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EFFECT OF DELAYING PRE COOLING TREATMENT ON FRUIT QUALITY AND STORABILITY OF "THOMPSON SEEDLESS" AND "FLAME SEEDLESS" GRAPES.

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ABSTRACT

Thompson Seedless and Flame Seedless grapes were harvested at maturity stage from a private farm at Cairo-Alex. desert road. Fruits were cooled using ice inside polyethylene bags to protect them from directly touch with ice. Fruits were cooled after 0, 1, 2, 3 hours after harvest or non-cooled (control). Fruits were left under the shadow of vines until cooled and were transported to the laboratory to be packed inside perforated polyethylene bags (40 mm and 400 halls per m^3), and stored at 0± C and 90:95 % RH for 35 days. Weekly intervals samples were taken to determined decay, weight loss, and shatter incidence, berry firmness, bunch freshness (stem color and dryness, berry appearance), total soluble solids and total acidity contents were measured and tabulated. Post harvest pre cooling treatments significantly reduced decay, weight loss, shatter, total spoilage incidence of grapes during storage. Also, pre cooling treatments had a significant effect on reducing the softening rate in berry firmness of grapes during storage. Moreover, post harvest pre cooling treatments had a good effect on total soluble solids and total acidity contents of grapes during storage. Moreover, in the most studied parameters were not affected significantly differences among the first three treatments (post harvest pre cooling after 0, 1, 2 hours from harvest).

These results confirmed that , post harvest pre cooling treatmants have to be done within 2 hours at the maximum delaying period in order to maintain grapes at a good quality for long distance transportation or long storage period.

INTRODUCTION

Grape is considered the second fruit crop in Egypt. The planted area reached in (2002) 152488 faddan, while the productive area reached 133897 faddan which produced 1073815 tons according to Horticulture General Administration , M.O.A. (unpublished data). Egypt has a good opportunity for increasing the quantity of the exports from grapes. However there are some inhibitors facing increasing of the Egyptian exported quantity of grapes. Lack of the pre cooling equipments and even if they are found it will be far away from the main production area, is one of these inhibitors.

Actually, there was a limited of literature on grape focusing directly on pre cooling, so this report will depend on all the available literature in this field. However, the literature will be arranged according to its position in the horticulture classification and it's relative to grape.

It has been reported that deterioration occurs much more rabidly at warm than at low temperatures, the more quickly field heat is removed after harvest, the longer the produce can be maintained in good markeTable condition in storage and transport. Massignan *et al*(1998) and Mohamed (1998) on grapes , Maezawa & Akimoto (1995), Mokkila *et al*(1997) on

strawberries , Kaska *et al* (1998) on sweet cherry , Brusewitz *et al* (1992) and Giauque *et al* (1997) on peach , Hussein *et al* (1997) on pear , Nanos *et al* (1999) on apricot , Martinez *et al* (1997) and Puttaraju & Reddy (1997) on mango.

It has been reported that, forced air cooling of grapes immediately after picking rather than 24 hours later inhibited "*B. cinerea*" development, that meaning reduced decay [(Jooste, (1987)]. Similar results were confirmed by Mohamed (1998) on grapes, Kapse *et al* (1997) on mango.

Chapon *et al*(1991), Mohamed (1998) and Crisosto *et al* (2001) proved that, post harvest pre cooling significantly decreased weight loss incidence of grapes during storage. The last author added that, post harvest water losses from Flame Seedless was influenced by temperature and length of cooling delaying. Flame Seedless grapes lost 0.19: 0.92 % of weight after 4 hours delaying at field temperature compared with 1.38 % after 8 hours delaying. The same results were concluded by Kapse *et al*(1997), Puttaraju and Reddy (1997) on mango, Celikel *et al*(1998) on figs.

Mohamed (1998) reported that, post harvest pre cooling significantly decreased shatter percentage of grapes during storage.

Popushoi *et al* (1986) in their study on 4 early Table grape cultivars mentioned that, losses during transport after pre cooling were lower than in the control. These results are confirmed by Kawada and Kitagawa (1987) and Mohamed (1998).

Mohamed (1998) in his study on Flame Seedless and Ruby Seedless grapes indicated that, post harvest pre cooling significantly reduced the softening rate of berries in the stored grapes.

It has been mentioned that, pre cooling of grapes immediately after picking rather than 24 hours later improved fruit freshness and appearance [Jooste (1987), Mohamed (1998) and Crisosto *et al* (2001)]. Similar results were suggested by Jakson *et al* (1999) on blueberry (Lowbush cv.).

On contrast, Ben *et al* (1984) cleared that, although forced air pre cooling of Perlette grapes maintained berry freshness, it accelerated the desiccation of the stems and pedicels even when the humidity of the forced air was high.

