Postharvest Ca and cold storage treatments in relation to storability, marketability and consumer acceptance of seedless guava fruits.

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Abstract: Sound and uniformly mature seedless guava fruits were divided into three groups the first one dipped in 2, 3, 4 % $CaCl_2$, dissolved in cold water at 5 °C, for 5 minutes and the second group with the same concentrations of $CaCl_2$, dissolved in hot water at 40 °C, for 5 minutes and the third group untreated fruits as a control. The three groups stored at 8 °C and 85-90 % RH. Ca^{+2} treatments prolonged the storage period, maintained fruit quality and had the highest initial content of Ca^{+2} and V.C, significantly maintained fruit firmness and improved marketability of fruit compared to control treatment.

Keywords: Guava- Postharvest treatments- Cold storage- Consumer acceptance.

INTRODUCTION

Guava is considered one of the most popular fruits, having a high nutritive value, widely studied for its medical benefits. It has been characterized as a very perishable fruit, which completes its ripening processes in a few days after harvest at ambient temperature (or which having a short shelf life after harvest).

Harvesting at maturity stage is the first step for good handling, long storage life and maintaining fruit quality El- Khoreiby *et al.*, 2005. Guava harvested at the mature green stage had a long shelf life about six days, maintained marketable quality and gave the best results with fruit quality (Gonzaga-Neto, 1999 and Gutierrez-Alonso *et al.*, 2002).

Firmness in seedless guava fruit is considered the most important quality parameter. Ca^{+2} has been applied to many fresh fruits to delay ripening and maintaining fruit quality by its cementing effect on cell wall and saving its structure (Poovaiah and Leopoid, 1973). Ca^{+2} has a complementary role with harvest stage and storage temperature in metabolism of fresh fruits.

Pre and postharvest treatments with Ca^{+2} increase Ca^{+2} content in the skin and flesh of guava fruit cv. Kumagai Carvalho *et al.*, 1998; El-Dengawy 2004 with seedy guava fruit and El-Naggar *et al.*, 2005 in mature green seedless guava fruit. There is a positive relation between Ca^{+2} content and fruit firmness postharvest Ca^{+2} treatments significantly increase fruit firmness and delay the softening El-Dengawy 2004 and El-Naggar *et al.*, 2005. the role of Ca^{+2} with storage temperature in regulating respiration and other metabolic processes affected in reducing the loss in guava fruit weight and maintained its chemical compositions. SSC (soluble solids content) acidity (citric acid) and vitamin C (ascorbic acid) contents are significantly higher during the storage life Raychaudharyh *et al.*, 1992; Chandra *et al.*, 1994; El-Dengawy 2004 and El-Naggar *et al.*, 2005.

Thus, the goals of the present trail is to find the most effective postharvest Ca^{+2} treatment for achieving the maximum quality of guava fruit and to know the effect of Ca^{+2} treatments and the following storage temperature on physical and chemical characteristics of seedless guava fruit.

MATERIALS AND METHODS

This study was carried out in the two successive seasons of 2004 & 2005, mature seedless guava fruits were picked from a private orchard in Ismailia governorate, then transported immediately to postharvest laboratory in Horticulture Department Faculty of Agriculture Suez Canal University. The sound fruits were washed and air dried then divided into three groups each of 180 fruits and packed in 20 foam plate put in perforated polyethylene pages.

The first group dipped in 2, 3, 4 % $CaCl_2$, dissolved in cold water at 5 °C, for 5 minutes as a precooling treatment and the second group with the same concentrations of $CaCl_2$, dissolved in hot water at 40 °C for 5 minutes Majumdar *et al.* (1991) and the third group untreated fruits as a control treatment.

The three groups were stored at 8 °C and 85–90 % RH. Zhang-FuPing *et al.* (2003). For every treatment, the fruits of 5 plates were labeled for the assessment of storage life, decay and physical characteristics, another 7 plates were specified for taste experiment. The last 8 plates were used for chemical analysis and marketability.

