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Improving Gerbera Cut Flowers by Using Pulsing and Holding Solutions under Cold Storage Periods Treatments

Helaly, A. A. E.
Vegetable and Floriculture Dept., Faculty of Agric., Mansoura University. Egypt.

ABSTRACT

To improve keeping quality of gerbera cv. Marleen cut flowers this work was conducted at the laboratories of Hort. Dept., Agric. Fac., Mansoura Univ., Egypt during January to February months of 2016 and 2017 seasons. This, by using pulsing and holding solutions and cold storage periods for different durations as well as their interaction treatments, besides, studying these treatments affects on cut flowers vase life, water balance, anthocyanin content and total sugars percentage of gerbera flowers. The used pulsing solution treatments were control as distilled water (DW), 5% sucrose (S) + 200 ppm 8-hydroxy quinolene sulphate (8-HQS) for 16 hours, 15 ppm kinitin (Kin) + 5 % S + 200 ppm 8-HQS for 16 hours, silver thiosulphate (STS) 1:4 mM for 20 minutes then placed in 5 % S + 200 ppm 8-HQS for 16 hours and 1:4 mM STS for 20 minutes then placed in 25 ppm Kin + 5 % S + 200 ppm 8-HQS for 16 hours. Moreover, cut flowers of gerbera were stored at 5±1˚C for 0, 6 and 12 days. In addition, holding solution treatments used after cold storage periods were controlas distilled water (DW) and 5% sucrose (S) + 200 ppm 8-HQS + 200 ppm ascorbic acid (AA), besides to the interaction treatments between them. The obtained results referred to that, the longest vase life of gerbera cut flowers were achieved by STS+S + 8-HQS for 16 hours as pulsing solution and storage at 5±1˚C for 0-time which followed by 6 days and holding solution under study compared to the other interactions. Also, the highest values of water balance were obtained with the same treatment at 0-time storage. Finally, the best data regard anthocyanin content and total sugars percentage were observed with pulsing solutions and storage at 6 days plus 5% S + 200 ppm 8-HQS + 200 ppm AA as holding solution.

Keywords: *Gerbera jamesonii*, pulsing solution, cold storage, holding solution, vase life, water balance and anthocyanin.

INTRODUCTION

Recently, cut flowers occupy, for example gerbera flowers, an important position in the foreign and local markets because of their importance as a source of Egypt national income. However, gerbera (*Gerbera jamesonii*, L.) is an important ornamental plant and is commonly used as beds, borders and a cutting flower belonging to *Asteraceae* family, it is classified as a flowering plant and is one of ten popular cut flowers in the world wich occupies the forth place according to the global trends in floriculture (Choudhary and Prasad, 2000).

Keeping quality is an important indicator for evaluation of quality of cut flowers, for both export and local markets. Additions of chemical preservatives of pulsing and holding solutions have beenrecommended to prolong the vase life of all cut flowers. In this connections, some chemical preservatives, i.e. sucrose + 8-hydroxy quinolene sulphate (8-HQS) in combination with kintin (Kin)or silver thiosulphate (STS) used as pulsing solutions, also, sucrose, 8-hydroxy quinolene sulphate (8-HQS) and ascorbic acid as holding solutions were used to prolong vase extension . Halevy and Mayak (1979) reported that sucrose antagonizes the effect ofAbscissic acid (ABA), which promotes senescence. Application of 8-hydroxy quinolene salts reduced blockages of vascular in cut flowers of rose plant (Marousky, 1971). However, sucrose alone has not been usually used, because sugar treatment without germicides promotes bacterial proliferation, leading to shortening vase life. 8-HQS increased vase life, flower quality, mean absorbed preservative solution, and quality score.Banaee *et al.* (2013) found that 8-HQS also decreased the curvature of stem in gerbera cut flowers. Halevy and Mayak (1979 and 1981) stated that sugars contribute to the osmotic potential of tissues and maintain the respiration rate and membrane integrity. (Reddy and Singh, 1996) reported that increase in water uptake by sucrose pulsing treated tuberose spikes might be due to, translocated sugars accumulated in flowers increased the osmotic potential and improved the ability of spikes to absorb water. Davood and Bagheri (2014) on chrysanthemum cut flower research they found that 100 mg l^{-1} 8-hydroxy quinolene sulfate treatment showed the highest vase life, water absorptionand petal carotenoids. In addition, Cook *et al.* (1985) demonstrated that cytokinins (as Kin) delayed senescence by its effect on ethylene synthesis processes in the tissue of carnation flowers. However, sliver thiosulphate (STS) having the effects of inhibiting ethylene production, reducing the rate of ethylene formation and delaying senescence have also been corroborated (Nowak and Rudnicki, 1990). Citric and ascorbic acidsare maintaining water balance and because of bactericide action it reduces the stem plugging (Meetern, 1979).

