J. Product. & Dev., 16(3):397 – 414(2011)

EFFECT OF SOME STORAGE AND PRESERVATIVE SOLUTION TREATMENTS ON VASE LIFE AND QUALITY OF *STRELITZIA REGINAE* L. CUT FLOWERS

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ABSTRACT

Such research was conducted during the two seasons of 2007and 2008 at the Hort. Lab. Dept., Fac. Agric., Zagazig Univ. to evaluate effects of five preservative solutions as pulsing applications and three cold storage periods as well as their interactions on vase life and quality of Strelitzia reginae L cut flower spikes. Pulsing treatments were implicated holding cut flower spikes in the following solutions: 1- Distilled water (dw) for 12 h as control, 2- Silver thiosulphate at 1: 4 mM (STS)for 30 minutes, 3- STS for 30 min., then solution containing 20% sucrose (S) + 200 ppm Ocimum basilicum L leaf extract for 12 h, 4- STS for 30 min., then solution containing 20% S + 200 ppm Matricaria chamomilla L. flower extract for 12 h, and 5- STS for 30 min., then solution containing 20% S + 200 ppm 8-hydroxy quinolene sulphate (8-HQS) for 12 h. Cut flowers were subjected to pulsing treatments just before cold storage. The three tested cold storage periods were without cold storage (control), storage for 5 or 10-days at 6±1°C and 80 – 90 % relative humidity (simulate transport conditions). After subjecting flowers to pulsing and storage treatments, treated cut flower spikes were hold in distilled water as permanent vase solution to record the effects on vase life.

All tested pulsing solutions significantly increased vase life and florets opening %, decreased contamination in vase solution, improved water balance for cut flower spikes, and maintained flower quality; i.e., anthocyanin content in petals. Pulsing treatment of STS at 1: 4 mM for 30 minutes, then in solution containing 20 % S + 200 ppm 8-HQS for 12 hours had the most favorable effect in this respect.

As the cold storage period was increased from zero-time to 10-days, the above mentioned characters of cut flower longevity and quality were decreased.

When pulsing applications interacted with cold storage periods, the highest quality and the longest vase life of Strelitzia reginae L. cut flower spikes were obtained under the interaction treatments of pulsing

in STS for 30 min. and then in 20% S + 200 ppm 8-HQS for 12 hours without cold storage or with storage for 5-days at 6±1°C compared to control and the other interaction treatments.

Key words: Storage & preservative solution, vase life & quality of *strelitzia reginae* L., cut flowers.

INTRODUCTION

Nowadays, cut flowers occupy an important position in the local and foreign markets because of their importance as a source of national income. Bird of paradise (*Strelitzia reginae* L.) cut flower spikes represent one of the most desirable and important flowering crops.

Preservative materials used as pulsing seemed to prolong flower longevity. In this respect, some preservatives materials; *i.e.,* sucrose (S), 8-hydroxy quinolene sulphate (8-HQS), silver thiosulphate (STS) and ethanol extracts of sweet basil (*Ocimum basilicum*) or German chamomile (*Matricaria chamomilla*) frequently used as pulsing solutions.

On cut snapdragon flowers, sucrose inhibited ethylene synthesis and consequently delayed flower senescence as well as promoted bud opening (Ichimura and Hisamatsu, 1999). Also, 8-hydroxy quinoline sulphate (8-HQS) eliminated bacterial growth in vase solution, the principal reason for reduction water uptake and transport, so it delayed gerbera flower senescence (Abdel Kader, 1987). Additionally, silver thiosulphate (STS) was reported as most effective bactericide and an inhibitor to ethylene production and action, (Nowak and Rudnicki, 1990).

With the presence of sucrose (S), adding germicide such as 8-HQS was necessary to inhibit microbial growth (Sacalis 1993). Since, S reduced the initial water uptake due to the caused reduction in osmotic potential of S solution. While, 8-HQS prevented growth of microorganisms in xylem and thus maintained water uptake by flower stems. Reid *et al.* (2001) reported that pulsing solution treatment of 20 % S + 250 ppm 8-HQS significantly improved vase life and flower opening of cut tuberose spikes. Similarly, Sashikala et al., (2001) on gladiolus reported that pulsing spikes with 20% S combined with 4 mM STS increased florets longevity and vase life. Since, STS inhibited ethylene action and reduced lipoxygenase activity as well as served as an antibacterial component.