It has been reported that, pre cooling reduced the increasing rate in total soluble solids during storage [Mohamed (1998) on Flame Seedless and Ruby Seedless grapes and Maezawa &Akimoto (1995) on Nyohou strawberries].

Pre cooling treatment reduced total acidity contents of grapes during storage. Similar results were recorded by Maezawa & Akimoto (1995) on strawberries. On contrast Mohamed (1998) found that pre cooling treatment increased total acidity contents of grapes during storage.

The purpose of this study is to determine the effects of delaying post harvest pre cooling treatment on quality and storability of Thompson Seedless and Flame Seedless grapes.

Figure (1) Effect of delaying pre cooling treatment on T.S .S. contents of grapes during storage.

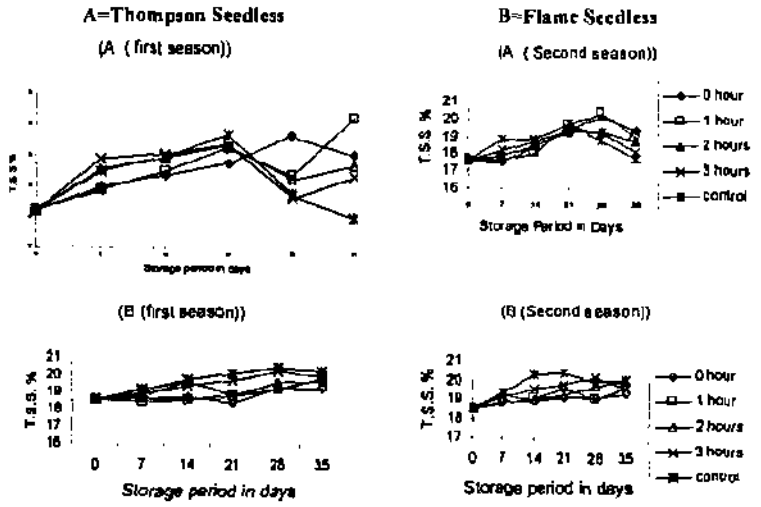
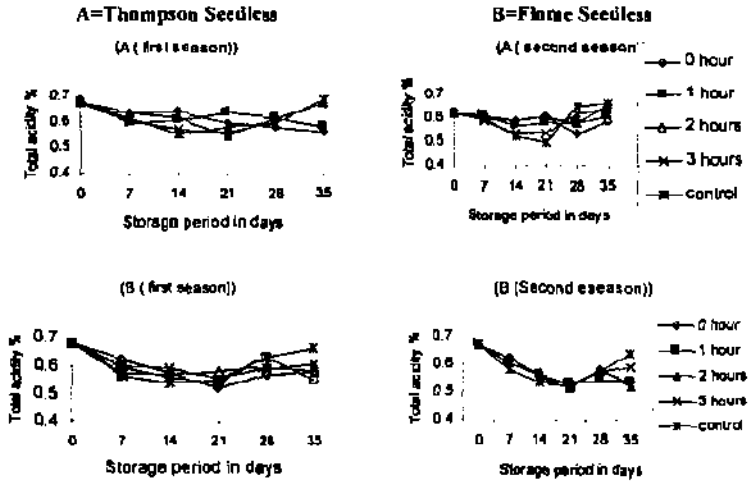


Figure (2) Effect of delaying pre cooling treatment on Total acidity contents of grapes during storage.



MATERIALS AND METHODS

This investigation was carried out during two successive seasons (2001 & 2002 for Thompson Seedless and 2002 & 2003 for Flame Seedless grapes) at Hort. Res. Inst. Giza, Egypt. Fruits were picked in the early morning at maturity stage (Thompson Seedless according to Winkler, 1932 and Flame Seedless according to Mohamed, 1994) from a private farm at Cairo-Alex. desert road. Vines were 15 and 10 years old for Thompson Seedless and Flame Seedless grapes respectively, planted on a spacing of 2.0 x 3.5 m in sandy soil , trained according to cane pruning under drip irrigation system , uniform in growth , in a good physical condition and subjected to all cultural practices. At harvest, fruits were divided into 5 treatments 0, 1, 2, 3 hours between picking and pre cooling treatments, or none cooled (control). The ice cooling system was used in pre cooling treatments. The ice was enclosed in polyethylene sheets to protect grapes from touch with ice. Grapes, for all treatments were held under the vines' shadow during the period before pre cooling treatments. The grapes were transported to the laboratory where packed in carton boxes inside perforated polyethylene bags (40 mm and 400 hall per m^3) and stored at 0°c and 90:95 % RH for 35 days. Each treatment had four replicates (1 box contains 2 kg of grape) .Three replicates were used in order to determine the physical characteristics. The other replicate was used for the chemical analysis. The stored fruits were examined at weekly intervals; a sample from each treatment was taken to study physical and chemical changes.

