Assiut J. Agric. Sci., (47) No. (3) 2016 (47-60) *ISSN: 1110-0486*
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Effect of Paraffin Oil and Polyethylene Packaging on "Manfaluty" Pomegranate Fruits During Storage

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Received on: 4/4/2016 **Accepted for publication on:** 24/4/2016

Abstract

This investigation aimed to study the effect of paraffin oil and polyethylene bags used separately or in combination on storage quality of "Manfaluty" pomegranate fruits during storage throughout 2012 and 2013 seasons. Fruits were stored at 5 °C with 85-90% RH and room temperature at 22 ± 5 C°. Generally, the storage period in the present study was 45 days at room temperature and 90 days at cold storage. All treatments, namely, coating with paraffin oil, packing with polyethylene bags and combination of both coating and packing, significantly decreased weight loss % and decay % of stored Manfalouty fruits compared with untreated fruits (control) under both storage conditions during 2012 and 2013 seasons. Concerning the chemical properties, total soluble solids (T.S.S) % and acidity gradually increased with the progress of storage period, under all storage conditions during both tested seasons. At the end of storage period the treated fruits with polyethylene bags + paraffin oil contained the lowest values of T.S.S and acidity % while the untreated fruits (control) had the highest percentage of both properties. Juice volume decreased with the extending of storage period and reached the minimum values after 45 days at room temperature and 90 days under cold storage during both investigated seasons. The highest juice content was obtained by polyethylene packing + paraffin oil coating, while the lowest content was found in untreated fruits (control).

***Keywords**: "*Manfaluty" pomegranate, paraffin oil, polyethylene bags, cold storage, room temperature.

Introduction

The total cultivated area of pomegranate in Egypt reached 8080 hectare and produced about 42934 tons (FAO, 2012). Local pomegranate cultivars are centered in Upper Egypt especially in Assuit Governorate since long period because of the increased of land reclamation with using new varieties which were introduced to cover the increased amount of export whereas, the total production exceeded 613,000 tons according to Annual Statistical of Ministry of Agriculture in 2012.

Pomegranate is worthwhile because it has some parts such as leaves, roots, and flowers, which had prominent in industry and medicine for thousands of years (Feng *et al*., 1998). Arils are the edible portion of fruit include juice and seeds and they are a rich source of minerals, sugars, pectin, fibers, amino acids, ascorbic acid, phytoestrogens, and above all, polyphenolic flavonoids (Aviram *et al*., 2000). Many clinical studies

demonstrate that pomegranate consumption contributes to prevent diseases such as coronary heart disease and some types of cancer (Malik *et al*., 2005, Sumner *et al*., 2005). Therefore, the increased demand for pomegranate fruits is facing the scarcity of international markets (Deepike and Anwar, 2010).

Storage temperature is the most important environmental factor affecting on senescence of fruits, because it regulates the rate of physiological and biochemical processes. The effect of storage temperature on keeping the quality of some pomegranate cultivars was studied by (Heikel *et al*.,1966, Kader *et al*.,1984, Al-Mughrabi and Bacha,1986).It is known that, the cold storage plays an important role in prolonging shelf life of many fruits and vegetables with keeping their quality during storage. For economically undeveloped countries, it is necessary to discover a cheap and effective storage method to increase its shelf-life by decreasing the natural physiological deterioration and preventing the activity of decay organisms (Manning, 1996).

Edible coatings are applied on fruits and vegetables to improve appearance, delay ripening, reduce water loss and decay, and extend shelf life (Saucedo-Pompa *et al.,* 2007). Coatings formed suitable atmosphere around fruit's surface for decreasing respiration rate of fruit and can improve the environmental conditions such as temperature and humidity (Baldwin *et al.,* 1996).