Extract of sweet basil (*Ocimum basilicum*) leaves contains many compounds; *i.e.,* 1, 8 cineol, eugenol, methyl-eugenol, thymol, p-cimene, cis-ocimene, and cis-caryophyllene. It inhibited organisms' growth of *Staphylococcus aureus, Shigella flexneri, Salmonella enteritidis, Escherichia coli, Klebsiella sp., Proteus mirabilis,* and *Pseudomonas aeruginosa* (Ntezurubanza *et al*., 1987).

Also, chamomile (*Matricaria chamomilla* L.) flower extract contains flavonoids, including flavone glycosides such as apigenin 7-glucoside and flavonols as quercetin glycosides and luteolin glucosides (Srivastava & Gupta, 2007). The pharmacological effect of chamomile is mainly connected with its essential oils (Salamon, 2007).

Subjecting cut flowers to cold conditions during different handling processes; *i.e.,* after cutting during grading and storage as well as transportation is an essential practice. Storage cut flowers at the optimum low temperature under high relative humidity percentage frequently delayed senescence and maintained flower quality. Song et al., (1992) on gladiolus cut flowers, they studied the effect of cold storage periods of 1 or 2 weeks at 8 °C, found that increasing storage period markedly reduced vase life. While, Palanikumar *et al*., (2000) recorded an enhancement in vas life and quality of cut roses by dry packaging and storage at 4 °C and 70 – 75% relative humidity for 4 or 5 days.

When pulsing solutions was combined with cold storage, Kushal *et al*., (2000) stated that subjecting gladiolus cut flower spikes to pulsing solution treatment of 20% S + 200 ppm 8-HQS for 20 h at 23 ± 2°C was more effective than at 5 ± 1°C since, this combined treatment controlled bacterial growth and increased vase life. Waithaka *et al*., (2001) on cut tuberose (*Polianthes tuberosa* L.) recorded that pulsing spikes with 20% S solution containing 8- HQS before cold storage significantly improved vase life.

Therefore, the main purpose of the current study was to evaluate the effectiveness of some pulsing solution treatments, cold storage periods under simulate transport cool truck conditions as well as their interaction treatments for prolonging longevity and keeping quality of *Strelitzia reginae* L. cut flower spikes.

MATERIALS AND METHODS

The present work was conducted during the two successive seasons of 2007 and 2008 at the Hort. Lab. Department, Faculty of Agriculture, Zagazig University to evaluate effects of cold storage periods, pulsing solution treatments and their interactions on vase life and quality of *Strelitzia reginae* L. cut flower spikes.

Bird of paradise (*Strelitzia reginae* L.) inflorescences consist of boat-shaped bracts containing a series of 5- 6 flowers were used in this study. Flower spikes were supplied from Agriculture Faculty Farm, Zagazig University, Zagazig, Egypt. The uniform flower spikes at colored bud stage (the first emerging orange flower) with 90 cm. long and about 1 cm. diameter were harvested at the morning, and then they were warped in tissue paper and quickly transported to the laboratory. Flower spikes bases were

re-cut (10 cm.) just before treatments and placed in glass containers containing distilled water, under Lab. conditions; *i. e.*, 24 hours fluorescent light (about 500 lux), temperature of 25±2 °C and at 60–70% relative humidity. The experiment was started on the 1st November at the two tested seasons of 2007 and 2008.

