Postharvest Quality of Two Pomegranate Genotypes as Influenced by Storage Temperature and Period

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ABSTRACT

The present investigation was carried out during 2011 season to study the effect of storage temperature and period on fruit storage behavior of local 'Sharmny' and 'Hablary' pomegranates. Fruits of both cultivars were stored at 2°C or 6°C with 85-90% RH for three storage periods; 1.5, 3 and 4.5 months. Results showed genotypic differences in total soluble solids (TSS), weight loss and titratable acidity. 'Sharmny' showed significantly higher TSS and lower fruit weight loss, while 'Hablary' recorded a significant increase in titratable acidity. Storing fruits of both cultivars at 6°C significantly reduced fruit chilling injury, titratable acidity but increased fruit weight loss in comparison with fruit stored at 2°C, while both storage temperatures didn't significantly affect the other parameters. Moreover, chemical characteristics of fruits were significantly decreased, while fruit weight loss and physiological disorders increased with prolonging of storage period.

Keywords: Pomegranate, cultivar, storage temperature, storage period, postharvest quality.

INTRODUCTION

The pomegranate (*Punica granatum* L.) belongs to the Punicaceae family and is one of the oldest known edible fruits (Singh, 1997). It is an important fruit crop of many subtropical and tropical regions of the world, grown especially in the moderate climate of the Mediterranean region. Pomegranate is classified as a non-climacteric fruit with no detectable levels of ethylene produced during storage. The fruits are generally harvested fully ripe (Kader *et al.,* 1984). The economic importance of pomegranate fruits appear through the fruit characterized by their tolerance to transport for long distances and could be stored by multiple methods (Al-Jumaili and Al-Dujaili, 1989). In Iraq, pomegranate cultivation is well succeeding for the appropriate environmental conditions with a need to provide protection for the fruits from sunburn in the summer (Al-Jumaili and Abo Elsaad, 1989). During postharvest, pomegranate exhibits important quality loss due to several physiological and enzymatic disorders. The main problems associated with prolonged storage of pomegranate fruit are weight loss, shrinkage, decay development and appearance of skin blemishes, especially scald (Elyatem and Kader, 1984). Storage temperature is the most important environmental factor affecting senescence of fruit, because it regulates the rate of all associated physiological and biochemical processes (Pantastico, 1979). Kader *et al.,* (1984) showed that when 'wonderful' pomegranate stored at temperatures 0, 2.2, 5 and 10°C for 16 weeks, weight loss increased with increasing storage temperature and duration, but total

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soluble solid (TSS) and titratable acidity decreased in fruits at all temperatures compared to their content at harvest. Moreover, after 8 weeks of storage at a temperature below 5°C, symptoms of chilling injury appeared and susceptibility to decay increased. Onur *et al.,* (1992) studied the storage of pomegranate at 2, 6 and 10°C for 5 months. The result indicated that fruit stored at 2ºC had minimum loss of weight but slight chilling injury, especially after long-term storage. Arte´s *et al.,* (2000) noticed that after 90 days of 'Mollar' pomegranate storage at 2 or 5°C and 95% RH, titratable acidity significantly reduced of both storage temperatures compared to fruit content at harvest, and fruit decay significantly increased. Hess-Pierce and Kader (2003) revealed that maintaining 'Wonderful' pomegranates at 5^{o}C, 7.5^{o}C or 10^{o}C for 3 months led to insignificant differences among treatments in TSS and titratable acidity throughout the storage period.

In Iraq and Kurdistan region, there is lack of studies about storage temperature and physiological disorders of pomegranate fruits that are known as susceptible to chilling injury. In addition, farmers store and market fruit under natural conditions that adversely affect the quality of the fruit. Thus, the aim of the current work was to study the effect of storage temperature and period on quality, fruit storage characteristics and fruit physiological disorders of two local pomegranate cultivars (Sharmny and Hablary) during storage.

MATERIALS AND METHODS

Fully mature pomegranate fruits were randomly harvested (when TSS was 15-17% and weight was 240-260g) from chosen 14-years old trees of two locally cultivars named Sharmny (sour- sweet) and Hablary (sour) in October 2011 from a private orchard in Kandy village, Duhok, Iraq. Picked fruits were directly brought to the central laboratory/ College of Agriculture and Forestry, where those with defects (sunburn, infected by insect and bruises in the husk) were discarded and sound fruits were preserved in cold room.

