

# The Effect of Pre-Harvest Applications of Gibberellic Acid and Calcium on Physical and Chemical Characteristics of Zaghoul and Samani Dates during Storage

Aiman K.A. Mohamed and Mokhtar M.M. Shaaban  
Horticulture Department, Faculty of Agriculture, Assiut University, Egypt

Received on: 9/9/2009

Accepted: 22/11/2009

## ABSTRACT

The study was conducted during two consecutive seasons of 2007 and 2008 on Zaghoul and Samani date palm cultivars grown at the fruit research orchard - Faculty of Agriculture - Assiut University. The fruits were sprayed twice, one during Kimri stage and other one during Khalal stage, with 100 ppm Gibberellic acid and 400 ppm chelated calcium. Following the harvest, fruits were stored under cold storage (6°C) or under room temperature (20-25°C).

The results indicated that the maximum period of cold storage reached 21 days for spraying treatments compared to untreated fruits, while it was 14 days for the fruits stored at room temperature (20-25°C) for spraying treatments and 7 days for untreated ones. These periods calculated upon the fruits reached 50% softening. The results showed a gradual decrease in the fruit weight from one week to another one during the period of storage for all treatments in both cultivars and seasons. There was a gradual decrease in the percentage of total soluble solids during the periods of cold storage in both seasons and cultivars for all the treatments. While the results of storage under room temperature contrary to the trend of cold storage where there was a slight increase in the percentage of total soluble solids after a week of storage. There was a gradual decline of acidity from a week to another one of Zaghoul cultivar and this decline was larger in the fruits stored under cold storage compared with those stored in the room while the decline of acidity percentage in Samani cultivar was slight. Generally, the results of the total sugars percentage took the same trend of the percentage of total soluble solids either under cold storage or at room temperature. There was a gradual decrease in the percentage of reducing sugars in all treatments in both seasons and cultivars.

**Key Words:** cold storage; date palm; GA<sub>3</sub>; post-harvest; *Phoenix dactylifera*

## INTRODUCTION

Date Palm is one of the most important fruit crops in the world in general and in the Arab region in particular. It was known until recently that the soft date cultivars not succeed in Assiut or Upper Egypt. The first attempt to cultivate these date palm cultivars such as Zaghoul and Samani in Assiut region was via the Fruit Section - Faculty of Agriculture - Assiut University in the seventies of the last century and we have proved the success of these cultivars in the province of Assiut.

One of the most important problems facing these two cultivars in Assiut is the rapid softening of the fruit where the fruits can not withstand on the sound state more than a few days. This leads to a lack of demand for farm cultivation of these cultivars as well as the traders preferring to bring in the fruits from the Lower Egypt, which have, the ability to stay solid for a long time. Thus, maintaining the freshness of fruits for a long time is the most important thing. Therefore, the storage process is the main core for preserving the firmness and quality for the longest possible period.

The storage methods of the date were studied in many researches. Most researches studied the fruit storage under refrigeration. Some investigators (Kamal 1995; Abou-Aziz *et al* 1975) stated that

Zaghoul and Samani date fruits can be stored up to 3 weeks under different storage temperatures. Some researches addressed storage under room temperature (Kamal 1995; Goneum *et al* 1993) or freeze (Badawy 2007; Rasmy *et al* 1996; Mikki and Taisan 1993) while others used other methods of storage. For instance, Al-Redhaiman (2005) used modified atmosphere to store Barhi date palm fruits. The objective of this research is to investigate the effect of GA<sub>3</sub> and Calcium on the storability and fruit quality during cool storage as well as the storage under room temperature of Zaghoul and Samani fruits in order to overcome the problem of softening speed of the fruits of these two cultivars after the harvest and try to maintain the fruit quality for the longest possible period

## MATERIALS AND METHODS

This study was conducted in the Research Section of the Horticultural orchard, Faculty of Agriculture - Assiut University during two successive seasons of 2007 and 2008 on Zaghoul and Samani date palm cultivars in an attempt to preserve the fruit quality of these two cultivars for the longest time whether at home or in the market

Nine Palms from each cultivar were selected and each treatment consisted of three palms (replicates). The palms were 32 years old at the start of experiment. They were grown in clay soil. The

earlier, later and weaker bunches were removed and then, the leaf bunch ratio was maintained at 7:1 on each palm.

The fruits of each replicate were sprayed twice, one of them during the Kimri stage and the other one during Khalal stage, with GA<sub>3</sub> at a concentration of 100 ppm and chelated calcium (13%) at a concentration of 400 ppm. In the first season (2007) the spraying dates were on June 24 (Kimri stage) and July 19 (Khalal stage) while in the second season they were on June 16 (Kimri stage) and July 21 (Khalal stage).

At maturity, (when 3-4 fruits began to reach softening on each bunch) each replicate (palm) was separately harvested and then, the strands were directly translocated to the laboratory of fruit section (pomology). The fruits were carefully separated from the strands with exclusion of any infected or damaged and non-homogeneous fruits and then, the fruits used in the storage process were approximately in a similar size.

The fruits of each replicate were divided to eight groups and each group placed in a bored cardboard. Four groups were cold stored at 6°C, and 70-80% relative humidity. The remained 4 groups were stored under room temperature of 20-25°C and 60% relative humidity. Each group was used for a certain period of storage included 7, 14, 21 and 28 days. The percentage of fruit softening after 28 days in the cold storage and 21 days in the room storage reached near 100%. Accordingly, these fruits did not interfere in the results of the experiment.

After each period of storage, 10 fruits from each group were selected to assess the following characteristics:

1. Average fruit weight (g).
2. Weight loss percentage.
3. Average fruit volume (cm<sup>3</sup>).
4. Average seed weight (g).
5. Total soluble solids (TSS %) using a hand refractometer.
6. Total acidity (g/100g) using titration by NaOH at 0.1N and phenolphthaleine as an indicator and expressed as citric acid.
7. Total, reducing and non-reducing sugars were determined according to A.O.A.C. (1975).