The Experimental Treatments:

1. Pulsing treatments:

Pulsing solution treatments were applied on *Strelitzia reginae* L. cut flower spikes just before subjecting flowers to the tested cold storage treatments. However, pulsing treatments were implicated holding spikes in five different solutions as follows:

1. Pulsing in distilled water (d.w) for 12 hours as control treatment.
2. Pulsing in silver thiosulphate (STS) at 1: 4 mM for 30 minutes.
3. Pulsing in STS at 1: 4 mM for 30 minutes, then in solution containing 20% sucrose (S) + 200 ppm *Ocimum basilicum* leaf extract (OE) for 12 hours.
4. Pulsing in STS at 1: 4 mM for 30 minutes, then in solution containing 20% S + 200 ppm *Matricaria chamomilla* flower extract (ME) for 12 hours.
5. Pulsing in STS at 1: 4 mM for 30 minutes, then in solution containing 20% S + 200 ppm 8-hydroxy quinolene sulphate (8-HQS) for 12 hours.

Silver thiosulphate (STS) was freshly prepared when ever needed according to the procedure described by Gorin *et al*., (1985) as follows:

1. Dissolving 0.079 g of ($AgNO_3$) in 500 ml distilled water (solution 1).
2. Dissolving 0.462 g of ($Na_2S_2O_3$, $5H_2O$) in 500 ml distilled water (solution 2).
3. Pouring solution 1 on solution 2 with stirring. The end concentration of silver was 0.463 mM.

To prepare the tested plant material extracts, leaves of *Ocimum basilicum* and flowers of *Matricaria chamomilla* were collected from Faculty of Agriculture, Zagazig University, plant materials were thoroughly washed using tap water and rinsed with distilled water. Then, they were subjected to 60 ^{o}C for 30 minutes for ensure stopping enzyme activity (Effraim *et al*., 2000). Then, collected plant materials were dried at airy and shady place. The dried materials were finely grinded and the powders were extracted in ethanol alcohol for 72 hours (one liter for 500 g powder) using Soxhlet extractor. Then, the extracts were filtered and concentrated at 40 °C using a rotary evaporator. The residues obtained were stored in a freezer until use.

The used pulsing solutions pH values are shown in Table A. They were measured using a corning 125-pH meter.

Table A. Pulsing solutions pH values

The pulsing solution	pH
1- Distilled water (d.w.)	6.60
2- STS	4.60
3- STS then 20% S + 200 ppm OE	4.70 then 5.40
4- STS then 20% S + 200 ppm ME	4.70 then 5.70
5- STS then 20% S + 200 ppm 8-HQS	4.70 then 4.10

2. Storage period treatments:

Subjected *Strelitzia reginae* L. cut flower spikes to the above-mentioned pulsing treatments were packaged (nine spikes were warped by tissue paper) in polyethylene sleeves (30 micron thickness, 70 x 100 cm) and butter paper (50 micron thickness, 70 x 100 cm). After that, flower bags were packed in carton boxes (120 x 50 x 30 cm) and were stored at 6.0±1°C and relative humidity of 80 – 90 % to simulate the transport conditions. Three storage periods were tested as follows:

1. Zero-time (without storage): cut flower spikes were hold until the end of experiment (wilting of 75 % florets of the total florets number of spike) in distilled water under Lab. conditions (24 hours fluorescent lighting at 500 lux, temperature of 25±2 °C and relative humidity at 60–70%) as control.
2. 5-Days: cut flower spikes were stored at the above mentioned simulated transport conditions for 5 days, then cut flower spikes were hold till end of the experiment in distilled water under Lab. conditions.
3. 10-Days: cut flower spikes were stored at the simulated transport conditions for 10 days, then cut flower spikes were hold till end of the experiment in distilled water under Lab. conditions.

Treatments of the present work were layout in a factorial experiment between the tested pulsing solutions (5 levels) and the tested storage periods (3 levels) in completely randomized design. So, the experiment contained 15 interaction treatments. Each treatment was implicated three replicates. Each replicate was represented with one Jar (measuring one-liter) containing 500 ml distilled water. Three cut flower spikes were hold per one jar.

Data Recorded

1. Post harvest characteristics

1. Vase life (longevity) of *Strelitzia reginae* L. cut flower spikes was determined as day's number from beginning of holding flowers in distilled water (after cold storage) until wilting of 75 % florets of the total florets number of spike.
2. Floret opening percentage was calculated as a percentage of opened florets from the total florets number of spike at the end of longevity.

