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Chemical preservatives for increasing shelf life of gerbera

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ABSTRACT

Preservative solutions, viz. T_0: Tap water (Control); T_1: Sugar (50-ppm); T_2: Citric Acid (50-ppm); T_3: Salicylic Acid (50-ppm); T_4: Chitosan (50-ppm); T_5: Silvar Thiosulphate (50-ppm); T_6: Sugar + Citric Acid (50-ppm); T_7: Sugar + Salicylic Acid (50-ppm); T_8: Sugar + Chitosan (50-ppm) and T_9: Sugar + Silvar Thiosulphate (50-ppm) were used as vase solution to increase post-harvest life of gerbera. Minimum score for petal discoloration (1.6) and flower freshness (3.8) was found from T_9. Stem bending (13.7 days), petal discoloration (10.5 days) and petal shriveling (13.3 days) were also found to be delay in T_9 treatment. Maximum stem diameter (7.2 mm), solution uptake (72.7 ml), petal water content (72.7%) and vase life (13.3 days) was found from T_9 followed by T_6. Sugar + Silvar Thiosulphate and Sugar + Citric Acid can lead to extend longevity of cut gerbera by reducing the fungal infection also by increasing solution uptake and supplementing carbohydrate.

Keywords: *Gerbera jamesonii, citric acid, salicylic acid, chitosan, silvar thiosulphate and vase life*

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I. Introduction

In the modern horticulture, there is more interest to find economical effective preservatives to improve post-harvest life of cut flowers. Gerbera (*Gerbera jamesonii*) is one of the popular cut flowers in Bangladesh having short vase life and mostly are used freshly, so their vase life improvement is one the first floriculture's purposes (Elgimabi and Ahmed, 2009). The major reasons for shorten vase life of cut flowers are nutrient deficiency, bacterial and fungal contaminations (Kazemi *et al.*, 2011) water stress-induced wilting and vascular blockage (Alaey *et al.*, 2011). Application of various chemicals could alter the post-harvest life of cut flowers (Prashanth *et al.*, 2010). Different chemicals have been used in vase solution to extend vase life of cut flowers mainly by improving their water uptake and reducing transpiration, thereby promote the vase life (Lu *et al.*, 2010). Vase life of gerbera can be extended using post-harvest treatments as evidenced by different authors (Abdel-Kader and Rogers, 1986; Accati and Jona, 1989; Amariutei *et al.*, 1986 and Nowak, 1981). Aim of this study was to search for the preservative solution(s) for extending vase life of cut gerbera.

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II. Materials and Methods

Experiment was conducted at *2abiotech*, Department of Horticulture of the Sher-e-Bangla Agricultural University, Dhaka, Bangladesh from June 2014 to July 2014 to find out the appropriate chemical preservative solution(s) for extending the vase life of gerbera. Ten chemical preservative solutions were used for vase life analysis, and these were T_0: Tap water (Control); T_1: Sugar (50-ppm); T_2: Citric Acid (50-ppm); T_3: Salicylic Acid (50-ppm); T_4: Chitosan (50-ppm); T_5: Silvar Thiosulphate (50-ppm); T_6: Sugar + Citric Acid (50-ppm); T_7: Sugar + Salicylic Acid (50-ppm); T_8: Sugar + Chitosan (50-ppm) and T_9: Sugar + Silvar Thiosulphate (50-ppm) using Completely Randomized Design (CRD) with three replications. Data were collected on stem diameter, petal discoloration score, flower freshness score, days to stem bending, days taken for first petal discoloration, days taken for first petal shriveling, solution uptake, petal water content, vase life and fungal infection. Flower petal color change or discoloration (fading) was assessed according to the procedures described by Macnish *et al.* (2000) with rating scale of 1 = none/slight fading, 2 = moderate fading and 3 = advanced fading. Freshness of flower was scored on 1-5 scale (1 = fresh flower, 2 = very slight petal enrolling, 3 = noticeable in-rolling, 4 = petal shriveling and 5 = maximum petal shriveling). Solution uptake was measured by subtracting the solution at the last days in flower vase from the initial solution of the flower vase. Petals water content (% WP) was determined with the below equation (Kalate Jari *et al.*, 2008):

$$\%WP = \{(FW-DW) \div DW\} \times 100$$

Collected data were analyzed statistically using MSTAT-C computer package program and significance of the difference among the treatment means was estimated by the Least Significant Difference (LSD) test at 5% level of significance (Gomez and Gomez, 1984).

