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A UNIQUE RAPID HOT WATER TREATMENT AND WRAPPING TO IMPROVE STORAGE QUALITY OF CANTALOUPE FRUITS

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ABSTRACT

This experiment consists of twenty four treatments, resulted from the combination of two cantaloupe cultivars (Vicar and Total) X four hot water dipping treatments [untreated (control), 50ºC for 2 min., 55ºC for 1 min and 60ºC for 30 s) X three wrapping treatments unwrapping (control); wrapping with PVC and wrapping with stretch fruits. This study was conducted to investigate the effect of variety, hot water treatments and over wrapping on storability. Results were recorded on changes in physical and chemical properties in fruits during storage i.e. weight loss, decay, firmness, T.S.S., and total sugar contents.

The main results can be summarized as follow:

1- Vicar cv. exhibited the least in weight loss and decay percent compared with Total cultivar.
2- Vicar cv. showed the highest firmness value than Total cv.
3- There were significant increases in weight loss and decay percent during storage period. Moreover, the rate of decrement in firmness was much higher with prolongation the storage period.
4- In relation to T.S.S. and total sugar contents, Vicar cv. showed the highest values compared with Total in both years. However, Total fruits were significantly lower in T.S.S. percentage and total sugar contents.
5- There were no significant differences was observed in weight loss %, T.S.S. % and total sugar content within most of the hot water treatments.
6- Significant difference was observed with decay incidence; the fruit at 55ºC for about 1 min significantly reduce incidence, compared with control and the other treatments.
7- Fruit that were dipped at 55ºC for about 1 min or 60ºC for about 30 s were significantly firmer than other treatments.
8- Over wrapping fruits with PVC or stretch films had the lowest values of weight loss and decay percent as compared with unwrapped fruits (control), these results also indicated that there was significant increment in the rate of wrapping fruits firmness compared with those unwrapped ones. Moreover, T.S.S. % and total sugar contents were not significantly affected by any wrapping treatments under cold storage conditions.

INTRODUCTION

Cantaloupe fruits as with other export fruits, needs to be free of disease agents, insects, synthetic chemicals, and cleaned from any dirt or dust before being packed for export.

Postharvest decay is a major factor limiting the extension of storage life of cantaloupe. The two main fungi responsible for storage decay are Botrytis cinerea and Alternaria alternata, the causal organisms of grey and black moulds, respectively (Barkai-Golan, 1981).

Postharvest heat treatments of fruits and vegetables for disease control and insect disinfectation have been used for many years (Barkai-Galon and Phillips, 1991). Heat can be applied to fruits and vegetables as hot water dips, vapour heat, or hot dry air (Couey, 1989). Dipping red sweet pepper for 3 min in water heated to

50°C significantly reduced decay caused by B. cinerea and A. alternata, although this treatment had no effect on cleanliness of the fruit skin (Fallik *et al*., 1996). High humidity hot air treatment maintained quality of Zucchini for up to 11 days (Jacobi *et al*., 1996), while exposing tomato fruits to 38°C for 3 days prior to storage has been shown to inhibit decay due to B. cinerea Pers. (Fallik *et al*., 1993). Hot water dips are used commercially for disinfestation of mangoes and papaya (Klein and Lurie, 1996), and heat treatments can inhibit ripening of many fruits and vegetables, and alleviate storage disorders, thus maintaining fruit quality during prolonged storage (Paull, 1990; Klein and Lurie, 1996).

Many investigators reported that there were significant differences in characters of all cultivars at picked time as well as during storage period (Ezzat, 1991; Emam, 1991 and Abd El-Khalek, 1996).

Many of the losses of fruits quality, i.e. weight loss, decay percentage and firmness can be minimized by selecting proper packaging materials and techniques. Correct controls losses through storage period (Teitel *et al*., 1989; Emam, 1993 and Abd El-Khalek, 1996).

The plastic bags and films provide excellent protection against the moisture loss only under fairly constant air temperatures. The use of polypropylene films creates a modified atmosphere which can be used to reduce decay, lower rate of respiration and ethylene production as well as maintain firmness (Kader *et al*., 1989).

