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RESEARCHARTICLE

Extending of vase life of *Narcissus tazetta* by AVG and antimicrobial agents

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ABSTRACT

The study was carried out to determine the effect of Aminoethoxyvinylglycine (AVG) (10 and 5 ppm), salicylic acid (SA) (100 ppm) and citric acid (CA) (100 ppm) applications on vase life, relative fresh weight, daily water uptake and total water uptake (100 ppm) of narcissus (*Narcissus tazetta* L.) cut flower. In the research, the longest vase life was obtained from 5 ppm AVG application with 12 days. In addition, 10 ppm AVG and 100 ppm citric acid applications significantly increased vase life compared to control. Fresh weight, daily water uptake and total water uptake were significantly higher in AVG (10 and 5 ppm) applications compared to other applications. As a result, it was determined that AVG has a positive effect on vase life of *Narcissus tazetta* flower.

Keywords: Aminoethoxyvinylglycine, antimicrobial, cut flower, ethylene, senescence

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INTRODUCTION

Narcissus (*Narcissus tazetta*) is a bulbous plant belonging to the family *Amaryllidacea* that blooms in mid-winter and early spring (Mathew, 2002). Narcissus has a significant place among ornamental plants as it can be used outdoors and indoors and as cut flowers. Narcissus attracts the attention of consumers with its color, appearance and fragrance. It is a significant plant for the use of cut flowers as it flowers in autumn and winter (Hunter and Reid, 2001; Dole and Wilkins, 1999). However, the short vase life is one of the major problems of narcissus cut flower. It has been reported that endogenous ethylene has a significant effect on the shortening of vase life of narcissus flower. Ichimura and Goto, 2002; Hunter et al., 2004). In addition, narcissus flowers are very sensitive to vascular blockages and the inhibiting of water uptake caused by bacteria developing in the vase solution (Van Doorn, 1998). The maintaining of the market value of cut flowers, one of the most significant products of the flower industry, depends on their maintaining of their post-harvest quality and freshness. As soon as the flowers leave from the mother plant, the factors that accelerate senescence become activity. Therefore, the way to preserve the quality and freshness of cut flowers for a long time is to stop or delay these factors (Edrisi, 2009; Rahemi, 2011). One of the factors limiting vase life of cut flowers by accelerating their senescence is ethylene hormone (Lima et al., 2013). Ethylene hormone is synthesized in plant tissues by 1-aminocyclopropane-1-carboxylic acid (ACC) (Yoon, 2015). Aminoethoxyvinylglycine (AVG) delays ACC synthesis (Agarwal et al., 2012) and increases vase life of cut flowers by decreasing the endogenous ethylene level (Baker et al., 1977; 1982). In the studies conducted, the effects of AVG on different species of cut flowers were

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investigated and it was determined that it had positive effects (Mapeli et al., 2009; Shimizu-Yumoto ve Ichimura, 2010; Pun et al., 2016). Another factor that accelerates the senescence of cut flowers and decreases vase life is the microorganisms that grow and reproduce in vase solution and flower stem. Since microorganisms cause vascular blocking in the flower stems, they reduce water uptake of flowers. (Van Doom and Perik, 1990; Kazemi et al., 2010).

The different components are used to prevent the growth and development of microorganisms (Halevy and Mayak, 1981; Solgi et al., 2009; Soad et al., 2011). Salicylic acid (SA), a natural hormone, plays a significant role in increasing the resistance of plants to biotic and abiotic stresses. (Mayak and Halevy, 1980). In addition, it has been determined that SA suppress ethylene biosynthesis (Leslie and Romani, 1988; Srivastava, 2000; Zheng and Zhang, 2002). SA lowers the pH of the water and thus prevents the growth of bacteria in vase solution. (Raskin, 1992; Popova et al., 1997; Bleeksma and van Doom, 2003). In studies, it was determined that SA was an effective biocide in increasing vase life of the different cut flower species (Kazemi et al., 2012; Vahdati et al., 2012; Kazaz et al., 2017; Bayat and Aminifard, 2017).