The experiment was set up in a split plot design. The analysis of variance (ANOVA) was applied according to Snedecor and Cochran (1972). Means were compared using the LSD values at 5% level of the probability.

## RESULTS AND DISCUSSION

### 1- The Physical properties

The results presented in Tables (1 and 2) showing the changes in the fruit weight and the percentage of weight loss of Zaghoul and Samai date Palm cultivars during the 21 days of storage under the temperature of the refrigerator and 14 days under room temperature and the impact of spraying with

Gibberellic acid and Calcium compared to the standard treatment (no spray).

Results show that the differences in the fruit weight at the beginning of storage (zero date) were due to spraying with GA<sub>3</sub> and calcium during the growth of fruits. The GA<sub>3</sub> spray caused an increment percentage in fruit weight by 5.2, 16.9 % (average of two seasons) as compared to the control for Zaghoul and Samani, respectively, while the effect of calcium is not clear on Zaghoul cultivar however, it led to an increase in fruit weight of Samani fruits by 6.4 %. It also found that GA<sub>3</sub> and calcium prolonged the period of storage of fresh fruit (without entering into the rutab stage) by a week compared to the control.

The results also show a gradual decrease in the fruit weight from one week to another during the period of storage of all treatments in both cultivars and seasons. The decrement percentage of fruit weight after a week of storage in Zaghoul cultivar (average of two seasons) was 5.23, 4.15 and 4.61%, while it was 3.33, 3.44 and 4.18% in Samani for the treatments GA<sub>3</sub>, calcium and control respectively. While the decrement percentage in the fruit weight during the period of 7 to 14 days in cold storage in Zaghoul was (average seasons) 3.3, 3.56 and 3.69 % for such previous treatments, respectively. On the other hand, the decrement percentage of Samani fruits for the same period was 2.49, 2.53, and 2.44 % for such treatments, respectively. The decrement percentage in the fruit weight during the period from 14 to 21 days of cold storage had a less value where it reached 2.46, 3.72, in Zaghoul cultivar while it was 2.74, 1.84 % in Samani for the treatments GA<sub>3</sub> and calcium, respectively.

The results also show the effect of storage period (regardless of the treatment). It was found a gradual decrease in the fruit weight from week to another one, in the first growing season only, while the decline was not statistically confirmed in the second season, in both date palm cultivars.

The above-mentioned results clearly revealed that there were great differences between cultivars and seasons. The later accordant with those reported by Samouni, 2009, El-Sese *et al.* (2000), Mostafa (1994), Hussain *et al.* (1985) and Brown (1983). They stated that the fruit characteristics of date palm differed between seasons and cultivars and that greatly affect by the weather status during the season.

On the other hand, the results of storage under room temperature took the same direction, but the decrement percentage of fruit weight was greater compared with the cold storage. The decrement percentage in the fruit weight after a week of storage of Zaghoul was 12.4, 11.8 and 13.7%, while it was 12.12, 11.74 and 12.5% in Samani for the treatments GA<sub>3</sub>, calcium and control, respectively. The results of present study accordant with that reported by Abboudi and Thompson

**Table 1: Effect of Calcium and Gibberellic acid on the weight changes (g) of Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

		Cool storage																		
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	17.4	19.1	15.5	18.5	15.5	19.2	16.1	18.9	24.7	23.1	22.3	21.2	20.0	20.9	22.3	21.7				
7	16.4	18.2	14.8	17.8	14.8	18.3	15.3	18.1	23.7	22.5	21.5	20.5	19.0	20.2	21.4	21.1				
14	15.8	17.4	14.2	17.2	14.3	17.5	14.8	17.4	22.9	22.1	20.9	20.0	18.6	19.6	20.8	20.6				
21	15.4	17.1	13.8	16.3	--	--	14.6	16.7	22.4	21.3	20.5	19.6	--	--	21.5	20.5				
Mean	16.3	18.0	14.6	17.5	14.9	18.3			23.4	22.3	21.3	20.3	19.2	20.2						
LSD 5%			2007				2008						2007				2008			
	A		0.25				0.35		A		1.23				1.55					
	B		0.33				0.76		B		0.58				0.78					
	AxB		0.58				1.30		AxB		1.00				1.36					

  

		Room storage																		
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day)(B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	17.4	19.1	15.5	18.5	15.5	19.2	16.1	18.9	24.7	23.1	22.3	21.2	20.0	20.9	22.3	21.7				
7	15.1	16.9	13.6	16.4	13.2	16.8	14.0	16.7	21.6	20.4	19.8	18.6	17.5	18.3	19.6	19.1				
14	13.5	15.1	11.8	14.4	--	--	12.5	14.8	19.9	18.2	17.8	16.5	--	--	18.9	17.5				
Mean	15.3	17.0	13.6	16.4	14.4	18.0			22.1	20.6	20.0	18.8	18.8	19.6						
LSD 5%			2007				2008						2007				2008			
	A		0.29				0.72		A		0.40				1.10					
	B		0.27				0.58		B		0.59				0.86					
	AxB		0.47				1.00		AxB		1.02				1.49					

**Table 2: Effect of Calcium and Gibberellic acid on the weight loss percentage of Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

<b>Cool storage</b>																	
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
7	5.75	4.71	4.52	3.78	4.52	4.69	4.93	4.39	4.05	2.60	3.58	3.30	5.00	3.35	4.21	3.08	
14	9.20	7.85	8.39	7.03	7.74	8.85	8.44	7.91	7.29	4.33	6.28	5.66	7.00	6.22	6.86	5.40	
21	11.49	10.47	10.97	11.89	--	--	11.23	11.18	9.31	7.79	8.07	7.55	--	--	8.69	7.67	
Mean	8.81	7.68	7.96	7.57	6.13	6.77			6.88	4.91	5.98	5.50	6.00	4.79			
LSD 5%			2007				2008				2007				2008		
	A		0.49				0.46		A		0.30				0.56		
	B		0.36				0.49		B		0.45				0.33		
	AxB		0.63				0.85		AxB		0.78				0.57		

