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THE ROLE OF SOME ORGANIC MATTERS ON THE KEEPING QUALITY AND EXTENDING THE VASE LIFE OF CARNATION (*DIANTHUS CARYOPHYLLUS* CV. AMERICA) CUT FLOWERS

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ABSTRACT: *Dianthus caryophyllus* is one of the most important produced cut flowers. The present experiment focuses on the effects of some organic matters on postharvest longevity and other related characters of *Dianthus caryophyllus* cv. America cut flowers. The obtained results emphasized that all preservative solutions caused a marked increment in the studied characters as compared to distilled water (control). In this regard, the flowers hold in the preservative solution of 2% sucrose + either garlic extract (1 ml/l) or jasmine oil (0.030%) significantly prolonged vase life, increased flowers fresh weight (%) and water uptake (cm^3), reduced the depletion of sugars content and increased anthocyanin content in the flowers. Moreover, the treatment of garlic extract (1 ml/l) + 2% sucrose increased markedly the flower diameter (cm), flower opening percentage and the other related characters. Fenugreek extract (1 g/l) + 2% sucrose affected positively on the studied characters of carnation cut flowers. Preservative solution containing 2% sucrose + either garlic extract (1 ml/l) or jasmine oil (0.030%) clearly reduced the number of bacteria and fungi in the vase solutions as compared to control or other treatments used.

Key words: Organic matters, carnation, cut flowers, vase life, microorganisms.

INTRODUCTION

Dianthus caryophyllus cv. America belongs to family Caryophyllaceae and commonly known as carnation. It is native to the Mediterranean region, these flowers are attractive and have much ornamental utilization, cut off with long stalk and picking at mature bud stage for facilitating handling, transportation and reduces damage possibilities. Picked can be done also in an earlier stage. The sensitivity of these flowers to ethylene shortens vase life as it stimulates a quick opening of flowers which may constitute a big loss to producers and traders.

Since jasmonates (Jasmine oil) were discovered in Jasmine flowers (*Jasminum grandifloum* L.) (Ueda, 1991); two effective components were determined, i.e. methyl jasmonate (MJ) and jasmonic acid (JA). Methyl jasmonate (MJ) is a natural growth regulator which induces plant defense responses. It was tested for postharvest to control the grey mould disease in various cut rose cultivars (Meir *et al*., 1998).

Garlic (*Allium sativum*) contains 0.10 – 0.36% of a volatile oil composed of sulfur-containing compounds, i.e. allicin, diallyl disulfide, diallyl trisulfide and others (Duke, 1992). Naganawa *et al.* (1996) stated that, ajoene, a garlic-derived sulfur-containing compound that prevents platelet aggregation, exhibited broad-spectrum antimicrobial activity.

Fenugreek (*Trigonella foenum-graecum* L.) contains the active constituents such as alkaloids, flavonoids, steroids, saponins etc.

The seeds are affecting as aromatic, bitter, carminative, galactogouge and antibacterial agents, containing a dietary fiber (50%) and protein (30%). The chemical components of fenugreek seeds include a large carbohydrate fraction (mucilaginous fiber, galactomannan); 20-30% proteins high in tryptophan and lysine; pyridine-type alkaloids; flavonoids; free amino acids (4-hydroxyisoleucine, arginine, lysine, histidine); saponins; glycosides; vitamins, minerals, (28%) mucilage, (22%) proteids, 5% of a stronger-smelling, bitter fixed oil and volatile oils. The seeds of the fenugreek herb possess toxic oils, and other constituents of the fenugreek leaf have been shown to be toxic to bacteria, parasites and fungi (Snehlata and Payal, 2012).

This study aims to investigate the effect of using the environmental safer materials in the keeping quality of carnation cut flowers.

