PHYSIOLOGICAL STUDIES ON POMEGRANATE FRUITS AND SEEDS DURING COLD STORAGE.

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Abstract

This study was conducted during the two seasons of 2001 and 2002 on fruits of Manfaloti Pomegranate obtained from a private orchard in Assuit Governorate. The first aim of this research is to study the effect of polyethylene film as a packaging liner to protect fruits duning storage at different cold temperatures. The second aim is to study some safe preserving materials on the keeping quality of Pomegranate seeds (as fresh cut) duning cold storage. Chemical and physical properties were studied. Lining boxes with polyethylene can be a successful method for minimizing weight loss % and keeping freshness of pomegranate fruits during storage and extended its storage life to 60 days at $0^{o}C$ and $5^{o}C$. Conceming the storage of Pomegranate seeds, the storage life was 15 days at $0^{o}C$ and $5^{o}C$. The best treatments for preserving Pomegranate seeds is the treatment by using citric acid followed by treating the seeds with ascorbic acid.

INTRODUCTION

Pomegranate (punica granatum L.) is one of the most popular fruits. Few egyptian data is available on their postharvest physiology and storage conditions.

Storage Pomegranate fruits:

Pomegranates are susceptible to chilling injury and because of their high sensitivity they can be stored only for a limited period at chilling temperatures. Fruits can be held for one month at $0^{o}C$, two months at $5^{o}C$ and for six weeks at $10^{o}C$, before being injured. Relative humidity should be 90 to 95 percent, with 95 percent preferred for long storage to minimize water loss. Symptoms of chilling injury are surface pitting and discoloration, internal discoloration of locular septa, and increased

susceptibility to decay (Kader *et al.*, 1984). Refrigeration has been recommended for storage and transport of Pomegranates (Pantastico *et al.*, 1975. Lutz and Hardenburg 1977, Kader *et al.*, 1984). Al Kahtani, 1992, found in his study on chemical characteristics of juice extracted from fresh Manfaloti Pomegranate fruits reported that it contains 15.8 % total soluble solids, 1.0 % acidity, 13.3 % total sugars and PH 3.5.

Loss of moisture can often be minimized with protective packaging to supplement the benefits of refrigeration. Plastic materials, such as polyethylene films can be used for consumer size. packaging or box liners to protect stored commodities (Hardenburg, 1986). The positive effects of using film packaging can include maintenance of high relative humidity and reduction of water loss (Kader et al 1989).

Storage Pomegranate seeds:

The structure of Pomegranate fruits make the fruits uneasy to be consumed. The edible part of the fruit is the purple pulp completely surrounding the seeds which are connected together within the leathery rind by a locular septa representing the whole pericarp. Fresh cut is an easy (or simple) technology which may solve this problem.

This life span of Pomegranate seeds and vegetables is controlled by product temperature. Cooling and holding all products just above freezing temperature will insure maximum shelf-life, maintain quality, keep the product safe from microbial contamination and allow modified atmosphere packing to perform well. Pomegranate seed products are particularly susceptible to oxidative browning reactions. Ascorbic acid is commonly added as 1% solution to prevent browning on the cut surface of numerous horticultural products. The addition of sugar, either dry or syrup, is another mean of preventing browning in peeled and Pomegranate seeds. Sugar also helps is maintaining flavor and texture, and color. Citric acid makes a suitable anti darkening agent and affective as ascorbic acid (Barrett M.D. 1995).

The shelf life differs among fresh cut fruits and ranges from 7 to 20 days when held at the recommended temperature (Watada and Ling 1999). The objective of this study was to investigate the response of Pomegranate fruits to different cold storage temperatures and evaluating the effect of polyethylene film as a packaging liner in protecting the fruit during storage. The second objective is to study some preserving materials on the keeping quality of Pomegranate (as fresh cut) during cold storage.