  

<b>Room storage</b>																	
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
7	13.22	11.52	12.26	11.35	14.84	12.50	13.44	11.79	12.55	11.69	11.21	12.26	12.5	12.41	12.09	12.12	
14	22.41	20.94	23.87	22.16	--	--	23.14	21.55	19.43	21.21	20.18	22.17	--	--	19.8	21.69	
Mean	17.82	16.23	18.07	16.76	14.84	12.50			16.00	16.45	15.70	17.22	12.5	12.41			
LSD 5%			2007				2008				2007				2008		
	A		0.53				0.54		A		0.13				1.14		
	B		0.48				0.54		B		0.06				0.07		
	AxB		0.83				0.93		AxB		0.10				0.13		

(1998). They studied the effect of different storage temperature on physical properties of Khalas and Khaniezy date palm cultivars. They found that weight loss percentage decreased with decreasing the temperature. Kamal (1995) stored Zaghoul and Samani dates under different temperature from 0 to 20°C and found that the loss in fruit weight increased with the high storage temperature. The lowest percentage was noticed at 0°C and the highest at 20°C.

Table (3) shows the effect of spraying with GA<sub>3</sub>, calcium and cold or room storage on the fruit volume of Zaghoul and Samani cultivars. It is clear from the results that the fruit volume took the same behavior of the fruit weight, where a gradual and statistical decrease in the fruit volume from storage period to another one was observed. Such decrease was more pronounced in the fruits stored at room temperature of the two date palm cultivars.

Table (4) shows the results of the treatments effect on the seed weight and the changes that have occurred during the period of storage compared to the standard treatment of Zaghoul and Samani date palm cultivars during two seasons of study. It is evident from the results that the changes that occurred in the seed weight during the period of storage in both date palm cultivars were very small and statistically insignificant in most cases, whether in cold storage or at room temperature. It is clear that the decrease in fruit weight (as already explained) is mainly due to the decrease in the flesh weight and the seed weight does not have any influence in this respect.

There is no doubt that the measure of the flesh weight percentage is one of the most important quality measurements of mature dates. The results show that, in general, GA<sub>3</sub> treatment resulted in a higher percentage of flesh weight percentage where it reached 90.45 in the case of Zaghoul cultivar while it was 89.25 and 89.58% for calcium and control respectively. The same trend was observed for Samani where the flesh weight percentage recorded 91.22, 90.68 and 89.92% for such previous treatments, respectively.

The results of current study came on line with those reported by Badawy 2007 and Rasmy *et al* 1996. They could store Zaghoul and/or Samani date fruits for prolonged period of times without loss in the fruit quality. Also Kamal 1995 and Abou-Aziz *et al* 1975. could store the fruits of such two cultivars up to 3 weeks and they added that Samani dates had better keeping quality and longer marketing life after cold storage than Zaghoul cultivar.

## 2--The chemical characteristics

The results presented in Table ( 5) in general, showing that TSS% in the first season was higher than that of the second season for all the treatments in both cultivar fruits.

The results show a gradual decrease in the percentage of total soluble solids during the storage periods in both seasons and cultivars for all the treatments. The percentage of TSS at the beginning of storage (average of two seasons) for Zaghoul was 30.5, 34.1 and 32.6% and for Samani it was 30.0, 32.4 and 31.4% for the treatments GA<sub>3</sub>, calcium and control, respectively. It is clear from this that the calcium treatment resulting in the highest percentage of the TSS compared with GA<sub>3</sub> and the control. The percentage of TSS at the end of the cold storage in Zaghoul cultivar (average seasons) reached 27.8, 30.8 and 30.2% and in Samani cultivar reached 28.3, 31.3 and 29.0% for such treatments, respectively. The more importantly is that the decrement percentage which occurred as a result of the treatments was 8.9, 9.7 and 7.4 % in Zaghoul cultivar and 5.7, 3.4 and 3.6% in Samani for the same previous treatments, respectively. This shows the different response of the cultivars to the same treatments where the calcium treatment in Zaghoul cultivar recorded the highest percentage of decrease, while the same treatment on Samani cultivar caused the lowest value.

Results also indicated that the decline in the TSS % from week to week (regardless of the treatments) was statistically significant compared to the zero date, in both seasons and cultivars. The percentage of TSS at the beginning of storage (average of two seasons) was 32.4, 31.3% while it reached 30.0 and 28.0% at the end of the storage for Zaghoul and Samani cultivars, respectively. The results also show that the highest TSS %, in general, at the end of the storage was for the treatment of calcium, and the differences were significant in both seasons compared to the GA<sub>3</sub> treatment. As for the impact of the interaction between the periods of storage and treatments, the largest TSS % in Zaghoul fruits was found at the beginning of storage for the calcium treatment in the first and second seasons where it reached 35.4 and 32.8%, respectively, and the least value was recorded for GA<sub>3</sub> treatment after 21 days of cold storage where it reached 30.8 and 24.7 for the two seasons, respectively. Samani cultivar took the same behavior where the calcium at the beginning of storage recorded the highest values (33.7 and 31.0%) while GA<sub>3</sub> after 21 days of cold storage gave the lowest percentages (28.8 and 23.8 for the two seasons, respectively.)