The objective of this work was to develop a fast method for simultaneously cleaning and disinfecting cantaloupe, based on the use of a hot water dip, and to identify optimum treatment times and temperatures to maintain fruit quality during a prolonged storage. Moreover, the aim of this work also was to evaluate the fruit storability of two cantaloupe cultivars in combination with the effect of different wrapping films and hot water treatments on their physical properties and keeping quality.

MATERIALS AND METHODS

The experiment was conducted at Isna-Qena governorate during 2000 and 2001 seasons in sandy soil. Two imported cantaloupe cultivars namely, Vicar (Novartis) and Total (Novartis) were used. Seeds of different cultivars were sown on September 15th 2000 and 2001 for the fall seasons in the open field.

This experiment consisted of twenty four treatments, resulted from the combination of two cantaloupe cultivars X four hot water treatments X three wrapping treatment.

Cultivation was carried out under drip irrigation system. Each replicate had sixty plants for each cultivar. Moreover, black mulch was used.

At fall bloom, flowers were labeled took place on labeled fruits where they were picked at 45-days after anthesis. Normal cultural practices were followed whenever needed according to the recommendation of the Ministry of Agriculture.

Fruits were carefully picked up and transferred immediately to post harvest laboratory of Horticulture Institute. In laboratory, fruits were sorted based on uniform size, colour and presence of spoilage or damage, where unsuitable fruits were discarded and healthy fruits were chosen.

Fruits were packed in five Kg carton boxes and divided into 24 treatments, resulted from the combination of:

I. Two cantaloupe varieties.

II. Four hot water dip. treatments: fruits were held submerged in water bath at:

1- 50°C for 2 min.
2- 55°C for 1 min.
3- 60°C for 30 sec.

At the end of this period, the fruits were removed and allowed to air-dry on blotting paper for 10 min. before repacking. Control fruits were dipped in a 22°C bath but otherwise treated identically.

C. Three fruits wrapping:

The fruits were wrapped in 12 μm polyvinyl chloride (PVC) and stretch film. Those fruits dipped in water bath were wrapped immediately upon drying, as follows:

1- Wrapping with P.V.C.
2- Wrapping with stretch.
3- Untreated (control-without wrapping).

The treatments were tested in a split-plot design with four replications, of which main plots devoted for cultivars while, hot water treatments and wrapping treatments in sub-plots.

All treated fruits were transferred to storage at 2.5°C with relative humidity of 90-95% for 28 days.

The determination of physical and chemical properties was done every 7 days during storage, starting at the beginning of storage period.

The estimated physical and chemical properties were as follows:

1- Weight loss (%): By the following equation:

$$\text{Weight loss \%} = \frac{\text{Initial weight} - \text{Weight at sampling date}}{\text{Initial weight}} \times 100$$

2- Decay (%): It was recorded in relation to the initial weight of stored fruits.

3- Firmness: Firmness were determined by Magness and Ballouf pressure tester equipped with 6/17 inch plunger caliberated to measure the number of pounds per square inch required to force the plunger into the fruit, as stated by Wills *et al*. (1982).

4- Total soluble solids (T.S.S.): were determined by hand refractometer (Wills *et al*., 1982).

5- Total sugar contents analyzed according to Shaffer and Hartman (1921).

All data were subjected to statistical analysis according to (Snedecor, 1962).

RESULTS AND DISCUSSION

Keeping quality:

Mean values of all storability characters regarding cultivars, hot water dip treatments, over wrapping treatments and storage period are presented in Table (1).

1- Effect of cultivars:

Concerning all studied characters i.e. weight loss %, decay %, firmness, T.S.S. and total sugar content of fruits, significant differences are detected in the respect as shown in Table (1). Such data show that weight loss percent ranged from 9.84% for Total to 7.06% for Vicar (average two years), while decay percentage ranged from 6.28% for Total to 3.58 for Vicar.

However, with respect to fruit firmness, Vicar variety which showed the lowest percent of weight loss and decay ranked first in this case (20.35) and the softest one Total (14.98), Table (1). This was quite clear in both seasons. The decrease in weight loss and decay of Vicar cv. might be attributed to this high firmness. The increase in a weight loss of Total cv. might be own to its low firmness Table (1).

In relation to T.S.S. and total sugar contents, Vicar cv. showed the highest values compared with Total in both two years. However, Total fruits are significantly lower in T.S.S. percentage of total sugar content.