MATERIALS AND METHODS

This research was carried out at the Hort. Res. Inst., ARC, Giza, Egypt, on January 1st for two successive seasons 2011 and 2012, using uniformly carnation flowers (*Dianthus caryophyllus*) cv. America, obtained at star stage (when petals emerge about 0.5 cm above the calyx) in the early morning from a commercial farm. They were placed in ice cold water for three hours and the flower stems were adjusted to 50 cm long.

The layout of the experiment was completely randomized design with three replicates per treatment; each replicate consisted of 4 flowers, i.e. 12 flowers in each treatment.

The flowers were placed in a vase (500 ml) containing 400 ml preservative solution containing:

1- Distilled water (control).

2- 8-Hydroxyquinoline citrate (8-HQC) at 200 mg/l + 2% Sucrose.

3- Jasmine oil dissolved in ethanol at the concentration of 0.030% + 2% Sucrose.

4- Fenugreek extract (filtered through Watman filter paper) at 1 g/l + 2% Sucrose.

5- Fenugreek extract (filtered through Watman filter paper) at 2 g/l + 2% Sucrose.

6- Garlic extract at 1 ml/l + 2% Sucrose.

7- Garlic extract at 2 ml/l + 2% Sucrose.

The experiment was carried out under lab conditions (24 hrs fluorescent light at 1000 Lux, 18±2˚C and 40-50% RH).

The following data had been recorded:

1- Flower vase life: the shelf life period (day) was defined as the number of days between full opening of flowers to clear enrolling and wilting of the petals.

2- Flower opening percentage was determined from star stage to complete opening stage.

3- Flower diameter (cm) was measured by vernier caliper after complete opening.

4- Flower fresh weight increase percentage.

5- Water uptake (cm^3) at the end of shelf life.

6- Bacteria counts: The samples of the vase solutions were taken at the end of shelf life period of control according to the method described by (Postage, 1969).

7- Fungi counts: The samples of the vase solutions were recorded at the end of shelf life period of control according to the method described by (Gravesen *et al*., 1994).

8- Total sugars (%) in the flowers were determined colorimetrically according to the method described by Dubois *et al*. (1956).

9- Anthocyanin (%) in the flowers was determined colorimetrically according to Husia *et al.* (1965).

Statistical analysis:

All data were subjected to statistical analysis according to the procedure reported

by Snedecor and Cochran (1989) and means were compared by Least Significant Difference (L.S.D) test at the 5% level of probability in the two seasons.

RESULTS AND DISCUSSION

1- Flower vase life:

Data presented in Table (1) exhibit that vase life was significantly increased in the two seasons by holding the flowers in all preservative solutions as compared with that held in distilled water. Moreover, the highest values of flower vase life were recorded for the flowers held in a solution of 2% Sucrose plus either garlic extract at 1 ml/l or jasmine oil at 0.030%. However, the prevalence was for garlic extract at 1 ml/l + 2% sucrose which gave the longest vase life (27.81 and 29.70 days, respectively) as compared with the other treatments in both seasons. Garlic extract at 2 ml/l + 2% sucrose has shown favorable results on vase life of the cut carnation flowers (24.68 and 25.30 days, respectively) in both seasons. Wanas *et al.* (1998) on *Cucurbita pepo* L. concluded that using garlic extract at a concentration of 50, 250 or 500 ml/l increased activity of plant growth regulators as gibberellins, auxins and cytokinins in plant leaves. Also, Shanan (2012) on *Rosa hybrida* added that cumin and geranium oils (25 mg L^{-1}) had a significant effect on prolonging the vase life of rose cut flower. In this connection, Gast (2001) on *Paeonia lactifolia* found that methyl jasmonate gave the best results for the vase life of the flowers at 8 and 10 weeks treatment.

