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THE EFFECT OF POSTHARVEST TREATMENTS WITH ETHANOL OR CALCIUM CHLORIDE ON FRUIT QUALITY OF FRESH ZAGHLOUL DATES

[52]

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ABSTRACT

Zaghloul date bunches (*Phoenix dactylifers L.*) were harvested at Khalal stage (maturity) after 21 weeks from pollination during 2001 and 2002 seasons. Fruits with the spikelets were subjected to different concentration of ethanol vapor (as externally naturally volatiles) in sealed jars (as container) or immersed in calcium chloride solutions and stored at 5°C. Both calcium dipped fruits at 6% and ethanol exposed ones at 6 ml./kg. gave the least percentage of rutab, decay, unmarketable fruits, weight loss and crude fibers, as well as length and width of fibers comparing with other treated and untreated fruits. Also, $CaCl_2$ immersed fruits surpassed other treatments regarding reduction in decay percentage and increasing in total soluble solid/total acidity ratio, total and reducing sugars content. Meanwhile, ethanol exposed fruits give the best reduction in shrinkage of fruits and increasing nonreducing sugars. On the other hand, low decay and weight loss percentages were observed during shelf life (marketability period) with the aforenamed Ca treatment. Such fruits had the highest TSS and TSS/acid ratio, while ethanol treated fruits appeared the lowest percentage of rutab fruits. Thus, it is adviseable to treat the Zaghloul date fruits with ethanol vapor on the container level at 6 ml./kg. or with calcium chloride solution at 6% rate accompanied with cold storage at 5°C and a 85% Relative Humidity . for entering the fruits into the rutab stage at slow rate, consequently extending the marketing season and keeping good eating quality.

Key Words: Date Palm, Ehtanol, Calcium, Storage ability, Quality

INTRODUCTION

Zaghloul date palm is the most important cultivar of soft dates and is very demanded in the Egyptian market, its fruits is consumed fresh at Khalal stage (full red colored stage). The main problem associated with this cultivar is the tendency to deteriorate quickly through physiological changes leading to ripening. The development of techniques to delay and/or manage ripening would enhance the commercial and economic value of this crop and provide a delicious product for consumers (**Al-Hooti *et al* 1997**). These techniques include: cold storage, control atmosphere storage, ethylene addition and/or removed and inhi-

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bition of ethylene action through chemical means. **Kamal (1995)** found that 5 or 7°C were suitable temperatures to store Zaghloul date for two months, meanwhile, **El-Shiekh (2001)** noted that 4°C was favourable for maintaining the Zaghloul quality for 3 week. The ability of ethanol to inhibit fruit ripening and senescence in climacteric fruits was reported by **Saltveit and Sharaf (1992)**, on tomato and **Hewage *et al* (1995)**, on banana. Moreover, **Ritenour *et al* (1997)** reported that this ability seems to be dependent on a number of factors which include species, cultivar, maturity, applied concentration, mode of application and duration of exposure. Also, **Serrano *et al* (2001)** reported that dates could be considered as a climacteric fruit. In addition, postharvest dipping with a Ca-solution improved storage quality **(Poovaiah, 1988)**. Calcium generally seen as protective in reducing the rate of plant senescence and fruit ripening **(Ferguson and Drobak, 1988)**.

The objectives of this study is to test whether ethanol or calcium treatments can delay the ripening and keep the best fruits appearance and quality of Zaghloul date under cold storage.

MATERIAL AND METHODS

Plant material

Mature bunches of Zaghloul date (*Phoenix dactylifera L.*) were harvested in 15th, Sept., 2001 and 17th Sept., 2002 seasons from the experimental orchard, Ministry of Agriculture at Kanater El-Khairia, Kalubia Governorate, Egypt. The bunches were picked when they reached the commercially derived color at Khalal stage, (21 weeks after pollination) according to **Mawlood, (1980)**, washed with tap water and air dried. Sound fruits with the spikelets were selected and divided into two groups:

The first group of fruits were paced with ethanol in 20 litre air tight glass jars for 12 hours using a rate of 4 ml ethanol/kg. fruits added to a 3 litre sealed container "jars" as noted by **Hewage *et al* (1995)**. Such, fruits were subjected to different ethanol concentrations as follows: 2,4 or 6 ml ethanol/kg. fruits/3 litre jars, these act 13.33, 26.66 or 40 ml ethanol/6.66 kg. fruits (= almost 220 fruits)/20 litre jars, the same amount for control treatment (untreated) imprisoned in 20 litre sealed jars for 12 hours to facilitate ethanol evaporation, reagent grade ethanol 95% was pipetted into a folded 9 cm diameter filter paper positioned on a Petri plate inside each jars according to **(Ritenour *et al* 1997)**. The jars were immediately sealed with blaster band for up to 12 h., then after ethanol exposure, the jars were opened and allowed to ventilate, and to ripen in four standard carton boxes per treatment.

The second group of fruits were dipped for 5 minutes in calcium chloride ($CaCl_2$) solution at 2,4,6% concentration. Also, the same quantity for control treatment (untreated) were immersed in distilled water for 5 min., then fruits per treatment were dried in open air, packed in four standard boxes. All carton boxes (eight different treatments) were stored at 5°C and 85% Relative Humidity in National Research Center. Each treatment was replicated three times, one box each, in addition, one box was added for chemical analysis.

Fruit quality determinations

They were conducted at 10 days intervals throughout the storage period till

the percentage of unmarketable fruits in all treatments reached ≥ 50%. Samples of the two treatments had the less unmarketability fruits in the end of storage (50 days) were taken and left at ambient room (21 ± 1°C & 56 ± 2 R.H.) for 2 and 4 days (shelf life) to simulate marketing conditions and analyzed thereafter.

