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# EFFECT OF SOME ESSENTIAL OILS ON CUT FLOWERS OF CHRYSANTHEMUM ( *Dendranthema grandiflorum* Ram. ) cv. "Flyer".

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## ABSTRACT

The experiment was carried out at the Laboratory of The Veget. and Floric. Depart., Fac. of Agric., Mansoura Univ., Egypt, during the two successive seasons of 2013 and 2014 to study the effect of preservative solutions containing some essential oils of peppermint, caraway and lemon grass with different concentrations (25 and 50 ml /L), on the quality, postharvest characters, water uptake, some chemical constituents and bacterial growth in the vase solution of chrysanthemum (*Dendranthema grandiflorum* Ram.) cv. Flyer cut flowers**.**

**The obtained results revealed that:**

Chrysanthemum cut flowers held in solution containing 25 mg/ L lemon grass oil recorded the highest longevity, maximum fresh weight %, highest values of relative fresh weight % and the better water balance up to the 2$^{nd}$ day of the vase life in both seasons. While, the least values of these characters were recorded by using distilled water (control) as a holding solution in the both seasons. The best total water uptake and the highest values of relative fresh weight % were recorded using a preservative solution contained 50 mg/ L caraway oil. The highest value of chlorophyll a and total chlorophyll content were recorded in the 7$^{th}$ day of the vase life period when preservative solution contained 50 mg/ L lemon grass oil. While, the lowest value of these characters were recorded in control flower in both seasons. The highest value of total sugar recorded in the 7$^{th}$ day during the vase life period when used preservative solutions contained 25 mg /L caraway oil and 25 mg/ L lemon grass oil, while the lowest value of total sugar were recorded in control flowers and solution containing 25 mg/ L peppermint oil in both seasons. The least average of bacterial count in vase solution resulted by using 25 mg/ L lemon grass oil as compared with other treatments, while the maximum average of bacterial count was recorded in distilled water (control) treatment in both seasons. It could be recommended that the use of preservative solution containing 25 mg /L lemon grass oil + 0.2 % sucrose extend vase life, increase fresh weight, increase water uptake, chlorophyll content, total sugar and bacterial counts of Chrysanthemum cut spikes.

**Keywords:** Chrysanthemum, *Dendranthema grandiflorum*, essential oils, preservative solutions, cut flowers, total chlorophyll, sucrose**.**

## INTRODUCTION

Mums (*Dendranthema grandiflorum* or *Chrysanthemum morifolium*) belong to family Asteraceae. It is one of the five most important cut flowers in the world Moreover, it is native to China and Southeast Asia and it is widely distributed in Europe, America and North Africa, (Khaligi, 2010).

Cut flowers are important products because it is a source of national income especially in countries that have suitable environmental for growth. Egypt is one of these countries which have many rectifiers production such as soil, temperature, humidity and light to cultivate and producing flower crops.

Cut flowers deteriorate for one or more reasons, one of the most common reasons for early senescence are carbohydrate depletion in respiration, the second main reason is caused by bacteria and fungi, which reduce water uptake due to blockage, in addition to excessive water loss from the cut flower and fluctuating temperatures during storage and transit cooler change. Short vase live could be one of the most important reasons for inability of florists to develop any appreciable market in Egypt. However, with flowers those in a good retailer and customer can easily double their vase life. Quality and vase life of many cut flowers can be improved by pulsing them after harvest in a solution containing sugar. Sugars play an important role in the keeping quality markedly extended the vase life, but the presence of sugar in the holding solution would encourage growth of microorganisms (Ichimura, 1999; Delaporte *et al.,* 2000; Reid and Nell, 2000).