From the aforementioned results, it could be suggested that Vicar cv. lost lower proportion of weight and decay percent than Total cultivar. Moreover, it was extremely firmer than the other. These results emphasized the findings of Ezzat (1991) on melon.

The differences between cultivars in storability might be due to inherited variatal characters.

2- Effect of hot water dip treatments:

After 28 days storage at 2.5ºC, as significant differences were observed in weight loss %, T.S.S. % and total sugar content within most of the hot water treatments. However, fruits that were dipped at 55ºC for about 1 min or 60ºC for about 30 s were significantly firmer the other treatments. Significant differences were observed with decay incidence, the treatment of fruit at 55ºCfor about 1 min significantly reduced incidence, compared with control and most of the other treatments (Table 1). Treating the fruits at 60ºC for 30 s significantly enhanced decay incidence, and many of the fruit suffered from heat damage. Apart over 55 and 60ºC for 30 s, no other treatment caused heat damage.

All fruits and vegetables for domestic or export markets should be free of dirt, dust, pathogens and chemicals before they are packed. Pre storage heat treatment appears to be one of the most promising in postharvest control decay (Couey, 1989).

In this work, the overall quality of the treated fruit was significantly better than that of untreated fruit after a prolonged period of storage. The optimal water temperature and time of exposure to reduce decay incidences and maintain the cantaloupe quality was found to be 55ºC for about 1 min. The relatively high temperature of the water (>50 ºC) weakness or kills spores sufficiently such that the water can be recycled (Fallik *et al*., 1996).

The relatively greater firmness of fruit dipped at 55ºC for 1 min or 60ºC for 30 sec. is probably due to rescrystallization or “melting” of the wax layer, which sealed barely visible cracks. Similar observations were reported with heated apples

(Roy *et al*., 1994; Lurie *et al*., 1996). Alternatively, the short heat treatment may have stimulated on increase in the synthesis of wax to fill the cracks, as suggested by Baker (1974).

Heat treatments can inhibit the ripening of many fruits and vegetables (Paull, 1990). Klein and Lurie (1996) concluded that heating fruit at 38-42ºC for 3-4 days results in limited damage to the respiratory mechanism, which is turn delays ripening and may partially explain the extended storage life of heated produce. The treatment described here heats fruit for much shorter time, yet it, too, seems to inhibit certain ripening processes as shown by the relatively low respiration rate of the dipped fruit. These results can be used for maintaining quality and extending the postharvest life of the fruits.

On the other hand, increased public awareness has, in recent years, brought about a resurgence for preservation in the use of non-chemical treatments for preservation and maintenance of fresh produce (Fallik *et al*., 1999).

3- Effect of Wrapping Film:

It is also clear from the same data in Table (1) that unwrapped cantaloupe fruits had the highest values of weight loss under cold storage as compared with wrapped fruits with P.V.C. or stretch film. The wrapping decreases water loss and dry matter loss through respiration. The increase in weight loss in unwrapping fruits might attribute to the increase in water loss and/or dry matter loss through respiration. On the contrary, the highest percentage of decay was found in the unwrapping fruits, while those of wrapped with P.V.C. or stretch showed the lowest values in this respect. The high percentage of decay may be due to that the biological activity in fruits become low and this in turn facilitates infection of fruits by micro-organisms.

These results are in agreement with those reported by Mitchell (1985) and Kader *et al*. (1989).

With respect to fruit firmness as affected by wrapping treatment, data in Table (1) also indicate clearly that wrapping cantaloupe fruits with P.V.C. or stretch film, in general, led to significant increments in the rate of fruit firmness compared with those unwrapped ones. On the other hand, T.S.S. and total sugar were not significantly affected by any wrapping treatments under cold storage conditions.

Thus obtained results could be attributed to the use of P.V.C. and stretch film which modificates O_2, CO_2 and/or C_2H_2 concentrations in atmosphere surrounding the commodity to levels different from those in open air. Hence, wrapping films can be used for maintaining quality and extending the postharvest life of the fruit as mentioned by Kader *et al*. (1989).

4- Effect of Storage Period:

As shown from data recorded also in Table (1) that there are significant differences in storability of all studied characters of cantaloupe fruits under cold storage conditions with prolongation of storage period.

