	6.12b	5.87b	8.27b	7.41b	11.59b	10.13b	16.84b	16.00b	26.22bc	24.55bc
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	5.76c	5.51b	6.79c	6.37b	8.09c	7.36c	11.55c	10.92d	21.15c	19.14c

Means followed by the same letter (s) in the same column don't significantly differ at 0.05 of probability according to Duncan's Multiple Range Test.

The fruits obtained from pre-harvest spraying with $CaCl_2$ or K_2SO_4 or both were significantly higher in total sugar content at the harvest date and retained the higher total sugar content during periods of cold storage compared to control fruits (Table 3). The concentration of total sugars was increased significantly by foliar application of potassium at varying concentrations as compared to control. Similar results were observed by Pandey *et al.* (1988) in guava fruits and Gill *et al.* (2012) in pear. These results came in the similar point of view with those reported by Ben *et al.* (2009); Gill *et al.* (2012); Kaur *et al.*, (2012); Prasad *et al.* (2015); Gayed *et al.* (2017); Kumar *et al.* (2017), Singh *et al.*, (2017) and Sharma and Pratima (2018).

Table 3. Total soluble sugars percentage, anthocyanin and pectic substances contents in peach fruit as affected by pre-harvest spraying treatments potassium sulphate, calcium chloride and their combination at 6-days intervals of cold storage during 2016 and 2017 seasons.

Treatments	Intervals of cold storage in days									
	0		6		12		18		24	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
	Total sugars (%)									
T_1. Control treatment	6.89b	7.10b	6.46b	6.68b	5.90a	6.23a	5.61b	5.90a	5.32b	5.56b
T_2. K_2SO_4 at 1.5%	7.44a	7.63a	7.00a	7.25ab	6.41a	6.74a	6.13ab	6.41a	5.84b	6.08a
T_3. $CaCl_2$ at 2.0%	7.34a	7.53ab	6.90ab	7.14ab	6.31a	6.65a	5.95ab	6.31a	5.59ab	5.97a
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	7.56a	7.75a	7.12a	7.37a	6.51a	6.86a	6.24a	6.51a	5.96a	6.16a
	Anthocyanin (mg/100 g)									
T_1. Control treatment	3.02c	2.94c	4.65c	4.51c	5.42b	5.36c	5.50b	5.41c	6.27c	5.98c
T_2. K_2SO_4 at 1.5%	5.73b	5.55b	5.84d	5.71d	6.10ab	5.88b	6.52a	6.27b	6.96b	6.94b
T_3. $CaCl_2$ at 2.0%	2.07d	1.99d	2.82b	2.66b	3.53c	3.30d	4.57c	4.33d	4.75d	4.56d
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	6.44a	6.20a	6.57a	6.52a	6.70a	6.61a	6.94a	6.85a	9.34a	8.56a
	Pectic substances content (%)									
T_1. Control treatment	16.26d	16.56c	15.77d	16.08d	15.19a	15.43a	14.34b	14.60b	13.49b	13.76b
T_2. K_2SO_4 at 1.5%	17.22c	17.58a	16.95b	17.05b	16.09a	16.26a	15.73a	15.94a	15.36a	15.61a
T_3. $CaCl_2$ at 2.0%	17.03c	17.36b	16.62c	16.84c	15.83a	16.08a	15.57a	15.76a	15.31a	15.44a
T_4. K_2SO_4 at 1.5% + $CaCl_2$ at 2.0%	17.54a	17.74a	17.06a	17.26a	16.21a	16.43a	15.89a	16.11a	15.57a	15.79a

Means followed by the same letter (s) in the same column don't significantly differ at 0.05 of probability according to Duncan's Multiple Range Test.

The pre-harvest spraying of $CaCl_2$ caused a decrease in the concentration of anthocyanins in fruit skin compared to the control and K_2SO_4 at harvest time and during the intervals periods of cold storage (Table 3). The combination treatment of K_2SO_4 and $CaCl_2$ showed the highest content of anthocyanin in fruit skin at the harvest date and during cold storage periods. The concentration of anthocyanins in the skin of peach fruits was increased with an increase in cold storage period.