Treatments

Fruits with uniform size and appearance of both cultivars were selected randomly of every cultivar according to their replicates and placed in perforated polyethylene bags with a capacity of 5 kg and were tied tightly (each bag represent experimental unit). Then fruits were stored in cold storage at 2°C and 6°C with 85-90% RH for three storage periods; 1.5, 3 and 4.5 months, Refrigerated room dimensions were (2.5*2.5*2.5m) and fitted with an electronic regulator to control the temperature and the relative humidity, after each period of storage the bags were opened for analysis.

Measurements

Total soluble solid (TSS %) was determined by Hand Refractometer as described in A.O.A.C. (1994). Titratable acidity (TA %) was determined by the method of Srivastava and Kumar (1993). Vitamin C was measured according to Pearson (1976). Fruit weight loss % was calculated according to El- Badawy (2007). Juice density was determined by the method of Otopeanu *et al.* (1967). Physiological disorders (Scald, chilling injury and decay) were determined on the bases used by Al- Bamarny (2008).

Statistical Analysis

The experiment was laid out as factorial in Randomized Complete Block Design (RCBD) including three factors (2 cvs× 2 temperatures× 3 storage periods) and 12 fruits for each replicate in each storage period, with 3 replicate for each treatment (Al-Rawi and Khalafalla, 2000).

Data were tabulated and statistically analyzed with a computer using SAS program (SAS, 2002). The variation between various treatment means were tested with Duncan Multiple Range Test at the $P < 0.05$ level (Duncan, 1955).

RESULTS AND DISCUSSION

Total soluble solids

The results in table 1 showed that 'Sharmny' pomegranate was significantly superior over 'Hablary' in fruit total soluble solids (TSS) content. No significant differences in TSS % were observed between fruits stored at 2 and those stored at 6°C. On the other hand, the results appeared that prolonging the storage period induced reduction in fruit TSS (%). Fruit stored for 1.5 months significantly induced higher TSS compared with 3 and 4.5 months storage periods, respectively. The highest fruit TSS was obtained in 'Sharmny' stored at 2 or 6°C for 1.5 months, which was significant when compared with the lowest TSS obtained in 'Hablary' sored at 6°C for 4.5 months. These results are in agreement with those obtained by Kader *et al.,* (1984), and Hess-Pierce and Kader (2003) on 'Wonderful' and 'Mollar' pomegranate fruits. The reason of increase in TSS with the raise of temperature might be due to the degradation of complex insoluble compounds to simple soluble compounds like sugars (Selvaraj *et al.*, 1989). The reduction in fruit TSS throughout the storage period might be as a result of lower respiration (Garica *et al.,* 1998), and to the decrease in transpiration rate (water loss) at cold storage.

Table 1: Effect of storage temperature and period and their interactions on the total soluble solids of two pomegranate cultivars.

Cultivar	Total soluble soilids %					
	Storage temperature (°C)	Storage period (Month)			Cultivar × Storage temp.	Cultivar mean
		1.5	3	4.5		
Sharmny	2	16.67 a	16.17 a	16.00 ab	16.28 a	16.36 a
	6	16.67 a	16.33 a	16.33 a	16.44 a	
Hablary	2	16.00 ab	15.33 bc	15.17 c	15.50 b	15.45 b
	6	16.00 ab	15.17 c	15.00 c	15.39 b	
Storage period mean		16.34 a	15.75 b	15.63 b	Storage temp. mean	
Temp. × Period	2	16.34 a	15.75 a	15.59 a	15.89 a	
	6	16.34 a	15.75 a	15.67 a	15.92 a	
Cultivar ×Period	Sharmny	16.67 a	16.25 b	16.17 b		
	Hablary	16.00 b	15.25 c	15.09 c		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level. TSS % at harvest in Sharmny cv. fruit=16.33 %, Hablary cv. fruit= 15.33 %

Titratable acidity:

Results founded in table 2 revealed that Hablary cv. significantly surpasses Sharmny cv. in fruit titratable acidity **(**TA). Fruits stored at 2°C recorded significantly highest TA compared to those stored at 6°C (Table 2). Fruit acidity was significantly decreased throughout the storage periods. Fruit stored for 1.5 months significantly maintained the highest TA in comparison with other storage periods. There were significant differences among the interactions of the three studied factors on fruit TA %. The maximum TA% was recorded for Hablary cv., stored at 2°C for 1.5 months. The significant decrease in fruit acidity with progress in fruit ripening might be due to higher rates of respiration and degradation of citric acid which could be resulted from increase the activity of citric acid glyoxylase or may be due to their further utilization in metabolic process in the fruit (Moing *et al*., 1998) The reduction in total acidity of fruits stored at 6 °C might be due to their conversion into sugars and utilization in metabolic process in the fruit **(Rathore *et al*., 2007)**.

