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EFFECT OF NATURAL EXTRACTS ON VASE LIFE OF GYPSOPHILA CUT FLOWERS

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ABSTRACT: The experimental trial was consummated throughout two successive seasons (2012 and 2013) at the Post-Harvest Lab. of Ornamental Plants and Landscape Gardening Research Dept., Hort. Res. Inst.; Giza, Egypt on *Gypsophila paniculata* L. "Perfecta" cut flowers. Short postharvest vase life is one of the most important problems on the cut flowers. In this study we investigated the effect of natural plant extracts of thyme (*Thymus vulgaris*) or moringa (*Moringa oleifera* Lam), chemical solutions (8-Hydroxyquinoline citrate, salicylic acid and sucrose) as holding solution and storage periods (0 and 7 days at 4°C) on extending the vase life of gypsophila cut flowers. The treatments were: distilled water (D.W.), thyme extract (25%), thyme extract (25%) + sucrose (2%) + salicylic acid (150 mg/l), moringa extract (25%), moringa extract (25%) + sucrose (2%) + salicylic acid (150 mg/l) and 8-Hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l).

Results showed that holding solution containing natural extracts: thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l), moringa (25%), moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l) increased flower longevity followed by the chemical solution of 8-Hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l) as compared to D.W. The results also revealed that extracts solution (thyme or moringa plus sucrose and salicylic acid) increased fresh weight %, total carbohydrates % and water uptake, but decreased water loss, maintained quality rate, water balance, and decreased number of bacteria in the solution. Concerning the effect of storage period (dry cold storage for 7 days) it has shown favorable effect on vase life and the other studied characters, but 0 day (unstored flowers) significantly surpassed the storage for 7 days. The results of interaction showed that holding solutions containing natural extracts with storage for 0 days (unstored flowers) had the highest effect on vase life, fresh weight %, total carbohydrates %, water uptake, water loss, water balance and quality rate.

It could be concluded that the best treatments were natural extracts: thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) and moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l) stored 0 day (unstored flowers), which significantly improved the studied characters compared to the other treatments.

Key words: Cold storage, cut flower, natural extracts, preservative solution, storage periods.

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INTRODUCTION

Gypsophila paniculata L. "Perfecta" (baby's breath or perennial gypsophila) is a member of the Caryophyllaceae family. Gypsophila flowers are popular as cut-flowers, used traditionally as filler in all types of floral arrangement, bouquets and wedding bouquets.

Gypsophila consists of a number of annual and perennial flowering plants grown almost throughout the world. They are useful for mist like effects in mixed borders, beds and edges and are also suitable for rock gardens. They make an excellent effect as filling amongst shrubbery and good for covering unkept places with a mass of delicate blooms.

Cut flowers have a very limited life after they had been cut off from the mother plant, as survival on their own reserves is generally low due to the special morphological and physiological characteristics of their tissues. The use of refrigeration for storage of flower cuts is very important because it reduces water loss, senescence, infections caused by bacteria and fungi, thus extending the shelf-life of flowers during the storage period. Therefore, the aim of the present work is to show the differences between natural extract solutions and chemical ones on vase life and keeping quality of gypsophila cut flowers during storage for 0 and 7 days at 4°C.

The main cause of deterioration in cut flowers is the blockage of vessels from xylem by microorganisms which accumulate in solution from the vessel or vessel conductors. Other less important causes of vascular occlusion are air embolism and the physiological response of the plant to cut stem (Ichimura *et al*., 1999).When the vessel is blocked, the transpiration process occurs continuously and there is no net gain of water by the fabric or flower stem. Germicides can be applied to inhibit the growth of microorganisms in the vessels conductive rod. Thus, stimulate the absorption of water by the reduction of vascular blockage, helping to maintain the turgor of flowers (Nowak *et al*., 1991).

The study of postharvest physiology of flowers involves metabolic processes and their changes in various parts of the plant from the time it was harvested until senescence completes. The deterioration processes occur as a result of complex physiological changes, such as depletion of reserves by breathing as a result of excessive water loss through transpiration and the occlusion of the stem after cutting plugging the vessels conductors, the air and causing embolism deposition of chemicals (Ferronato, 2000).

The decrease in water uptake, depending on species, may be due to a number of factors, which are classified as inherent to the rod, also called lock physiological blockage due to microbial growth and blockage caused by formation of air bubbles (embolism) (Van Doorn, 1999 and He *et al*., 2006). With the blocking of conducting vessels, the development of negative water balances occur, because the rate of water absorption is less than the rate of transpiration (Van Meeteren *et al*., 2006).