Pre-harvesting application of $CaCl_2$ or K_2SO_4 alone or in combination resulted in a significant increase in the pectin content of the fruits, at harvest date and during cold storage periods up to 24 days compared to control (Table 3). Calcium and pectin contents are very important for good fruit quality. Whearas, Inserting Ca^{2+} into a polygalacturon chain supplies a strong structure (Grant *et al*., 1973) in which Ca^{2+} plays chemical and structural roles that effect on the enzmes action like pectinesterase and polygalacturonase on the pectin polymer and thus on texture and firmness of the vegetables and fruits that is very important for fruits storage and processing (Rigney and Wills, 1981). As well as, Ca^{2+} treatment also raise cell turgor and this too could effect tissue firmness (Labavitch and Mignanim 1993).

CONCLUSION

From obtained data in this study; it could be recommended spraying peach trees at pre-harvest with the combination treatment of potassium sulphate (1.5 %) and calcium chloride (2 %) to improve quality and chemical characters of peach fruits during cold storage.

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تأثير معاملات ما قبل الحصاد لأشجار الخوخ على خصائص الثمار أثناء التخزين البارد

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أجريت هذه الدراسة خلال موسمي 2016 و 2017 على أشجار خوخ منزرعة في بستان تجاري لدراسة تأثير معاملات ما قبل الحصاد لأشجار الخوخ على صفات الجودة للثمار أثناء التخزين البارد. حيث كان عمر الأشجار 35 سنة مغروسة على مسافة 5 × 4 أمتار في تربة طينية فى مزرعة تجارية تقع في ميت غمر - محافظة الدقهلية – مصر، وتلقت الأشجار برامج الري والتسميد والممارسات الزراعية الأخرى وفقا لتوصيات وزارة الزراعة لظروف التربة الطينية. الأشجار المختارة (24 شجرة) تم تقسمها عشوائياً إلى أربع مجموعات متساوية ، 6 أشجار لكل منها. تم رش كل مجموعة قبل الحصاد باحدى المعاملات التالية: ماء الصنبور (معاملة المقارنة) ، كبريتات البوتاسيوم بمعدل 1.5 ٪ ، كلوريد الكالسيوم بمعدل 2 ٪ أوخليط منهما .تم تخزين الثمار الناضجة المتحصل عليها من المعاملات السابقة تخزينا باردا لمدة 24 يوم، مع أخذ القياسات الفيزيائية والكيميائية لجودة الثمار عند الحصاد وعلى فترات 6 أيام أثناء التخزين.أوضحت النتائج التي تم الحصول عليها: أن ثمار الخوخ التي تم رشها بـ K_2SO_4 بمعدل 1.5% سجلت أعلى قيم لمحتوى فيتامين ج والنسبة المئوية للمواد الصلبة الذائبة الكلية (TSS%) بعد 6 و 12 و 18 يومًا خلال التخزين البارد في كلا الموسمين. في حين ، أعطت أشجار الخوخ التي تم رشها بنسبة 2% من كلوريد الكالسيوم $CaCl_2$ أعلى قيم لصلابة الثمار في وقت الحصاد وبعد 24 يومًا من التخزين البارد ، وأدنى قيمة لكل من النسبة المئوية للثمار التالفة و TSS% ومحتوى الأنثوسيانين في جلد الثمرة، بعد جميع فترات التخزين في كلا الموسمين. كما أظهر تطبيق الجمع بين 1.5% K_2SO_4 و 2% $CaCl_2$ أعلى قيم لفيتامين ج والحموضة والسكريات الكلية٪ والأنثوسيانين ومحتويات المواد البكتينية وكذلك أدنى قيمة لنسبة المواد الصلبة الذائبة الكلية/الحموضة والنسبة المئوية لفقد الوزن فى الثمار عند 18 و 24 يوما من التخزين البارد في كلا الموسمين. ومع ذلك ، كانت الاتجاهات المعاكسة حقيقية بالنسبة لمعاملة الكنترول.أخيرًا ، يمكن التوصية: بتطبيق الرش المركب من كل من بنسبة 1.5% $K2SO_4$ و 2% $CaCl_2$ على أشجار الخوخ في مرحلة ما قبل الحصاد (شهر ونصف بعد الإزهار الكامل) لتحسين الحفاظ على الصفات الفيزيائية والكيميائية لثمار الخوخ عند الحصاد أثناء التخزين البارد لمدة تصل إلى 24 يومًا .