Using essential oils in preservative solutions significantly decreased the microbial density, and increased spikes vase-life, (Van Meetern *et al.,* 2001; Hegazi and El-Kot, 2009). Greatest longevity of vase life of Alstroemeria flowers was related to 50mg $L^{-1}$ thyme essential oil treatment and it improved stem cut vase life more than 2 days longer than the control treatment. Cut Alstroemeria placed in 100mg$L^{-1}$ thyme oil, 100 and 50 mg $L^{-1}$ peppermint oil maintained fresh weights higher than initial fresh weights. Solution containing 100 mg$L^{-1}$ black cumin essential oil was more effective especially vase life and flower fresh weight losses than the control on Carnation cut flowers. Artemisia oil improved vase life and solution uptake when compared with the control of Chrysanthemum. Rose cut flower stems which held in solutions containing oils of sweet basil, cinnamon or lemon grass reduced plugging caused by the accumulation of microorganisms. The growth of these organisms destroyed the vessel cells and, as a result, xylem occlusion took place. But using essential oils of common lavender, geranium and anise minimized or inhibited the growth of microbial organisms and caused an enhancement of conductivity within the xylem vessels. As well using sage and lemon grass oils represented the highest percentages of water loss by flower comparing to the control. In addition using sage oil represented the highest values of transpiration rate comparing to the control, (Bazaz and Tehranifar; Fariman and Tehranifar, 2011; Hashemabadi *et al.* and Shanan, 2012).

So, the aim of this investigation was to study the effect of some natural essential oils such as peppermint, caraway and lemon grass with different concentrations as a holding solution on Chrysanthemum cut flower for maintaining the quality of the flower during shelf life as well as the treatment on postharvest characters, water uptake, some chemical constituents and bacterial counts.

## MATERIALS AND MOTHEDS

The experiment was carried out at the Laboratory of the Veget. and Floric. Depart., Fac. of Agric., Mansoura Univ., during the two successive seasons from November to January of 2013 and 2014 to study the effect of preservative solutions on the vase life of Chrysanthemum (*Dendranthema*

*grandiflorum* Ram. cv. "Flyer") cut flowers for keeping quality and extending the shelf life period.

**Plant material:**

Cut spikes were obtained from a flower shop delivered from a well known flower farm. Flowers were moved to the laboratory at the same day of delivery to the flower shop where they were pre-cooled by placing in cold water for 30 minutes after that the stems were re-cut under water to a length of 60 cm in all spikes and the leaves on the lower third part of the stem were removed. Every spike was placed individually in graduated cylinder (100 ml) filled with preservative solutions under 21 ± 1 ◦C and relative humidity 65 ± 5 % .

**Preparation of the essential oils:**

Stock solutions of the oils were prepared by dissolving 0.4 gm of the crude oil in 100 ml of 80 % ethyl alcohol, giving a stock solution of 4000 ppm for each crude oil as according to **Shanan (2012).**

**Preservative solutions:**

All the preservative solutions in this experiment fortified with 0.2 % sucrose as a carbon source and the experiment consists of 7 treatments as following: Control as distilled water - 25 and 50 ppm peppermint oil - 25 and 50 ppm caraway oil - 25 and 50 ppm lemon grass oil.

**Data recorded:**

**1-** Vase life (days): was judged when 50 % or more of head flowers on a spike were deemed unattractive as according to **Joyce *et al.* (2000).**

**2-** Maximum increase of fresh weight (%): was measured immediately after cutting the stem. Every 48 hrs, each stem was weighted to estimate the change in fresh weight until the end of the experiment.

**3-** Total Water uptake (ml/flower): was recorded as the decrease in the solution level of the graduated cylinder then calculated as according to Hatamzadeh *et al*. (2012).

**4-** Chlorophyll content (mg /gm F.W): was recorded in the $7^{th}$ day during the shelf life period. Chlorophyll a, b and Total chlorophyll were determined according to Machinney (1941). The color was measured spectrophotometrically at wave lengths 650 and 665nm, respectively.

**5-** Total sugar (mg /gm D.W): was recorded in the $7^{th}$ day during the shelf life period. Total sugars of air dried leaves were determined according to Dubois *et al.* (1956).