Citric acid (CA), which is an organic acid found in plants, has the ability to acidify water. Due to this feature, it reduces vascular blocking in flowers by preventing microorganisms developing in vase solution and the stems of cut flowers (Dole and Wilkins, 2005). In studies, it has been determined that CA has a positive effect on vase life of the different cut flower species (Jowkar, 2006; Hasanpour Asil and Hasani, 2012; Vahdati et al., 2012; Kazaz et al., 2017). In some studies, it has been reported that narcissus flowers are sensitive to endogenous ethylene and that its senescence accelerates with ethylene. In the literature, the studies investigated the effect of AVG, an ethylene biosynthesis inhibitor, on vase life of narcissus flowers are quite limited. In our study, it was aimed to determine the effects of AVG, which is ethylene inhibitor, and salicylic acid and citric acid biocides on vase life of narcissus cut flower.

MATERIALS AND METHODS

In the experiment, *Narcissus tazetta* species, which grows naturally in Ordu, Persembe district, was used as plant material. The cut narcissus flower was harvested by hand at the goose-neck stage on December month in 2018 years. In the study, 75 narcissus flowers were used in total. The harvested flowers were transferred to Ordu University, Faculty of Agriculture, Horticulture Department, Post-Harvest Physiology Laboratory within 1 hour. The new cutting was made from the lower part of the stem to be approximately 35 cm. length of the flower stem. Then the flowers were put in vases containing pure water (T1), 100 ppm salicylic acid (SA) (T2) (Sigma- Aldrich, Turkey), 100 ppm citric acid (CA) (T3) (Sigma- Aldrich, Turkey), 10 ppm Aminoethoxyvinylglycine (AVG) (T4) and 5 ppm Aminoethoxyvinylglycine (AVG) (T5) solution (Table 1). While the vase solution was preparing, the pure water was used in all applications. The vase life trial was conducted under conditions of 21 ± 1 ° C and 65 ± 5% relative humidity. The parameters such as vase life, relative fresh weight, water uptake and total water uptake in the flowers were investigated. The measurements were performed in 3 day intervals. The experiment was designed with 3 replications and 5 flowers were used in each repetition.

Table 1: Treatments in This Experiment

Treatments	
T1	Distilled water
T2	100 ppm salicylic acid (SA)
T3	100 ppm citric acid (CA)
T4	10 ppm AVG
T5	5 ppm AVG

Vase life (days): It was determined as the number of days passed from the day when the flowers are placed in the vase until the day 50% of the petals wilting (Alipur et al., 2013).

Relative fresh weight (RFW %) = (At / At = 0) x100 (He et al., 2006). A_t: weight of stem (g) at t = day (eg 1, 3, 6 etc.) $A_{t=0}$: weight of the same stem (g) at t=day 0.

Daily water uptake (DWU) = S_{t-1}-S_t (He et al., 2006). S_{t-1} = the weight of the vase solution for the previous day, S_t= the weight of the vase solution on day t (eg 1, 2, 3, etc.).

Total Water Uptake (TWU) = Refers to the total daily water uptake at the end of the vase life.

At the result of the control done, the descriptive statistics of the data fulfilling the conditions were calculated and evaluated with variance analysis. After the data obtained were analyzed with analysis of variance (ANOVA), the level of significance between treatments was determined by Tukey's multiple comparison test. Statistical analyzes was done in MINITAB 17 package program. The significance level of statistical analyzes and interpretation of the results was taken into account as α = 5%

RESULTS

Vase life

The significant differences between applications on the vase life of the narcissus cut flower are presented in Figure 1. The longest vase life was obtained from T5 application with 12 days. T5 application increased the vase life by approximately 30% compared to the control. In addition, the vase life of T3 and T4 applications with 11 days was longer than the control. The shortest vase life was obtained from T2 application with 6.3 days.