The results of storage at room temperature contrary to the trend of cold storage where there was a slight increase in the TSS % after a week of storage. The percentage of TSS in Zaghoul cultivar (two seasons average) was 31.7, 35.1 and 33.7 % and in Samani it was 31.1, 34.1 and 32.1% for the same treatments, respectively, and then there was a slight decrease after two weeks where TSS % in Zaghoul reached 31.2, 33.4, while it was 30.8%, Samani for GA<sub>3</sub> and calcium, respectively. Perhaps

**Table 3: Effect of Calcium and Gibberellic acid on the volume of Zaghloul and Samany fruits stored under cool or room temperature during 2007 and 2008 years.**

		<b>Cool storage</b>																		
Treatment (A)	<b>Zaghloul</b>								<b>Samany</b>											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	18.0	19.7	16.7	19.7	16.7	20.3	17.1	19.9	26.3	24.7	23.8	22.9	21.4	22.5	23.8	23.4				
7	17.1	18.9	16.2	18.8	15.9	19.3	16.4	19.0	25.3	24.0	23.0	22.0	20.3	21.6	22.9	22.5				
14	16.7	18.2	15.7	17.9	15.2	18.4	15.9	18.2	24.7	23.4	22.7	21.3	19.7	20.7	22.4	21.8				
21	15.8	17.6	14.8	17.3	--	--	15.3	17.5	23.8	22.6	21.9	20.5	--	--	22.9	21.6				
Mean	16.9	18.6	15.9	18.4	15.9	19.3			25.0	23.7	22.9	21.7	20.5	21.6						
LSD 5%			2007				2008						2007				2008			
	A		0.78				0.32		A		0.96				1.04					
	B		0.49				0.64		B		0.84				0.64					
	AxB		0.85				1.11		AxB		1.45				1.10					
		<b>Room storage</b>																		
Treatment (A)	<b>Zaghloul</b>								<b>Samany</b>											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	18.0	19.7	16.7	19.7	16.7	20.3	17.1	19.9	26.3	24.7	23.3	23.9	21.4	22.5	23.8	23.4				
7	15.4	17.5	14.9	18.0	13.9	17.2	14.7	17.6	23.0	22.3	20.6	20.0	18.2	19.7	20.6	20.7				
14	13.7	15.3	12.3	15.8	--	--	13.0	15.6	21.7	20.4	18.3	18.2	--	--	20.0	19.3				
Mean	15.7	17.5	14.6	17.8	15.3	18.8			23.7	22.5	20.7	20.7	19.8	21.1						
LSD 5%			2007				2008						2007				2008			
	A		1.35				0.49		A		0.61				0.66					
	B		0.70				0.77		B		0.74				0.54					
	AxB		1.22				1.34		AxB		1.28				0.93					

**Table 4: Effect of Calcium and Gibberellic acid on the seed weight of Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years.**

		Cool storage															
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
Zero date	1.73	1.74	1.76	1.88	1.60	2.02	1.70	1.88	2.20	2.27	2.18	2.17	2.13	2.30	2.17	2.25	
7	1.75	1.74	1.75	1.88	1.63	2.03	1.71	1.88	2.19	2.26	2.19	2.18	2.12	2.31	2.17	2.25	
14	1.72	1.73	1.74	1.91	1.66	1.98	1.71	1.87	2.21	2.26	2.18	2.17	2.10	2.33	2.16	2.25	
21	1.72	1.73	1.75	1.91	--	--	1.73	1.82	2.19	2.24	2.20	2.17	--	--	2.19	2.21	
Mean	1.73	1.74	1.75	1.90	1.63	2.01			2.20	2.26	2.19	2.17	2.12	2.31			
LSD 5%			2007				2008				2007				2008		
	A		0.04				0.04		A		0.05				0.05		
	B		0.05				0.06		B		0.07				0.04		
	AxB		0.09				0.11		AxB		0.12				0.07		

  

		Room storage															
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
Zero date	1.73	1.74	1.76	1.88	1.60	2.02	1.70	1.88	2.20	2.27	2.18	2.17	2.13	2.30	2.17	2.25	
7	1.72	1.74	1.76	1.85	1.64	1.98	1.71	1.86	2.20	2.27	2.18	2.17	2.13	2.30	2.17	2.25	
14	1.71	1.73	1.75	1.88	--	--	1.73	1.81	2.22	2.28	2.19	2.15	--	--	2.20	2.22	
Mean	1.72	1.74	1.76	1.87	1.62	2.00			2.21	2.27	2.18	2.16	2.13	2.30			
LSD 5%			2007				2008				2007				2008		
	A		0.09				0.03		A		0.04				0.05		
	B		0.04				0.06		B		0.06				0.05		
	AxB		0.06				0.10		AxB		0.10				0.09		

**Table 5: Effect of Calcium and Gibberellic acid on the percentage of TSS in Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

		Cool storage																
Treatment (A)	Zaghloul								Samany									
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean			
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008		
Zero date	33.4	27.6	35.4	32.8	35.1	30.0	34.6	30.1	32.4	27.6	33.7	31.0	32.6	30.2	32.9	29.6		
7	31.9	26.6	34.4	31.7	34.2	29.3	33.5	29.2	31.2	26.9	33.1	30.5	31.2	29.2	31.8	28.9		
14	31.2	25.4	33.2	30.9	32.4	27.9	32.3	28.1	29.6	25.8	32.6	29.9	30.4	27.5	30.9	27.7		
21	30.8	24.7	31.8	29.7	--	--	31.3	28.7	28.8	23.8	30.6	28.6	--	--	29.7	26.2		
Mean	31.8	26.1	33.7	31.3	32.9	29.1			30.5	26.0	32.5	30.0	31.4	29.0				
LSD 5%			2007				2008						2007				2008	
	A		1.16				1.06		A		1.41				1.28			
	B		1.00				1.10		B		1.15				0.87			
	AxB		1.73				1.91		AxB		1.99				1.50			
		Room storage																
Treatment (A)	Zaghloul								Samany									
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean			
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008		
Zero date	33.4	27.6	35.4	32.8	35.1	30.0	34.6	30.1	32.4	27.6	33.7	31.0	32.6	30.2	32.9	29.6		
7	34.4	28.9	36.4	33.7	35.8	31.5	35.5	31.4	32.6	29.5	35.2	32.9	33.6	30.5	33.8	31.0		
14	33.0	29.7	34.0	32.7	--	--	33.5	31.2	33.8	27.8	34.2	31.8	--	--	34.0	29.8		
Mean	33.6	28.7	35.3	33.1	35.5	30.8			32.9	28.3	34.4	31.9	33.1	30.4				
LSD 5%			2007				2008						2007				2008	
	A		1.63				1.73		A		1.39				0.85			
	B		0.93				1.06		B		1.18				1.01			
	AxB		1.61				1.83		AxB		2.05				1.75			