2- Flower opening (%) and diameter (cm):

Data in Table (1) clearly indicate that the holding solutions affected significantly on the opening percentage of carnation flowers. The highest opening percentages (95.25, 93.71%, 100% and 100%) are obtained from the application, garlic extract (1 ml/l) + 2% sucrose; jasmine oil (0.030%) + 2% sucrose in the first and 2nd season, respectively. In the contrary, the lowest percentage values (61.8 and 64.7%) are recorded for control treatment in the first and 2nd season, respectively. Concerning the flower diameter, the data were similar in trend with that of flower opening percentage as affected with the different treatments. Our results are in a parallel line with those of Zaky and Amin (2013) who observed that dipping cut Calla flowers in 1 ml/l anise and Eucalyptus oils increased significantly the percentage of flower opening. Zaky and ElZayat (2008) revealed that dipping cut carnation flowers in jasmine oil at (0.015 and 0.030%) for one hour were most effective on increasing the percentage of flower opening and diameter.

3- Flowers fresh weight increase (%):

The data in Table (1) show that the percentages of fresh weight increase were affected as a result of using the holding solutions. In this connection, all holding solutions increased the percentages of flowers fresh weight compared with control which proved its superiority in the solution of garlic extract at 1 ml/l + 2% sucrose giving (6.90 and 7.17%) in both seasons. The flowers treated either with 2% sucrose + jasmine oil (0.030%) or garlic extract (2 ml/l) showed high values of flower fresh weight percentages (6.82, 6.17 and 7.04, 6.30%, respectively) in both seasons, whereas the lowest percentages of fresh weight (4.03 and 4.17%) were observed for control in both seasons. These results agreed with those of Shanan (2012) on *Rosa hybrida* cut flowers who cleared that cumin and geranium oils (25 mg L^{-1}) increased flowers fresh weight. Also, Noor El-Deen (2005) pointed out that garlic extract at 50 and 100% increased fresh weight of *Majorana hortensis* plants. Zaky and ElZayat (2008) stated that dipping of cut carnation flowers in jasmine oil (0.015 and 0.030%) for one hour were most effective on increasing flowers fresh weight percentage.

4- Water uptake:

Data in Table (1) show differences in water uptake (cm^3) of *Dianthus caryophllus* cv. America when subjected to different treatments. The data cleared that all treatments increased the water uptake which

Table 1. Effect of some organic matters as postharvest on traits of *Dianthus caryophllus* cv. America flowers during the seasons (2011 & 2012).

Treatments	Vase life (days)	Flower Opening (%)	Flower diameter (cm)	Flower fresh weight increase (%)	water uptake (cm^3)
			1st season		
Distilled water (control)	17.51	61.80	3.50	4.03	36.17
8-HQC (200 mg/l) + 2% sucrose	20.17	80.00	5.66	5.07	48.12
Fenugreek (1 g/l) + 2% sucrose	23.40	85.00	6.69	6.00	55.40
Fenugreek (2 g/l) + 2% sucrose	21.32	82.30	6.25	5.60	51.20
Jasmine oil (0.030%) + 2% sucrose	26.08	93.71	7.20	6.82	66.42
Garlic (1 ml/l) + 2% sucrose	27.81	95.25	7.69	6.90	68.52
Garlic (2 ml/l) + 2% sucrose	24.68	90.60	6.98	6.17	62.56
L.S.D. at 0.05	3.49	3.53	3.41	N.S	3.95
			2nd season		
Distilled water (control)	18.87	64.70	4.34	4.17	40.20
8-HQC (200 mg/l) + 2% sucrose	21.30	82.20	5.83	5.40	51.67
Fenugreek (1 g/l) + 2% sucrose	25.00	87.34	6.81	6.28	59.56
Fenugreek (2 g/l) + 2% sucrose	22.34	83.60	6.40	5.82	54.30
Jasmine oil (0.030%) + 2% sucrose	27.60	100.0	7.48	7.04	68.35
Garlic (1 ml/l) + 2% sucrose	29.70	100.0	7.91	7.17	70.00
Garlic (2 ml/l) + 2% sucrose	25.30	92.60	7.12	6.30	65.40
L.S.D. at 0.05	3.51	2.76	3.51	N.S	3.56