Regarding weight loss, data in Table (1) show that there were significant and considerable increase in weight loss toward the end of storage period, i.e. 28 days. As it is known that the continuous loss in weight during storage was due to evaporation and respiration (Wills *et al*., 1982).

The process of fruit decay as shown in Table (1) took place after seven days and showed progressive and significant increase as storage period was prolonged.

Generally, it is clear also that fruits became were susceptible to decay with extension of the storage period (Table 1). The present results are in line with those reported by Abd El-Khalek (1996) on melon.

The same data indicate also that firmness of cantaloupe fruits stored under cold storage conditions gradually and significantly decreased with prolongation of storage period and reached its lowest value at the end of storage period, i.e. 28 days. The decrease in firmness might be attributed to the conversion of protopectin to soluble forms and/or the decrease of both water and dry matter with prolongation of storage period.

T.S.S. and total sugar were also consistently and significantly decreased with the prolongation of storage period (Table 1).

The decrement in T.S.S. or total sugar contents during storage period might be due to the relatively higher rates as sugar loss through respiration.

5- Effect of interaction between cultivars and storage period:

Data presented in Table (2) and Fig. (1) show a general trend, that prolongation of storage period led to reduction in firmness and all chemical properties, i.e. T.S.S. and total sugar contents and also deterioration of fruits expressed as an increase in weight loss % and in percentage of decayed fruit for the different cultivars under study. The physical characters, i.e. weight loss %, decay % and firmness showed gradual deterioration with prolongation of storage period under cold storage conditions. This reduction in fruit quality became significant after 7 days.

However, Vicar cv. exhibited the lowest percentage in the occurrence of the general trend observed with higher fruit characteristics (Table 2) at the end of storage period (28 days) under cold storage conditions.

Regarding T.S.S. and total sugar contents, Vicar cv. showed the highest values followed by Total (Table 2 and Fig. 1).

Chemical properties of cantaloupe fruits stored under cold storage at 2.5ºC showed gradual reduction through storage period.

This reduction became significant in T.S.S.% and in total sugar after 7 days based on cultivars.

These results might be due to evaporation, respiration and hereditary differences among the cultivars. Moreover, increasing storage period may result in increasing the duration through which the pectin estrase perform and this may lead to increase the soluble form of pectin substances, as stated by Wills *et al*. (1982).

6- Effect of interaction between cultivars and wrapping films:

It appears from data shown in Table (3) and Fig. (2) that weight loss of fruits of the two cultivars under the study was at minimal percentage when fruits were stored either with P.V.S. or stretch film than those stored unwrapped (control). Moreover, it is also evident from the same data (Table 3) that cultivar which showed the lowest weight loss (Vicar) were also the same when fruits were wrapped with P.V.C. or stretch film.

Regarding decay percentage, data in Table (3) and Fig. (2) also, show clearly a progressive and constant increase in the percentage of decayed fruits of all studied cultivars specially those unwrapped (control).

Concerning the variability of cultivar in the fruit firmness (pound/inch^2), the highest values were obtained for Vicar cv. specially when it was wrapped with

P.V.C. or stretch film. However, the lowest value in this respect was obtained for Total cv. when it was stored unwrapped (control).

On the other hand, it is noticed that wrapped cantaloupe fruits with P.V.C. or stretch film tended to slightly decrease in values of all the studied chemical properties, i.e. T.S.S. and total sugar content of different studied cultivars and the lowest one was that of unwrapped fruits in both seasons.

These results were in agreement with those reported by Emam (1993) and Abd El-Khalek (1996) on melon.

7- Effect of interaction between wrapping film treatments and storage period:

Results in Table (4) clearly show the same trend observed before in (Tables 1 & 3) concerning the effect of wrapping treatments (unwrapped and/or wrapped with P.V.C. or stretch film) as well as the effect of storage period. Prolonged storage period led to reduction in firmness, increase in weight loss % and an increase in percentage of decay fruits for all two cultivars under this study as shown also in (Table 1 & 2). The control (unwrapped treatment) exhibited the highest percentage of fruit spoilage during storage. Meanwhile, wrapping fruits with stretch film led to the healthy appearance, firm and reduced the percent of loss in weight in comparison with fruits wrapped in P.V.C. film. These results were true under cold storage conditions as well as in the two seasons of this work.

