

## EFFECT OF USING CALCIUM CHLORIDE AND COLD STORAGE ON PROLONGING THE STORABILITY OF ZAGHLOUL DATES

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**ABSTRACT:** *The present investigation was carried out during the 2008 and 2009 seasons on Zaghloul dates (*Phoenix dactylifera* L.). Dates were post harvest treated by dipping in CaCl<sub>2</sub> solutions (2 & 4 %). They were then stored at cold storage (0 & 5°C) and at ambient temperature to increase the storage period and maintain fruit quality.*

*Results in both seasons showed that dipping Zaghloul dates in Calcium chloride solutions (2 & 4 %) for 3 minutes were effective in maintaining fruit quality during cold storage at 0 & 5°C and at ambient temperature, in terms of decreasing loss of fruit weight, rutab, decay, acidity, tannins percentage and increasing total sugars percentage.*

*Finally, storage ability of Zaghloul dates dipping in CaCl<sub>2</sub> solutions (2 & 4%) could be prolonged with good keeping quality to 32 days by cold storage at 0°C, 5°C and 12 days of ambient temperature.*

**Key words:** *Zaghloul date fruit, dipping, calcium chloride, cold storage, fruit quality.*

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### INTRODUCTION

Date palm (*Phoenix dactylifera* L.) produces fruit of highly nutritive values. It is one of the oldest cultivated plants. In Egypt, and date cultivars cover a large area from Aswan to northern parts, besides the oases. (Approximately 14 million date palms with total fruit production of 1.3 million tons of dates) . Zaghloul date is one of the demanded fruits in the Egyptian markets and many foreign markets but it has a short marketing period. Fruits are harvested at the khalal stage but they develop to the Rutab stage at a rapid rate which is usually accompanied by softening of the fruit so, cold storage and calcium chloride were applied to retard the tissue softening or senescence. Abou Aziz *et al.*, (1975) reported that Zaghloul dates were kept at 0°C or 5°C without chilling injury.

Hussein *et al.*, (1993) dipped Zaghloul dates in CaCl<sub>2</sub> solution to extend the khalal stage.

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<sup>\*</sup> Horticulture Research Institute bulletin (2009). A.R.C. Ministry of Agriculture.

Calcium has widely been reported to play an important structural role in providing firmness and mechanical strength to cell walls, (Povaiah *et al*, 1988). Nawar and Ezz (1994) observed that 3 % CaCl<sub>2</sub> reduced fruit browning and improved fruit quality of guava fruit.

Daood (1995) found that cold storage (0 & 5°C) and CaCl<sub>2</sub> (2 & 4 %) were more effective to improve fruit quality of Zaghoul dates.

Fawaz (2006) reported that 2 % CaCl<sub>2</sub> was effective in maintaining fruit quality and storability of Mango fruit

So, this investigation aims to maintain fruit quality and increase the storability of Zaghoul dates by post harvest dipping in calcium chloride solutions during khalal stage and then stored at 0 & 5°C.

## **MATERIALS AND METHODS**

This work was carried out during two successive seasons (2008 & 2009) on Zaghoul dates cultivar at Horticulture Research Institute, Fruit Handling Department, Agriculture Research Center, Ministry of Agricultural, Egypt. In both seasons mature dates (Zaghoul cultivar) were harvested at maturity (khalal stage) in mid September of each season from the farm of El-kanater horticulture research station. Sound fruits (uniform in size and color) were chosen, washed with tap water and air dried, then randomly divided into three groups and subjected to the following treatments:-

- 1- Dipping in CaCl<sub>2</sub> solution 2 % for 3 minutes.
- 2- Dipping in CaCl<sub>2</sub> solution 4 % for 3 minutes.
- 3- Dipping in distilled water for 3 minutes (control).

After dipping, all fruit were washed, dried and each treatment was divided into three groups to be stored at (0 & 5°C) with 85-90 % RH and at 23 ± 2°C with 60-65 % RH.

