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Betterment vase life and keeping quality of cut Gerbera flowers by post-harvest nano silver treatments

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ABSTRACT: Gerbera or Transvaal daisy (*Gerbera jamesonii*) is one of 10 most important cut flowers in the world. One of the most problems faced the flowers is the short-life after harvest and neck bending. Producers want to increase longevity of these flowers with using chemical solutions. In this study, effects of various postharvest treatments on postharvest quality and quantity parameters of Gerbera were evaluated. The present study was carried out in Department of Horticulture, Faculty of Agriculture, Islamic Azad University of Isfahan (Khorasgan) branch. Flowers were kept in 48 preservation solutions containing with different levels of preservatives, including, Nano-Silver (0, 5, 10 ppm). Completely Randomized Factorial Designs was applied to test the significance of treatments and means were compared using Duncan's multiple range test at P = 0.01. Results showed that using postharvest treatments significantly affected vase life, stem and flower diameter, related fresh weight and carotenoids total contents. However, the effects of treatments on leaf longevity, PH and water content percentage of florets were not significant. About of using Nano-Silver the best dosage of each material was 10 ppm. In conclusion, the best treatment to enhance postharvest factors of Gerbera, was the exact 10 ppm Silver Nano particles. This treatment can be proposed as additional substance for Gerbera postharvest quality increasment**.**

Keywords**:** Gerbera, Nano-Silver, Preservation solution, Vase life

INTRODUCTION

Gerbera (Gerbera jamesonii Hook) popularly known as Transvaal daisy, belongs to the Asteraceae family, which is a perennial Mediterranean plant. Gerbera is considered to be the native of South African and Asiatic regions. It is mostly found inhabit temperate and mountainous regions. Gerberas are grown for garden decoration also as cut flowers for interior decoration and for making bouquets and in dry flower crafts. They are easy to grow, light weight flowers with long (50-70 cm) and slender flower stalk, exquisitepetal arrangements with different shades of attractive colours and moderate vase life, all in a combined way renders gerbera flowers to a prominent position amongst the elite group of top ten cut flowers (the fourth place) of the international flower markets (Choudhary and Prasad, 2000). It is inconsiderable demand in both domestic and export markets. Keeping quality is an important parameter for evaluation of cut flower quality, for both domestic and export markets. One of the most important problems of postharvest of Gerbera is bent neck and less vase life**.** Addition of chemical preservatives to the holding solution is recommended to prolong the vase-life of cutflowers. All holding solutions must essentially containtwo components viz., sugar and germicides. Sucrose is widely used in floral preservatives, which acts as a food source or respiratory substrate and delays the degradation of proteins and improves the water balance of cut flowers, while the germicides control harmful bacteria and prevent plugging of the conducting

tissues. Therefore, the techniques of prolonging the vase-life of flowers will be a great asset to the growers and users (Nair et al., 2003). In this regard, (Meman and Dabhi ,2007) mentioned that the vase solution of sucrose at 4% +8-HQC at 250 ppm + citric acid at 250 ppm increased fresh weight of Gerbera jamesonii cv. Savana Red flowers by promoting solution uptake, improving the vase life and useful life of flowers, opening of disc florets, with bright, shining red colour and freshness for a longer duration. (Likewise, Amiri et al., 2009) reported that using a combination of 30 ppm sucrose + 250 ppm AgNO + 250 ppm citric acid improved water uptake and consequently extended vase life, delayed scape bending, wilting and the curvature of the stem in the end of vase life of Gerbera jamesonii cv. Pags flowers. The cut gerbera flowers often bend and break when they are placed in water, but including antibacterial compounds such as silver nitrate in the vase water decreased the number of bent scapes (Steinitz, 1984).

Short postharvest vase life is one of the most important problems on the cut flowers. The maintenance of vase life is an important quality attribute in these economically significant cut flowers. A suitable method for vase life extension, which easy to use, natural, safe and inexpensive compounds is always crucial in this respect for large-scale applications.

Vase life termination for many cut flowers is characterized by wilting (He et al., 2006). The water balance is a major factor determining the quality and longevity of cut flowers. It is influenced by water uptake and transpiration and balance between two mentioned processes (Da Silva, 2003). When the amount of transpiration exceeds the volume of water uptake, water deficit and wilting develops. Low water uptake is often due to occlusions located mainly in the basal stem end (He etal., 2006), and microbes are a common cause of stemend blockage (Van Doorn, 1997). Many agents have been used in cut flowers vase solutions, extends the vase life by improving water uptake. These include and silver nitrate, aluminum sulphate (Ichimura and Shimizu**-**Yumoto, 2007) and 8-hydroxyquinoline sulphate **(**Ichimura et al., 1999). Therefore; it is important to use these materials in vase solutions to extend the vase life of cut flowers.