Moringa (*Moringa oleifera* Lam.) is native to the Indian subcontinent and has become naturalized in the tropical and subtropical areas around the world. The tree is known by such regional names as Benzolive, Drumstick tree, Horseradish tree, Kelor, Marango, Mlonge, Mulangay, Saijihan and Sajna (Fahey, 2005). The plant thrives best under the tropical insular climate. It can grow well in the humid tropics or hot dry lands and can survive in less fertile soils and it is also little affected by drought (Anwar *et al*., 2007). It is considered as one of the World's most useful trees, as almost every part of the moringa tree can be used for food, medication and industrial purposes (Khalafalla *et al*., 2010). People use its leaves, flowers and fresh pods as vegetables, while others use it as livestock feed (Anjorin *et al*., 2010). This tree has the potential to improve nutrition, boost food security and foster rural development (Hsu,

2006). Seeds of moringa contain an active coagulant compound traditionally used for the purification of drinking water (Jahn, 1988). The dried leaves had the following mineral contents: calcium (3.65%), phoshorus (0.3%), magnesium (0.5%), potassium (1.5%), sodium (0.164%), sulphur (0.63%), zinc (13.03 mg/kg), copper (8.25%), manganese (86.8 mg/kg), iron (490 mg/kg) and selenium (363 mg/kg) (Moyo *et al*., 2011).

Thyme (*Thymus vulgaris* L.) volatile phenolic oil has been reported to be among the top 10 essential oils, showing antibacterial, antimycotic, antioxidative, natural food preservative and mammalian age delaying properties (Deans and Ritchie, 1987; Deans *et al*., 1993 and Letchamo and Gosselin, 1996). Such studies showed that thyme plant could be considered as an alternative natural growth promoter for poultry instead of antibiotics (McDevitt *et al*., 2007). Previous studies show that thymol has antifungal activity in a number of species, including *Cryptococcus neoformans, Aspergillus, Saprolegnia* and *Zygorhynchus* species. Use of the essential oils as safe and environmentally friendly substances and for their antimicrobial properties against some bacteria and fungi was mentioned by Bounatirou *et al.* (2007).

The purpose of this study is to compare between the efficiency of natural plant extracts (moringa and thyme) and chemical solution (8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l) to improve the keeping quality of gypsophila flowers and retarding bacteria and fungi activity, after harvest.

MATERIALS AND METHODS

The present study was conducted at Post-Harvest Laboratory of Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst.; Giza, Egypt during the two seasons of 2012 and 2013.

Plant material and experimental design:

Gypsophila paniculata L. "Perfecta" (baby's breath) cut flowers were obtained from a local commercial ornamental farm (Floramix) at Giza Governorate. The cut flowers were harvested in the early morning, (15% of the flowers are open). The flowers were quickly transported to the laboratory. After that, gypsophila cut flowers were recut (2 cm) before pre-cooling were performed by placing them in ice cold water for 3 hours. The pre-cooling is an important postharvest operation, which removes the field heat and greatly improves quality and enhances the vase life of cut flowers. Uniform cut flowers (about 80cm) were used. Gypsophila cut flowers studied were performed in an ambient environment lab at 18±2°C, 50–55% RH and 24 hr lighting by fluorescent lamp at 1000 lux.

The layout of the experiment was factorial in a complete randomized design with two factors. The first factor was cold storage for 0 and 7 days at 4°C and the second factor was holding solutions: distilled water (D.W.), thyme (25%), thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l), moringa (25%), moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l) and 8-Hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l). Also, their interaction treatments on gypsophila cut flowers post harvest characters, water relations and some chemical constituents. The objective of this study was to evaluate two storage periods (0 and 7 days at 4°C), different holding solutions and their interaction treatments to improve postharvest quality of *Gypsophila paniculata* L. "Perfecta".

Data recorded:

- Cut flowers longevity (day): the vase life was determined as the number of days to wilting.
- Opening cut flowers: opening cut flowers number was recorded as a percentage during shelf life periods.
- Quality rating of gypsophila cut flowers after storage periods. Quality of flowers was rated on a scale of 1 to 5 with rating index given below:

1. Turgid florets, no visible deterioration of florets observable.
2. Incipient wilting of florets, and/or incipient deterioration (browning) of florets.
3. Greater than 20% of florets wilted in a single bunch and/or greater than 20% of florets deteriorated.
4. Severe wilting and deterioration of florets, 75%of florets turned brown.
5. Severe wilting, all florets deteriorated and become brown (Marousky and Nanney, 1972).

- Flower fresh weight increase percentage.
- Water uptake (g) by the cut spikes was estimated by subtracting the weight of water at the end of experiment from the initial weight.
- Water loss (g) was calculated as the difference between fresh weight of cut flower with weight of solution at the end of experiment from the initial weight.
- Water balance (g) was calculated as the difference between water uptake and water loss at the end of longevity.
- Total carbohydrates % content in the flowers was determined colorimetrically, according to the methods described by Dubois *et al*. (1956).

Method of extraction of thyme and moringa:

Dry leaves of thyme (*Thymus vulgaris*) and moringa (*Moringa oleifera*) were ground and kept at laboratory temperature until use, for the preparation of aqueous extract, 40 grams of thyme and moringa powder were taken, placed in the two conical flasks containing 200 cm^3 of distilled water, mixed by magnetic blender for 30 minutes and a centrifuge for 15 minutes. After that the solution stand in the electric furnace at 35 °C until we get the extract and from it we prepared solutions (Fayad *et al*., 2013).