All fruits were packed inside carton boxes (2 kg in each box). Each treatment as well as the control was represented in three replicates.

Fruits were examined every 8 days intervals from cold storage and every 3 days intervals from storage at room temperature.

The following properties were estimated

### **A- Fruit physical analysis:**

- 1- Weight loss %: was calculated and recorded.
- 2- Rotab %: were monitored for each fruit individually according to an established score as follow:-
  - 1 = No rotab.
  - 2 = > 0 - < 25 % rotab.
  - 3 = > 25 - < 50 % rotab.
  - 4 = > 50 - < 75 % rotab.
  - 5 = > 75 - < 100 % rotab.
  - 6 = 100 % rotab.
- 3- Decay fruit percentage: decayed fruit including all the injured, spoiled and shriveled fruit was calculated.

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### - Fruit chemical analysis:

- 1- Titratable acidity: was determined in well-mixed juice by titratable with NaOH (0.1 N) and the results were expressed as malic acid (mg/100gm of fresh weight) according to A.O.A.C (1965).
- 2- Tannins content: was determined as gallotannic acid (mg/100 gm fresh weight) according to A.O.A.C (1965).
- 3- Total sugars: were determined as mg/100 gm fresh weight according to the method adopted by Dubais *et al.*, (1956).

All obtained data were subjected to analysis of variance according to Snedecor and Cochran (1980). Differences among means were compared using Duncan's Multiple Range test (Duncan, 1955) at 5 % level.

## RESULTS AND DISCUSSION

The effects of post harvest dipping in  $\text{CaCl}_2$  solutions on some physical and chemical properties of Zaghoul dates during storage at 0°C & 5°C and ambient temperature were studied:

### 1. Fruit physical composition:

#### 1.1. The percentage of weight loss:

Data in Tables (1, 3 and 5) and figure (1) showed that weight loss percentage significantly increased by extending the storage periods in treated and control fruit in all storage temperatures.

Date fruit stored at 0°C caused significantly the lowest fruit weight loss compared to those stored at 5°C or room temperature.

Also, data in Tables (1, 3 & 5) and Fig.(1) showed that the reduction in weight loss percentage significantly was noticed with dipping in 2 & 4  $\text{CaCl}_2$  solutions than control fruit in all storage temperatures.

Furthermore, the storability of fruit under cold storage was 32 days against 12days for storage at ambient temperature. The weight loss is mainly a result of water loss from the fruit tissues and partially of the respiration process, so the storage at 0°C induced a remarkable reduction in fruit weight loss than 5°C or at ambient temperature.

These findings are in harmony with those of Daood (1995), proved that dipping dates in  $\text{CaCl}_2$  4 % (at 0°C) was more effective in reducing weight loss percentage in Zaghoul dates, Attia *et al.*, (1997), found that sealing Zaghoul dates stored at °C reduced weight loss, Zambrano and Manzano (1995) on mango fruit, Mehaisen (1999) on Le-Conte pear fruit and Fawaz (2006) on mango fruit ,they obtained similar results.

#### 1.2. Rutab %:

Results in Tables (1, 3 and 5) and fig. (1) indicated that fruits of all storage temperatures tended to have lower values of rutab score when compared to control.

As for storage temperature, significant differences were noticed among (0°C, 5°C and room temperature). Fruit stored at room temperature exhibited

the highest value then followed by 5°C while fruit stored at 0°C recorded the lowest values.

This is due to the enhancing effect of increasing storage temperature on enzymatic activities and respiration rate, which lead to ripe stage (rutab) significantly. Treating fruit with CaCl<sub>2</sub> 4 % was more effective in reducing rutab % in all storage temperature than other treatments.

These results are in agreement with those obtained by many investigators who reported that CaCl<sub>2</sub> post harvest dipping is effective in reducing rutab percentage. Hussein *et al.*, (1993) reported that calcium was used to keep tissue integrity and retard rutab development, also Daood (1995) on Zaghloul dates and Fawaz (2006) on mango fruit they found similar results.