ranged between 48.12 to 68.52 in 1st season and 51.67 to 70.00 cm^3 in 2nd one more than control (36.17 and 40.20 cm^3 in both seasons). Garlic extract at 1 ml/l + 2% sucrose solution gave the highest water uptake as compared with the other treatments, which was reflected on prolonging the vase life, followed by jasmine oil (0.030%) + 2% sucrose then garlic extract (2 ml/l) + 2% sucrose in the two seasons. These results are in accordance with those of Zaky and ElZayat (2008), they found that dipping of cut carnation flowers in jasmine oil (0.015%) for one hour exhibited the highest rate of water uptake.

5- Bacteria and fungi counts:

The results of bacteria and fungi counts presented in Table (2) confirmed that the greatest bacteria and fungi counts were found by holding in control solution, followed by 8- hydroxyquinoline citrate (200 mg/l) + 2% Sucrose. On the contrary, the lowest bacteria and fungi counts were obtained with the holding solutions of either 2% sucrose + garlic extract (1 ml/l) or jasmine oil (0.030%) in both seasons. These solutions were very effective as antimicrobial agents on inhibiting the growth of microorganisms and consequently, preventing the occlusion of xylem vessels. As a result, the vase life of cut flowers continued for longer period. In this respect, Lawson *et al*. (1991) pointed out that allicin, the main thiosulphinate produced by garlic, acts as antibiotic and antimutagenic component of garlic. Naganawa *et al*. (1996) stated that, ajoene, a garlic-derived sulfur-containing compound that prevents platelet aggregation, exhibited broad-spectrum antimicrobial activity. Methyl jasmonate (MJ) is a natural growth regulator used to induce plant defense responses. It was tested for postharvest to control the grey mould disease in various cut rose cultivars (Meir *et al.*, 1998). In this regard the seeds of the fenugreek herb possess toxic oils, and other constituents of the fenugreek leaf have been shown to be toxic to bacteria, parasites and fungi (Snehlata and Payal, 2012).

Table 2. Effect of some organic matters on total counts of bacteria and fungi (Log^{10} CFU/ml) of *Dianthus caryophllus* cv. America during the seasons (2011 & 2012).

Treatment	Bacteria counts (Log^{10} CFU/ml)	Fungi counts (Log^{10} CFU/ml)
1st season		
Distilled water (control)	7.40	22.43
8-HQC (200 mg/l) + 2% sucrose	6. 33	12.06
Fenugreek (1 g/l) + 2% sucrose	6.09	8.03
Fenugreek (2 g/l) + 2% sucrose	6.15	9.08
Jasmine oil (0.030%) + 2% sucrose	5.30	7.06
Garlic (1 ml/l) + 2% sucrose	5.10	5.02
Garlic (2 ml/l) + 2% sucrose	5.56	5.72
2nd season		
Distilled water (control)	7.25	24.10
8-HQC (200 mg/l) + 2% sucrose	6. 25	13.05
Fenugreek (1 g/l) + 2% sucrose	6.14	7.76
Fenugreek (2 g/l) + 2% sucrose	6. 17	8.59
Jasmine oil (0.030%) + 2% sucrose	5.22	6. 59
Garlic (1 ml/l) + 2% sucrose	5.20	5.10
Garlic (2 ml/l) + 2% sucrose	5.42	5. 43

6- Total sugars (%) in the flowers:

Data illustrated in Fig. (1) demonstrate that all preservative solutions increased the percentage of total sugars in the flowers which proved its superiority in the treatment of garlic extract at 1 ml/l + 2% sucrose, whereas the least percentage of total sugars was obtained from control in both seasons. This may be due to the reduction in respiration and metabolic rate of the flowers. Moreover, the treatment of 2% sucrose + jasmine oil (0.030%) came in the following category after garlic extract (1 ml/l) in their effects values of the total sugars percentage in both seasons. However, fenugreek extract (1 g/l) + 2% sucrose has shown favorable effect on total sugars percentage of the cut carnation flowers in both seasons. These results are in line with those of Zaky and ElZayat (2008), they stated that dipping of cut carnation flowers in jasmine oil (0.015 and 0.030%) for one hour was most effective on increasing total sugars percentage. Also, Noor El-Deen (2005) found that garlic extract at 50 and 100% increased carbohydrate content.