Ca^{+2} content :- Was determined in guava fruit samples (10 fruit) about 20 g of fresh weight from skin and flesh of fruits, were taken and dried at 70 °C then ground to a fine powder. A sample of 0.5 g was digested by sulphuric acid and Hydrogen peroxide. The solution was completed to total volume of 100 ml. flame photometer was used according to Brown and Lilleland. (1946).

Weight loss percentage: Labeled fruits were weighted individually at each sampling time (5 days) intervals up to 20 days. Weight loss was expressed as a percentage of the original fresh weight of the fruits. The percentage was calculated for each treatment.

The following equation was used:-

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

Fruit firmness: It was measured on the two opposite sides of guava fruit samples (8 fruits) by using a hand Magness Taylor pressure tester (lb/in^2).

Soluble solids content (SSC): It was measured in fruit juice by using ATTAGO hand refractometer at 20 °C and expressed as percent.

Titratable acidity: It was determined in fruit juice by using 0.1 NaOH in the presence of phenolphthalein until pH 8.0 and expressed as citric acid percent.

Vitamin C: It was determined in juice as mg Ascorbic acid/100 ml fruit juice by titration with 2,6 dichlorophenol- indophenol solution in the presence of oxalic acid solution (AOAC, 1980).

Decay % was recorded during cold storage period as browning of surface appearance. In every inspection, the number of decayed fruits per replicate was recorded to express fruit decay.

Storage was stopped when fruit firmness reached the average of less than 3 lb/in^2.

Marketability: At the end of storage period about 20 fruit from every treatment placed in a ripening chamber at (20 °C ± 1) and 65 % RH for 4 days to assess fruit ripeness as well as ensuring its quality.

Taste experiments: consumer acceptance of fruits after cold storage is very important to assess the success of storage. For this test, about 30 consumers were presented 60 guava fruit samples from each treatment after market period. Each consumer was presented 2 guava fruits from every treatment the taste of fruit was determined by giving a numerical values as follows: like slightly = 1, like moderately = 2 and like extremely = 3, as a degree of liking the number of fruit per each category was assessed. Acceptance percentage was calculated as the number of fruit in like extremely category in relation to the total number of fruit.

The following equation was used:

$$\text{Acceptance \%} = \frac{\text{No. of fruits per each degree of fruits}}{\text{Total No. of fruits in each treatment}} \times 100$$

Statistical analysis: Data were statistically analyzed according to Sendecor and Cochran (1980). Means were compared by "Multiple Range Test" Duncan (1955) at 5 % level by using Co stat programme.

RESULTS AND DISCUSSION

Ca^{+2} treatments significantly increased Ca^{+2} contents in guava fruits and the higher significant content was recorded for the treatment of $CaCl_2$ 4 % in hot water 40°C, the increasing rates were 15.5 and 15.4 g / 100g dry weight in both seasons, respectively (Table 1). This increment in Ca^{+2} content might explain the higher firmness of the treated fruit specially with Ca^{+2} treatments with cold water. These findings came in agreement with those reported by Bhatt *et al.* (1993) who found the high concentrations of Ca^{+2} with pear fruits, Carvalho *et al.* (1998) with Kumagai guava fruit, El-Saedy, (2000) on peach, El-Dengawy (2004) and El-Naggar *et al.* (2005).

Concerning the effect of $CaCl_2$ treatments and cold storage at 8 °C on weight loss of guava fruits, all $CaCl_2$ treatments reduced fruit weight loss. The best results were obtained for the $CaCl_2$ 3, 4 % in cold water 5 °C (Table 2) up to the end of storage period. It is clear from table (2) that weight loss was slightly happened during the first 10 days and the less percentages were concomitant to $CaCl_2$ in cold water at 3, 4 % while, $CaCl_2$ at 2 % in hot water and control treatments were significantly higher and the percentages were (5.3, 5.2) and (5.1, 5.1) in both seasons, respectively. Weight loss is a result of water loss from fruit tissues and respiration process. It is obvious that fruit weight loss of all treatments increased with advancing storage period. Ca^{+2} is might to enhance membrane stability and is most reasonable to speculate that with suboptimal Ca^{+2}, more rapid penetration of mitochondrial membrane by metabolic process leads to accelerated decarboxylation rates Singh and Singh, 1988 on Allahabad Safeda guava, Raychaudharyi *et al.*, 1992 on L-49 guava; El-Saedy, (2000), El-Naggar *et al.*, 2005 on seedless guava fruits.