### **1.3. Decayed fruit percentage:**

Data presented in Tables (1, 3 & 5) and Fig. (1) indicated that the decay percentage of date fruit significantly increased as the storage period increased in all storage temperatures. Dates fruit treated with CaCl<sub>2</sub> 4 % showed a remarkable reduction in decayed fruit percentage.

In this concern dipping in CaCl<sub>2</sub> 4 % was more effective than 2 % and control at the end of storage in both seasons. The interaction effect of storage period and treatments in both seasons for all storage temperature was recorded.

Also, fruit stored at 0°C showed the lowest values of decay percentage than those stored at 5°C or at ambient temperature whereas the respiration rate was inhibited. These results could be confirmed with those obtained by Abou Aziz *et al.*, (1975) who found that Zaghloul dates were kept bitter at 0°C or 5°C without, showing chilling injury. Daood (1995) on Zaghloul dates, Nawar and Ezz (1994) revealed that 3 % CaCl<sub>2</sub> dipping treatment reduced fruit decay and improved fruit quality of guava fruit, and Fawaz (2006) on mango fruit.

## **2. Fruit chemical properties:**

### **2.1. Total acidity content:**

Data in Tables (2, 4 and 6) and Fig. (2) showed that there was a decrease in fruit acidity with the increase in storage period in all storage temperatures. Concerning the effect of CaCl<sub>2</sub> treatments, it could be noticed that there was no significant differences, especially, when the fruit were stored at 0°C then at 5°C, but fruit treated by dipping in CaCl<sub>2</sub> and stored at room temperature showed slightly increase in acidity content when compared to control in both seasons. It is obvious that the rate of decrease in fruit total acidity at 0 & 5°C with the advancement of storage period is comparatively lower than those placed under room temperature. These results are partially in agreement with those found by Daood (1995) on Zaghloul dates, Mehaisen (1999) on Le-Conte pear and Higazy *et al.*, (2002) reported that, fruit juice acidity of Zaghloul dates gradually decreased with extending the storage period during cold storage. Mohamed *et al.*, (2003) on Valencia orange.

**Effect of using calcium chloride and cold storage on prolonging.....**

**Table 1**

**Table 2**

**Effect of using calcium chloride and cold storage on prolonging.....**

**Table 3**

**Table 4**



**Effect of using calcium chloride and cold storage on prolonging.....**

**Table 5**

**Table 6**

**Effect of using calcium chloride and cold storage on prolonging.....**

**Fig 1**

**Fig 2**

## **Effect of using calcium chloride and cold storage on prolonging.....**

### **2.2. Tannins content:**

Data in Tables (2, 4 & 6) and Fig. (2) cleared that there is a remarkable reduction in tannins content with extended period during storage in all storage temperatures, but fruit were stored at room temperature had the lowest rate of reduction compared to those stored at 0 & 5°C.

No significant differences were noticed between all post harvest treatments on tannins content of Zaghloul dates.

These results are in harmony with that of Sawaya *et al.*, (1983) who found that tannins were decreased by advancing from Khalal to tamr stage, Rensburg *et al.*, (1986) proved that CaCl<sub>2</sub> post harvest treatment reduced phenolic compounds in avocado fruits, Daood (1995) stated a similar results on Zaghloul dates.

### **2.3. Total sugars:**

Presented data in Tables (2, 4 & 6) and Fig. (2) indicated that total sugars significantly increased till 9 days for fruits were stored at room temperature and 24 days for that stored at 0°C & 5°C in both seasons in all post harvest treatments.

Slight differences among treatments were noticed. Total sugars decrease at the end of the storage period could be due to the increase in rutab and decay percentage. The obtained data are in harmony with those of Sawaya *et al.*, (1983) and Daood (1995) on dates.