the decline in TSS % during the cold storage was due to the consumption of sugars in the fruit respiration as well as the demolition and decrease of acidity. It is important to take into account the fact that the slight decrease in the fruit weight under cold storage did not lead to an increase in sugars concentration and therefore TSS %, while the large gap that happened in the weight of the fruits stored in the room led to an increase in the sugars concentration and acidity, and this compensate the decline that has occurred in the sugar consumed in respiration.

The results of current study were confirmed by the previous findings found by Kamal (1995). He found that TSS % were increased by raising storage temperature of Zaghoul and Samani date cultivars and reached the highest percentage at 20°C. He noted that such increase in TSS% was due to the conversion of starch and loss of weight. He also found that TSS % increased with prolonged storage period.

Data of Table ( 6) showing the effect of various treatments on the percentage of acidity in the fruits of the two cultivars. It is clear from the results of Zaghoul cultivar that a gradual and significant decline was observed from storage period to another and the decline was more pronounced on the fruits stored under cold storage compared with those stored in the room while, the decline was slight in Samani cultivar in most cases. The results of current study were confirmed by the previous findings found by Kamal (1995), who found that the total acidity gradually decreased with the extending of the storage period.

Table (7) shows the results of various treatments on the percentage of total sugars during storage. Overall, the proportion of total sugars in the first season was higher than the second season for all the treatments in both cultivars and seasons.

The results of the total sugars took the same direction as TSS % did with a gradual decrease in the proportion of the total sugars in the fruits stored under cold storage of all the treatments from one week to another one until it reached its lowest value at the end of the storage and the differences were significant in most cases. The percentage of total sugars in Zaghoul cultivar at the beginning of cold storage (two season's average) was 25.0, 28.3 and 27.1, while it was 24.3, 26.5 and 25.4 % in Samani fruits for the same previous treatments, respectively. It is also found that calcium spraying gave the highest percentage of total sugars in both date palm cultivars. The percentage of total sugars at the end of the storage for Zaghoul cultivar reached 22.9, 25.2 and 24.5 while in Samani it reached 20.6, 23.9 and 23.6 for the same treatments, respectively. The results also showed that the highest percentage of total sugars in most cases was obtained due to calcium spraying, in both cultivars. The interaction effect shows that the largest proportion the total

sugars in Zaghoul cultivar was obtained from calcium and control in the first season at the beginning of storage (29.9 and 29.7% respectively) while the least value was for the treatment of GA<sub>3</sub> in the second season during the different periods of storage and the differences were statistically confirmed. Samani cultivar took the same trend of Zaghoul cultivar. The results show that the total sugars in fruits stored under room temperature has the same direction as TSS % where the changes were very slight and fluctuated between slight increase and decrease at the end of storage compared to the beginning of it and the differences were not significant in most cases in both cultivars.

These results partially came on line with that reported by Goneum *et al* (1993). They stated that the total sugars of date fruits stored at room temperature increased. Kamal (1995) also found that the total sugars enhanced with the increase of storage temperature reaching the maximum at 20°C. He recommended that the best storage temperature for Zaghoul and Samani date ranged between 5 and 7°C.

Table( 8) shows that there were a gradual decrease in the reducing sugars percentage in all treatments and in both seasons and cultivars and this is consistent with what happened in the TSS %, but the decrease in the proportion of reducing sugars was higher than that happened with TSS %. It was also observed that the percentage of reducing sugars was higher in the first season compared to the second one. The percentage of reducing sugars at the beginning of storage in Zaghoul cultivar under cold storage (average seasons) was 16.5, 19.7 and 19.1 and while in Samani cultivar it was 16.6 18.7 and 17.5 for the same treatments, respectively. The percentage of reducing sugars at the end of storage periods in Zaghoul cultivar reached 13.1, 13.9 and 14.1 and in the case of Samani it reached 11.2, 13.4 and 15.3 for the same treatments, respectively.

The above-mentioned results accordant with that reported by Rasmy *et al* (1996). They stored date fruits from Zaghoul and Samani cultivars and found that there was a gradual decrease of reducing and total sugars in both studied cultivars. They ascribed such decrease to the respiration activity of fruits and to the growth of microorganisms on the surface of dates during cold storage.

This significant decrease in reducing sugars which it is considered as one of the TSS components (reducing sugars, non-reducing sugars and the total acidity) is probably due to the consumption of part of the reducing sugars in respiration in addition to turning the larger proportion of it to non-reducing sugars. The results show that the spraying of GA<sub>3</sub> recorded the lowest value of reducing sugars in both seasons and date palm cultivars. The results also showed the interaction effect between the treatments and periods of storage. The highest proportion of the

**Table 6: Effect of Calcium and Gibberellic acid on the acidity percentage in Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

		Cool storage																		
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	0.384	0.346	0.294	0.269	0.281	0.192	0.320	0.269	0.179	0.179	0.192	0.179	0.154	0.179	0.175	0.179				
7	0.325	0.307	0.267	0.212	0.267	0.179	0.286	0.233	0.192	0.179	0.192	0.167	0.179	0.167	0.188	0.171				
14	0.277	0.290	0.188	0.190	0.177	0.128	0.214	0.203	0.167	0.154	0.178	0.141	0.154	0.141	0.166	0.145				
21	0.197	0.217	0.168	0.174	--	--	0.183	0.196	0.141	0.135	0.155	0.128	--	--	0.148	0.132				
Mean	0.296	0.290	0.229	0.211	0.242	0.166			0.170	0.162	0.179	0.154	0.162	0.162						
LSD 5%			2007				2008						2007				2008			
	A		0.03				0.03		A		0.01				0.02					
	B		0.03				0.02		B		0.01				0.02					
	AxB		0.05				0.04		AxB		0.02				0.04					