The effects of such interaction on T.S.S. and total sugar content are shown in Table (4). It is clear that the wrapped fruits with stretch film exhibited significantly higher values at the end of storage period compared to other wrapping treatments. It is also noticed that unwrapped fruits (control) at different storage periods showed less values in all chemical properties under study. These results are in harmony with those obtained by Emam (1993) and Abd El-Khalek (1996).

8- Effect of interaction between cultivar and hot water treatments:

It appears from data shown in Table (5) and Fig. (3) that no significant differences were observed in weight loss % of fruits for the two cultivars under this study when fruits were treated with hot water, data in Table (5).

Regarding decay percentage, data in Table (5) and Fig. (3) also, show clearly that significant differences were observed with decay incidence for the two cultivars at different hot water treatments. All cultivar fruits at 55ºC for about 1 min significantly reduce incidence compared to control and/or most of the other treatments. Treating the two cultivar fruits at 60ºC for 30s significantly enhanced decay incidence.

These results were in agreement with those reported by Fallik *et al*. (1996) and Fallik *et al*. (1999).

With respect to firmness data in Table (5), all cultivar fruits that were dipped at 55ºC for about 1 min or 60ºC for about 30 s were significantly firmer than other treatments.

The relatively greater firmness of the two cultivar fruits rinsed at 55ºC for 1 min or 60ºC for 30 s is probably due to rescrystallization or "melting" of the wax layer which sealed barely visible cracks. Similar results were reported by Lurie *et al*. (1996).

With respect to the effect of interaction between cultivars and hot water treatments on T.S.S. and total sugar contents (as shown in Table 5), it is noticed that there were no significant different was observed in this respect (Roy *et al*., 1994).

9- Effect of interaction between hot water treatments and storage period:

Results in Table (6) clearly show the same trend observed before in (Tables 1 & 5) concerning the effect of hot water treatments (untreated and/or 50ºC for 2 min, 55ºC for 1 min and 60ºC for 30 s) as well as the effect of storage period. Prolonged storage period led to reduction in firmness, increase in weight loss % and an increase in percentage of decayed fruits for all two cultivars under study as shown also in (Table 1 & 2). The control (untreated treatment) exhibited the highest percentage of fruit spoilage during storage. Meanwhile, fruits treated with hot water at different treatments led to the healthy appearance, firm and reduced the percent of loss in decay in comparison with untreated fruits. These results were true under cold storage conditions as well as in the two seasons of this work.

It is clear treated fruits with 55ºC for 1 min. or 60ºC for 30 sec. exhibited significantly higher values at the end of storage period compared to other hot water treatments. It is also noticed that untreated fruits (control) at different storage periods showed less value in all chemical properties under study. These results are in harmony with those obtained by Teitel *et al*. (1989) on melon.

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المعاملة السريعة والفريدة بالماء الساخن والتغليف لزيادة القدرة التخزينية وجودة ثمار الكنتالوب

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تمت الدراسة على صنفين من أصناف الكنتالوب (فيكار وتوتال) مع ٤ معاملات بالغمر فى الماء الساخن (بدون معاملة ، ٥٠ °م لمدة دقيقتان ، ٥٥ °م لمدة دقيقة واحدة ، ٦٠ °م لمدة ٣٠ ثانية)° مع ٣ معاملات من التغليف (غير مغلف ، مغلف بفيلم من بى فى سى ، مغلفة بفيلم من المطاط) .

أجريت هذه الدراسة بهدف دراسة تأثير كل من الصنف والمعاملة بالماء الساخن والتغليف على القدرة التخزينية . وأخذت نتائج التغيرات فى محتوى ثمار الكنتالوب الطبيعى والكيماوى كالآتى : فقد الوزن ، التالف ، الصلابة ، المواد الصلبة الذائبة ، والسكريات الكلية.