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**تأثير استخدام كلوريد الكالسيوم والتخزين المبرد على إطالة فترة تخزين البلح  
صنف "الزغلول"**

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**الملخص العربي**

أجرى هذا البحث خلال موسمي ٢٠٠٨، ٢٠٠٩ على صنف البلح الزغلول من النخيل النامي بمحطة بحوث البساتين بالقنطرة الخيرية بهدف إطالة الفترة التخزينية وتحسين صفات الجودة للثمار، حيث تم قطف الثمار في مرحلة الخلال بعد اكتمال تلونها في منتصف سبتمبر خلال موسمي الدراسة حيث تم اختيار الثمار المتماثلة في الحجم واللون والخالية من الأضرار وتم غسلها وتجفيفها وقسمت إلى ثلاث مجموعات وأجريت عليها المعاملات التالية:

١- ثمار غمرت في الماء المقطر لمدة ٣ دقائق للمقارنة.

٢- ثمار تم غمرها في محلول كلوريد الكالسيوم ٢ % لمدة ٣ دقائق.

٣- ثمار تم غمرها في محلول كلوريد الكالسيوم ٤ % لمدة ٣ دقائق.

ووضعت الثمار في عبوات من الكرتون سعة ٢ كجم وقسمت كل مجموعة إلى ثلاث أقسام

للتخزين على درجة حرارة الغرفة والصفير المئوي و ٥٥ م.

وأوضحت النتائج أن معاملة الثمار بكلوريد الكالسيوم بعد الحصاد كان له أثر فعال في تقليل

فقد وزن الثمار ونسبة الترتيب والتالف وتحسين باقي صفات الجودة وخاصة كلوريد الكالسيوم ٤

% أثناء التخزين المبرد وخاصة التخزين على درجة الصفير المئوي.

**Table (1): Effect of dipping treatments on some physical characteristics of Zaghoul dates held at ambient temperature during 2008 and 2009 seasons.**

Characters	Weight loss (%)				Rutab %				Decay %			
Treatments	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean
Storage periods in days	1st season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00D	0.00	0.00	0.00	0.00E
3	3.20	2.80	2.00	2.67D	1.04	1.00	1.00	1.01D	6.50	3.50	2.50	4.17D
6	5.60	4.50	3.30	4.47C	2.50	1.90	1.80	2.07C	25.20	15.20	9.30	16.57C
9	7.60	6.40	5.20	6.40B	3.20	2.40	2.50	2.70B	36.60	22.20	14.00	24.27B
12	10.50	8.90	7.40	8.93A	4.50	3.20	3.80	3.83A	51.50	26.50	18.30	32.10A
Mean	5.38A	4.52B	3.58C		2.45A	1.90C	2.02B		23.96A	13.48B	8.82C	
L.S.D.	T = 0.138 P = 0.178 T x P = 0.308				T = 0.116 P = 0.150 T x P = 0.259				T = 0.138 P = 0.178 T x P = 0.308			
	2nd season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00D	0.00	0.00	0.00	0.00E
3	3.60	3.00	2.20	2.93D	1.05	1.00	1.00	1.02D	6.30	3.30	2.30	3.97D
6	6.20	5.00	3.80	5.00C	2.90	2.10	2.20	2.40C	23.00	15.00	8.50	15.50C
9	8.20	7.00	5.40	6.87B	3.80	2.60	2.70	3.03B	36.00	21.00	13.20	23.40B
12	11.20	9.50	7.60	9.43A	4.90	3.50	3.90	4.10A	51.00	25.20	16.00	30.73A
Mean	5.84A	4.90B	3.80C		2.73A	2.04C	2.16B		23.26A	12.90B	8.00C	
L.S.D.	T = 0.138 P = 0.178 T x P = 0.308				T = 0.095 P = 0.122 T x P = 0.212				T = 0.138 P = 0.178 T x P = 0.308			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.