Statistical analysis:

The data were statistically analyzed as a factorial experiment (two storage periods and six holding solutions) using MSTAT-C. Each treatment was replicated three times and each replicate contained three cut flowers. The results were subjected to analysis of variance (ANOVA) and the means were compared by Duncan's Multiple Rang Test at $P \leq 0.05$ as described by Waller and Duncan, (1969) to verify differences among means of various treatments.

RESULTS AND DISCUSSION

Effect of storage periods, holding solutions and their interactions on keeping quality of gypsophila cut flowers:

In this study, when thyme and moringa extracts were used with sucrose and salicylic acid gave better results compared with its used alone.

1- Vase life:

Data presented in Table (1) show the effect of holding solutions, storage periods and their interactions on vase life (day) of gypsophila cut flowers. The results indicate that all holding solution treatments prolonged the vase life of gypsophila cut flowers, in both seasons.

Holding of gypsophila cut flowers in natural extracts solution containing moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l), were the most effective treatments for increasing vase life as compared with chemical solution containing 8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l) in both seasons.

Regarding the effect of storage periods, it can be concluded from Table (1) that storage periods for (0 day) gave the highest values of vase life (20.7 and 19.6 days) in the first and second seasons, respectively than those stored for 7 days (18.1 and 17.7 days).

The combination between holding solution containing moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) and storage period (0 day) produced

the longest vase life (23.8 and 22.0, 23.6 and 22.5 days) in the first and second seasons, respectively in comparison to the same previous holding solutions with storage period at 4°C for 7 days which recorded 21.3 and 21.6, 20.9 and 20.5 days in the two seasons, respectively.

The above mentioned results are in agreement with Amini *et al*. (2013) findings which show that leaf extract of thyme can be appropriate for increasing the life of gerbera cut flowers due to having volatile essences with anti-bacterial characteristics. Jalili *et al.* (2011) found that salicylic acid treatment showed the best effect on vase life of gladiolus cut flowers. Josephat (2005) on lisianthus (*Eustoma grandiflorum* L.) cut flowers observed that 8-HQC was phytotoxic and caused browning and blackening of immersed stem sections. Also, Zaky *et al*. (2008) mentioned that 0 week storage period had the longest vase life on cut Fatsia leaves compared with one week and two weeks. Elashwah (2011) reported that pulsing carnation cut flowers stored for 0 day in STS and kept in preservative solution containing "suc. + lime" recorded the highest vase life compared with cut flowers stored for 2 weeks at 0°C or 4°C.

Table 1. Effect of storage periods, holding solutions and their interactions on vase life (day) of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	12.3 f	9.5 g	10.9 e	10.4 G	8.6 h	9.5 d
2	20.5 c-d	17.4 e	18.9 d	20.0 c-e	17.6 f	18.8 c
3	22.4 a-b	20.1 c-d	21.3 b-c	21.4 a-c	19.3 d-e	20.3 b
4	21.5 b-c	19.6 d	20.5 c	20.8 b-d	19.0 e-f	19.8 b-c
5	23.6 a	20.9 b-d	22.3 a-b	22.5 a	20.5 b-e	21.5 a
6	23.8 a	21.3 b-c	22.6 a	22.0 a	21.6 a-b	22.45 a
Means	20.7 a	18.1 b		19.6 a	17.7 b	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

2- Opening cut flowers:

Data illustrated in Table (2) show that placing gypsophila cut flowers in different holding solutions improved opening of cut flowers in the two seasons when compared with distilled water (control) as a check. Holding solution containing natural extracts as moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) increased opening cut flowers (88.1, 85.1 and 87.6, 85.1%) more than chemical solution containing 8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l) (87.5 and 84.7% in the first and second seasons respectively).

The results presented in Table (2) pointed out that the period of storage of gypsophila cut flowers for 0 day increased opening cut flowers more than cut flowers stored for 7 days at 4 °C, in both seasons.

The results of interaction between holding gypsophila cut flowers in solution containing natural extract moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l), and storage period for 0 day increased opening cut flowers over other treatments in both seasons.

These findings are in agreement with those previously obtained by Zaky and El Zayat (2008) who indicated that the highest opening percentage of carnation cut flowers was obtained with flowers pulsed with jasmine oil (0.030 and 0.015%) at 0-time (unstored flowers). Also, Hashemabadi *et al*. (2012) found that Artemisia oil (50%) increased flower opening of chrysanthemum cut flowers. Stored cut tuberose inflorescences at 2°C for 3 days significantly decreased floret opening (Waithaka *et al*., 2001). Also, Çelikel and Reid (2005) found that gypsophlia cut flowers treated with sucrose plus CM1/MI-AS (an isothiazolinonic germicide in combination with aluminum sulfate) at different temperatures of 10 or 20°C for different periods (24,48 or 72 h) increased number of open florets.