**6-** Averages of Bacterial Counts (C.F.U /ml): was determined in the keeping solutions after 3 days. Where 1 ml taken from each sample and diluted by using sterilized distilled water from the first dilution to sixth dilution. After that 1 ml of each fourth, fifth and sixth dilution were inoculated in petri dishes on media consisting of agar, peptone and beaf extract then it incubated for 48hours at 30◦C and the colonies have been counted according to Marousky (1969).

**Statistical Analysis:**

The layout of this experiment was a completely randomized design with six replicates for each treatment. Each replicate consisted of one spike carrying 5-7 head flowers. Data were subjected to analysis of variance

(ANOVA) using the costat program. The treatments means were compared using the least significance differences (L.S.D) test at 5 % probability level procedure as mentioned by Gomez and Gomez, (1984).

## RESULTS AND DISCUSSIONS

**1. Vase life:**

Data in Table (1) showed that Chrysanthemum cut spikes placed in preservative solution containing each caraway and lemon grass oil had significant longer vase life than those placed in the control. But, it was clear that the longest vase live was achieved using the preservative solution of 25 ppm lemon grass oil which were 22.33 and 24.00 in the both seasons respectively.

Also the same vase life was obtained with spikes fortified with 50 ppm caraway oil in the second season. In general it could be concluded that all the essential oils preservative solutions significantly extend the vase life period when compared with the distilled water (control) except when using peppermint oil at all its concentrations.

**Table (1): Effect of preservative solution treatments on vase life (days) of Chrysanthemum at 2013 and 2014 seasons.**

| Treatments | Vase life (days) | |
|---|---|---|
| | First season (2013) | Second season (2014) |
| Distilled water (control) | 17.67 c | 10.67 d |
| 25 ppm peppermint oil | 19.00 bc | 16.67 c |
| 50 ppm peppermint oil | 19.67 abc | 18.67 bc |
| 25 ppm caraway oil | 20.67 ab | 22.00 ab |
| 50 ppm caraway oil | 20.67 ab | 24.00 a |
| 25 ppm lemon grass oil | 22.33 a | 24.00 a |
| 50 ppm lemon grass oil | 20.67 ab | 23.00 a |
| L.S.D at 5 % | **2.80** | **4.15** |

**2. Maximum increase on fresh weight ( %**

The effect of the preservative solutions treatments on maximum increase of fresh weight (%) were studied and shown in Table (2). It was obvious that preservative solution contained 25 ppm lemon grass oil significantly tabulated the maximum change on fresh weight of 3.04 when compared with all of the other treatments in the first season. On the other side, no significant differences were shown between all the preservative solutions on this characteristic, but the same treatment (25 ppm lemon grass oil) still higher than all the other treatments.

**Table (2): Effect of the preservative solution treatments on maximum increase on fresh weight (%) of Chrysanthemum at 2013 and 2014 seasons.**

| Treatments | Maximum increase on fresh weight (%) | |
|---|---|---|
| | First season (2013) | Second season (2014) |
| Distilled water (control) | 0.00 b | 0.28 a |
| 25 ppm peppermint oil | 1.09 b | 0.60 a |
| 50 ppm peppermint oil | 0.00 b | 0.64 a |
| 25 ppm caraway oil | 0.54 b | 0.14 a |
| 50 ppm caraway oil | 0.79 b | 1.18 a |
| 25 ppm lemon grass oil | 3.04 a | 1.84 a |
| 50 ppm lemon grass oil | 1.08 b | 0.59 a |
| LSD (5%) | **1.39** | **N.S** |

**3. Total water uptake (ml /flower):**

It is quite clear from the date in Table (3) that preservative vase solutions contained any essential oils type or concentration had an upper hand in increasing the total water uptake than the control treatment. Moreover, no significant differences were shown between all the essential oil preservative solutions but, it was clear that adding 50 mg/L lemon grass oil recorded the highest total water uptake of 200 ml, followed by 194.50, 187.33, 172.00 ml for preservative solutions contained 50 mg/L caraway oil, 25 mg/L lemon grass oil and 25 mg/L caraway oil, respectively. Also the previous preservative solutions had significantly higher than the control (distilled water). On the other hand, no significant differences were shown between vase solutions received 25, 50 ml /L of peppermint oil and the control, since they recorded 151.50, 258.67 and 122.33 ml respectively, in the first season. But in the second season were shown significantly differences between 25, 50 ml / L of peppermint oil and the control, since they recorded 70.17, 61.17 and 36.67 ml respectively.