Recently, several attempts were conducted to prolong the marketing season of pomegranate fruits, among these attempts besides cold storage is the use of paraffin oil as natural product and supports chilling or long-life storage fruits by reduction of transpiration. (Magashi and Bukar, 2006)

Modified atmosphere packaging (MAP), is a dynamic process to modify the gaseous component inside a package via the interaction between the natural process of produce respiration and permeation of gas over the packaging film (Mahajan *et al.,* 2008, Caleb *et al.,* 2012). Moreover, atmospheres inside the MAP prolong shelf-life of fresh fruits by reduction the metabolic activities such as ethylene biosynthesis and respiration whereas, this slows down biological and physiological changes of produce like softening, decay, senescence and the rate of changes in texture, flavor, color and nutritional quality attributes (Mangaraj *et al.,* 2011, Siddiqui *et al.,* 2011; Mahajan *et al.,* 2014).

In recent years, many researchers are interest to study the improvement of agriculture processes of pomegranate such as post-harvest and storage and marketing because it became the most important fruits for consumer from the nutritional and health terms whereas, pomegranate contains vitamins and minerals and a lot of compounds that have high values of the antioxidants. Therefore , this study was focused on the importance of storage and marketing of pomegranate fruits such as prolonged storage life and marketing's period by using the edible coating (paraffin oil) and modified atmosphere packaging (polyethylene bags) and effect that on physical and chemical properties of fruits during cold storage and room temperature.

The aim of this research is achieving the following specific objectives;

1. Prolonged the storage period of pomegranate fruits with retention the highest quality of marketing and consumables with the lowest coast.

2. Investigation the effect of paraffin oil and polyethylene bags on physical and chemical properties and storage quality of fruits.

3. Comparison of the effect of cold storage and room temperature of fruits quality.

Materials and Methods

Pomegranate fruits were collected in maturity stage from orchard of Pomology Department, Faculty of Agriculture, Assiut University during two seasons 2012 and 2013. Harvested fruits were directly transferred to the laboratory in the same faculty.

The maturity signs of the fruit were: the peel is red color and shiny, full opening of the calyx, juice of arils is deep red colored and TSS/TA for juice arils (12/1). The fruits were selected for uniformity of shape, size and free of physical damage and infections.

*Maturity index (TSS/TA): was calculated based on the classification made by (Martinez *et al*., 2012). Simi-Sweet varieties: MI =12

Fruits were washed with running tap water, dipped in a 500 ppm binomial solution and were left them in air almost 10mins until dry. Experimental fruits were divided into four similar groups. One group of each was subjected to one of the following treatments:-

1- Control group (untreated fruits), T_1.

2- Packing with polyethylene bags, T_2

3- Coating with thin layer of paraffin oil, T_3.

4- Coating with thin layer of paraffin oil + packing in polyethylene bags, T_4

Each treatment was replicated three times and each replicate put as one layer in a carton box. The half of experimental boxes were stored at (5±1ºC) and (90±5%) relative humidity and the other, at room temperature (22±5C°). Changes in some physical and chemical fruits properties were determined every 15 days interval.

Physical and chemical properties were measured as follow:

A- Physical properties:-

1-Fruit weight loss percentage:

Each box was individually weighted before storage to get the initial weight and then weighted after each period of both storage conditions. Fruit weight was recorded and then percentage of weight loss was calculated according to the following equation:

$$\text{Fruit weight loss \%} = \frac{wi - ws}{wi} \times 100$$

Where; wi = initial fruit weight before cold storage.

ws = fruit weight at the end of sampling period.

2-Fruit decay percentage:

The decayed fruits as percentage were calculated according to the following equation:

$$\text{Decay percentage} = \frac{\text{Total number of decayed fruits}}{\text{Initial number of stored fruits}} \times 100$$

3- Juice volume of 100(g) arils: was determined in ml by Graduated cylinder

B- Chemical properties:

1- Soluble Solids Content (TSS%):

A refractometer was used to determine the soluble solids content in fruit flesh according to AOAC (1990).

2-Total acidity % (TA):

It was determined according to the method described in AOAC (1990), 10ml of the extracted juice was diluted to 100ml and titrated against 0.1 N NaOH to pH 8.1.