Rutab percentage, Decay percentage as well as, unmarketable fruits % were calculated as sum of Rutab and Decay %. Weight loss in each sampling time was determined after excluding Rutab fruits and the percentage of loss was calculated.

Total soluble solids (TSS) using hand refractometer, total titratable acidity as citric acid (according to the **A.O.A.C., 1995**). TSS/acid ratio was calculated. Total sugars in dry weight were determined according to the method of Lane and Eynon as described in **A.O.A.C. (1995)**, crude fibers was determined in dry weight according to the procedure described by the **A.O.A.C. (1995)**. Also, Shrinkage % in the end of storage was determined.

Fiber length and width: 0.5gm. pulp samples were first impregnated in definite amount of water. For isolating non-cellulosic fibers and bleaching the fibers, sodium hydroxide was used as alkalin at a concentrations of 2% and 8%, consistency on water bath at 80°C for half hour, then the samples were treated with 5 ml of chlorox (5.2% conc.), 3% consistency and pH of 10.5 at start and 9 at the end, this stage was carried out at temperature of 60°C for ½ hour, this stage was repeated another time, with filtration and washing of sample after every stage, then it was impregnated in distilled water for 24 hours, follow by stirring using glass rod for desintegration. Few amount of fibers was transferred between two sites from glass rod. **(Casey, 1952)**. The fiber length and width were measured using Nikon Profile Projector V-12, 18/88 Nippon Kogaku, X100, 1min. vernier), expressed as micron "μ", this was measured in the second season only because there was difficult chewing or masticatory of pulp was observed at the end of storage period in the first season.

Statistical anlaysis: The obtained data were statistically analysed according to **Snedecor and Cochran (1982)**. Means were compared using Duncan's multiple range test **(Duncan, 1955)** at the 5% level of probability.

RESULTS AND DISCUSSION

A) Physical and Chemical Changes during cold storage

1- ***Rutab fruits percentage***: It means that the fruits begin to soften and acquiring a darker and less attractive color from the previous stage **(Sawaya *et al* 1986)**.

The results presented in Table (1_a) indicated that rutab fruits gradually increased as the cold storage period extended till 50 days during the two seasons. This result is in harmony with **Kamal (1995)** on Zaghloul and Samani date fruits. Both calcium dipped date fruits at high concentration (6%) and ethanol exposed date fruits at 6 ml./kg. had the lowest rutab percentage as compared with the untreated and other treated dates, this was more obvious in the first season. Moreover, date fruits exposed to ethanol at 6ml/kg. gave significantly lower rutab % than those dipped in calcium at 6% conc. throughout shelf life period, (Table 1_b). This was true in the two seasons. This may be due to possible mechanism for the retardation of ripening

Table 1a. Rutab fruits percentage of Zaghloul date during cold storage (5°C& 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001						Season 2002					
Storage period(days) / Treatment	10	20	30	40	50	Mean	10	20	30	40	50	Mean
Without ethanol (untreated)	22.67	29.07	30.46	55.25	79.00	43.29A	16.02	23.69	26.47	47.49	76.74	38.08AB
Exposure to ethanol at 2 ml./kg.	12.19	21.15	23.37	60.02	77.73	38.89AB	6.12	18.49	22.34	49.67	81.80	35.68AB
Exposure to ethanol at 4 ml./kg.	6.01	13.92	17.31	60.14	76.27	34.73AB	9.57	18.23	24.57	53.39	84.26	38.00AB
Exposure to ethanol at 6 ml./kg.	13.91	16.98	20.59	38.59	64.21	30.86B	6.01	11.98	15.55	50.54	62.84	29.38B
Without calcium chloride (untreated)	19.79	25.62	30.63	64.80	76.49	43.74A	14.34	25.51	31.25	49.47	74.00	38.91A
Dipping in calcium chloride at 2%	18.57	23.22	25.53	64.32	72.03	40.73A	17.14	19.45	21.77	54.22	67.77	36.07AB
Dipping in calcium chloride at 4%	21.58	25.47	27.06	52.73	73.29	40.03A	16.60	19.97	22.36	49.13	62.62	34.14AB
Dipping in calcium chloride at 6%	8.86	12.80	14.40	26.24	48.58	22.18C	7.03	13.27	20.54	50.66	63.82	31.06AB
Mean	15.45D	21.08CD	23.67C	52.76B	70.95A		11.60D	18.82E	23.11C	50.57B	71.73A	

Table 1b. Rutab fruits percentage of Zaghloul date during shelf life (21 ± 1°C and 56 ± 2R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001			Season 2002		
Shelf life (days) / Treatment	2	4	Mean	2	4	Mean
Exposure to ethanol at 6 ml./kg	9.45d	18.08b	13.76B	3.03c	15.60b	9.33B
Dipping in calcium chloride at 6%	15.29c	37.33a	26.31A	16.25b	43.75a	30.00A
Mean	12.37B	27.71A		9.64B	29.68A	

Means with the same letters are not significantly different at 5% level.

(rutab) that under these anaerobic conditions ethanol accumulate, therefore, inhibits or slows down the ripening process (rutab) in some way (**Davies, 1980**). These results are in line with the findings of **Hewage *et al* (1995)**, who found that ethanol retarded banana ripening at the highest conc. used. Also, **Ferguson and Drobak (1988)** reported that Ca^{++} is generally seen as protective in reducing the rate of plant senescence and fruit ripening.