7- Anthocyanin content in the flowers:

Data illustrated in Fig. (2) show that the control treatment of *Dianthus caryophyllus*, cv. America flowers was less effective on increasing anthocyanin (%) as compared with all tested vase solutions during the two successive seasons. Treating the flowers with 2% sucrose + either garlic extract (1 ml/l) or jasmine oil (0.030%) increased anthocyanin content in the flowers as compared with the other treatments, giving the highest content with garlic extract (1 ml/l) + 2% sucrose in the two seasons. In this respect, the flowers treated with the preservative solution of fenugreek extract (1 g/l) + 2% sucrose has shown desired results on increasing anthocyanin content in both seasons. The above mentioned results coincided with those of El-Desouky *et al*. (1998) who found that soaking squash (*Cucurbita pepo* L) seeds in garlic extract at the concentration of 50, 250 or 500 ml/l increased chlorophyll's (a and b), carotenoids content.

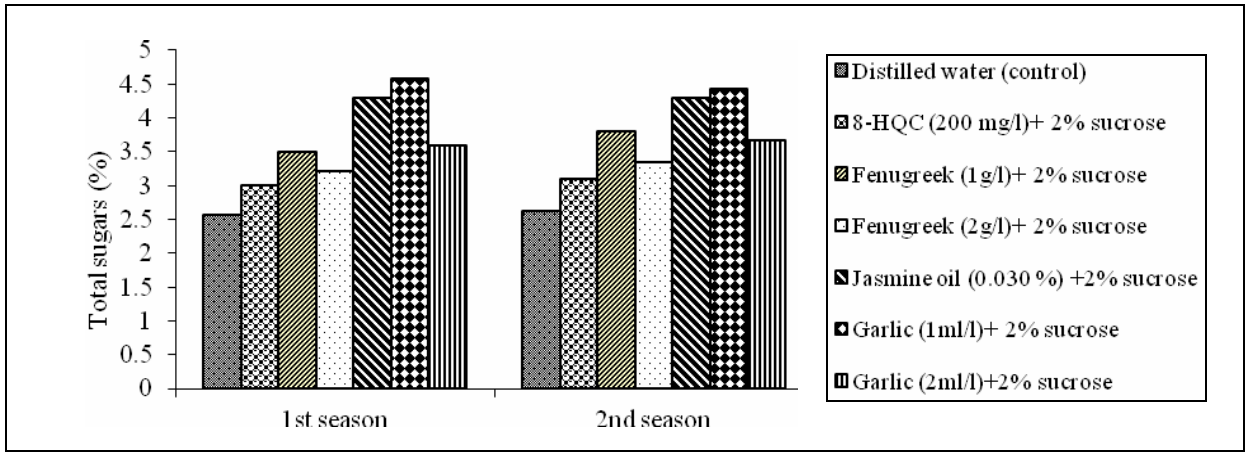

Fig. 1. Effect of some organic matters on total sugars percentage in the flowers of *Dianthus caryophllus* cv. America during the seasons (2011&2012).

