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STUDIES ON STORAGE LIFE OF LE CONTE PEAR FRUITS

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ABSTRACT

This study was undertaken during the three successive seasons of 2003, 2004 and 2005 (the first season was a preliminary season to determine the best concentration of each material under study) on Le Cont pear fruits to evaluate the effect of using calcium chloride ($CaCl_2$), carbendazime, potassium permanganate ($KMnO_4$), hot water and ethanol treatments on fruit quality at harvest time and their effect on storage ability under cold storage at 0°C ±1 and through marketing for 3 days at room temperature after cold storage.

From this study, the data revealed that dipping "Le Conte" pear fruits in $CaCl_2$ solution at 2 or 3 % was effective for reducing loss in fruit weight percentage and progress fruit firmness while, carbendazime either at 750 or 1000 ppm reduced decayed fruits and total loss percentage in fruit weight. Moreover, ethanol vapour at 100 % enhanced SSC and SSC / acid ratio and progress carotenoids content, but decreased total acidity during cold storage. Furthermore, potassium permanganate kept carotenoids content to a long time and decreased total acidity during marketing. while, hot water at 52°C increased SSC / acid ratio in fruit juice which showed to increase marketing period of pear fruits.

INTRODUCTION

Pear fruits (*Pyrus communis* L.,) are considered the third in importance among other deciduous fruits in the world and fourth among all fruits for which statistics are available (Childers,1994). In Egypt, its area reached about 8362 feddans with total area production amounted 38192 metric tons according to the statistics of the Ministry of Agriculture in 2004.

Le cont pear is the main cultivar grown in Egypt with other minor cultivars, "Kiefer" cultivar is one of such minor varieties and it is usually found as a catered pollinating trees in Le cont orchard.

The storage life of most fruits is lengthened if they are cooled quickly immediately after harvest, temperature has a direct effect on the respiration rates of fruits and on the activity of decay caused by organisms. The respiration rate is an index of the valet which the fruit is using up its reserves of sugar and other metabolites.

The cause of superficial scald is that conjugated trines, the oxidative products of a naturally occurring terpene, ∞- farnesene, are toxic to the epidermal and endodermic cells of the fruit peel (Chen *et al*., 1990). Factors that usually increase the severity of the disorder include immaturity, high fruit nitrogen, low fruit calcium, warm preharvest weather, delayed cold storage, high storage temperature and high RH during cold storage.

The chemical reactions associated with respiration result in the production of heat. The amount of heat generated varies with the commodity and with its temperature. In general, the respiration rate increases two - four times for each 10 °C increase in temperature. Thus, more heat is produced at high temperature and less at the low temperature to which the product is cooled. Microbial organisms also are more active at high than at low

temperatures. So, precooling and storage at optimum temperatures is required to reduce this generation of heat and to slow decay.

$CaCl_2$ application delayed the appearance of external fruit color at harvest and reduced the occurrence of rots at the end of storage period and during the subsequent. Moreover, $CaCl_2$ under saturated humidity delayed pathogen onset and greatly suppressed their development, improved fruit resistance to chilling injury and lowered the declining rate of the external fruit appearance. It is also well known that Ca^{+2} is an integral part of the cell wall where it provides stability, resulting in cell wall rigidity **(**Schirra *et al*., 1997).

Considering the commercial importance, perishable nature and extent of losses caused by storage rots in pear, it was through to investigate the effect of fungicides like carbendazime on the fungi which causes post-harvest spillage.

One of the simplest ways to remove ethylene from the atmosphere is to absorb and oxidize it with potassium permanganate ($KMnO_4$), to produce CO_2 and H_2O.

Heat seems to be an useful mean of improving maintaining fruit quality during the post-harvest period. Elevated temperatures (above 35 °C) have been reported to inhibit ripening of many fruit and skin blackening.**(**Mitchell, 1986)

Ethanol was effective in controlling spore germination of *B. cinerea* and gray mold on bunches at a similar range of concentrations.

So, this investigation studied the effect of $CaCl_2$, carbendazime, potassium permanganate, hot water and ethanol which has found to play the following objectives:

1**-** Controlling insect pests as a quarantine treatments.
2- Increasing the shelf - life of pear fruits.
3- Improve the fruits life during storage as long as possible to raise the valuable economic value.