Nanometer sized silver (Ag^{+}) particles (NS) are considered to more strongly inhibit bacteria and other microorganisms than Ag in various oxidation states; Ag^{0}, Ag^{+}, Ag^{2+}, Ag^{3+} (Furno et al., 2004; Jilanget al., 2004). Usage of nano-silver compounds (NS) as apulse and the vase solution treatment for cut flowers is relatively new (Liu et al., 2009; Solgi et al., 2009) and has demonstrated importance as an antibacterial agent (Alt et al., 2004; Morones et al., 2005). NS releases Ag+ (Lok et al., 2007), which has been reported to interact with cytoplasmic components and nucleicacids, to inhibit respiratory chain enzymes and to interfere with membrane permeability (Park et al., 2005).

Use of NS is becoming increasingly widespread in medicine, fabrics, water purification and various other industrial and non-plant applications (Jain and Pradeep, 2005; Dubas et al**,.** 2006; Chen and Schuesener, 2008). (Liu et al., 2009) reported vase life extension for cut gerbera cv. Ruikou flowers following pulsing with 5 mgL^{-1} NS solution for 24 h. The positive effect of a NS pulse treatment was attributed to inhibition of bacterial growth in the vase solution and at the cut stems ends during the postharvest period. However, physiological activity of Ag^{+} from NS is also a possibility. Ag^{+}, generally applied as silver thiosulfate, effectively inhibits ethylene-mediated process, such as flower senescence and abscission (Ichimura et al., 2008). As with other cations (e.g. k^{+}, ca^{2+}), positive effects on plant stem hydraulic conductivity of Ag^{+} (Van leperen, 2007) is possible. (Ohkawa et al., 1999) reported that silver-containing compounds extended the vase life of cut roses. (Peitaolu et al., 2010) reported pulse treatment for 1h with 50 and 100 mgL^{-1} NS solutions extended vase life and suppressed reduction in fresh weight during the vase period. (Kim et al., 2005) reported vase life extensions for Asiatic hybrid Lilium cv. Dreamland and Oriental hybrid Lilium cv. Siberica by dipping in a mixture of 0.1% nanoparticle pure colloidal Ag^{+} ion, H_2O_2, and naturalChitosan**.**

With the above research background presentstudy has investigated the effects of NS solution treatments on extending the vase life of cut gerbera flowers. Moreover possibility of change in flower characteristic or any sort of damage to the leaves has been other considerations focused on current research.

MATERIALS AND METHODS

The experiment was carried out in pots, to evaluate the effects of different nano silvers on Gerbera (Gerbera jamesonii) growth in greenhouse condition. Gerbera cut flowers were obtained from local commercial greenhouses (Isfahan, Iran). Plants were grown under standard greenhouse conditions with 22 and 16°C day and night temperatures, respectively. A factorial experiment was established, including nano silver at 0.0 (with distilled water), 5 and 10 ppm, effect on gerbera cut flowers morphological properties. The cut flowers were harvested in the early morning and transported with appropriate cover (in plastic packages) immediately to laboratory. Sucrose

at 4% was added to all treatments as a base solution. The flowers were kept in a controlled room at 19±2°C, 70±5% relative humidity and 12 µmol m^{-2} s^{-1} light intensity (cool-white fluorescence lamps) under a daily light period of 12 h. The period from the first day (0 day) when cut flowers were placed in vase solutions, until they lost their ornamental value were investigation traits.

Relative fresh weight, water uptake, water loss and water balance were recorded 2 days intervals by measuring weights of vases without flowers and of flowers separately (He et al., 2006).

Vase life was assessed as the number days to wilting of flowers. The flowers were checked once a day for signs of deterioration. Carotenoid content in petals was determined (5 days intervals) in two wavelength (480 and 510 nm) by spectrophotometer (SPAD-502, Minolta, Tokyo), which is presented by SPAD values. Average of 3 measurements from different spots of a single leave was considered (Kazemi and Ameri, 2012).

The data were statistically processed by analysis of variance according to a randomized complete block design and means with standard errors were calculated using the program Statistical Analysis System, version 9.1 (SAS Institute, Cary, NC, USA). Differences between the treatments were determined using Duncan's test.

RESULTS AND DISCUSSION

The significant differences ($p<0.01$) were revealed among the treatments for vase life, that the control treatment had the lowest vase life and 10 ppm nano silver treatment had the highest vase life after harvest (Table1). With respect to the results, using nano silver treatment increased significantly the vase life cut gerbera flowers, as compared to control treatment during experiment. Previous researches had revealed that the nano silver treatments significantly extend the vase life of cut flowers (Furno et al., 2004; Liu et al., 2009), that is in agreement with our results.