III. Results

Stem diameter

Stem diameter of gerbera showed variation among different vase solutions at different days after treating. Maximum stem diameter was found from T_9 (7.2 mm) followed by T_6 (6.2 mm) while minimum from T_0 (1.6 mm) at 7th days after placement (Figure 01a).

Petal discoloration score

Petal discoloration score showed variation among the vase solution at different days after treating. Maximum petal discoloration score was found from T_0, T_1, T_2, and T_3 (3.0) i.e., advanced fading conditions whereas minimum from T_9 (1.6) i.e., none or slight fading conditions at 7th days after placement in vase solutions (Figure 01b).

Freshness of flower

Freshness of gerbera flower showed variation among the vase solution at different days after treating. Maximum flower freshness score was found from T_0 and T_3 (5.0) i.e., maximum petal shriveling conditions whereas minimum from T_6 and T_9 (3.8) i.e., near to petal shriveling conditions at 7th days after placement in vase solutions (Figure 01c).

Days taken for stem bending

Days to first stem bending was varied among the vase solution. Late stem bending was found from T_9 (13.7 days) followed by T_7 (13.2 days) while early stem bending was found from T_3 (7.4 days) (Table 01).

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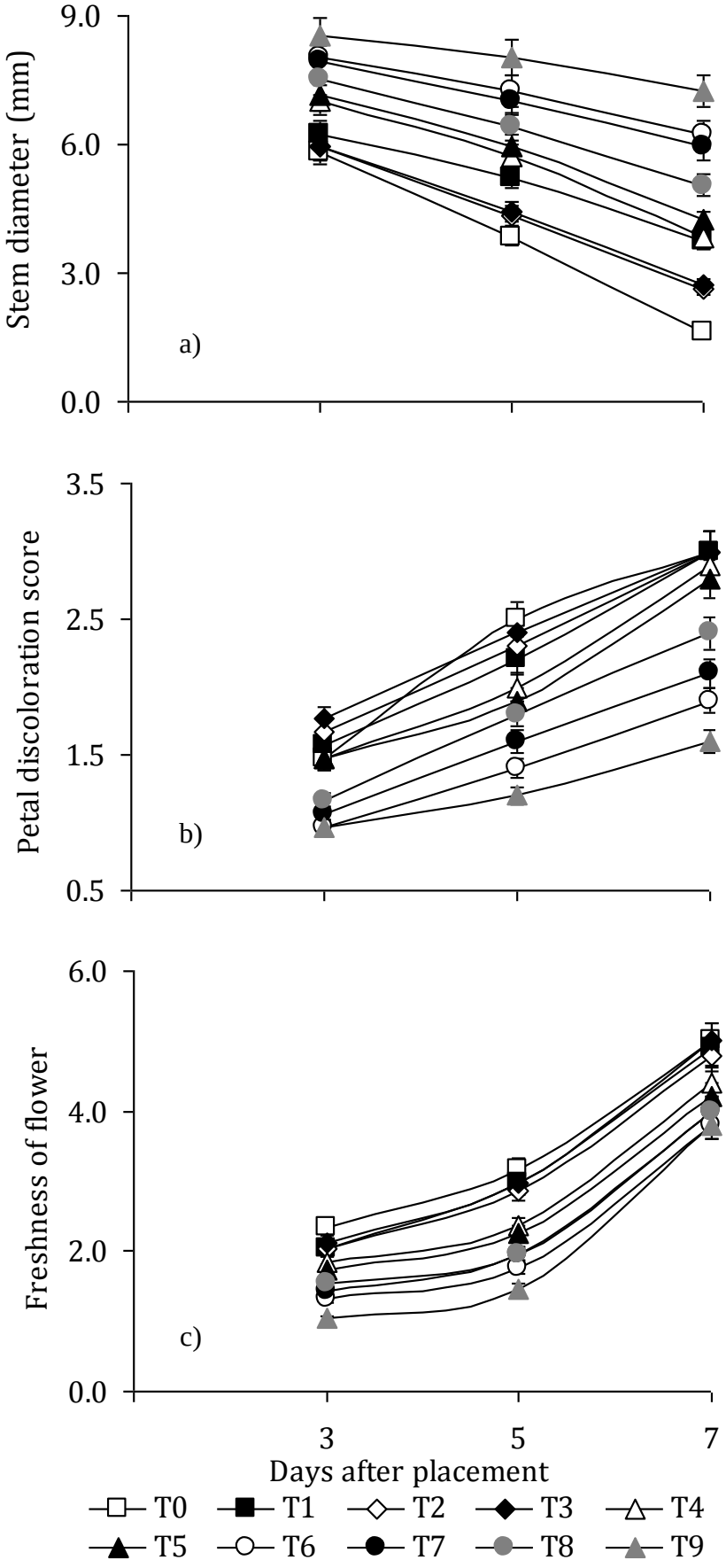

Figure 01. Response of gerbera to vase solutions on a) stem diameter b) petal discoloration score and c) freshness of flower at different days after treating

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Petal water content

Petal water content of gerbera varied among the vase solutions. Maximum petal water content was found from T_9 (72.7%) followed by T_6 (66.6%) whereas minimum from T_0 (41.7%) (Table 01).

Vase life

Vase life of gerbera varied among the vase solutions. Maximum vase life was found from T_9 (13.3 days) followed by T_6 (8.7 days) while minimum from T_0, T_2 and T_3 (4.0 days) which were statistically similar with T_1 (4.3 days) (Table 01).

Fungal infection

From the experiment T_0, T_1, T_4 and T_8 solutions were infected by fungus and rest of the solutions were not to be found by fungal infection (Table 01).

Table 01. Response of gerbera to different vase solution on shelf life related attributes[X]

Vase solutions[Y]	Days taken for stem bending	Days taken for first petal discoloration	Days taken for petal shriveling	Solution uptake (ml)	Petal water content (%)	Vase life (Days)	Fungal infection
T_0	7.8 h	4.3 h	7.0 h	55.7 h	41.7 i	4.0 E	+
T_1	8.4 g	4.7 g	7.4 g	55.7 h	48.7 f	4.3 E	+
T_2	7.7 h	4.2 h	6.9 h	57.7 g	46.5 g	4.0 E	-
T_3	7.4 i	4.1 h	6.8 h	57.7 g	45.3 h	4.0 E	-
T_4	10.1 f	6.7 f	9.4 f	60.7 f	52.4 e	6.3 D	+
T_5	10.4 e	7.1 e	9.8 e	62.7 e	52.5 e	6.7 D	-
T_6	12.6 c	9.1 c	11.8 c	71.7 b	66.6 b	8.7 B	-
T_7	13.2 b	10.0 b	12.7 b	70.7 c	60.2 c	7.7 C	-
T_8	10.9 d	7.8 d	10.5 d	65.7 d	53.8 d	6.3 D	+
T_9	13.7 a	10.5 a	13.3 a	73.7 a	72.7 a	13.3 A	-
LSD 0.05	*0.2*	*0.2*	*0.2*	*0.9*	*0.4*	*0.6*	
CV %	*1.2*	*1.8*	*1.3*	*0.3*	*0.9*	*5.4*	

[X]In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability
[Y]Different vase solutions

IV. Discussion

Flower longevity and quality of cut flowers in vase solution depend on a numerous number of factors like genetical constituents, pre-harvest conditions, harvesting technique, packaging, post-harvest handling and storage. But for the post harvesting storage different chemicals influences the vase life and floral quality of cut flowers. From the current study Sugar + Silvar Thiosulphate (50-ppm) was found the best treatment for all of the studied parameters which was closely followed by Sugar + Citric Acid (50-ppm). The vase life of Gerbera is mostly dependent on the how upright the stem is, or in scientific terms, depends on "bent neck." The slowest stem bending was found in the gerbera kept in the treatment solution of sugar and silver thiosulphate. Sugar acts as the carbohydrate source and also makes the cells of the gerbera stem concentrated with sugars that are carried up by the phloem. The hypertonic solutions inside the cells allow water to enter the cells by osmosis and thus make them turgid. This turgidity gives the stem a rigid, upright structure. The longest vase life was found in the treatment containing a combination of sugar and silver thiosulphate. Silver thiosulphate has certain antimicrobial properties, which reduce the degree of vascular blockage, thus allowing for optimum solution uptake and reducing stem bending by doing so.

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Sucrose serves the food for cut flowers and reduces starch degradation which is important to increases the cut flower longevity but influence in the formation of various microbial organisms reduces the longevity of cut flowers in vase (Mehraj *et al.*, 2013a; 2013b; 2013c). Addition of chemical preservative solution greatly influence on the petal discoloration score and flower freshness (Khan *et al.*, 2015) and may stop the formation of various microbial organisms. Addition of silvar thiosulphate in holding solution had beneficial effect on vase life and quality of cut flowers (De *et al.*, 1996). Pulsing cut flowers with silvar thiosulphate + sucrose inhibited the ethylene synthesis which has become an essential tool for delaying the senescence of cut flowers, inhibited chlorophyll, soluble protein and sugar losses during senescence also improved the post-harvest quality (Burzo *et al.*, 1995; Wei *et al.*, 1997). Longevity of many cut flowers is negatively influenced by the presence of ethylene by inducing various physiological responses like abscission and wilting of leaves, petals and sepals. Silver thiosulphate is known to suppress autocatalytic ethylene production (Da Silva, 2003). For the maintenance of turgor pressure, carbohydrates are necessary and also important for energy sources facilitating flower opening (Sarkka, 2005). Low carbohydrate levels in stem will reduce vase life (Hashemabadi and Gholampour, 2006) while Sugars are essential precursors for cut flower respiration. The rate of fresh weight decline was slowed down in the cut flowers treated with silvar thiosulphate (Song *et al.*, 2001; Chikkasubbanna and Yogitha, 2002). Additionally, silver ion available in the silvar thiosulphate had bactericidal property and reduced the frequency of bent necks and improved the vase life of cut roses (Torre and Fjeld, 2001). On the other hand, citric acid has also been found to play a key role to extended vase life of cut gerbera. Citric acid has an ability to extend vase life of cut flowers in association with inhibition of ethylene production (Srivastava and Dwivedi, 2000). Pathogens also affect vase life due to vascular blockage (Van Dome *et al.*, 1994). Citric acid made the solution acidic that inhibits growth and proliferation of bacteria and other microorganisms (Redman *et al.*, 2002; Dole *et al.*, 1998). CA can alleviate water uptake and extend vase life due to its antiembolism trait (Bhattacharjee *et al*., 1993).

However, fungal infection was present in this optimum treatment solution as well, contrary to the theory that microbes are a major determinant of vase life (Marandi *et al.*, 2011). This exception may have arisen due to the other beneficial properties of a combination of sugar and STS, as sugar can be a major suppressor of ethylene biosynthesis (Ichimura and Hisamatsu, 1999).

Positive efficacy of sugar + silvar thiosulphate in this study could be attributed to providing food for cut flowers also their antimicrobial activity that act as biocide in the holding solution and reduce the bacterial population in the vase solution and as a result increase the vessels conductivity, water uptake and longevity of cut gerbera.

V. Conclusion

Sugar and Silvar Thiosulphate (50-ppm), i.e., treatment T_9 was the best chemical treatments for increasing the vase life of gerbera. Sugar and Citric Acid (50-ppm) was also showed better performance just after treatment T_9 for the improvement of vase life of gerbera. Thus, it is recommended to use Silvar Thiosulphate or Citric Acid with Sugar as a vase solution for gerbera to extent shelf life.

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