MATERIALS AND METHODS

This study was conducted during the two successive seasons of 2001 and 2002 on Manfaloti Pomegranate fruits obtained from a private orchard in Assiut Governorate. This study contains two parts. The first part of the study was dealing with the storage of Pomegranate fruits while the second one dealing with the sto rage of the seeds.

• **1St part:** Mature fruits were harvested according to Arie.et al., (1984) who found that wonderful Pomegranate fruits reached horticultural maturity for commercial harvest when the Soluble Solid Content (SSC) attained a fairly constant level of 15% and cleaned by wet towels, then sorted for size and shape uniformity. Fruits were divided into two groups, the first one was packed in carton boxes lined with polyethylene 30 U, and the second group was packed in carton boxes without lining,. Each box contained 3 kilos, and was considered as one replicate. Three replicates of each group were stored in cold room in (Hort. Instit.) at 0°C & 5°C and 10°C and relative humidity 85-90 %.Temperature and humidity inside these rooms are controlled.- Fruits were examined every twenty days intervals until the end of the storage period (60 days) for the determination of various physical properties (weight loss %, fruit appearance and storage life) and chemical properties (total soluble solids %, acidity %, total sluble sugars % and anthocyanin content.

• **2nd part:** Fresh fruits were weighed, hand cracked and the arils were separated from the other tissues (one kilo of Pomegranate fruits contained about 418 gm peel and 582 gm seeds). 200 gm of the Pomegranate seeds were packed in small sealed polyethylene bags (30 u), 36 bags were prepared and divided into four groups; 1St group without any treatment (control), the 2nd group was treated with citric acid, the 3rd group was treated with Ascorbic acid while the last group was treated with Sugar (1 gm from each material /100 gm seeds).

The bags were held at 0°C, 5° C and 1 0°C for 15 days

Physical and chemical properties of the seeds were determined:

1- Physical properties:

• Weight loss % was recorded by weighing seeds periodically and the percentage of weight loss was calculated according to the initial weight.

• **Fruit and seed appearance.**

Fruit and seed appearance were evaluated visually.

For fruits:

1 = very good. & 2 = good. & 3 = fair.

For seeds:

1- Red & 2 = Brownish red. & 3 = Brown.

• Storage life.

2- Chemical Properties:

• Total soluble solids % was determined by using a hand refractometer.

• Total acidity % was estimated as citric acid according to A.O.A.C 1960.

• Total soluble sugars % was determined by using the phenol, sulphuric acid method (Smith *et al* 1956).

• Total anthocyanine was determined according to Husia *et al* 1965.

Statistical analysis:

The statistical analysis of the obtained data was carried out according to Snedicor and Cachran 1972. Means are compared using the L.S.D values at 5 % level.

RESULTS

Pomegranate fruits: .

Weight loss Percentage:

It is evident from table (1) that fruits stored at 0^{o}C had significant less weight loss percentage than those held at 5^{o}C or 10^{o}C during the two seasons. On the other hand, percent loss in weight increased with the advanced storage period. It is also evident that using polyethylene liners resulted in significant reduction in the average values of weight loss percentages as compared to the control fruits (9.30 & 11.40) for the first season and (7.77 & 12.32) for the second season Table(1) it is obvious from data that physical main factor effecting the general storage life of Pomegranate fruits was weight loss percentage. These results are in harmony with those of Hardenburg (1986), and Kader *et al.*,1989.

Storage life:

The storage life of Pomegranate fruits depends on the storage temperature as the fruits can be stored for 40 days at the temperatures of 0°C and 5°C and for only 20 days at 10°C. Lining boxes with polyethylene can be a successful method for keeping freshness of fruits during storage and extend its storage life to 60 days at 0°C, 5°C and for 30 days at 1 0°C. Loss of water from fruits is a major cause limited storage life of fruits. Water loss not only results in appreciable weight loss but also in less attractive appearance and lowered quality. Similar results were obtained by Kader *et al.,* (1984), Pantastico *et al.,* (1 975).

