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# Extending the Vase Life of Carnation with Different Preservatives

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**Abstract:** In this research were analyzed effects of different concentrations of 5-sulfosalicylic acid (5-SSA), essential oil of Thyme (*Thymus vulgaris*) (EOs) and silver nitrate ($AgNO_3$) on extending carnation (*Dianthus caryophyllus*) vase-life. For this purpose trial were conducted using a factorial test based on completely randomized design with six replications. The treatments of this experiment consisted of 5-SSA (1, 2, 3,4 and 5 mM), essential oils *Thymus vulgaris* (50,100,150 and 200 mg $L^{-1}$) and silver nitrate ($AgNO_3$) (0, 1.5, 2, 2.5 and 3 mM). Evaluated traits consisted of flower longevity, ACC-oxidase activity (ACO), anthocyanin leakage, microbial population, SPAD value, water uptake, superoxide dismutase (SOD) activity, Assays of MDA content. Results of this experiments showed that the microbial population of vase solution which treated with essential oils *Thymus vulgaris* and 5-sulfosalicylic acid were lower than other treatments. ACC-oxidase activity, anthocyanin leakage and the vase life of cut flowers significantly affected by 5-sulfosalicylic acid treatment, in comparison with control so that this treatment had better effect than control. It is distinguished that silver nitrate treatment had the best effect on fresh weight (%), followed by 5-sulfosalicylic acid treatment, respectively.

**Key words:** Carnation, 5-sulfosalicylic acid, essential oils, silver nitrate, vase life, malondialdehyde, ACC-oxidase activity, superoxide dismutase

## INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) is an important cut flower in the world. Carnation is a climacteric flower that is highly sensitive to ethylene (Pun *et al*., 1999). Ethylene antagonists inhibit the action of ethylene at the molecular level by blocking its receptor site (Woodson *et al*., 1992; Woltering *et al*., 1993; Sisler *et al*., 2003; El-Tayeb *et al*., 2006; Ansari and Misra, 2007; Mba *et al*., 2007; Mahdavian *et al*., 2007; Canakci, 2008; Karlidag *et al*., 2009). SA is a phenol that acts as a potential non-enzymatic antioxidant as well as plant growth regulators and plays an important role in regulating a number of plant physiological processes including photosynthesis (Abdou *et al*., 2001; Shakirova *et al*., 2003; Sawada *et al*., 2006; Munne-Bosch *et al*., 2007). Kazemi *et al*. (2011b) showed that SA could extend the vase life of cut flowers by decreasing ROS and ethylene. Addition of bactericides and fungicides in vase solution improved the vase life of cut flowers. Essential oils have many therapeutic and they aid the distribution of drugs and antiseptics. Their most important characteristics are their anti-infection, antimicrobial, antifungal and antioxidative effects (Deans and Ritchie, 1987; Deans *et al*., 1993; Teissedre and Waterhouse, 2000). In this study, we investigated the effects of essential oil as safe preservative solutions, 5-sulfosalicylic acid (5-SSA) and silver nitrate ($AgNO_3$) on flower longevity, ACC-oxidase activity, anthocyanin leakage, microbial population and SPAD value as a measure of leaf greenness in postharvest of carnation flowers.

## MATERIALS AND METHODS

**Plant material and storage conditions:** Cut flowers (*Dianthus caryophyllus* L. cv. Pink) were harvested before blooming in the morning from a local commercial greenhouse (Pakdasht, Tehran, Iran) and transported with appropriate covers (in plastic packages) immediately to Laboratory. The flowers were then kept in a controlled room under the following conditions: 12 h photoperiod at a photo synthetically activated radiation of 850 lux, provided by fluorescent lamps, constant temperature of