During storage decay, shatter, weight loss percentage were calculated according to the equal [weight of decayed or shattered berries or weight loss per box *100 / the initial weight of box]. Total spoilage percentage was calculated as the sum of the last three parameters (decay, weight loss and shatter percentage). Berry firmness were estimated in 15 berries by Ifra texture analyzer instrument using a penetrating cylinder of 1 mm of diameter to a constant distance 1 mm inside the skin of berry and by a constant speed 2 mm per sec. and the peak of resistance was recorded per gram. Bunch freshness = (stem color + stem dryness + berry appearance) / 3, stem color, dryness and berry appearance were estimated as shown in the following chart:

Degree The property	1	2	3	4
Stem color	Green	Little brown	Little green	Brown
Stem dryness	Plump	50% dry	Dry	Very dry
Berry appearance	Excellent	Good	AccepTable	Poor

Total soluble solids were estimated by using the Abbè refractometer. (A.O.A.C., 1980). Total acidity contents were estimated by titration against 0.1 N. sodium hydroxide using phenolphthalein as indicator. (A.O.A.C., 1980). Data were subjected to analysis of variance as a factorial experiment in random complete design as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of delaying post harvest pre cooling treatment on the physical and chemical properties:

Decay percentage:

Data presented in Table (1) show clearly that, decay percentage in Thompson Seedless and Flame Seedless grapes was increased as post harvest treatment was delayed throughout the two seasons of this work. Also, it is clear that there were no significant differences between the first two treatments (after 0 and 1 hour treatment) in the two cultivars of this work. However, there was a significant difference between the effect of the first (pre cooling after 0 hour) and the second (pre cooling after 1 hour) on decay percentage of Flame Seedless grapes during the second season.

Concerning the interaction between post harvest treatment and storage period, the data as well showed that, there were no significant differences between the effects of all pre cooling treatments regardless of the control treatment until the second week of storage.

These results are in line with those obtained by Jooste (1987), Mohamed (1998), and Kapse *et al*(1997).

Weight loss percentage:

It is clear from data presented in Table (2) that, weight loss percentage in Thompson Seedless and Flame Seedless grapes increased significantly with the delaying of post harvest pre cooling treatment in the two seasons of the investigation.

Concerning the interaction within treatments, data also appeared to reflect that, there were no significant differences between Thompson Seedless grapes pre cooled after any delaying period until the third week in the first season and until the second week in the second season. Although, these differences were significant from the first week in Flame Seedless grapes cultivar during the first season, however they were not significant until the fourth week during the second season.

These results are in harmony with those confirmed by Chapon (1991), Kapse *et al*(1997), Puttarju & Reddy (1997), Celikel *et al*(1998) Mohamed (1998), and Crisosto *et al* (2001).

Shatter percentage:

Data obtained in Table (3) show that, shatter percentage increased with the extension of delaying period. However, there were no significant differences between the first three delaying periods during the second season in Thompson Seedless grape cultivar and in the two seasons in Flame Seedless grape cultivar in the current study.

Concerning the interaction within treatments, data also reveal that, there were significant differences between pre cooled and control grapes after the second week in Thompson Seedless grapes and after the first week in Flame Seedless grapes. However, there were no significant differences between the first three pre cooling treatments till the end of this work in Thompson Seedless grapes during the two seasons.

Table (1) Effect of delaying pre cooling treatment on decay % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	0.0	0.0	0.0	0.0	0.00	0.6	0.4	0.8	1.0	1.3	0.86
14	0.1	0.1	0.3	0.4	1.0	0.38	0.7	0.8	1.0	1.1	2.7	1.23
21	0.3	0.5	0.8	1.4	2.8	1.16	2.0	2.3	2.8	3.0	7.0	3.38
28	0.8	0.9	2.8	5.3	7.6	3.42	2.9	4.1	3.5	8.1	19.6	7.22
35	1.9	2.7	4.3	8.3	11.5	5.73	3.6	4.9	8.3	10.8	20.5	9.25
Mean	0.51	0.70	1.34	2.57	3.83	1.78	1.65	2.08	2.72	4.02	7.84	3.66

Variety	Flame Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
14	0.4	0.5	0.7	1.4	0.9	0.78	0.2	0.0	0.3	0.8	1.4	0.67
21	0.4	1.2	1.0	2.9	2.2	1.49	0.4	1.0	0.8	1.8	2.2	1.24
28	0.8	1.6	2.3	3.4	5.5	2.72	0.4	1.7	1.8	1.9	2.9	1.70
35	3.8	3.6	4.3	4.7	9.3	4.98	1.8	3.7	5.0	5.3	7.0	4.58
Mean	0.64	1.07	1.37	2.00	2.97	1.60	0.48	1.10	1.29	1.64	2.25	1.36

