

POSTHARVEST STUDIES ON THE CUT FLOWERS OF DAHLIA (*Dahlia hybrida* L.):

II: EFFECT OF PREVENTING LATEX FLOW, PULSING, AND HOLDING SOLUTIONS ON VASE LIFE AND QUALITY.

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ABSTRACT

The cut flowers of dahlia (*Dahlia hybrida* L.) Fam. Asteraceae tend to have a very short vase life, which reduces their potential as a commercial cut flower. Upon cutting from the plant, the flower stem exudes a milky sap (called latex) that plugs the conductive tissues at the cut base of the stem and prevents water uptake causing rapid wilting and reduced vase life of the flower. A comprehensive postharvest study on dahlia cut flowers was carried out during the two successive seasons of 1995/1996 and 1996/1997, at the Veget. and Flor. Dept., Fac. of Agric., Mansoura Univ. Three stepwise postharvest treatments were used in order to improve the vase life and quality of cut dahlia. The first step included treatments to overcome the latex problem (untreated control, dipping in ethanol, searing over a flame, and dipping in boiling water), followed by short term pulsing treatments (silver thiosulfate complex (STS), an antibiotic complex, or 8-hydroxyquinoline sulfate (8-HQS)). In the final step, different components of the flower holding solutions (sucrose, boric acid, citric acid, or cycocel (CCC)) were applied.

In part I, the effect of these treatments on water relations and the anatomical structure of the flower stem were studied. In this part (Part II), the effects of these treatments on vase life and quality of the flower were evaluated. Data were collected on reducing sugars contents of the petals, vase life (days), maximum fresh weight gain of the flower, content of anthocyanin pigment in the petals, and flower opening velocity.

The results showed that the higher the reducing sugars in the petals, the longer the vase life of the flower was observed. Placing the base (5 cm) of the stem in ethanol alcohol (95%) for 5 minutes was the best method to prevent latex problem, and that placing the cut stem in 4 mM silver thiosulfate complex (STS) for 10 minutes was the best pulsing method. In addition, sucrose 1.5% was the best holding solution.

These three treatments resulted in higher reducing sugars content in the petals and longer vase life of cut dahlia than the other comparable treatments. These treatments also resulted in the best quality; measured as maximum fresh weight gain, highest anthocyanin content, and lowest velocity of flower opening. The combination of ethanol treatment and STS pulsing treatment resulted in better quality than the other combinations between preventing latex flow and pulsing treatments in all quality measurements. The results also showed that longest vase life of cut dahlia in both seasons (8 days) was achieved by placing the stem of cut dahlia flowers in ethanol (95%) for 5 minutes, followed by 10 minutes pulse in 4 mM silver thiosulfate complex (STS). The final step was placing the cut flower in a holding solution containing 1.5 % sucrose.

INTRODUCTION

The cut flowers of dahlia (*Dahlia hybrida*, L) Fam. Asteraceae have a great potential as commercial cut flowers. They are available in the Egyptian

market, and are likely to be more popular in the future. The cut flowers of dahlia tend to have a very short vase life, which reduces their potential as a commercial cut flower. Once dahlia flowers are cut from the plant, a milky sap called latex fuses out of the base of the flower stem and agglutinates causing plugging of the conducting vessels at the cut base of the flower stem. The latex prevents water uptake causing a rapid wilting of the flower. Through the years, many methods of conditioning cut flowers, which exude latex, have been tried. These methods included searing the base of the stem over a flame or steam, dipping the stem in boiling water, and pulsing in alcohol (Gordon *et al.*, 1986; Halevy and Mayak, 1981; Rogers, 1963 and 1973).

The fundamental causes for the quick deterioration and death of fresh cut flowers are the exhaustion of respirable substrates, desiccation or drying out, maturation and continued development of the flowers, ravages of diseases, ethylene injury and fading of flower color or color changes (Rogers, 1973). Any thing that florists do to prolong the vase life of the cut flowers would be related to one or more of these factors.

In this work, three stepwise postharvest procedures were conducted on cut dahlia flowers in order to improve its useful vase life. In the first step, treatments to overcome the latex problem (searing, dipping in boiling water, and dipping in ethanol solution) were used, followed by short term pulsing treatments to overcome growth of microorganisms and/or to antagonize ethylene (silver thiosulfate complex (STS), antibiotic complex, and 8-hydroxyquinoline sulfate (8-HQS)). In the final step, different components of the flower holding solutions (sucrose, boric acid, citric acid, and cycocel (CCC)) were evaluated.

In part (I), The effects of these treatments on water relations of cut dahlia flowers in addition to the anatomical changes within the flower stem were studied. In this part (II), the effect of these treatments on vase life and quality of cut dahlia flowers were evaluated.

MATERIALS AND METHODS

The present investigation was performed during the two successive seasons of 1995/1996 and 1996/1997 at the Experimental Station, Faculty of Agriculture, Mansoura University. Dahlia tuberous roots (*Dahlia hybrida* cv. Small Decorative) were planted on September 15th in both seasons. Plot size was 6 m x 8 m = 48 m². with 6 rows at 1m apart. Plant spacing was done at 80 cm. Number of replications was 4 replicates. Standard cultural practices were performed as usual for dahlia plants.

Postharvest treatments: Dahlia plants flowered during spring of 1996 and 1997. Flowers were cut when they were semi-open (just beginning to open and show about one cm of ray florets). Flowers were cut early in the morning and immediately brought to the laboratory where they were graded according to size of flower and length of the flower stem. Upon arrival to the laboratory, the flower stem was re-cut in air, removing about 3cm from the base and the fresh weight of the flower was recorded before treatments.

I. First step (main treatments) for preventing latex flow:

Flowers were divided into four groups:

- 1- Untreated flowers
- 2- Ethanol treatment: the lower 5 cm from the base of the flower stem was placed in 95% ethanol for 5 min.
- 3- Searing treatment: the cut end of the flower was seared on a flame for 15 sec.
- 4- Boiling water treatment: the lower 5 cm from the cut end of the flower stem was held for 1 min.

II. Second step (sub-treatments) for pulsing flowers:

Each group of the previously mentioned four groups was divided into the following three groups:

- 1-Silver thiosulfate (STS) treatment: Silver thiosulfate (STS) solution was freshly prepared according to Reid *et al.*, 1980, and the flowers were placed in 4mM STS solution for 10 min.
- 2-8-hydroxyquinoline sulfate (8-HQS) treatment: Flowers were placed in 400 ppm 8-HQS solution for 10 min.
- 3-Antibiotic treatment: Flowers were placed in an antibiotic complex (150 ppm tetracycline hydrochloride and 50 ppm streptomycin (sulfate) U.S.P.16) for 10 min.

III. Third step (sub-sub-treatments) for holding solutions:

The previously mentioned two steps ended with 12 groups; each group of them was divided into another five groups of solutions and flowers were placed in them until the end of the experiment as follows:

- 1- Distilled water (DW).
- 2- Sucrose solution (1.5%).
- 3- Boric acid solution (10 ppm).
- 4- Citric acid solution (10 ppm).
- 5- Cycocel (CCC) solution: flowers were dipped in 200 ppm CCC solution for 24 hours, then placed in DI water.

N.B. All solutions were prepared using distilled (DW) water.

The tested flowers were placed individually in 100 ml graduated cylinder filled with designated holding solutions and left in the laboratory conditions at 23 C and 60-70% relative humidity. Additional ten graduated cylinders filled with water only were added to the whole experiment and placed in the laboratory under the same conditions, in order to measure the average daily evaporation value.

The following data were recorded:

1. **Reducing sugars content in the petals:** the reducing sugars content of the fresh dahlia petals was measured according to Lindsay (1973). The amount of reducing sugars was measured as mg glucose by comparing the optical density of the solutions with a standard curve of v/w solutions of D-glucose. Finally, it was calculated as a percentage of the dry weight of the sample.

2. **Vase life (days):** The useful vase life of each inflorescence was terminated when the flower lost 10% of its maximum fresh weight, the ray florets wilted, or when shattering of the corolla and/or petal scorch (browning of the petal edge) occurred.
3. **Fresh weight:** The initial fresh weight was recorded immediately after cutting the flower. Every 24 hrs, each flower was weighed in order to estimate the maximum fresh weight gain (%). The percentage of maximum increase in fresh weight of dahlia flower was calculated in both seasons, based on the initial fresh weight.
4. **Anthocyanin content of the petals:**
Anthocyanin was extracted from dahlia petals at the fourth day (when control flowers started to show wilting symptoms). Petals were separated by hand from flower heads, and the pigment was extracted and determined, using the colorimetric method, as described by Fuleki and Francis (1968).
5. **Flower opening velocity:**
The number of opened petal rows was recorded daily and the flower opening velocity was calculated according to the equation of seed emergence described by Kotowski (1926):

$$\text{Velocity coefficient} = \frac{\text{Total number of opened petal rows}}{N_1 T_1 + N_2 T_2 + T_3 N_3 \dots \dots \dots + N_x T_x} \times 100$$

Where:

N₁, N₂... N_y = Number of opened petal rows within each two consecutive days.
T₁, T₂... T_x = Number of days from the start of the experiment and the end of measurement.

Statistical analysis: A split-split plot design with 4 replicates/treatment was adopted. Each replicate contained 10 individual flowers. The main plot was the treatments used to control latex flow, and the sub-plot was the pulsing treatments, while the sub-sub-plot was the holding solution treatments. Treatment differences were determined by analysis of variance procedure as mentioned by Gomez and Gomez (1984). Computation was done using SAS computer software program (SAS Institute, 1985). Treatment means were compared using the least significant difference test (LSD), (probability 5 %).

RESULTS AND DISCUSSION

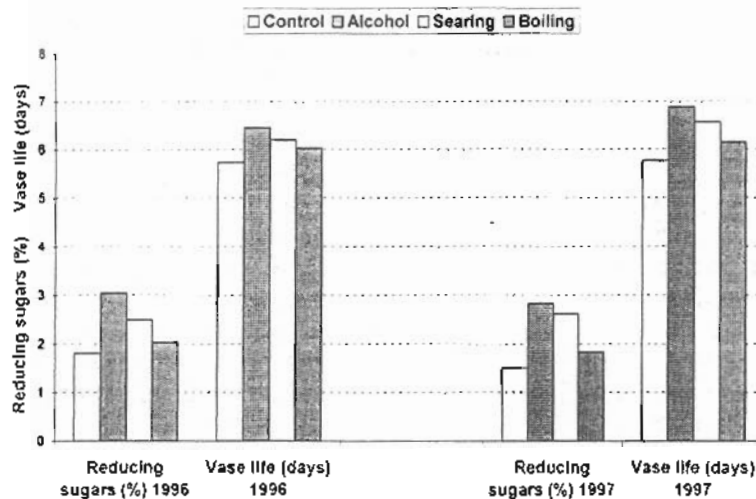
1. Effect of different treatments on vase life:

a. Effect on the reducing sugars percentage and vase life:

Highest reducing sugars (%) were obtained from using ethanol treatment to prevent latex flow (Figure, 1), which averaged 3.05 and 2.83 % in the first and second season, respectively. The lowest percentages of reducing sugars in petals were recorded when latex flow was not prevented. The increases in reducing sugars (%) of dahlia petals due to dipping in ethanol (95 %) might be attributed to the role of alcohol in increasing water uptake and water balance, which reflected high rates of photosynthesis in petals causing

increase in percentage of reducing sugars. The vase life followed identical trend to that of the reducing sugars. Longest vase life was a result of ethanol treatment, while shortest one was that of the untreated control. Ethanol (95%) treatment increased vase life of cut dahlia flowers than those treated by searing or boiling treatments.

Figure 1. Reducing sugars percentage in petals and vase life of cut Dahlia flowers as affected by treatments used to prevent latex flow during 1996 and 1997 seasons.



The increase in vase life of dahlia flowers due to ethanol treatment seems to be mainly due to increased water uptake through conducting vessels by dissolving latex components (Balbaa *et al.*, 1976), and thus, maintenance of favorable water balance within the cut flower. It was shown in part 1 that ethanol treatment increased water uptake, reduced microbial population, preserved the internal anatomical structure, and reduced tyloses plugging in the conductive tissues of the flower stem. These results are in good accordance with those reported by Gordon *et al.* (1986) who pointed out that treating the cut stems with alcohol was the best method for of the post harvest life of cut poinsettias. Another role of ethanol could be as an inhibitor of ethylene biosynthesis, and thus, to retard early aging of the flower (Pun *et al.*, 2001).

The percentage of reducing sugars was also affected by pulsing treatments in both seasons (Figure 2). Maximum percentage of reducing sugars was obtained due to pulsing in STS solution, which averaged 2.60 and 2.46% in the first and second season, respectively. Pulsing in 8-HQS gave values of 2.41 and 2.25% in the first and second season, respectively, while the lowest reducing sugars percentage was recorded when dahlia flowers were pulsed in antibiotic solutions (2.02 and 1.89 %) in the same order. In addition, the vase life followed identical trend to the reducing sugars percentage. These results agreed with those reported by Reid *et al.* (1980) who mentioned that the vase life of cut flowers can be extended using short

pulses with STS complex. STS has a very important role as an inhibitor of ethylene action which plays a critical role in flower senescence (Halevy and Mayak, 1979, Reid *et al*, 1989; Celikel and Reid, 2002). In part 1 of the study, STS also reduced microbial plugging of the conductive tissues of the stem and increased water uptake by the flower leading to favorable water balance within the flower.

Data illustrated in Figure (3) clearly indicated that using sucrose (1.5 %) or citric acid (10 ppm) as holding solutions significantly maximized percentages of reducing sugars. The corresponding values were 2.68, 2.50 % for sucrose, while they were 2.58, 2.25 % for citric acid in the first and second season, respectively. The lowest percentages were produced due to holding flowers in distilled water, boric acid (10 ppm), and cycocel (200 ppm). Similarly, Hussein *et al* (2001) reported that sucrose significantly increased the amount of soluble carbohydrates in gladiolus florets. Earlier work by Nichols (1973) revealed that absorbed sucrose was rapidly converted in petals to reducing sugars, which accumulate in the corolla. Sacalis and Chin (1976) also reported that the flower petals possessed a high sucrose inversion capacity. The longest vase life (days) of cut dahlia flowers was recorded due to sucrose (1.5 %) as a holding solution in both seasons, which averaged 6.81 and 7.10 days in the first and second season, respectively. However, the shortest vase life was obtained using distilled water in both seasons (5.2 and 5.4 days). Sucrose was reported to increase vase life of many cut flowers (Dhekney *et al*, 2000; Redman *et al*, 2002). Marousky (1972) stated that the sucrose might perform multifunctional roles in delaying senescence; as a respiratory substrate, as an osmoticum, or as an agent causing stomatal closure. On the other hand, Sacalis and Chin (1976) revealed that depletion of available carbohydrates is an important factor influencing the vase life of cut flowers. They added that addition of a carbohydrate source such as sucrose to the holding solution lead to an extension of vase life, if growth of microorganisms was controlled. Moreover, Jones and Hill (1993) reported that sucrose did not extend vase life of cut flowers by improving solution uptake, but by delaying senescence of the cut flower.

It is very important to note that, the three previous figures clearly showed a strong relation between the effect of various treatments on the reducing sugars percentage in the petals of cut dahlias and their potential vase life. The illustrated data clearly showed that the higher the reducing sugars percentage in the petals of cut dahlia, the longer was the vase life of the flower.

Sucrose was reported to increase soluble proteins and soluble carbohydrates (Hussein *et al*, 2001) and maintained osmotic pressure (Marousky, 1972). Paulin, 1986 also reported that sucrose maintained membrane integrity by inhibiting of phospholipids break down, protected the structure of mitochondria, and preserved various enzymatic activities. In addition, sucrose prevented accumulation of ammonia and delayed ethylene outburst in cut flowers (Halevy and Mayak, 1981).

Figure 2. Reducing sugars percentage in petals and vase life of cut Dahlia flowers as affected by pulsing treatments during 1996 and 1997 seasons.

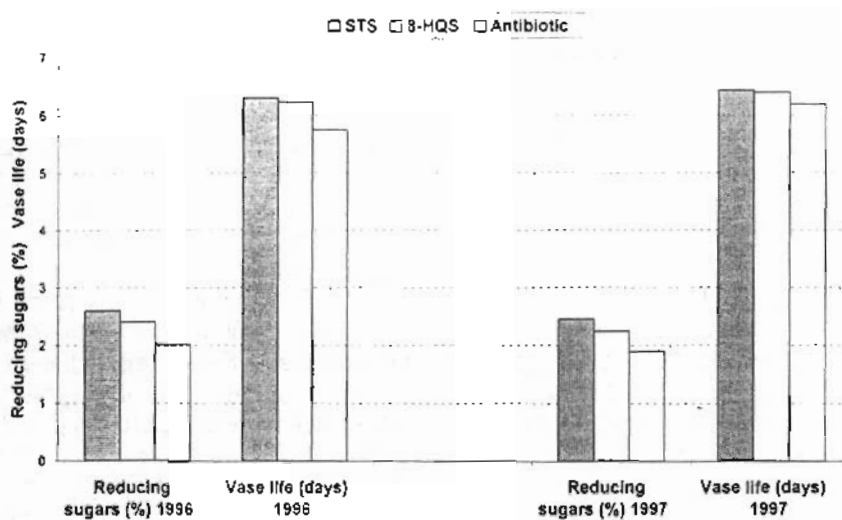
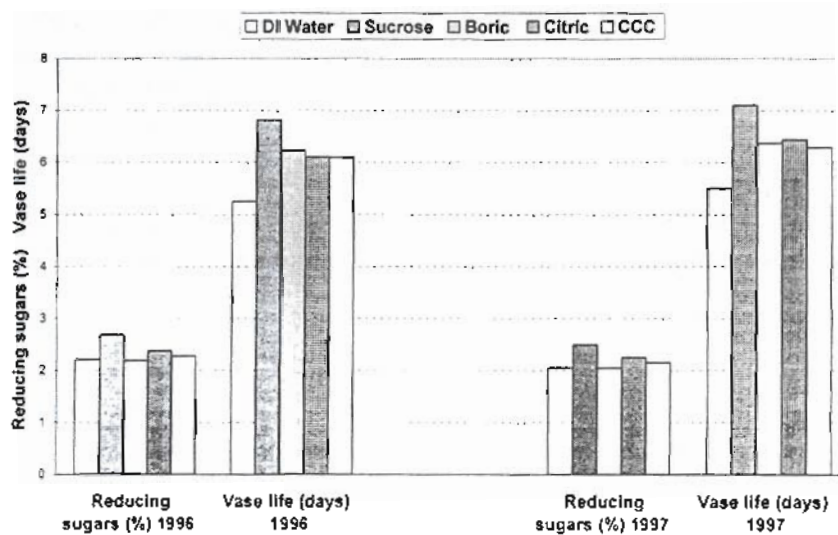


Figure 3. Reducing sugars percentage in petals and vase life of cut Dahlia flowers as affected by pulsing treatments during 1996 and 1997 seasons.



b. Effect of the interaction among treatments on vase life:

The fundamental causes for the deterioration and death of fresh cut flowers are the exhaustion of respirable substrates, desiccation or drying out, maturation and continued development of the flowers, ravages of diseases, ethylene injury and fading of flower color or color changes (Rogers 1973). Any thing that florists do to prolong the vase life of the cut flowers would be related to one or more of these factors.

The combination of preventing latex flow, pulsing, and the holding solutions affected vase life of cut dahlia in both seasons (Table 1). Maximum vase-life (days) was recorded due to sucrose (1.5 %) as a holding solution following STS pulse after latex flow was prevented by ethanol (95%) in both seasons. Relevant means were 8 days in both seasons. However, the shortest vase life was obtained using distilled water (4.8 days) in both seasons when latex flow was not prevented. The multifunctional roles of sucrose in delaying senescence were previously discussed. On the other hand, the additive effects of both ethanol (95%) and STS (4mM) pulse on improving water uptake and water balance in addition to their role in retardation of senescence of the flowers were previously discussed in details. However, it is worthy to note that Rogers (1973) also reported that treating poinsettia flowers with short stems in close proximity to heat might cause damage to the floral bracts. Accordingly, ethanol treatment, as a first stepwise procedure, could be recommended as the best method to prevent latex flow of cut dahlias.

Table 1. Effect of the interaction between the three stepwise postharvest treatments on vase life (days) of cut dahlia flowers during 1996 and 1997 seasons.

Preven ting latex flow	Pulsing Pulsing	Holding solutions									
		Distilled water		Sucrose (1.5%)		Boric acid (10 ppm)		Citric acid (10 ppm)		CCC (200 ppm)	
		1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Control	STS (4mM)	4.8	6.0	7.3	7.0	6.3	6.0	5.8	6.3	5.8	6.5
	8-HQS (400 ppm)	4.8	5.0	6.5	6.3	6.0	5.8	5.5	6.0	6.0	5.5
	Antibiotic	4.8	4.8	6.5	5.3	5.3	5.3	5.5	5.5	5.5	5.5
Ethanol	STS (4mM)	6.5	6.5	8.0	8.0	7.0	7.3	7.3	7.5	7.0	6.8
	8-HQS (400 ppm)	5.5	5.0	6.3	7.3	7.0	7.8	6.8	7.3	6.5	6.8
	Antibiotic	4.8	5.5	6.3	7.3	5.8	6.8	6.8	6.3	5.5	6.5
Searing	STS (4mM)	5.5	5.3	7.5	7.3	5.8	5.5	5.8	6.5	5.5	6.3
	8-HQS (400 ppm)	5.8	5.5	5.8	7.5	7.3	7.3	7.0	6.8	7.8	7.3
	Antibiotic	5.0	5.8	6.8	7.5	5.3	6.8	6.0	7.0	5.5	6.5
Boiling	STS (4mM)	5.5	5.0	7.3	7.5	5.8	5.8	6.0	6.3	6.3	5.8
	8-HQS (400 ppm)	5.3	5.5	6.8	7.0	6.5	6.3	5.5	5.3	6.5	6.3
	Antibiotic	5.0	6.3	7.0	6.5	6.0	6.3	5.5	6.8	5.5	6.0

L.S.D. at 5% for 1996 season = 0.8

L.S.D. at 5% for 1997 season = 0.7

2. Effect of different treatments on quality:

a. Effect on maximum fresh weight gain (%):

The results in Table (2) indicated that preventing latex flow treatments significantly increased the maximum fresh weight gain (%) during vase-life of dahlia flowers in both seasons. Using ethanol (95%) to prevent latex flow significantly favored the maximum fresh weight gain (%) of cut flowers compared with the control and other treatments, as well. The corresponding data were 30.05 and 29.28 % in the first and second season, respectively. However, the lowest values were those of the untreated flowers (control) in both seasons (24.91 and 25.5%). The increase in maximum fresh weight gain (%) of dahlia cut flowers seemed to be a result of the effect of ethanol in dissolving latex in the basal stems of flowers thereby, increasing water uptake through the conducting vessels. In part 1 of this study, ethanol treatment resulted in maximum solution uptake by dahlia and favored maintenance of fresh weight at high values for a longer time than the other treatments or the untreated control. In roses, Durkin (1979) and Burdett (1970) showed that the loss of petal turgidity and the decrease in fresh weight of cut roses was preceded by a decreased rate of water uptake.

It is also clear from Table (2) that pulsing dahlia flowers in STS (4 mM) resulted in higher maximum fresh weight gain (%) by the flower (28.14 and 28.96) in the first and second season, respectively. The effect of STS on dahlia flowers was to increase water uptake of cut flower by inhibiting growth of microorganisms and bacterial plugging (as shown in part 1). STS also delayed senescence of the cut flowers by inhibiting ethylene action (Veen, 1986; Celikel and Reid, 2002), allowing the cut flower to live longer, to absorb more water, and to gain more weight.

The highest value of percentage of maximum fresh weight gain was obtained from using sucrose (1.5 %) in both seasons, which averaged 29.89 and 31.29 % in the first and second season, respectively. Cycocel and boric acid were intermediate, while the lowest was obtained due to using distilled water (25.25 and 25.35 %). In addition to its role in improving water balance of the cut flowers, sucrose is a respirable substrate necessary for opening and continued development of the flower (Halevy and Mayak, 1981; Rogers, 1973). Similar results were reported on roses (Bhattacharjee and Palanikumar, 2001) and gerbera (Abdel-Kader, 1987; Abdel-Kader and Rogers, 1986).

Table (3) showed the interaction between preventing latex flow and pulsing treatments. The data clearly indicated that the highest significant fresh weight gain (%) during vase life of dahlia cut flowers was achieved due to ethanol (95 %) and pulsing flowers in STS (4 mM) solution. Percentage of maximum fresh weight gain averaged 30.51 and 31.07 % in the first and second season, respectively. However, the lowest values of maximum increase of fresh weight (%) were obtained using distilled water under all pulsing treatments. From these results, It seems very likely that the effect of ethanol and STS to reduce plugging caused by latex and/or microorganisms allowing more water uptake by the flower is the main key leading to increase fresh weight of cut dahlia flowers. opening velocity of dahlia flowers as affected by different treatments in both seasons. The lowest flower opening

velocity was produced using ethanol (95 %) to prevent latex flow, which valued 51.33 and 46.87 in the first and second season, respectively.

Table 2. Effect of the three stepwise postharvest treatments on quality measurements of cut dahlia flowers.

Treatments	Characters					
	Maximum fresh weight gain (% of the original fresh weight)		Flower opening velocity		Anthocyanin content (mg/100g)	
	1996	1997	1996	1997	1996	1997
A. First step : Preventing latex flow						
Control	24.91	25.5	61.01	55.32	68.41	70.07
Ethanol 95%	30.05	29.28	51.33	46.87	73.71	78.35
Searing	28.05	27.94	54.02	50.19	71.09	74.59
Boiling water	26.03	27.78	59.08	53.45	69.40	71.89
L.S.D. 5%	0.72	0.57	0.47	0.34	0.2	0.30
B. Second step: Pulsing treatments						
STS	28.14	28.96	52.42	48.71	72.06	74.82
8-HQS	27.41	27.92	55.94	50.84	70.50	73.76
Antibiotic complex	26.23	26.01	60.72	54.83	69.39	72.60
L.S.D. 5%	0.46	0.44	0.42	0.13	0.31	0.24
C. Third step : Holding solutions						
Distilled water	25.25	25.35	60.68	57.59	69.16	71.79
Sucrose (1.5%)	29.89	31.29	49.03	45.26	73.88	76.82
Boric acid (10 ppm)	25.78	25.58	61.85	55.46	69.96	73.30
Citric acid (10ppm)	28.26	29.44	53.59	48.58	70.73	73.97
Cycocel (200 ppm)	27.12	26.47	56.65	50.40	69.53	72.75
L.S.D. (5%)	0.43	0.62	0.9	0.42	0.69	0.66
Interaction (F-Test)						
AxB	*	*	*	*	*	*
AxC	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
BxC	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
AxBxC	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

* Significant (probability 5%).

N.S. Not Significant (probability 5%).

From these results, It seems very likely that the effect of ethanol and STS to reduce plugging caused by latex and/or microorganisms allowing more water uptake by the flower is the main key leading to increase fresh weight of cut dahlia flowers. opening velocity of dahlia flowers as affected by different treatments in both seasons. The lowest flower opening velocity was produced using ethanol (95 %) to prevent latex flow, which valued 51.33 and 46.87 in the first and second season, respectively.

This might be caused by improving water uptake and maintenance of favourable water balance (as shown in part 1) and/or related to the effect of ethanol on ethylene biosynthesis (Pun *et al*, 2001). However, the highest flower opening velocity was obtained using distilled water, which averaged 61.01 and 55.32 in the first and second season, respectively.

Flowers treated with STS solution had the lowest velocity during vase life among the three pulsing treatments. The velocity averaged 52.42 and 48.71 in the first and second season, respectively. The results of part 1 showed that STS treatment resulted in the least bacterial growth and highest water uptake by dahlia. In addition, retarding fast or even normal senescence

of cut dahlia flowers caused by STS treatment seemed to be related to its anti-ethylene action. This conclusion coincides with previous work by Reid *et al.* (1989) in their study on the effect of STS on bud opening of cut roses.

Table 3. Effect of the interaction between preventing latex flow and pulsing treatments on quality measurements of cut dahlia flowers.

Character	Maximum fresh weight gain %							
	1996				1997			
Preventing latex flow	Cont.	Ethanol (95%)	Searing	Boiling water	Cont.	Ethanol (95%)	Searing	Boiling water
Pulsing								
STS	26	30.5	29	27.1	27	31.1	29.6	28.2
8-HQS	25	30.4	28.1	26.1	25.6	29.6	28.2	28.3
Antibiotic	23.8	29.2	27	24.9	23.9	27.2	26.1	26.9
L.S.D. 5%	0.9				0.9			
Character	Flower opening velocity							
Season	1996				1997			
Preventing latex flow	Cont.	Ethanol (95%)	Searing	Boiling water	Cont.	Ethanol (95%)	Searing	Boiling water
Pulsing								
STS	56.6	47.7	50.7	54.7	52.7	44.2	47.2	50.8
8-HQS	60.7	50.7	53.6	58.8	54.7	46.3	49.6	52.8
Antibiotic	65.7	55.7	57.8	63.8	58.6	50.2	53.8	56.7
L.S.D. 5%	0.8				0.3			
Character	Anthocyanin content (mg/100g)							
Season	1996				1997			
Preventing latex flow	Cont.	Ethanol (95%)	Searing	Boiling water	Cont.	Ethanol (95%)	Searing	Boiling water
Pulsing								
STS	69.7	72.3	72.7	70.6	71	79.9	75.6	73.1
8-HQS	68.2	73.5	71	69.3	70.2	78.6	74.6	71.7
Antibiotic	67.3	72.3	69.6	68.3	69.1	76.9	73.5	71
L.S.D. 5%	0.6				0.2			

The lowest value of flower opening velocity was recorded using sucrose (1.5 %) in both seasons, which valued 49.03 and 45.26 in the first and second season, respectively. Boric acid and CCC had intermediate velocity. However, the highest flower opening velocity was recorded using distilled water in both seasons. In this concern, sucrose was found to improve flower opening several cut flowers species (Redman *et al.*, 2002). Sucrose is required for flower opening, since the carbohydrate reserves available in the flower stem after cutting are limited (Halevy and Mayak 1979). Sucrose increased cut flower longevity by providing a substrate for respiration, allowing the inflorescence to maintain cell integrity and organelle functions.

Regarding the interaction effect between preventing latex flow and pulsing treatments on flower opening velocity (Table 3), the lowest opening rate of petals per day was realized using ethanol (95 %) as preventing latex flow material and STS complex as pulsing treatment. The average flower

opening velocity of this combination valued 47.66 and 44.16 % in the first and second season, respectively. The role of ethanol and STS was previously discussed. However, these results indicated that the effects of both ethanol and STS on flower opening were additive.

c. Effect on color (anthocyanin content):

Fading of color or color change is one of the reasons for the termination of the vase life of cut flowers (Rogers, 1963). Anthocyanins are a group of red, blue-purple pigments, located mainly in the skins and largely responsible for the color in the fruits or flowers, for example in roses, violets and dahlia (Halevy and Mayak, 1981).

Herein, the highest anthocyanin content in dahlia petals was obtained using ethanol (95 %), which averaged 73.71 and 78.35 mg/100 g, compared with other treatments or the control in both seasons (Table, 2). The control (untreated) treatment recorded the lowest anthocyanin content in both seasons, and valued 68.41 and 70.07 mg/100 g in the first and second season, respectively. These results are in harmony with those reported by Gordon *et al.*, (1986) who mentioned that treating cut stems with alcohol was the best method for improvement of the postharvest quality of cut poinsettias.

Results also indicated that STS significantly increased anthocyanin content of petals compared with the other solutions. Relevant data were 72.06 and 74.82 mg / 100 g in the first and second season, respectively. However, the lowest value of anthocyanin in the petals was recorded due to pulsing flowers in an antibiotic complex. About color stability of petals of cut flowers, Halevy and Mayak (1981) reported that the coloring matter in red rose cultivars (e.g. Better Times) became more blue and less red as the petal tissue aged and this was associated with increased pH. Such pH change was related to the accumulation of ammonia in the petal tissue. Because of the anti-ethylene action and rapid movement of STS, it interacts directly with the ethylene-binding site and inhibited ethylene responses in flowers. Moreover, silver thiosulfate (STS) redirected the movement of carbohydrates away from the ovary to the petals (Cook and Staden 1984).

Maximum value of anthocyanin (mg / 100 g) in petals was recorded due to sucrose (1.5 %) as holding solution in both seasons. The corresponding data were 73.88 and 76.82 mg / 100 g in the first and second season, respectively. However, the lowest anthocyanin content of petals was recorded (69.16 and 71.79 mg/100g) using distilled water in both seasons. On the other hand, CCC and boric acid had intermediate values. The role of applied sugars in delaying senescence has been reviewed. Paulin (1986) mentioned that the change in spathe color apparently was associated with protein breakdown and production of ammonium ion in the tissue from the released amino acids. The author also reported that when cut flowers were supplied with sugar solution, the soluble protein content increased in the petals and the flower developed a process of detoxication by producing amides.