2. Water relations:

Water uptake and water loss per *Strelitzia reginae* L. cut flower spike were determined by weighting the jars with and without flower spikes and correcting for the evaporation. Water balance per *Strelitzia reginae* L. cut flower spike was calculated (g /spike) as the difference between water uptake and water loss at 15 days vase live.

3. Bacterial count:

Bacterial contamination was determined in samples of vase solution (distilled water) at 15 days vase life (starting appearances of wilting symptoms on control spikes) according to the methods which described by Marousky (1968) at the Micro. Lab., Fac. Agric., Zagazig Univ. Determinations were duplicated for each replicate and average bacteria count was calculated and represented as number of colonies/ ml.

***4. Chemical determinations*:**

Chemical determinations were done in flower petals at 15 days vase life. They were implicated the flowing determinations:

1. **Anthocyanin content (mg/ 100 g petals):**
   Anthocyanin pigment was extracted from flower petals using ethanolic / HCL solvent (95% ethanol: 1.5N HCL, 85:15) according to procedures of Fuleki and Francis (1968). Pigment content was expressed as mg/ 100 g fresh weight according to Luque-Rodríguez *et al.*, (2007).
2. **Total sugars percentage:**
   Total sugars percentage was calorimetrically determined in the dried floret samples according to the method described by Smith *et al*., (1956).

Statistical analysis:

Collected data were subjected to statistical analysis according to the methods described by Thomas and Hill (1978). Mean separation was done using least significant difference (L.S.D.) at 5% and 1% levels.

RESULTS AND DISCUSSION

1. Effect of pulsing solution treatments:

1-1. Post harvest characteristics and water relations:

Data presented in Table 1 indicate that all pulsing solution treatments recorded highly significant increase in post harvest characters (vase life and floret opening %) and water relations (water balance) of *Strelitzia reginae* L. cut flower spikes comparing to control in the two tested seasons. The treatment of STS+S+8-HQS showed highly significant increase in vase life; floret opening percentage and water balance comparing

Table 1: Effect of pulsing solution treatments on vase life, floret opening %, water balance and bacterial count in vase solution as well as anthocyanin content and total sugars % in florets of *Strelitzia reginae* L cut flower spikes during 2007and 2008 seasons.

Pulsing solution treatments*	Vase life (days)	Floret opening (%)	Water Balance✷ (g/ spike)	Bacterial count (colonies/ ml)	Anthocyanin (mg/100g)	Total Sugars (%)
			2007 Season			
d.w. (Control)	17.83	62.06	-4.51	416.19	6.91	2.95
STS	21.52	72.22	-0.48	260.41	7.46	3.17
STS+S+OE	24.57	79.87	1.24	256.42	7.79	3.21
STS+S+CE	19.76	76.96	-1.77	293.80	7.72	3.29
STS+S+8HQS	27.57	85.42	2.87	202.11	8.28	3.52
L.S.D. at 5%	0.27	0.21	0.15	1.94	0.10	0.03
L.S.D. at 1%	**0.36**	**0.28**	**0.20**	**2.58**	**0.13**	**0.05**
			2008 Season			
d.w. (Control)	19.17	63.79	-5.07	452.81	7.18	3.02
STS	23.68	73.51	-0.55	268.63	7.56	3.20
STS+S+OE	25.73	79.88	1.94	272.20	7.86	3.25
STS+S+CE	20.99	78.49	-1.61	304.73	7.79	3.29
STS+S+8HQS	28.76	87.26	3.07	219.38	8.42	3.51
L.S.D. at 5%	0.22	0.18	0.48	1.40	0.06	0.04
L.S.D. at 1%	0.29	0.24	0.64	1.87	0.08	0.06

***** d.w.= Distilled water, STS= Silver thiosalphate at 1: 4mM, S =Sucrose at 20 %, OE= Ocimum Extract at 200 ppm, CE= Chamomile Extract at 200 ppm, and 8-HQS = 8-hydroxy quinolene sulphateat 200 ppm. Pulsing was done for 30 minutes in STS and for 12 hours in the other tested solutions.