Total soluble solids:

It is evident from table (2) that fruits stored at 0°C resulted significantly in a decrease in total soluble solids percentage as compared either with fruits stored at 5°C or at 10°C. This may be due to that fruits stored at 0°C had less weight loss than other fruits.

With prolonged storage period, a gradual decrease in T.S.S % was obvious. There is no obvious difference in the T.S.S % of fruits packed in either lined or not lined boxes in the 1st season but this difference was significant in the 2nd season.

Total sugars %:

From table (3) it is clear that fruits at 10°C gave the highest percentage of total sugars. This may be due to that fruits stored at 1 0°C had high weight loss than other fruits. Total.sugars decreased at the end of storage period (60 days). Total sugars % in fruits packed in boxes lined with PE had a significant increase in the second season.

Total acidity %:

As shown in table (4) the data cleared that acidity percentage decreased with some fluctuations in the 1St season. In the 2nd season fruit acidity decreased gradually till the end of the storage period at the three storage temperature 0°C, 5°C and 10°C. Fruits packed in boxes lined with PE had higher acidity contents in the 1st season than fruits packed in unlined boxes. This may be attributed to the fact that packaging material can protective fruits from deterioration in storage. On the contrary, this was not obvious in the 2nd season.

Anthocyanin contents:

Data of anthocyanin content shown in table (5) clearly revealed that a highest percentage of anthocyanin content was in fruits stored at 1 0°C. It is obvious that

anthocyanin content, decreased with the extension of the storage period in the two seasons. Fruits packed in boxes lined with PE had significant increase in anthocyanin contents.

Conclusion: Lining boxes with polyethylene can protect fruits from chilling injury at 0 °C and from dryness at 1 0 °C. This method of packaging kept freshness of fruits and extended its storage life.

Pomegranate seeds (Fresh cut):

Weight loss %:

It could be noticed clearly that loss in weight percentage in Pomegranate seeds showed the highest values in seeds stored at 10 °C in the two seasons of the study (tables 6 & 7). On the other hand, the rate of weight loss % responded significantly to different treatments. The lowest percentage of weight loss was recorded in the Pomegranate seeds treated with citric acid followed by those treated with sugars compared to control seed which showed the highest values in the two seasons.

Texture:

Data in (tables 6 & 7) showed that Pomegranate seeds stored at 0 °C and 5 °C had the greatest values of texture in the two seasons. Regarding the effect of pre storage treatments the control seeds showed the lowest values in the 2nd season. Although this difference was not clear in the 1st season.

T.S.S % and sugar content:

It is evident from (tables 6 & 7) that the changes in T.S.S % and sugar content were affected by storage temperature. Fruits stored at 10 °C had the lowest values of T.S.S % and sugar contents. The highest values of T.S.S % and sugar contents were observed in fruits treated with sugar.

Acidity %:

The data revealed that acidity percentage was the least in seeds stored at 5 °C in all treatments. The Pomegranate seeds treated with ascorbic acid had the highest significant values of acidity during the two seasons (tables 6 & 7).

Anthocyanin contents:

Data in (tables 6 & 7) showed that, with regard to changes in the anthocyanin content of Pomegranate seeds, it is evident that those stored at 10 °C had the lowest values of anthocyanin content in the two seasons. The best results were those of

Pomegranate seeds treated with citric acid followed by those treated with ascorbic acid and sugar.

Conclusion:

Pomegranate seeds treated by adding 1 % citric acid can be stored (for 15 days) at 0 °C, 5 °C without browning of color and maintained appearance. These results are in agreement with those reported by Barretle 1995, Watada and Ling 1999.