ويمكن تلخيص أهم النتائج فيما يلى :

1- أعطت ثمار صنف فيكار أقل نسبة فى فقد الوزن والتالف بالمقارنة بصنف توتال .
2- أعطت ثمار صنف فيكار أعلى قيمة فى الصلابة من الصنف توتال .
3- زادت قيمة نسبة الفقد فى الوزن والتالف أثناء فترة التخزين ، علاوة على ذلك فإن نسبة الفقد فى قيمة الصلابة تزداد بزيادة طول فترة التخزين .
4- ولقد شوهد أن قيم كل من المحتوى من المواد الصلبة الذائبة والسكريات الكلية فى الصنف فيكار كانت أكبر من الصنف توتال فى كل من السنتين . وعلى أى حال فلقد وجد أيضاً أن الصنف توتال أقل قيمة معنوية فى المحتوى من T.S.S. والسكريات الكلية .
5- ولقد وجد أنه لا يوجد فروق معنوية فى نسبة الفقد فى الوزن . المحتوى من المواد الصلبة الذائبة والسكريات الكلية بين المعاملات بالماء الساخن .
6- ولقد وجدت فروق معنوية فى نسبة التالف ، فلقد وجد أن الثمار المعاملة ٥٥ °م لمدة دقيقة واحدة أظهر أقل قيمة فى التالف بالمقارنة للمعاملات الماء الساخن الأخرى .

7- أظهرت المعاملة بغمر الثمار فى ٥٥ °م لمدة دقيقة واحدة أو المعاملة ٦٠ °م لمدة ٣٠ ثانية أكثر صلابة معنوياً عن باقى المعاملات .

8- ولقد أظهرت أن الثمار المغلفة بكل من بى فى سى أو المطاط فيلم أقل قيم في كل من نسبة الفقد فى الوزن أو التالف بالمقارنة بالثمار الغير معاملة ، وأوضحت هذه النتائج أيضاً أن صلابة الثمار المغلفة كانت هناك فروق معنوية بالمقارنة بالثمار الغير مغلفة. علاوة على ذلك فلقد وجد أنه لا يوجد فروق معنوية بين معاملات التغليف بعضها مع بعض فى المحتوى من المواد الصلبة الذائبة والسكريات الكلية .

Table (1): Effect of cultivars, hot water treatments, wrapping films and storage period on keeping quality of cantaloupe fruits.

	2000					2001				
	Weight loss (%)	**Decay (%)**	**Firmness (Pound/inch^2)**	**T.S.S. (%)**	**Total sugar mg/100 mg edible portion**	**Weight loss (%)**	**Decay (%)**	**Firmness (Pound/inch^2)**	**T.S.S. (%)**	**Total sugar mg/100 mg edible portion**
Effect of cultivars :										
Vicar	6.51	3.03	19.80	13.32	8.65	7.12	3.64	20.41	13.93	9.05
Total	9.29	5.73	14.43	11.61	7.54	9.89	6.33	15.04	12.22	7.94
L.S.D. at 0.05	0.43	0.67	1.87	0.69	0.35	0.52	0.74	1.93	0.73	0.38
Effect of hot water treatments :										
Control	7.55	8.87	16.94	12.37	8.04	8.15	9.47	17.53	12.96	8.42
50°C + 2 min	7.81	4.00	16.96	12.42	8.07	8.41	4.61	17.57	13.03	8.46
55°C + 1 min	7.71	3.20	17.25	12.54	8.15	8.31	3.80	17.86	13.14	8.54
60°C + 30 sec	7.74	3.08	17.30	12.51	8.13	8.34	3.69	17.91	13.12	8.52
L.S.D. at 0.05	N.S.	0.04	0.13	N.S.	N.S.	N.S.	0.03	0.15	N.S.	N.S.
Effect of wrapping :										
Control	9.30	6.56	16.11	12.19	7.93	9.91	7.11	16.72	13.78	8.95
P.V.C.	7.18	4.28	17.59	12.55	8.15	7.49	4.89	18.18	13.16	8.55
Stretch	6.70	3.58	17.65	12.63	8.20	7.31	4.18	18.26	13.24	8.60
L.S.D. at 0.05	0.14	0.11	0.29	N.S.	N.S.	0.16	0.13	0.32	N.S.	N.S.
Effect of storage period/days :										
0	--	--	19.11	12.75	8.29	--	--	19.72	13.36	8.68
7	4.17	0.98	18.41	12.64	8.21	4.77	1.58	19.01	13.23	8.59
14	5.40	4.33	17.63	12.48	8.11	6.00	4.63	18.23	13.03	8.51
21	10.13	6.15	15.97	12.38	8.04	10.73	6.76	16.57	12.98	8.44
28	11.91	9.15	14.56	12.07	7.84	12.52	9.75	15.16	12.68	8.24
L.S.D. at 0.05	0.12	1.36	0.16	0.19	0.18	0.11	1.42	0.18	0.16	0.15

Table (2): Effect of interaction between cultivars and storage period on keeping quality of cantaloupe fruits.

