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DIFFERENT PRESERVATIVE SOLUTIONS ENHANCED THE VASE LIFE OF CARNATION CUT FLOWERS (*DIANTHUS CARYOPHYLLUS*)

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ABSTRACT

The vase life of carnation cut flowers were studied to determine the physiological factors that affect there vase live and longevity. Cut carnation flowers were obtained from commercial grower in Taif, Sudia Arabia, and treated with 100, 200 or 300 ppm of 8-hydroxyquniline sulfate (8-HQS) and sucrose at concentrations of 1, 2, or 3%w/v. Longevity of cut carnation was determined on the basis of wilting, chlorophyll retention and carbohydrate degradation. After treatment the cut carnation were kept at room temperature (23± 1 ^{0}C) at normal day light and natural ventilation. The vase life of cut flowers studied were prolonged by (8-HQS) treatment. The best concentration was 100 ppm. The effect was better when combined with 3% sucrose, which recorded the best vase life compared to other concentration of sucrose. The per cent of wilting was minimized as a result of using this treatments .However the per cent of wilting increased with the increase in concentrations of 8-HQS, and complete wilting occurred after 15, 14 and 14 days when treated with 100, 200 and 300ppm of 8-HQS respectively, while sucrose resulted in the lowest period to reach wilting. Also 8-HQS at 100ppm retarded the chlorophyll as well as carbohydrate degradation during the postharvest life. These experiments were carried out in the laboratory of the Department of Biology -Taif University- Sudia Arabia. The experiments were repeated three times with three replicates, and a completely randomized design had been used. The difference between means were performed using Duncan multiple range test at 0.05 level.

KEYWORDS: vase life, 8- HQS, sucrose pulsing, carnation plants.

INTRODUCTION

Carnation (*Dianthus caryophyllus*) belong to family Caryophyllaceae, which one of the most popular cut flowers due to there highest economic importance in the floriculture industry such like a medicinal and nutrient products. However, the main idea of carnation plant cultivation is to get the cut flowers, which greatly deals with the floricultural business.

Vase life of cut carnation flowers is usually short.[1] Ethylene is one of factors that affect the vase life of carnation cut flowers, which result in the senescence of flowers.[2,3] A large amount of ethylene is produced in a several days after full opening of the flower petals[4], the increased ethylene production promotes the in-rolling of petals resulting in wilting of the flowers which shortened the carnation vase life.[1] Also the carnation cut flowers wilt and floral axis become bent(bent-neck) just below the flower head.[5] The development of such symptoms is considered to be caused by vascular occlusion, which inhibits water supply to the flowers.[6]

Several methods to increase the vase life of cut flowers to keeping their freshness for longer period have been reported .Cut flowers should be free of any deteriorations, as this is one of the principal entry points for decay organisms.[7] A major form of deterioration in cut flowers is the blockage of xylem vessels by air and microorganisms that cause xylem occlusion.[7]

The germicide 8-hydroxyquinoline sulfate(8-HQS)is one of the very important preservatives used in floral industry.[8] Application of HQS significantly increased the vase life as well as the gain of fresh weight of carnation cut flowers in compared to control.[9] Also, sucrose acts as a preservatives materials, in addition to extended the vase life of cut flower[10,11] treated cut spry carnation by different concentrations of sucrose ranging from (0-7.5) ,and found that 5.0% sucrose recorded the best vase life and delayed the climacteric ethylene in petals. Furthermore, expression of the flower color is improved by treatment in some cut flowers such as carnation.[12] Also different concentrations of sucrose had been investigated by Butte, 2005[13] on two cultivars of (*Rasa hybirida*) and results showed that sucrose at 25 gl^{-1} extended the vase life by 8.2 days in var. Whisk Mc and 7.5 days in var. Trika as compared to 5.3days in control.[13]

Furthermore sugars with biocides have become an important commercial preservative for several cut flowers.[14] The treatments were more effective when sucrose was added to HQS as observed by Ichimura and Goto (1999)[15] in rose cut flowers.

In addition the preservative solutions containing 3% sucrose and 200ppm 8-HQS extend the vase life and inhibited the flower senescence and bent neck in rose cut flowers.[16] 8-HQS treatment prevented the growth of microorganism in xylem and thus maintained water uptake by Freesia flower stems. Also the combination treatment with 8-HQS and sucrose improved the postharvest quality of Gladiolus spikes.[17] In Dendrobium flowers, holding solutions containing 8-HQS +sucrose extended the vase life and improved flower quality.[18] They also improved water consumption, fresh weight and flower freshness .In addition they reduced respiration rate and physiological loss in weight.[18]

Aim of the present study was to investigate the effect of 8-HQS pulse treatment followed by sucrose on vase life and postharvest physiology in carnation cut flowers.

MATERIAL AND METHODS

Preparation of plant material: Cut flowers of carnation were obtained from commercial grower in Taif, Sudia Arabia. Flower stems were trimmed to 35cm underwater to avoid air embolisms.[19] All leaves on the lower section of the stem were removed.

Experiment (1). 8-hydroxyquinoline sulfate (8-HQS) was applied at concentrations of 0, 100, 200,or 300 ppm. Sucrose were used at concentrations of 0, 1, 2 or 3% w/v The two compounds were dissolved in sterilized distilled water in 250ml bottle glass. The sample had been divided into seven groups with three replications containing three flowers each .The flowers were kept at room temperature (23 ± 1^0C) at normal day light and natural ventilation. Visual rating of flowers was carried out according to Hassan (2005).[20]

Experiment(2). 8-HQS at concentration of 100 ppm and sucrose at concentration 3%(w/v) gave the best results in experiment (1). Hence the effect of both concentrations of 8-HQS and sucrose on vase life, chlorophyll retention and carbohydrate degradation were further investigated.

Chlorophyll determination: Chlorophyll was extracted by methanol, and the absorbance was determine by spectrophotometer on day 1, 5 and 9 (at which the vase life of control was

terminated) according to Harborne method (1998).[21] chl. *a* and chl. *b* were then calculated using the flowing equation.

Chl *a* (mg 1^{-1})= 12.21 A_{663} -2.81 A_{646} Chl *b*(mg 1^{-1})=20.13A_{646} -5.03A_{663}

Carbohydrates determination: Carbohydrates were determined on the stems and petals of the best treatment of the two compounds. Samples were taken on day 1, 5 and 9, then separated by a high performance liquid chromatography (HPLC) fitted with differential refractometer to detect fructose, glucose and sucrose in different samples.

RESULTS

Effect of 8-HQS and sucrose on vase life of carnation cut flowers.

The vase life of carnation cut flowers was extended by the different concentrations of 8-HQS, used in table 1.The vase life was longer in 8-HQS at 100 ppm which resulted in 13.5 days compared to other concentrations. Sucrose resulted in the lowest vase life compared to 8-HQS in different concentrations. The longest vase life result when applying sucrose at 3% w/v, which gave 11.8 days in comparison to 9.2 days for control (Table 1). The statistical analysis of result show that the two compounds used significantly extended the vase life of carnation cut flowers compared to control.

Table 2 showed the per cent of wilting increased with the increasing in concentrations of 8-HQS, the vase life was terminated till 15, 14 and 14 days, when cut flowers were treated with 100, 200 and 300ppm 8-HQS respectively, compared to 10 days in control. Sucrose result in the lowest period to reach wilting per cent. Thus, wilting occurred on 12, 12 and14 days after treated with sucrose at concentrations of 1, 2 and 3% compared to 10 days for control. (Table 2)

Table (1): Effect of 8-HQS and sucrose on vase life of carnation cut flowers (*Dianthus caryophyllus*).

Treatments	Vase life values (Day)
8-HQS 100ppm	13.5 a
8-HQS 200ppm	12.5 b
8-HQS300ppm	12 a b
Sucrose 1%	10 d
Sucrose 2%	10.5 cd
Sucrose 3%	11.8 c
Control	9.2 e

Different letters indicate the significant differences between means (Duncan multiple range, p=0.05

Table (2) calculation of per cent wilting in carnation cut flowers treated with different concentrations of 8-HQS and sucrose compared to control.

Days after treatments	* Per cent of wilting in different concentrations of 8-HQS and sucrose						
	8-HQS .conc. in (ppm)			Sucrose .conc. in(w/v)			Control
	100	200	300	1%	2%	3%	0
2	0	0.5	0.25	1.5	1	0	1
4	1	2.5	1.5	10.5	11.5	5.5	7
6	2.5	10.5	7	29	32.6	20	24.5
8	7	31.5	14.5	63.5	75.8	53.5	68.5
10	26.5	87.5	39.5	89	89.5	74	95.5
12	44	93.5	84.9	91	96	89.5	-
14	86	99	95	-	-	96	-
15	96	-	-	-	-	-	-

- reading of % wilting was done every tow days after treatments.

Effect of the best treatment for 8-HQS and sucrose on vase life and postharvest quality of carnation cut flowers.

The result of table 3 showed that, the treatment by 8-HQS at 100 ppm prolonged the vase life of carnation cut flowers with or without sucrose compared to control. When sucrose was added to 100ppm 8-HQS, the vase life was extended to 15 days compared to 13 days without sucrose. However, sucrose at 3% extended the vase life by 12 days compared to control, 9.8 days only (Table 3).

Chlorophyll content: The previous treatments lead to a considerable delay in degradation of chl. *a* and chl. *b* compared to control in carnation leaves (Table 4). The concentration of chlorophyll *a* was higher than chlorophyll *b* at any time point through out the vase life. When treated flowers with 8-HQS 100ppm chlorophyll content on the 1^{st} day was 1.96, 0.35 mg 1^{-1} weight for chl. *a* and chl. *b* respectively. Further increasing in chlorophyll content was attained when added sucrose at 3% to 100ppm 8-HQS. Thus, at the end of the experiment the accumulated of chl. *a* and chl. *b*, were 4.66, 2.43 mg 1^{-1} respectively (Table 4).

Carbohydrate content: Data of tables 5and 6 show that fructose, glucose and sucrose were the main soluble carbohydrates in petals as well as stems of carnation flowers. Fructose was the major component in the petals as well as stems and generally its values were higher than those of stems. The sucrose content in petals and stem were lower than that of glucose.

The carbohydrate content more increased as a result of using 100ppm 8-HQS + 3% sucrose till day 5 then sharply decreased on day 9 at which the vase life of control was terminated. The concentrations of fructose, glucose and sucrose in carnation petals were 4.23, 0.98 and 0.55 mg g^{-1}dry weight for controls at the end of experiment(table 5). Also stem contents of the previous sugars increased at the beginning of the experiment then decreased towards the end of the experiment compared to control (table 6).

Table (3): Effect of the best treatment of 8-HQS and sucrose on vase life and postharvest quality of carnation cut flowers.

Treatments	Vase life values(day)
8-HQS 100ppm	13 b
8-HQS 100ppm+ sucrose 3%	15 a
Sucrose 3%	12 c
Control treatment	9.8 d

Different letters explain the significant differences between means, according to Duncan multiple range p= 0.05.

Table (4): Effect of 8-HQS with or without sucrose and sucrose alone on chlorophyll content for carnation cut flowers.(unit was mg 1^{-1} fresh weight).

Treatments	Days of determination of chl. *a* and chl. *b*					
	1st day		5th day		9th day	
	Chl. *a*	Chl. *b*	Chl. *a*	Chl. *b*	Chl. *a*	Chl. *b*
8-HQS 100ppm	1.96	0.35	2.54	1.00	3.20	1.92
8-HQS 100ppm+sucrose3%	2.31	0.98	3.22	1.56	4.66	2.43
Sucrose 3%	1.82	0.65	3.02	1.09	2.01	0.98
Control treatment	1.33	0.21	4.11	2.21	0.12	0.11

Table (5): Effect of 8-HQS with or without sucrose and sucrose alone on carbohydrate content for petals of carnation cut flowers (unit was mg^{-1} dry weight).

Treatment	days of determination of carbohydrate content								
	1st day			5th day			9th day		
	Fructose	glucose	Sucrose	Fructose	glucose	sucrose	Fructose	Glucose	Sucrose
8-HQS 100 ppm	9.66	2.04	1.02	9.90	2.18	1.18	8.53	0.23	0.82
8-HQS 100ppm+sucrose 3%	7.89	1.23	0.54	9.08	1.99	1.02	6.19	0.68	0.08
Sucrose 3%	4.76	1.98	1.08	5.03	2.21	1.54	3.63	1.22	0.67
Control	6.79	0.98	0.55	6.99	1.22	0.67	4.23	0.98	0.55

Table (6): Effect of 8-HQS with or without sucrose and sucrose alone on carbohydrate content for stems of carnation cut flowers (unit was mg^{-1} dry weight).

Treatment	days of determination of carbohydrate content								
	1st day			5th day			9th day		
	Fructose	glucose	sucrose	Fructose	glucose	sucrose	Fructose	Glucose	Sucrose
8-HQS 100 ppm	2.47	2.63	0.07	2.90	3.01	0.17	1.66	1.98	0.03
8-HQS 100ppm+sucrose 3%	4.77	3.11	1.21	5.00	3.45	1.54	2.93	1.89	0.85
Sucrose 3%	5.04	2.06	0.67	5.78	2.87	1.01	3.09	1.73	0.13
Control	2.77	1..93	0.41	3.01	2.03	0.87	1.53	0.97	0.07

DISCUSSION

One of the greatest problems in postharvest flower physiology is the blockage of vascular system, due to air or bacterial growth[6], which reduce the water uptake and this blocks xylem vessels leading to water stress.[6] That was expressed in the form of early wilting of leaves or flower[22], as a result of premature loss of cell turgidity and might appear when water uptake and transpiration are out of balance during a lasting period of time. This finally leads to an unrecoverable situation and the premature end of flower vase life.[23]

Its well known that the 8-HQS is extend the vase life of carnation cut flowers, by preventing the accumulation of microorganisms in xylem vessels.[24] This explains the short vase life of untreated (control) carnation cut flowers and long vase life when 8-HQS was applied (Table 1). This in agreement with the observation of Kwon and Kim, (2000)[24] when treated the Freesia flower stem by 8-HQS ,the growth of microorganism had been prevented. Thus, 8-HQS may act as an antimicrobial agent and hence, reduce stem plugging.

Also, 8-HQS delayed wilting compared to control (Table 2), which is similar to findings by Kim and Lee,(2002).[16] Further, 8-HQS minimized losses in chlorophyll (Table 4) as well as carbohydrates (Tables 5,6). This in agreement with earlier findings of Husein, 1994;[25] Knee, 2002;[9] Bhattacharjee, 1994[26] and Ichimura and Goto,1999).[15]

Generally sugar supply, increase the longevity of many cut flowers.[10] Since they act as a source of nutrition for tissues approaching carbohydrate starvation, thereby lead to the promoting of subsequent water relations.[27] The dissolved sugars in cells of the petals are osmotically active substances that are drawn into the corolla-cells making the cells turgid with hydrolyzed sugars for respiration.[27] Similar findings were obtained by Ichimura, (1998)[28], when sucrose was added to 8-HQS extending the vase life of rose cut

flowers[29,17&18] Preservative solutions containing sucrose + 8-HQS extended the vase life by inhibiting senescence and bent neck of carnation cut flowers, which led to improving the postharvest quality of the flowers as obtained by Altman and Solomos(1995)[5] in carnation cut flowers.

Also, sucrose +8-HQS reduced chlorophyll degradation and preserved carbohydrates content in carnation cut flowers (Tables 5, 6) This might be inhibiting ethylene action. As a result, the vase life could be increased. Similarly, Bartoli *et al*.,(1997)[30] and WeiMing *et al*., (1997)[31] reported that, the vase life of chrysanthemum cut flowers was significantly increased when treated with 8-HQS+sucrose.

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