Table 2: Effect of storage temperature and period and their interactions on titratable acidity of two pomegranate cultivars.

Cultivar	Titratable acidity %					
	Storage temp (°C)	Storage period (Month)			Cultivar × storage temp.	Cultivar mean
		1.5	3	4.5		
Sharmny	2	1.01 e	0.79 fg	0.75 fg	0.85 b	0.82 b
	6	0.89 ef	0.78 fg	0.67 g	0.78 b	
Hablary	2	2.46 a	2.31 ab	2.07 c	2.28 a	2.19 a
	6	2.37 a	2.19 bc	1.76 d	2.11 a	
Storage period mean		1.68 a	1.52 b	1.31 c	Storage temp. mean	
Temp. × Period	2	1.74 a	1.55 a	1.41 a	1.57 a	
	6	1.63 a	1.49 a	1.22 a	1.44 b	
Cultivar ×Period	Sharmny	0.95 d	0.79 e	0.71 e		
	Hablary	2.42 a	2.25 b	1.92 c		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level. TA % at harvest in Sharmny cv. fruit=1.15 %, Hablary cv. fruit= 2.57 %

Vitamin C content:

Tabulated results showed that there was no significant variation between Sharmny and Hablary cultivars on fruit vitamin C content (Table 3). Fruit vitamin C was not significantly influenced by 2 and 6 °C storage temperature. On the other hand, fruit vitamin C was significantly decreased with the increasing storage period. Fruit stored for 1.5 months was succeeded in preserving significantly the highest vitamin C (5.00 mg. 100 ml $^{-1}$ juice) in comparison with 3 and 4.5 months storage periods. Concerning the effect of interactions among the three studied factors, there was a significant influence on fruit vitamin C, the maximum vitamin C content (5.40 mg. 100 ml $^{-1}$ juice) was significantly observed in combination between Sharmny cv., 6°C and 1.5 months storage period when compared to the minimum vitamin C (1.23 mg. 100 ml $^{-1}$ juice) obtained in Sharmny cv. Stored at 6°C for 4.5 months, and Hablary cv. stored at 2°C or 6°C and 4.5 months. Similar results were gained by by Al-Mughrabi *et al.,* (1995) on three pomegranate cultivars (Taeifi, Manfaloti and Banati) and Nada *et. al.,* (2001) on 'Ganesh' pomegranate.

Vitamin C is very sensitive to degradation due to its oxidation compared to other nutrients during storage (Veltman *et al.*, 2000). Ascorbic acid is highly susceptible to oxidation, either directly or through the enzymes (Sanmartin *et al*., 2007). Enzymes such as ascorbic acid oxidase, phenolase, cytochrome oxidase, and peroxidase can oxidize ascorbic acid. In a non-enzymic oxidation process, copper and iron salts catalyze the oxidation. The monodehydro ascorbic acid is formed first and then dehydroascorbic acid in the second stage.

Table 3: Effect of storage temperature and period and their interactions on fruit vitamin C content of two pomegranate cultivars.

	Vitamin C mg. 100 ml^{-1} juice					
Cultivar	**Storage temp (°C)**	**Storage period (Month)**			**Cultivar × storage temp.**	**Cultivar mean**
		1.5	**3**	**4.5**		
Sharmny	**2**	4.43 a	2.58 b	1.95 bc	2.99 a	2.98 a
	6	5.40 a	2.30 bc	1.23 c	2.98 a	
Hablary	**2**	4.97 a	2.88 b	1.23 c	3.03 a	2.95 a
	6	5.18 a	2.23 bc	1.23 c	2.88 a	
Storage period mean		5.00 a	2.50 b	1.41 c	**Storage temp. mean**	
Temp. × Period	**2**	4.70 a	2.73 b	1.59 cd	3.01 a	
	6	5.29	2.27	1.23	2.93	

		a	bc	d	a
Cultivar × Period	**Sharmny**	4.92 a	2.44 b	1.59 c	
	Hablary	5.08 a	2.56 b	1.23 c	

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level.
Vitamin C at harvest in Sharmny cv. fruit= (6.48 mg. 100 ml $^{-1}$ juice), Hablary cv. fruit= (7.25 mg. 100 ml $^{-1}$ juice)