Table 2. Effect of storage periods, holding solutions and their interactions on opening of *Gypsophila paniculata* L. "Perfecta" (%) cut flowers during 2012and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	39.1 f	35.5 g	37.3 d	30.3 f	25.5 g	27.9 d
2	65.7 d	60.2 e	63.0 c	63.4 c	55.4 e	59.4 c
3	90.7 a	84.4 b	87.5 a	64.6 a	80.6 b	84.7 a
4	68.5 c	63.4 d	65.9 b	64.6 c	60.5 d	62.5 b
5	90.8 a	84.5 b	87.6 a	89.8 a	80.5 b	85.1 a
6	90.7 a	85.6 b	88.1a	89.5 a	80.6 b	85.1 a
Means	74.2 a	68.9 b		71.1 a	63.8 b	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

3- Water uptake:

The data concerning the effect of different solutions, storage periods and their interaction on water uptake are presented in Table (3). These data reveal that holding solution containing natural extracts as extract moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) were more effective on the water uptake than the other treatments and the differences were significant in both seasons.

Regarding the effect of storage periods, it can be observed from Table (3) that 0 day was the best storage period compared with cut flowers stored for 7 days at 4°C, in both seasons.

The results of interaction stated that the highest water uptake of gypsophila cut flowers was obtained by placing cut flowers in natural extract solutions containing moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l) and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) and stored for 0 day, than the other treatments in the two seasons. These results coincided with the findings of Shanan *et al.* (2010) who showed the maximum net water uptake was recorded with *Dianthus caryphyllus* L. cv. Farida cut flowers which were kept in natural essential oils extracted from mandarin (*Citrus nobilis* var. *deliciosa*), coriander (*Coriandrum sativum* L.), dill (*Anethum graveolens* L.), clove (*Syzygium aromaticum* L.). Zadeh and Mirzakhani (2012) found that thyme oil at level of 200 ppm was the best treatment on relative water content (RWC). Also, he found that salicylic (SA) at level of 400 ppm increased solution absorption in cut *Dianthus caryphyllus* cv.

Liberty. Amini *et al*. (2013) considering the fact that thyme extract has proven anti-bacterial effects and also the fact that bacteria gathering in the end of gerbera cut stem make water absorption very difficult for the plant. Basiri *et al*. (2011) and Rahman *et al*. (2012) indicated that rosemary or *Psidium guajava* and *Piper betle* leaf extracts inhibited the growth of microorganisms in vase solution and increased water uptake of carnation (*Dianthus caryphyllus*) cut flowers. Elashwah (2011) reported that carnation cut flowers stored for 2 weeks at 4°C and kept in preservative solutions showed the lowest values of water uptake. Also, carnation cut flowers (stored for 0 day) pulsed in STS and kept in preservative solution "suc. + lime" reached the highest total water uptake compared with cut flowers stored for 2 weeks at 0°C or 4°C and other treatments.

Table 3. Effect of storage periods, holding solutions and their interactions on water uptake (g) of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	19.3 f	12.8 g	16.1 e	20.6 h	14.6 i	17.6 e
2	25.4 e	19.3 f	22.4 d	30.4 f	20.2 h	25.3 c
3	62.3 c	54.3 d	58.3 c	63.3 c	55.5 e	59.4 b
4	23.7 e	21.0 f	22.4 d	23.8 g	22.2 g	23.0 d
5	66.6 b	55.5 d	61.1 b	66.8 b	60.4 d	63.6 b
6	71.5 a	61.6 c	66.6 a	70.9 a	61.5 d	66.2 a
Means	44.8 a	37.4 b		46.0 a	39.1 b	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

4- Water loss:

Data in Table (4) show that the effects of all holding solutions on water loss were significant in gypsophila cut flowers. The highest record in this concern belonged to cut flowers kept in chemical solution (8-hydroxyquinoline citrate (200 mg/l)+sucrose (2%) + salicylic acid (150 mg/l), (51.0 and 47.2 g), followed by natural extracts (thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) (45.4 and 42.5 g) and moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), (41.9 and 41.2 g) in the first and second seasons, respectively.

Data in Table (4) clearly indicate that water loss of gypsophila cut flowers was increased in cut flowers stored for 7 days at 4°C (38.8 and 39.7 g) compared to cut flowers stored for 0 day (32.7 and 33.1 g) in both seasons, respectively.

The results of interaction stated that the lowest water loss was obtained by holding gypsophila cut flowers (stored for 0 day) in chemical solution (8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l) followed by natural extracts containing thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) and moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), as compared with those held in the same solutions (stored for 7 days at 4°C) in the two seasons. These results were in agreement with the findings of Elashwah (2011) who showed that the highest amount of water loss belonged to carnation cut flowers kept in solution containing "suc.+ clorox + lime". However, the effect of

storage periods and the interaction between storage periods and holding solutions were conflicting with the finding of Elashwah (2011) who mentioned that carnation cut flowers (stored for 0 day) recorded the highest amount of total water loss compared with cut flowers stored for 2 weeks at 4°C. Also, pulsing carnation cut flowers (stored for 0 day) in STS and kept in solution containing "suc. + lime" reached the highest water loss.