Cultivars	**Storage period (days)**	**2000**					**2001**			
		Weight loss (%)	**Decay (%)**	**Firmness (Pound/inch^2)**	**T.S.S. (%)**	**Total sugar mg/100 mg edible portion**	**Weight loss (%)**	**Decay (%)**	**Firmness (Pound/inch^2)**	**T**
Vicar	0	--	--	21.89	13.60	8.84	--	--	22.45	14
	7	2.94	0.56	21.07	13.49	8.76	3.53	1.17	21.66	14
	14	3.94	2.99	20.02	13.35	8.67	4.54	3.58	20.63	13
	21	8.61	4.47	18.61	13.29	8.63	9.22	5.07	19.22	13
	28	10.56	7.11	17.65	12.90	8.38	11.17	7.72	18.26	13

Total	0	--	--	16.34	11.90	7.73	--	--	16.93	12
	7	5.41	1.40	15.76	11.80	7.67	6.02	2.01	16.37	12
	14	6.89	5.68	15.25	11.62	7.55	7.47	6.29	15.86	12
	21	11.66	7.83	13.34	11.47	7.45	12.26	8.44	13.63	12
	28	13.25	11.20	11.48	11.24	7.30	13.85	11.81	11.09	11
L.S.D. at 0.05		0.47	0.63	0.31	0.04	0.03	0.42	0.66	0.33	0

Table (3): Effect of interaction between cultivars and wrapping films on keeping quality of cantaloupe fruits.

Cultivars	Wrapping treatment	2000					2001				
		Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion	Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion
Vicar	Control	8.03	5.03	18.71	13.08	8.46	8.62	5.64	19.32	13.62	8.85
	P.V.C.	5.99	3.56	20.33	13.41	8.71	6.58	4.17	20.94	14.02	9.11
	Stretch	5.60	2.93	20.35	13.47	8.75	6.21	3.54	20.96	14.06	9.13
Total	Control	10.81	7.98	13.50	11.35	7.37	11.42	8.57	14.11	11.96	7.77
	P.V.C.	8.37	5.00	14.86	11.59	7.53	8.98	5.61	15.47	12.18	7.91
	Stretch	7.80	4.23	14.95	11.78	7.65	8.41	4.84	15.56	12.39	8.05
L.S.D. at 0.05		0.11	0.14	0.54	0.03	0.02	0.12	0.16	0.57	0.04	0.02

Table (4): Effect of interaction between wrapping films and storage period on keeping quality of cantaloupe fruits.

Wrapping treatment	Storage period (days)	2000					2001				
		Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion	Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion
Control	0	--	--	19.12	12.75	8.28	--	--	19.73	13.36	8.68
	7	5.98	1.27	17.32	12.56	8.16	6.59	1.88	17.92	13.17	8.56
	14	7.26	5.87	16.37	12.24	7.95	7.87	6.47	16.98	12.83	8.33
	21	12.07	7.63	14.56	11.93	7.75	12.68	8.24	15.17	12.54	8.15
	28	14.02	11.27	13.18	11.53	7.49	14.61	11.88	13.79	12.13	7.88
P.V.C.	0	--	--	19.12	12.75	8.28	--	--	19.73	13.36	8.68
	7	3.39	0.36	18.91	12.68	8.84	3.38	1.47	19.52	13.29	8.63
	14	4.88	3.50	18.22	12.57	8.17	5.47	4.11	18.83	13.16	8.55
	21	9.35	5.10	16.57	12.41	8.07	9.96	5.71	17.18	13.03	8.46
	28	11.11	6.77	15.17	12.34	8.02	11.72	7.38	15.77	12.93	8.40
Stretch	0	--	--	19.12	12.75	8.28	--	--	19.73	13.36	8.68
	7	3.17	0.58	19.03	12.71	8.26	3.78	1.19	19.64	13.32	8.65
	14	4.06	2.56	18.34	12.65	8.22	4.67	3.17	18.33	13.26	8.61
	21	8.99	4.36	16.80	12.57	8.17	9.58	4.96	17.41	13.16	8.55
	28	10.59	6.66	15.38	12.29	7.98	11.19	7.27	15.99	12.28	8.37
L.S.D. at 0.05		0.32	0.45	0.63	0.03	0.04	0.35	0.46	0.62	0.02	0.04

Table (5): Effect of interaction between cultivars and hot water treatments on keeping quality of cantaloupe fruits.