In the present study, all $CaCl_2$ treatments increased Ca^{+2} content in the fruit and this might explain the higher firmness of treated fruits. The effect of Ca^{+2} on firmness is believed to be related to the tight bending of Ca^{+2} ions in the cell wall resulting in immediate rigidity of the wall. Pectins are composed of polygalacturonic acid residues in a chain with rhamnose interspersed in the chain. Bhatt *et al.*, 1993, Choi and Lee, 1993 and El-Naggar *et al.* (2005). Ca^{+2} treatments may delay galactolipids breakdown, increase the rate of sterol conjugation and thus affect membrane organization and function during the postharvest life of fruit Picchioni *et al.* (1995). It is clear from table (3) that the higher firmness values were obtained with $CaCl_2$ in cold water till the end of storage period in both seasons, respectively. The decrease of fruit firmness is due mainly to decomposition enzymatic degradation of insoluble protopectin to more simple soluble pectin solubilization of cell wall contents as a result of an increase in pectinesterase activity, and subsequent development of juiciness and the loss in fruit hardness Picchioni *et al.* (1995), El-Saedy, (2000) on peach and El-Naggar *et al.* (2005).

$CaCl_2$ at 3, 4 % in cold water 5 °C were significant for increasing fruits SSC in the two seasons, respectively up to the end of storage period, table (4). However, different Calcium treatments increased fruit SSC. These increments are due to the role of Ca^{+2} in regulating the respiration and other metabolic processes in the maturity fruits. Chandra *et al.*, 1994 El-Saedy, (2000) on peach and El-Naggar *et al.* (2005) on guava. It is clear from table (4) that control treatment had lower values of SSC all along the storage period in the two seasons, respectively. This is may due to acceleration of senescence in untreated fruits.

Fruit acidity showed a gradual decrease with the progress of storage period in all treatments in the two seasons, respectively. It is obvious from table (5) that treatments of $CaCl_2$ at 2, 3, 4 % in cold water followed by cold storage at 8 °C which are significantly higher in acidity percentages till 5 days of storage. After that, no significant difference between all $CaCl_2$ treatments in acidity percentages, but untreated fruits had the least percentages of citric acid till the end of storage period in

the two seasons, respectively. In treated fruits, Ca^{+2} retarded the metabolic process respiration and as a result, the fruits contained more citric acid as a respiratory substance. Raychaudharyi *et al.*, 1992 on L-49 guava ; Chandra *et al.*, 1994, El-Saedy, (2000) and El-Naggar *et al.* (2005). Citric acid might be used as an organic substrate in the respiration process Chandra *et al.* (1994), Zaghloul, (1997) on seedy guava; Bashir and Abu Goukh, 2002 and El-Naggar *et al.* (2005).

In both seasons Vitamin C decreased with the progress period in all treatments. Generally, the fruits which treated with $CaCl_2$ at 2, 3, 4 % in cold water followed by cold storage at 8 °C contained higher significant percentages of V.C than $CaCl_2$ in hot water and control treated fruits (Table 6). The decrease of V.C is due to the rapid conversion of L-ascorbic acid into dihydro-ascorbic acid in the presence of L-ascorbic acid oxidase Bashir and Abu Goukh, 2002 and El-Naggar *et al.* (2005).

Considering the effect of $CaCl_2$ treatments followed by duration of cold storage on decay percentage of seedless guava fruits, all Ca^{+2} treatments prevented decay in both seasons till the end of storage period. Decay percentage was 16 % in untreated fruit.