Table (1) Effect of storage temperatures and lining of boxes on Weight loss% of Pomegranate Fruits

Storage		2001			2002		
Period in days ©	Degree (A)	Treatments (B)		Means	Treatments (B)		Means
		Con	P.E		Con	P.E	
0 day	0	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
Mean		0.00	0.00	0.00	0.00	0.00	0.00
20	0	5.61	3.84	4.73	5.54	2.96	4.25
	5	6.06	5.72	5.89	6.8	4.22	5.51
	10	6.31	4.8	5.56	6.05	5.62	5.84
Mean		5.99	4.79	5.39	6.13	4.27	5.2
40	0	11.15	8.35	9.75	10.4	5.46	7.93
	5	12.17	12.36	11.96	12.72	6.62	9.67
	10	14.49	10.87	12.68	13.72	11.07	12.40
Mean		12.4	10.53	11.47	12.28	7.72	10.00
60	0	14.15	10.52	12.34	15.77	8.11	11.94
	5	15.71	14.08	14.9	18.28	9.31	13.8
	10	17.63	13.18	15.41	21.66	16.55	19.11
Mean		15.83	12.59	14.21	18.57	11.32	14.95
Average	0	1030	7.57	8.94	10.54	5.51	8.03
	5	11.11	10.72	10.92	12.6	6.72	9.66
	10	12.81	9.62	11.22	13.81	11.08	12.45
Mean		11.41	9.30	10.36	12.32	7.77	10.04
L.S.D at 5% level for		A	1.120		A	0.097	
		B	0.910		B	0.079	
A: Storage degree		C	1.120		C	0.97	
		AxBxC	N.S		AxBxC	N.S	
B: Treatments.		AxB	1.372		AxB	1.579	
		AxC	1.681		AxC	N.S	
C: Period in days		BxC	1.372		BxC	N.S	

Table (2) Effect of storage temperatures and lining of boxes onT.S.S% of PomegranateJuice .

Storage		2001			2002		
Period in days ©	Degree (A)	Treatments (B)		Means	Treatments (B)		Means
		Con	P.E		Con	P.E	
0 day	0	15.67	15.67	15.67	17.20	17.20	17.20
	5	15.67	15.67	15.67	17.20	17.20	17.20
	10	15.67	15.67	15.67	17.20	17.20	17.20
Mean		15.67	15.67	15.67	17.20	17.20	17.20
20	0	13.37	13.3	13.52	16.2	16.8	16.5
	5	15.4	15.1	15.25	16.87	17.13	17
	10	14.9	14	14.45	16.33	16.97	16.65
Mean		14.68	14	14.41	16.47	16.97	16.72
40	0	12.5	13	12.75	15.87	16.63	16.25
	5	13.6	15.13	14.37	16.43	17	16.72
	10	14.4	13.6	14	16.1	16.6	16.35
Mean		13.5	13.91	13.71	16.5	16.74	16.44
60	0	14	14	14	17	17	16.75
	5	14	14	14	16.4	17.1	17.05
	10	14	14	14	16.63	16.5	16.45
Mean		14	14	14	16.44	16.87	16.75
Average	0	13.98	13.99	13.99	16.44	16.91	16.68
	5	14.67	14.96	14.82	16.88	17.11	17
	10	14.74	14.32	14.53	16.51	16.82	16.67
Mean		14.46	14.42	14.44	16.61	16.95	16.78
L.S.D at 5% level for		A	0.154		A	0.222	
		B	N.S		B	0.182	
A: Storage degree		C	0.178		C	0.257	
		AxBxC	0.436		AxBxC	N.S	
B: Treatments.		AxB	0.218		AxB	N.S	
		AxC	0.308		AxC	N.S	
C: Period in days		BxC	0.251		BxC	N.S	

Table (3) Effect of storage temperatures and lining of boxes on Sugar % of PomegranateJuice .