Cultivar	Hot water treatment	2000					2001				
		Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion	Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion
Vicar	Control	6.46	6.59	19.61	13.22	8.59	7.42	7.18	20.22	13.83	8.98

	50°C+ 2 min	6.46	3.43	12.54	13.27	8.62	7.07	4.04	20.13	13.88	9.02
	55°C + 1 min	6.41	2.72	20.01	13.43	8.72	7.02	3.33	20.62	14.04	9.12
	60°C + 30 sec	6.36	2.62	20.04	13.38	8.69	6.97	3.23	20.63	14.99	9.74
Total	Control	8.67	11.15	14.28	11.52	7.48	9.28	11.76	14.89	12.13	7.88
	50°C+ 2 min	9.16	4.57	14.39	11.58	7.52	9.77	5.18	14.98	12.18	7.91
	55°C + 1 min	9.01	3.68	14.49	11.66	7.57	9.62	4.29	15.09	12.27	7.97
	60°C + 30 sec	9.13	3.55	14.56	11.67	7.58	9.74	4.16	15.17	12.28	7.98
L.S.D. at 0.05		0.11	0.08	0.06	0.03	0.02	0.12	0.09	0.05	0.02	0.04

Table (6): Effect of interaction between hot water treatments and storage period on keeping quality of cantaloupe fruits.

Hot water treatment	Storage period (days)	2000					2001				
		Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion	Weight loss (%)	Decay (%)	Firmness (Pound/inch^2)	T.S.S. (%)	Total sugar mg/100 mg edible portion
Control	0	--	--	19.16	12.75	8.28	--	--	19.77	13.36	8.68
	7	4.27	3.61	18.25	12.60	8.19	4.88	4.22	18.86	13.21	8.58
	14	5.46	7.35	17.45	12.39	8.05	6.07	7.96	18.06	12.98	8.43
	21	11.07	9.99	15.60	12.32	8.00	11.68	10.59	16.21	12.91	8.39
	28	12.58	14.54	14.32	11.95	7.76	13.19	15.13	14.93	12.56	8.16
50°C + 2 min.	0	--	--	19.16	12.75	8.28	--	--	19.77	13.36	8.68
	7	4.09	--	18.41	12.64	8.21	4.68	--	19.02	13.23	8.59
	14	5.31	3.48	17.62	12.42	8.07	5.92	4.09	18.23	13.01	8.45
	21	9.97	5.07	15.74	12.35	8.02	10.58	5.68	16.33	13.96	8.42
	28	11.89	7.46	14.47	12.04	7.82	12.49	8.07	15.08	12.64	8.21
55°C + 1 min	0	--	--	19.16	12.75	8.28	--	--	19.27	13.36	8.68
	7	4.06	--	18.49	12.67	8.23	4.67	--	19.05	13.28	8.63
	14	5.26	2.72	17.72	12.54	8.15	5.86	3.33	18.33	13.13	8.53
	21	9.86	3.95	16.24	12.39	8.05	10.47	4.56	16.84	12.98	8.43
	28	11.69	6.14	14.69	12.19	7.92	12.29	6.73	15.29	12.79	8.30
60°c + 30 sec	0	--	--	19.16	12.75	8.28	--	--	19.27	13.36	8.68
	7	4.28	--	18.51	12.68	8.24	4.69	--	19.12	13.39	8.63
	14	5.59	2.58	17.77	12.56	8.16	6.13	3.19	18.38	13.17	8.56
	21	9.65	3.76	16.31	12.42	8.07	10.26	4.37	16.92	13.03	8.46
	28	11.48	6.00	14.80	12.23	7.94	12.09	6.61	14.41	12.84	8.34
L.S.D. at 0.05		0.52	0.29	0.46	0.06	0.04	0.54	0.33	0.48	0.06	0.03