Marketability of seedless guava fruit has been evaluated as a function of the different fruit quality parameters after cold storage at 8 °C. The parameters were weight loss, firmness, SSC (soluble solids content), acidity and vitamin C.

As for weight loss, it is clear from table (7) that stored seedless guava fruits showed an increment in physiological weight loss in all treatments. Untreated fruits gave the highest percentages of weight loss and the $CaCl_2$ at 4 % in cold water had the least percentages in the two seasons, respectively.

The data presented in table (7) pertaining, fruit firmness sharply decreased at 20 °C in treated fruits with $CaCl_2$ at 2, 3, 4 % in hot water and untreated fruits.

But, $CaCl_2$ at 2, 3, 4 % in cold water treatments maintained fruit firmness at range of (3.3- 3.2- 3.6) & (3.2- 3.3 –3.6) lb/in^2 in the two seasons, respectively. This shows that $CaCl_2$ 2, 3, 4 % in cold water followed by cold storage at 8 °C and market period at 20 °C was suitable for maintaining guava fruit quality because the fruits were still firm at the end of ripening process.

Concerning soluble solids content (SSC) after ripening at 20 °C, data presented in (Table 7) showed that SSC, in all Ca^{+2} treatments slightly increased and significantly higher than untreated fruits in the two seasons, respectively.

It is clear from table (7) that there was a slight decrease in titratable acidity during ripening process. No significant difference between all treatments in acidity percentages, it was ranged between (0.2– 0.3 %) mg/100ml fruit juice.

Concerning ascorbic acid level. it is almost steady in all treatments, except $CaCl_2$ at 2 % in hot water which showed less significant averages and the highest significant averages were obtained in $CaCl_2$ at 2, 3, 4 % in cold water treatments (Table 7).

Concerning the effect of $CaCl_2$ treatment and cold storage at 8 °C on consumer acceptance percentage of guava fruits after market period at 20 °C showed that the best percentages were in fruit treated with $CaCl_2$ 2, 3, 4 % dissolved in cold water at 5 °C. The percentages ranged from 90– 95 % (Table 8). Thus, the fruits had a very good taste, texture flavor and overall acceptance.

Generally, it can be safely concluded that Ca^{+2} dipping treatments in cold water treatment followed by cold storage at 8 °C seems to be promising for shipping guava fruits to distant markets which may take about 2-3 weeks without any decay and had the highest acceptance from consumers, In addition, that 20 °C is suitable for ripening and maintaining quality of stored guava fruits.

Table (1): *Ca content (%) in seedless guava fruit as affected by $CaCl_2$ postharvest treatments during 2004 & 2005 seasons.

Treatments	Season 2004	Season 2005
$CaCl_2$ in hot water		
2%	13.9^{e}	13.9^{e}
3%	14.7^{c}	14.7^{c}
4%	15.4^{a}	15.5^{a}
$CaCl_2$ in cold water		
2%	13.6^{f}	13.6^{f}
3%	14.3^{d}	14.4^{d}
4%	15.1^{b}	15.2^{b}
control	9.3 g	9.2 g

Values followed by the same letter in each column are not significantly different at 5% level.
* g / 100 g dry weight

Table (2): Effect of postharvest $CaCl_2$ and cold storage treatments on weight loss (%) of seedless guava fruit during 2004 & 2005 seasons.