  

		Room storage																		
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	0.384	0.346	0.294	0.269	0.281	0.192	0.320	0.269	0.179	0.179	0.192	0.179	0.154	0.179	0.175	0.179				
7	0.282	0.243	0.256	0.192	0.217	0.167	0.252	0.201	0.192	0.179	0.192	0.179	0.179	0.179	0.188	0.179				
14	0.177	0.215	0.177	0.141	--	--	0.177	0.178	0.192	0.179	0.192	0.166	--	--	0.192	0.173				
Mean	0.281	0.268	0.242	0.201	0.249	0.180			0.188	0.179	0.192	0.175	0.167	0.179						
LSD 5%			2007				2008						2007				2008			
	A		0.04				0.01		A		0.01				0.03					
	B		0.03				0.02		B		0.01				0.02					
	AxB		0.05				0.04		AxB		0.02				0.03					

**Table 7: Effect of Calcium and Gibberellic acid on the percentage of total sugars in Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

<b>Cool storage</b>																				
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	27.8	22.1	29.9	26.6	29.7	24.6	29.1	24.4	26.6	22.0	27.4	25.5	26.3	24.4	26.8	24.0				
7	26.2	21.7	28.4	25.7	28.9	23.9	27.8	23.8	26.2	20.3	26.3	24.7	25.3	23.5	25.9	22.8				
14	25.8	18.9	28.1	25.1	26.9	22.1	26.9	22.0	23.6	17.9	26.3	24.3	24.8	22.3	24.9	21.5				
21	25.5	18.2	26.4	23.9	--	--	26.0	22.4	22.9	18.2	24.5	23.3	--	--	23.7	20.8				
Mean	26.3	20.2	28.2	25.3	28.5	23.5			24.8	19.6	26.1	24.5	25.5	23.4						
LSD 5%			2007				2008						2007				2008			
	A		1.13				0.77				A		1.31				1.38			
	B		0.74				0.62				B		0.94				0.52			
	AxB		1.28				1.08				AxB		1.62				0.90			

  

<b>Room storage</b>																				
Treatment (A)	Zaghloul								Samany											
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008				
Zero date	27.8	22.1	29.9	26.6	29.7	24.6	29.1	24.4	26.6	22.0	27.4	25.5	26.3	24.4	26.8	24.0				
7	28.5	23.3	30.2	28.1	29.3	25.4	29.3	25.6	27.1	22.5	29.4	27.1	27.4	24.4	28.0	24.7				
14	27.2	22.6	28.7	25.4	--	--	28.0	24.0	27.9	21.9	27.5	25.3	--	--	27.7	23.6				
Mean	27.8	22.7	29.6	26.7	29.5	25.0			27.2	22.1	28.1	26.0	26.9	24.4						
LSD 5%			2007				2008						2007				2008			
	A		1.69				1.59				A		0.97				0.58			
	B		1.19				1.00				B		1.12				0.84			
	AxB		2.06				1.73				AxB		1.94				1.45			

**Table 8: Effect of Calcium and Gibberellic acid on the percentage of reducing sugars in Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

		Cool storage																			
Treatment (A)	Period (day) (B)	Zaghloul								Samany											
		GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
	Zero date	19.5	13.4	20.7	18.7	20.7	17.4	20.3	16.5	18.1	15.0	19.5	17.9	18.7	16.3	18.8	16.4				
	7	17.1	14.7	16.3	17.7	18.6	15.4	17.3	15.9	17.5	12.1	18.6	17.4	17.7	15.1	17.9	14.9				
	14	15.3	13.2	16.2	14.0	15.9	12.2	15.8	13.1	14.2	12.3	17.9	16.1	16.5	14.1	16.2	14.2				
	21	13.8	12.3	14.8	12.9	--	--	14.3	12.6	12.5	9.8	13.9	12.8	--	--	15.2	11.3				
	Mean	16.4	13.4	17.0	15.8	18.4	15.0			15.6	12.3	17.5	16.1	17.6	15.2						
	LSD 5%			2007				2008						2007				2008			
		A		0.74				0.97				A		1.06				0.78			
		B		0.52				0.83				B		0.66				0.42			
		AxB		0.91				1.43				AxB		1.15				0.72			
		Room storage																			
Treatment (A)	Period (day) (B)	Zaghloul								Samany											
		GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean					
	Zero date	19.5	13.4	20.7	18.7	20.7	17.4	20.3	16.5	18.1	15.0	19.5	17.9	18.7	16.3	18.8	16.4				
	7	20.6	15.4	20.5	19.5	20.5	17.7	20.5	17.5	19.1	14.5	20.0	19.1	19.6	17.7	19.6	17.1				
	14	17.5	15.6	18.1	17.5	--	--	17.8	16.6	18.9	14.9	18.6	18.2	--	--	18.8	16.6				
	Mean	19.2	14.8	19.8	18.6	20.6	17.6			18.7	14.8	19.4	18.4	19.2	17.0						
	LSD 5%			2007				2008						2007				2008			
		A		0.55				1.41				A		0.48				1.13			
		B		0.72				1.02				B		0.67				0.51			
		AxB		1.24				1.76				AxB		1.16				0.88			

**Table 9: Effect of Calcium and Gibberellic acid on the percentage of non-reducing sugars in Zaghloul and Samany dates stored under cool or room temperature during 2007 and 2008 years**