**Table (2): Effect of dipping treatments on some chemical characteristics of Zaghoul dates kept at ambient temperature during 2008 and 2009 seasons.**

Characters	Acidity (%)				Tannins				Total sugars (%)			
	Treatments	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %
Storage periods in days	1st season											
0	0.58	0.58	0.58	0.58A	1.15	1.15	1.15	1.15A	71.00	71.00	71.00	71.00C
3	0.55	0.53	0.55	0.54B	0.97	0.86	0.75	0.86B	75.00	80.10	78.50	77.87B
6	0.51	0.52	0.53	0.52C	0.92	0.75	0.62	0.76C	78.00	84.00	79.50	80.50A
9	0.48	0.50	0.51	0.50D	0.78	0.63	0.60	0.67D	84.00	77.20	74.20	78.47B
12	0.44	0.48	0.50	0.47E	0.58	0.52	0.53	0.54E	74.00	69.00	67.00	70.00C
Mean	0.51C	0.52B	0.53A		0.88A	0.78B	0.73B		76.40A	76.30A	74.00B	
L.S.D.	T = 0.007 P = 0.01 T x P = 0.017				T = 0.07 P = 0.09 T x P = 0.16				T = 1.545 P = 1.995 T x P = 3.455			
	2nd season											
0	0.52	0.52	0.52	0.52A	1.20	1.20	1.20	1.20A	69.00	69.00	69.00	69.00D
3	0.50	0.48	0.49	0.49B	1.00	1.10	1.05	1.05B	72.00	75.00	77.00	74.67C
6	0.46	0.47	0.48	0.47C	0.95	0.82	0.81	0.86C	77.00	81.50	84.00	80.83A
9	0.44	0.45	0.46	0.45D	0.79	0.68	0.75	0.74D	82.00	75.00	74.00	77.00B
12	0.38	0.43	0.45	0.42E	0.62	0.57	0.58	0.59E	69.00	68.00	67.00	68.00D
Mean	0.46C	0.47B	0.48A		0.91A	0.87A	0.88A		73.80A	73.70A	74.20A	
L.S.D.	T = 0.007 P = 0.01 T x P = 0.017				T = 0.07 P = 0.09 T x P = 0.16				T = 1.517 P = 1.959 T x P = 3.392			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.

**Table (3): Effect of dipping treatments on some physical characteristics of Zaghloul dates stored at 0 °C during 2008 and 2009 seasons.**

Characters	Weight loss (%)				Rutab %				Decay %			
Treatments	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean
Storage periods in days	1st season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00E	0.00	0.00	0.00	0.00E
8	0.84	0.74	0.60	0.73D	1.80	1.70	1.50	1.67D	7.00	3.00	2.70	4.23D
16	1.70	1.40	1.00	1.37C	2.60	2.10	2.00	2.23C	19.00	8.00	7.10	11.37C
24	2.60	2.20	1.80	2.20B	3.40	2.40	2.20	2.67B	22.00	14.00	12.80	16.27B
32	4.20	3.70	3.10	3.67A	4.20	3.10	3.20	3.50A	48.50	32.50	30.80	37.27A
Mean	1.87A	1.61B	1.30C		2.60A	2.06B	1.98B		19.30A	11.50B	10.68C	
L.S.D.	T = 0.1159 P = 0.1496 T x P = 0.259				T = 0.138 P = 0.178 T x P = 0.308				T = 0.1317 P = 0.17 T x P = 0.2945			
	2nd season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00E	0.00	0.00	0.00	0.00E
8	0.92	0.82	0.66	0.80D	1.80	1.60	1.40	1.60D	8.20	2.87	2.50	4.52D
16	2.10	1.70	1.40	1.73C	2.50	2.10	2.00	2.20C	15.90	9.00	6.80	10.57C
24	2.80	2.50	2.00	2.43B	3.20	2.60	2.40	2.73B	36.20	20.60	21.80	26.20B
32	4.40	3.80	3.30	3.83A	4.00	3.20	3.50	3.57A	51.50	33.60	32.20	39.10A
Mean	2.04A	1.76B	1.47C		2.50A	2.10B	2.06B		22.36A	13.21B	12.66C	
L.S.D.	T = 0.1159 P = 0.1496 T x P = 0.259				T = 0.138 P = 0.178 T x P = 0.308				T = 0.2007 P = 0.259 T x P = 0.449			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.