2- Decay percentage: From Table (2_a) it can be concluded that no significant changes were shown in decay percentage of Zaghloul dates as storage period advanced till 30 days from the cold storage at 5°C then decay was significantly increase till the end of storage (50 days), where they reached 15.00% in the first season and 13.08% in the second season. Thus, exposure to ethanol at a rate of 6ml/kg was effective in decreasing decay % followed with dipping in $CaCl_2$ at 6% rate. On the other hand, when the treated dates were hold at shelf life conditions (Table 2_b), calcium treated fruits appeared to be the lowest in decay percentage compared with ethanol exposed fruits. This was true in both seasons, Calcium induced resistance to postharvest pathagens which attributed to an interaction between certain cell wall components and Ca ions (**Conway *et al* 1994**). The obtained results are confirmed by **Singh *et al* (2000)**, on mango; **Abd Al-Naby and Nadir (2002)** and **Souza *et al* (1999)**, on peach with calcium rule. Also, by **Ghahramani *et al* (2000)**, on apple and **Hewage *et al* (1995)**, on banana with ethanol rule.

3- Unmarketable fruits percentage: Unmarketable fruits percentage was significantly increased as the cold storage period advanced throughout the two studied seasons (Fig. $1_{a,b}$), it acts the sum of rutab and decay fruits. The most unmarketable fruits were due to increasing rutab fruits (they are undesirable character). Treated fruits with either ethanol vapor at 6 ml./kg. rate or $CaCl_2$ at 6% conc. both were more effective in lowering unmarketable fruits % than the other treated and control fruits. This was true in two seasons. On the other hand, both the previous treatments (Fig. $3_{a,b}$) had no significant differences in their behaviour during shelf life (4 days on ambient room after 50 days storage on 5°C). In this respect, **Abdulsalam (1995)** found that the high concentrations of propolis ethanol extract were more effective than lower conc. against all the soilborne tested fungi.

4- Weight loss percentage: It is clear from Table (3_a) that weight loss percentage was significantly increased with prolonged storage period. The same trend was observed in both seasons of the study. Also, all treated and untreated fruits recorded high weight loss because of removing rutab fruits at each storage period (date sampling). The Ca-treated fruits at 6% rate in the first season and those that exposed to ethanol at 6 ml./kg. in the second season had the lowest weight loss (22.21 and 18.12%, respectively). Meanwhile, the untreated and other treated fruits were recorded from 34.48-26.25% loss in the first season and 34.05-24.00% in the second season. Besides, $CaCl_2$ at 6% and ethanol at 6 ml./kg. treatments under shelf life condition (Table 3_b) gave the same trend in the first season, but in the second season, Ca treated fruits had lower weight loss than ethanol exposed fruits. In genral, the loss in fruit weight is mainly due to water loss

Table 2a. Decay percentage of Zaghloul date fruits during cold storage (5°C& 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001						Season 2002					
Storage period (days) / Treatment	10	20	30	40	50	Mean	10	20	30	40	50	Mean
Without ethanol (untreated)	6.11	10.27	10.27	13.88	18.20	11.75A	3.50	6.05	6.05	6.25	10.88	6.55DE
Exposure to ethanol At 2 ml./kg.	6.67	11.11	13.33	13.33	14.47	11.78A	1.33	2.92	4.70	5.95	7.28	4.44EF
Exposure to ethanol At 4 ml./kg.	8.16	9.67	11.33	12.85	17.24	11.85A	1.64	2.37	2.37	3.29	5.79	3.09F
Exposure to ethanol At 6 ml./kg.	2.28	4.86	4.86	5.53	5.53	4.61C	0.0	1.44	1.44	1.74	4.74	1.87F
Without calcium Chloride (untreated)	8.86	8.86	8.86	11.26	15.24	10.62AB	7.34	8.11	8.11	22.79	24.37	14.14A
Dipping in calcium Chloride at 2%	6.20	7.83	8.64	15.29	16.74	10.94AB	5.43	7.66	7.66	16.13	22.30	11.84AB
Dipping in calcium Chloride at 4%	5.79	7.22	7.22	13.12	18.04	10.28AB	6.42	7.90	10.00	13.0	15.07	10.48BE
Dipping in calcium Chloride at 6%	0.0	0.0	0.97	14.89	14.55	6.10BC	3.17	4.03	5.58	11.93	14.25	7.79CD
Mean	5.51B	7.48B	8.18B	12.52A	15.00A		3.60B	5.06C	5.74C	10.13B	13.08A	

Table 2b. Decay percentage of Zaghloul date fruits during shelf life (21 ± 1°C and 56 ± 2 R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001			Season 2002		
Shelf life (days) / Treatment	2	4	Mean	2	4	Mean
Exposure to ethanol at 6 ml./kg	5.50b	15.70a	10.60A	19.39	21.05	20.20A
Dipping in calcium chlorid at 6%	2.70c	5.26b	3.99B	0.00	1.37	0.69B
Mean	4.10B	10.48A		9.70A	11.21A	

Means with the same letters are not significantly different at 5%level.

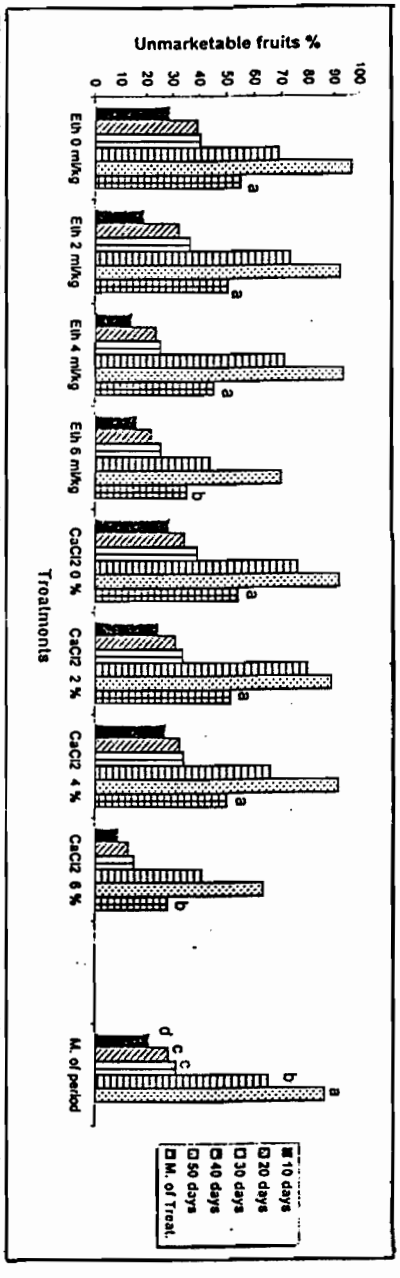

Fig. (1 a): Unmarketable fruits percentage of Zaghloul date fruits during cold storage (5°C + 85 % R.H.) as affected with ethanol and calcium chloride treatments in 2001 season.

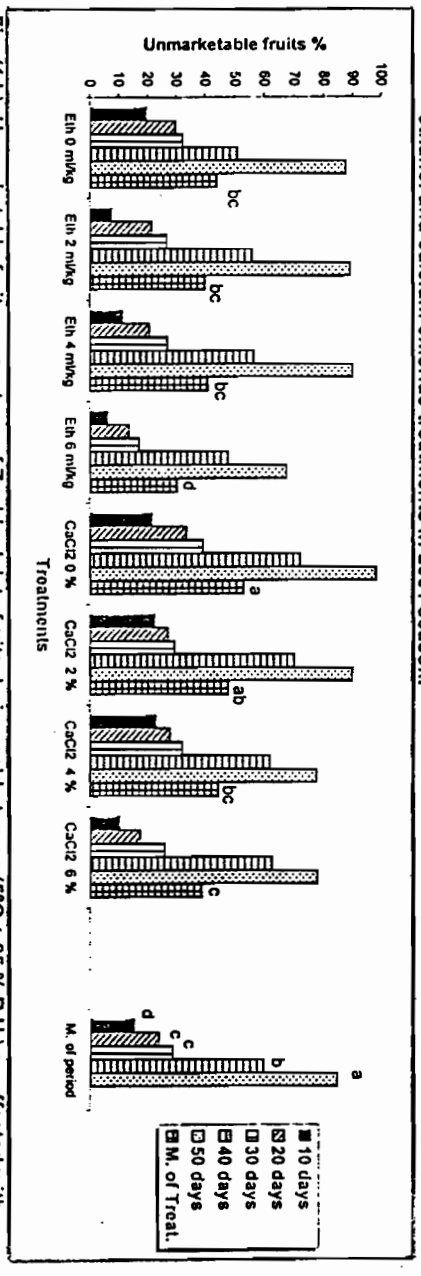

Fig. (1 b): Unmarketable fruits percentage of Zaghloul date fruits during cold storage (5°C + 85 % R.H.) as affected with ethanol and calcium chloride treatments in 2002 season.

Table 3a. Weight loss percentage of Zaghloul date fruits during cold storage (5°C & 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001						Season 2002					
Storage period (days) / Treatment	10	20	30	40	50	Mean	10	20	30	40	50	Mean
Without ethanol (untreated)	5.04	30.78	36.20	41.24	57.54	34.16A	13.77	21.94	30.44	38.38	60.05	32.92A
Exposure to ethanol at 2 ml./kg.	3.59	25.23	31.21	36.75	51.34	29.62AB	7.16	18.33	24.91	33.26	43.88	25.51BC
Exposure to ethanol at 4 ml./kg.	6.01	17.82	25.92	34.86	46.64	26.25BC	10.32	12.54	21.80	27.32	48.05	24.00C
Exposure to ethanol at 6 ml./kg.	6.72	16.23	23.52	29.52	58.66	26.93BC	0.83	8.51	16.20	21.11	43.93	18.12D
Without calcium chloride (untreated)	2.83	28.04	32.18	38.41	69.98	34.29A	8.41	26.98	30.78	33.86	67.57	33.52A
Dipping in calcium chloride at 2%	4.41	25.96	33.13	37.10	71.80	34.48A	9.55	25.00	29.29	36.69	69.71	34.05A
Dipping in calcium chloride at 4%	4.16	22.89	28.13	32.80	66.05	30.81AB	3.27	19.67	30.03	41.26	58.93	30.63AB
Dipping in calcium chloride at 6%	4.47	17.37	22.69	26.29	40.24	22.21C	4.06	15.70	24.11	37.46	64.27	29.12ABC
Mean	4.65E	23.04D	29.12C	32.62B	57.78A		7.17E	18.58D	25.94C	33.67B	57.05A	

Table 3b. Weight loss percentage of Zaghloul date fruits during shelf life (21 ± 1°C and 56 ± 2 R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001			Season 2002		
Shelf life (days) / Treatment	2	4	Mean	2	4	Mean
Exposure to ethanol at 6 ml./kg	12.50	33.50	23.00A	19.85b	35.57a	27.71A
Dipping in calcium chlorid at 6%	8.69	36.95	22.82A	8.69c	34.34a	21.52B
Mean	10.59B	35.22A		14.27B	34.96A	

Means with the same letters are not significantly different at 5% level.

as a result of evaporation and transpiration, plus the amount of dry matter lost by respiration. Such, Calcium is responsible for reducing the evaporation of water through fruit surface and consequently gave the lowest loss in fruit weight. These results are in a good agreement with those obtained with calcium application by **Abd El-Naby and Nadir (2002),** on Peach; **Kaundal *et al* (2000),** on plum and with ethanol rule **Ahmed and Abd El-Naby (1999)** and **Hewage *et al* (1995),** on banana.

5- Total Soluble solids percentage (TSS%): Results in Table (4_a) showed that TSS was increased in the first 20 days of storage at 5°C and 85% R.H. followed by a reduction till the end of storage period. This was significant and true in the two seasons. Ethanol exposed fruits at 2 ml./kg. in the first season and Ca-dipped fruits at 6% in the second season gave significantly the highest TSS% comparing with other treated or untreated fruits, while Ca-treated fruits at 2% or ethanol exposed ones at 6 ml./kg. and the control had the lower TSS values in the two seasons. During the shelf life conditions Table (4_b) TSS values decreased with prolonged storage period up to the fourth date, as well as, Ca-dipped fruits gave significantly high TSS values over ethanol exposed ones. The interaction between treatments and storage periods was significant and more obvious with the end of storage where fruits treated $CaCl_2$ at 6% gave the highest TSS values for 50 days of cold storage. Thus, TSS in fruit is associated with sensory sweetness and is the most important indicator of quality and eating acceptability. This is in accordance with those recorded by **Hewage *et al* (1995)** and **Poovaiah *et al* (1988).**

6- Total acidity percentage (TA%): As seen in Table (5_a) total acidity percentage was significantly decreased after 20 days of all the tested treatments in the first season, while it was observed after 10 days in the second season of storage at 5°C and 85% R.H. up to the end storage period. No significant difference was observed between all treated and untreated fruits during storage at 5°C in the first season or during the duration at shelf life (Table 5_b) in the two seasons. Where in the second season, Ca dipped fruits at 6% rate at 5°C and 85% R.H. had the lowest acidity. The interaction between treatments and storage periods was significant in the second season where fruits treated with $CaCl_2$ at 6% or ethanol at 6 ml/kg. and stored for 50 days contained the lowest acidity. This results agreed with those obtained by **Singh *et al* (2000); Al-Hooti *et al* (1997)** and **Hewage *et al* (1995).**

7- Total soluble solid/total acidity ratio (TSS/TA): It is shown in Fig. ($2_{a,b}$) that TSS/TA ratio gradually increased as storage period advanced, after 10 days from the storage at 5°C and 85% R.H. Where, Ca-dipped fruits at 6% rate had the highest TSS/TA ratio comparing with all treatments in the two seasons. Also, this treatment had the high TSS/TA ratio than those exposed of ethanol during the duration at shelf life (Fig. 4_{a-b}). This was true in the two seasons. The same results were reported by **Serrano *et al* (2001); Hewage *et al* (1995)** and **Davies (1980).**

B) Some fruit physical and chemical properties at the end of cold storage period

It is quite clear from Table (6_a), that Ca-dipped fruits, specially at 6% rate, had

Table 4a. Total soluble solids percentage (TSS) of Zaghloul date fruits during cold storage (5°C & 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001							Season 2002						
Storage period (days) / Treatment	0	10	20	30	40	50	Mean	0	10	20	30	40	50	Mean
Without ethanol (untreated)	22f	28c	30b	22f	18ij	15 lm	22.5B	20fg	22de	29a	23d	17ij	15kl	21.0AB
Exposure to ethanol at 2 ml./kg.	22f	25de	32a	25de	19hi	16kl	23.2A	20fg	22de	28ab	23d	16jk	16jk	20.8ABC
Exposure to ethanol at 4 ml./kg.	22f	22f	29bc	24e	16kl	16kl	21.5C	20fg	21ef	28ab	23d	19gh	15kl	21.0AB
Exposure to ethanol at 6 ml./kg.	22f	22f	29bc	22f	16kl	14mn	20.8D	20fg	20fg	29a	22de	16jk	14l	20.2C
Without calcium chloride (untreated)	22f	22f	25de	19hi	17jk	13n	19.7E	20fg	21ef	27bc	20fg	18hi	15kl	20.2C
Dipping in calcium chloride at 2%	22f	22f	26d	20gh	20gh	15 lm	20.8D	20fg	21ef	26c	21ef	20fg	16jk	20.7BC
Dipping in calcium chloride at 4%	22f	22f	29bc	21fg	20gh	15 lm	21.5C	20fg	20fg	29a	23d	19gh	17ij	21.3AB
Dipping in calcium chloride at 6%	22f	22f	30b	24e	20gh	17jk	22.5B	20fg	20fg	28ab	22de	21ef	18hi	21.5A
Mean	22.0C	23.1B	28.8A	22.1C	18.2D	15.1E		20.0D	20.8C	28.0A	22.1B	18.2E	15.7F	

Table 4b. Total soluble solids percentage of Zaghloul date fruits during shelf life (21 ± 1°C and 56 ± 2 R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001				Season 2002			
Shelf life (days) / Treatment	0	2	4	Mean	0	2	4	Mean
Exposure to ethanol at 6 ml./kg	14bc	13cd	12cd	13.0B	14	12	11	12.3B
Dipping in calcium chlorid at 6%	17a	15b	12cd	14.6A	18	15	12	15.0A
Mean	15.5A	14.0B	12.0C		16.0A	13.5B	11.5C	

Means with the same letters are not significantly different at 5% level.

Table 5a. Total acidity percentage (TA) of Zaghloul date fruits during cold storage (5°C& 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001							Season 2002						
Storage period (days) / Treatment	0	10	20	30	40	50	Mean	0	10	20	30	40	50	Mean
Without ethanol (untreated)	0.092	0.099	0.093	0.090	0.077	0.064	0.086A	0.094a	0.094a	0.092a	0.077c	0.064d	0.058e	0.080A
Exposure to ethanol at 2 ml./kg.	0.092	0.094	0.094	0.077	0.054	0.032	0.074A	0.094a	0.094a	0.093a	0.077c	0.051d	0.038j	0.074B
Exposure to ethanol at 4 ml./kg.	0.092	0.098	0.090	0.054	0.026	0.026	0.064A	0.094a	0.094a	0.092a	0.058e	0.026l	0.026l	0.065D
Exposure to ethanol at 6 ml./kg.	0.092	0.094	0.094	0.058	0.026	0.026	0.065A	0.094a	0.096a	0.077c	0.049h	0.026l	0.019m	0.060F
Without calcium chloride (untreated)	0.092	0.096	0.094	0.077	0.049	0.045	0.075A	0.094a	0.098a	0.090b	0.064d	0.045i	0.045i	0.073C
Dipping in calcium chloride at 2%	0.092	0.096	0.092	0.077	0.051	0.019	0.071A	0.094a	0.094a	0.089b	0.054f	0.032k	0.026l	0.065D
Dipping in calcium chloride at 4%	0.092	0.098	0.092	0.064	0.032	0.026	0.067A	0.094a	0.094a	0.076c	0.051g	0.032k	0.019m	0.061E
Dipping in calcium chloride at 6%	0.092	0.098	0.092	0.058	0.026	0.019	0.064A	0.094a	0.094a	0.064d	0.051g	0.026l	0.019m	0.058G
Mean	0.092A	0.097A	0.093A	0.070B	0.043C	0.032C		0.094A	0.094A	0.084B	0.060C	0.038D	0.031E	

Table 5b. Total acidity percentage (TA) of Zaghloul date fruits during shelf life (21 ± 1°C and 56 ± 2 R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001				Season 2002			
Shelf life(days) / Treatment	0	2	4	Mean	0	2	4	Mean
Exposure to ethanol at 6 ml./kg	0.026	0.020	0.015	0.020A	0.019	0.017	0.012	0.016A
Dipping in calcium chlorid at 6%	0.019	0.018	0.015	0.017A	0.019	0.016	0.012	0.015A
Mean	0.022A	0.019A	0.015A		0.019A	0.016A	0.012A	

Means with the same letters are not significantly different at 5% level.

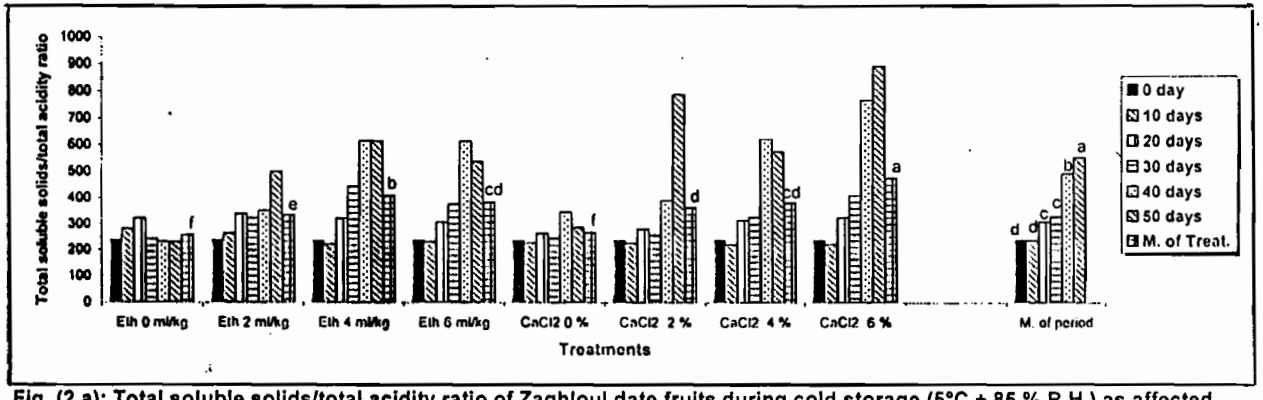

Fig. (2 a): Total soluble solids/total acidity ratio of Zaghloul date fruits during cold storage (5°C + 85 % R.H.) as affected with ethanol and calcium chloride treatments in 2001 season.

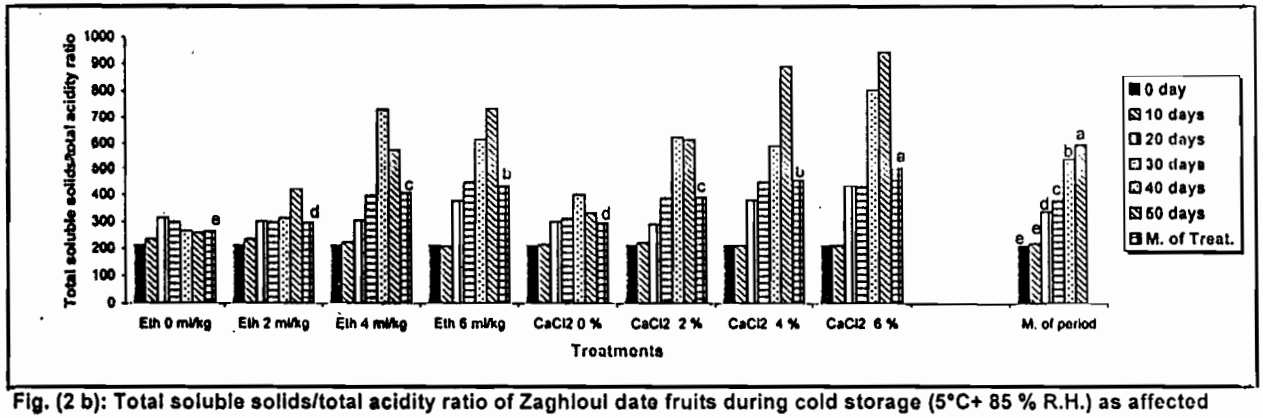

Fig. (2 b): Total soluble solids/total acidity ratio of Zaghloul date fruits during cold storage (5°C+ 85 % R.H.) as affected with ethanol and calcium chloride treatments in 2002 season.

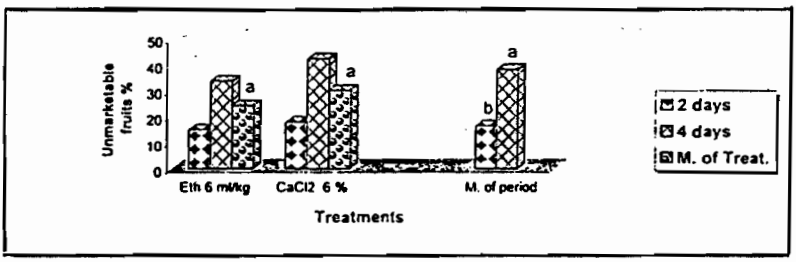

Fig. (3 a): Unmarketable fruits percentage of Zoghloul date fruits during shelf life (21±1 °C+ 56% R.H.) as affected with ethanol and calcium chloride treatments in 2001 season.

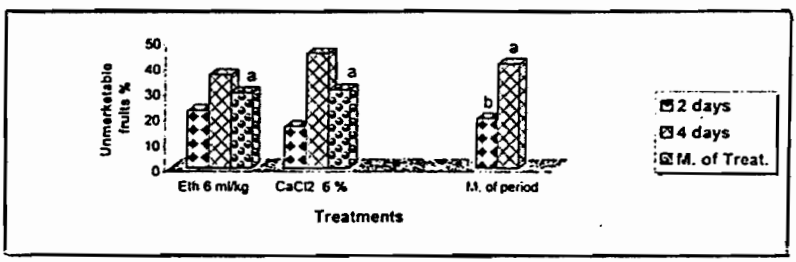

Fig. (3 b): Unmarketable fruits percentage of Zoghloul date fruits during shelf life (21±1 °C+ 56% R.H.) as affected with ethanol and calcium chloride treatments in 2002 season.

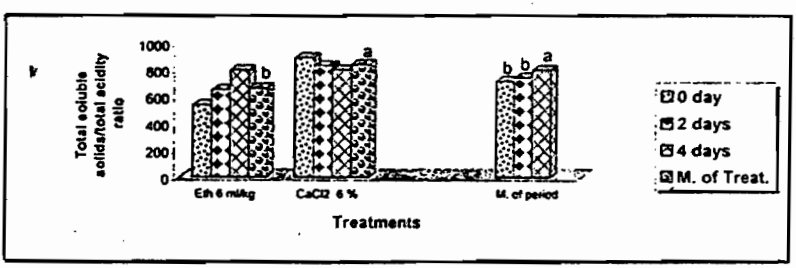

Fig. (4 a): Total soluble solids/total acidity ratio of Zoghloul date fruits during shelf life (21±1°C+56% R.H.) as affected with ethanol and calcium chloride treatments in 2001 season.

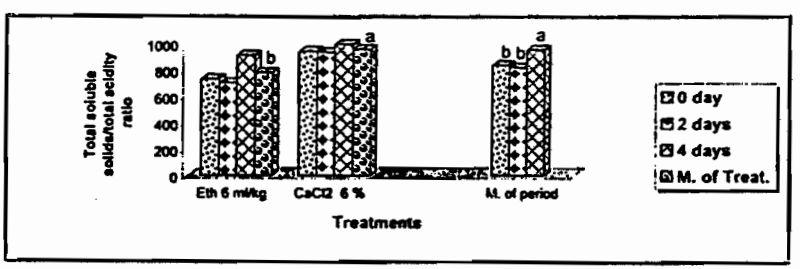

Fig. (4 b): Total soluble solids/total acidity ratio of Zoghloul date fruits during shelf life (21±1°C+56% R.H.) as affected with ethanol and calcium chloride treatments in 2002 season.

Table 6a. Change in some physical and chemical properties of Zaghloul date fruits during cold storage (5°C & 85% R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001				Season 2002						
Properties / Treatment	Total Sugars	Reducing sugars	Non-reducing sugars	Shrinkage %	Total sugars	Reducing sugars	Non-reducing sugars	Shrinkage %	Crude fibers (g/100gD.W.)	Fiber Length (μ)	Fiber Width (μ)
	g/100g D.W.				g/100g D.W.						
Without ethanol (untreated)	38.20f	34.80c	3.40cd	1.00cd	40.81e	31.44d	9.36c	5.00a	1.65a	0.904c	0.521a
Exposure to ethanol at 2 ml./kg.	40.58c	30.95e	9.63a	5.48a	41.91d	32.62c	9.29c	4.60a	1.54b	0.707d	0.463b
Exposure to ethanol At 4 ml./kg.	41.90b	33.50d	8.40a	0.00d	40.70f	29.80e	10.90ab	2.05b	1.44c	0.568e	0.347cd
Exposure to ethanol At 6 ml./kg.	37.58g	33.50d	4.08bc	0.00d	39.95h	28.70f	11.25a	1.00b	1.33d	0.475f	0.336d
Without calcium chloride (untreated)	36.90h	33.60d	3.30cd	5.00a	40.51g	30.20e	10.31b	1.14b	1.53b	0.985a	0.510a
Dipping in calcium chloride at 2%	38.90e	36.30b	2.60d	6.23a	42.20c	34.00b	8.20d	5.58a	1.34d	0.927b	0.475b
Dipping in calcium chloride at 4%	39.80d	35.00c	4.80cd	3.38b	43.16b	35.30a	7.85d	5.18a	1.31e	0.707d	0.359c
Dipping in calcium chlorideat 6%	44.00a	39.19a	4.81b	2.15bc	44.75a	33.80b	10.95a	2.04b	1.29f	0.347g	0.220e

Table 6b. Change in some physical and chemical properties of Zaghloul date fruits during shelf life (21 ± 1°C + 56% ± 2 R.H.) as affected with ethanol and calcium chloride treatments in 2001 and 2002 seasons

Season	Season 2001				Season 2002			
Properties / Treatment	Total Sugars	Reducing sugars	Non-reducing sugars	Shrinkage %	Total sugars	Reducing sugars	Non-reducing sugars	Shrinkage %
	g/100g D.W.				g/100g D.W.			
Exposure to ethanol at 6 ml./kg	37.55b	33.20a	4.35b	64.88a	37.00a	31.50b	5.50a	63.33a
Dipping in calcium chloride at 6%	40.55a	31.10b	8.45a	54.67b	37.20a	32.16a	5.04a	53.25b

Means with the same letters are not significantly different at 5% level.

the highest total and reducing sugars contents comparing with other treatments. This was true in the two seasons. While, ethanol exposed fruits had the highest non-reducing sugars content specially with 2-4 ml.kg. in the first season and 6-4 ml./kg. in the second season. Ethanol exposed fruits at 6 ml./kg. appeared the lowest fruit shrinkage % in the two seasons, (disrelish character) followed by Ca-treated fruits at 6% rate. This agreed with **Kamal (1995); Siddique and Gupta (1994)** and **Abd El-Rahman (1974)** who reported similar results on some date varieties.

In regard to, Crude fibers (sum of pectin, hemicellulose, cellulose and lignin), length and width of fibers of date fruits, both Ca-treated fruits and ethanol exposed fruits gave the lowest values compared with the untreated ones, the reduction was positively correlated with increasing concentrations. Ca-treated fruits at 6% rate surpassed ethanol exposed ones at 6ml./kg. This is in accordance with, **Sobotka and Stelzig (1974)** who reported that cellulose occurs in orderly arrangements throughout the primary and secondary walls of plant cells and it might be expected that cellulose should play a key role in texture changes, these changes occurred in date.

Conclusion

It is adviseable to treat the Zaghloul date fruits with ethanol vapor in the seal container level at 6 ml./kg. or with calcium chloride solution at 6% rate followed by cold storage at 5°C and 85% R.H.for entering of fruits into the rutab stage at slow rate, consequently extending the market season and keeping good eating quality of fruits.

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مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ، ١١(٢) ، ٧١٥ - ٧٣٢ ، ٢٠٠٣

تأثير معاملات ما بعد الحصاد بالايثانول وكلوريد الكالسيوم على حفظ جودة ثمار البلح الزغلول طازجاً

[٥٢]

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أجريت هذه الدراسة على ثمار البلح الزغلول فى مرحلة الخلال من إكتمال النمو خلال موسمى ٢٠٠١-٢٠٠٢ وذلك بهدف دراسة تأثير بعض معاملات الإيثانول وكلوريد الكالسيوم على إطالة فترة التسويق (الاستهلاك الطازج) مع حفظ جودة الثمار.

بعد جمع السوباطات تم تعريض الثمار الموجودة على شماريخها لتركيزات مختلفة من بخار الإيثانول (بدون، ٢، ٤، ٦ مل/كجم) فى أوعية محكمة أو بالغمس فى محاليل كلوريد الكالسيوم (بدون، ٢، ٤، ٦%) وبعد ذلك تركت لتجف ثم وضعت الثمار فى عبوات من الكرتون وخزنت فى ثلاجة على درجة ٥°م ورطوبة نسبية ٨٥%.

وكانت أهم النتائج المتحصل عليها كالآتى

* لوحظ أن غمس ثمار البلح الزغلول فى كلوريد الكالسيوم بتركيز ٦% أو تعرضها لأبخرة الإيثانول بمعدل ٦ مل/كجم ثمار أعطت أقل القيم فى النسبة المئوية للترطيب (صفة غير مستحبة) والفساد والثمار الغير قابلة للتسويق الطازج وكذلك الفقد فى الوزن والمحتوى الكلى للألياف وطول وسمك الليفة مقارنة بالمعاملات الأخرى.
* أظهرت الثمار المعاملة بكلوريد الكالسيوم بتركيز ٦% نقص فى نسبة الفساد وزيادة معدل المواد الصلبة الذائبة إلى الحموضة وكذلك السكريات الكلية والمختزلة بينما أظهرت الثمار المعاملة بالإيثانول بمعدل ٦مل/كجم ثمار أقل كرمشة للثمار وزيادة النسبة المئوية للسكريات الغير مختزلة.
* عند ترك الثمار بعد إخراجها من الثلاجة على درجة حرارة الغرفة ٢١ ± ١°م ورطوبة نسبية ٥٦ ± ٢% (الفترة التسويقية) فإن معاملة الكالسيوم السابقة (٦%) أدت إلى تقليل نسبة الفساد والفقد

فى الوزن وزيادة النسبة المئوية للمواد الصلبة الذائبة وكذلك معدل المواد الصلبة الذائبة إلى الحموضة كما أدت معاملة الإيثانول السابقة(٦مل /كجم)إلى قلة نسبة الترطيب فى الثمار.

ومن هذه النتائج فإنه من المفيد معاملة ثمار البلح الزغلول وهى على شماريخها ببخار الإيثانول على مستوى العبوات بمعدل ٦مل/كجم ثمار أو بالغمس فى محلول كلوريد الكالسيوم بتركيز ٦% مع التخزين البارد على درجة ٥°م ورطوبة نسبية ٨٥% لكى تصل الثمار لمرحلة الترطيب بمعدل بطئ وبالتالى إمتداد فترة التسويق (الاستهلاك الطازج) مع حفظ جودة الثمار.

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