Treatments	Storage period in days				
	0 Fruit weight (g)	5	10	15	20
Season 2004					
$CaCl_2$ in hot water					
2%	167.0	2.4 ^{a}	3.5 ^{a}	4.8 ^{a}	6.6 ^{a}
3%	176.0	2.1 ^{b}	2.5 ^{b}	3.4 ^{c}	6.1 ^{b}
4%	165.5	2.0 ^{b}	2.6 ^{b}	3.2 ^{c}	5.9 ^{b}
$CaCl_2$ in cold water					
2%	160.8	2.0 ^{b}	2.6 ^{b}	3.3 ^{c}	5.5 ^{c}
3%	170.0	1.1 ^{c}	2.0 ^{c}	2.8 ^{d}	5.3 ^{cd}
4%	164.5	1.0 ^{c}	2.0 ^{c}	2.7 ^{d}	5.2 ^{d}
Control	169.7	2.5 ^{a}	3.3 ^{a}	4.3 ^{b}	6.7 ^{a}
Season 2005					
$CaCl_2$ in hot water					
2%	175.7	2.5 ^{a}	3.6 ^{a}	5.1 ^{a}	6.7 ^{a}
3%	167.6	2.0 ^{b}	2.5 ^{c}	3.3 ^{c}	6.0 ^{b}
4%	163.9	1.9 ^{b}	2.5 ^{c}	3.4 ^{c}	6.1 ^{b}
$CaCl_2$ in cold water					
2%	170.9	2.1 ^{b}	2.8 ^{b}	3.2 ^{c}	5.8 ^{b}
3%	173.2	1.1 ^{c}	2.0 ^{d}	2.6 ^{d}	5.1 ^{d}
4%	177.2	1.0 ^{c}	1.9 ^{d}	2.5 ^{d}	5.1 ^{d}
Control	173.5	2.6 ^{a}	3.6 ^{a}	4.3 ^{b}	7.0 ^{a}

Values followed by the same letter in each column are not significantly different at 5% level.

Table (3): Effect of $CaCl_2$ and cold storage treatments on firmness (lb/in^2) of seedless guava fruit during 2004 & 2005 seasons.

Treatments	Storage period in days				
	0	5	10	15	20
Season 2004					
$CaCl_2$ in hot water					
2%	7.7 ^{a}	5.4 ^{d}	3.8 ^{c}	2.3 ^{d}	1.1 ^{c}
3%	7.3 ^{a}	6.0 ^{c}	5.2 ^{b}	3.3 ^{c}	1.2 ^{c}
4%	7.1 ^{a}	6.5 ^{bc}	5.3 ^{b}	3.6 ^{bc}	1.6 ^{b}
$CaCl_2$ in cold water					
2%	7.5 ^{a}	6.8 ^{ab}	5.8 ^{a}	3.9 ^{ab}	1.8 ^{a}
3%	7.3 ^{a}	7.1 ^{a}	5.9 ^{a}	4.1 ^{ab}	1.9 ^{a}
4%	7.6 ^{a}	7.2 ^{a}	6.1 ^{a}	4.3 ^{a}	1.9 ^{a}
Control	7.1 ^{a}	5.3 ^{d}	3.4 ^{c}	1.9 ^{d}	1.0 ^{c}
Season 2005					
$CaCl_2$ in hot water					
2%	7.4 ^{a}	5.2 ^{c}	3.1 ^{c}	1.9 ^{c}	1.1 ^{c}
3%	7.7 ^{a}	6.4 ^{b}	5.1 ^{b}	3.1 ^{b}	1.1 ^{c}
4%	7.6 ^{a}	6.6 ^{b}	5.2 ^{b}	3.3 ^{b}	1.5 ^{b}
$CaCl_2$ in cold water					
2%	7.7 ^{a}	6.9 ^{a}	5.7 ^{a}	3.5 ^{b}	1.8 ^{a}
3%	7.4 ^{a}	7.0 ^{a}	5.8 ^{a}	4.3 ^{a}	1.9 ^{a}
4%	7.5 ^{a}	7.1 ^{a}	5.9 ^{a}	4.3 ^{a}	2.0 ^{a}
Control	7.3 ^{a}	5.1 ^{c}	3.0 ^{c}	2.0 ^{c}	0.9 ^{c}

Values followed by the same letter in each column are not significantly different at 5% level.

Table (4): Effect of $CaCl_2$ postharvest treatments and cold storage on SSC of seedless guava fruit during 2004 & 2005 seasons.