**Table (4): Effect of dipping treatments on some chemical characteristics of Zaghloul dates stored at 0 °C during 2008 and 2009 seasons.**

Characters	Acidity (%)				Tannins				Total sugars (%)			
	Treatments	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %
Storage periods in days	1st season											
0	0.58	0.58	0.58	0.58A	1.15	1.15	1.15	1.15A	71.00	71.00	71.00	71.00D
8	0.50	0.48	0.49	0.49B	1.00	0.98	0.97	0.98B	73.00	74.00	75.00	74.00C
16	0.46	0.45	0.46	0.46C	0.95	0.92	0.94	0.94BC	76.00	78.00	79.00	77.67B
24	0.44	0.43	0.41	0.43D	0.90	0.88	0.86	0.88C	80.00	83.00	82.00	81.67A
32	0.42	0.41	0.42	0.42E	0.82	0.76	0.77	0.78D	72.00	74.00	75.00	73.67C
Mean	0.48A	0.47B	0.47B		0.96A	0.94A	0.94A		74.40B	76.00A	76.40A	
L.S.D.	T = 0.008    P = 0.01    T x P = 0.017				T = 0.007    P = 0.01    T x P = 0.017				T = 1.527    P = 1.971    T x P = 3.414			
	2nd season											
0	0.52	0.52	0.52	0.52A	1.20	1.20	1.20	1.20A	69.00	69.00	69.00	69.00E
8	0.46	0.44	0.43	0.44B	0.96	0.94	0.92	0.94B	76.00	77.00	76.00	76.33C
16	0.44	0.42	0.42	0.43C	0.94	0.90	0.84	0.89BC	78.00	79.00	78.00	78.33B
24	0.42	0.40	0.39	0.40D	0.86	0.80	0.78	0.81CD	80.20	82.00	81.00	81.07A
32	0.39	0.38	0.37	0.38E	0.80	0.70	0.68	0.73D	71.00	72.67	73.00	72.22D
Mean	0.45A	0.43B	0.43B		0.95A	0.91A	0.88A		74.84A	75.93A	75.40A	
L.S.D.	T = 0.008    P = 0.01    T x P = 0.017				T = 0.07    P = 0.09    T x P = 0.1587				T = 1.47    P = 1.897    T x P = 3.286			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.

**Table (5): Effect of dipping treatments on some physical characteristics of Zaghloul dates stored at 5 °C during 2008 and 2009 seasons.**

Characters	Weight loss (%)				Rutab %				Decay %			
	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean
Storage periods in days	1st season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00E	0.00	0.00	0.00	0.00E
8	1.58	1.36	1.00	1.31D	2.20	2.10	1.90	2.07D	10.20	8.60	7.20	8.67D
16	3.30	2.66	1.90	2.62C	3.00	2.40	2.20	2.53C	19.00	16.30	16.10	17.13C
24	4.60	3.90	3.20	3.90B	3.60	2.90	2.50	3.00B	37.00	29.00	31.00	32.33B
32	5.80	5.00	4.20	5.00A	4.80	3.40	3.20	3.80A	54.53	45.20	41.80	47.18A
Mean	3.06A	2.58B	2.06C		2.92A	2.36B	2.16C		24.15A	19.82B	19.22C	
L.S.D.	T = 0.121 P = 0.156 T x P = 0.269				T = 0.136 P = 0.175 T x P = 0.304				T = 0.134 P = 0.173 T x P = 0.299			
	2nd season											
0	0.00	0.00	0.00	0.00E	1.00	1.00	1.00	1.00E	0.00	0.00	0.00	0.00E
8	1.70	1.50	1.20	1.47D	2.20	1.90	1.80	1.97D	10.50	7.80	7.40	8.57D
16	3.60	2.88	2.30	2.93C	2.80	2.57	2.20	2.52C	20.20	17.00	15.80	17.67C
24	4.88	4.30	3.40	4.19B	4.40	2.80	2.90	3.37B	40.60	30.50	28.00	33.03B
32	6.20	5.40	4.40	5.33A	4.30	4.10	3.80	4.07A	55.60	47.20	44.00	48.93A
Mean	3.28A	2.82B	2.26C		2.94A	2.47B	2.34C		25.38A	20.50B	19.04C	
L.S.D.	T = 0.118 P = 0.153 T x P = 0.264				T = 0.129 P = 0.167 T x P = 0.2897				T = 0.140 P = 0.181 T x P = 0.313			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.