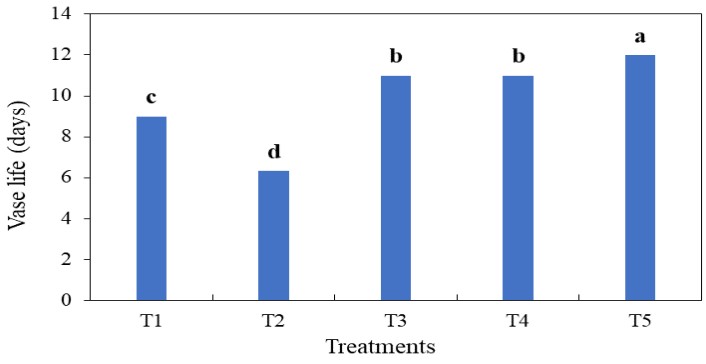

Figure 1: Effect of different treatments on vase life of narcissus flower.

Relative fresh weight

The effects of the different vase solutions on the relative fresh weight of the narcissus cut flower during the vase life are shown in Figure 2. The increase in fresh weight has been occurring until the 3rd day of the vase life in all other applications except T3 application. The highest fresh weight was obtained from T4 application with 111.2%, followed by T5 with 106.8%. In addition, the fresh weights of T4 and T5 applications did not fall below their initial weights during the vase life. Generally, all applications

had a higher fresh weight than the control during the vase life. Although T2 application was effective in increasing of the fresh weight, the fresh weight loss was happening faster.

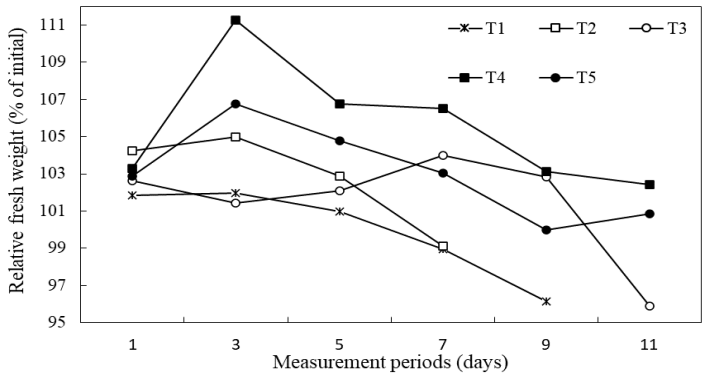

Figure 2: Effect of different treatments on relative fresh weight of narcissus flower during vase life.

Total water uptake

In total water uptake, the significant differences were found between applications (Figure 3). At the end of the vase life, the highest total water uptake was in T4 (10 ppm AVG) application with 10.7 g stem^{-1} day^{-1}, while the lowest was in T2 application with 2.0 g stem^{-1} day^{-1}. In T5 and T3 applications, higher total water uptake occurred with 9.6 and 6.4 g stem^{-1} day^{-1} compared to the control (5.7 g stem^{-1} day^{-1}), respectively.

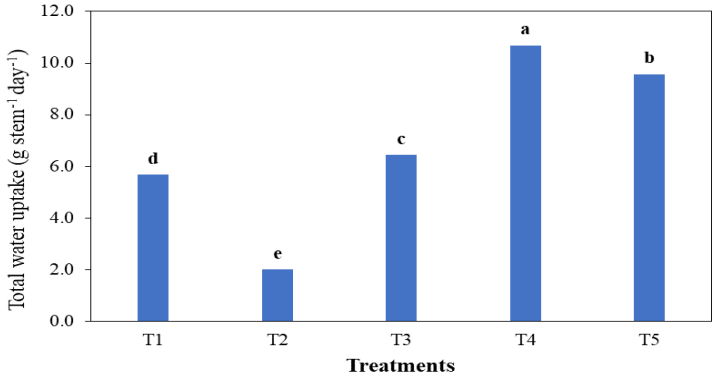

Figure 3: Effect of different treatments on total solution uptake of narcissus flower.

Daily water uptake

In daily water uptake, the significant differences between applications have been determined (Figure 4). Generally, the daily water uptake tended to increase in all applications during vase life. The highest daily water uptake was obtained on the 11th day of vase life from 2.61 and 2.65 g stem^{-1} day^{-1} and T4 and T5 applications, respectively. During vase life, the daily water uptake was higher in T4 and T5 applications compared to control, while T2 and T3 applications were lower.