Table 4. Effect of storage periods, holding solutions and their interactions on water loss (g) of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	30.5 e	41.5 c	36.0 d	35.3 f	45.2 b	40.3 c
2	20.7 g	22.7 f	21.7 e	25.1 h	30.7 g	27.9 d
3	45.5 b	56.4 a	51.0 b	43.4 c	50.9 a	47.2 a
4	19.5 g	22.8 f	21.2 e	18.2 j	20.7 i	19.5 e
5	40.6 c-d	45.3 b	45.4 a	39.5 d	45.4 b	42.5 b
6	39.4 d	44.3 a	41.9 c	37.3 e	45.2 b	41.2 c
Means	32.7 b	38.8 a		33.1 b	39.7 a	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%) + salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

5- Water balance:

Data registered in Table (5) show that all holding solutions (natural extracts and chemical solution increased the water balance (g) in gypsophila cut flowers compared with control (D.W.), in the two seasons.

Holding gypsophila cut flowers in natural extracts containing moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150mg/l), were the most effective treatment for increasing water balance as compared with holding cut flowers in chemical solution.

The effect of storage periods was significant as gypsophila cut flowers stored for 0 day attained higher values of water balance (+12.1 and +12.8 g/flower) in the first and second seasons, respectively compared to cut flowers stored for 7 days at 4°C (-01.4 and -0.69/flower) in the two seasons, respectively as shown in Table (5).

Data presented in Table (5) clear that the effect of interaction between storage periods and holding solution treatments was significant.

Gypsophila cut flowers that achieved the highest values of water balance were those stored for 0 day and 7 days at 4°C and placed in holding solutions containing natural extracts of moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) in both seasons compared to cut flowers stored for 0 day and 7 days at 4°C and placed in holding solutions containing chemical preservatives of 8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) +salicylic acid (150 mg/l in both seasons.

The present results are in agreement with those reported by Elashwah (2011) who found that carnation cut flowers kept in suc. + clove + lime improved water balance. Shanan (2012) found that applications of essential oils, lavender, geranium and anise increased the water uptake and reduced the

rate of water loss of rose cut flowers. Elashwah (2011) mentioned that pulsing carnation cut flowers (stored 0 day) in STS and kept in preservative solution "suc. + lime" increased total water balance compared with cut flowers stored for 2 weeks at either 0°C or 4°C.

Table 5. Effect of storage periods, holding solutions and their interactions on water balance (g) of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	-11.2 g	-28.7 h	-19.9 e	-14.7 i	-30.6 j	-22.7 f
2	+4.7 e	-3.4 f	+0.7 d	+5.3 e	-10.5 h	-2.6 e
3	+16.8 b	-2.1 d	+7.3 b	+19.9 b	+4.6 d	+12.2 b
4	+4.3 e	-1.8 f	+1.2 d	+5.6 e	+1.5 g	+3.5 d
5	+26.0 b	+10.2 f	+15.7 c	+27.3 b	+15.0 f	+21.1 c
6	+32.1 a	+17.3 c	+24.7 a	+33.6 a	+16.3 c	+25.0 a
Means	+12.1 a	-1.4 c		+12.8 a	-0.6 c	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

6- Fresh weight increase percentage:

Data concerning the effect of different solutions, storage periods and their interaction on fresh weight percentage are presented in Table (6). These data reveal that holding solution containing natural extracts as moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) were more effective on fresh weight percentage than the other treatments and the differences were significant in both seasons.

Regarding the effect of storage periods, it can be observed from Table (6) that 0 day was the best storage period compared with cut flowers stored for 7 days at 4°C, in both seasons.

The results of interaction stated that the highest fresh weight percentage of gypsophila cut flowers was obtained by placing cut flowers in natural extract solutions containing moringa (25%) + sucrose (2%) + salicylic acid (150 mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) and stored for 0 day, than the other treatments in the two seasons.

Moreover, the results of the studies conducted by Amini *et al*. (2013) showed that the maximum fresh weight in medical treatment was for thyme 0.2 mg/l solution pulse of gerbera cut flowers. Pirpour *et al*. (2013) on Lilium cut flowers indicated that thyme essence 300 and 900 mg/l mixed with sucrose 4% preserve their wet weight compared to other treatments. Also, Hashemabadi *et al*. (2012) found that Artemisia oil 30% decreased fresh weight loss flower and improved postharvest quality of chrysanthemum cut flowers.

Hettiarachchi and Balas (2004) reported that fresh weight change of gloriosa stems was markedly reduced by increasing cold storage temperature and duration. Elashwah (2011) mentioned that pulsing carnation cut flowers (stored 0 day) in STS and kept in preservative solution "suc. + lime" recorded less reduction in flower fresh weight during shelf life periods compared with cut flowers stored for 2 weeks at either 0°C or 4°C.