**Table (6): Effect of dipping treatments on some chemical characteristics of Zaghloul dates stored at 5 °C during 2008 and 2009 seasons.**

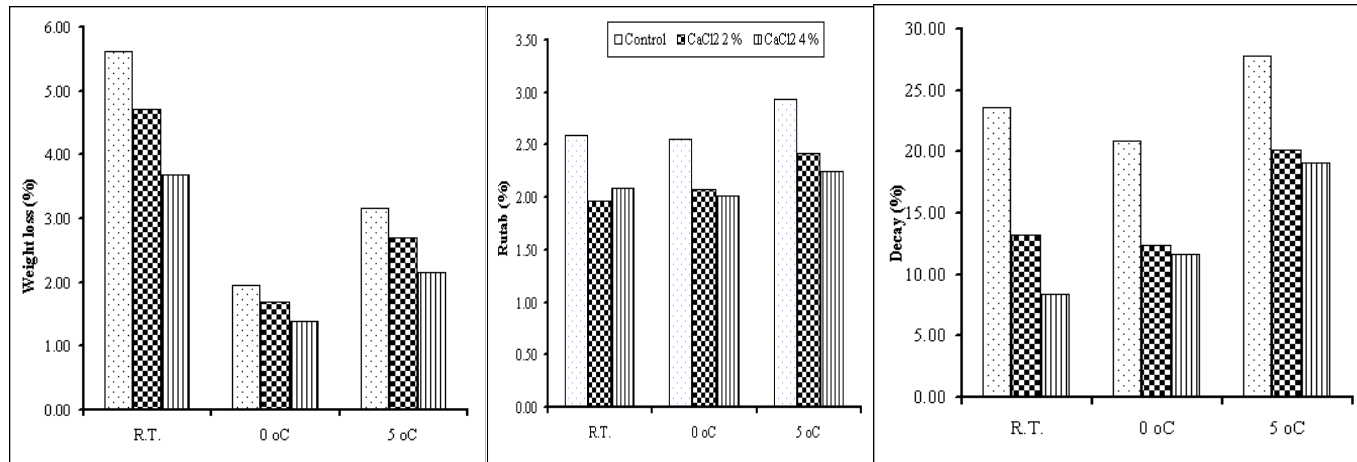
Characters	Acidity (%)				Tannins				Total sugars (%)			
	Treatments	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %	Mean	Contol	CaCl <sub>2</sub> 2 %	CaCl <sub>2</sub> 4 %
Storage periods in days	1st season											
0	0.58	0.58	0.58	0.58A	1.15	1.15	1.15	1.15A	71.00	71.00	71.00	71.00D
8	0.46	0.44	0.42	0.44B	0.98	0.95	0.93	0.95B	75.20	78.00	79.00	77.40C
16	0.42	0.43	0.40	0.42C	0.92	0.88	0.86	0.89BC	80.00	80.50	81.00	80.50B
24	0.40	0.39	0.38	0.39D	0.88	0.82	0.82	0.84CD	82.00	83.20	84.00	83.07A
32	0.39	0.38	0.39	0.39D	0.80	0.74	0.73	0.76D	77.00	78.00	80.20	78.40C
Mean	0.45A	0.44A	0.43B		0.95A	0.91A	0.90A		77.04B	78.14AB	79.04A	
L.S.D.	T = 0.007 P = 0.01 T x P = 0.017				T = 0.007 P = 0.086 T x P = 0.150				T = 1.515 P = 1.956 T x P = 3.388			
	2nd season											
0	0.52	0.52	0.52	0.52A	1.20	1.20	1.20	1.20A	69.00	69.00	69.00	69.00D
8	0.45	0.43	0.42	0.43B	0.94	0.90	0.88	0.91B	76.00	79.00	78.00	77.67C
16	0.42	0.41	0.42	0.42C	0.90	0.82	0.80	0.84BC	79.00	81.00	82.00	80.67B
24	0.38	0.38	0.37	0.38D	0.82	0.76	0.72	0.77CD	81.00	83.50	84.00	82.83A
32	0.36	0.36	0.35	0.36E	0.76	0.68	0.67	0.70D	75.00	77.00	76.00	76.00C
Mean	0.426A	0.420AB	0.416B		0.92A	0.87A	0.85A		76.00B	77.90A	77.80A	
L.S.D.	T = 0.007 P = 0.01 T x P = 0.017				T = 0.007 P = 0.091 T x P = 0.159				T = 1.508 P = 1.947 T x P = 3.373			