The short vase life of cut flowers was caused by poor water relations in association with a lower water uptake (probably due to growth of microbes and vascular blockage), high rate of transpiration and water loss. The data indicated that the nano silver treatments increased significantly vase life of cut gerbera flowers than in the control treatment. This effect of nano silver is might be due to reduced the bacteria growth and vascular blockage, maintained a more favourable water uptake, suppressed water loss (Mori et al., 2001), inhibiting ethylene action (Zamani et al., 2011) and decrease in transpiration rate (Mei-hua et al., 2008).

These results are in harmony with those of (Safa et al., 2012) on *Gerbera jamesonii L.* cv. 'Balance' who indicated that the maximum vase life was obtained in 10 $mg.l^{-1}$ silver nanoparticles. (Nair et al., 2003) on *Gerbera jamesonii* reported that the maximum number of days was recorded in 20 ppm $AgNO^3$+6% sucrose treatment. He added that the improvement in vase-life of cut flowers in 20 ppm silver nitrate ($AgNO^3$) solution might be due to the fact that it is a very effective biocide, which completely inhibits the microbial growth. Also, (Awad et al., 1986) attributed the beneficial effect of $AgNO^3$ on the vase-water to the production of Ag^+ ions, which might inhibit the rise of ethylene precursor, thereby enhancing the longevity of cut flowers.

As shown in table 1, relative fresh weight increased significantly during the experiment. Similar patterns of changes were also reported for cut rose flowers (Lu et al., 2010; Alaey et al., 2011). A variation in terms of relative fresh weight was observed among the treatments and the differences were statistically significant ($p<0.01$). The relative fresh weight was affected by nano silver treatments, since control cut flowers had significantly lower relative fresh weight during experiment, while the highest levels were obtained with 10 ppm nano silver treatment (Table 1). (Kazemi and Ameri ,2012) showed that the treated cut gerbera flowers with salicylic acid had the highest levels of relative fresh weight during vase period.

The decrease in relative fresh weight of cut flowers during the days of after harvest could be due to the decrease in water uptake (Serek et al., 1995). (Alaey et al., 2011) reported that the highest relative fresh weight of cut rose flowers was observed in vase solutions which showed the greatest water uptake.

Table 1 shows considerable differences between measuring factories on different concentrations of nano silver at $p\leq 0.05$**.** This table indicates no significant ($p\leq0.05$) differences were found among various concentrations of nano silver on stem and flower diameter of gerbera. The lowest stem diameter and flower diameter were obtained with 0 ppm nano silver (control) and the highest rate were seen with 10 ppm nano silver treatment.

Table 1. Effect of silver nanoparticles treatments on different characteristics of cut gerbera flowers

Nano-Silver Levels (ppm)	vase life (day)	stem diameter (cm)	flower diameter (cm)	relative fresh weight (% of initial)
0	15.3b	18.7c	8.84c	4.52c*
5	25.6a	28.4a	14.91a	7.61b
10	23.3a	22.3b	14.89a	9.05a

*Values followed by the same small or capital letter are not significantly different within rows or columns at Duncan test P≤0.05

According to results shown in table 2, the carotenoids content decreased significantly during experiment, that the levels of total carotenoid at the initial of the after harvest were higher than the end ones just. There were significant differences in the carotenoids contentof the different treatments. The lowest and highest carotenoid values were observed in 10 and 0 ppm nano silver treatments, respectively (Table 2).

Table 2. Effect of silver nanoparticles treatments on carotenoids content of cut gerbera flowers

Nano-Silver Levels (ppm)	carotenoid (480 nm)	carotenoid (510 nm)
0	0.08a	0.7a*
5	0.03b	0.02b
10	0.02b	0.01b

*Values followed by the same small or capital letter are not significantly different within rows or columns at Duncan test P≤0.05

The naturally short vase life of the cut flowers is one of the most important problems. The using of different treatments is recommended to keeping quality and extending the vase life of cut flowers. In this study, influence of nano silver post-harvest applications on keeping quality and vase life of cut gerbera flowers during vase period were investigated. This research showed that the same behaviour in all measured factors after harvest for all treatments. The relative fresh weight, stem and flower diameterand vase life increased significantly during vase period. In addition, statistically significant differences were observed between control and nano silver treatments in all measured parameters. Nano silver treatment is able to increase vase life of cut gerbera flowers by regulating the plant water and increasing relative fresh weight. Thus, the data suggest that nano silver treatment has the potential to be used commercially to extend the vase life of cut gerbera flowers.

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