MATERIAL AND METHODS

The present study was carried out during the three successive seasons of 2003, 2004 and 2005 (the first season was a preliminary season to determine the best concentration of each material under study) on “Le Conte” pear fruits to evaluate the effect of $CaCl_2$, Carbendazime, potassium permanganate, hot water and ethanol applications as a post-harvest treatments to keep pear quality under cold storage and during marketing for 3 days at room temperature.

In this study, Le Conte pear fruits were picked from trees about nine years old grown in clay loam soil and spaced at 5- meters apart under drip irrigation system in a EL-Gendy orchard at El-Khatatba city, Monifia, Governorate.

Le Cont pear fruits were harvested at approximately 135 to 147 days from full bloom, when the average of fruit firmness reached about 14-15 $lb/inch^2$ according to Swindeman (2002) and when soluble solids in fruits juice reached about 13-14 % .

Fruits were harvested from trees expected common horticultural practices, undamaged and free from any obvious pathogen infection, then transported to the Pomology Department, Faculty of Agriculture, Mansoura University.

At the beginning of the experiment, samples of 15 fruits were taken to determine the initial fruits properties.

For storage studies, all infected and damaged fruits were removed, then fruits were packed using ventilated plastic bags. All bags with fruits were weighted and every six bags were put in ventilated carton box (50×30×12)cm. The total number of boxes were 24 for all treatments, each treatment consists of 3 carton boxes, each box contains 6 ventilation plastic bags received one of the following treatments as shown from Table (1).

Table (1). The applied treatments used:

No.	Treatment used
1	Control (Dipping in tap water).
2	Dipping fruits for 5 minutes in CaCl2 solutions 2%.
3	Dipping fruits for 5 minutes in CaCl2 solutions 3%.
4	Dipping fruits for 5 minutes in Carbendazime solution at 750 ppm.
5	Dipping fruits for 5 minutes in Carbendazime solution at 1000 ppm.
6	Small packet, each content 20g potassium permanganate.
7	Dipping fruits for 5 minutes in hot water at 52 °C.
8	Fumigation with ethanol vapor at 100% for 30 minutes

Calcium chloride solutions:

Fruits were dipping in 2 and 3 % calcium chloride solution for 5 min.

Carbendazime solutions :

Carbendazime is Methyl benzimidazole -2- YI carbamate and it is light gray powder, sparsely soluble in water (5.8mg / liter at 20°C and pH 7) and most organic solvents. It is readily soluble in dimethyl form amide and stable in acid medium, but slowly decomposes in alkaline conditions with the formation of water- soluble salts, as well as it is compatible with most pesticides, contact, similar to benomyl in its fungicidal activity and not phytotoxic when sprayed on plants.

Potassium permanganate :

20 g potassium permanganate was placed into a glass in the center of each box at cold storage for 3 days during shelf - life.

Hot water socking:

The fruits were soaked in hot water at 52°C for 5 min.

Ethanol fumigation:

About 6 ml of ethanol (100 %) was put immediately in closed flask and injected through plastic tube into the chamber using small generator. Fumigation was carried out through 30 min. then the exhaust port was opened, the air tight seal broken to allow outside air into the chamber and the fan was turned to blow out any remaining gas.

Samples from each replicate were taken to study the effect of these treatments on fruit quality at harvest time to determine the initial properties.

After the treatments, carton boxes were taken and stored under cold storage at 0°C and 90-95% relative humidity (R.H) for 90 days. One carton box for each treatment was taken monthly intervals to determine loss in fruit weight, decay percentage and changes in fruit quality during cold storage using 3 plastic bags from each box , the other 3 plastic bags were left in each box and held 3 days at room temperature (as shelf - life) to present the changes in fruit properties during marketing after each period of cold storage. *The parameters were determined and analyzed as following:*

1-Total loss in fruit weight :
a- Weight loss percentage:

$$\text{Weight loss \%} = \frac{\text{Initial weight} - \text{weight at sampling date}}{\text{Initial fruit weight}} \times 100$$

b– Decay percentage :

$$\text{Decay \%} = \frac{\text{Weight of decayed fruits}}{\text{Initial fruit weight}} \times 100$$

c- Total loss in fruit weight percentage :

It was calculated by adding percentage of loss in fruit weight and decayed fruits as followed :

Total loss in weight % = loss in fruit weight % + decayed fruits %

2- Fruit firmness :

It was measured on 15 fruits for each treatment by using a hand Effegi- Penetrometers supplemented with a plunger 8 mm diameter and the average was estimated as Ib/inch². This plunger size reflects standard method for the respective (Harker *et al*., 1996).