Fruit weight loss

The data of fruit weight loss founded in table 4 showed that 'Sharmny' fruit has significantly less weight loss than that of 'Hablary'. Storing fruits at 2°C cold storage succeeded significantly in reducing fruit weight loss compared with those stored at 6°C. Fruit weight loss increased with the prolong of storage duration, the highest fruit weight loss was significantly recorded after 4.5 months in comparison with the other (1.5 and 3 months) storage durations. The interaction among cultivars, storage temperature and period, had a significant impact on fruit weight loss. The lowest fruit weight loss was found in fruits of 'Hablary' stored at 2°C for 1.5 months. The obtained results are in line with those recorded by Kader *et al.,* (1984) on 'Wonderful' pomegranate and Al-Mughrabi *et al.,* (1995) on three pomegranate cultivars (Taeifi, Manfaloti and Banati) and Navale *et al.,* (2010) on 'Phule Arakta' pomegranate.

High storage temperature causes a high transpiration and respiration rate which leads to a fruit weight loss (Hardenburg *et al*., 1990). Fruit weight loss was significantly increased with advance of storage duration. This might caused by increased water exchange between the internal and external atmosphere; the transpiration or evaporation rate being accelerated due to advanced fruit ripening when storage prolonged (Woods, 1990) or to the decrease in membrane integrity and the removal of epicuticular waxes, which play an important role in water exchange through the skin (Schirra and D'Hallewin, 1997).

Table 4: Effect of storage temperature and period and their interactions on weight loss of two pomegranate cultivars.

Cultivar	**Weight loss %**					
	Storage temp (°C)	**Storage period (Month)**			**Cultivar × Storage temp.**	**Cultivar mean**
		1.5	**3**	**4.5**		
Sharmny	**2**	2.43 e	3.16 e	4.96 cd	3.52 a	4.10 b
	6	2.58 e	5.22 cd	6.25 ab	4.68 a	
Hablary	**2**	2.40 e	4.40 d	5.82 a-c	4.21 a	4.51 a

	6	2.69 e	5.32 b-d	6.41 a	4.81 a	
Storage period mean		2.53 c	4.53 b	5.86 a	**Storage temp. mean**	
Temp. × Period	**2**	2.42 d	3.78 c	5.39 b	3.86 b	
	6	2.64 d	5.27 b	6.33 a	4.75 a	
Cultivar × Period	**Sharmny**	2.51 d	4.19 c	5.61 ab		
	Hablary	2.55 d	4.86 bc	6.12 a		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level.

Juice density

Results in table 5 revealed that there was no significant difference between the two studied cultivars on fruit juice density. Juice density of fruits was not significantly influenced by storage temperature (2°C or 6°C). It is clear that the highest fruit juice density was observed by storing fruits for 1.5 months, which was significant when compared to the other storage periods. Regarding the interactions among the three studied factors, 'Hablary' fruits stored at 6 °C for 1.5 months had the highest juice density, which was significant as compared to the lowest juice density in Hablary fruits stored at 2°C for 4.5 months (Table 5). Similar results were showed by Tehranifar *et al.,* (2010) on pomegranate fruits. The significant increase in fruit juice density with prolonged storage period might due to fruit ripening process that correlated with some steps including excessive ethylene formation, and respiration (**Abeles *et al.,* 1992**).

Table 5: Effect of storage temperature and period and their interactions on juice density of two pomegranate cultivars.

Cultivar	**Juice density**					
	Storage temp (°C)	**Storage period (Month)**			**Cultivar × Storage temp.**	**Cultivar mean**
		1.5	**3**	**4.5**		
Sharmny	**2**	1.061 a-c	1.060 a-c	1.061 a-c	1.061 a	1.060 a
	6	1.061 a-c	1.058 a-c	1.059 a-c	1.059 a	
Hablary	**2**	1.063 ab	1.059 a-c	1.056 c	1.059 a	1.060 a

	6	1.065 a	1.060 a-c	1.057 bc	1.061 a	
Storage period mean		1.063 a	1.059 b	1.058 b	**Storage temp. mean**	
Temp. × Period	**2**	1.062 ab	1.059 ab	1.059 ab	1.060 a	
	6	1.063 a	1.059 ab	1.058 b	1.060 a	
Cultivar × Period	**Sharmny**	1.061 ab	1.059 bc	1.060 bc		
	Hablary	1.064 a	1.060 bc	1.056 c		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level.