Treatments	Storage period in days				
	0	5	10	15	20
Season 2004					
$CaCl_2$ in hot water					
2%	8.6 [a]	9.0 [b]	9.6 [bc]	10.3 [ab]	10.6 [a]
3%	8.8 [a]	9.2 [b]	10.4 [ab]	10.4 [ab]	10.8 [a]
4%	8.2 [a]	9.1 [b]	10.2 [ab]	10.4 [ab]	10.1 [a]
$CaCl_2$ in cold water					
2%	9.8 [a]	10.2 [a]	10.4 [ab]	10.6 [ab]	10.3 [a]
3%	9.2 [a]	10.0 [a]	11.2 [a]	11.1 [a]	10.2 [a]
4%	9.0 [a]	10.0 [a]	11.0 [a]	10.8 [a]	10.2 [a]
Control	9.8 [a]	8.9 [c]	8.7 [c]	9.6 [b]	8.9 [b]
Season 2005					
$CaCl_2$ in hot water					
2%	9.0 [a]	9.0 [b]	9.8 [bc]	10.1 [b]	10.9 [a]
3%	9.4 [a]	9.3 [b]	10.2 [ab]	10.4 [ab]	10.6 [a]
4%	8.9 [a]	9.1 [b]	10.5 [ab]	10.4 [ab]	10.5 [a]
$CaCl_2$ in cold water					
2%	9.2 [a]	10.0 [a]	10.6 [ab]	10.5 [ab]	10.4 [a]
3%	9.5 [a]	10.2 [a]	10.8 [a]	11.0 [a]	10.4 [a]
4%	9.8 [a]	10.1 [a]	10.7 [a]	10.9 [a]	10.6 [a]
Control	10.0 [a]	8.4 [c]	9.3 [c]	9.2 [c]	8.8 [b]

Values followed by the same letter in each column are not significantly different at 5% level.

Table (5): Effect of $CaCl_2$ postharvest treatments and cold storage on V.C* (%) of seedless guava fruit during 2004 & 2005 seasons.

Treatments	Storage period in days				
	0	5	10	15	20
Season 2004					
$CaCl_2$ in hot water					
2%	177 [a]	155.7 [b]	150.0 [b]	137.7 [c]	133.0 [b]
3%	173 [a]	160.0 [b]	151.3 [b]	141.3 [bc]	133.0 [b]
4%	176 [a]	158.7 [b]	147.3 [b]	137.7 [c]	132.7 [b]
$CaCl_2$ in cold water					
2%	170 [a]	171.7 [a]	160.3 [a]	154.7 [a]	140.3 [a]
3%	172 [a]	172.3 [a]	163.6 [a]	156.3 [a]	142.0 [a]
4%	173 [a]	173.3 [a]	161.1 [a]	154.0 [a]	141.0 [a]
Control	171 [a]	170.0 [a]	62.0 [a]	146.0 [b]	136.0 [b]
Season 2005					
$CaCl_2$ in hot water					
2%	174 [a]	155.0 [b]	148.0 [b]	137.3 [c]	134.0 [b]
3%	177 [a]	155.7 [b]	151.0 [b]	142.0 [bc]	133.3 [b]
4%	170 [a]	157.3 [b]	150.3 [b]	138.0 [c]	132.7 [b]
$CaCl_2$ in cold water					
2%	172 [a]	171.7 [a]	161.3 [a]	155.0 [a]	140.7 [a]
3%	171 [a]	173.7 [a]	163.0 [a]	154.7 [a]	140.3 [a]
4%	177 [a]	173.7 [a]	163.3 [a]	155.3 [a]	141.0 [a]
Control	173 [a]	171.3 [a]	160.0 [a]	146.2 [b]	135.0 [b]

Values followed by the same letter in each column are not significantly different at 5% level.
* mg/100 ml juice

Table (6): Effect of $CaCl_2$ postharvest treatments and cold storage on acidity (%) of seedless guava fruit during 2004 & 2005 seasons.