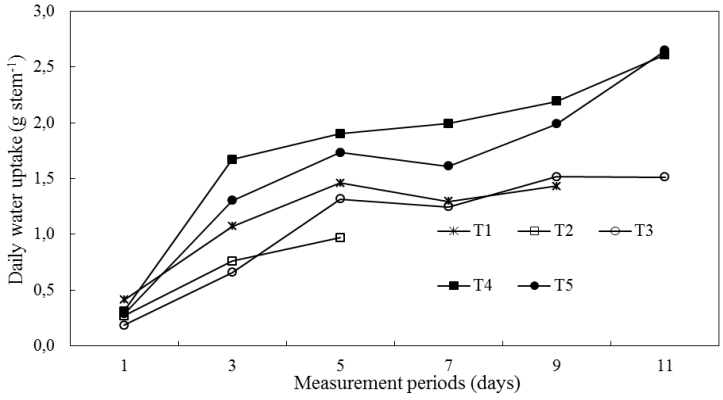

Figure 4: Effect of different treatments on daily water uptake of narcissus flower during vase life

DISCUSSION

The vase life of cut flowers is affected by 2 factors, these are ethylene that accelerates the senescence of cut flowers and microorganisms that cause the vascular blocking and reduce the water uptake. (Halevy, 1976; Van Doorn et al., 1994; Zencirkıran, 2010). Endogenous ethylene plays a role in the senescence of the narcissus flower and limits vase life (Hunter et al., 2004). In our study, AVG (10 and 5 ppm), which is an ethylene blocker, significantly increased vase life of narcissus flower. The longest vase life was obtained with 12 days at a dose of 5 ppm AVG. Similarly, it was determined that AVG application increased vase life of carnation (Pun et al., 2016; Tanase et al., 2008), eustoma (Shimizu-Yumoto and Ichimura, 2010) ve cut orchid (*Epidendrum ibaguense*) (Mapeli et al., 2009). In addition, in our study, the fresh weight and water uptake of AVG applied flowers were higher in parallel with their vase life. Indeed, Tanase et al. (2008) obtained similar results in carnation flower with AVG application. Shimizu-Yumoto and Ichimura, (2010) reported that AVG increased vase life of the ethylene-sensitive cut flowers (such as carnation) by suppressing ethylene production. In our study, it is thought that AVG application has a similar effect on narcissus flowers. In addition, in other studies, it has been determined that STS, which are an ethylene blocker, has a significant effect on increasing vase life the different narcissus species (Ichimura and Goto, 2002; Roein et al., 2009; Gul and Tahir, 2013).

Bacteria that grow and reproduce in vase solution cause vascular blocking and thus decrease vase life by reducing water uptake. In this respect, narcissus flower is very sensitive to bacteria that grow in vase solution (Van Doorn, 1998). Acidic components such as CA increase the water uptake of cut flowers by preventing bacterial growth and accumulation in the vase solution (Alaey et al., 2011; Monsouri, 2012).

In studies conducted, the application of the different doses of CA (100, 200 and 300 mg / L) increased vase life in parallel to the increase in fresh weight and water uptake of narcissus (Bayat and Aminifard, 2018) and rose (Kazaz et al., 2017). In our study, the effect of the CA application on narcissus flower was similar. As a matter of fact, 100 ppm CA increased the fresh weight and water uptake of the narcissus flower and increased vase life by about 23%. In other studies, CA had a similar effect on vase life of the different cut flower species (Asil and Hasani, 2012; Vahdati et al., 2012; Sheikh et al., 2014).

SA inhibits ethylene synthesis in cut flowers and bacterial growth in vase solution (Kazemi et al., 2012). In previous studies, SA increased vase life of the different cut flower species (Marandi et al., 2011; Mansouri, 2012; Soleimany-Fard et al., 2013; Langroudi et al., 2020; Kazaz et al., 2017). However, contrary to these findings, in our study, SA application decreased vase

life of narcissus flower. Van Doom and Perik (1990) and Knee (2000) reported that the biocides used in vase solution may reduce vase life by causing toxic effects on cut flowers depending on their dose. It is thought that the result obtained from SA application in our study is similarly due to the applied dose. Indeed, Sardoei et al. (2013) reported that SA application reduced water uptake and fresh weight of narcissus flower. In another study, it has been found that SA has no significant effect on vase life of the cut sunflower and water uptake is lower (Kılıç et al., 2020). Also, Kazemi et al. (2012) reported that lower doses of SA were more effective in carnation flower. As a result, it has been revealed that AVG can be used as a biocide in vase solution to increase vase life of narcissus.

REFERENCES

Agarwal, G., Choudhary, D., Singh, V. P. and Arora, A. 2012. Role of ethylene receptors during senescence and ripening in horticultural crops. Plant Signaling & Behavior, 7(7), 827-846.

Alaey, M., Babalar, M., Naderi, R. and Kafi, M. 2011. Effect of pre-and postharvest salicylic acid treatment on physio-chemical attributes in relation to vase-life of rose cut flowers. Postharvest Biology and Technology, 61(1), 91-94.

Alipur, S., Farahmand, H., Nasibi, F. and Kamyab, A. 2013. Effect of antioxidant compounds arginine, sodium nitroprusside, putercine and proline on vase life, and activity of several enzymes in ionic liquids narcissus flower. Iranian Horticultural Science and Technology.14(4): 415-426

Baker, J.E., Wang, C.Y., Lieberman, M. and Hardenburg, R. 1977. Delay of senescencein carnations by rhizobitoxine analog and sodium benzoate. American Society for Horticultural Science 12,38–39.

Baker, J.E., Anderson, J.D., Adams, D.O., Apelbaum, A. and Lieberman, M. 1982. Biosynthesis of ethylene from methionine in aminoethoxyvinylglycine- resistant avocado tissue. Plant Physiol. 69 (January), 93–97.

Bayat, H. and Aminifard, M. H. 2017. Salicylic acid treatment extends the vase life of five commercial cut flowers. Electronic Journal of Biology, 13(1), 67-72.

Bayat, H. and Aminifard, M. H. 2018. Effects of Different Preservative Solutions on Vase Life of. Journal of Ornamental Plants, 8(1), 13-21.

Bleeksma, H. C. and van Doom, W. G. 2003. Embolism in rose stems as a result of vascular occlusion by bacteria. Postharvest Biology and Technology, 29(3), 335-341.

Dole, J. M. and Wilkins, H. F. 1999. Floriculture: principles and species. Prentice. p.287

Dole, M. and Wilkins, H. 2005. Floriculture: principles and species. Prentice-Hall. Inc. Upper Saddle River, USA.

Edrisi, B. 2009. Postharvest physiology of cut flowers. Payam-e Digar Publication. Arak, Iran. 150 pages. (In Persian)

Gul, F. and Tahir, I. 2013. An effective protocol for improving vase life and postharvest performance of cut *Narcissus tazetta* flowers. Journal of the Saudi Society of Agricultural Sciences, 12(1), 39-46.

Halevy, A. H. 1976. Treatments to improve water balance of cut flowers. In Symposium on Production of Potted Plants and Cut Flowers, 64 (pp. 223-230), (August).

Halevy, A. H. and Mayak, S. 1981. Senescence and postharvest physiology of cut flowers-part 11. Horticulture Review, 3, 59-143.

Hasanpour, Asil, M. and Hasani, M. R. 2012. Effects of various chemical compounds on vase life of cut gladiolus flower. Horticultural Science (Agricultural Science and Technology), 2, 132-140.

He, S., Joyce, D. C., Irving, D. E. and Faragher, J. D. 2006. Stem end blockage in cut Grevillea 'Crimson Yul-lo' inflorescences. Postharvest Biology and Technology, 41(1), 78-84.

Hunter, D. A. and Reid, M. S. 2000. Senescence-associated gene expression in narcissus 'Dutch master'. In IV International Conference on Postharvest Science 553 (pp. 341-344).

Hunter, D. A., Yi, M., Xu, X., and Reid, M. S. 2004. Role of ethylene in perianth senescence of daffodil (*Narcissus pseudonarcissus* L. 'Dutch Master'). Postharvest Biology and Technology, 32(3), 269-280.

Ichimura, K. and Goto, R. 2002. Extension of vase life of cut *Narcissus tazetta* var. chinensis flowers by combined treatment with STS and gibberellin A3. Journal of the Japanese Society for Horticultural Science, 71(2), 226-230.

Jowkar, M. M. 2006. Water relations and microbial proliferation in vase solutions of *Narcissus tazetta* L. cv. 'Shahla-e-Shiraz' as affected by biocide compounds. The Journal of Horticultural Science and Biotechnology, 81(4), 656-660.

Kazaz, S., Ergür, E. G., Kiliç, T. and Seyhan, S. 2017 (July). Effects of some preservative solutions on the vase life of cut rose flowers. In VII International Symposium on Rose Research and Cultivation 1232 (pp. 93-98).

Kazemi, M., Hadavi, E. and Hekmati, J. 2010. The Effect of Malic Acid on the Bacteria Populations of cut flower of carnation vase solution. World Applied Sciences Journal, 10(7), 737-740.

Kazemi, M., Hadavi, E. and Hekmati, J. 2012. Effect of salicylic acid, malic acid, citric acid and sucrose on antioxidant activity, membrane stability and ACC-oxidase activity in relation to vase life of carnation cut flowers. Journal of Agricultural Technology, 8(6), 2053-2063.

Kılıç, T., Kazaz, S., Şahin, E. G. E., and Uran, M. 2020. Extension of the vase life of cut sunflower by different vase solutions. Ornamental Horticulture, 26(1), 45-50.

Knee, M. 2000. Selection of biocides for use in floral preservatives. Postharvest Biology and Technology, 18(3), 227-234.

Langroudi, M. E., Hashemabadi, D., KalateJari, S. and Asadpour, L. 2020. Effects of silver nanoparticles, chemical treatments and herbal essential oils on the vase life of cut alstroemeria (*Alstroemeria* 'Summer Sky') flowers. The Journal of Horticultural Science and Biotechnology, 95(2), 175-182.

Lima, J. D., Moraes, W. S. and Silva, C.M. 2008 Tecnologia pós-colheita de flores de corte. Revista Brasileira de Horticultura Ornamental, 14(1), 29-34

Leslie, C. A. and Romani, R. J. 1988. Inhibition of ethylene biosynthesis by salicylic acid. Plant physiology, 88(3), 833-837.

Mapeli, A. M., Finger, F. L., Oliveira, L. S. D. and Barbosa, J. G. 2009. Extending vase life of cut *Epidendrum ibaguense* inflorescences with aminoethoxyvinylglycine. Pesquisa Agropecuária Brasileira, 44(3), 258-262.

Mansouri, H. 2012. Salicylic acid and sodium nitroprusside improve postharvest life of chrysanthemums. Scientia Horticulturae, 145, 29-33.

Marandi, R. J., Hassani, A., Abdollahi, A. and Hanafi, S. 2011. Application of Carum copticum and Satureja hortensis essential oils and salicylic acid and silver thiosulfate in increasing the vase life of cut rose flower. Journal of Medicinal Plants Research, 5(20), 5034-5038.

Mathew, B., 2002. Classification of the genus Narcissus, Narcissus and Daffodil, Editors: Hanks, G., R. 30-52. Publisher: Taylor&Francis. London

Mayak, S. and Halevy, H. 1980. Flower senescence. In: Senescence in plants. Thiman KV. (ed.), CRC, Boca Raton, Florida, USA. 131-156

Popova, L., Pancheva, T. and Uzunova, A. 1997. Salicylic acid: properties, biosynthesis and physiological role. Bulgarian Journal of Plant Physiology, 23(1-2), 85-93.

Pun, U. K., Yamada, T., Azuma, M., Tanase, K., Yoshioka, S., Shimizu-Yumoto, H. and Ichimura, K. 2016. Effect of sucrose on sensitivity to ethylene and enzyme activities and gene expression involved in ethylene biosynthesis in cut carnations. Postharvest biology and technology, 121, 151-158.

Rahemi, M. 2011. Postharvest. Shiraz University Press, 437 page.

Raskin, I. 1992. Role of salicylic acid in plants. Annual Review of Plant Biology, 43(1), 439-463.

Roein, Z., Asil, M. H. and Rabiei, B. 2009. Silver Thiosulphate in Relation to Vase Life of Narcissus Cut Flowers (*Narcissus jonquilla*). Horticulture Environment and Biotechnology, 50(4), 308-312.

Sheikh, F., Neamati, S. H., Vahdati, N. and Dolatkhahi, A. 2014. Study on effects of ascorbic acid and citric acid on vase life of cut lisianthus (*Eustoma grandiflorum* 'Mariachi-Blue'). Journal of Ornamental Plants, 4: 57-64.

Shimizu-Yumoto, H., and Ichimura, K. 2010. Combination pulse treatment of 1-naphthaleneacetic acid and aminoethoxyvinylglycine greatly improves postharvest life in cut Eustoma flowers. Postharvest biology and technology, 56(1), 104-107.

Soleimany-Fard, E., Hemmati, K. and Khalighi, A. 2013. Improving the keeping quality and vase life of cut alstroemeria flowers by pre and post-harvest salicylic acid treatments. Notulae Scientia Biologicae, 5(3), 364-370.

Solgi, M., Kafi, M., Taghavi, T. S. and Naderi, R. 2009. Essential oils and silver nanoparticles (SNP) as novel agents to extend vase-life of gerbera (*Gerbera jamesonii* cv. 'Dune') flowers. Postharvest biology and technology, 53(3), 155-158.

Soad, M. M. I., Lobna, S. T. and Rawia, A. E. 2011. Extending postharvest life and keeping quality of Gerbera cut-flowers using some chemical preservatives. Journal of Applied Sciences Research, 7(7), 1233-1239.

Srivastava, M. K. and Dwivedi, U. N. 2000. Delayed Ripening of Banana Fruit by Salicylic Acid. Plant Science. 158: 87-96.

Tanase, K., Onozaki, T., Satoh, S., Shibata, M., and Ichimura, K. 2008. Differential expression levels of ethylene biosynthetic pathway genes during senescence of long-lived carnation cultivars. Postharvest biology and technology, 47(2), 210-217.

Vahdati, N. M., Tehranifar, A., Bayat, H. and Selahvarzi, Y. 2012. Salicylic and citric acid treatments improve the vase life of cut chrysanthemum flowers. Journal of Agricultural Science and Technology 14, 879-887.

Van Doorn,W. G., Zagory, D., Witte, Y. D. and Harkema, H. 1994. Effect of vase-water bacteria on the senescence of cut carnation flowers. Postharvest Biology and Technology 1 (2), 161–168.

Van Doorn, W. G. 1998. and Vase Life of Roses and Tulips. Journal of the American Society for Horticultural Science, 123(1), 146-149.

van Doom, W. G. and Perik, R. R. 1990. Hydroxyquinoline citrate and low pH prevent vascular blockage in stems of cut rose flowers by reducing the number of bacteria. Journal of the American Society for Horticultural Science, 115(6), 979-981.

Yoon, G.M. (2015) New insights into the protein turnover regulation in ethylene biosynthesis. Molecules and Cells, 38, 597-603.

Zencirkiran, M. 2010. Effects of 1-MCP (1methylcyclopropene) and STS (silver thiosulphate) on the vase life of cut Freesia flowers. Scientific research and Essays, 5(17), 2409-2412.

Zheng, Y. and Zhang, Q. 2002. Effects of polyamines and salicylic acid on postharvest storage of 'Ponkan'mandarin. In XXVI International Horticultural Congress: Citrus and Other Subtropical and Tropical Fruit Crops: Issues, Advances and 632 (pp. 317-320).