Scald:

The specific effect of cultivar or storage temperature was not significant on fruit scald. The obtained data in table 6 showed that fruit scald increased as the storage period prolonged; fruit stored for 4.5 months significantly recorded the maximum scald percentage in comparison to 1.5 and 3 months storage periods. It is clear that the scald did not appear after 1.5 months storage. With respect to the interaction among the three studied factors, it was found that fruits stored of both cultivars at 2 or 6 °C for 1.5 months recorded the most effective treatment in preventing the emergence of scald% on fruits, which was significant as compared to the highest fruit scald% obtained for Hablary cv. with 6 or 2°C for 4.5 months storage period. The results were in agreement with results reported by Arte´s *et al.,* (2000) on 'Mollar' pomegranate.

Table 6: Effect of storage temperature and period and their interactions on scald percentage of two pomegranate cultivars.

Cultivar	**Scald %**					
	Storage temp (°C)	**Storage period (Month)**			**Cultivar × Storage temp.**	**Cultivar mean**
		1.5	**3**	**4.5**		
Sharmny	**2**	0.00 c	8.33 c	11.67 c	6.67 a	7.75 a
	6	0.00 c	8.33 c	18.18 bc	8.84 a	
Hablary	**2**	0.00 c	2.78 c	30.09 ab	10.96 a	12.30 a

	6	0.00 c	2.78 c	38.13 a	13.64 a	
Storage period mean		0.00 b	5.56 b	24.52 a	**Storage temp.mean**	
Temp. × Period	**2**	0.00 b	5.56 b	20.88 a	8.81 a	
	6	0.00 b	5.56 b	28.16 a	11.24 a	
Cultivar × Period	**Sharmny**	0.00 c	8.33 bc	14.93 b		
	Hablary	0.00 c	2.78 c	34.11 a		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level.

Chilling injury:

There was no significant difference between the two studied cultivars on fruit chilling injury%. Results showed that the storage temperature had a significant difference on chilling injury %. Fruit stored at 6°C succeed significantly in reducing fruit chilling injury as compared with those stored at 2°C. Evaluating the effect of storage periods, it was noticed that fruit chilling injury increased with extension of the storage period. Storing fruits for 1.5 months was significantly the most sufficient treatment in preventing the appearance of chilling injury on fruits (0%) in comparison with the highest obtained at 4.5 months storage period. There were significant differences among the interactions of the three studied factors on fruit chilling injury. Storing fruit of 'Sharmny' at 2°C for 4.5 months storage period was the surpassed treatment as it gave the highest fruit chilling injury (Table 7). These results are in accordance with those reported by Kader *et al.,* (1984) and Onur *et al.,* (1992) on pomegranate fruits. The reasons of a significant increase of fruit chilling injury that stored at 2°C might be due to chilling conditions, changes in cell membrane lipids from a liquid-crystalline to a solid-gel state induced in plant tissues, which lead to an increase in membrane permeability and leakage of ions (G´omez-Galindo *et al*., 2004). Galactolipids and phospholipids are essential constituents of all hiomembranes. The lipid composition of various membranes in plant cells greatly affects the fluidity of their lipid matrix. Changes occurring in the lipid composition of these membranes will certainly modify their permeability and the activities of membrane-bound enzymes (Lynch and Thompson, 1982).

Table 7: Effect of storage temperature and period and their interactions on chilling injury percentage of two pomegranate cultivars.

Cultivar		Chilling injury %				
	Storage temp (°C)	Storage period (Month)			Cultivar × Storage temp.	Cultivar mean
		1.5	3	4.5		
Sharmny	2	0.00 c	8.33 c	58.89 a	22.41 a	19.54 a
	6	0.00 c	0.00 c	50.00 ab	16.67 a	
Hablary	2	0.00 c	8.33 c	54.29 ab	20.87 a	18.56 a
	6	0.00 c	0.00 c	48.74 b	16.25 a	
Storage period mean		0.00 b	4.17 b	52.98 a	Storage temp. mean	
Temp. × Period	2	0.00 d	8.33 c	56.59 a	21.64 a	
	6	0.00 d	0.00 d	49.37 b	16.46 b	
Cultivar × Period	Sharmny	0.00 b	4.17 b	54.45 a		
	Hablary	0.00 b	4.17 b	51.52 a		

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to DMRT at 5% level.