L S D at 5% level

	Thompson First season (2001)				Thompson Second season (2002)				Flame First season (2001)				Flame Second season (2002)			
Factor	P.T.(a)	S.P.(b)	A*B		P.T.(a)	S.P.(b)	A*B		P.T.(a)	S.P.(b)	A*B		P.T.(a)	S.P.(b)	A*B	
Value	0.64	0.49	1.07		0.94	1.03	2.29		0.92	1.01	2.25		0.45	0.49	1.09	

P.T (a)= Postharvest treatment; S.P (b)= Storage period; A*B= The interaction

Table (2) Effect of delaying pre cooling treatment on weight loss % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.9	1.6	1.6	1.9	2.8	1.72	0.1	0.1	0.2	0.5	0.5	0.27
14	1.9	2.1	2.4	2.7	3.5	2.54	0.4	0.8	1.1	1.5	1.8	1.14
21	2.9	3.8	3.4	4.8	5.4	3.87	1.8	1.8	2.3	2.9	3.2	2.30
28	4.4	5.0	5.6	7.9	7.8	5.90	2.8	2.8	3.8	4.3	5.0	3.63
35	6.3	8.6	7.4	8.5	10.3	7.42	3.6	3.9	4.8	6.7	6.5	4.78
Mean	2.58	3.01	3.40	4.11	4.93	3.60	1.30	1.51	1.88	2.48	2.82	2.03

Variety	Flame Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.2	0.2	0.8	1.2	1.3	0.69	0.5	0.3	0.6	0.5	1.3	0.62
14	0.6	1.0	1.4	1.6	1.8	1.28	0.9	0.8	1.2	0.9	1.9	1.09
21	1.9	1.7	1.9	1.8	2.5	1.70	1.5	1.0	1.7	1.5	2.7	1.68
28	1.8	2.8	2.9	2.7	3.1	2.66	2.9	1.9	3.2	3.1	4.0	3.03
35	2.1	3.5	3.6	3.7	4.2	3.41	3.0	3.0	3.9	6.9	5.1	4.00
Mean	0.95	1.92	1.72	1.81	2.18	1.83	1.43	1.17	1.75	1.83	2.51	1.74

L S D at 5% level	Factor	P.T.(a)	S.P.(b)	A*B
Thompson Seedless, First season (2001)	Value	0.74	0.81	1.81
Thompson Seedless, Second season (2002)	Value	0.21	0.29	0.65
Flame Seedless, First season (2001)	Value	0.3	0.31	0.74
Flame Seedless, Second season (2002)	Value	0.16	0.4	0.89

P.T (a)= Postharvest treatment; S.P (b)= Storage period; A*B= The interaction

Table (3) Effect of delaying pre cooling treatment on shatter % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	0.0	0.0	0.0	0.0	0.00	0.4	0.7	0.6	0.9	0.6	0.64
14	0.1	0.2	0.1	0.6	0.7	0.34	0.8	1.0	1.1	1.1	1.2	1.01
21	0.6	0.7	0.7	1.2	1.8	0.88	1.6	2.2	2.6	2.8	4.5	2.73
28	1.8	2.0	2.1	2.9	3.8	2.48	7.4	7.8	8.1	15.7	28.1	13.04
35	3.8	4.0	5.6	6.3	7.9	5.57	15.6	18.2	17.1	37.5	44.8	27.07
Mean	1.03	1.26	1.42	1.81	2.28	1.58	4.25	5.01	4.91	9.88	13.23	7.42

Variety	Flame Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
14	1.7	1.0	1.5	1.8	10.2	3.28	1.7	1.2	2.0	1.1	10.2	3.40
21	3.2	1.4	3.1	3.5	21.4	6.52	2.8	1.8	3.8	6.1	18.1	6.69
28	10.7	10.3	11.1	11.8	34.1	15.61	3.5	8.4	8.4	21.0	25.9	13.05
35	18.7	22.0	25.5	34.8	51.3	30.45	12.2	16.9	27.1	40.9	53.7	30.19
Mean	5.71	5.78	8.87	8.88	19.50	9.31	3.35	4.38	6.48	11.65	18.14	8.88

L S D at 5% level	Factor	P.T.(a)	S.P.(b)	A*B
Thompson Seedless, First season (2001)	Value	0.36	0.39	0.88
Thompson Seedless, Second season (2002)	Value	1.64	1.79	4.01
Flame Seedless, First season (2001)	Value	3.28	3.6	8.05
Flame Seedless, Second season (2002)	Value	2.89	3.17	7.09

P.T.(a)= Postharvest treatment   S P (b)= Storage period   A*B= The interaction

Regarding Flame Seedless grapes, this trend was noticed in the second season only, but the third pre cooling treatment was associated with significant higher shatter percentage than the first two pre cooling treatments in the second season. These results are in accordance with those found by Mohamed (1998).