Treatments	Storage period in days				
	0	5	10	15	20
Season 2004					
$CaCl_2$ in hot water					
2%	0.63 [a]	0.48 [b]	0.40 [a]	0.32 [a]	0.30 [a]
3%	0.65 [a]	0.46 [b]	0.38 [a]	0.29 [a]	0.29 [a]
4%	0.62 [a]	0.47 [b]	0.38 [a]	0.31 [a]	0.30 [a]
$CaCl_2$ in cold water					
2%	0.65 [a]	0.54 [a]	0.38 [a]	0.30 [a]	0.30 [a]
3%	0.63 [a]	0.53 [a]	0.39 [a]	0.29 [a]	0.28 [a]
4%	0.62 [a]	0.54 [a]	0.40 [a]	0.31 [a]	0.28 [a]
Control	0.65 [a]	0.43 [c]	0.27 [b]	0.20 [b]	0.17 [b]
Season 2005					
$CaCl_2$ in hot water					
2%	0.64 [a]	0.47 [b]	0.39 [a]	0.30 [a]	0.30 [a]
3%	0.62 [a]	0.48 [b]	0.40 [a]	0.28 [a]	0.29 [a]
4%	0.65 [a]	0.47 [b]	0.40 [a]	0.30 [a]	0.30 [a]
$CaCl_2$ in cold water					
2%	0.66 [a]	0.51 [a]	0.39 [a]	0.29 [a]	0.29 [a]
3%	0.64 [a]	0.53 [a]	0.40 [a]	0.30 [a]	0.30 [a]
4%	0.62 [a]	0.53 [a]	0.39 [a]	0.28 [a]	0.28 [a]
Control	0.64 [a]	0.41 [c]	0.26 [b]	0.19 [b]	0.15 [b]

Values followed by the same letter in each column are not significantly different at 5% level.

Table (7): Physical and chemical characteristics of seedless guava fruits as affected by $CaCl_2$ treatments and cold storage for 20 days and placing for 4 days at 20 °C for determined fruit ripeness and marketability during 2004 & 2005 seasons.

Treatments	Weight loss %	Firmness lb/in^2	SSC	*V.C	*Acidity %
Season 2004					
$CaCl_2$ in hot water					
2%	8.6 [b]	1.8 [c]	10.4 [c]	130.0 [c]	0.2 [a]
3%	8.2 [bc]	2.2 [bc]	10.6 [bc]	133.5 [bc]	0.3 [a]
4%	8.0 [cd]	2.5 [b]	10.8 [abc]	135.3 [abc]	0.2 [a]
$CaCl_2$ in cold water					
2%	8.1 [c]	3.3 [a]	11.0 [ab]	140.5 [ab]	0.2 [a]
3%	8.0 [cd]	3.2 [a]	11.0 [ab]	138.0 [ab]	0.2 [a]
4%	7.5 [d]	3.6 [a]	11.2 [a]	142.2 [a]	0.3 [a]
Control	9.2 [a]	1.1 [d]	9.2 [d]	133.6 [bc]	0.2 [a]
Season 2005					
$CaCl_2$ in hot water					
2%	8.6 [b]	2.1 [d]	10.6 [c]	132.0 [b]	0.2 [a]
3%	8.3 [bc]	2.6 [c]	10.8 [bc]	134.6 [ab]	0.3 [a]
4%	8.0 [bc]	2.8 [bc]	10.8 [bc]	135.3 [ab]	0.3 [a]
$CaCl_2$ in cold water					
2%	8.3 [bc]	3.2 [ab]	11.0 [abc]	138.6 [ab]	0.2 [a]
3%	8.0 [bc]	3.3 [a]	11.2 [ab]	140.3 [a]	0.3 [a]
4%	7.6 [c]	3.6 [a]	11.4 [a]	140.6 [a]	0.3 [a]
Control	9.6 [a]	0.9 [e]	9.4 [d]	134.0 [ab]	0.2 [a]

Values followed by the same letter (s) in each column are not significantly different at 5% level.
* mg/100ml fruit juice

Table (8): Effect of $CaCl_2$ postharvest treatments and cold storage followed by market period for 4 days at 20 °C on consumer acceptance of seedless guava fruits. The values are means of the 2004 & 2005 seasons.