Fruit decay:

Results reported in table 8 appeared that there was no significant different between 'Sharmny' and 'Hablary' concerning fruit decay percentage. On the other hand, fruit decay was not significantly affected by storage temperature (2°C or 6°C). Fruit decay increased with the prolong of storage period, in which storage for 1.5 months induced a significant reduction in fruit decay as compared to the highest decay in fruits stored for 4.5 months. It is recorded that storing 'Sharmny' fruits at 2°C for 1.5 months significantly succeeded to maintain them without any decay when compared to the highest fruit decay at interaction between 'Sharmny', stored at 2°C for 3 months. Similar results were gained by Kader *et al.,* (1984) and Arte´s *et al.,* (2000) on 'Wonderful' and 'Mollar' pomegranate fruits, respectively. Fruit decay for fruits at 2°C was higher than those stored at 6°C, indicating that these decays were resulted from chilling

injury (Wang and Wang , 2009). Chilling injury caused decay by fruit softening, which resulted from changes in cell wall structure (Fischer and Bennet, 1991), in addition to the modification of membrane phase transition inducing deleterious effects on the tissues with increasing membrane permeability from alteration of lipids and proteins (Bouchereau *et al.*, 1999).

Table 8: Effect of storage temperature and period and their interactions on fruit decay percentage of two pomegranate cultivars.

Cultivar	Storage Temp (°C)	Fruit decay %				
		Storage period (Month)			Cultivar × Storage temp.	Cultivar mean
		1.5	3	4.5		
Sharmny	2	0.00 b	13.89 a	13.03 a	8.97 a	7.86 a
	6	8.33 ab	5.56 ab	6.36 ab	6.75 a	
Hablary	2	2.78 ab	5.81 ab	9.09 ab	5.89 a	5.35 a
	6	2.78 ab	2.78 ab	8.84 ab	4.80 a	
Storage period mean		3.47 b	7.01 ab	9.33 a	Storage temp. mean	
Temp. × Period	2	1.39 b	9.85 a	11.06 a	7.43 a	
	6	5.56 ab	4.17 ab	7.60 ab	5.78 a	
Cultivar × Period	Sharmny	4.17 a	9.73 a	9.70 a		
	Hablary	2.78 a	4.30 a	8.97 a		

Means of each factor and their interactions followed by the same letter's are not significantly different from each other, according to DMRT at 5% level.

CONCLUSION

From the obtained results, it might be concluded that pomegranate fruits of both local cultivars (Sharmny and Hablary) could be stored safely at 6°C for a period of 3 months without shriveling and with a low decrease in fruit quality or physiological disorders. On the other hand, fruits of both cultivars are sensitive to low storage temperature and had different behavior in storage period through the measured parameters.

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تأثير درجة حرارة التخزين والمدة التخزينية على نوعية ثمار صنفي الرمان شرمني وهبلري بعد الحصاد

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ملخص

أجريت الدراسة خلال موسم النمو 2011 على ثمار صنفين محليين من الرمان (شرمني و هبلري) لدراسة تاثير درجة حرارة التخزين ومدة التخزين على نوعية الثمار بعد الحصاد. خزنت ثمار الصنفين على درجة حرارة 2 أو 6°م ورطوبة نسبية 85–90 % لثلاث مدد تخزينية. اظهرت النتائج اختلافا معنويا بين الصنفين في نسبة المواد الصلبة الذائبة والحموضة الكلية وفقدان الوزن للثمار، حيث أظهر الصنف شرمني زيادة في نسبة المواد الصلبة الذائبة وانخفاض في نسبة فقدان الوزن بصورة معنوية. بينما سجل الصنف هبلري ارتفاعا في نسبة الحموضة الكلية. أظهرت ثمار الصنفين المخزونة في درجة 6 °م انخفاضا معنويا في اضرار البرودة والحموضة الكلية للثمار، ومن جهة أخرى ازداد فيها نسبة فقدان الوزن مقارنة مع الثمار التي تم تخزينها على درجة 2 °م . لم تؤثر درجة حرارة التخزين (2و 6 °م) بصورة معنوية على الصفات التخزينية الأخرى للثمار، ولكن الخصائص الكيمياوية للثمار انخفضت بصورة معنوية أما بالنسبة لفقدان الوزن والاضرار الفسيولوجية للثمار فقد ازدادت بتقدم المدة التخزينية للثمار.

الكلمات الدالة: الرمان، الصنف، درجة حرارة التحزين، مدة التخزين، نوعية ما بعد الحصاد.

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