Storage		2001			2002		
Period in days ©	Degree (A)	Treatments (B) Con	P.E	Means	Treatments (B) Con	P.E	Means
0 day	0	16.57	16.57	16.57	17.01	17.01	17.01
	5	16.57	16.57	16.57	17.01	17.01	17.01
	10	16.57	16.57	16.57	17.01	17.01	17.01
Mean		16.57	16.57	16.57	17.01	17.01	17.01
20	0	16.57	16.37	16.47	16.9	17	16.95
	5	16.2	16.07	16.14	16.77	17	16.89
	10	17.1	17.3	17.2	17.13	17.2	17.17
Mean		16.62	16.58	16.6	16.93	17.07	17
40	0	16.43	16.6	16.52	16.7	16.9	16.8
	5	16.13	15.83	15.98	16.6	16.9	16.75
	10	16.8	17.07	16.94	17.23	17.3	17.27
Mean		16.45	16.5	16.48	16.84	17.03	16.94
60	0	15.1	15.3	15.2	16.5	16.7	16.6
	5	15.7	15.9	15.8	16.53	16.8	16.67
	10	16	16.07	16.04	16.5	16.6	16.55
Mean		15.6	15.76	15.68	16.51	16.7	16.61
Average	0	16.17	16.21	16.19	16.78	16.9	16.84
	5	16.15	16.09	16.12	16.73	16.93	16.83
	10	16.62	16.75	16.69	16.97	17.03	17
Mean		16.31	16.35	16.33	16.83	16.95	16.89
L.S.D at 5% level for	A	0.189		A	0.041		
	B	N.S		B	0.033		
A: Storage degree	C	0.218		C	0.047		
	AxBxC	N.S		AxBxC	N.S		
B: Treatments.	AxB	N.S		AxB	0.058		
	AxC	0.378		AxC	0.081		
C: Period in days	BxC	N.S		BxC	0.067		

Table (4) Effect of storage temperatures and lining of boxes on Acidity% of PomegranateJuice .

Storage		2001			2002		
Period in days ©	Degree (A)	Treatments (B)		Means	Treatments (B)		Means
		Con	P.E		Con	P.E	
0 day	0	1.24	1.24	1.24	1.26	1.26	1.26
	5	1.24	1.24	1.24	1.26	1.26	1.26
	10	1.24	1.24	1.24	1.26	1.26	1.26
Mean		1.24	1.24	1.24	1.26	1.26	1.26
20	0	0.6	0.93	0.77	1.15	1.1	1.13
	5	0.74	0.8	0.77	1.07	1.03	1.05
	10	0.8	0.96	0.88	1.12	1.1	1.11
Mean		0.71	0.9	0.81	1.11	1.08	1.1
40	0	0.9	0.96	0.93	1.04	1	1.02
	5	0.86	0.9	0.88	0.99	0.97	0.98
	10	0.96	0.96	0.96	1.01	1	1.01
Mean		0.91	0.94	0.92	1.01	0.99	1.00
60	0	0.77	0.77	0.77	1.02	0.97	1
	5	0.96	0.96	0.96	0.97	0.91	0.94
	10	1.09	1.01	1.09	1	0.96	0.98
Mean		0.94	0.94	0.94	1	0.95	0.97
Average	0	0.88	0.98	0.93	1.12	1.08	1.1
	5	0.95	0.98	0.97	1.07	1.05	1.06
	10	1.02	1.06	1.04	1.1	1.08	1.09
Mean		0.95	1.01	0.98	1.1	1.07	1.08
L.S.D at 5% level for		A	0.020		A	N.S	
		B	0.016		B	N.S	
A: Storage degree		C	0.023		C	0.042	
		AxBxC	0.056		AxBxC	N.S	
B: Treatments.		AxB	0.028		AxB	N.S	
		AxC	0.040		AxC	N.S	
C: Period in days		BxC	0.032		BxC	N.S	

Table (5) Effect of storage temperatures and lining of boxes on Anthocyanin of Pomegranate Juice .