Total spoilage percentage:

According to data shown in Table (4), total spoilage percentage of Thompson Seedless and Flame Seedless grapes increased significantly as well as pre cooling delaying period increased during the two seasons in this investigation. Moreover, there were no significant differences between the first two pre cooling treatments in Thompson Seedless and between the first three pre cooling treatments in Flame Seedless grapes during the second season in this investigation. Concerning the second season, there was no significant differences between the first two pre cooling treatments in the two cultivars of this work.

Concerning the interaction within treatments, it is clear that there were no significant differences between all pre cooling treatments until the third week in the two seasons in Flame Seedless cultivar and in the second season in Thompson Seedless cultivar. Moreover, during the first season in Thompson Seedless there were no significant differences between all pre cooling treatments until the second week only. These results are in agreement with those reported by Popushoi *et al* (1986), Kawada &Kitagawa (1987) and Mohamed (1998).

Berry firmness:

Data presented in Table (5) clearly show that, berry firmness of Thompson Seedless and Flame Seedless grapes decreased significantly with the delaying of the pre cooling treatments during the two seasons of this investigation. However, the data also indicated that, there were no significant differences between the first three pre cooling treatments, for both cultivars in this respect.

These results are in line with those suggested by Maezewa & Akimoto (1995), Kapse *et al*(1997), Lulla *et al*(1997), Puttarju & Reddy (1997), and Mohamed (1998).

Bunch freshness:

Data presented in Table (6) cleared that, the deterioration rate of Thompson Seedless and Flame Seedless bunches was inhibited by post harvest pre cooling treatments. Also it is clear that, the inhibition rate increased as well as post harvest pre cooling treatment was done quickly. Moreover, data also confirmed that, the three examined periods of delaying (0, 1 and 2 hours after harvest) pre cooling treatments had the same effect on bunch freshness (berry appearance, stem color and dryness) at the same individual storage period. These results are in accordance with those mentioned by Jooste (1987), Mohamed (1998), Jakson *et al*(1999), and Cristosto *et al*(2001). On the contrary these results disagree with those reported by Ben *et al*(1984), they mentioned that, forced air pre cooling accelerated the desiccation of the stems and pedicels of grapes during storage.

Table (4) Effect of delaying pre cooling treatment on total spoilage % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless												Flame Seedless											
Season	First season (2001)						Second season (2002)						First season (2001)						Second season (2002)					
S. Per. / Treat.	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	1.0	1.0	1.0	2.0	1.72	1.0	1.3	1.7	2.3	2.0	1.77	0.2	0.2	0.0	1.2	1.3	0.80	0.5	0.3	0.0	0.5	1.3	0.62
14	2.3	2.5	2.0	3.0	6.3	3.37	1.0	2.4	3.2	3.0	5.7	3.38	2.0	2.0	3.7	4.7	13.0	5.35	2.0	2.4	3.0	3.0	13.5	6.17
21	3.7	4.0	5.0	7.1	10.0	6.11	5.2	6.3	7.5	8.0	14.7	8.90	4.7	4.2	5.0	7.9	20.1	9.74	4.0	3.0	6.4	9.5	24.0	9.01
28	8.7	7.0	10.3	15.7	19.1	11.00	12.0	14.0	17.2	26.0	46.6	23.80	11.4	14.0	18.3	17.6	47.7	00.00	6.0	10.1	13.2	25.0	32.6	17.78
35	11.1	13.0	17.2	23.1	28.3	18.74	22.0	38.7	28.0	54.2	73.0	41.60	21.4	28.6	33.3	43.2	84.7	36.84	17.1	23.7	35.0	51.2	69.0	36.73
Mean	4.06	4.58	6.16	8.49	11.8 4	6.05	7.36	8.50	9.60	16.10	23.0 8	13.11	7.54	8.38	8.90	12.48	21.6 4	12.60	5.27	6.71	9.03	15.12	22.9 0	11.00
	L S D at 5% level						L S D at 5% level						L S D at 5% level						L S D at 5% level					
	Factor	P.T.(a)	S P(b)	A*B			Factor	P.T.(a)	S P (b)	A*B			Factor	P.T.(a)	S.P (b)	A*B			Factor	P.T.(a)	S.P (b)	A*B		
	Value	1.28	1.4	3.13			Value	2.28	2.5	5.56			Value	3.27	3.58	7.00			Value	1.17	3.46	7.15		
	P.T.(a)=	Postharvest treatment					S.P (b)=	Storage period					A*B=	The interaction										

Table (5) Effect of delaying pre cooling treatment on berry firmness of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Thompson Seedless