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19±2°C and relative humidity of 60±10% . In this study five levels of 5-SSA (1, 2, 3, 4 and 5 mM), four levels of essential oils of Thyme (*Thymus vulgaris*) (EOs) (50,100,150 and 200 mg $L^{-1}$), five levels of silver nitrate ($AgNO_3$) (0, 1.5, 2, 2.5 and 3 mM) were applied on carnation cut flowers. In the first of experiment chlorophyll content, Membrane stability, MDA content and ACC-oxidase activity were measured. Evaluated traits consisted of flower longevity, ACC-oxidase activity, anthocyanin leakage, microbial population, SPAD value, water uptake, superoxide dismutase activity, assays of MDA content. Vase life was determined as the number of days to wilting of flowers. The flowers were checked once a day for signs of deterioration. Chlorophyll index was measured by chlorophyll meter (SPAD-502, Minolta Co. Japan), which is presented by SPAD value. Average of 3 measurements from different spots of a single leave was considered. Anthocyanin leakage was measured based on the method of Poovaiah (1979). Malondialdehyde content was measured based on the method of Heath and Packer (1968). The water uptake was calculated by subtracting the mean volume of water evaporated from three control bottle without cut flowers, from the amount of water decreased in bottles containing flowers in experimental course. The activity of superoxide dismutase was measured based on the method described by Beauchamp and Fridovich (1971). Microbe population was isolated from vase solutions of carnation by measuring to the method described by Zagory and Reid (1986). Experiment was arranged in a factorial test based on completely randomized complete design with 6 replications. Analysis of variance was performed on the data collected using the General Linear Model (GLM) procedure of the SPSS software) Version 16, IBM Inc.). The mean separation was conducted by Tukey analysis in the same software ($p = 0.05$).

## RESULTS AND DISCUSSION

Water uptake and Microbe population were affected by 5-sulfosalicylic acid (5-SSA), essential oils of Thyme (*Thymus vulgaris*) (EOs) and silver nitrate ($AgNO_3$) ($p = 0.05$). Water uptake decreased rapidly in distill water (control), while flowers in the solutions containing 5-SSA showed the minimum decrease in water uptake rate from 15 days ($p = 0.05$) (Table 1). 5-SSA, $AgNO_3$ and EOs concentration affected on the microbial population in vase solution of carnation cut flowers significantly, the microbial population decreased with the increase in concentrations of 5-SSA, $AgNO_3$ and EOs ($p = 0.05$) (Table 1). Anjum *et al.* (2001) reported Adding a suitable germicide in vase water can prevent the growth of microbes and increased water uptake. Kazemi and Shokri (2011) showed that the treatment of salicylic acid reduced microbial population in vase solution of carnation cut flowers and increased Water uptake in carnation cut flowers also 5-SSA seems to act by germicide the decrease of microbial population. Essential oils treatment had significant effect on Anthocyanin leakage and ACO activity cut flowers, in comparison with control ($p = 0.05$) (Table 1). Anthocyanin leakage and ACO activity and the vase life of cut carnation significantly affected by 5-SSA and silver nitrate, in comparisons with control ($p = 0.05$). It is distinguished that 5-SSA and silver nitrate treatments

Table 1: Mean comparisons of chlorophyll content, vase life, MDA, SOD activity, membrane stability and ACC-oxidase activity in $AgNO_3$, 5-SSA, EOs treatments