Means followed by the letter (s) are not significant at 5 % level.

T = Treatments.

P. Storage periods.

T x P = The interaction between T and P.



**Fig (1): Effect of dipping in calcium chloride solutions on physical properties of Zaghoul dates after storage at (0 °C & 5 °C for 32 days) and room temperature for 12 days (average of two seasons).**

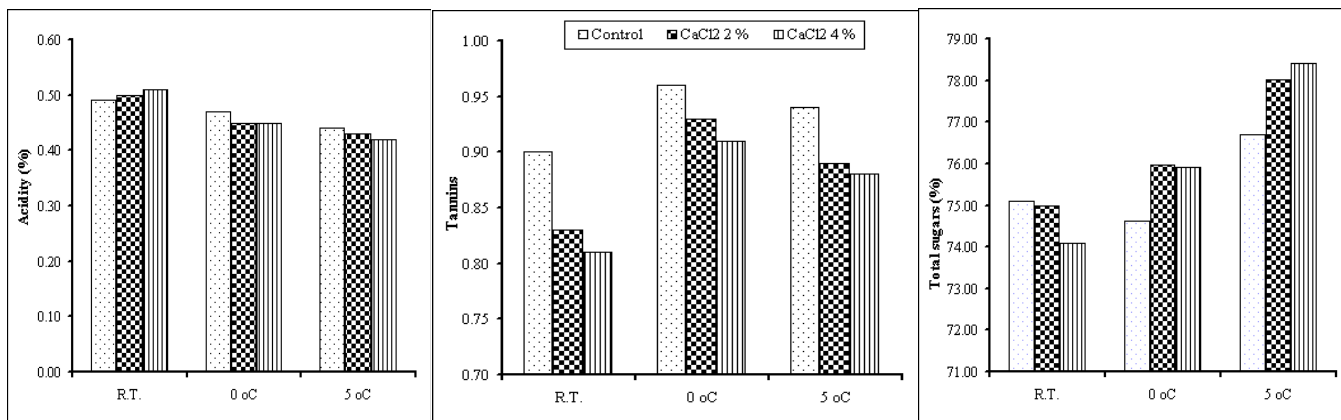


Fig (2): Effect of dipping in calcium chloride solutions on chemical properties of Zaghoul dates after storage at (0 °C & 5 °C for 32) days and room temperature for 12 days (average of two seasons).