Table 6. Effect of storage periods, holding solutions and their interactions on fresh weight increase percentage of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	3.8 i	2.5 i	3.2 e	6.6 g	4.2 h	5.4 d
2	13.3 f	10.2 h	11.7 d	14.5 e	8.7 f	11.6 c
3	20.9 b	15.8 d-e	18.3 b	21.8 b	17.0 c-d	19.4 b
4	14.7 e	11.5 g	13.1 c	15.8 d-e	8.6 f	12.2 c
5	21.0 b	17.4 c	19.2 a-b	22.5 a-b	16.9 c-d	19.7 ab
6	22.9 a	16.5 c-d	19.7 a	23.6 a	17.7 c	20.6 a
Means	16.1 a	12.3 b		17.4 a	12.2 b	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

7- Quality rate:

Data presented in Table (7) show the quality rate of gypsophila cut flowers. Gypsophila cut flower held in 8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) +salicylic acid (150 mg/l) (chemical solution), moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) (natural extracts) showed turgid florets and no visible deterioration of florets observable after storage periods compared to other treatments in both seasons.

As for the storage periods, it is clear that the storage periods of gypsophila cut flowers for 0 day had the highest score in quality rate compared to gypsophila cut flowers stored for 7 days in the two seasons.

Data presented in Table (7) clear that the effect of interaction between storage periods and holding solution treatments was significant.

Gypsophila cut flowers that achieved the highest score in quality rate were those stored for 0 day and 7 days at 4°C and placed in holding solutions containing natural extracts of moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) and chemical solution 8-hydroxyquinoline citrate (200 mg/l + sucrose (2%) +salicylic acid (150 mg/l), in both seasons compared to cut flowers stored for 0 day and 7 days at 4°C and placed in other solutions.

In this respect, Marousky and Nanney (1972) reported that gypsophila cut flowers held in preservative solutions maintained quality. Also, Pirpour *et al*. (2013) noticed that the external quality and freshness of *Lilium* santander cut flowers was observed in the thyme treatment with a concentration of 900 mg/l. Basiri *et al*. (2011) mentioned that the highest quality of carnation leaves and flowers was obtained by using rosemary extract at 20 and 25%, respectively.

Zaky and Khenizy (2007) found that solidago cut flowers treated with STS (1:4 m M) + 250 mg/l 8-HQC+ 3% sucrose enhanced general appearance in stored and unstored spikes. Elashwah (2011) found that treating carnation cut flowers (stored 0 day) with preservative solution "suc. + clove + lime" increased flowers quality compared with cut flowers stored for 2 weeks at either 0°C or 4°C.

Table 7. Effect of storage periods, holding solutions and their interactions on quality rate after storage periods of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	4.0 b	5.0 a	4.5 a	4.0 b	5.0 a	4.5 a
2	2.0 d	3.0 c	2.5 b	2.0 e	2.7 d	2.3 b
3	1.0 e	2.0 d	1.5 c	1.0 f	2.0 e	1.5 c
4	2.0 d	3.0 c	2.5 b	2.0 e	3.3 c	2.7 b
5	1.0 e	2.0 d	1.5 c	1.0 f	2.3 d-e	1.7 c
6	1.0 e	2.0 d	1.5 c	1.0 f	2.0 e	1.5 c
Means	1.8 b	2.8 a		1.8 b	2.9 a	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

Rating index: 1=Turgid florets, no visible deterioration of florets observable.2= Incipient wilting of florets, and/or incipient deterioration (browning) of florets. 3= Greater than 20% of florets wilted in a single bunch and/or greater than 20% of florets deteriorated. 4= Severe wilting and deterioration of florets, 75%of florets turned brown. 5= Severe wilting, all florets deteriorated and brown.

8- Bacteria number in vase solution:

Data in Table (8) demonstrate that, the number of bacteria in distilled water (control) was highly increased more than natural and chemical solutions.

As for the storage periods, it is clear that number of bacteria increased with increasing storage periods in the two seasons.

All holding solutions (natural extracts of moringa, moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), thyme, thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) and chemical solution (8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) +salicylic acid (150 mg/l)) with 0 day as a storage period decreased number of bacteria compared with solution of distilled water (control) followed by all holding solutions (natural extracts and chemical) with 7 days as a storage period in the first and second season. This is in agreement with Futi *et al*. (2011) who found that *Moringa oleifera* extract showed antibacterial activity in ground water, Elashwah (2011) found that keeping carnation cut flowers in solution "suc. + lupin + lime" and "suc. + clove + lime" proved their superiority in reducing the number of bacteria in vase. Amini *et al.* (2013) reported that leaves thyme extract has proven anti- bacteria effects and also the fact that bacteria gathering in the end of gerbera cut flowers stems make water absorption very difficult for the plant and consequently result in a decrease in wet weight in the days after harvest. Also, Shanan (2012) revealed that geranium, lavender, anise and sweet basil oils suppressed the blockage of xylem vessels by reducing the number of bacteria and fungi in *Rosa hybrida* L. cv. Grand vase solutions. Kazemi *et al*. (2011) reported that salicylic acid and sucrose increase membrane stability by decreasing malonadialdehyde content, ACC – oxidase activity and bacteria populations in vase flower preservative solution of carnation cut flowers. Nowak and Rudnicki (1990) mentioned that the 8-HQS is very important germicide in preservatives used in floral industry. Abou El-Ghait *et al*. (2012) stated that number of bacteria in vase solution was progressively increased as the cold storage period was increased from 0 up to 21 days however, stored chrysanthemum

cut flowers for 21 days scored the highest number of bacteria colonies/ml vase solution as compared with storage periods for 0 or 7 days.