3-Soluble solids content (SSC) /acid ratio :

4- Total carotenoid content :

Weight of 0.5 gm fresh skin fruits was ground by 10 ml methanol for 24 hr. under laboratory temperature after adding trace amount from sodium bicarbonate, then total carotenoid was determined by spectrophotometer at the wave length 452.5 nm according to the methods of Mackinny, (1941).

5- Marketing study :

Three replicates (each replicate one bag) in every carton box for each treatment was left at the end of each cold storage period , then held 3 days at room temperature conditions (as shelf - life) to study the effect of above mentioned treatments on fruit weight loss and decayed fruits percentage, then weighting damaged fruits to be calculated under room temperature conditions which determined by Thirmohydrograph as presented in the following table.

Table (2): Average temperature and relative humidity % during marketing :

Days	9/9	10/9	11/9	9/10	10/10	11/10	9/11	10/11	11/11
Temp.°c	30	30	29	28	27	27	25	24	23
R.H %	82	75	75	76	75	75	71	70	70

Sample of 10 fruits from each treatment were taken to determine the following parameters:
-Fruit firmness lb/inch².
-SSC / acid ratio .
-Total carotenoid (mg/100 gm fresh weight).

6-Statistical analysis :

Data of both seasons of the study were statistically analyzed by using complete randomized block design as described by Snedecor and Cochran, (1980). Differences among treatment means were compared by using the least significant differences test (LSD) at 5 % level of probability.

RESULTS AND DISCUSION

1-Total loss in fruit weight :

a- Weight loss percentage in pear fruits:

Data from Tables (3 and 4) reveal that, the loss in fruit weight increased as storage period advanced. All applied treatments reduced loss in fruit weight than the control. Since, the percent of loss in fruit weight at the untreated fruits was 3.4 % after 90 days of cold storage as mean of both seasons. Dipping pear fruits in $CaCl_2$ at 2 % significantly reduced the loss in fruit weight, since it averaged about 2.4 % as a mean of two seasons after 90 days of cold storage.

Table (3): Effect of post-harvest treatments on weight loss %, decay % and total loss % in "Le Conte" pear fruits after 90 days under cold storage seasons 2004 – 2005.

Treatments	weight Loss %		Decay %		Total loss %	
	2004	2005	2004	2005	2004	2005
Control	3.06	3.76	7.00	7.30	10.06	11.06
Calcium chloride at 2.0 %	2.33	2.43	6.60	6.00	8.93	8.43
Calcium chloride 3.0 %	2.86	2.46	4.10	4.60	6.96	7.06
Carbendazime at 750 PPm	2.53	2.70	3.20	3.00	5.73	5.70
Carbendazime at 1000 PPm	2.63	2.80	2.20	2.00	4.83	4.80
Potassium Permanganate at 20 g	2.73	2.86	4.50	4.70	7.23	7.56
Hot water at 52 °C	2.53	2.63	5.50	5.00	8.03	7.63
Ethanol at 100 %	2.66	3.03	5.90	6.00	8.56	9.03
L.S.D. at 5 %	**0.16**	**0.15**	**0.12**	**0.17**	**0.20**	**0.25**

In this respect, Raese (1997) reported that, calcium chloride application increased the concentration of Ca^{+2} and improved shelf - life by rising fruit firmness of Anjou pear fruits. Also, Kovacs *et al*. (1988) indicated that dipping pear fruits cv. Anjou in $CaCl_2$ under different storage period existing the cell membranes and middle lamella.

On the other hand, treated "Le Cont" pear fruits with ethanol at 100 % produced a higher percent of loss in fruit weight than the other treatments

used but less than control reached about 2.9 % as a mean of two seasons after 90 days during the storage.

Concerning, the effect on fruit weight loss 3 days during marketing after cold storage, the data show clearly that, the loss in fruit weight increased after 3 days during marketing at room temperature.
So, fruits stored for three months (90 days) and held 3 days at room temperature showed a higher loss in fruit weight than under cold storage.