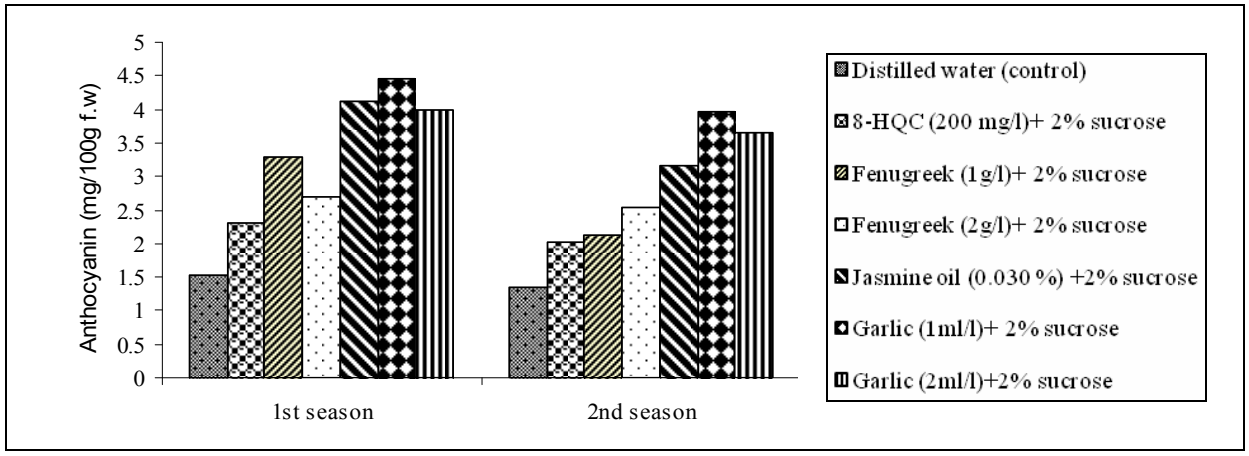

Fig. 2. Effect of some organic matters on anthocyanin (mg/100g f.w.) in flowers of *Dianthus caryophllus* cv. America during the seasons (2011&2012).

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دور بعض المواد العضوية في الحفاظ على جودة وإطالة عمر أزهار القرنفل المقطوفة (*Dianthus caryophyllus*) صنف "America"

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أجرى هذا البحث في معمل بحوث تداول الزينة بمعهد بحوث البساتين خلال موسمي ٢٠١١ و٢٠١٢ وذلك بهدف دراسة تأثير بعض محاليل الحفظ على زيادة عمر وجودة أزهارا القرنفل المقطوفة (*Dianthus caryophyllus*) صنف 'America'.

وقد أظهرت النتائج الأتي :

- أدت كل محاليل الحفظ المستخدمة إلى زيادة ملحوظة في كل الصفات المدروسة مقارنة بالكنترول (الماءالمقطر).
- أدت معاملة حفظ أزهار القرنفل المقطوفة في محلول الفازة المكون من مستخلص الثوم (١ مل/ لتر) + ٢% سكروز وزيت الياسمين (٠,٠٣٠%) + ٢% سكروز إلى زيادة معنوية في عمر الأزهار وزيادة الوزن الطازج لها (%) وكذلك حجم المحلول (سم^{٣}) وكانت الأكثر تأثيراً في خفض إستهلاك السكريات وزيادة محتوى الأزهار من صبغة الأنثوسيانين بالمقارنة بالمعاملات الأخرى.

- كانت معاملة غمس أزهار القرنفل المقطوفة في المحلول المكون من مستخلص الثوم (١ مل/ لتر) + ٢% سكروز أكثر تأثيراً في زيادة قطر الأزهار(سم) وزيادة نسبة تفتحها.
- أشارت النتائج إلى أن معاملة محلول الفازة المكون من مستخلص الحلبة (١ جم/لتر) + ٢% سكروز كان له أثراً متميزاً على زيادة الصفات المدروسة لأزهار القرنفل المقطوفة.

تفوقت معاملة حفظ أزهار القرنفل المقطوفة في محلول الفازة المكون من مستخلص الثوم (١ مل/ لتر) + ٢% سكروز وزيت الياسمين (٠,٠٣٠%) + ٢% سكروز في تأثيره على تقليل عدد البكتيريا والفطريات في محلول الفازة مقارنة بالكنترول أوالمعاملات الأخرى.