Cold storage of cut flowers after harvesting is essential. Palanikumar *et al.* (2000) recorded that dry packed flowers were stored at 4°C at 70 – 75% RH for 4 and 5 days storage enhanced post-harvest life and quality of cut roses. In addition, Abd El- Sadek (2005) observed that gypsophila cut flowers stored at 5°C for (0–5) days recorded significant increase in flowers longevity and improvement in water balance compared to storage at 5°C for 15 days treatment.

Thiswork aimed to evaluate the effectiveness of some pulsing solutions, cold storage periods and holding solution treatments, as simulate cool truck conditions transport in order to minimize transport costs as well as their combination treatments for prolonging longevity and keeping quality of *Gerbera jamesonii* L. cv. Marleencut flowers.

MATERIALS AND METHODS

The present work was conducted at the Laboratories of Hort. Dept., Agric. Fac., Mansoura Univ., Egypt during the two consecutive seasons of 2016 and 2017. Aiming to study the effect of some pulsing solutions, cold storage periods, holding solution and their interaction treatments on vase life, water balance as well as anthocyanin content and total sugars percentage in cut flowers. *Gerbera jamesonii* L. cv. "Marleen" cut flowers of uniform size 12 cm diameter, 65 cm flower stalk length with dark red color. The gerberas cut flowers were obtained from commercial Farm, at Kafrhakim, Imbaba, Giza Governorate, Egypt. The variety used in the investigation was dark red color flower with medium size and attractive appearance. The gerberas flowers were harvested when the ray florets are completely elongated. Immediately after harvest the flowers were brought to the laboratory (light was about 500 lux, temperature 24-26°C and 60-70% relative humidity) for imposing the treatments.

The gerbera cut flowers were subjected to the following treatments:

Pulsing Solutions (PS)

All flowers were divided to equal and similar five groups and were cut again to be (50 cm) which were pulsed in various chemical solutions before storage periods at 5±1°C at different periods (as simulate transport).

- First group was pulsed in distilled water (D.W) for 16 hours (as a control treatment).
- Second group was pulsed in sucrose (S) at 5% + 8-hydroxy quinolenesulphate (200 ppm 8-HQS) for 16 hours.
- Third group was placed in kinitin (15 ppm Kin) + 5% S + 200 ppm 8-HQS for 16 hours.
- Fourth group was pulsed in silver thiosulphate (1: 4 mMSTS) for 20 minutes then 5% S + 200 ppm 8-HQS for 16 hours.
- Fifth group was pulsed in silver thiosulphate (1: 4 mMSTS) for 20 minutes then placed in 25 ppm Kin + 5% S + 200 ppm 8-HQS for 16 hours.

Cold storage periods as simulate transport (CS)

All groups mentioned above packing; every nine stems were warped by tissue paper and packed in carton boxes, then were moved to room storage at 5±1°C and relative humidity between 90-95% for several durations which were 0.0 time, 6 and 12 days. At the end of storage period, gerbera cut flowers were hold till the end of experimental in the holding solutions and distilled water under laboratory condition.

Holding solutions (HS):

After the end of storage period, cut flowers hold in glass containers with two different vase solutions as following:

- D.W (control treatment).
- H.S (25 g/l S + 200 mg/l 8-HQS + 200mg/l ascorbic acid).

Each treatment of pulsing solutions was combined with one of treatment of both storage periods and holding solutions to consist 30interaction treatments.

The treatments of the present work were arranged in split-split plot design, since the main plot contained the pulsing treatments, the sub-plot contained storage periods treatments and finally the sub-sub-plot contained the holding solution treatments with three replicates. Each replicate consisted of three jars. Three cut flowers were held in the jar (500 ml capacity) containing 250 ml solution.

Data Recorded

Post harvest characteristics

The vase life of gerbera cut flowers (days) was determined when the wilted flowers reach 75% from the total number of flowers.

Water balance:

Water balance (g/flower) was calculated as the difference between water uptake and water loss after 4, 8 and 12 days from the treatment.

1. Water uptake (absorbed solution) as g/ flower was determined after 4, 8, and 12 days from the treatment.
2. Water loss (g/flower) was calculated as the difference between the beginning fresh weight of cut flower plus the beginning weight of the solution and fresh weight of cut flowers besides the weight of solution after 4, 8, and 12 days from the treatments.

Chemical constituents

Chemical constituents were determined when control treatment started to show wilting symptoms after 8 days of the beginning of experiment.

Total sugars % were determined in the dried ray flowers samples, calorimetrically according to the method described by Mazumder and Majumder (2003). Anthocyanin content (mg/100g dry weight) in ray flowers: a sample of air dried weighted ray flowers was determined cholorimertrically according to the method described by Abou-Arab *et al.*(2011).

Statistical Analysis

All collected data were subjected to analysis of variance (ANOVA) and comparing between means were by using the least significant difference (LSD) test at $P \leq 0.05$ as reported by Gomez and Gomez (1984). The statistical calculations were performed with statistix software version 9 (Analytical Software, 2008).

RESULTS AND DISCUSSION

Effect of pulsing solution treatments

Data presented in Table 1 illustrate that, in most cases all pulsing solution treatments recorded significant increase in vase life and water balance of gerbera cut flowers comparing to control in the two tested seasons. However, the treatment of silver thiosulphate (STS) at 1:4 mM for 20 minutes then placed in 5% S + 200 ppm 8-HQS for 18 hours (STS + S + 8-HQS) recorded significant increase in vase life and water balance comparing to control and the all other treatments during the two seasons. These results are in accordance with those reported by (Kwon *et al*., 2000) on freesia using STS + S + 8-HQS for vase life; (Chamani *et al*., 2005) on rose cv. First Red reported that STS complex with application of sucrose gave promising results in prolonged vase life and enhanced flower vase quality; (Hayat *et al*., 2012) on rose using combination between STS with sucrose regarding longevity as well as (Asrar, 2012) on snapdragon and (Elshereef, 2015) on carnation and solidago cut flowers using 8-HQS + sucrose regarding vase life and water balance, whereas, the increase in water balance due to STS treatment was also found by Selamawit*et al*.(2018) on rose cut flower spikes.

Chamani *et al*.(2005) observed an increase in rose cut flowers vase life caused by STS + S + 8-HQS treatment might be due to STS inhibition effect on ethylene production which caused a decrease in lipoxygenase activity and served as an antibacterial component. Sucrose reduced the initial water uptake due to the decrease in osmotic potential of sucrose solution. Moreover, Abdel Kader (1987) indicated that 8-HQS salts delayed senescence and eliminated bacterial growth, which was the principal reason for reduction water uptake and transport of gerbera flower.

Table 1. Vase life (days) water balance (g/flower) and some chemical constituents of gerbera cut flowers as influenced by pulsing solutions during 2016 and 2017 seasons

Pulsing solution	Vase life (day)	Water balance (g/flower)			Chemical constituents	
		Shelf life period (day)			Anthocyanin (mg/100g D.W.)	Total Sugars (%)
		4	8	12		
First season (2016)						
Control (DW)	15.93	0.58	0.10	-0.16	2.89	5.20
S+8HQS	16.73	0.73	0.45	0.25	2.71	4.21
Kin+S+8HQS	18.01	0.83	0.67	0.35	2.97	3.55
STS+S+8HQS	20.98	1.01	0.88	0.55	2.87	5.07
STS+Kin+S+8HQS	18.65	0.88	0.72	0.47	2.84	3.78
LSD at 5%	0.17	0.022	0.077	0.005	0.10	0.15
Second season (2017)						
Control (DW)	13.37	0.72	-0.03	-0.17	3.22	5.05
S+8HQS	15.15	0.67	0.53	0.36	3.10	4.38
Kin+S+8HQS	16.27	0.63	0.56	0.41	3.40	3.50
STS+S+8HQS	19.49	0.96	0.86	0.67	3.08	5.31
STS+Kin+S+8HQS	16.35	0.66	0.60	0.42	3.06	6.19
LSD at 5%	0.24	0.008	0.004	0.006	0.17	0.40

DW distilled water, S sucrose, 8HQS 8-hydroxy quinolenesulphate, Kkinitin, STS silver thiosulphate.

Data tabulated in Table 1 show that, in most cases, anthocyanin content in flowers (mg/ 100 g dry weight) and total sugars percentage in flowers of *Gerbera jamesonii* L. recorded a decrease as a result of exposing to pulsing solutions comparing to control treatment. (Yamane *et al*., 2005) on gladiolus using sucrose, (El-Bouhy, 2002) on tuberose using kinetin and (Abd El-Sadek, 2005) on gypsophila using STS regarding total soluble sugars percentage as well as Almasi *et al*. (2012) on *Dendrobium* using sucrose + 8-HQC regarding anthocyanin content, also had reported similar results.

Effect of storage periods treatments

Resultsunder discussion in Table 2 suggest that, in most cases, there are gradual decrease in post-harvest characters (vase life) and water balance of gerbera cut flowers with extending the cold storage period. Stored cut flowers for 12 days recorded significant decrease in vase life as compared to 0-timestorage period in the two seasons. However, cut flowers stored for zero and 6 days recorded an increase in this regardwhen compared to the long storage period of 12 days in both seasons.These results are in line with those obtained by Abd El-Sadek (2005) on gypsophila cut flowers and Jadhav (2018) on rose, gerbera, gladiolus, tuberose and carnation. Hettiarachchi and Balas (2005) stated that cold storage at 4 °C maintained good flower quality during the vase of cut *Kniphofia uvaria* flowers.

The recorded data in Table 2 suggest that, gerberas cut flowers stored for 6 days 5±1°C recorded an increase in anthocyanin content and total sugars as compared to the start (0-time) and the long storage period of 12 days in the two seasons. Furthermore, anthocyanin content and total sugars in cut flowers were significantly increased when stored to 5 or 10 days compared to control (0-time). Since, Gul *et al.* (2007) attributed this increase to enhanced influx of water and osmolytes into cells. In addition, cold storage treatment before transfer to holding solutions improved iris species floral diameter, membrane integrity and maintained higher fresh and dry mass of flowers, sugar content, and soluble proteins (Ahmad *et al.,* 2013).

Effect of holding solution treatments

The data presented in Table 3 show that, holding solution contained 5% sucrose + 200 mg/l 8-HQS + 200 mg/l ascorbic acid significantly increased the vase life and water balance of gerbera cut flowers in comparison with control (D.W treatment) in most cases in both seasons. In the same time, water balance decreased as they advanced in age to be the minimum after 12 days from the treatment during first season. In addition, the treatment of holding solution contained S + 8-HQS + AA significantly decreased water balance (g /flower) compared to the control in the two seasons after 4, 8, and 12 days from the treatment and at the end of shelf life (after 12 days) in mostly.

Table 2. Vase life (day), water balance (g/flower) and some chemical constituents of gerbera cut flowers as influenced by storage period on during 2016 and 2017 seasons

Storage period (day)	Vase life (day)	Water balance (g/flower)			Chemical constituents	
		Shelf life period (day)			Anthocyanin (mg/100g D.W.)	Total Sugars (%)
		4	8	12		
First season (2016)						
0 time	20.97	0.80	0.59	0.42	2.67	3.25
6 days	16.43	0.82	0.65	0.52	2.99	5.20
12 days	16.78	0.79	0.46	-0.06	2.91	4.63
LSD at 5%	0.14	0.025	0.082	0.008	0.10	0.14
Second season (2017)						
0 time	19.30	0.82	0.56	0.37	2.80	3.43
6 days	14.39	0.72	0.52	0.34	3.41	5.72
12 days	14.09	0.65	0.43	0.30	3.30	5.50
LSD at 5%	0.20	0.009	0.010	0.008	0.11	0.41

Generally, there were similar results mentioned by Khenizy (2000) on carnation by using S + 8-HQS + CA as well as (Cho *et al.,* 2001) on *Eustoma grandiflorum* (Raff.) by using sucrose. Moreover, ascorbic acid might be increased vase life by decreasing the pH of holding solution consequently the increase of water uptake as mentioned by Phavaphutanon and Ketsa (1989) on cut rose's cv. Christian Dior. So by application of these chemicals, blockage of vessels is prevented and ethylene levels retain resulting in prolonged fresh vase life.

Table 3 pointed out that the treatment of S + 8HQS+ citric acid as holding solution recorded significant decrease in anthocyanin content (mg/100g) and total sugars percentage of gerbera cut flowers comparing to control (distilled water). Such results hold true in both seasons. These results are in similar with those stated by Gendy (2000) on gladiolus cut flower spikes and Koley *et al.* (2017) on *Strelitzia reginae* cut flowers.

Table 3. Effect of holding solution on vase life (day), water balance (g/flower) and chemical constituents of gerbera cut flowers during 2016 and 2017 seasons

Holding solution	Vase life (day)	Water balance (g/flower)			Chemical constituents	
		Shelf life period (day)			Anthocyanin (mg/100g D.W.)	Total Sugars (%)
		4	8	12		
		First season (2016)				
Control (DW)	17.31	0.61	0.27	0.02	2.90	4.61
S+8HQS+AA	18.81	1.00	0.87	0.56	2.80	4.10
LSD at 5%	0.14	0.014	0.046	0.004	0.07	0.10
		Second season (2017)				
Control (DW)	14.84	1.07	-0.08	0.70	3.25	5.12
S+8HQS+AA	17.01	1.40	2.60	4.33	3.09	4.64
LSD at 5%	0.15	0.007	0.004	0.005	0.07	0.28

DW distilled water, S sucrose, 8HQS 8-hydroxy quinolenesulphate, AAAscorbic acid

Effect of interaction treatments regards pulsing solutions, storage periods and holding solutions

It is clear from the results in Table 4 that, in most cases, under the interaction treatments among pulsing, cold storage periods and holding solutions, there were gradual decrease in vase life as well as water balance (g / flower) of gerbera cut flowers with extending storage periods at 5±1°C for different days (0 time, 6 and 12 days). The interaction between the pulsing in STS + S + 8-HQS for all the storage periods with holding in HS produced in most cases the highest vase life and water balance parameters in the two seasons. However, treatments of interaction among storage periods at 5±1°C (0-time), pulsing solution of STS + S + 8-HQS and holding solution of S + 8-HQS + AA significantly increased the vase life and water balance of *Gerbera jamesonii* L. cut flowers compared to control and the other ones under study in the two seasons.

Similar results were found by Abd El-Sadek (2005) on gypsophila cut flowers. Such increase in gerbera cut flowers longevity due to the interaction treatments among pulsing solutions, storage periods (0, 6 and 12 days at 5±1°C) and holding solution (S + 8-HQS + AA) might be attributed to that, each pulsing solution used alone or storage periods or holding treatments recorded a promotive effect in this connection as mentioned and attributed just before. Consequently, their interactions together might maximize their effects in this regard.

Table 4. Vase life (day) and water balance (g/ flower) of gerbera cut flowers as influenced by the combination between storage periods, pulsing solutions and holding solutions on during 2016 and 2017 seasons

Storage period	Pulsing solution	Holding solution	Vase life (day)		Water balance (g/ flower)					
					Shelf life period (day)					
					First season (2016)			Second season (2017)		
			1st	2nd	4	8	12	4	8	12
0-time (start)	Control (DW)	DW	17.73	13.20	0.32	-0.36	-0.63	0.94	-0.52	-0.63
		HS	20.03	18.47	0.62	0.56	0.44	0.71	0.60	0.41
	S+8HQS	DW	18.53	17.55	0.56	0.36	0.28	0.61	0.42	0.31
		HS	21.39	21.25	0.93	0.90	0.76	0.86	0.78	0.49
	Kin +S+8HQS	DW	18.83	19.15	0.71	0.49	0.17	0.62	0.60	0.36
		HS	20.25	18.40	0.92	0.82	0.78	0.78	0.62	0.52
	STS+S+8HQS	DW	24.40	20.65	0.89	0.72	0.52	0.92	0.80	0.41
		HS	27.14	25.90	1.24	1.09	0.98	1.10	0.92	0.83
	STS+ Kin +S+8HQS	DW	20.11	19.00	0.74	0.37	0.06	0.68	0.51	0.29
		HS	21.27	19.42	1.11	0.96	0.81	0.96	0.82	0.68
6-days	Control (DW)	DW	13.55	11.85	0.23	-0.23	-0.46	0.58	-0.51	-0.74
		HS	14.00	14.40	0.76	0.57	0.33	0.62	0.51	0.43
	S+8HQS	DW	14.50	11.95	0.39	0.26	0.20	0.64	0.50	0.23
		HS	15.23	14.40	1.02	0.83	0.79	0.85	0.59	0.53
	Kin +S+8HQS	DW	16.57	15.50	0.55	0.48	0.29	0.58	0.49	0.29
		HS	15.67	16.55	0.97	0.83	0.67	0.61	0.60	0.39
	STS+S+8HQS	DW	17.85	15.30	0.90	0.82	0.59	0.86	0.79	0.52
		HS	18.85	17.07	1.28	1.09	0.98	1.08	0.96	0.89
	STS+ Kin +S+8HQS	DW	17.67	12.05	0.84	0.71	0.68	0.51	0.49	0.19
		HS	20.44	14.80	1.29	1.18	1.09	0.86	0.80	0.72
12-days	Control (DW)	DW	14.50	10.33	0.69	-0.53	-0.39	0.69	-0.96	-0.81
		HS	15.77	11.95	0.86	0.62	-0.31	0.82	0.71	0.31
	S+8HQS	DW	15.33	11.87	0.64	-0.38	-0.18	0.52	0.43	0.27
		HS	15.40	13.90	0.87	0.76	-0.33	0.54	0.49	0.37
	Kin +S+8HQS	DW	17.87	13.47	0.70	0.42	-0.25	0.55	0.50	0.47
		HS	18.87	14.53	1.12	1.01	0.46	0.61	0.53	0.45
	STS+S+8HQS	DW	17.70	15.43	0.56	0.40	-0.30	0.82	0.80	0.52
		HS	19.93	16.57	1.20	1.18	0.51	0.99	0.90	0.83
	STS+ Kin +S+8HQS	DW	14.53	15.30	0.52	0.48	-0.34	0.36	0.29	0.19
		HS	17.87	17.55	0.81	0.63	0.50	0.59	0.62	0.44
LSD at 5%			0.50	0.58	0.055	0.018	0.017	0.010	0.017	0.016

Pulsing solution: DW distilled water, S sucrose, 8HQS 8-hydroxy quinolenesulphate, KinKinitin, STS silver thiosulphate. Holding solution (H.S) S sucrose, 8HQS 8-hydroxy quinolenesulphate.

Data in Table 5 shows that, in most cases, the treatment of interaction among STS + S + 8-HQS as pulsing solution, storage at 5±1°C for 0- time or 5 days and holding solution of HS recorded significant increase in total sugars percentage as compared to the other treatments under study in the first and second seasons, respectively. These results are in line with those stated by Abd El-Sadek (2005) on gypsophila cut flowers. Furthermore, anthocyanin content significantly increased with all interaction treatments between pulsing solution, storage periods and holding solution compared with control (DW) of pulsing solution and 0 time of storage and DW of holding solution during both seasons, in most cases. These results coincided with those found by Gendy (2007) on gladiolus cut flower spikes.

Table 5. Anthocyanin (mg/100g D.W.) and total sugars (%) of gerbera cut flowers as influenced by the combination between storage periods, pulsing solutions and holding solutions on during 2016 and 2017 seasons

Storage period	Pulsing solution	Holding solution	Anthocyanin (mg/100g D.W.) 1st	2nd	Total Sugars (%) 1st	2nd
0-time (start)	Control (DW)	DW	2.88	2.43	6.83	6.74
		HS	2.57	3.00	2.46	3.90
	S+8HQS	DW	2.46	2.64	1.47	1.99
		HS	2.35	2.71	0.65	0.50
	Kin+S+8HQS	DW	3.01	3.45	5.36	5.03
		HS	2.81	2.87	0.84	1.10
	STS+S+8HQS	DW	2.29	2.52	2.17	1.41
		HS	2.97	2.76	4.12	4.30
	STS+ Kin +S+8HQS	DW	2.16	2.80	5.20	5.93
		HS	3.12	2.82	3.45	3.43
6-days	Control (DW)	DW	3.04	3.60	2.79	2.49
		HS	2.84	3.32	8.23	8.91
	S+8HQS	DW	3.21	3.30	2.53	2.99
		HS	3.01	3.18	9.16	9.22
	Kin +S+8HQS	DW	3.06	3.99	0.63	0.43
		HS	3.22	3.65	3.52	4.02
	STS+S+8HQS	DW	3.43	3.65	4.34	4.25
		HS	2.33	3.29	8.59	10.99
	STS+ Kin +S+8HQS	DW	3.18	3.47	3.64	4.01
		HS	2.59	2.66	8.55	9.92
12-days	Control (DW)	DW	2.98	3.59	8.50	6.26
		HS	3.00	3.37	2.38	2.00
	S+8HQS	DW	2.62	3.35	7.41	9.39
		HS	2.62	3.42	4.06	2.16
	Kin +S+8HQS	DW	3.07	3.37	8.46	7.29
		HS	2.63	3.07	2.46	3.10
	STS+S+8HQS	DW	3.18	3.30	8.50	8.13
		HS	3.00	2.94	2.68	2.77
	STS+ Kin +S+8HQS	DW	2.98	3.31	1.41	10.60
		HS	2.99	3.30	0.45	3.27
LSD at 5%			0.28	0.31	0.37	1.04

Pulsing solution: DW distilled water, S sucrose, 8HQS 8-hydroxy quinolenesulphate, KinKinitin, STS silver thiosulphate. Holding solution (H.S) S sucrose, 8HQS 8-hydroxy quinolenesulphate.

REFERENCES

Abd El-Sadek, O.A. (2005). Effect of some post-harvest treatments on gypsophilla cut flowers. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Abdel Kader, H. H. (1987). Effect of flower preservative solutions on post-harvest physiology, development ultrastructure, and the stem break problem of cut gerbera. Ph. D. Thesis, Fac. Graduate School Üniv., Missouri, Columbia.

Abou-Arab, A.A., F.M. Abu-Salem and E.A. Abou Arab (2011). Physico-chemical properties of natural pigments (anthocyanin) extracted from roselle calyces (*Hibiscus subdariffa*). J. Am. Sci., 7:445-456.

Ahmad, S.S., I. Tahir and W. Shahri (2013). Effect of different storage treatments on physiology and post-harvest performance in cut scapes of three iris species. J. Agric. Sci. Tech., 15: 323-331.

Almasi, P., M.T.M. Mohamed, S.H. Ahmad, J. Kadir and A. Mirshekari (2012). Post-harvest responses of cut *Dendrobium* orchids to exogenous ethylene. Afr. J. Biotechnol., 11 (6): 3895-3902.

Analytical Software (2008). Statistix Version 9, Analytical Software, Tallahassee, Florida, USA.

Asrar, A.A. (2012). Effects of some preservative solutions on vase life and keeping quality of snapdragon (*Antirrhinum majus* L.) cut flowers. J. Saudi Soc. Agric. Sci., 11: 29–35.