3-TSS/Acid ratio: = $\frac{\text{T.S.S}}{\text{TA}}$

Statistical analysis:

The obtained data were tabulated and statistically analyzed according to the complete randomized block design with three replicates (Snedecor and Cochran, 1989) using L.S.D test to recognize the significance of the differences among various treatments means.

Result and Discussion

Storage period duration:

Under the present study condition, the duration of storage periods were found about 45 days under room temperature and 90 days for cold storage.

A- Physical properties:

1- **Weight loss %:**

Data in Table 1 showed the weight loss % in pomegranate fruits during storage under room temperature and cold storage.

In general, by the progress of storage period increased, the weight loss % was increased under different storage conditions. At the end of storage period, the results showed that, the treatments had positive effect on decreased the percentage of weight loss compared with control under both storage conditions during the two investigated seasons. In the first season under room temperature, paraffin oil treatment alone or in combination with polyethylene pack gave the high level of reduction on the weight loss (23.67, 22.93%), respectively whereas, in the second season, combination between paraffin oil and polyethylene pack (T_4) was the leader in reduction of weight loss (21.00 %) compared with the other treatments and control. At the end of cold storage period after 90 days, the results demonstrated that, the polyethylene pack alone or in combination with paraffin oil, had significantly reduced the weight loss T_2 (20.80,20.10%) and T_4 (20.30, 20.60%) in both successive seasons, respectively compared with paraffin and control. These results are in line with the findings of (Saftner, 1999, Nanda *et al*., 2001)

The loss water from fruits during storage period is a substantial problem to shrinkage and weight loss thus, the fruit could be damaged and loss its quality (Ben-Yehoshua and Rodeo 2003). Coatings were used widely in fruits to reduce dehydration and water loss, prevents shriveling in fruit skin and delay the fruit ripening. Coatings can act as a semi-permeable barrier against oxygen, carbon dioxide, moisture so they can reduce the rates of the respiration, water loss and oxidation reaction (Baldwin *et al.,* 1999 and Park, 1999).

2-Decay%:

It is clear to notice from data in Table 2 that, the decay % was in-

creased with the prolonging of storage period under both storage conditions in 2012 and 2013 seasons. At the end of storage, the percentage of decay reached to the highest value with control compared with other treatments whereas, the lowest value of decay % was obtained by T_4 (10.42, 10.02%) in room temperature and (2.08, 2.08%) by cold storage, in the two investigated seasons respectively compared with the other treatments and control.

The most observed, decay of pomegranate fruits during storage are mostly the cause of Penicillium sp **(**Artes *et al.,* 1998). Moreover, the function of coating is a partial retention of gas exchange through the fruit peel and inhibiting the action of ethylene. Inhibition can give more prevention against postharvest decay and the water loss from the peel so decrease the incidence of decay during storage (Elham and Sawsan, 2013). The stored apple fruits in polyethelen bags had minor percentage of decay (El-Anany *et al.,* 2009).

Table 1. Effect of polyethylene packs and paraffin oil on weight loss% during cold storage at 5°C and room temperature at (22±5 °C) of "Manfalouty" pomegranate fruits during 2012 and 2013 seasons

Season 2012											
	Days of room temperature				Days of cold storage						
Treatment	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	13.65	17.50	35.13	22.09	9.00	14.33	16.73	20.63	24.00	27.73	18.74
Polyethylene pack (T_2)	10.73	18.93	25.50	18.39	6.13	11.20	14.20	16.07	18.67	20.80	14.51
Paraffin oil(T_3)	9.87	17.42	23.67	16.99	5.38	9.23	13.00	17.00	20.23	23.37	14.70
pack + oil (T_4)	9.77	14.67	22.93	15.79	5.37	8.97	12.00	17.30	18.67	20.30	13.77
Mean	12.01	17.13	25.88	18.34	6.47	10.93	13.98	17.75	20.39	23.05	15.43
LSD5% Treatment 1.81					LSD5% Treatment 2.28						
Period 2.43					Period 2.86						
Treatment × Period 4.82					Treatment × Period 5.74						

Season 2013											
	Days of room temperature				Days of cold storage						
Treatment	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	12.82	19.43	37.43	23.23	8.27	13.53	15.27	20.13	24.57	27.87	18.44
Polyethylene pack (T_2)	11.77	15.27	22.90	16.65	5.73	10.67	13.67	15.47	18.37	20.10	16.83
paraffin oil (T_3)	11.97	17.67	22.90	17.51	5.67	8.83	12.33	16.33	19.53	22.20	15.82
pack + oil (T_4)	8.67	14.67	21.00	14.78	5.43	8.33	12.80	17.43	18.67	20.60	11.71
Mean	11.56	16.76	24.24	17.52	6.28	10.84	13.77	18.09	20.53	24.69	15.70

LSD5%	**Treatment**	**1.68**	**LSD5%**	**Treatment**	**2.08**
	Period	**2.11**		**Period**	**2.47**
	Treatment × Period	**4.19**		**Treatment × Period**	**4.88**

Table 2. Effect of polyethylene packs and paraffin oil on Decay % during cold storage at 5°C and room temperature at (22±5 °C) of "Manfalouty" pomegranate fruits during 2012 and 2013 seasons

Season 2012											
	Days of room temperature				**Days of cold storage**						
Treatment	**15days**	**30days**	**45days**	**Mean**	**15days**	**30days**	**45days**	**60days**	**75days**	**90days**	**Mean**
Control (T_1)	12.50	20.83	22.92	18.75	0.00	0.00	0.00	2.08	4.17	10.42	2.78
Polyethylene pack (T_2)	4.17	10.42	16.67	10.42	0.00	0.00	0.00	0.00	0.00	4.17	0.70
paraffin oil (T_3)	2.08	8.33	14.58	8.33	0.00	0.00	0.00	0.00	0.00	4.17	0.70
pack + oil (T_4)	2.08	8.33	10.42	6.94	0.00	0.00	0.00	0.00	0.00	2.08	0.35
Mean	5.21	11.98	16.15	11.11	0.00	0.00	0.00	0.00	1.04	4.17	0.87
LSD5% Treatment			**2.99**		**LSD5% Treatment**				**1.21**		
Period			**1.78**		**Period**				**1.61**		
Treatment × Period			**3.7**		**Treatment × Period**				**3.12**		
Season 2013											
	Days of room temperature				**Days of cold storage**						
Treatment	**15days**	**30days**	**45days**	**Mean**	**15days**	**30days**	**45days**	**60days**	**75days**	**90days**	**Mean**
Control (T_1)	6.25	16.67	20.83	14.58	0.00	0.00	0.00	4.17	10.42	16.67	5.21
Polyethylene pack (T_2)	6.25	10.42	14.58	10.42	0.00	0.00	0.00	4.17	6.25	8.33	3.13
paraffin oil (T_3)	4.17	6.25	13.50	6.95	0.00	0.00	0.00	2.08	4.17	6.25	2.08
pack + oil (T_4)	2.08	6.25	10.02	6.94	0.00	0.00	0.00	0.00	0.00	2.08	0.35
Mean	4.69	9.90	14.06	9.55	0.00	0.00	0.00	2.08	4.17	6.77	2.17
LSD5% Treatment			**2.83**		**LSD5% Treatment**				**1.28**		
Period			**2.11**		**Period**				**2.05**		
Treatment × Period			**4.16**		**Treatment × Period**				**4.14**		

3-juice volume of 100(g) arils:

Data in Table 3 proved that, the juice volume of "Manfaloty" pomegranate fruits was decreased with the storage period increasing for all treatments during both tested seasons. Significant differences found were between treatments and control in different storage conditions during both investigated seasons. Under room temperature condition, T_4 treatment gave the best effect of preserving the reduction of juice volume during storage (75.67, 82.59 ml), in two successive seasons respectively. In cold storage, all treatments were retained the juice volume higher as possible during storage compared with control which gave the lowest values (66.00, 65.33 ml), in both seasons respectively and there were insignificant differences between treatments. These results are in line with the findings by (Yaman, 2002, Sakhale and Kapse, 2012).

Table 3. Effect of polyethylene packs and paraffin oil on juice volume (mg/ of 100 g arils) during cold storage at 5°C and room temperature at (22±5 °C) of "Manfalouty" pomegranate fruits during 2012 and 2013 seasons

Season 2012											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	71.67	70.33	68.67	70.22	72.67	71.33	70.33	68.67	66.33	66.00	69.22
Polyethylene pack (T_2)	74.33	74.33	72.33	73.66	77.33	75.33	74.33	73.00	70.67	70.33	73.50
paraffin oil (T_3)	77.00	75.00	72.33	74.78	78.33	76.33	74.00	73.67	70.33	70.00	73.78
pack + oil (T_4)	81.67	78.33	75.67	78.56	82.67	80.67	77.33	82.33	73.33	72.00	78.06
Mean	76.17	74.50	72.25	74.31	77.75	75.92	74.00	74.42	70.17	69.58	73.64
LSD5% Treatment	2.24				LSD5% Treatment	2.26					
Period	3.33				Period	3.14					
Treatment ×Period	5.13				Treatment × Period	5.2					
Season 2013											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	76.33	75.84	73.67	75.28	72.33	70.67	70.33	68.67	67.33	65.33	69.11
Polyethylene pack (T_2)	78.33	77.67	77.00	77.67	74.00	73.50	73.33	72.00	69.33	68.33	71.75
Paraffin oil(T_3)	81.67	80.67	80.03	80.89	77.00	77.00	76.33	75.67	75.33	75.33	76.11
pack + oil (T_4)	89.67	85.51	82.59	85.90	79.33	78.33	77.67	77.67	76.00	75.33	77.39
Mean	81.50	79.92	78.38	79.93	75.67	74.88	74.42	73.50	72.00	71.08	73.59
LSD5% Treatment	2.33				LSD5% Treatment	2.15					
Period	1.54				Period	1.91					
Treatment × Period	3.44				Treatment × Period	3.55					

B- Chemical properties

1- Total Soluble solids (T.S.S %):

Data in Table 4 show the seasonal changes of T.S.S % in "Manfalouty" pomegranate fruits as affected by polyethylene bags and paraffin oil treatments under cold and room temperature storage. Generally, the obtained results took approximately the same trend for both storage conditions during 2012 and 2013 seasons. It could be notice that, TSS percentage gradually increased in all stored fruits with the extending the storage period until 45 days at room temperature and 90 days under cold storage. Moreover, at the end of storage period the highest values of TSS content were found in the juice of untreated fruits (16.33, 17%) at room temperature and (16.33, 16.67%) at cold storage during both investigated seasons, respectively. On the other hand, the treated fruits with paraffin oil + polyethylene bags (T_4) had significantly the lowest values of TSS % as compared with other treatments (15.33, 16%) at room temperature and (15.67, 15.67%) at cold storage during both tested seasons, respectively.

Pomegranate is a non-climacteric fruit of a low respiration rate and recorded a slight decrease in total sugar content during storage at different temperatures. However, the increasing in juice TSS was referred

to the loss water of fruit then leading to increase concentration of the soluble solids. The obtained data were agreement with those found by (Koksal, 1989, Nanda *et al.,* 2001, Omayma *et al.,* 2014).

Table 4. Effect of polyethylene packs and paraffin oil on TSS (%) during cold storage at 5°C and room temperature at (22±5 C°) of "Manfalouty" pomegranate fruits during 2012 and 2013 seasons

Season 2012											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control(T_1)	14.67	15.33	16.33	15.44	14.00	14.33	15.00	15.33	15.67	16.33	15.11
Polyethylene pack (T_2)	13.67	15.33	16.00	15.00	12.47	14.67	15.00	15.00	15.33	16.00	14.75
paraffin oil (T_3)	14.00	15.67	16.00	15.22	12.67	14.33	14.67	15.33	15.67	16.00	14.78
pack + oil (T_4)	13.33	15.00	15.33	14.55	13.00	14.67	15.00	14.67	15.67	15.67	14.78
Mean	13.92	15.33	16.08	15.11	13.03	14.50	14.92	15.08	15.58	16.00	14.85
LSD5% Treatment	0.37				LSD5% Treatment	0.21					
Period	0.4				Period	0.25					
Treatment × Period	0.78				Treatment × Period	0.51					
Season 2013											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	15.33	16.00	17.00	16.11	15.00	15.33	15.67	16.00	16.33	16.67	15.83
Polyethylene pack (T_2)	15.00	15.00	16.67	15.56	14.33	15.33	15.00	15.33	15.33	15.67	15.17
paraffin oil (T_3)	15.33	15.67	16.67	15.89	14.67	15.33	15.00	16.00	16.00	16.00	15.50
pack + oil (T_4)	15.00	15.00	16.00	15.33	14.00	15.00	15.67	15.33	15.67	15.67	15.22
Mean	15.17	15.42	16.58	15.72	14.50	15.25	15.33	15.67	15.83	16.00	15.43
LSD5% Treatment	0.17				LSD5% Treatment	0.17					
Period	0.23				Period	0.23					
Treatment × Period	0.44				Treatment × Period	0.44					

2- Total acidity (%):

Data in Table 5 illustrated that, gradually decreased in acidity values of the fruit, were observed during storage in all treated and control fruits and reached the minimum values at the end of storage period in the two storage conditions. At room temperature, there were insignificant differences between T_2, T_3 and control while, T_4 had significant difference compared with the other treatment and control. The lowest values of acidity were found in T_4 (0.80, 0.89%), while the highest values were found in control (1.14, 1.05%) in the two successive seasons, respectively. Similar tendency was observed during cold storage condition in the two tested seasons. The highest percentage of acidity were measured in control (untreated) fruits (0.92, 0.84%) while, the lowest values were found in the treated fruits with paraffin oil + polyethylene bags (T_4) which had (0.80, 0.65%) acidity during both seasons respectively.

Organic acids in pomegranate such as citric, malic, acetic, fumaric, tartaric and lactic acids while, the main acid accounting for terrible acidity in pomegranate arils is citric

acid. At storage, fruits still respire and this process was consumed the main acid content of fruits (citric acid). For this reason, the acidity decreased during storage (Melgarejo *et al.,* 2000).

The obtained results are in line with the findings of (Waskar *et al.,* 1999, Artes *et al*., 2000).

Table 5. Effect of polyethylene packs and paraffin oil on total acidity (%) during cold storage at 5°C and marketing condition at (22±5 C°) of "Manfalouty" pomegranate fruits during 2012 and 2013

Season2012											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	1.18	1.11	1.14	1.14	1.12	1.14	1.10	1.17	1.10	0.92	1.09
Polyethylene pack (T_2)	1.19	1.12	1.11	1.14	1.15	1.10	1.12	1.02	1.12	0.90	1.07
paraffin oil(T_3)	1.06	0.94	1.10	1.03	1.14	1.05	1.11	1.07	1.11	0.88	1.06
pack + oil (T_4)	1.14	1.09	0.80	1.01	1.09	1.05	1.01	1.03	0.86	0.80	0.97
Mean	1.14	1.06	1.03	1.08	1.13	1.09	1.09	1.07	1.05	0.88	1.05
LSD5% Treatment			0.04		LSD5% Treatment			0.07			
Period			0.05		Period			0.09			
Treatment × Period			0.09		Treatment × Period			0.12			
Season 2013											
Treatment	Days of room temperature				Days of cold storage						
	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	1.14	1.08	1.05	1.09	1.19	1.07	0.92	0.93	0.74	0.84	0.95
Polyethylene pack (T_2)	1.15	1.10	1.00	1.08	1.11	1.06	0.82	0.89	0.78	0.59	0.88
paraffin oil (T_3)	1.11	1.05	0.99	1.05	1.13	1.09	0.94	0.85	0.74	0.59	0.89
pack + oil (T_4)	1.04	0.95	0.89	0.96	1.07	1.05	1.03	0.70	0.68	0.56	0.85
Mean	1.48	1.39	1.31	1.39	1.13	1.07	0.93	0.84	0.74	0.65	0.89
LSD5% Treatment			0.06		LSD5% Treatment			0.04			
Period			0.09		Period			0.06			
Treatment × Period			0.17		Treatment × Period			0.12			

3- T.S.S/Acid ratio :-

Data in Table 6 showed that, TSS/acid ratio increased by the prolonging the storage period in 2012 and 2013 seasons under both storage conditions. This measurement depends on the percentage of total soluble acid and acidity in fruits. In room temperature, the highest values were found by T_4 (19.16, 17.98), respectively in both seasons compared with the other treatments and control while, the lowest values were found by control fruits (14.32 and 16.19) during both seasons, respectively. The same trend was observed under

cold storage. At the end of storage, untreated fruits (control) had the lowest values of TSS/acid ratio (917.57 and 19.89) while, the highest values were found by T_4 treatment (19.59 and 28.13) during both seasons, respectively.

It is known that, during storage there is antagonistic relation between T.S.S and acidity while water loss and TSS increase but acidity decrease that due to the process of respiration in fruits, thus, T.S.S/Acid ratio increases too. The same line of results was showed by (Javed *et al*., 1987, Kays, 1997).

Table 6. Effect of polyethylene packs and paraffin oil on TSS/acid ratio during cold storage at 5°C and marketing condition at (22±5 C°) of "Manfalouty" pomegranate fruits during 2012 and 2013

Season 2012											
	Days of room temperature				Days of cold storage						
Treatment	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	12.39	13.76	14.32	13.49	12.47	12.56	13.61	13.07	14.29	17.57	13.93
Polyethylene pack (T_2)	11.19	13.65	14.41	13.08	10.84	13.32	13.35	14.77	13.68	17.78	13.96
paraffin oil(T_3)	13.24	16.68	14.55	14.82	11.14	13.59	13.24	14.36	14.11	18.18	14.1
pack + oil (T_4)	11.66	13.78	19.16	14.87	11.95	13.90	14.89	14.20	18.19	19.59	15.45
Mean	12.12	14.47	15.61	14.07	11.60	13.34	13.77	14.10	15.07	18.28	14.36
LSD5% Treatment	0.76				LSD5% Treatment	0.67					
Period	0.79				Period	0.6					
Treatment × Period	1.53				Treatment × Period	1.64					
Season 2013											
	Days of room temperature				Days of cold storage						
Treatment	15days	30days	45days	Mean	15days	30days	45days	60days	75days	90days	Mean
Control (T_1)	13.41	17.31	16.19	15.64	12.60	14.31	16.99	17.14	22.12	19.89	17.18
Polyethylene pack (T_2)	13.06	15.63	16.67	15.12	12.90	14.48	18.40	17.28	19.62	26.42	18.18
Paraffin oil(T_3)	17.88	16.46	16.84	17.06	12.94	14.04	15.97	18.85	21.56	27.11	18.41
pack + oil (T_4)	14.40	15.77	17.98	16.05	13.13	14.28	15.20	21.90	23.11	28.13	19.29
Mean	14.69	16.29	16.92	15.97	12.89	14.28	16.64	18.79	21.60	25.39	18.27
LSD5% Treatment	0.68				LSD5% Treatment	0.58					
Period	1.05				Period	0.63					
Treatment × Period	1.37				Treatment × Period	1.42					

Conclusion

This study illustrated that, polyethylene packing and paraffin oil used separately or in combination, prolongs the storage period and retains the quality of pomegranate fruits whether under room temperature or cold storage. Whereas, the combination between polyethylene and paraffin oil gave the best positive effect on prolonging the storage period with best fruits quality.

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تأثير زيت البرافين وأكياس البولى ايثيلين علي ثمار الرمان صنف "المنفلوطى" أثناء فترة التخزين

طلعت كامل المهدى ، علاء عبد الجابر بدوى مسعود، مها محمد عبد السلام حسين ، منار محمد صفوت حسن

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الملخص

أجريت هذه الدراسة على ثمار الرمان المنفلوطى خلال موسمى ٢٠١٢ ، ٢٠١٣ التى أخذت من مزرعة البحوث الخاصة بكلية الزراعة – جامعة أسيوط. تم إجراء التجربة في معمل قسم الفاكهة – حيث قسمت الثمار بعد غسلها وتنظيفها وتجفيفها إلي مجموعتين رئيسيتين إحداهما لتخزينها في جو الغرفة (درجة حرارة ٢٢± ٥ °م) والأخرى للتخزين البارد (٥ °م ورطوبة حوالى ٨٥–٩٠ %). تم تخصيص عدد من الثمار من كلتا المجموعتين لتقدير نسبة الإصابة (% الفساد) وعدد آخر لتقدير نسبة الفقد في الوزن أثناء التخزين.

قسمت الثمار من كلا المجموعتين إلي أربعة أقسام لإجراء المعاملات التالية عليها:

١- ثمار غير معاملة (كنترول)
٢- ثمار تم غمسها في زيت البرافين.
٣- ثمار تم تغليفها بأكياس البولي إيثيلين المثقبة.
٤- ثمار تم غمسها في زيت البرافين ثم تغليفها بأكياس البولي إيثيلين.

وضعت ثمار المجموعة الأولى في ثلاجات (٥±°م) والأخرى تركت في المعمل (درجة حرارة الغرفة ٢٢± ٥°م).

اخذت عينات دورية (كل أسبوعين) من المعاملات السابقة لإجراء بعض التحليلات مثل نسبة المواد الصلبة الذائبة الكلية ، الحموضة ونسبة العصير في الثمار. وكانت أهم النتائج المتحصل عليها كالتالى:-

-زاد محتوى عصير الثمار من المواد الصلبة الذائبة الكلية وكذلك الحموضة بزيادة فترة التخزين سواء في الغرفة أو الثلاجة ووصلت لأعلى قيمتها بنهاية فترة التخزين. من ناحية أخرى احتوت الثمار الغير معاملة (الكنترول) على أعلى نسبة من الحموضة والمواد الصلبة الذائبة الكلية بنهاية فترة التخزين بينما احتوت الثمار المعاملة بأكياس البولى ايثيلين بالإضافة إلي زيت البرافين (المعاملة الرابعة) إلي أقل نسبة. وقد يكون ذلك نتيجة زيادة فقد الرطوبة في الثمار الغير معاملة (الكنترول).

-زادت النسبة المئوية لفقد الرطوبة من الثمار بزيادة فترة التخزين وكانت أعلى القيم لهذه النسبة للفقد في الرطوبة في ثمار الكنترول ، بينما فقدت الثمار المعاملة بزيت البرافين + أكياس البولى ايثيلين أقل نسبة من الرطوبة سواء في الغرفة أو الثلاجة.

-وجد أن أكثر الثمار فساداً (إصابة) هي ثمار الكنترول بينما أقلها إصابة هي المعاملة بزيت البرافين + أكياس البولى ايثيلين وذلك أثناء التخزين بالغرفة أو الثلاجة خلال موسمى الدراسة.

-كان الفقد في نسبة العصير مشابهه تقريباً للفقد في نسبة الرطوبة خلال موسمى الدراسة تحت ظروف التخزين البارد أو بالغرفة.