Concerning the interaction between preventing latex flow and pulsing treatments point of view, relevant data (Table 3) showed that the highest

anthocyanin content of dahlia petals was achieved using the combination of ethanol (95 %) and STS (4 mM) during vase life in both seasons. Anthocyanin averaged 75.28 and 79.64 (mg / 100 g) in the first and second season, respectively, due to preventing latex flow by using ethanol (95 %) and pulsing flowers in STS (4 mM) solution. The role of both ethanol and STS to retard early aging of the flower was discussed previously in details.

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دراسات ما بعد الحصاد على زهور الداليا المقطوفة (*Dahlia hybrida* L.)
الجزء الثاني : تأثير معاملات وقف تدفق المادة اللبنيّة و الغمس (الإنباض) و
محاليل الحفظ على عمر الزهرة و جودتها.

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الزهور المقطوفة من الداليا (*Dahlia hybrida* L.) التابعة للعائلة المركبة عمرها
قصير مما يقلل من إمكانياتها تجاريا كزهرة قطف. و عند قطع زهور الداليا من النبات يخرج ساق
الزهرة سائل لبني يؤدي لإتسداد الأوعية الناقلة عند قاعدة الساق و يمنع إمتصاص الماء مما يؤدي
إلى ذبول سريع للزهرة و قصر عمرها. و لقد تم عمل دراسة شاملة على معاملات ما بعد قطف
لزهور الداليا خلال العامين المتتاليين 1996/1995 و 1997/1996 في قسم الخضرا و الزينة
بكلية الزراعة جامعة المنصورة. تم إستخدام معاملات على ثلاثة مراحل متتالية لتحسين عمر و
جودة زهور الداليا المقطوفة. المرحلة الأولى تضمنت معاملات للقضاء على مشكلة المادة اللبنيّة
(كونترول بدون معاملة و الغمس في الإيثانول و الحرق فوق اللهب أو الغمس في الماء المغلي) و
يليه معاملات غمس لمدة قصيرة (أو ما يسمى بالإنباض) (محلول ثيوكبريتات الفضة (STS)
أو مركب مضاد حيوي أو 8-هيدروكسي كوينولين سلفات (8-HQS)) و في الخطوة النهائية
تم إستخدام مكونات مختلفة لمحاليل الحفظ (سكرورز و حمض البوريك و حمض الستريك و
السيكوسيل (CCC)).

في الجزء الأول تم دراسة تأثير هذه المعاملات على العلاقات المائية للزهرة و التركيب
التشريحي لساق الزهرة. و في هذا الجزء (الجزء الثاني) تم تقويم تأثير هذه المعاملات على عمر و
جودة الزهرة. و قد تم جمع البيانات على كمية السكريات المختزلة بالبيتلات و عمر الزهرة بعد
القطف بالأيام و أقصى زيادة في الوزن الطازج للزهرة و كمية صبغة الأنثوسيانين في البيتلات و
سرعة تفتح الزهرة.

ولقد أظهرت النتائج أنه كلما زادت كمية السكريات المختزلة في البيتلات كلما زاد عمر
الزهرة و أوضحت النتائج أن غمس 5 سم من قاعدة ساق الزهرة في كحول الإيثانول (95%)
لمدة 5 دقائق هي أفضل طريقة للتغلب على مشكلة السائل اللبني و أن غمس الساق في محلول 4
ملليمولر من ثيوكبريتات الفضة هي أفضل معاملة غمس و أن محلول السكرورز 1.5 % أفضل
محلول حفظ. و هذه المعاملات نتج عنها أعلى كميات من السكريات المختزلة و أطول عمر للزهرة
عن المعاملات المقارنة ، كما نتج عنها أيضا أفضل جودة للزهرة تم قياسها كأقصى زيادة في
الوزن الطازج و أعلى كمية أنثوسيانين و أبطأ سرعة لتفتح الزهرة. و لقد أدى التفاعل بين معاملة
الكحول و الغمس في ال STS إلى الحصول على أفضل جودة بالمقارنة بتفاعل المعاملات
الأخرى لمنع السائل اللبني مع معاملات الغمس الأخرى في كل قياسات الجودة.
و لقد أظهرت النتائج أيضا أن أطول عمر لزهرة الداليا في الموسمين (8 يوم) تم
الوصول إليه عن طريق وضع ساق الزهرة في الكحول 95% لمدة 5 دقائق يليها الغمس في
محلول ال STS لمدة 10 دقائق و في المرحلة الأخيرة بوضع الزهرة في محلول حفظ يحتوى
على 1.5 % سكرورز.