Storage		2001			2002		
Period in days ©	Degree (A)	Treatments (B) Con	P.E	Means	Treatments (B) Con	P.E	Means
0 day	0	18.25	18.25	18.25	15.97	15.97	15.97
	5	18.25	18.25	18.25	15.97	15.97	15.97
	10	18.25	18.25	18.25	15.97	15.97	15.97
Mean		18.25	18.25	18.25	15.97	15.97	15.97
20	0	17.2	17.3	17.25	15.5	15.67	15.59
	5	17.22	17.63	17.43	15.8	16.1	15.95
	10	18.84	19.25	19.05	16.43	16.7	16.57
Mean		17.75	18.06	17.91	15.91	16.16	16.03
40	0	16.9	17.03	16.97	14.15	15	14.58
	5	17.03	17.38	17.21	14.2	15.8	15
	10	19.2	19.84	19.52	16.9	16.93	16.92
Mean		17.71	18.08	17.9	15.08	15.91	15.50
60	0	15.9	16	15.95	12.33	14.3	13.32
	5	16.2	16.53	16.37	11.73	15.06	13.4
	10	18.6	18.84	18.72	15.6	16	15.8
Mean		16.9	17.12	17.01	13.22	15.12	14.17
Average	0	17.06	17.15	17.11	14.49	15.23	14.86
	5	17.17	17.45	17.31	14.43	15.73	15.08
	10	18.72	19.05	18.89	16.22	16.4	16.31
Mean		17.65	17.88	17.77	15.22	15.79	15.42
L.S.D at 5% level for	A	0.086		A	0.150		
	B	0.070		B	0.122		
A: Storage degree	C	0.099		C	0.173		
	AxBxC	N.S		AxBxC	0.425		
B: Treatments.	AxB	0.121		AxB	0.212		
	AxC	0.172		AxC	0.30		
C: Period in days	BxC	0.141		BxC	0.245		

Table (6) Effect of storage temperatures and lining of boxes on Pomegranate fruit appearance .

storage		1 st season		2 nd season	
period in days	degree	Treatments		Treatments	
		Control	PE	Control	PE
20	0^0C	1	1	1	1
	5^0C	1	1	1	1
	10^0C	1	1	1	1
40	0^0C	1	1	1	1
	5^0C	1	1	1	1
	10^0C	2	1	2	1
60	0^0C	2	1	2	1
	5^0C	2	1	2	1
	10^0C	3	3	3	3

(1) Very good.

(2) Good.

(3) fair.

Table (7) Effect of storage temperatures and different treatments on some properties of seed Pomegranate in first season (2001).

Treatments		Properties						
Storage degree (s)	(T)	Texture	Weight loss%	sugars%	Antho-cyanin	T.S.S%	Acidity %	Appearance of seeds
0 °C	Control	3.00	0.00	15.40	15.87	15.40	1.22	2
	T 1	4.67	0.00	16.00	16.07	15.10	1.25	1
	T 2	4.33	0.00	15.80	15.99	14.70	1.68	1
	T 3	3.33	0.00	17.10	16.10	16.00	1.16	2
Mean		3.83	0.00	16.08	16.01	15.30	1.33	
5 °C	Control	5.00	0.00	15.27	15.97	15.50	1.16	2
	T 1	3.67	0.00	15.90	16.10	15.13	1.10	1
	T 2	5.33	0.00	15.80	16.20	14.73	1.65	1
	T 3	5	0.00	17.00	16.40	16.00	1.03	2
Mean		4.75	0.00	15.99	16.17	15.34	1.24	
10 °C	Control	0.00	4.15	13.37	11.71	13.60	1.31	3
	T 1	0.00	1.29	14.62	13.93	11.80	1.25	2
	T 2	0.00	3.38	13.00	14.16	11.60	1.60	3
	T 3	0.00	1.60	12.13	14.50	13.40	1.16	2
Mean		0.00	2.61	13.28	13.58	12.60	1.33	
Mean	Control	2.67	1.38	14.68	14.51	14.83	1.23	
	T 1	2.78	0.43	15.51	15.36	14.01	1.20	
	T 2	3.22	1.13	14.87	15.45	13.68	1.64	
	T 3	2.78	0.53	15.41	15.67	15.13	1.12	
L.S.D at 5% level for:								
	(T)	N.S	0.198	0.389	0.131	0.119	0.087	
	(S)	1.39	0.171	0.337	0.113	0.103	0.075	
	(Txs)	N.S	0.343	0.675	0.227	0.207	N.s	

(1) Red.
(2) Brownish Red.
(3) Brown.