✷ Water balance was calculated at 15 days vase live as the difference between water uptake and water loss/ flower spike.

to control and the all other treatments during the two seasons. Furthermore, the effect of treatments may be arranged descending as follows: (STS + S + 8-HQS) > (STS + S + OE) > STS > (STS + S + ME) > control. This was confirmed in the two seasons. However, the increase in vase life due to (STS + S + 8-HQS) treatment was also found by Anju *et al.,* (1999) on chrysanthemum and Kwon *et al.* (2000) on freesia. The increase in floret opening percentage and water balance due to STS treatment was also found by El- Saka (1992) on bird of paradise, Gendy (2000) on gladiolus cut flower spikes and El-Bouhy (2002) on tuberose cut flower spikes.

Such increase in bird of paradise cut flower spikes longevity caused by (STS + S + 8-HQS) or (STS + S + OE) treatments might be attributed to STS inhibition effect on ethylene production which leads to 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, while 8-HQS prevented growth of microorganisms in xylem and thus maintained water uptake by flower stems (Kwon *et al*., 2000 on freesia). In addition, sucrose inhibited ethylene synthesis and flower senescence as well it promoted bud opening (Ichimura and Hisamatsu, 1999). Furthermore, 8-HQS salts delayed senescence and eliminated bacterial growth, which was the principal reason for reduction water uptake and transport of gerbera flower (Abdel Kader, 1987). Sweet basil leaf extract components, also was previously reported as possess inhibition action on growth of *Staphylococcus aureus, Shigella flexneri, Salmonella enteritidis, Escherichia coli, Klebsiella sp., Proteus mirabilis,* and *Pseudomonas aeruginosa* (Ntezurubanza *et al*., 1987).

1-2. Bacterial count

Results tabulated in Table 1 reveal that subjecting cut bird of paradise spikes to all pulsing solution treatments showed highly significant decreases in bacteria count represent as (colonies/ ml vase solution) comparing to control. Generally, pulsing cut flower spikes bases in 1: 4 mM STS for 30 minutes then in 20% S + 200 ppm 8-HQS for 12 hours recorded the least number of colonies/ ml vase solution as compared to the other studied treatments. Such reduction was highly significant in the two seasons. Zagory and Reid (1986) published similar results on many cut flowers regarding (STS and 8-HQS). Van Doorn (1997) on cut rose flowers, stated that sugars usually resulted in an increase in bacterial growth, while hydroxyl quinoline compounds often used as antimicrobial agents. Inclusion of 300 mg/L of 8-HQC in the vase solution at the onset of the experiment prevented the increase in bacterial numbers in the basal end of cut stems and this completely prevented water stress symptoms. Also, Ntezurubanza *et al*., (1987) reported that adding *Ocimum basilicum* leaf extract to vase solution inhibited growth of *Staphylococcus aureus, Shigella flexneri, Salmonella enteritidis, Escherichia coli, Klebsiella sp., Proteus mirabilis,* and *Pseudomonas aeruginosa*.

1-3. Chemical determinations

Anthocyanin content in the petals (mg/ 100 g fresh weight) and total sugars % in florets of *Strelitzia reginae* L. cut flower spikes recorded high significant increases as a result of exposing to all tested pulsing solution treatments comparing to chick treatment (Table 1). Generally, pulsing cut flower spikes bases in (STS + S + 8-HQS) or (STS + S + OE) recorded highly significant increase respecting anthocyanin content as compared to other treatments under study. These results are in similar to those reported by Gendy (2000) on gladiolus cut flower spikes.

2. Effect of cold storage period treatments

2-1. Post harvest characteristics and water relations

It is quite clear from the data in Table 2 that there are gradual decrease in post harvest characters (vase life and floret opening %) and water balance of bird of paradise cut flower spikes with extending the cold storage period. Stored cut flower spikes for 10 days recorded highly significant decrease in vase life as compared to other different storage periods in both seasons. While, cut flower spikes stored for zero and 5 days recorded highly significant increase in longevity, floret opening percentage and water balance as compared to the long storage period of 10 days in both seasons.