**Table(3):Effect of the preservative solution treatments on total water uptake(ml/flower)of Chrysanthemum at2013 and 2014 seasons.**

| Treatments | Total water uptake (ml / flower) | |
|---|---|---|
| | First season (2013) | Second season (2014) |
| Distilled water (control) | 122.33 b | 36.67 c |
| 25 ppm peppermint oil | 151.50 ab | 70.17 b |
| 50 ppm peppermint oil | 158.67 ab | 61.17 b |
| 25 ppm caraway oil | 172.00 a | 83.17 b |
| 50 ppm caraway oil | 194.50 a | 109.50 a |
| 25 ppm lemon grass oil | 187.33 a | 110.17 a |
| 50 ppm lemon grass oil | 200.00 a | 117.33 a |
| LSD (5%) | 49.43 | 24.09 |

**4. Chlorophyll (mg / gm F.W):**

Concerning chlorophyll content under effect of holding essential oil preservative solutions data in Table (4) shown that *Chrysanthemum* cut spikes held in solution contained lemon grass oil at 25 or 50 mg /L significantly gave a maximum values (1.25 and 1.33 mg /gm F.W) of chlorophyll a, comparing with most of the other treatments respectively, in the first season, followed by the treatment of received a preservative solution 50 mg /L caraway oil, it was (1.06 mg /gm F.W.). But, in the second season all the essential oil preservative solutions recorded higher content of chlorophyll a than the control and no significant differences were shown between all this essential oil preservative solutions. Moreover, the same three treatments 25 or 50 mg /L lemon grass oil and 50 mg /L caraway oil significantly higher than the control, since they were (0.90, 0.92, 0.81 and 0.37 mg /gm F.W.) respectively, in the second season. As for chlorophyll b data in the Tab. (4) shown gain increase with using 25 or 50 mg /L lemon grass and 50 mg /L caraway oil preservative solutions was (0.43, 0.36 and 0.28 mg /gm F.W.) and (0.30, 0.26 and 0.22 mg/gm F.W.) respectively, in the first and second seasons, when comparing with the control and most of the other treatments. Concerning the highest numbers of total chlorophyll, a correlation between the preservative solutions which increased the content of chlorophyll a and b directly increased the total chlorophyll content, since the same treatments 25 or 50 mg /L lemon grass and 50 mg /L caraway oils produced the highest total chlorophyll content was (1.68, 1.70 and 1.35 mg /gm F.W.) and (1.20, 1.29 and 1.03 mg / gm F.W.) respectively, of the first and second seasons.

**Table (4): Effect of the preservative solution treatments on Chlorophyll a, b and total contents (mg / gm F.W.) of Chrysanthemum at 2013 and 2014 seasons.**

| Treatments | Chlorophyll content (mg / gm F.W) | | | | | |
|---|---|---|---|---|---|---|
| | First season (2013) | | | Second season (2014) | | |
| | a | b | Total | a | b | Total |
| Distilled water (control) | 0.28 d | 0.09 d | 0.58 d | 0.37 b | 0.12 c | 0.60 c |
| 25 ppm peppermint oil | 0.67 cd | 0.19 bcd | 0.86 cd | 0.53 ab | 0.16 bc | 0.69 bc |
| 50 ppm peppermint oil | 0.67 cd | 0.16 cd | 0.84 cd | 0.58 ab | 0.15 bc | 0.73 bc |
| 25 ppm caraway oil | 0.81 bc | 0.23 bcd | 1.04 bcd | 0.58 ab | 0.15 bc | 0.72 bc |
| 50 ppm caraway oil | 1.06 abc | 0.28 abc | 1.35 abc | 0.81 a | 0.22 abc | 1.03 abc |
| 25 ppm lemon grass oil | 1.25 ab | 0.43 a | 1.68 ab | 0.90 a | 0.30 a | 1.20 ab |
| 50 ppm lemon grass oil | 1.33 a | 0.36 ab | 1.70 a | 0.92 a | 0.26 ab | 1.29 a |
| LSD (5%) | 0.47 | 0.19 | 0.66 | 0.42 | 0.14 | 0.52 |

**5. Total sugar (mg/ gm D.W):**

Date in Table (5) showed that *Chrysanthemum* cut spikes when placed in preservative solution containing 25 ppm lemon grass oil had a maximum value of total sugar content in dry leaves was (0.48 and 0.38 mg /gm D.W.) respectively, in the first and second seasons compared with other treatments. While, preservative solution contained 25 and 50 ppm of caraway oil recorded (0.47 and 0.41 mg/ gm D.W.) and (0.38 and 0.36 mg/ gm D.W.) respectively, in the both seasons compared with other treatments or the control. Contrary, The control treatment (distilled water) recorded the lowest values of total sugar content (0.18 and 0.17 mg /gm D.W.) respectively, in the both seasons.

**Table (5): Effect of the preservative solution treatments on total sugar content (mg / gm D.W) of Chrysanthemum at 2013 and 2014 seasons.**

| Treatments | Total sugar content (mg / gm D.W) | |
|---|---|---|
| | First season (2013) | Second season (2014) |
| Distilled water (control) | 0.18 c | 0.17 b |
| 25 ppm peppermint oil | 0.25 bc | 0.18 b |
| 50 ppm peppermint oil | 0.33 abc | 0.26 ab |
| 25 ppm caraway oil | 0.47 a | 0.38 a |
| 50 ppm caraway oil | 0.41 ab | 0.36 a |
| 25 ppm lemon grass oil | 0.48 a | 0.38 a |
| 50 ppm lemon grass oil | 0.31 abc | 0.24 ab |
| LSD (5%) | 0.19 | 0.15 |

**6. Bacterial counts (C.F.U. / ml):**

The results tabulated in Table (6) revealed that all pulsing solution treatments decreased the bacterial counts of *Chrysanthemum* cut spikes when compared with the control treatment. However, using 25 ppm lemon grass oil had the least average of bacterial count was ($58.33 \times 10^5$ C.F.U. / ml and $62.66 \times 10^5$ C.F.U. / ml) respectively, in the first and second seasons as compared with other treatments. The maximum average of bacterial count with the control treatment recorded ($2210.00 \times 10^5$ and $2216.66 \times 10^5$ C.F.U. / ml) respectively, in the first and second seasons.

**Table (6):Effect of the preservative solution treatments on bacterial counts(C.F.U./ml) of Chrysanthemum at 2013 and 2014 seasons.**

| Treatments | Bacterial counts (C.F.U. / ml) × $10^5$ | |
|---|---|---|
| | First season (2013) | Second season (2014) |
| Distilled water (control) | 2210.00 | 2216.66 |
| 25 ppm peppermint oil | 134.33 | 143.33 |
| 50 ppm peppermint oil | 72.66 | 77.66 |
| 25 ppm caraway oil | 2063.33 | 2087.66 |
| 50 ppm caraway oil | 113.66 | 123.66 |
| 25 ppm lemon grass oil | 58.33 | 62.66 |
| 50 ppm lemon grass oil | 149.66 | 150.33 |

## DISCUSSION

Many researched stated that one of the most important causes of deterioration in cut flowers is the decreased in water uptake due to occlusions located mainly in the basal stem end probably caused by growth of microbes and vascular blockage and increase in water loss by leaves transpiration, (He *et al.*, 2006 and Alimordi *et al.*, 2013).

Serek *et al.* (1995) found that, the decrease in relative fresh weight of cut flowers during the days after harvest could be due to the decrease in water uptake. Hassan *et al.* (2003) found that, the increment in fresh weight of *Solidago canadensis* may be due to its additional role in increasing water uptake. He *et al.* (2006) reported that, low water uptake is often due to occlusions located mainly in the basal stem end and vase life termination for many cut flowers of *Grevillea* is characterized by wilting which is due to loss of water from the cells. Many researchers stated that shortage of soluble carbohydrates in petals is one of the most important causes for shortening cut flowers vase life but applying sucrose to vase solution increased flower longevity (Liao *et al.*, 2000 and Ichimura *et al.*, 2006). Delaying protein degradation and flower senescence, regulating water rate due to controlling respiration, higher water uptake, inhibition of ethylene producing and decreasing ethylene sensitivity of cut flowers, (Chanasut *et al*. 2003 and Ichimura *et al*. 2006). Aromatic and medicinal plants are the source of natural antioxidants thanks to their main secondary metabolites such as polyphenols and essential oils, (Singer *et al.*, 2003). They can act as antioxidants by donating hydrogen to highly reactive radicals, thereby preventing further radical formation (Lapornik *et al.*, 2005). The mode of action of essential oils can be enables to separate the lipid components of the bacterial cell membrane and mitochondria, binding to membrane proteins and releasing lipopolysaccharides (LPS) which resulted in disturbing cell wall structures (Ultee *et al.*, 2000; Lambert *et al.*, 2001 and Braga *et al.*, 2008).

Solgi *et al.* (2009) suggested that, Vase-life of Gerbera flowers was improved approximately two-fold from 8.3 days for the control to 16.0 and

15.9 days after keeping flowers in solutions containing carvacrol (50 or 100 mg $L^{-1}$), respectively. In addition, the relative fresh weight and solution uptake of Gerbera flowers were increase by addition of 100 mg $L^{-1}$ essential oils compared with the control flowers. In this study treated cut Chrysanthemum with the higher concentration of lemon grass oil caused visible damage to leaves and their early abscission, this may be due to the phytotoxic effect of high concentration of essential oil which causing damage to cell membrane (Teper Bamnolker *et al.*, 2010). Fariman and Tehranifar (2011) found that essential oils are very effective antimicrobial agents, which inhibited the microbial growth and prevented bacterial plugging of water conducting tissues so they should increase vase life of Carnation cut flowers. Lemon grass (*Cymbopogon citratus*) essential oil possesses various pharmacological activities such as antibacterial, antifungal properties, (Shah *et al.*, 2011).

Hashemabadi *et al.* (2012) suggested that the positive effect of essential oil may be due to improving hydraulic conductivity, preventing vascular occlusion and improving water relation. Also, essential oils are natural antimicrobial compounds that have synergic effects on maintaining carbohydrates. The degrees of influence of the essential oils were different and it could change 9because of the chemical compositions and the own antioxidant capacity of oils. This study showed that used essential oils decreased the bacterial counts compared with the control treatment. In the fact, essential oils are very effective antimicrobial agents, which inhibited the microbial growth and prevented bacterial plugging of water conducting tissues which led to increasing water uptake and vase life.

Depending on what previously are mentioned, this study showed that the best treatment that gave significantly in most characteristics was 25 ppm lemon grass oil and then 50 ppm caraway oil, followed with the treatment used 50 ppm lemon grass oil without significant differences between them.

It could be recommended that the use of preservative solutions containing 25 mg /L lemon grass oil + 0.2 % sucrose extend vase life, increase fresh weight, increase water uptake, improve water balance, chlorophyll content, total sugar, decrease water loss and bacterial counts of *chrysanthemum* cut spikes.

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# تـأثير محاليـل حفـظ تحتـوى بعـض الزيـوت العطريـة علـي أزهـار الاراولا المقطوفة

**حكمت يحيى مسعود *، محمود مكرم قاسم *و ناردين بولس بدير فرج****
*** قسم الخضر و الزينة – كلية الزراعة – جامعة المنصورة.**
**** قسم الخضر والزينة – كلية الزراعة – جامعة دمياط.**

إجريت هذة الدراسة في معمل قسم الخضروالزينه كليه الزراعة- جامعه المنصورة خلال موسمين متتاليين (٢٠١٣ و٢٠١٤). وتهدف هذة التجربة لدراسة تأثيرمحاليل الحفاظ التى تحتوى على زيوت عطرية مثل (زيت النعناع وزيت الكراوية وزيت حشيشة الليمون) بتركيزات مختلفة (٢٥-٥٠ ملجم /لتر علي جودة وصفات ما بعد الحصاد لأزهار الأراولا ( مدة البقاء- الماء الممتص- المحتوى الكيماوى- العد البكتيرى).

**يمكن تلخيص نتائج الدراسة كما يلي :**

أعطى محلول الحفظ الذى يحتوي علي ٢٥ ملجم/ لتر زيت حشيشة الليمون أطول مدة بقاء للشماريخ الزهرية وعلي أعلي زيادة في الوزن الطازج وأعلي نسبة مئوية للتغير في الوزن الطازج وأعلى معدل فى التوازن المائى فى اليوم الثانى وذلك في كلا الموسمين بينما سجلت أقل القيم للصفات السابقة عند المعاملة بمحلول حفظ يحتوي علي الماء المقطر (الكنترول) في كلا الموسمين.

سجلت المعاملة بمحلول حفظ يحتوي علي ٥٠ ملجم/ لتر زيت كراوية أفضل معدل للماء الكلي الممتص وإمتصاص الماء وأقل فقد فى الماء في اليوم الثاني من دورة الحياة بعد القطف وأعلي نسبة مئوية للتغير في الوزن الطازج بينما كانت أقل قيمة لهذه الصفات عند إستخدام الماء المقطر (الكنترول) في كلا الموسمين.

سجلت أعلي قيمة للكروفيل أ والكلوروفيل الكلي في اليوم السابع من دوره الحياة بعد القطف عند إستخدام محلول حفظ يحتوي على ٥٠ ملجم/ لتر زيت حشيشة الليمون. وكانت أقل قيمة للكلوروفيل أ و ب والكلوروفيل الكلي في اليوم السابع خلال دورة الحياة بعد القطف عند إستخدام محلول حفظ يحتوي علي الماء المقطر (الكنترول) في كلا الموسمين.

سجلت أعلى قيمة للسكريات الكلية في اليوم السابع أثناء دورة الحياة بعد القطف عند إستخدام محلول حفظ يحتوي علي ٢٥ ملجم/ لتر زيت كراوية و٢٥ ملجم/ لتر زيت حشيشة الليمون بينما سجلت أقل قيمة للسكريات الكلية عند إستخدام الماء المقطر (الكنترول) وإستخدام ٢٥ ملجم/ لتر زيت نعناع وذلك في كلا الموسمين.

سجلت معاملة الحفظ بإستخدام محلول يحتوي علي ٢٥ ملجم/ لتر زيت حشيشة الليمون أقل متوسط للعد البكتيري مقارنة بالمعاملات الأخري وكان أعلى متوسط للعد البكتيري عند إستخدام الماء المقطر (الكنترول) وذلك في كلا الموسمين.

يمكن **التوصية** بإستخدام محلول حفظ يحتوي علي ٢٥ ملجم/ لتر زيت حشيشة ليمون + ٠,٢ % سكروز لأطالة فترة الحياة وزيادة الوزن الطازج وزيادة الماء الممتص وقلة الفقد في محتوي الكلوروفيل والسكريات الكلية وتقليل النشاط البكتيري عند حفظ أزهار الأراولا.