Table (8) Effect of storage temperatures and different treatments on some properties of seed Pomegranate in first season (2002)

Treatments		Properties						
Storage degree (s)	(T)	Texture	Weight loss%	sugars%	Antho-cyanin	T.S.S%	Acidity %	Appearance of seeds
0 °C	Control	4.00	0.00	16.60	14.06	16.80	1.12	2
	T 1	6.00	0.00	15.40	13.66	16.60	1.28	1
	T 2	4.33	0.00	15.00	15.37	16.40	1.98	1
	T 3	4.67	0.00	17.50	14.35	17.50	1.02	1
Mean		4.75	0.00	16.13	14.36	16.83	1.35	
5 °C	Control	4.67	0.00	15.60	14.20	16.90	1.09	2
	T 1	5.33	0.00	15.70	14.00	16.80	1.22	1
	T 2	5.00	0.00	15.20	15.00	16.50	1.86	1
	T 3	4.67	0.00	17.80	15.15	17.60	0.99	1
Mean		4.92	0.00	16.08	14.59	16.95	1.29	
10 °C	Control	0.00	1.53	15.10	10.86	16.00	1.06	3
	T 1	0.00	0.75	13.80	8.66	15.30	1.34	1
	T 2	0.00	0.64	13.61	9.26	15.87	1.93	1
	T 3	0.00	0.26	13.20	11.19	16.30	1.22	2
Mean		0.00	0.80	13.93	9.99	15.87	1.39	
Mean	Control	2.89	0.51	15.77	13.04	16.57	1.09	
	T 1	3.78	0.25	14.97	12.11	16.23	1.28	
	T 2	3.11	0.21	14.60	13.21	16.26	1.92	
	T 3	3.11	0.09	16.17	13.56	17.13	1.08	
L.S.D at 5% level for:								
	(T)	0.623	0.134	0.081	0.419	0.081	0.075	
	(S)	0.540	0.116	0.070	0.363	0.070	0.065	
	(Txs)	N.S	0.233	0.141	0.726	0.048	N.s	

(1) Red.
(2) Brownish Red.
(3) Brown.

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دراسات فسيولوجية علي ثمار الرمان المنفلوطي والثميرات أثناء التخزين

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أجريت هذه الدراسة خلال عامي (٢٠٠١ – ٢٠٠٢) علي ثمار الرمان صنف منفلوطي من مزرعة بأسيوط .

الهدف الأول من الدراسة : دراسة تأثير التعبئة في عبوات كرتون مبطنة بالبولي ايثلين خلال التخزين في درجات حرارة مختلفة (صفر ، ٥ °م ، ١٠ °م) .

الهدف الثاني من الدراسة : الحفاظ علي جودة الثميرات (البذور) أثناء التخزين البارد (صفر ، ٥ °م ، ١٠ °م) ودرست الصفات الطبيعية والكيماوية .

وجد أن التغليف بالبولي ايثلين أدي الي تقليل الفقد في الوزن والمحافظة علي المظهر الطازج للثمار كما أدي الي اطالة فترة التخزين المبردحتي ٦٠ يوم علي درجتي (صفر ، ٥ °م) كما وجد أنه يمكن تخزين ثميرات الرمان لمدة ١٥ يوم علي درجة (صفر ، ٥ °م) . وكانت أحسن المعاملات بالنسبة للثميرات هي أستخدام الستريك أسيد تليها الاسكوربيك أسيد .