Table 8. Effect of storage periods, holding solutions and their interactions on number of bacteria (cfu) in vase solution of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012and 2013.

Holding solutions	First season			Second season		
	Storage periods					
	0 day	7 days	Means	0 day	7 days	Means
1	$11.20x10^8$	$25.60x10^8$	$18.40x10^8$	$14.30x10^8$	$28.20x10^8$	$21.25 x10^8$
2	$0.01x10^8$	$0.05x10^8$	$0.03x10^8$	$0.03 x10^8$	$0.09 x10^8$	$0.06 x10^8$
3	$0.07x10^8$	$0.13x10^8$	$0.10x10^8$	$0.08 x10^8$	$0.5 x10^8$	$0.29 x10^8$
4	$0.01x10^8$	$0.03x10^8$	$0.02x10^8$	$0.04 x10^8$	$0.07 x10^8$	$0.06 x10^8$
5	$0.02x10^8$	$0.06x10^8$	$0.04x10^8$	$0.04 x10^8$	$0.08 x10^8$	$0.06 x10^8$
6	$0.03x10^8$	$0.07x10^8$	$0.05x10^8$	$0.05 x10^8$	$0.09 x10^8$	$0.07 x10^8$
Means	$1.89x10^8$	$4.32x10^8$		$2.42 x10^8$	$4.84 x10^8$	

1- Distilled water (control)
2- Thyme (25%)
3- 8- Hydroxyquinoline citrate (200 mg/l) + sucrose (2%)+ salicylic acid (150 mg/l)
4- Moringa(25%)
5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)
6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)

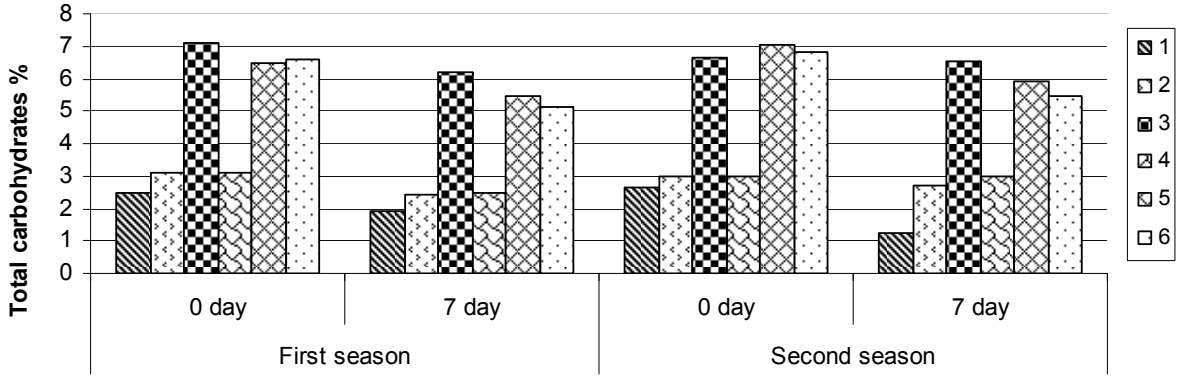
9- Total carbohydrates percentage:

Data illustrated in Fig. (1) show that control (D.W.) gave the least value of total carbohydrates percentage in flowers of gypsophila cut flowers compared to the other treatments in the two seasons.

Natural extracts of holding solution of moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), and thyme (25%) + sucrose (2%) + salicylic acid (150mg/l), recorded the highest value of total carbohydrates percentage as compared to chemical holding solution of 8- hydroxyquinoline citrate (200 mg/l) + sucrose (2%) +salicylic acid (150 mg/l in both seasons.

As for the storage periods, it is clear that the storage periods for 0 day had the highest value of the percentage of total carbohydrates compared to storage for 7 days in the two seasons.

The interaction effects (holding solutions x storage periods) show that gypsophila cut flowers stored for 0 day and 7 days at 4°C and placed in holding solutions containing natural extracts of either moringa (25%) + sucrose (2%) + salicylic acid (150mg/l), or thyme (25%) + sucrose (2%) + salicylic acid (150mg/l) were the best treatments for obtaining the highest percentage of total carbohydrates in flowers compared to those stored for 0 day and 7 days at 4°C then placed in a chemical solution of 8-hydroxyquinoline citrate (200 mg/l) + sucrose (2%) +salicylic acid (150 mg/l in the two seasons. The above mentioned results coincided with Elashwah (2011) who found that carnation cut flowers held in a solution containing "suc. + lupin + lime" recorded the highest increase in total sugars in petals. Also, freshly harvested (non-stored) flowers of carnation scored the highest contents of total sugars in petals, followed by those stored for 2 weeks at 0°C and 4°C. Moreover, the highest values of petal content of total sugars were obtained by fresh cut flowers (stored 0 day) pulsed in STS and kept in preservative solution containing "suc. + lime" or "suc. + lupin + lime" compared with cut flowers stored for 2 weeks at 0°C or 4°C other treatments.