Table (4): Effect of post-harvest treatments on weight loss %, decay % and total loss % in "Le Conte" pear fruits three days during marketing after 90 days of cold storage seasons 2004 – 2005.

Treatments	weight Loss %		Decay %		Total loss %	
	2004	2005	2004	2005	2004	2005
Control	4.40	4.03	49.03	47.96	53.43	52.00
Calcium chloride at 2.0 %	3.50	4.23	21.00	22.30	24.50	26.53
Calcium chloride 3.0 %	3.50	3.70	20.00	21.00	23.50	24.70
Carbendazime at 750 PPm	4.60	4.00	10.13	13.56	14.73	17.56
Carbendazime at 1000 PPm	4.20	4.70	14.40	13.80	18.60	18.50
Potassium Permanganate at 20 g	3.60	3.40	19.40	19.00	23.00	22.40
Hot water at 52 °C	3.70	3.60	29.20	29.03	32.90	32.63
Ethanol at 100 %	3.80	3.76	18.26	19.00	22.06	22.76
L.S.D. at 5 %	**0.15**	**0.17**	**0.14**	**0.13**	**0.20**	**0.25**

The data also reveal that, dipping fruits in potassium permanganate produced a lower loss in fruit weight which averaged about 3.5 % compared with the untreated fruits since it presented 4.2 % as mean of two seasons after 3 days through marketing.

Moreover, The weight loss from harvested horticultural crops is a major cause of deterioration in storage and results not only in loss in salable weight but also in less attractive produce of poorer texture and lowered quality.

This loss is due to the water loss, which is known as transpiration, while some weight loss is due to loss of carbon in respiration but this is only a minor part of the total. The high storage temperature causes a high respiration rate which lead to a fruit weight loss (Hardenburg *et al*., 1990)

b- Decay percentage:

It is clear from Tables 3 and 4 that, all treatments significantly reduced the percentage of decayed fruits than the untreated fruits either after 90 days of cold storage or 3 days during marketing at room temperature during both seasons. Yet, dipping "Le Cont" pear fruits in carbendazime at 750 and 1000 ppm significantly reduced decay percentage during storage period and after 90 days of cold storage than the other treatments used or the untreated fruits. Since, carbendazime application at 1000 ppm was more effective which presented 2.1 % decayed fruits while, fruits treated with carbendazime at 750 ppm recorded 3.1 % decayed fruits after 90 days of cold storage as mean of both seasons. Thus, the untreated fruits (control)presented 7.2 % decayed fruits as a mean of the two seasons.

Furthermore, calcium chloride at 3 % and potassium permanganate at 20 g applications reduced the percentage of decayed fruits since it averaged

4.4 and 4.6 % respectively, than those treated with hot water at 52 °C , ethanol at 100 % or the control.

In this respect, Conway *et al*. (1992) found that calcium applications are necessary to reduce decay significantly usually in higher than standard fertilization practices, but dipping fruits in CaCl2 solutions is more effective than others.

Knee and Hatfield (1981) found that potassium permanganate delayed ethylene accumulation in the storage atmosphere for 40 days with Golden Delicious and 200 days with Bramley's seedling apples stored at 4 °C in 5% CO2 and 3% O2. Ethylene removal retarded softening and alpha - farnesene accumulation, and scald affected only 0-33% of Bramley's seedling apples, compared with 85-100 % in controls without KMnO4.

The percent of decayed fruits were gradually increased as the storage period advanced. Yet, fruits treated with carbendazime gave a lower decayed percent than the other treatments used or the control since, the percent of decayed fruits due to use carbendazime at 750 ppm averaged 11.9 % and reached 14.1 % when treated with carbendazime at 1000 ppm as a mean of two seasons. These materials almost used to reduce fruit damaged and control decay caused by *Monilinia Laxa, M. Fructigena and Rizopus sp* (Aurang *et al*., 2000).

Additionally, ethanol at 100 % and potassium permanganate 20 g presented lower decayed fruits when held 3 days during marketing after 90 days of cold storage which ranged 18.63 % and 19.20 % as mean of both seasons respectively.

Lichter *et al*. (2002) showed that dipping table grapes in ethanol was previously shown to control bunch decay caused by *Botrytis cinerea*
and further studies were conducted in order to quaintly the effect of ethanol on the fungus. In the same line Samra (2004) fumigated Crimson seedless grape with 75 and 100 % ethanol vapor and found that both concentrations reduced cluster weight loss and berry decay than the control.

The untreated ones presented 48.5 % decayed fruits at the end of storage period as a mean of two seasons.

c- Total loss in weight percentage:

Total loss include loss in fruit weight and decay percentage are presented in Tables 3 and 4. It is clear that dipping “Le Cont” pear fruits in carbendazime solution at 750 and 1000 ppm significantly reduced the percentage of total loss in fruit weight in both seasons than the other treatments or the control. Since, carbendazime at 750 and 1000 ppm presented about 5.7 and 4.8 % decayed fruits after 90 days of cold storage, whereas the percent reached 16.2 and 18.6 % through out marketing 3 days at room temperature as mean of two seasons respectively.

Our data are similar with those mentioned by Sharma and Kaul (1997) reported that, pre-harvest sprays of carbendazime and captan were completely inhibited to fruit rotting and 100 % effective in controlling post-harvest fruit decay in storage up to 60 days and were also at par in controlling the cumulative rot for 90 days in apples.

Furthermore, $CaCl_2$ at 3 % reduced the percentage of total loss in fruit weight than the other treatments or the control after 90 days of cold storage

which ranged about 7.0 % as mean of both seasons. So, Kizil *et al*. (1991) found that the local practice for preparing Jonathan, Mantuaner, Golden Delicious, Starkrimson and Wellspur apple for storage after harvest and dipped for one minute in 4 % $CaCl_2$ solution, then dried and cold storage over several months. The treatment generally reduced storage losses by 6 – 7 %.

Aki *et al*. (1994) studied the effect of post-harvest dipping of Le Cont pear fruits on solutions of different calcium salts (chloride, nitrate, hydroxide and sulphate) at 0.0, 1.0, 2.0 and 3.0 % found that, increasing calcium salt concentration caused a gradual prolongation in shelf - life of fruits as well as reducing the percentage of fruit weight loss and decayed fruits. The best results with regard to prolonging the shelf - life on Le Cont pear fruits without on adverse effect on quality were obtained by dipping the fruits for 5 minutes in a solution of 2.5 $CaCl_2$ and storing them at 0°C.

In addition, ethanol at 100 % reduced the percentage of total loss in fruit weight than the other treatments or the control when held 3 days at room temperature after 90 days of cold storage which reached about 22.4 % as mean of both seasons. The reduce level of ethylene following ethanol treatment may be due to eliminate of ethylene producing microflora. Alternatively, the inhibitory effect of ethanol on ethylene production could be endogenous and similar to its effect on the ripening of climacteric fruits (Saltveit and Sharaf, 1992).

Moreover, the percentage of total loss in fruit weight was gradually increased during marketing than those obtained at cold storage and that is due to the increasing of loss in fruit weight and decayed fruits percentage. Since, the percent of total loss at the untreated fruits were about 10. 6 % after 90 days of cold storage but reached 52.7 % when held 3 days at room temperature at the same period as mean of both seasons.

2-Effect on firmness of pear fruits:

Data from Table 5 showed that, fruit firmness was reduced as storage period advanced and all treatments used significantly reduced the changes in fruit firmness than the control at cold storage or during marketing at room temperature in the two seasons. However, the reduction in fruit firmness was higher during marketing at room temperature than at cold storage.

Furthermore, treated fruits with $CaCl_2$ at 2 and 3 % produced a higher fruit firmness (10.2 and 9.9lb/inch^2) after 90 days of cold storage while, it ranged 5.3 and 5.4 lb/inch^2 when held 3 days at room temperature as a mean of the two seasons respectively.

In this respect, Mkrtchyan *et al*. (1989) reported that calcium appears to delay softening and this could be explained by delaying degradation of cell wall polymers. Pre-harvest calcium sprays inhibit the hydrolysis of pectic substances and delay protection degradation. The increase in protopectin stability delays the occurrence of over ripening and improves storability.

Bantash and Arasimovich (1989) treated Richord Delicious and Jonathan apple, with 4 % aqueous solution of $CaCl_2$ after picking and held at 18 – 20 °C for 12 days. They found that the exogenous calcium was incorporated into protopectin molecular in the middle membrane, and retarded hydrolysis during post-harvest ripening.

