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Effects of floral preservative solutions for vase life evaluation of Gerbera

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ABSTRACT

An experiment was conducted to evaluate the postharvest life of cut gerbera cultivars under the different preservative solutions. Three (yellow, magenta and orange) cut gerbera cultivars were placed on nine different preservative solution viz. T_1: Control; T_2: Sugar (100-ppm); T_3: Citric Acid (100-ppm); T_4: Salicylic Acid (100-ppm); T_5: Chitosa[1] (100-ppm); T_6: Sugar + Citric Acid (100-ppm); T_7: Sugar + Salicylic Acid (100-ppm); T_8: Citric Acid + Chitosan (100-ppm); T_9: Salicylic Acid + Chitosan (100-ppm) following completely randomized design. Yellow gerbera provided the maximum petals water content (52.4%) when placed in T_9 and also provided 8.0 days more vase life compared to the control. For magenta and orange gerbera, maximum petals water content (magenta: 56.3% and orange: 63.0%) in T_8 and also 6.9 days more vase life than control.

Key Words: *Gerbera cultivars, Preservative solutions and Vase life*

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I. Introduction

Gerbera (*Gerbera jamesonii*) belongs to the *Asteraceae* family,itis an important cut flower. Cut flowers have short vase life, 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, water stress-induced wilting and vascular blockage (Alaey *et al.*, 2011). Water relation is another important and complex factor that affecting the vase life and post harvest quality of cut flowers. Slightly acidic sucrose solution plays an important role to extend the vase life providing the food for cut flowers and by stopping the growing of microorganisms on solution (Mehraj *et al.*, 2013a).Senescence of cut flowers is induced by several factors like water stress (Sankat

[1] *Chitosanis (linear polysaccharide) is the most most important derivative of chitin (natural polysaccaride), is a sugar. It is soluble in acidic aqueous, generally used for seed treatment, plant growth enhancher and as a biopesticide in agriculture. It helps the plants and post harvest agricultural commodities to fight off fungal infections.*

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and Mujaffar, 1994), carbohydrate depletion, microorganisms (Witte and Van Doom, 1991) and ethylene effects (Wu *et al*., 1991; Da Silva, 2003). Senescence of ethylene-sensitive flowers is associated with a loss of membrane integrity, climacteric rise of respiration and enhanced ethylene synthesis (Tang *et al*., 1994; Da Silva, 2003). Ethylene production of cut gerbera flowers increased with flower senescence and treatment with salicylic acid, an ethylene produce inhibitor, extended flower longevity. Citric acid caused extended vase life (Darandeh *et al*., 2010). The postharvest life of flowers is strongly dependent on the carbohydrate status and the acceptable amount of metabolic sugars is factors that affect the rate of senescence. Placing all field-grown cut flowers in a preservative solution will extend their postharvest life and keep their quality. Cut flower requires food (carbohydrates) to ensure a long post harvest life. Carbohydrates can be mobilized for the flower and that can be increases the vase life of the cut flowers. Fully developed harvested flowers requires adequate reserved for the maintenance of the metabolic activities including respiration also in order to achieve a reasonable postharvest life. When the stored carbohydrates are low, flowers senesce rapidly and petals that develop at low sugar levels have pale colors. Under these situations, supplements can be provided to the flowers by adding sucrose to the vase solutions. However, it is important to remember that a sugar solution is also perfect for the growth of microorganisms, so that a biocide should be added to the vase solution as well. External sugars can be provided to cut flowers by dissolving a known amount of sugar, along with a biocide into the vase solution. So, the use of proper preservative solutions is recommended to extend the cut flower's vase life. Keeping the above point in view the current study was undertaken to find out the proper preservative solution for cut gerbera.

II. Materials and Methods

The experiment was conducted at *2abiotech* laboratory, Department of Horticulture, Sher-e-Bangla Agricultural University (SAU), Bangladesh from December 2013. Uniform sticks (total 27 of each colored) yellow, magenta and orange gerbera cultivars were collected from *2a rooftop garden*, SAU. These flowers were grown at uniformly maintained growing conditions. Gerbera sticks were trimmed in equal length. Slanting cut was made to provide more solution accumulated area. The study was conducted by following completely randomized design with three replications. Nine preservative solutions viz. T_1: Control (Tap water); T_2: Sugar (100-ppm); T_3: Citric Acid (100-ppm); T_4: Salicylic Acid (100-ppm); T_5: Chitosan (100-ppm); T_6: Sugar + Citric Acid (100-ppm); T_7: Sugar + Salicylic Acid (100-ppm); were used on the experiment. Flowers were kept in room temperature during the period of experiment and the vase solutions were changed at every 5 days after interval. Data wee taken from weight loss, days taken for the flower dropping/stem bending, days taken for petal discoloration, days taken for petal shriveling, petals water content (WP %) and vase life (days). Petal discoloration and petal shriveling were measured by organoleptic test. Petals water content (% WP) was determined with the below equation (Kalate Jari *et al.*, 2008):

$$\%WP = FW\text{-}DW/DW \times 100$$

Collected data were statistically analyzed using MSTAT-C computer package program. Mean was calculated and analysis of variance for each of treatment was represented by F-test (Variance Ratio). Differences between treatments were evaluated by Least Significance Difference Test (LSD) at 5% level of significance (Gomez and Gomez, 1984).


Yellow


Magenta


Orange

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III. Results and Discussion

Weight loss

Weight loss of gerbera cultivars was varied significantly among different preservative solutions. Maximum weight loss was observed in T_1 (21.6 g) whereas minimum in T_9 (12.2 g) in yellow cultivar (Table 01). In magenta, maximum weight loss was observed in T_3 (20.4 g) which was statistically similar with T_4 (20.1 g) while minimum from T_8 (11.8 g) (Table 01). Maximum weight loss was observed in T_3 (19.3 g) that was statistically similar with T_4 (19.0 g) while minimum in T_8 (10.9 g) in orange cultivar (Table 01).

Days taken for the flower dropping or stem bending

Maximum days for flower dropping was taken by T_9 (16.8) followed by T_8 (16.2) while minimum by T_3 (11.2) in yellow gerbera (Table 02). On the other hand, maximum day was required for flower dropping in T_8 (20.2 days in magenta and 21.4 days in orange) followed by T_9 while minimum in T_4 (14.1 days) for magenta and T_3 (14.5 days) for orange (Table 02).

Days taken for petal discoloration

Maximum days taken for petal discoloration by T_9 (13.6) followed by T_8 (12.7) while minimum by T_4 (7.9) in case of yellow cultivars (Table 02). On the other hand, maximum day was required for petal discoloration in T_8 (18.2 days in magenta and 19.5 days in orange) followed by T_9 while minimum in T_4 (10.2 days for magenta and 11.3 days for orange) that was statistically similar with T_3 (Table 02).

Days taken for petal shriveling

Maximum days taken for petal shriveling by T_9 (16.3) followed by T_8 (15.4) while minimum by T_4 (10.6) in case of yellow cultivar (Table 02). On the other hand, maximum day was required for petal discoloration in T_8 (18.9 days in magenta and 20.1 days in orange) followed by T_9 while minimum in T_4 (12.6 days for magenta and 13.6 days for orange) that was statistically similar with T_3 (Table 02).

Petals water content (WP)

Maximum WP was in T_9 (52.4%) followed by T_8 (52.1%) while minimum by T_1 (50.0%) in case of yellow cultivars (Table 03). On the other hand, maximum petals WP was in T_8 (56.3% in magenta and 63.0% in orange) followed by T_9 while minimum in T_4 (53.5% for magenta and 56.2% for orange) (Table 03).

Vase life

The screening of three gerbera cultivars against different preservative solutions showed interesting results for vase life. The vase life of these three gerbera cultivars ranged from 9.7 to 18.7 days. Maximum vase life was in T_9 (16.3 days) followed by T_8 (15.1 days) while minimum by T_1 (9.7 days) which was statistically similar with the T_3 (9.9 days) in case of yellow cultivars (Table 3). On the other hand, maximum vase life was in T_8 (18.4 days in magenta and 18.7 days in orange) followed by T_9 while minimum in T_1 (11.5 days for magenta and 11.8 days for orange) (Table 03).

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Table 01. Weight loss of three different colored gerbera under some chemical preservatives [x]

Vase Solutions[Y]	Yellow						Magenta						Orange					
	Placement days				Weight loss (g)		Placement days				Weight loss (g)		Placement days				Weight loss (g)	
	Before (g)		7th (g)				Before (g)		7th (g)				Before (g)		7th (g)			
T_1	31.6	b	11.2	i	21.6	a	33.1	a	15.0	g	19.2	b	34.7	a	17.6	g	18.3	b
T_2	31.0	de	13.5	f	18.7	d	32.8	ab	16.0	f	18.0	c	34.3	b	18.5	f	17.0	c
T_3	30.8	e	11.7	h	20.2	c	32.5	bc	13.2	i	20.4	a	33.9	c	15.6	i	19.3	a
T_4	32.0	a	12.0	g	21.1	b	32.9	a	13.9	h	20.1	a	34.3	b	16.3	h	19.0	a
T_5	31.4	bc	14.9	e	17.9	e	32.5	bc	18.8	d	15.0	e	33.9	c	21.2	d	13.9	e
T_6	30.2	f	16.9	d	14.6	f	32.3	c	17.6	e	16.0	d	33.8	c	20.1	e	15.0	d
T_7	31.0	de	18.3	c	14.1	g	32.9	a	21.9	c	12.4	f	34.4	b	24.4	c	11.4	f
T_8	31.2	cd	18.8	b	13.9	g	33.0	a	22.7	a	11.8	g	34.6	ab	25.3	a	10.9	g
T_9	31.0	de	20.3	a	12.2	h	32.9	a	22.3	b	12.1	fg	34.4	b	24.8	b	11.1	fg
LSD 0.05	*0.3*		*0.3*		*0.3*		*0.3*		*0.3*		*0.3*		*0.3*		*0.3*		*0.3*	
CV %	*0.5*		*1.1*		*1.0*		*0.6*		*1.1*		*1.2*		*0.6*		*1.0*		*1.3*	

Table 02. Performance evaluation of three colored gerbera under some chemical preservatives at different attributes [x]

Vase Solutions[Y]	Days taken for the flower dropping/stem bending						Days taken for petal discoloration						Days taken for petal shriveling					
	Yellow		Magenta		Orange		Yellow		Magenta		Orange		Yellow		Magenta		Orange	
T_1	11.7	g	14.3	g	15.1	g	8.2	g	11.2	f	12.5	g	10.9	g	13.4	g	14.6	g
T_2	12.2	f	15.5	f	15.5	f	8.5	f	12.1	e	13.3	f	11.2	f	14.1	f	15.2	f
T_3	11.5	g	14.6	g	14.5	h	8.0	gh	10.3	g	11.4	h	10.7	gh	12.9	h	13.9	h
T_4	11.2	h	14.1	h	14.9	g	7.9	h	10.2	g	11.3	h	10.6	h	12.6	h	13.6	h
T_5	13.8	e	16.5	e	18.0	d	10.4	e	13.0	d	14.1	e	13.1	e	15.5	e	16.5	e
T_6	14.1	d	16.9	d	17.6	e	10.8	d	13.2	d	15.4	d	13.5	d	15.9	d	17.0	d
T_7	14.5	c	17.9	c	18.6	c	11.4	c	13.8	c	17.0	c	14.1	c	16.4	c	17.5	c
T_8	16.2	b	20.2	a	21.4	a	12.7	b	18.2	a	19.5	a	15.4	b	18.9	a	20.1	a
T_9	16.8	a	18.9	b	19.6	b	13.6	a	15.1	b	18.3	b	16.3	a	18.3	b	19.4	b
LSD 0.05	*0.2*		*0.2*		*0.3*		*0.3*		*0.4*		*0.3*		*0.3*		*0.4*		*0.3*	
CV %	*1.2*		*1.2*		*1.1*		*1.6*		*1.5*		*1.3*		*1.3*		*1.3*		*1.2*	

[x] In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly at 0.05 level of significance; [Y]T_1: Control; T_2: Sugar (100-ppm); T_3: Citric Acid (100-ppm); T_4: Salicylic Acid (100-ppm); T_5: Chitosan (100-ppm); T_6: Sugar + Citric Acid (100-ppm); T_7: Sugar + Salicylic Acid (100-ppm); T_8: Citric Acid + Chitosan (100-ppm); T_9: Salicylic Acid + Chitosan (100-ppm)

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Table 03. Petals water content and vase life of three colored gerbera under some chemical preservatives [x]

Vase Solutions[Y]	Petals water content (%)						Vase life (Days)					
	Yellow		Magenta		Orange		Yellow		Magenta		Orange	
T_1	50.0	g	53.6	f	56.8	g	8.3	g	11.5	h	11.8	h
T_2	50.6	e	54.1	e	57.7	f	10.5	e	13.2	f	13.6	f
T_3	50.3	f	53.7	f	56.5	gh	9.9	f	11.7	gh	12.2	g
T_4	50.1	fg	53.5	f	56.2	h	9.7	f	11.9	g	12.4	g
T_5	51.1	d	54.5	d	58.9	e	13.1	d	15.0	e	15.5	e
T_6	51.6	c	55.1	c	59.5	d	13.7	c	16.3	d	16.7	d
T_7	51.8	c	55.3	c	60.0	c	13.9	c	16.7	c	17.1	c
T_8	52.1	b	56.3	a	63.0	a	15.1	b	18.4	a	18.7	a
T_9	52.4	a	55.8	b	61.4	b	16.3	a	17.9	b	18.3	b
LSD 0.05	*0.2*		*0.3*		*0.3*		*0.2*		*0.3*		*0.3*	
CV %	*1.5*		*1.3*		*3.3*		*1.3*		*1.2*		*1.3*	

[x] In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly at 0.05 level of significance; [Y]T_1: Control; T_2: Sugar (100-ppm); T_3: Citric Acid (100-ppm); T_4: Salicylic Acid (100-ppm); T_5: Chitosan (100-ppm); T_6: Sugar + Citric Acid (100-ppm); T_7: Sugar + Salicylic Acid (100-ppm); T_8: Citric Acid + Chitosan (100-ppm); T_9: Salicylic Acid + Chitosan (100-ppm)

The results of the present study disclosed that there were significant differences between different gerbera cultivars for days taken to flower dropping or stem bending, petal discoloration, petal shriveling also for weight loss, petals water content and vase life (9.7-18.7 days). Some had early flower dropping and petal shriveling & discoloration while some had late. Based on vase life and other criteria it can be graded for three gerbera cultivars as follows: orange > magenta > yellow. Cultivar differences for vase life have been reported in gerbera (Ferrante *et al.*, 2007; Nazari deljou *et al.*, 2011; Emongor, 2004) and roses (Ichimura *et al.*, 2002). Increase of flower vase life was found by the application of different floral preservatives in gerbera (Pavana *et al.*, 2015a) rose (Pavana *et al.*, 2015b), orchid (Pavana *et al.*, 2015c), tuberose (Jamal Uddin *et al.*, 2015), gladiolus (Mehraj *et al.*, 2013a) and chrysanthemum (Mehraj *et al.*, 2013b). Water stress is a function of water content at harvest and rates of water uptake and water loss after harvest (Halvey and Mayak, 1979; Meman *et al.*, 2006; Zamani *et al.*, 2011). Cut gerbera flower after harvest is very sensitive to water uptake (Van Meeteren, 1978). Water uptake and fresh weight of cut gerbera decreased sharply and finally led to stem neck (Van Meeteren, 1978). Many other researches have been reported that there is a close relationship between vase life and water stress in anthurium (Paull, 1982) and gerbera (Nazari deljou *et al.*, 2011), which is in agreement with this study. Chemicals like salicylic acid, citric acid might have decreased microbial growth and prevented vascular blockage, thereby helped in increasing vase life and improving turgidity and other characteristics recorded in the present investigation. Previous study had revealed that pathogens affect water uptake due to vascular blockage (Vahdati *et al.*, 2012). The decrease in water uptake of cut flowers during vase period was probably due to growth of microbes and vascular blockage. Anjum *et al.* (2001) suggested adding a suitable germicide in vase solution can prevent the growth of microbes and increased water uptake. Salicylic acid (SA) treatments maintained significantly a more favorable water uptake than in the control treatment. Salicylic acid can be decreased pH of vase solution and consequently, the growth and proliferation of bacteria was reduced which led to increase water uptake (Raskin, 1992). Improvement in vase life with citric acid was due to acidification of solution, improvement in water balance and reduction in stem plugging (Durkin, 1979). Citric acid, especially in higher concentrations increased turgidity compared to other treatments. This may be due to reducing the solution viscosity and the microorganism growth (Alvarez *et al.*, 1994; Reddy *et al.*, 1995; Van Doorn and Peirik, 1990) via lowering the pH of vase solution. The beneficial effect of added sugars on the prolongation of the flower vase life in several species has been attributed to the suppression of ethylene biosynthesis or sensitivity to ethylene (Aarts, 1957). Exogenous sugars extended vase life of several cut flowers such as spray carnations (Borochov and Mayak, 1984), limonium, carnations (Dilley and Carpenter, 1975). SA and Sucrose treatments extended the vase life and improved flower quality with reduced respiration rate and delay senescence. Chitosan is the most abundant basic biopolymer or modified natural, biodegradable, biocompatible, non toxic as well as linear nitrogenous polysaccharides a basic polysaccharide homo-polymer (Malviya, 2010) and is structurally similar to cellulose, which is composed of only one monomer of glucose. So Chitosan with citric acid or salicylic acid will extend the vase life of cut flowers.

IV. Conclusion

According to the results of current research, it can be concluded that chitosan with citric acid extend the post harvest life of yellow gerbera and chitosan with salicylic acid extend the post harvest life of magenta and orange gerbera.

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