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Effect of Pre- and Post-harvest Treatments on Quality and Storability of "Manfalouty" Pomegranates under Room Temperature

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Abstract

This study was carried out during 2011 and 2012 seasons on "Manfalouty" pomegranate cv. grown at the experimental orchard of Pomology Department, Faculty of Agriculture, Assiut University. The objectives of this study were examining the effects of pre-harvest spray with $CaCl_2$ (4%) and GA_3 (100 ppm) as well as post-harvest treatments with jasmine oil (2.5 cm^3/L), olive oil (2.5 cm^3/L), fiber gard (20 cm^3/L) and wrapping individually fruit with food polyolefin stretch as an improving effect in physicochemical characteristics of "Manfalouty" pomegranate cv. during storage under room temperature (22±5°C). The experiments were set up on split-plot arrangements in complete randomized block design (CRBD), with three replicates, 20 fruits each. According to the obtained results of this study, it could be deduced that pre-harvest spray with GA_3 (100 ppm) gave in general, the best results on improving physical and chemical characteristics, followed by $CaCl_2$ (4%) during the two growth seasons, as well as wrapping individually fruits with food polyolefin stretch gave the best quality during shelf-life period, followed by dipping fruits in both jasmine oil or olive oil and fiber gard during fruit storage under room temperature. Therefore, the authors recommended with wrapping individually fruits to keep fruits with good quality during fruit storage under room temperature.

Keywords: *GA_3, $CaCl_2$, Manfalouty pomegranate, natural oils and food polyolefin stretch*

Introduction

Pomegranate cultivars (*Punica granatum* L.) are grown in many different regions, mainly in subtropical Mediterranean region. "Manfalouty" pomegranate cv. is considered one of the most important pomegranate cvs. grown successfully in Egypt, mainly in Assiut Government. In recent years, production and consumption of pomegranate fruits are increasing rapidly due to the health benefits produced by the very high content of bioactive phytochemicals of the fruits (Opara *et al*., 2009 and Vinda-Martos *et al*., 2010).

Pomegranate fruits contain a substantial amount of polyphenols of high biological value including flavonoids (anthocyanins, flavonols), hydrolysable tannins (ellagitannins, gallotannins) condensed tannins (proathocyanidins), Fawole and Opara, 2013a, b. Despite these health benefits, pomegranate consumption is still limited due to the difficulty of extracting the arils (pomegranate grains).

These polyphenols exhibit various biological activities such as eliminating free radicals, inhibiting oxidation and microbial growth and

decreasing the risk of cardio- and cerebra vascular diseases and some type of cancers (Mena *et al*., 2011).

Furthermore, the incidence of post-harvest losses and poor keeping quality of pomegranate fruits are largely attributed to the high sensitivity of their fruits to temperature below 4°C and above 10°C (Nanda *et al*., 2001). The storage temperature recommended for pomegranates varies from 5 to 7.5°C with shelf-life from 8 to 16 weeks depending on cultivar (Arendse *et al*., 2014).

Mphahlele *et al*. (2016) reported that commercially pomegranate fruits were packed in ventilated carton with polyliner referred to as passive modified atmosphere packaging (MAP), individual shrink wrap and open top carton (control) and stored under 7±0.5°C and 92±2% RH for 4 months. Incidence of physiological disorders and changes in biochemical properties, phenolic compounds, total phenols, total flavonoids, total tannins, total anthocyanins, antioxidant activity and vitamin C were analysed monthly. The results showed that fruits stored under polyliner and individual shrink wrapped significantly minimized weight loss compared to control. Amongst phenolic compounds identified, calcium and rutin increased in fruits packed inside polyliners and individual shrink wrap after 4 months. Total phenolic and total tannins declined in fruits stored under polyliner and individual shrink wrap after 3 months. Furthermore, total anthocyanin was significantly higher in fruits packed in MAP than individual shrink wrap fruits.

Among different elite horticultural practices, growth regulators have been used to increase fruit yield and fruit quality of applying GA_3 on pomegranate plants to improve plant growth, yield, fruit quality parameters have been studied by Singh *et al*., 2003; Khalil and Aly, 2013 and Korkmaz *et al*., 2016.

Korkmaz *et al*. (2016) demonstrated that spraying calcium nitrate (2% or 4%) and GA_3 (50 & 75 ppm) on pomegranate cv. Hicaznar has been increased the fruit yield by both doses of calcium nitrate and the second dose of GA_3 (75 ppm) in the 1st year, while GA_3 at 50 ppm had an improving effect in the 2nd year.

Currently, there is a trend towards healthier diets. Modified atmosphere packaging (MAP) is typically used for maintaining quality of fruits, mainly, healthier fruits such as pomegranate fruits. The use of MAP shows down physiological processes such as transpiration and respiration rate. Furthermore, relatively low oxygen concentration within the MAP may decrease the activity of the oxidizing enzymes (polyphneol oxidase, glycolic oxidase and ascorbic acid oxidase) meanwhile prolong the shelf life of stored fruits (Aries *et al*., 2000 and Arendse *et al*., 2014).

Selcuk and Erkan (2016) studied the effect of two different types of modified atmosphere packaging (MAP) on the physiochemical properties, biochemical composition and storage quality of sweet pomegranate cv. "Beynan" during long-term storage. they found that the MAPs significantly reduced weight loss and external physiological disorders, maintained visual quality and prevented the decline of skin colour. During storage period, O_2 levels de-

creased and CO_2 levels increased inside the MAPs packaging compared to the control fruits.

Furthermore, MAP technology has been successfully used to maintain post-harvest quality and to prolong the storage period of many fruits. By creating higher CO_2 and lower O_2 concentration in the surrounding atmosphere of the fruits, decay, respiration rate, ethylene production and enzymatic activity can be controlled resulting in an increase in shelf life quality (Caleb *et al*., 2012 and Selak and Erkan, 2014, 2015).

Calcium (Ca^{2+}) has been extensively reviewed both as an essential element for its potential role in maintaining post harvest quality of fruits by contributing to the linkage between pectic substances within cell wall (Arhtas *et al*., 2010). It is also involved in reducing the rate of senescence and fruit ripening (White and Broadley, 2003; Mahajan and Dhatt, 2004 and Lara *et al*., 2004).

Therefore, the objective of this study was to examine the effects of pre-harvest spray with GA_3 & $CaCl_2$ and post harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits and the combination of these treatments as modified atmosphere packaging of pomegranate fruit on physical and chemical characteristic under room temperature storage.

Materials and Methods

Two main experiments of this study were carried out during two successive seasons 2011 and 2012 on "Manfalouty" pomegranate cultivars grown at the experimental orchard of Pomology Department, Faculty of Agriculture, Assiut University. Healthy trees and uniformely in growth were selected for this study. The trees age was approximately 35 years old at the beginning of the experiment and they were planted of 5x5 m apart. As indicated before, the objectives of this investigation were to study 1) the effect of pre-harvest treatments with both $CaCl_2$ and GA_3 on some physical and chemical characteristics of pomegranate fruits. 2) the effect of these pre-harvest treatments on shelf life properties of pomegranate fruits during storage under room temperature. 3) the effect of post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping individually fruit with food polyolefin stretch and as well as the interactions between the pre-harvest and the post harvest treatments on fruit quality during storage under room temperature.