| Treatment | | Vase life (day) | Total chlorophyll (SPAD reading) | ACC-oxidase activity (nmol $h^{-1}$ $mL^{-1}$) | Anthocyanin leakage (absorption at 525 nm) | MDA (µmol $mg^{-1}$ protein) | Water uptake (mL $flower^{-1}$) | Superoxide dismutase (U $g^{-1}$ Protein) | Colony count (CFU$mL^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| Control | 5 | 2.3 | 112.23 | 201.5 | 255.32 | 75 | 113.21 | 110 | |
| $AgNO_3$ (mM) | 1 | 5 | 2 | 109 | 165 | 201.25 | 80 | 121.45 | 87 |
| | 1.5 | 5.5 | 2.33 | 103.36 | 143.21 | 164.25 | 80 | 125 | 80 |
| | 2 | 6 | 2.01 | 101 | 123.85 | 147.89 | 90 | 136.21 | 76 |
| | 2.5 | 6 | 2 | 95.36 | 118 | 130 | 95 | 139 | 70 |
| | 3 | 10 | 2.9 | 76.3 | 97 | 121.3 | 100 | 145.23 | 63 |
| 5-SSA (mM) | 1 | 7 | 3 | 94.25 | 109.96 | 119.86 | 100 | 130.15 | 67 |
| | 2 | 7.5 | 4.12 | 86.36 | 76.32 | 92.3 | 115 | 156.36 | 60 |
| | 3 | 8 | 4.63 | 74.12 | 54.23 | 85.63 | 125 | 187.98 | 55 |
| | 4 | 9 | 5 | 60.36 | 50.12 | 76.3 | 125 | 200.1 | 50 |
| | 5 | 15 | 6.12 | 55 | 43.12 | 49.91 | 155 | 210 | 43 |
| EOs (mg $L^{-1}$) | 50 | 6 | 2 | 123.3 | 179.36 | 200 | 95 | 99.14 | 76 |
| | 100 | 8 | 2.03 | 110 | 167.45 | 186.35 | 100 | 100 | 70 |
| | 150 | 8 | 2.78 | 100 | 150.23 | 142.35 | 105 | 106.32 | 63 |
| | 200 | 10 | 2.9 | 96.56 | 152.06 | 130 | 115 | 118 | 52 |
| **F-test probabilities** | | | | | | | | | |
| $AgNO_3$ | | 0 | 0.1 | 0.02 | 0.02 | 0.05 | 0.01 | 0 | 0.05 |
| 5-SSA | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EOs | | 0 | 0.1 | 0.7 | 0.1 | 0.1 | 0.03 | 0 | 0.1 |

had the best effect on Anthocyanin leakage and ACO activity. Similarly, Kazemi *et al.* (2011a) that treatment with salicylic acid significantly extends the vase life with reduced the anthocyanin leakage and ACO activity. It's thought that SA can decrease respiration through inhibition of ethylene biosynthesis or action (Srivastava and Dwivedi, 2000). Salicylic acid also caused decrease in respiration rate and fruit weight losses by closing stoma (Zheng and Zhang, 2004). The treatment 5-SSA lead to a considerable delay in degradation of chlorophyll total compared to other concentrations and control ($p = 0.05$) (Table 1). Chlorophyll content decreased in present cut flower in solutions containing silver nitrate and EOs while flowers in the solutions containing 5-SSA concentration showed the minimum decrease in chlorophyll content from 15 days ($p = 0.05$) (Table 1). Essential oils and silver nitrate treatments had not significant effect on chlorophyll content cut flowers, in comparison with control ($p = 0.05$) (Table 1). The cut flowers were treated with 5-SSA, Significantly decreased and increased in malondialdehyde MDA content and SOD activity ($p = 0.05$) (Table 1). Under the effect of 5-SSA concentration increased SOD activity and decreased accumulation MDA significantly in compared to control ($p<0.05$). The results indicate that the treatment 5-SSA improved membrane permeability by increasing SOD activity and decrease accumulation MDA in compared to control ($p = 0.05$). Superoxide dismutase activity were not affected by Essential oils and silver nitrate treatments. The protective function of SA includes the regulation of ROS and antioxidant enzymes (Khan *et al*., 2003; Shi and Zhu, 2008). Similarly, Kazemi *et al.* (2011c) and Kazemi and Shokri (2011) showed that pretreatment with SA decreased the level of lipid peroxidation induced by paraquat oxidative stress in cut flowers. The results of this study were in agreement with those of previous studies which showed that addition of 5-SSA, EOs and silver nitrate in holding solution had positive effect on vase life and quality of cut flowers; for example, Fariman and Tehranifar (2011) showed that EOs containing solution showed maximum beneficial effects on longevity of cut carnation flowers. Similarly, Kazemi *et al.* (2011a) that treatment with salicylic acid significantly extends the vase life. Positive efficacy of 5-SSA and essential oils in this study could be attributed to their antimicrobial activity that act as biocide in the holding solution and reduce the bacterial population in the vase solution of cut flowers and as a result increase the vessels conductivity, water uptake and longevity of cut flowers. In this study, 5-SSA, silver nitrate and essential oils had positive effect in vase life and quality properties of cut carnation flowers.

## CONCLUSION

In conclusion, present results showed that application of 5-SSA, silver nitrate and essential oils could be useful for preservative to increase of vase life and quality of cut carnations flowers.

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