These results are in harmony with those obtained by Song *et al.,* (1992) on gladiolus cut flower spikes, Reid et al., (2001) on tuberose cut flower spikes and Abd El-Sadek (2005) on gypsophila cut flowers. Hettiarachchi and Balas (2005) stated that cold storage at 4 °C maintained good flower quality during the vase of cut *Kniphofia uvaria* flowers.

2-2. Bacterial count

It is obvious that number of bacterial colonies/ ml vase solution was increased as the cold storage period was increased from zero up to 10 days (Table 2). Stored cut flower spikes for 10-days recorded highly significant increase in bacteria count in vase solution comparing to storage for zero or 5 days treatments. In this respect, Nowak and Rudnicki (1990) and Van Doorn (1997) recorded similar results on cut flowers.

However, increase of bacterial count in vase solution because increasing cold storage period may be due to the harmful effects of cold conditions. Since, cold temperatures may cause damages to cell walls of cut flower spikes, which facilitate microorganisms' growth. Wouter *et al*., (1991) reported that the number of bacteria in the basal 5 cm of cut rose flower stems stored for 1 to 4 days was positively correlated with the number of bacteria in the water. During dry storage at 5 °C, the increase in bacterial count was smaller than during dry storage at 20 °C.

2-3. Chemical determinations

The data located in Table 2 show that there are gradual decrease in anthocyanin content in petals and total sugars % in the florets of *Strelitzia reginae* L. cut flower spikes with extending storage periods at 6±1°C for different days (zero, 5 and 10 days). However, cut flower spikes stored at 6±1°C for zero or 5 days recorded highly significant increase in anthocyanin content in the petals and total sugars percentage in the florets as compared to the long storage period of 10 days. These results are in accordance with those recorded by Vinod *et al.,* (2003) on tuberose cut flower spikes and El- Saka *et al.*, (2000) on cut rose flowers.

Table 2: Effect of storage period treatments on vase life, floret opening %, water balance and bacterial count in vase solution as well as anthocyanin content and total sugars % in florets of *Strelitzia reginae* L cut flower spikes during 2007and 2008 seasons.

Storage period treatments*	Vase life (days)	Floret opening (%)	Water balance✷ (g/spike)	Bacterial count colonies/ ml)	Anthocyanin (mg/100g)	Total Sugars (%)
2007 Season						
Zero-time (Without storage)	23.83	77.99	0.78	245.59	7.93	3.53
5-days	22.81	76.18	-0.48	275.33	7.74	3.39
10-days	20.12	72.15	-1.90	336.44	7.22	2.77
L.S.D. at 5%	**0.21**	**0.16**	**0.12**	**1.50**	**0.07**	**0.03**
L.S.D. at 1%	**0.28**	**0.22**	**0.16**	**2.00**	**0.10**	**0.04**
2008 Season						
Zero-time (Without storage)	25.44	78.35	0.47	261.05	8.08	3.50
5-days	24.36	77.82	-1.50	296.17	7.83	3.46
10-days	21.21	73.60	-2.04	353.44	7.38	2.81
L.S.D. at 5%	**0.17**	**0.14**	**0.37**	**1.09**	**0.04**	**0.03**
L.S.D. at 1%	**0.22**	**0.18**	**0.50**	**1.44**	**0.06**	**0.04**

* Cut flower spikes were stored at 6±1°C and relative humidity of 80 – 90 % (simulate to transport conditions).

✷ Water balance was calculated at 15 days vase live as the difference between water uptake and water loss/ flower spike.