The first experiment

This experiment was conducted as field work to achieve the pre-harvest treatments as follows:

1- Untreated trees (sprayed with tap water) control fruits).
2- Sprayed trees with 100 ppm GA_3.
3- Sprayed trees with 4% $CaCl_2$.

Both $CaCl_2$ (4%) or GA_3 (100 ppm) was sprayed twice time on the trees throughout the two studied seasons, the 1st application time was two months (2/6/2011 and 2/6/2012 seasons) after fruit set of pomegranate trees and the 2nd time of spraying was a month later of the 1st application time.

The second experiment:

It was conducted to examine the effect of post-harvest treatments on physiological characteristics of

pomegranate fruits under room temperature. The post-harvest treatments were carried out at the laboratory at Dept. of Pomology commercial ripe fruits were harvested and immediately were transported to the laboratory. After cleaning fruits and allowed to air dry, they were divided to five groups for storage under room temperature (22±5°C) as follows:

1- Untreated fruits (control of stored fruits).
2- Dipping fruits in jasmine oil (2.5 cm^3/L).
3- Dipping fruits in olive oil (2.5 cm^3/L).
4-Dipping fruits in fiber gard (20 cm^3/L).
Individually wrapping fruits with food polyolefin stretch.

Samples of the stored fruits bi weekly were taken for assessment the physical and chemical characteristics of fruits as follows:

1- Fruit weight (g).
2- Fruit peel (g)
3- Arils (pomegranate grains) whight (g)
4- Fruit weight loss %.

The fruits of each replicate treatment were individually weighed before storage to get the initial weight (iw), then the sample fruit weight (sw) after each biweekly interval period of storage. Thereafter, the percentage of fruit weight loss was calculated according to the following equation:

$$\text{Fruit weight loss \%} = \frac{iw - sw}{iw} \times 100$$

Where: iw= initial fruit weight before storage

sw= fruit weight at the end of sample period.

5- Juice volume (cm^3/100 ml g of arils (pomegranate grains).
6- Total soluble solids % (TSS%)

The total soluble solids % were determined using a hand refractometer.

7- Titratable acidity percentage (TA%)

It was determined by titrating 10 ml juice with ph.ph. as an indicated against 1.0 N NaOH and calculated as grams of citric acid/100 ml juice according to the method described in A.O.A.C. (2000).

8- Total soluble solids acid ratio (TSS/TA ratio). This ratio was determined by obtaining the ratio between total soluble solids and percentage of acidity.
9- Total sugar (reducing, non-reducing and total sugars) were determined using Lyne and Eynon methods as described in the A.O.A.C. (1975).

Statistical analysis:

The experiments were set up in split-split plot arrangements at two levels in complete randomized block design (CRBD) with three replicates, 20 fruits each, whereas, pre-harvest treatments were the whole plots (A), the 1st level of splits was the post harvest treatments (B) and the 2nd level of splits was the storage periods (C) according to Snedecor & Cochran (1980) and Gomez & Gomez (1984).

Results and Discussion

The obtained results of this research will focus on the effect of pre-harvest spraying with GA_3 (100 ppm) and $CaCl_2$ (4%) as well as the post-harvest treatments with jasmine oil (2.5 cm^3/L), olive oil (2.5 cm^3/L), fiber gard (20 cm^3/L) and individually wrapping fruits with food polyolefen stretch (all the post-harvest treatments as modified atmosphere packaging of MAP of pomegranate fruits)

on the physical and chemical characteristics of "Manfalouty" pomegranate fruits stored under room temperature during 2011 and 2012 seasons.

1- Effect of pre- and post-harvest treatments on some physical characteristics of pomegranate fruits stored under room temperature:

1.1- Effect of fruit weight:

Data presented in Table (1) indicated that the pre- and post-harvest treatments resulted in significant increase in fruit weight of Manfalouty pomegranate cv., compared with untreated (control) fruits in 2011 and 2012.

Table 1. Effect of pre- and post-harvest treatments on fruit weight (g) of "Manfalouty" pomegranate cv. under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	301.8	287.2	248.8	279.3	516.7	386.7	345.3	416.2
	Jasmine oil	366.9	319.9	301.7	329.5	474.8	371.9	332.1	392.9
	Olive oil	363.4	326.8	267.1	319.1	479.7	375.4	311.7	388.9
	Fiber gard	336.9	301.9	260.5	299.8	403.5	323.8	322.8	350.0
	Wrapping	390.9	365.8	305.4	354.0	510.6	412.6	371.9	431.7
	Mean	352.0	320.3	276.7	316.3	477.1	374.1	336.8	396.0
GA_3 (100 ppm)	O	421.7	377.1	297.0	365.3	645.4	497.0	478.6	540.3
	Jasmine oil	398.3	360.7	277.4	345.5	772.2	634.6	573.6	660.1
	Olive oil	457.8	423.8	294.8	392.1	845.4	688.9	586.9	707.1
	Fiber gard	429.4	410.6	362.8	400.9	767.4	639.0	592.6	666.3
	Wrapping	436.7	418.1	328.1	394.3	825.1	696.3	625.9	715.8
	Mean	428.8	398.1	312.0	379.6	771.1	631.2	571.5	657.9
$CaCl_2$ (4%)	O	347.8	312.2	255.3	305.1	600.3	456.4	421.0	492.6
	Jasmine oil	388.1	351.3	223.5	321.0	553.4	425.9	353.3	444.2
	Olive oil	360.5	335.1	262.1	319.2	600.1	490.0	463.3	517.8
	Fiber gard	373.9	354.8	252.8	327.2	525.1	406.4	390.1	440.5
	Wrapping	386.7	367.0	317.7	357.1	561.4	459.1	415.2	478.6
	Mean	371.4	344.1	262.3	325.9	568.0	447.5	408.6	474.7
Mean		384.1	354.2	283.7		605.4	484.3	439.0	
Mean	O	357.1	325.5	267.0	316.5	587.5	446.7	415.0	483.0
	Jasmine oil	384.4	344.0	267.5	332.0	600.1	477.5	419.7	499.1
	Olive oil	393.9	361.9	274.7	343.5	641.7	518.1	454.0	537.9
	Fiber gard	380.1	355.8	292.0	342.6	565.3	456.4	435.2	485.6
	Wrapping	404.8	383.6	317.1	368.5	632.4	522.7	471.0	542.0

L.S.D. 0.05			
A (Pre)	=	13.5	19.5
B (Post)	=	17.5	25.1
AB	=	30.2	43.5
C (Period)	=	13.5	19.5
AC	=	23.4	n.s
BC	=	n.s	n.s
ABC	=	n.s	n.s

Concerning, pre-harvest spraying with GA_3 or $CaCl_2$ on fruit weight, it was obviously that the group of fruits sprayed with GA_3 (100 ppm) gave the heaviest fruit weight (428.8 & 771.1 g), followed by the group of fruits sprayed with $CaCl_2$ 4% (371.4 & 568.0 g), then the

group of untreated (control) fruits gave the lowest value of fruit weight (352.0 & 477.1 g) in both season 2011 and 2012, respectively. As well as the pre-harvest treatment showed the same trend on the fruit weight at the end of storage period of stored fruits under room temperature during the two studied seasons, compared with untreated (control) fruits.