Treatments	Number of fruit / each degree of liking			*Acceptance %
	slightly	moderately	extremely	
$CaCl_2$ in hot water				
2%	22	17	21	35 %
3%	19	24	17	28.3 %
4%	23	21	16	26.7 %
$CaCl_2$ in cold water				
2%	0	5	55	91.6%
3%	0	3	57	95 %
4%	0	6	54	90 %
Control	25	20	15	25 %

*Acceptance as a percentage of fruit in extremely liking degree/total number of fruits.

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معاملات الكالسيوم والتخزين المبرد بعد الحصاد وعلاقتها بالقدرة التخزينية والتسويقية ومدى قابلية المستهلك لثمار الجوافة البناتي

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أجريت هذه الدراسة على ثمار الجوافة البناتي المكتملة النمو والتي جمعت من مزرعة خاصة بمحافظة الإسماعيلية خلال موسمي ٢٠٠٤ ، ٢٠٠٥ وقد غسلت الثمار السليمة والمتجانسة في الحجم والخالية من الإصابات الميكانيكية ثم جففت وقسمت إلى ثلاثة مجموعات الأولى غمست في كلوريد الكالسيوم المذاب في ماء بارد على درجة ٥٥م لمدة ٥ دقائق بتركيزات ٢،٣،٤٪ غمست المجموعة الثانية في كلوريد الكالسيوم المذاب في ماء ساخن على درجة ٤٠م لمدة ٥ دقائق بنفس التركيزات السابقة والمجموعة الثالثة ثمار غير معاملة (كنترول) خزنت المجاميع الثلاثة على درجة ٨ م ورطوبة نسبية ٨٥ – ٩٠ ٪.

بانتهاء فترة التخزين المبرد وضعت ثمار المجموعات الثلاثة في غرفة الإنضاج على ٢٠ م لدراسة القدرة التسويقية للثمار وذلك لمدة ٤ أيام للتأكد من وصول الثمار للنضج عن طريق تقدير الصفات الطبيعية والكيماوية.

أظهرت نتائج الكالسيوم والتخزين المبرد الآتي :-

أدت جميع معاملات الكالسيوم إلى زيادة محتوى الثمار من الكالسيوم في كلا الموسمين وكانت صلابة الثمار المعاملة بالكالسيوم أعلى معنوياً وأقل فقداً في الوزن في كلا الموسمين وذلك بالمقارنة بالثمار غير المعاملة. احتوت ثمار المجموعة الأولى على أعلى محتوى من المواد الصلبة الذائبة وأعلى قيم لفيتامين ج و أعلى محتوى من حمض الستريك (في بداية التجربة) يليها ثمار المجموعة الثانية وبالنسبة للتلف فكان المظهر الوحيد عبارة عن بقع بنية اللون (تلف فسيولوجي) على السطح الخارجي للثمرة وظهرت بنسبة ١٦٪ في ثمار الكنترول فقط.

أظهرت نتائج القدرة التسويقية للثمار الآتي :-

حدث زيادة في نسب الفقد في الوزن في جميع المعاملات وسجلت ثمار الكنترول أعلى قيم كما حدث نقص معنوي في صلابة الثمار وكان النقص طفيف في الثمار المعاملة بكلوريد الكالسيوم المذاب في الماء البارد على درجة ٥ م بتركيزات ٢ ،٣ ، ٤ ٪. كما حدثت زيادة في قيم المواد الصلبة الذائبة وفيتامين ج في الثمار المعاملة بالكالسيوم.

خضعت الثمار بعد فترة محاكاة التسويق إلى اختبارات التذوق من قبل ٣٠ شخص لمعرفة مدى تأثر طعم الثمار بالمعاملات المختلفة وقد أعطت معاملة كلوريد الكالسيوم المذاب في ماء بارد بجميع تركيزاته أفضل نسب قبول من المستهلك.