S. Per / Treat	First season (2001) T1	T2	T3	T4	T5	Mean	Second season (2002) T1	T2	T3	T4	T5	Mean
0	29.3	29.3	29.3	29.3	29.5	29.30	32.7	34.7	32.7	32.7	34.7	33.70
7	30.5	27.5	27.8	29.3	27.4	28.48	30.2	29.5	28.1	27.2	27.2	28.24
14	27.8	29.9	25.9	24.0	26.0	26.64	28.4	25.9	28.2	26.2	24.3	26.60
21	29.9	25.0	21.9	21.8	22.5	23.60	29.3	25.3	27.5	24.5	22.4	25.60
28	26.8	24.8	21.8	26.5	19.8	22.58	25.1	26.2	22.2	21.5	18.7	22.84
35	22.4	20.7	23.2	19.4	18.7	20.48	21.3	22.8	23.4	19.7	18.8	20.80
Mean	27.06	28.85	24.90	24.85	23.47	25.08	27.87	26.40	26.00	25.13	23.80	25.91

Flame Seedless

S. Per / Treat	First season (2001) T1	T2	T3	T4	T5	Mean	Second season (2002) T1	T2	T3	T4	T5	Mean
0	36.1	38.1	36.1	36.1	38.1	36.05	36.3	36.3	36.3	36.3	36.3	36.30
7	36.1	36.8	35.6	34.2	33.4	35.20	35.8	36.0	35.2	33.1	31.5	34.70
14	37.2	36.4	35.8	35.2	32.1	34.34	34.0	36.2	32.5	34.8	32.6	33.68
21	36.5	35.2	32.1	32.2	30.4	33.28	32.6	33.9	33.8	32.1	30.0	32.48
28	33.4	32.9	31.3	30.5	28.7	31.36	30.7	31.9	32.2	29.4	29.3	30.70
35	29.0	27.6	26.2	26.4	23.0	26.44	30.5	29.8	28.7	30.4	25.7	29.02
Mean	35.03	34.46	33.16	32.75	30.94	33.28	33.46	33.04	33.11	32.65	30.90	32.61

L S D at 5% level

Variety / Season	Factor	P.T.(a)	S.P.(b)	A*B
Thompson Seedless, First season (2001)	Value	2.78	3.04	6.8
Thompson Seedless, Second season (2002)	Value	2.28	2.5	3.58
Flame Seedless, First season (2001)	Value	2.1	2.3	4.15
Flame Seedless, Second season (2002)	Value	2.14	2.34	5.24

P.T.(a)= Postharvest treatment S.P.(b)= Storage period A*B= The interaction

Table (6) Effect of delaying pre cooling treatment on bunch freshness of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless												Flame Seedless											
Season	First season (2001)						Second season (2002)						First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T5	T4	T5	Mean	T1	T2	T2	T4	T5	Mean	T1	T2	T5	T4	T5	Mean
0	1.0	1.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	1.0	1.00
7	1.0	1.0	1.0	1.0	1.3	1.07	1.0	1.0	1.0	1.0	1.2	1.04	1.0	1.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	1.0	1.00
14	1.0	1.0	1.0	1.3	2.0	1.27	1.0	1.0	1.0	1.1	1.9	1.20	1.0	1.0	1.1	1.1	1.8	1.20	1.0	1.0	1.1	1.1	2.0	1.24
21	1.1	1.1	1.3	2.0	2.8	1.87	1.0	1.1	1.2	2.0	2.7	1.60	1.0	1.0	1.3	1.6	2.6	1.49	1.0	1.1	1.3	1.7	2.6	1.56
28	2.1	2.1	2.4	3.0	3.7	2.67	1.7	1.8	2.1	2.7	3.7	2.38	1.7	2.0	2.3	2.8	3.7	2.44	1.8	2.0	2.3	2.8	3.8	2.51
35	2.7	2.9	2.8	3.3	4.0	3.10	2.4	2.8	2.7	3.0	4.0	2.93	2.7	3.0	3.0	3.4	4.0	3.22	2.7	3.0	3.0	3.3	4.0	3.27
Mean	1.48	1.52	1.61	1.94	2.46	1.80	1.38	1.41	1.50	1.80	2.41	1.59	1.36	1.50	1.63	1.78	2.32	1.73	1.41	1.52	1.63	1.83	2.44	1.77
	L S D at 5% level						L S D at 5% level						L S D at 5% level						L S D at 5% level					
	Factor	P.T.(a)	S.P.(b)	A*B			Factor	P.T.(a)	S.P.(b)	A*B			Factor	P.T.(a)	S.P (b)	A*B			Factor	P.T.(a)	S.P (b)	A*B		
	Value	0.19	0.21	0.46			Value	0.14	0.15	0.33			Value	0.2	0.22	0.5			Value	0.17	0.19	0.43		
	P.T.(a)=	Postharvest treatment					S.P (b)=	Storage period					A*B=	The interaction										