Within the group of untreated (control) fruits, wrapping fruits showed the heaviest fruit weight (354.0 & 431.7 g), followed by treatment with jasmine oil (329.5 & 392.9 g), thereafter treatment with olive oil (319.1 & 388.9 g), then untreated fruits gave the highest fruit weight (279.4 & 416.2 g) in season 2011 and 2012, respectively.

Within the group of fruits sprayed with GA_3, wrapping fruits gave the highest value of fruit weight (394.3 & 715.8 g), while untreated fruits resulted in the lowest value of fruit weight (365.4 & 540.3 g), in seasons 2011 and 2012, respectively.

Within the group of fruits sprayed with $CaCl_2$, wrapping fruit induced the highest fruit weight (357.1 g) in the 1st season, while treatment with olive oil resulted in the heaviest fruit weight (517.8 g) in the 2nd season, followed by untreated fruits (492.6 g), compared with untreated fruits stored under room temperature.

In general, wrapping fruits resulted in the heaviest fruit weight, while untreated fruits showed the highest fruit weight as response to the effect of pre- and post-harvest treatments on pomegranate fruits stored under room temperature. The positive effects of pre-harvest spraying with GA_3 or $CaCl_2$ could be due to the pomotive effects of both of them on plant growth, increasing yield and fruit weight as found by Singh *et al*., 2003; Khalil and Aly, 2013 and Korkmaz *et al*., 2016).

1.2- Effect of peel weight:

Data recorded in Table (2) revealed that all pre- and post-harvest treatments induced significant effects on peel weight of Manfalouty pomegranate fruits during their shelf-life under room temperature in 2011 and 2012 seasons.

Concerning the effect of pre-harvest treatments on peel weight, it was clear that spraying GA_3 (100 ppm) resulted in heaviest peel weight (144.8 and 245.5 g, respectively), followed by spraying $CaCl_2$ (4%) (125.0 & 182.8 g) in seasons 2011 and 2012, respectively, compared with untreated fruits.

Regarding to the effect of post-harvest treatments on peel weight of pomegranate fruits under room temperature, it could be deduced that wrapping fruits gave the best treatments in both the group of untreated fruits and group of pre-harvest fruits sprayed with $CaCl_2$, while spraying fiber gard on group of fruits sprayed with GA_3 gave the best heaviest weight in season 2011, on the other hand, wrapping fruits in group of untreated fruits, as well as spraying olive oil gave of treated with GA_3 and untreated fruits of gave of treated fruits with $CaCl_2$ gave the best results under room temperature in season 2012.

Table 2. Effect of pre- and post-harvest treatments on peel weight of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	99.6	116.8	105.0	107.1	172.1	134.2	124.1	143.5
	Jasmine oil	121.1	137.1	113.8	124.0	158.1	129.6	116.6	134.8
	Olive oil	122.8	123.0	96.9	114.2	145.5	119.5	115.2	126.7
	Fiber gard	112.2	117.0	114.5	114.6	143.8	112.1	103.1	119.7
	Wrapping	132.4	133.7	112.9	126.3	177.5	146.1	132.2	151.9
	Mean	117.6	125.5	108.6	117.2	159.4	128.3	118.2	135.3
GA_3 (100 ppm)	O	142.3	138.4	108.9	129.9	207.5	168.0	155.1	176.9
	Jasmine oil	135.4	146.4	115.6	132.5	251.8	188.8	162.5	201.0
	Olive oil	154.6	169.8	112.0	145.5	274.6	195.8	166.8	212.4
	Fiber gard	145.4	185.2	141.4	157.3	247.6	179.4	165.8	197.6
	Wrapping	146.3	185.5	119.8	150.5	246.1	205.5	179.1	210.2
	Mean	144.8	165.1	119.6	143.2	245.5	187.5	165.9	199.6
$CaCl_2$ (4%)	O	117.4	151.4	99.2	122.7	201.5	151.9	141.8	165.1
	Jasmine oil	133.1	129.8	104.1	122.3	182.7	143.4	116.1	147.4
	Olive oil	120.5	136.4	99.8	118.9	188.4	154.1	142.8	161.8
	Fiber gard	124.6	131.9	96.1	117.5	165.8	136.6	130.8	144.4
	Wrapping	129.6	135.2	125.3	130.0	175.3	153.9	151.8	160.3
	Mean	125.0	136.9	104.9	122.3	182.8	148.0	136.7	155.8
Mean		129.2	142.5	111.0		195.9	154.6	140.3	
Mean	O	119.8	135.5	104.4	119.9	193.7	151.4	140.3	161.8
	Jasmine oil	129.9	137.8	111.2	126.3	197.5	153.9	131.7	161.1
	Olive oil	132.6	143.1	102.9	126.2	202.8	156.5	141.6	167.0
	Fiber gard	127.4	144.7	117.3	129.8	185.7	142.7	133.2	153.9
	Wrapping	136.1	151.5	119.3	135.6	199.6	168.5	154.4	174.2

L.S.D. 0.05			
A (Pre)	=	6.6	5.7
B (Post)	=	8.5	7.4
C (Period)	=	6.6	5.7
AB	=	14.7	12.7
AC	=	11.4	9.9
BC	=	n.s	n.s
ABC	=	n.s	n.s

Generally, post-harvest treatments on the group of sprayed fruits with GA_3 (100 ppm) as pre-harvest treatment gave the highest value of peel weight of fruits, followed by pre-harvest treatment with $CaCl_2$ (4%), compared with untreated fruits during the two studied seasons.

The obtained results are in harmony with those reported by Jumaa and Ali (2016).

1.3- Effect of pre- and post-harvest treatments on arils (pomegranate grains) weight:

According to data recorded in Table (3), it could be demonstrated that all pre- and post-harvest treatments induced significant increase in arils weight of pomegranate fruits during 2011 and 2012 seasons, compared to untreated fruits.

Regarding to the effects of pre-harvest treatments on grain weight of pomegranate fruits, it could be deduced that pre-harvest spraying with GA_3 (100 ppm) gave the heaviest grain weight (279.9 & 519.6 g), followed by pre-harvest spraying with $CaCl_2$ (4%) (248.1 & 385.5 g), compared with untreated fruits in 2011 and 2012 seasons, respectively.

Table 3. Effect of pre- and post-harvest treatments on arils weight of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	202.1	170.1	143.8	172.0	344.6	252.5	221.2	272.8
	Jasmine oil	245.8	182.8	187.9	205.5	316.7	242.3	215.5	258.2
	Olive oil	240.6	203.9	170.2	204.9	336.3	255.9	196.5	262.9
	Fiber gard	208.8	184.9	146.1	179.9	295.3	211.7	219.7	242.2
	Wrapping	258.6	232.1	192.5	227.7	371.0	265.8	239.7	292.2
	Mean	231.2	194.8	168.1	198.0	332.8	245.7	218.5	265.7
GA_3 (100 ppm)	O	279.3	238.7	188.1	235.4	437.9	329.0	323.4	363.4
	Jasmine oil	262.9	214.3	161.8	213.0	520.4	445.9	411.1	459.1
	Olive oil	283.2	254	182.8	240.0	540.9	493.1	420.1	484.7
	Fiber gard	283.9	225.5	221.4	243.6	519.8	459.5	435.7	471.7
	Wrapping	290.4	232.6	208.2	243.7	579.1	495.2	446.7	507.0
	Mean	279.9	233.0	192.5	235.1	519.6	444.5	407.4	457.2
$CaCl_2$ (4%)	O	230.4	160.8	156.1	182.4	398.8	304.5	279.2	327.5
	Jasmine oil	261.7	221.5	119.3	200.8	370.7	282.4	237.2	296.8
	Olive oil	240.0	198.8	163.6	200.8	412.8	336.3	320.5	356.5
	Fiber gard	249.3	222.9	156.7	209.6	359.2	269.8	259.3	296.1
	Wrapping	259.1	231.8	192.4	227.8	386.1	305.2	263.5	318.3
	Mean	248.1	207.2	157.6	204.3	385.5	299.6	271.9	319.0
Mean		253.1	211.7	172.7		412.6	329.9	299.3	
Mean	O	237.3	189.9	162.7	196.6	393.8	295.3	274.6	321.2
	Jasmine oil	256.8	206.2	156.3	206.4	402.6	323.5	287.9	338.0
	Olive oil	254.6	218.9	172.2	215.2	430.0	361.8	312.4	368.0
	Fiber gard	247.3	211.1	174.7	211.1	391.4	313.7	304.9	336.7
	Wrapping	269.4	232.2	197.7	233.1	445.4	355.4	316.6	372.5

L.S.D. 0.05			
A (Pre)	=	11.3	15.4
B (Post)	=	14.5	19.9
C (Period)	=	11.3	15.4
AB	=	25.2	34.5
AC	=	n.s	n.s
BC	=	n.s	n.s
ABC	=	n.s	n.s

Concerning, the effect of post-harvest treatments on grain weight, it could be observed that within the group of untreated fruits, post-harvest treatment with wrapping gave the best results (227.7 g), followed by dipping fruits in jasmine oil (205.5 g), thereafter spraying fruits with olive oil (204.9 g), than dipping fruits in fiber gard (179.9 g). Moreover, within the group of fruits sprayed with GA_3, wrapping fruits gave the heaviest grain weight (243.7 g), followed by spraying fiber gard (243.6

g), thereafter spraying fruits with olive oil (240.0 g), then dipping fruits in jasmine oil (213.0 g), as well as within the group of fruits sprayed with $CaCl_2$ (4%). The results showed the same trend of post-harvest treatment on the sprayed fruits with GA_3, all results compared with untreated fruits in 2011 season. As well as, wrapping fruits of untreated fruits or sprayed fruits with GA_3 as pre-harvest treatment showed the best treatment in 2012 seasons, while within the group of fruits sprayed with $CaCl_2$, spraying fruits with olive oil gave the heaviest grain weight under room temperature.

Generally, the post-harvest treatment on the group of fruits sprayed with GA_3 resulted in the best positive effects on arils weight of Manfalouty pomegranate fruits under room temperature during 2012 and 2012 seasons compared with untreated fruits.

All the obtained results could be attributed to the enhancement effects of pre-harvest treatment with spraying both GA_3 or $CaCl_2$ on increasing fruit weight, as well as increasing grain weight of fruits under the conditions of this study.

These obtained results are in parallel with those found by Mir *et al*. (1993).

1.4- Effect of fruit weight loss %:

Data presented in Table (4) indicated that pre-harvest treatments with spraying GA_3 (100 ppm) or $CaCl_2$ (4%), as well as post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits with food polyolefin stretch resulted in significant decrease in fruit weight loss % compared with untreated fruits during 2011 and 2012 seasons.

Concerning the response of pre-harvest treatments of pomegranate fruit weight loss % to the post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits with food plastic stresh, it could be observed that the group of fruits sprayed with $CaCl_2$ gave the least decrease in fruit weight loss % (15.17% & 13.6%), followed by the group of fruits sprayed with GA_3 (15.93 & 15.10%), then the group of untreated fruits (17.63 and 17.60%) in 2011 and 2012 seasons, respectively.

Within each group of pre-harvest treated or untreated fruits, it could be demonstrated that within the group of untreated fruits, wrapping fruits induced the least decrease in fruit weight loss %, followed by dipping fruits with fiber gard, thereafter dipping fruits with olive oil, then dipping fruits with jasmine oil, as well as within both the groups of pre-harvest treated fruits with GA_3 or $CaCl_2$ took the same trend of the untreated pre-harvest fruits during the two studied seasons.

These obtained results could be due to the positive effects of pre-harvest treatments with GA_3 or $CaCl_2$ on improving fruit quality of Manfalouty pomegranate cv. under the condition of this study.

These obtained results are in accordance with those finding reported by Nanda *et al.* (2001).

Table 4. Effect of pre- and post-harvest treatments on weight loss % of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	0.00	24.57	39.88	21.48	0.000	24.630	37.470	20.700
	Jasmine oil	0.00	20.78	34.91	18.56	0.000	21.920	33.110	18.343
	Olive oil	0.00	21.98	31.50	17.83	0.000	21.300	32.460	17.920
	Fiber gard	0.00	19.90	27.25	15.72	0.000	20.830	28.000	16.277
	Wrapping	0.00	19.00	24.75	14.58	0.000	17.670	26.260	14.643
	Mean	0.00	21.20	31.70	17.63	0.000	21.300	31.500	17.600
GA_3 (100 ppm)	O	0.00	23.31	35.35	19.55	0.000	21.580	33.830	18.470
	Jasmine oil	0.00	21.33	29.87	17.07	0.000	19.080	26.220	15.100
	Olive oil	0.00	19.33	26.47	15.27	0.000	20.000	26.170	15.390
	Fiber gard	0.00	17.20	25.57	14.26	0.000	17.500	23.930	13.810
	Wrapping	0.00	16.13	24.07	13.40	0.000	16.590	21.250	12.613
	Mean	0.00	19.50	28.30	15.93	0.000	19.000	26.300	15.100
$CaCl_2$ (4%)	O	0.00	22.78	34.18	18.99	0.000	20.300	31.820	17.373
	Jasmine oil	0.00	20.63	31.15	17.26	0.000	18.180	23.000	13.727
	Olive oil	0.00	18.54	25.15	14.56	0.000	17.170	22.810	13.327
	Fiber gard	0.00	17.14	22.22	13.12	0.000	16.170	21.320	12.497
	Wrapping	0.00	15.83	19.87	11.90	0.000	14.270	19.100	11.123
	Mean	0.00	19.00	26.50	15.17	0.000	17.200	23.600	13.600
Mean		0.00	19.90	28.82		0.000	19.149	27.119	
Mean	O	0.00	23.55	36.47	20.01	0.000	22.170	34.373	18.848
	Jasmine oil	0.00	20.91	31.98	17.63	0.000	19.727	27.443	15.723
	Olive oil	0.00	19.95	27.71	15.89	0.000	19.490	27.147	15.546
	Fiber gard	0.00	18.08	25.01	14.36	0.000	18.167	24.417	14.194
	Wrapping	0.00	16.99	22.90	13.29	0.000	16.177	22.203	12.793

L.S.D. 0.05			
A (Pre)	=	0.42	0.491
B (Post)	=	0.55	0.634
C (Period)	=	0.42	0.491
AB	=	n.s	n.s
AC	=	0.74	0.850
BC	=	0.95	1.10
ABC	=	1.64	n.s

1.5- Effect of pre- and post harvest treatments on juice volume (ml/100 g arils) (pomegranate grains):

As pointed out in Table (5) it was clear that pre-harvest treatments with $CaCl_2$ (4%) and GA_3 (100 ppm), as well as post-harvest treatments with jamine oil, olive oil, fiber gard and individually wrapped fruit with food polyolfen stretch induced significantly increase in juice volume (g/100 g arils), during shelf-life period of storage pomegranate fruits under room temperature, compared with untreated fruits in 2011 and 2012 seasons.

Concerning, the effect of pre-harvest treatments on juice volume of pomegranate fruit, it could be noticed that spraying GA_3 (100 ppm) gave the highest value of juice volume (71.9 & 71.0 ml), followed by spraying $CaCl_2$ (4%) (70.9 & 69.1 ml) then the untreated fruits (68.0 & 63.5 ml) during 2011 and 2012 seasons, respectively.

Regard to the effect of post-harvest treatments on juice volume it was clear that the group of fruits sprayed with

GA_3, in response to the post-harvest treatment, resulted in the heaviest juice volume (70.43 & 62.27 ml), followed by the group of fruits sprayed with $CaCl_2$ (69.30 & 61.67 ml), then the group of untreated fruits (65.27 & 58.17 ml), in 2011 and 2012 seasons, respectively.

Within each group of fruits treated with the tested post-harvest treatments, it could be deduced that in the group of untreated fruits wrapping fruits gave the highest value of juice volume, followed by fiber gard, thereafter olive oil, then untreated fruits with post-harvest treatment and jasmine oil gave the lowest value of juice volume in the 1st season, while in the 2nd season of storage fruits, all the post-harvest treatments showed the same trend of the 1st season except the treatment with jasmine oil indicate an improving of juice volume than the untreated fruits.

Within the group of fruits sprayed with GA_3, it was obviously that storage fruits under room temperature, treated fruits with fiber gard gave the highest value of juice volume, followed by wrapping fruits, thereafter treatment with olive oil, then jasmine oil compared with untreated fruits with post harvest treatments in both studied seasons.

Within the group of fruits sprayed with $CaCl_2$, all the post-harvest treatments improved juice volume during the two seasons, moreover, wrapping fruits gave the highest value of juice volume in the 1st season, while, fiber gard treatments gave the highest value of juice volume in the 2nd season, followed by treatment with both of jasmine oil or olive oil during 2011 and 2012 seasons.

These positive effects of the post-harvest treatments could be due to reducing moisture loss in response to the modified atmosphere surrounding the treated fruits stored under room temperature, compared to the untreated fruits.

These obtained results are in harmony with those found by Higazi *et al*. (1983).

Table 9. Effect of pre- and post-harvest treatments on juice volume (ml/100 g) of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	67.67	63.00	61.33	64.00	64.33	52.33	50.00	55.55
	Jasmine oil	65.00	62.67	59.00	62.22	62.33	55.67	49.67	55.89
	Olive oil	70.00	63.67	61.67	65.11	59.00	57.33	52.33	56.22
	Fiber gard	68.33	66.67	66.00	67.00	65.33	58.00	54.67	59.33
	Wrapping	69.00	67.67	67.33	68.00	66.33	65.00	59.67	63.67
	Mean	68.00	64.70	63.10	65.27	63.50	57.70	53.30	58.17
GA_3 (100 ppm)	O	71.00	70.00	67.00	69.33	69.33	56.67	54.67	60.22
	Jasmine oil	71.00	71.33	67.33	69.89	69.67	54.67	52.33	58.89
	Olive oil	73.00	69.67	68.67	70.45	70.67	61.33	57.33	63.11
	Fiber gard	73.33	72.33	70.00	71.89	72.33	63.67	60.00	65.33
	Wrapping	71.00	70.00	70.67	70.56	73.00	61.33	57.00	63.78
	Mean	71.90	70.70	68.70	70.43	71.00	59.50	56.30	62.27
$CaCl_2$ (4%)	O	70.00	68.67	66.00	68.22	68.00	60.33	55.67	61.33
	Jasmine oil	70.67	69.33	67.00	69.00	69.67	62.33	51.33	61.11
	Olive oil	70.67	69.33	67.00	69.00	69.33	58.33	54.67	60.78
	Fiber gard	71.33	70.33	67.67	69.78	69.00	61.67	57.33	62.67
	Wrapping	71.67	70.33	69.33	70.44	69.67	60.33	57.33	62.44
	Mean	70.90	69.60	67.40	69.30	69.10	60.60	55.30	61.67
Mean		70.25	68.33	66.40		67.87	59.27	54.94	
Mean	O	69.56	67.22	64.78	67.19	67.22	56.44	53.45	59.04
	Jasmine oil	68.89	67.78	64.44	67.04	67.22	57.56	51.11	58.63
	Olive oil	71.22	67.56	65.78	68.19	66.33	59.00	54.78	60.04
	Fiber gard	71.00	69.78	67.89	69.55	68.89	61.11	57.33	62.44
	Wrapping	70.56	69.33	69.11	69.67	69.67	62.22	58.00	63.30

L.S.D. 0.05			
A (Pre)	=	0.9	1.192
B (Post)	=	1.2	1.539
C (Period)	=	0.9	1.192
AB	=	2.1	2.666
AC	=	n.s	2.065
BC	=	n.s	n.s
ABC	=	n.s	n.s

2- Effect of pre- and post-harvest treatments on some chemical characteristics of pomegranate fruits:

2.1- Effects on TSS%:

Data recorded in Table (6) showed that both of pre-harvest treatments with GA_3 and $CaCl_2$ or post-harvest treatment with jasmine oil, olive oil, fiber gard and individually wrapping fruit with food polyolfen stretch resulted in significant effects on TSS% in juice of Manfalouty pomegranate fruits during shelf-life period under room temperature in 2011 and 2012 seasons.

Regard to, the effect of pre-harvest spraying with GA_3 (100 ppm) and $CaCl_2$ (4%), it was obviously that spraying GA_3 gave the highest value of TSS% in fruit juice during the 1st season, on the other hand GA_3 treatments gave the lowest value of TSS% in fruit juice in the 2nd season, while spraying $CaCl_2$ gave the lowest value of TSS% in fruit juice at the 1st season and gave the highest value of TSS% in the 2nd season, all results were compared with untreated fruits. The positive or negative effects of pre-harvest treatments with GA_3 or $CaCl_2$ on TSS% in juice could be attributed with the effects of GA_3 or $CaCl_2$ on delaying fruit ripening stages during the two studied seasons.

Concerning the effect of post-harvest treatments with jasmine oil, olive

oil, fiber gard and wrapping fruits on TSS% in fruit juice during shelf life period under room temperature, it could be deduced that group of untreated pre-harvest treatments gave the highest value of TSS% in fruit juice during the 2 studied seasons. Thus should be due to more moisture loss of untreated fruits comparing with treated fruits as modified atmosphere packaging surrounding the fruits stored under room temperature.

Within each group of fruits treated with pre-harvest treatments, untreated fruits with the post-harvest treatments resulted in the highest value of TSS% in fruit juice during the 1st season, followed by wrapping fruits in the group of untreated fruits or the group of sprayed fruits with GA_3 and dipping fruits in olive oil within the group of treated fruits with $CaCl_2$ during the 1st season. During storage fruits in the 2nd seasons, it was noticed that untreated fruits with post-harvest treatments gave the highest value of TSS%, followed by jasmine oil treatment, while in the group of treated fruits with GA_3, jasmine oil treatment gave the highest value of TSS%, followed by fiber gard, moreover, fiber gard also gave the highest value of TSS% in the group of fruits treated with $CaCl_2$ followed by jasmine oil treatments in 2011 and 2012 seasons.

These obtained results are in agreement with those reported by Samar *et al*. (2016).

Table 6. Effect of pre- and post-harvest treatments on T.S.S.% in juice of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	16.73	17.33	18.13	17.40	16.00	16.93	17.87	16.93
	Jasmine oil	16.33	16.67	17.40	16.80	16.07	16.87	17.80	16.91
	Olive oil	16.20	17.00	17.13	16.78	15.80	16.40	17.47	16.56
	Fiber gard	16.00	17.13	17.07	16.73	15.93	16.60	16.80	16.44
	Wrapping	16.20	17.27	17.27	16.91	16.13	16.80	17.00	16.64
	Mean	16.30	17.10	17.40	16.93	16.00	16.70	17.40	16.70
GA_3 (100 ppm)	O	16.93	17.00	17.27	17.07	15.47	16.07	17.13	16.22
	Jasmine oil	16.73	16.87	16.73	16.78	16.00	16.53	17.00	16.51
	Olive oil	16.40	16.53	16.67	16.53	15.53	16.13	16.87	16.18
	Fiber gard	16.20	16.93	17.13	16.75	15.67	16.20	16.93	16.27
	Wrapping	16.27	17.07	17.27	16.87	15.67	15.93	16.87	16.16
	Mean	16.50	16.90	17.00	16.80	15.70	16.20	17.00	16.30
$CaCl_2$ (4%)	O	16.40	16.67	17.67	16.91	16.13	16.40	16.87	16.47
	Jasmine oil	16.13	16.60	17.13	16.62	16.33	16.87	16.93	16.71
	Olive oil	16.13	17.07	17.27	16.82	16.20	16.13	17.40	16.58
	Fiber gard	16.00	16.27	17.07	16.45	16.27	16.93	17.27	16.82
	Wrapping	15.80	16.20	16.80	16.27	16.13	16.40	16.87	16.47
	Mean	16.10	16.60	17.20	16.63	16.20	16.50	17.10	16.60
Mean		16.30	16.85	17.20		15.96	16.48	17.14	
Mean	O	16.69	17.00	17.69	17.13	15.87	16.47	17.29	16.54
	Jasmine oil	16.40	16.71	17.09	16.73	16.13	16.76	17.24	16.71
	Olive oil	16.24	16.87	17.02	16.71	15.84	16.22	17.25	16.44
	Fiber gard	16.07	16.78	17.09	16.64	15.96	16.58	17.00	16.51
	Wrapping	16.09	16.85	17.11	16.68	15.98	16.38	16.91	16.42

L.S.D. 0.05			
A (Pre)	=	0.15	0.194
B (Post)	=	0.20	n.s
C (Period)	=	0.15	0.194
AB	=	0.34	n.s
AC	=	0.26	n.s
BC	=	n.s	n.s
ABC	=	n.s	n.s

2.2- Effect on titratable acidity %:

Data presented in Table (7) indicated that all pre-harvest treatments with GA_3 or $CaCl_2$ and the post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits induced significantly increase in the titratable acidity % (as g citric acid, TA%) in fruit juice of Manfalouty pomegranate cv. compared with untreated fruits in 2011 and 2012 seasons.

Table 7. Effect of pre- and post-harvest treatments on titratable acidity % (TA%) in juice of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	1.473	1.407	1.250	1.377	1.360	1.283	1.140	1.261
	Jasmine oil	1.560	1.530	1.397	1.496	1.683	1.663	1.433	1.593
	Olive oil	1.567	1.460	1.403	1.477	1.590	1.710	1.373	1.558
	Fiber gard	1.647	1.513	1.380	1.513	1.437	1.410	1.277	1.375
	Wrapping	1.550	1.457	1.323	1.443	1.847	1.823	1.543	1.738
	Mean	1.600	1.500	1.400	1.500	1.600	1.600	1.400	1.533
GA_3 (100 ppm)	O	1.780	1.757	1.603	1.713	1.777	1.730	1.520	1.676
	Jasmine oil	1.697	1.663	1.457	1.606	1.650	1.667	1.433	1.583
	Olive oil	1.710	1.653	1.450	1.604	1.933	1.930	1.580	1.814
	Fiber gard	1.787	1.710	1.567	1.688	1.760	1.740	1.440	1.647
	Wrapping	1.737	1.723	1.673	1.711	1.887	1.863	1.553	1.768
	Mean	1.700	1.700	1.600	1.667	1.800	1.800	1.500	1.700
$CaCl_2$ (4%)	O	1.707	1.650	1.637	1.665	1.787	1.747	1.390	1.641
	Jasmine oil	1.850	1.800	1.613	1.754	1.927	1.870	1.490	1.762
	Olive oil	1.767	1.720	1.633	1.707	1.947	1.983	1.717	1.882
	Fiber gard	1.717	1.670	1.607	1.665	2.100	2.050	1.793	1.981
	Wrapping	1.717	1.710	1.663	1.697	2.083	2.033	1.753	1.956
	Mean	1.800	1.700	1.600	1.700	2.000	1.900	1.600	1.833
Mean		1.687	1.629	1.514		1.787	1.767	1.496	
Mean	O	1.653	1.605	1.497	1.585	1.641	1.587	1.350	1.526
	Jasmine oil	1.702	1.664	1.489	1.619	1.753	1.733	1.452	1.646
	Olive oil	1.681	1.611	1.495	1.596	1.823	1.874	1.557	1.751
	Fiber gard	1.717	1.631	1.518	1.622	1.766	1.733	1.503	1.667
	Wrapping	1.668	1.630	1.553	1.617	1.939	1.906	1.616	1.821

L.S.D. 0.05			
A (Pre)	=	0.030	0.069
B (Post)	=	0.039	0.089
C (Period)	=	0.030	0.069
AB	=	0.067	0.154
AC	=	n.s	n.s
BC	=	n.s	n.s
ABC	=	n.s	n.s

Concerning the effect of pre-harvest spraying with GA_3 and $CaCl_2$ on pomegranate trees, it could be revealed that spraying $CaCl_2$ resulted in the highest percentage of the titratable acidity (TA%) in fruit juice (1.8 & 2.0%), followed by GA_3 (1.7 & 1.8%), then the untreated fruits (1.6 & 1.6%) in 2011 and 2012 seasons, respectively.

Within the group of untreated fruits (the control group) treatment

with fiber gard gave the highest value of TA% followed by jasmine oil treatments, then untreated fruits with post-harvest treatments resulted in the lowest value of TA% in the 1st season, while wrapping fruits gave the highest value of TA%, followed by jasmine oil, then the untreated fruit gave the lowest value of TA% in the 2nd season.

Regard to the effect of post-harvest treatments on TA% during the shelf life period under room temperature, it could be demonstrated that the group of fruits sprayed with $CaCl_2$ showed the highest value of TA% (1.7 & 1.83%), followed by the group of fruits sprayed with GA_3 (1.67 & 1.77%), then the group of untreated fruits (the control) gave the lowest value of TA% (1.40 & 1.53%). These effects of spraying both of GA_3 or $CaCl_2$ on TA% could be due to the causing a delay of ripening and senescence occurring of pomegranate fruits. Furthermore, treated of stored fruits with some natural oils or wrapping fruits with food polyolefin stretch as modified atmosphere packaging (MAP) surrounding the fruits resulted in decreasing O_2 levels and increasing CO_2 levels inside the MAP compared to the untreated (control) fruits.

These obtained results are in parallel with those reported by Badawy *et al*. (2016).

2.3- Effect on TSS/TA ratio in fruit juice:

As shown in Table (8), it was obviously that pre-harvest spraying with GA_3 (100 ppm) and $CaCl_2$ (4%), as well as the post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits resulted in significantly decrease in the TSS/TA ratio in juice of stored fruits under room temperature in 2011 and 2012 seasons.

Concerning the effect of pre-harvest spraying with GA_3 or $CaCl_2$ on TSS/TA ratio in fruit juice of Manfalouty pomegranate cv., it was clear that untreated (control) fruits showed the highest ratio between the TSS% and TA% in the fruit juice (10.50 & 10.30), followed by spraying fruits with GA_3 (9.50 & 8.70) and then the fruits sprayed with $CaCl_2$ (9.20 & 8.30) during seasons 2011 and 2012, respectively. This reduction of TSS/TA ratio in fruit juice could be attributed to decreasing TSS% and increasing TA% in juice of treated fruits with GA_3 and $CaCl_2$ during the 2 studied seasons as aforementioned in the effects of GA_3 and $CaCl_2$ on both of TSS% and TA% in fruit juice.

As well as, the effect of the post-harvest treatments in TSS/TA ratio in fruit juice tock the same trend of the pre-harvest treatment on this parameter. Whereas, the post harvest treatments on the group of untreated (control) fruits gave the highest value of TSS/TA ratio, followed by the group of fruits sprayed with GA_3, then the group of fruits sprayed with $CaCl_2$ during the two studied seasons.

Table 8. Effect of pre- and post-harvest treatments on TSS/TA ratio in juice of "Manfalouty" pomegranate fruits under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	11.36	12.33	14.51	12.73	11.77	13.10	15.77	13.55
	Jasmine oil	10.51	10.98	12.49	11.33	9.57	10.20	13.52	11.10
	Olive oil	10.34	11.65	12.21	11.40	10.16	9.91	12.85	10.97
	Fiber gard	9.71	11.34	12.41	11.15	11.11	11.83	13.19	12.04
	Wrapping	10.45	11.87	13.12	11.81	8.74	9.24	12.46	10.15
	Mean	10.50	11.60	12.90	11.67	10.30	10.90	13.60	11.60
GA_3 (100 ppm)	O	9.51	9.67	10.78	9.99	8.72	9.42	11.70	9.95
	Jasmine oil	9.87	10.14	11.49	10.50	9.66	10.02	12.07	10.58
	Olive oil	9.59	9.63	11.31	10.18	8.03	8.36	10.73	9.04
	Fiber gard	9.08	9.93	10.95	9.99	8.95	9.38	11.94	10.09
	Wrapping	9.38	9.93	10.33	9.88	8.31	8.59	10.88	9.26
	Mean	9.50	9.90	11.00	10.13	8.70	9.20	11.50	9.80
$CaCl_2$ (4%)	O	9.62	10.34	10.83	10.26	9.06	9.40	12.22	10.23
	Jasmine oil	8.72	9.22	10.63	9.52	8.48	9.02	11.60	9.70
	Olive oil	9.14	9.94	13.58	10.89	8.32	8.17	10.28	8.92
	Fiber gard	9.34	9.75	10.59	9.89	7.72	8.33	9.67	8.57
	Wrapping	9.22	9.51	10.17	9.63	7.78	8.09	9.67	8.51
	Mean	9.20	9.80	11.20	10.07	8.30	8.60	10.70	9.20
Mean		9.72	10.42	11.69		9.09	9.54	11.91	
Mean	O	10.16	10.78	12.04	10.99	9.85	10.64	13.23	11.24
	Jasmine oil	9.70	10.11	11.54	10.45	9.24	9.75	12.40	10.46
	Olive oil	9.69	10.41	12.37	10.82	8.84	8.81	11.29	9.65
	Fiber gard	9.38	10.34	11.32	10.34	9.26	9.85	11.60	10.24
	Wrapping	9.68	10.44	11.21	10.44	8.28	8.64	11.00	9.31

L.S.D. 0.05			
A (Pre)	=	0.39	0.490
B (Post)	=	0.51	0.632
C (Period)	=	0.39	0.490
AB	=	0.88	1.095
AC	=	n.s	n.s
BC	=	n.s	n.s
ABC	=	n.s	n.s

Regard to the effect of post-harvest treatments on TSS/TA ratio in fruit juice with each group of sprayed with GA_3 or $CaCl_2$ on the untreated (control) fruits, untreated fruits within the control group gave the highest TSS/TA ratio, while jasmine oil treatments gave the highest value of TSS/TA ratio in the group of sprayed fruits with GA_3, and treated fruits with olive oil in the group fruits treated with $CaCl_2$ gave the highest value of TSS/TA ratio in fruit juice in the 1st season, as well as in the 2nd season, with the exception of untreated fruits in the group of fruits sprayed with $CaCl_2$ gave the highest value of TSS/TA ratio in fruit juice, all results compared with untreated control fruits in 2011 and 2012 season.

The obtained results are in harmony with those pointed out by Tripathi and Bhargave (1993).

2.4- Effects on total sugar % in fruit juice:

Data indicated in Table (9) that the effects of pre-harvest spraying with GA_3 (100 ppm) and $CaCl_2$ (4%), and post-harvest treatments with jasmine oil, olive oil, fiber gard and wrapping fruits revealed significantly decrease in the total sugars % in fruit juice of Manfalouty pomegranate cv. in the 1st season 2011, while induced significantly increase in the total sugars % in fruit juice in the 2nd season 2012.

Concerning the effect of pre-harvest spraying with GA_3 or $CaCl_2$ on the total sugars % in fruit juice, at could deduced that untreated fruits (control) gave the highest value of the total sugars % (11.4%) followed by pre-harvest spraying with GA_3 (11.10%), then spraying $CaCl_2$ gave the lowest value of the total sugars % in the 1st season, while in the 2nd season, spraying $CaCl_2$ gave the highest value of the total sugars % (12.10%), followed by spraying GA_3 (11.50%), then the untreated (control) fruits gave the lowest value of total sugars (11%) in fruit juice.

Regard to the effect of post-harvest treatments in total sugars %, in juice of stored fruits under room temperature, the results showed the same trend of the pre-harvest treatments on this parameter during the 2 studied seasons compared with untreated (control) fruits.

Within each group of fruits treated or untreated with the post-harvest treatments, it was obviously that within the untreated (control) fruits. Fiber gard treatments gave the highest value of total sugars %, while wrapping fruits gave the lowest total sugars % in fruit juice at the 1st season. On the other hand, untreated fruit with post-harvest treatments gave the highest value of total sugars %, and jasmine oil treatment gave the lowest value of total sugars % in the 2nd season.

Within the group of fruits sprayed with GA_3, untreated fruits gave the highest value of total sugars %, and treatment with fiber gard gave the lowest value of total sugars % in the 1st season, as well as, in the 2nd season untreated fruits gave the highest value of total sugars %, while wrapping fruits results in the lowest value of total sugars %. Within the group of fruits sprayed with $CaCl_2$ during the two studied season untreated fruits induced the highest value of total sugars % and wrapping fruit gave the lowest value of total sugars %, compared with untreated fruits.

Table 9. Effect of pre- and post-harvest treatments on total sugars % of "Manfalouty" pomegranate cv. under room temperatures during 2011 and 2012 seasons.

Pre-harvest Treatments A	Post-harvest Treatments B	2011 season				2012 season			
		Periods C			Mean	Periods C			Mean
		Zero point	1	2		Zero point	1	2	
Control	O	11.67	12.27	12.65	12.20	11.38	12.26	12.48	12.04
	Jasmine oil	11.47	12.32	12.78	12.19	11.03	12.07	12.57	11.89
	Olive oil	11.07	12.48	12.77	12.11	10.97	12.28	12.62	11.96
	Fiber gard	11.43	12.50	12.77	12.23	11.38	12.07	12.53	11.99
	Wrapping	11.23	12.10	12.60	11.98	11.37	11.98	12.40	11.92
	Mean	11.40	12.30	12.70	12.13	11.20	12.10	12.50	11.93
GA_3 (100 ppm)	O	11.53	12.23	12.87	12.21	11.93	12.74	12.91	12.53
	Jasmine oil	11.47	12.40	12.67	12.18	11.57	12.71	12.85	12.38
	Olive oil	10.97	11.95	12.62	11.85	11.17	12.30	12.58	12.02
	Fiber gard	10.83	11.53	12.27	11.54	11.52	11.97	12.72	12.07
	Wrapping	10.77	11.8	12.47	11.68	11.30	12.18	12.52	12.00
	Mean	11.10	12.00	12.60	11.90	11.50	12.40	12.70	12.20
$CaCl_2$ (4%)	O	11.33	12.20	12.82	12.12	12.12	12.90	13.27	12.76
	Jasmine oil	11.17	12.00	12.70	11.96	12.22	12.65	13.35	12.74
	Olive oil	10.90	12.12	12.53	11.85	12.07	12.81	13.18	12.69
	Fiber gard	10.70	11.85	11.97	11.51	12.13	12.55	12.93	12.54
	Wrapping	10.53	11.53	11.75	11.27	11.80	12.33	12.93	12.35
	Mean	10.90	11.9	12.40	11.73	12.10	12.60	13.10	12.60
Mean		11.14	12.08	12.55		11.60	12.38	12.79	
Mean	O	11.51	12.23	12.78	12.17	11.81	12.63	12.89	12.44
	Jasmine oil	11.37	12.24	12.72	12.11	11.61	12.48	12.92	12.34
	Olive oil	10.98	12.18	12.64	11.93	11.40	12.46	12.79	12.22
	Fiber gard	10.99	11.96	12.34	11.76	11.68	12.20	12.73	12.20
	Wrapping	10.84	11.81	12.27	11.64	11.49	12.16	12.62	12.09

L.S.D. 0.05			
A (Pre)	=	0.08	0.115
B (Post)	=	0.10	0.149
C (Period)	=	0.08	0.115
AB	=	0.17	0.257
AC	=	n.s	n.s
BC	=	0.17	n.s
ABC	=	n.s	n.s

In general, the combination of pre- and post-harvest treatments effect on total sugars % in juice of stored fruits under room temperature, untreated fruits resulted in the highest value of total sugars % and wrapping fruits induced the lowest value of total sugars %. These positive effects of pre- and post-harvest treatment on stored fruits under room temperature could be due to reducing the respiration rate as well as the senescence of fruits stored under room temperature by decreasing O_2 and increasing CO_2 under modified atmosphere packaging of fruits stored under room temperature as pointed out by White and Broadley, 2003; Lara *et al*., 2004; Caleb *et al*., 2012 and Selcuk and Erkan, 2014, 2015).

These obtained results are in accordance with those found by Nurten and Mustafa (2013).

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تأثير معاملات ما قبل وبعد الحصاد علي جودة وقابلية ثمار الرمان المنفلوطي للتخزين تحت درجة حرارة الغرفة

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠١١، ٢٠١٢ علي صنف الرمان المنفلوطي المنزرع بمزرعة بحوث قسم الفاكهة – كلية الزراعة – جامعة أسيوط بهدف دراسة تأثير معاملات ما قبل الجمع برش كل من GA_3 (بتركيز ١٠٠ جزء في المليون) وكلوريد الكالسيوم (تركيز ٤%) مرتين لكل منهما الأولي عند وصول ثمرة الرمان حجم البرتقالة (حوالي شهرين بعد العقد) والثانية بعد شهر من الأولي وكذلك معاملات ما بعد الجمع لكل من زيت الياسمين (٢,٥ سم^3/لتر) وزيت الزيتون (٢,٥ سم^3/لتر) وزيت الفايبرجارد (٢٠ سم^3/لتر) ولف ثمار الرمان كل علي حده بالبولي فيلين (الخاص بالأغذية) وذلك علي خصائص الجودة الطبيعية والكيميائية لثمار الرمان خلال تخزينها تحت درجة حرارة الغرفة ٢٢±٥°م وذلك لمدة شهر. وتم تصميم التجربة باستخدام القطع المنشقة كاملة العشوائية في مستوين خلال تصميم القطاعات كاملة العشوائية (RCBD) حيث كانت معاملات ما قبل الجمع هي العامل (A) ومعاملات ما بعد الحصاد هي القطع المنشقة في المستوي الأول (B) ، وفترات التخزين هي القطع المنشقة في المستوي الثاني (C). مع تكرار كل معاملة ثلاث مرات وتخصيص ٢٠ ثمرة لكل مكررة.

ولقد أتضح من نتائج هذه الدراسة أن رش أشجار الرمان المنفلوطي بحمض الجبريليك أعطي أفضل النتائج خلال موسمي النمو ويليه الرش بكلوريد الكالسيوم ، بينما لف ثمار المجموعة التي تم رشها بحمض الجبريليك بالبولي فيلين أعطي أفضل خصائص الجودة الطبيعية والكيميائية لثمار الرمان المنفلوطي المخزنة تحت ظروف حرارة الغرفة يليها معاملات غمس الثمار بالزيوت الطبيعية وعليه فإننا نوصي برش ثمار الرمان المنفلوطي بحمض الجبريليك (١٠٠ جزء في المليون) قبل الجمع ولف ثمار هذه المجموعة بالبولي فيلين عند تخزينها تحت ظروف حرارة الغرفة للمحافظة علي خصائصها الطبيعية والكيميائية.