		Cool storage															
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
Zero date	8.3	8.7	9.2	7.9	9.0	7.2	8.8	7.9	8.5	7.0	7.9	7.6	7.6	8.1	8.0	7.6	
7	9.1	7.0	12.1	8.0	10.3	8.5	10.5	7.8	8.7	8.2	7.7	7.3	7.6	8.4	8.0	8.0	
14	10.5	7.8	11.9	11.1	11.0	9.9	11.1	9.6	9.4	5.6	8.4	8.2	8.3	8.2	8.7	7.3	
21	11.7	7.9	11.6	11.0	--	--	11.7	9.5	10.4	8.4	10.6	10.5	--	--	10.5	7.5	
Mean	9.9	7.9	11.2	9.5	10.1	8.5			9.3	7.3	8.7	8.4	7.8	8.2			
LSD 5%					2007		2008						2007		2008		
	A		0.66				1.10		A		0.74				0.86		
	B		0.68				0.65		B		0.71				0.31		
	AxB		1.17				1.12		AxB		1.23				0.54		
		Room storage															
Treatment (A)	Zaghloul								Samany								
	GA <sub>3</sub>		Ca		Control		Mean		GA <sub>3</sub>		Ca		Control		Mean		
Period (day) (B)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	
Zero date	8.3	8.7	9.2	7.9	9.0	7.2	8.8	7.9	8.5	7.0	7.9	7.6	7.6	8.1	8.0	7.6	
7	7.9	7.9	9.7	8.6	8.8	7.7	8.8	8.1	8.0	8.0	9.4	8.0	7.8	6.7	8.4	7.6	
14	9.7	7.0	10.6	7.9	--	--	10.7	7.5	9.0	7.0	8.9	7.1	--	--	9.0	7.1	
Mean	8.6	7.9	9.8	8.1	8.9	7.5			8.5	7.3	8.7	7.6	7.7	7.4			
LSD 5%					2007		2008						2007		2008		
	A		1.82				0.82		A		0.61				0.37		
	B		1.05				0.79		B		0.61				0.33		
	AxB		1.83				1.37		AxB		1.06				0.57		

reducing sugars was produced from calcium spraying in both seasons and cultivars while GA<sub>3</sub> in the second season gave the least value in both cultivars.

Table (9) shows that there were gradual increases in the percentage of non-reducing sugars from time to time during the period of storage for all the treatments. This increases were more distinguished in Zaghoul cultivar than Samani one. The percentage of non-reducing sugars of Zaghoul cultivar (two season's average) at the beginning of the storage was 8.5, 8.6 and 8.1, while in Samani it was 7.8, 7.8 and 7.9 for GA<sub>3</sub>, calcium and control, respectively. At the end of the storage period the percentage of non-reducing sugars (two season's average) for Zaghoul cultivar reached 9.8, 11.3 and 10.5 while it reached 9.4, 10.6 and 8.3 in Samani for the same treatments, respectively.

The increase in the proportion of non-reducing sugars at the end of the storage compared to the beginning of storage probably due to the gradual decrease in the fruit weight with increasing the storage period. On the other hand, this increase may be due mainly to the transformation of the simple sugars to the Oligo sugars at the end of Khalal stage and the beginning of softening stage and this explains the significant decline in the percentage of reducing sugars. Hussein, *et al* 1979 stated that the non-reducing sugars of Zaghoul date fruits gradually increased during the fruit development and reached the maximum values when the fruit reached the full color while the reducing and total sugars decreased.

## CONCLUSIONS

It can be recommended that the possibility of preserving the fruits of Zaghoul and Samani cultivars on their fresh state for a period of 3 weeks in the cold storage or two weeks under room temperature by spraying the fruits twice with Gibberellic acid or calcium, one of them during the Kimri stage and the other one during Khalal stage.

## REFERENCES

- Abboudi, A.A.H. and A.K. Thompson, 1998. Effect of temperature on the storage of rutab dates harvested at different maturity stages. Proc. of the 1<sup>st</sup> international conf. of date palm. Al-Ain, U.A.E. (March 8-10) 399-416.
- Abou-Aziz, A.B.; S.M. EL-Nabawy; F.K. Abd el-Wahab, and A.S. Abdel-Kader, 1975. Keeping quality of fresh date fruits as affected by cultivar and storage temperature. Egyptian Journal of Horticulture 2(1):67-74.
- Al-Redhaiman K.N. 2005. Modified atmosphere extends storage period and maintains quality of 'Barhi' date fruits. Acta Hort. 682:979-986
- A.O.A.C. 1985. Official Methods of Analysis. 14<sup>th</sup> Association of Official Agricultural Chemists, Washington, DC (USA).
- Badawy I.F. 2007. Effect of gibberellic acid and sida film on Samani date palm at harvest and during storage. Ph.D dissertation, Assiut University pp. 135.
- Brown, G.K., 1983. Date production mechanization in the USA. Proceedings of the First Symposium on the date palm in Saudi Arabia. Al-Hassa, Saudi Arabia; King Faisal University, 2-12.
- El-Sese, A.M.A.; M.A. Shaheen and J.A. Al-Ahmadi. 2000. Effect of dusting pollination in Rothana and Rabia date palm cultivars on: b- Physical fruit properties. JKAU: Met., Env. and arid land Agric. Sci., 11: 49-62.
- Goneum, S.I.; S.K. El-Samahy; S.S. Ibrahim; M.G. Abd-El-Fadeel, and S.M. Mohamed, 1993. Compositional changes in the date fruits during ripening by freezing. Proc. of the 3<sup>rd</sup> Symb. on date palm. Al-Hassa, Saudi Arabia, King Faisal Univ; (Jan.17-20) 275-288.
- Hussein, F.; M.S. Al-Kahtany, and Y.A. Wally, 1979. Date palm growing and production in the Arab and Islamic World. Ain Shams Press (In Arabic), Egypt.
- Hussain, F.A., M. Bader and S.S. Al-Attear, 1985. Effect of different pollination methods on quality and quantity of date palm (*Phoenix dactylifera* L.) fruits. J. Agric. Water Resources Res., 4 (1): 265-282.
- Kamal, H.M. 1995. Effect of cold storage temperatures on storability and quality of date palm fruits. Bull. Fac. Agric. Univ. Cairo, 46:265-276.
- Mikki, M.S. and S.M. Al-Taisan, 1993. Physico-Chemical changes associated with freezing storage of date cultivar at their rutab stage of maturity. Proc. of the 3<sup>rd</sup> Symb. on date palm. Al-Hassa, Saudi Arabia, King Faisal Univ; (Jan.17-20) 253-266.
- Mostafa, R.A.A. 1994. Effect of different pollination methods on improving productivity of certain palm (*Phoenix dactylifera* L.) cultivars under Assiut condition. Ph.D. Thesis, Fac. Agric., Assiut Univ., Assiut, Egypt.
- Rasmy, N.; Y.H.Foda; I.M Hassan, and A.A.Kamal, 1996. Effect of cold and freezing storage on pigments and compositional changes of two date varieties. Annala Agric. Sci., Sp. issue 125-137.
- Samouni, M.T. 2009. Effect of pollen grains concentration on bunch weight and fruit quality of Halawy and Hayany date palm cultivars. M.Sc thesis, Fac. Agric Assiut University Assiut, Egypt.
- Snedecor, G.W. and W.G. Cochran, 1972. "Statistical Methods" 6<sup>th</sup> ed. The Iowa State University Press, Ames, Iowa, U.S.A. pp. 593

## الملخص العربي

## تأثير الرش ما قبل الحصاد بحامض الجبريليك والكالسيوم على الصفات الطبيعية والكيماوية لثمار صنفي نخيل البلح الزغلول والسماطي أثناء التخزين

أيمن كمال أحمد محمد – مختار ممنوح محمد شعبان

قسم البساتين- كلية الزراعة- جامعة أسيوط

أجريت هذه الدراسة خلال موسمين متعاقبين ٢٠٠٧ و ٢٠٠٨ على صنفي نخيل البلح الزغلول والسماطي المزروعين في مزرعة أبحاث قسم البساتين - كلية الزراعة- جامعة أسيوط بهدف التغلب على مشكلة سرعة ترطيب ثمار هذين الصنفين عقب القطف مع احتفاظها بخصائصها الطبيعية والكيماوية لأطول فترة ممكنة.

لتحقيق هذا الهدف تم انتخاب ٩ نخلات من كل صنف. تم رش ثمار الصنفين مرتين إحداهما خلال مرحلة الكمري والأخرى خلال مرحلة الخلال بحامض الجبريليك (١٠٠ جزء في المليون) والكالسيوم المخلبي ١٣% (٤٠٠ جزء في المليون). عقب الجمع تم تخزين الثمار المرشوشة تخزيناً بارداً (٥ - ٧ م) أو في جو الغرفة (25-٢٠ م).

توضح من نتائج الدراسة الآتي:

- ١- أقصى فترة تخزين بارد لثمار الصنفين المرشوشة بلغت ٢١ يوم مقابل أسبوعين لغير المرشوشة بينما كانت ١٤ يوم للمخزنة في جو الغرفة مقابل ٧ أيام لغير المرشوشة وكان ذلك عند وصول الثمار المخزنة إلى أعلى من ٥٠% ترطيب.
- ٢- توضح النتائج وجود تناقص تدريجي ومؤكد إحصائياً في وزن الثمرة من أسبوع إلى آخر خلال فترة التخزين البارد لجميع المعاملات في كلا الصنفين وموسمي الدراسة من ناحية أخرى أخذت نتائج التخزين تحت درجة حرارة الغرفة نفس الاتجاه السابق تماماً ولكن كانت نسبة التناقص في وزن الثمرة أكبر مقارنة بالتخزين البارد وسلك حجم الثمرة نفس الاتجاه.
- ٣- كما توضح النتائج وجود تناقص تدريجي في النسبة المئوية للمواد الصلبة الذائبة الكلية خلال فترات التخزين البارد وكلا موسمي الدراسة والصنفين لجميع المعاملات. بينما أخذت نتائج التخزين تحت درجة حرارة الغرفة اتجاهها مخالفاً للتخزين البارد حيث حدثت زيادة طفيفة في النسبة المئوية للمواد الصلبة الذائبة الكلية بعد أسبوع من التخزين. أما النسبة المئوية للحموضة في صنف الزغلول فلقد حدث نقص تدريجي ومؤكد إحصائياً من فترة تخزين لأخرى وكان النقص لكبير لثمار البلح المخزنة تخزيناً بارداً مقارنة بتلك المخزنة في جو الغرفة. بينما للنقص في صنف البلح السماطي كان طفيفاً في معظم الحالات.
- ٤- أخذت نتائج السكريات الكلية نفس اتجاه النسبة المئوية للمواد الصلبة الذائبة الكلية في كلا موسمي الدراسة وصنفي نخيل البلح سواء عند التخزين البارد أو تحت درجة حرارة الغرفة.
- ٥- حدث تناقص تدريجي في نسبة السكريات المختزلة في جميع المعاملات وكلا الصنفين وموسم الدراسة بينما حدثت زيادة تدريجية طفيفة في النسبة المئوية للسكريات الغير مختزلة من فترة إلى أخرى خلال فترة التخزين في جميع المعاملات وفي كلا موسمي النمو والصنفين.

تتصح الدراسة بإمكانية المحافظة على ثمار صنفي البلح الزغلول والسماطي على حالتها عقب الجمع لمدة تتراوح بين ٣ أسابيع في التخزين البارد أو أسبوعين في جو الغرفة وذلك برشها بحامض الجبريليك بتركيز ١٠٠ جزء في المليون أو الكالسيوم المخلبي ١٣% بتركيز ٤٠٠ جزء في المليون مرتين إحداهما خلال مرحلة الكمري والأخرى خلال مرحلة الخلال