Total Soluble Solid contents:

According to data presented in Table (7) there was no significant differences between total soluble solid contents of grapes either pre cooled or non pre cooled. However , data shown in Figure (1) and the interaction between these factor under study proved that, post harvest pre cooling treatments significantly reduced the increasing rate of total soluble solids contents of grapes during storage. Total soluble solids contents of non pre cooled grapes increased during storage to reach the maximum value, then tended to decrease until the end of storage period. Moreover, and this decreasing was delayed in the pre cooled grapes.

These results partially agree with those findings of Maezawa & Akimoto (1995) and Mohamed (1998). They mentioned that pre cooling treatments reduced the increasing rate of total soluble solid contents of grapes during storage.

Total acidity contents:

Data shown in Table (8) and Figure (2) confirmed that, although pre cooled grapes had less total acidity contents than non pre cooled grapes, yet there were no significant differences between total acidity contents of grapes either pre cooled or non pre cooled. However, it is clear that, post harvest pre cooling treatments significantly inhibited the decreasing rate of total acidity contents of grapes during storage. Also, post harvest pre cooling treatments delayed or prevented the decrease occurrence in total acidity contents of grapes during storage, for both cultivars.

These results are in agreement with those obtained by Kim (1995), Maezawa & Akimoto (1995). On contrast they disagree with those suggested by Mohamed (1998).

Table (7) Effect of delaying pre cooling treatment on T.S.S. % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless												Flame Seedless											
Season	First season (2001)						Second season (2002)						First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	18.2	18.2	18.2	18.2	18.2	18.23	17.6	17.8	17.6	17.8	17.8	17.63	18.8	18.8	18.8	18.8	18.8	18.80	18.5	18.5	18.5	18.5	18.5	18.50
7	19.0	18.9	19.8	18.8	18.5	19.37	17.3	17.7	17.9	18.2	18.8	18.01	18.7	19.4	18.8	18.9	19.2	18.79	18.8	18.8	19.2	19.2	19.4	19.08
14	18.4	19.5	19.9	20.1	20.0	19.78	18.4	18.1	18.5	18.7	18.8	18.51	18.7	18.8	18.8	19.4	19.7	19.20	18.8	19.1	19.0	19.8	20.3	19.37
21	19.7	20.2	20.3	20.3	20.7	20.25	19.5	19.8	19.3	19.4	19.8	19.61	18.4	18.8	18.8	18.7	20.1	19.17	19.1	19.5	19.2	19.7	20.4	19.58
28	20.6	19.3	19.2	18.8	18.7	19.31	20.1	20.4	19.4	18.3	18.8	19.60	19.2	19.3	19.8	20.7	20.4	19.72	19.1	19.0	19.7	20.2	18.8	19.38
35	20.0	21.2	18.7	18.6	18.0	19.49	19.3	18.9	18.8	18.1	17.7	18.57	19.3	19.9	18.7	20.0	20.2	19.51	19.3	19.8	20.0	19.8	20.1	19.70
Mean	19.49	19.57	19.48	19.20	19.18	19.40	18.74	18.72	18.57	18.80	18.61	18.64	18.81	18.91	19.19	19.48	19.71	19.21	18.95	19.08	19.20	19.46	19.75	19.38

L S D at 5% level

Factor	P.T.(a)	S.P (b)	A*B
Thompson Seedless, First season (2001) – Value	N.S	0.58	1.3
Thompson Seedless, Second season (2002) – Value	N.S	0.35	0.78
Flame Seedless, First season (2001) – Value	N.S.	0.27	0.5
Flame Seedless, Second season (2002) – Value	N.S	0.11	0.71

P.T.(a)= Postharvest treatment S.P (b)= Storage period A*B= The interaction

Table (8) Effect of delaying pre cooling treatment on Total acidity % of Thompson Seedless and Flame Seedless Grapes during storage at 0°C

Variety	Thompson Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.68	0.68	0.68	0.68	0.68	0.68	0.62	0.62	0.62	0.62	0.62	0.62
7	0.63	0.56	0.63	0.60	0.61	0.62	0.60	0.61	0.61	0.58	0.60	0.60
14	0.64	0.60	0.61	0.57	0.55	0.59	0.59	0.57	0.58	0.53	0.52	0.56
21	0.60	0.53	0.54	0.56	0.58	0.58	0.60	0.58	0.60	0.53	0.50	0.56
28	0.56	0.61	0.61	0.60	0.60	0.60	0.53	0.56	0.50	0.62	0.65	0.59
35	0.58	0.56	0.67	0.60	0.69	0.64	0.58	0.60	0.65	0.64	0.66	0.63
Mean	0.61	0.62	0.62	0.61	0.63	0.62	0.50	0.59	0.61	0.58	0.60	0.60

Variety	Flame Seedless											
Season	First season (2001)						Second season (2002)					
S Per / Treat	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
0	0.68	0.58	0.60	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67
7	0.63	0.60	0.59	0.60	0.67	0.59	0.63	0.61	0.63	0.61	0.58	0.61
14	0.67	0.58	0.57	0.58	0.54	0.57	0.50	0.56	0.55	0.56	0.53	0.55
21	0.52	0.54	0.58	0.58	0.55	0.55	0.63	0.54	0.52	0.53	0.53	0.53
28	0.57	0.63	0.60	0.59	0.63	0.60	0.57	0.55	0.58	0.57	0.57	0.57
35	0.58	0.55	0.58	0.61	0.68	0.58	0.54	0.54	0.52	0.59	0.64	0.57
Mean	0.59	0.59	0.60	0.60	0.60	0.60	0.58	0.58	0.58	0.59	0.58	0.58

L S D at 5% level (Thompson Seedless, First season)

Factor	P.T.(a)	S.P.(b)	A*B
Value	N.S	N.S.	0.08

L S D at 5% level (Thompson Seedless, Second season)

Factor	P.T.(a)	S.P.(b)	A*B
Value	N.S	0.03	0.07

L S D at 5% level (Flame Seedless, First season)

Factor	P.T.(a)	S.P.(b)	A*B
Value	N.S	0.01	N.S

L S D at 5% level (Flame Seedless, Second season)

Factor	P.T.(a)	S.P.(b)	A*B
Value	N.S	0.02	0.05

P.T.(a)= Postharvest treatment S.P.(b)= Storage period A*B= The interaction

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تأثير تأخير أجراء عملية التبريد السريع علي خواص الجودة و القدرة التخزينية لثمار العنب صنفي "البناتي " و " الفليم"

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اجري هذا البحث على ثمار عنب صنفي "البناتي " و "فليم". أخذت الثمار من مزرعة خاصة تقع علي طريق القاهرة – الإسكندرية الصحراوي. عند وصول الثمار إلى مرحلة اكتمال النمو تم جمع العناقيد و تم إجراء المعاملات الاتيه ١- تبريد سريع بعد القطف مباشرة ٢و٣ و٤ تبريد سريع بعد ساعة أو ساعتين أو ثلاث ساعات ٥- معاملة المقارنة . تركت الثمار انتظارا لإجراء المعاملات تحت ظل الكرمات و بعيدا عن السقوط المباشر لأشعة الشمس المباشرة. عقب الانتهاء من إجراء المعاملات تم نقل الثمار الى المعمل حيث تم تخزينها على درجة الصفر المئوي و رطوبة نسبية من ٩٠ الى ٩٥% لمدة خمسة أسابيع.تم فحص الثمار أسبوعيا حيث تم تقدير نسبة كل من الفقد فى الوزن و التالف والفرط و الفقد الكلى. كذلك تم تقدير صلابة الحبات و طزاجة العنقود(لون و جفاف الساق ومظهر الحبات) كما تم ايضا تقدير كل من نسبة المواد الصلبة الذائبة و الحموضة الكلية بالعصير. كان لمعاملة التبريد السريع تأثيرا فعالا فى تقليل كل من الفقد فى الوزن و التالف والفرط والفقد الكلى فى العنب اثناء التخزين . كما كان ايضا لمعاملة التبريد السريع تأثيرا فعالا في تقليل معدل الطراوة فى الحبات ومعدل التدهور في خواص العنقود الظاهرية. ايضا كان لمعاملة التبريد السريع تأثيرا فعالا في المحافظة على نسبة المواد الصلبة الذائبة و الحموضة الكلية بالعصير عند المستوى المناسب. كذلك أوضحت هذه الدراسة انه لم يكن هناك فارقا إحصائيا بين كل من المعاملات الثلاث الأول (تأخير لمدة ٠ و ١ و ٢ ساعه بعد القطف) من حيث قدرتها علي المحافظة على جودة الثمار سواء أثناء التخزين او الشحن لمسافات طويلة بينما تفوقت هذه المعاملات علي المعاملتين الأخيرتين. وعلي هذا يمكن التاكيد على اهمية سرعة اجراء عملية التبريد السريع لثمار العنب ويجب ان تتم خلال فترة اقصاها ساعتين بعد القطف على ان توضع الثمار خلال هذه الفترة بعيدا عن التعرض المباشر لأشعة الشمس. وذلك للحفاظ على حيويه الثمار و قدرتها على التخزين و الشحن لمسافات طويله.