3. Effect of interaction treatments between pulsing solutions and storage periods:

3-1. Post harvest characteristics and water relations

Data presented in Table 3 show that pulsing solution treatments of (STS + S + 8-HQS) or (STS + S + OE) interacted with storage periods of Zero-time, 5 or 10 days recorded high significant increases in vase life, floret opening percentage and water balance of *Strelitzia reginae* L. cut flower spikes compared to control and the most other interaction treatments. This was true during the two seasons. There are gradual decreases in longevity, floret opening percentage and water balance of cut flower spikes with extending storage period for different days (zero, 5 and 10 days). Furthermore, cut flower spikes treated with all pulsing solutions before storage at 6±1°C for 10 days recorded high significant decrease in vase life as compared to flowers treated with (STS + S + 8-HQS) or (STS + S + OE) before storage periods for zero or 5 days in both seasons. Moreover, the treatments of interaction between all pulsing solutions and storage periods at 6±1°C for zero or 5 days resulted in highly significant increases in vase life of cut spikes compared to control in the two seasons. These results are in

agreement with those of Kushal *et al.,* (2000) and Waithaka *et al.,* (2001) on cut tuberose as well as Kushal *et al.,* (2002) on gladiolus cut flower spikes respecting to S + 8-HQS then cold storage. In addition, Abd El Sadek (2005) on gypsophila cut flowers recorded similar findings respecting STS then cold storage.

However, Ntezurubanza *et al.* (1987) found that *Ocimum basilicum* leaf extracte contains many compounds (1, 8 cineol, eugenol, methyl-eugenol, thymol, p-cimene, cis-ocimene, and cis-caryophyllene) had an inhibition effect on growth of *Staphylococcus aureus, Shigella flexneri, Salmonella enteritidis, Escherichia coli, Klebsiella sp., Proteus mirabilis*, and *Pseudomonas aeruginosa*. Belynskaya and Kondrat (1990), on cut tulip flower, recorded increases in post harvest characters and water balance caused by pulsing flowers before storage in 6 % sucrose for 24 hrs. Also, Reid *et al*., (2001) concluded that cold storage of cut tuberose spikes resulted in a pronounced increase in ethylene production by the florets, particularly by immature buds. Pretreatment of spikes with STS eliminated the effects of exogenous ethylene on fresh spikes, but had no effect on the reduced vase life of cold-stored flowers.

3-2. Bacterial count

Data in Table 4 demonstrate that all tested pulsing solutions interacted with zero or 5-days cold storage periods resulted in high significant reduction in number of bacterial colonies/ ml vase solution as compared to the other interaction treatments between pulsing solutions X 10-days clod storage period. Gradual increases in number of bacterial colonies in vase solution were noticed with extending storage period from zero-time to 10- days. However, the interaction treatments of (STS + S + 8-HQS) as pulsing solution X storage at 6±1°C for zero or 5-days had the superior effect in suppressing bacterial growth in vase solution comparing to other interaction treatments. This was confirmed during the two tested seasons. However, Loubaud *et al.,* (2004) concluded that the xylem blockage that prevents water uptake into several cut flowers is mainly due to the presence of bacteria. The inclusion of antibacterial compounds in vase solution considerably delayed time to wilting of cut flowers and increased vase life. Antimicrobial compounds that delay wilting without being toxic to cut flowers include 8-HQS and HQC. These compounds positively affected the length of vase life of gladiolus, gypsophila and rose.

3-3. Chemical determinations

Results in Table 4 show, under any examined interacted pulsing solution, gradual decreases in anthocyanin content in petals and in total sugars % in florets of *Strelitzia reginae* L. cut flower spikes associated with increasing the interacted storage period at 6±1°C from zero-time to 10-days.

Simultaneously, under the same cold storage period, subjecting cut flower spikes to any tested pulsing solution increased anthocyanin content in petals and total sugars % in florets. However, the highly significant increments in this regard were recorded in petals and florets of cut spikes pulsed in (STS + S + 8-HQS) and then stored at 6±1°C for zero or 5 days as compared to the other interaction treatments with 10 days storage period.

This result may be due to the caused suppression in bacterial activity in vase solution associated with the improvement in water balance in cut spikes under effect of these interaction treatments (previous results of such research in Tables 3 & 4).