Banaee, S., E. Hadavii and P. Moradi (2013). Interaction effect of sucrose, salicylic acid and 8-hydroxyquinoline sulfate on vase-life of cut gerbera flowers. Current Agric. Res. J., 1(1): 39-43.

Chamani, E., A. Khalighi, D.C. Joyce, D.E. Irving, Z.A. Zamani, Y. Mostofi and M. Kafi (2005). Ethylene and anti-ethylene treatment effects on cut 'First Red' rose. J. Appl. Hort., 7 (1): 3-7.

Cho, M., F.G. Celikel, L. Dodge and M.S. Reid (2001). Sucrose enhances the post-harvest quality of cut flowers of *Eustoma grandiflorum* (Raf.) Shinn. Proc. VII Int. Symp. on Post-harvest Physiology Ornamentals Eds. T.A. and D.G.Clark. Acta Hort., 543.

Choudhary, M.L. and K.V. Prasad (2000). Protected cultivation of ornamental crops- An insight. Indian Hort., 45 (1): 49-53.

Cook, D., M. Rasche and W. Elisinger (1985). Regulation of ethylene biosynthesis and action in cut carnation flower senescence by cytokinins. J. Am. Soc. Hort. Sci., 110: 24-27.

Davood, H. and H. Bagheri (2014). Comparison tea extract, 8-hydroxy quinolene sulfate and rifampicin on the vase life of cut chrysanthemum (*Denderanthema grandiflorum* L. cv. purple). Journal of Ornamental Plants 4 (1): 39-43.

El-Bouhy, N. F. (2002). Effect of some post-harvest treatments on *Poliamthes tuberosa*cut flowers. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Elshereef, E.A.Y. (2015). Effect of some post-harvest treatments on some cut flowers. M. Sc. Thesis, Fac. Agric., Cairo Univ.

Gendy, A.S. (2000). Physiological study on the effects of some post-harvest treatments on gladiolus cut flowers. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Gendy, A.S. (2007). Effect of some storage and preservative solution treatments on characters of gladiolus cut flowers. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Gomez, K. A. and A. A. Gomez (1984). Statistical Procedures for Agricultural Research. John Wiley & Sons Inc., Singapore 680.

Gul, F., I. Tahir and S.M. Sultan (2007). Effect of storage temperature on post-harvest performance of *Amaryllis belladonna* L. cv. Rosea Scapes. J. Plant Biol., 34: 43-47.

Halevy, A.H. and S. Mayak (1979). Senescence and post-harvest physiology of cut flowers: Part 1. Hort. Rev., 1 : 204-236.

Halevy, A.H. and S. Mayak (1981). Senescence and post-harvest physiology of cut flowers. Hort. Rev., 3: 59-143.

Hayat, S., N. Ul Amin, M.A. Khan, T.M.A. Soliman, M. Nan, K. Hayat, I. Ahmad, M.R. Kabir and L. Zhao (2012). Impact of silver thiosulfate and sucrose solution on the vase life of rose cut flower cv. Cardinal. Adv. in Environ. Biol., 6 (5): 1643-1649.

Hettiarachchi, M.P. and J. Balas (2005). Post-harvest handling of cut Kniphofia (*Kniphofia uvaria*) flowers. ISHS Acta Horticulture (Feb.). VIII Int. Symposium on Post-harvest Physiol. of Ornamental Plants.

Jadhav, P. B. (2018). Extending shelf-life of different cut-flowers under cold room conditions. Inter. J. Environ., Agric. and Biotechn., 3 (5): 1776-1778.

Khenizy, S.A.M. (2000). Physiological studies on some cut flowers. M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Koley, T., Y. C. Gupta, P. Sharma and S. R. Dhiman (2017).Standardization of holding solution to enhance vase life and postharvest quality of cut stem of bird of paradise, Strelitzia reginae Ait. Inter. J. of Farm Sci., 7(4): 53-57.

Kwon, H., K. Kim, H.J. Kwon and K.S. Kim (2000). Inhibition of lipoxygenase activity and microorganisms' growth in cut freesia by pulsing treatment. J. Korean Soc. Hort. Sci., 41: 135-138.

Marousky, F.J. (1971). Inhibition of vascular blockage and increased moisture retention in cut roses induced by pH, 8-hydroxyquinolinecitrate and sucrose. J. Am. Soc. Hort. Sci., 96:38–41.

Mazumdar, B. C. and K. Majumder (2003). Methods of Physiochemical Analysis of Fruits. Daya Publishing House Delhi, India.

Meetern, U.V. (1979). Water relation and keeping quality of cut gerbera flowers. IV. Internal water relations of ageing petal tissue. Sci. Hort., 11 (1): 83-93.

Nowak, J. and R.M. Rudnicki (1990). Post-harvest Handling and Storage of Cut Flowers, Florist Greens and Potted Plants. In: Champan and Hall, London. New York.

Palanikumar, S., S.K. Mishra, D.S. Khurdiya and S.K. Bhattacharjee (2000). Influence of dry storage on post-harvest life and quality of cut roses. Annals Agric. Res., 21 (2): 271-273.

Phavaphutanon, L. and S. Ketsa (1989). Effect of pH adjustment of the holding water on vase life and post-harvest changes of cv. Christian Dior cut roses. Kasetsart. J. Nat. Sci., 23 (2): 111-118.

Reddy, B.S. and K. Singh (1996). Effect of aluminiumsulphate and sucrose on vase life of tuberose. J. Maha. Agril. Uni., 21 (2): 201-203.

Selamawit, Z., M. Alemayehu and T. Yeshiwas (2018).Pulsing preservatives to prolong vase life of cut rose flowers in Bahir Dar, Northwestern Ethiopia. International Journal of Sustainable Agricultural Research, 5(4): 54-67

Yamane, K., T. Kawachi, Y. T. Yamaki and N. Fujishige (2005). Effects of treatment with trehalose and sucrose on sugar contents, ion leakage and senesce of florets in cut gladiolus spikes. ISHS Acta Horticulture 669 (Feb. 2005) VIII Int. Symposium on Post-harvest Physiol. of Ornamental Plants.

تحسين أزهار الجربيرا المقطوفة باستخدام معاملات محاليل الحفظ المؤقتة والدائمة وفترات التخزين البارد

أحمد عبد المنعم السيد هلالي

قسم الخضر والزينة- كلية الزراعة - جامعة المنصورة

أجري هذا العمل في معامل قسم البساتين كلية الزراعة جامعة المنصورة في مصر خلال شهرى يناير و فبراير من العامين2016 و2017 لتحسين جودة أزهار الجربيرا المقطوفة صنف مارلين.وذلك، باستخدام معاملات محاليل الحفظ المؤقتة والدائمة وفترات التخزين البارد ومعاملات التفاعل بينهم، بالإضافة إلى دراسة تأثيرات هذه المعاملات على صفات عمر الأزهار في الفازةوالإتزان المائي والمحتوي من الأنثوسيانين ونسبة السكريات الكلية المئوية لأزهار الجربيرا المقطوفة. كانت معاملات محاليل الحفظ المؤقتة المستخدمة هي الماء المقطر، و5 % سكروز + 200 جزء في المليون 8-هيدروكسى كينولين سلفات لمدة 16 ساعة، و15 جزء في المليون كينيتين + 5 % سكروز + 200 جزء في المليون 8-هيدروكسى كينولين سلفات لمدة 16 ساعة، وثيوسلفات الفضة بتركيز 4:1 ملليمول لمدة 20 دقيقة ثم وضعت في 5 % سكروز + 200 جزء في المليون 8-هيدروكسى كينولين سلفات لمدة 18 ساعة، وثيوسلفات الفضة بتركيز 4:1 ملليمول لمدة 20 دقيقة + 25 جزء في المليون كينيتين + 5 % سكروز + 200 جزء في المليون 8-هيدروكسى كينولين سلفات لمدة 16 ساعة. كذلك، معاملات فترات التخزين حيث تم تخزين أزهار الجربيرا المقطوفة على 5± °م لمده صفر، 6 ، 12 يوم.بالإضافة إلى ذلك، كانت معاملات محاليل الحفظ الدائم المستخدمة بعد معاملات التخزين هي ماء مقطر، 25 جرام / لتر سكروز + 200 مليجرام/ لتر سلفات هيدروكسى كينولين سلفات + 200 مليجرام / لتر حمض اسكوربيك.أظهرت النتائج المتحصل عليها بأنه يمكن الحصول على أطول عمر لأزهار الجربيرا المقطوفة صنف مارلين باستخدام معاملات التداخل بين محلول الحفظ المؤقت ثيوسلفات الفضة + سكروز + + 8-هيدروكسى كينولين سلفات لمدة 16 ساعة كمحلول حفظ مؤقت وفترات التخزين علي درجة 5±1 °م لمدة صفر والذي تبع بستة أيام ومحلول الحفظ الدائم مقارنة بمعاملات التفاعل الأخرى.أيضاً، أعلى القيم للإتزان المائي مع ذات المعاملة عند عدم التخزين. أخيراً، كانت أفضل النتائج للمحتوى من الأنثوسيانين ونسبة السكريات الكلية المئوية عند المعاملة بمحاليل الحفظ المؤقتة والتخزين عند 6 أيام بجانب5% سكروز + 200 جزء في المليون من 8-هيدروكسى كينولين سلفات + 200 ملليجرام / لتر حمض الأسكوربيك) كمحاليل حفظ دائمة.