1- Distilled water (control)	**4- Moringa(25%)**
2- Thyme (25%)	**5- Thyme (25%)+ sucrose (2%)+ salicylic acid (150 mg/l)**
3- 8- Hydroxyquinoline citrate(200 mg/l)+sucrose (2%)+ salicylic acid (150 mg/l)	**6- Moringa (25%) + sucrose (2%)+ salicylic acid (150 mg/l)**

Fig. 1. Effect of storage periods, holding solutions and their interactions on total carbohydrates of *Gypsophila paniculata* L. "Perfecta" cut flowers during 2012 and 2013.

CONCLUSION

Based on the results of this study, it could be concluded that solutions containing natural extracts (thyme (25%) + sucrose (2%) + salicylic acid (150 mg/l) and moringa (25%) +sucrose (2%) + salicylic acid (150 mg/l) used in this study improved the keeping quality of the gypsophila cut flowers by increasing vase life, fresh weight percentage and improving quality rate, water relations (water uptake, water loss, water balance), and total carbohydrates %. The main tool in this study is to use natural extracts as safe and environmentally friendly substances and for their antimicrobial properties against some bacteria and fungi.

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تأثير المستخلصات الطبيعية على عمر أزهار الجبسوفيلا المقطوفة في الفازات

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تم إجراء هذا البحث على أزهار الجبسوفيلا (نفس الطفل) صنف بيرفكتا خلال موسمى ٢٠١٢ و ٢٠١٣ بقسم بحوث نباتات الزينة و تنسيق الحدائق – معهد بحوث البساتين – الجيزة.

فى هذا البحث تم دراسة تأثير مستخلصات النباتات الطبيعية مثل مستخلص (أوراق الزعتر و أوراق المورينجا) و المحاليل الكيماوية مثل ٨-هيدروكسى كينولين سترات، حمض السالسليك و السكروز كمحاليل دائمة لحفظ الأزهار مع تخزينها لفترتين (صفر يوم و ٧ أيام على درجة ٤°م لإطالة عمر أزهار الجبسوفيلا المقطوفة. و كان الهدف من الدراسة هو تحسين جودة هذه الأزهار المقطوفة و إطالة عمرها.

و إشتملت المعاملات على معاملة الماء المقطر (كنترول)، مستخلص أوراق الزعتر بتركيز ٢٥% ، مستخلص أوراق الزعتر بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر، مستخلص أوراق المورينجا بتركيز ٢٥% ، مستخلص أوراق المورينجا بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر، ٨- هيدروكسى كينولين سترات ٢٠٠ ملجم /لتر+ السكروز ٢ % +حمض السالسليك ١٥٠ ملجم/لتر.

و أوضحت النتائج المتحصل عليها ما يلى:

محاليل الحفظ الدائمة المتكونة من مستخلص أوراق الزعتر بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر، مستخلص أوراق المورينجا بتركيز ٢٥% ، مستخلص أوراق المورينجا بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر أدت ألى زيادة عمر الأزهار المقطوفة يليها المعاملة بالمحلول الكيماوى المتكون من ٨- هيدروكسى كينولين سترات ٢٠٠ ملجم /لتر+ السكروز ٢ % +حمض السالسليك ١٥٠ ملجم/لتر مقارنة بمعاملة الكنترول.

أوضحت النتائج أيضاً أن المستخلصات الطبيعية من أوراق الزعتر أو المورينجا المضاف إليها السكروز و حمض السالسليك أدت إلى زيادة النسبة المئوية للوزن الطازج و النسبة المئوية للكربوهيدرات الكلية و الماء الممتص و أدت إلى نقص الماء المفقود و حافظت على معدل الجودة للأزهار و الإتزان المائي وتقليل عدد البكتريا في المحاليل.

و بالنسبة لتأثير فترة التخزين البارد الجاف لمدة ٧ أيام أعطت نتائج جيدة بالنسبة لعمر الأزهار و الصفات الأخرى تحت الدراسة و لكن الأزهار الغير مخزنة (صفر يوم) تفوقت عليها في العديد من الصفات.

و كانت نتائج التفاعل بين محاليل الحفظ الدائمة المتكونة من المستخلصات الطبيعية و فترة التخزين لمدة صفر يوم أنها أفضل في تأثيرها على عمر الأزهار و النسبة المئوية للزيادة في الوزن الطازج للأزهار و النسبة المئوية للكربوهيدرات الكلية و الماء الممتص و الماء المفقود و الإتزان المائى و معدل جودة الأزهار.

و من هذه الدراسة يوصى بإستخدام محاليل الحفظ المحتوية على المستخلصات الطبيعية المتكونة من الزعتر بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر، مستخلص أوراق المورينجا بتركيز ٢٥% ، مستخلص أوراق المورينجا بتركيز ٢٥% + سكروز ٢% + حمض السالسليك بتركيز ١٥٠ ملجم/لتر و المخزنة لمدة صفر يوم حيث أعطت تحسن معنوى فى الصفات المدروسة مقارنة بالمعاملات الأخرى.