Table (5): Effect of post-harvest treatment on firmness (lb/inch²) in "Le Conte" pear fruits after 90 days under cold storage and three days during marketing at room temperature seasons 2004 – 2005.

Treatments	Cold storage				3 days during marketing			
	Season 2004		Season 2005		Season 2004		Season 2005	
	Storage period in days							
	0	90	0	90	0	90	0	90
Control	13.13	8.30	13.70	8.26	13.13	4.16	13.70	4.56
Calcium chloride at 2.0 %	13.13	10.20	13.70	10.10	13.13	5.26	13.70	5.30
Calcium chloride 3.0 %	13.13	9.60	13.70	10.16	13.13	5.30	13.70	5.53
Carbendazime at 750 PPm	13.13	9.40	13.70	9.10	13.13	5.00	13.70	4.90
Carbendazime at 1000 PPm	13.13	9.83	13.70	9.46	13.13	4.56	13.70	4.86
Potassium Permanganate at 20 g	13.13	8.76	13.70	8.56	13.13	4.23	13.70	4.60
Hot water at 52 °C	13.13	9.10	13.70	9.60	13.13	4.16	13.70	4.36
Ethanol at 100 %	13.13	9.33	13.70	9.83	13.13	4.10	13.70	4.33
L.S.D. at 5 %	-	0.15	-	0.16	-	0.22	-	0.20

Also, Raese (1997) reported that, calcium chloride increased Ca^{+2} concentration in d´ Anjou fruits and improved shelf - life by increasing fruit firmness. Fruits held longer in cold storage (145 days) had higher concentrations of Ca +2 , lower soluble solids sucrose, glucose and fructose and were less firm and had less acid than those in short term storage (45 days).

Fruit firmness decreased with the progress of the storage time at all temperature used. The decrease of firmness could be a result of changes of insoluble carbohydrates (protopectin, cellulose and hemicelluloses) to simple carbohydrates like pectin. Fruit weight loss increased with the progress of storage time (Abd EL- Magid, 1986).

3-Effect on SSC/ acid ratio in juice of pear fruits:

Considering to the effect on SSC/acid ratio, data in Table 6 reveal that, SSC / acid ratio was gradually increased during storage period advanced from harvest till 90 days either at cold storage or during marketing at room temperature. The increment in SSC/acid ratio during the storage period mainly due to the increase of SSC content with the reduction in total acidity in fruit juice with the storage period advanced.

Ethanol at 100% gave a higher significance SSC/ acid ratio than all treatments used after 90 days of cold storage since it averaged about 64.8 % as mean of both seasons. That is in the same line with Xiaomet *et al*., (1998) reported that, SSC percentage in Nangouli" pear fruits was increased initially during storage at 0°C with using ethanol treatments as an anti pathogen.

Yet, carbendazime application at 750 ppm gave a somewhat increment in SSC / acid ratio in fruit juice. While, calcium treatments produced a lower values of SSC / acid ratio during the both seasons under the study.

Table (6): Effect of post-harvest treatment on SSC / acid ratio % in "Le Conte" pear fruits after 90 days under cold storage and three days during marketing at room temperature seasons 2004 – 2005.

Treatments	Cold storage				3 days during marketing			
	Season 2004		Season 2005		Season 2004		Season 2005	
	Storage period in days							
	0	90	0	90	0	90	0	90
Control	49.05	62.11	50.41	62.98	49.05	61.99	50.41	62.30
Calcium chloride at 2.0 %	49.05	61.20	50.41	61.95	49.05	59.21	50.41	63.29
Calcium chloride 3.0 %	49.05	61.02	50.41	60.17	49.05	60.66	50.41	63.00
Carbendazime at 750 PPm	49.05	63.00	50.41	63.09	49.05	62.50	50.41	63.04
Carbendazime at 1000 PPm	49.05	62.34	50.41	60.25	49.05	61.57	50.41	60.50
Potassium Permanganate at 20 g	49.05	60.34	50.41	63.52	49.05	62.05	50.41	65.02
Hot water at 52 °C	49.05	61.80	50.41	63.00	49.05	61.70	50.41	64.01
Ethanol at 100 %	49.05	65.02	50.41	64.50	49.05	61.40	50.41	60.96
L.S.D. at 5 %	-	1.00	-	0.89	-	0.86	-	1.03

4-Effect on total carotenoids content of pear fruits:

It is clear from Table 7 that, carotenoids content in pear fruits increased with storage period advanced from harvest till 90 days at cold storage and during marketing at room temperature. Yet, the values of total carotenoid during marketing were higher than those obtained at cold storage during the both seasons of study.

Table (7): Effect of post-harvest treatment on total carotenoids (mg / 100g fresh weight) in "Le Conte" pear fruits after 90 days under cold storage and three days during marketing at room temperature seasons 2004 – 2005.

Treatments	Cold storage				3 days during marketing			
	Season 2004		Season 2005		Season 2004		Season 2005	
	Storage period in days							
	0	90	0	90	0	90	0	90
Control	0.831	0.876	0.825	0.869	0.831	0.889	0.825	0.881
Calcium chloride at 2.0 %	0.831	0.899	0.825	0.890	0.831	0.904	0.825	0.900
Calcium chloride 3.0 %	0.831	0.896	0.825	0.895	0.831	0.908	0.825	0.899
Carbendazime at 750 PPm	0.831	0.903	0.825	0.893	0.831	0.918	0.825	0.904
Carbendazime at 1000 PPm	0.831	0.909	0.825	0.900	0.831	0.920	0.825	0.904
Potassium Permanganate at 20 g	0.831	0.911	0.825	0.999	0.831	0.921	0.825	0.909
Hot water at 52 °C	0.831	0.910	0.825	0.902	0.831	0.929	0.825	0.912
Ethanol at 100 %	0.831	0.903	0.825	0.898	0.831	0.928	0.825	0.918
L.S.D. at 5 %	-	0.002	-	0.002	-	0.002	-	0.002

In this respect, potassium permanganate gave a somewhat increment since it averaged about 0.955 mg/100g fresh weight while, the control reached about 0.873 mg/100g fresh weight after 90 days of cold storage as means of both seasons under the study.

Furthermore, vapour with ethanol at 100 % after 3 days during marketing increased the total carotenoids averaged 0.923 mg/100g fresh weight than the other treatments used or the untreated fruits which presented 0.885 mg/100g fresh weight as mean of both seasons. Since, Simon (1997) found that, carotenoid are protect the chlorophyll from photo-oxidation and are accessory, light harvesting pigments and photoreceptors.

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دراسات على تخزين ثمار الكمثرى صنف الليكونت

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أجريت هذه الدراسة خلال أعوام ٢٠٠٣- ٢٠٠٤-٢٠٠٥ لتقييم استخدام ،كلوريد الكالسيوم،كاربندازيم, برمنجنات البوتاسيوم, الماء الساخن والايثانول كمعاملات ما بعد الحصاد على صفات ثمار الكمثرى الليكونت وقدرتها التخزينيه أثناء التخزين البارد على ± ١ م° وكذلك خلال التسويق على درجه حرارة الغرفة بعد ٣ أيام من التخزين البارد.

أوضحت النتائج أن نقع ثمار كمثرى الليكونت فى محلول كلوريد الكالسيوم ٢ أو ٣ % أدى لخفض النسبة المئوية للفقد فى الوزن مع احتفاظ الثمار بصلابتها لفترة أطول. بينما استخدام كاربندازيم سواء ٧٥٠ أو ١٠٠٠ جزء فى المليون ساعد على خفض نسبه الثمار التالفة و تقليل معدل الفقد الكلى فى الوزن.

فى حين أن التبخير بالايثانول بتركيز ١٠٠ % أدى لزيادة محتوى عصير الثمار من المواد الصلبه الذائبة و نسبه المواد الصلبه الذائبة للحموضة الكلية وكذلك محتواها من صبغه الكاروتين بعد ٣ أيام من التخزين البارد لكن أدى لخفض الحموضة الكلية أثناء التخزين البارد.

كما أن نقع الثمار فى برمنجنات البوتاسيوم ساعد فى المحافظة على محتواها من صبغه الكاروتين لفترة أطول مع خفض الحموضة الكلية أثناء التداول. بينما نقع الثمار فى الماء الساخن على ٥٢ م° أدى لزيادة محتوى عصير الثمار من المواد الصلبه الذائبة للحموضة الكلية مما ساعد على أطاله الفترة التسويقية لثمار الكمثرى بالأسواق.