Conclusively,

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تأثير بعض معاملات التخزين ومحاليل الحفظ على عمر وجودة أزهار عصفور الجنة المقطوفة

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أُجري هذا البحث خلال الموسمين ٢٠٠٧ ، ٢٠٠٨ في معمل قسم البساتين بكلية الزراعة – جامعة الزقازيق لتقييم تأثيرات خمس محاليل حافظة كمعاملات "إنباض" وثلاث فترات تخزين بارد و التفاعل بينهما علي عمر وجودة شماريخ أزهار عصفور الجنة المقطوفة، ضُمنت معاملات الإنباض وضع الحوامل الزهرية في المحاليل الآتية: ١- ماء مقطر لمدة ١٢ ساعة(للمقارنة) ، ٢- محلول ثيوسلفات الفضة بتركيز ١:٤ ملليمول لمدة ٣٠ دقيقة ، ٣- محلول ثيوسلفات الفضة لمدة ٣٠ دقيقة ثم محلول مكون من ٢٠% سكروز + ٢٠٠ جزء في المليون مستخلص أوراق الريحان لمدة ١٢ ساعة ، ٤- محلول ثيوسلفات الفضة لمدة ٣٠ دقيقه ثم محلول مكون من ٢٠% سكروز + ٢٠٠ جزء في المليون مستخلص أزهار البابونج لمدة ١٢ ساعة ، ٥- محلول ثيوسلفات الفضة لمدة ٣٠ دقيقة ثم محلول مكون من ٢٠% سكروز + ٢٠٠ جزء في المليون ٨-هيدروكسى كينولين سلفات لمدة ١٢ ساعة ، أُجريت معاملات "إنباض" الأزهار المقطوفة قبل تخزينها مباشرة على درجات الحرارة الباردة. كانت فترات التخزين المختبرة هي: بدون تخزين (للمقارنة)، أو التخزين لمده ٥ ، ١٠ أيام على درجة حرارة ١±٦ °م ورطوبة نسبية ٨٠ – ٩٠% (لمحاكاة ظروف الشحن). وُضعت قواعد حوامل الأزهار (السابق معاملتها بمحاليل "الإنباض" وبالتخزين) في دوارق بها ماء مقطر مباشرة بعد انتهاء التخزين البارد لتسجيل أثر المعاملات على عمر الأزهار وجودتها.

أدت كل معاملات محاليل الحفظ المؤقت "الإنباض" المختبرة إلي: زيادة معنوية في عمر الأزهار المقطوفة وفى النسبة المئوية لتفتح الزهيرات على الحامل الزهري ، خفضت التلوث البكتيري لمحلول الحفظ الدائم (الماء المقطر) ، حسنت الاتزان المائي للحوامل الزهرية ، كذلك حافظت على جودة الحوامل الزهرية حيث حافظت على محتوى بتلات الأزهار من صبغة الأنثوسيانين. كانت معاملة "الإنباض" في محلول ثيوسلفات الفضة بتركيز ١:٤ ملليمول لمدة ٣٠ دقيقة ثم في محلول محتوى على ٢٠ % سكروز + ٢٠٠ جزء في المليون ٨-هيدروكسى كينولين سلفات لمدة ١٢ ساعة هي الأفضل تأثيرا بهذا الخصوص. بينما أدى زيادة فترات التخزين من صفر إلى ١٠ أيام إلي تقليل عمر وجودة الأزهار.

عندما تفاعلت معاملات محاليل الحفظ المؤقتة مع فترات التخزين أمكن الحصول على أعلى جودة وأطول عمر لشماريخ أزهار عصفور الجنة المقطوفة تحت تأثير معاملات التفاعل بين "الإنباض" في محلول ثيوسلفات الفضة بتركيز ١:٤ ملليمول لمدة نصف ساعة ثم في محلول مكون من ٢٠% سكروز + ٢٠٠ جزء في المليون ٨-هيدروكسى كينولين سلفات لمدة ١٢ ساعة بدون تخزين بارد أو مع التخزين لمدة ٥ أيام علي ١±٦ °م مقارنة بباقي معاملات التفاعل الأخرى.

التوصيــة: