

EFFECT OF SOME CHEMICAL AND NATURAL HOLDING SOLUTIONS ON THE POST HARVEST QUALITY OF GLADIOLUS SPIKES

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Abstract

Spikes of cut *Gladiolus cv. Rose Supreme* were placed in holding solutions containing different chemicals, i.e. 50 ppm silver nitrate, 250 ppm 8-hydroxyquinoline + 5 % sucrose, 5 % sucrose alone, 25, 50 or 100 ppm sodium hypochlorite. All these chemicals were compared with the safety, friendly and non-toxic natural resources, i.e. 0.5, 1.0 and 1.5 g/l of powdered dried sepals of *Hibiscus sabdariffa*, with or without 5 % sucrose, 0.5, 1.0 and 1.5 g/l of powdered dried leaves of *Lawsonia inermis* with 5 % sucrose or adding branch from *Coleus blumei* or *Ocimum basilicum* with or without 5 % sucrose to extend the vase life of *Gladiolus* spikes. Observations were then recorded for the number of opened florets on the spike on the fourth day, floret diameter, flower longevity, floret opening percentage, chlorophyll content, water uptake and bacteria and fungi count in the vase solution. The obtained results showed the following:

Cut spikes treated with 1.0 g/l roselle (*Hibiscus sabdariffa*) and 1.0 or 1.5 g/l roselle + 5% sucrose improved significantly the vase life, florets diameter, floret opening percentage, water uptake and showed reducing of bacterial and fungi growth in the vase solution. Thus, it is possible to use these natural safety treatments for extending the post harvest life of *Gladiolus* spikes as an alternative treatment to the chemical compounds.

Key word : *Gladiolus*, silver nitrate, 8 hydroxy quinoline, sucrose, sodium hybochloride, hibiscus sabdariffa, *Lawsonia inermis*, *Coleus blume*, *Ocimum basilicum*, vase life.

INTRODUCTION

Gladiolus (Family Iridaceae) is an important commercial bulbous flowering crop which is extensively cultivated in many countries; it is considered one of the most important cut flower crops in the floricultural industry and is the most widely grown outdoor cut flower in Egypt and can be grown successfully in tropical, sub-tropical and temperate climates.

Gladiolus cut flowers are accelerated to senescence and lose quality and life by increasing the biosynthesis processes during harvesting, storage, marketing and handling, (Khenizy, 2004).

Several investigators showed how to minimize postharvest losses of *Gladiolus* cut spikes.

Beura and Singh (2002) found that the greatest diameter of the first (12.17 cm) and fifth (11.63 cm) florets was obtained with 1000 ppm silver nitrate + 10 % sucrose. They showed also that the longest floret life (5.93 and 5.83 days), vase life of spike (12 days) and the greatest solution uptake were also observed in 1000 ppm silver nitrate + 10 or 20% sucrose.

Singh and Sharma (2003) found that the combination of sucrose and metal salts increased the vase life of cut *Gladiolus* spikes from 8.5 days in the control to 13.0 days in 5 % sucrose + 600 mg/l 8-hydroxyquinoline citrate. They found also that number of florets fully opened, floret diameter and water uptake were highest (8.4, 7.8 cm. and 72.5 ml respectively)

Holding of *Gladiolus* spikes in silver nitrate at 800 mg/l delayed spike bending (7.2 day), improved floret opening (87 %) and vase life (13 days) at room temperature of 20 – 25°C and 80 % relative humidity as recorded by Barman and Rajini (2004).

The 8-HQ pulse treatment before the sucrose treatment eliminated the microbial growth and improved the uptake of sucrose pulse treatment (Singh *et al.*, 2005).

The longest vase life was obtained with the application of silver nitrate at 50 ppm as found by both Sharma and Devi (2005) and Sheikh and John (2005).

Post storage vase solution treatment (300 ppm 8 HQ + 5 % sucrose) significantly improved the cut *Gladiolus* spike quality and vase life as reported by Singh *et al.* (2006).

It was found by Sharma and Singh (2006) that sucrose + 8 HQ recorded the greatest diameter of the 2nd and 5th florets of *Gladiolus* and was effective on the enhancement of vase life.

Singh *et al.* (2007) suggested the use of 200 and 300 ppm 8-HQ treatment with 5 % sucrose for improving the keeping quality of *Gladiolus* cut spikes

Using holding solutions such as 8-hydroxyl quinoline (for eliminating microbial growth), sucrose (source of carbohydrates for cut flowers), sodium hypochlorite (against ethylene and antimicrobial agent) and silver nitrate, (for reducing ethylene binding capacity and suppressing endogenous ethylene production thereby delaying the appearance of senescence characteristics) were reported by Van Doorn and Woltering (1991). However, silver is a heavy metal and environmental concerns led many countries to actively moving towards its elimination from commercial use. Thus, searches were made to find safety, friendly and non-toxic substances to human and also can extend the vase life of *Gladiolus* spikes. Several investigators had referred to antibacterial

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plants since several years, Malekzadeh (1968) found that both gram positive and gram negative bacteria were inhibited using the henna extract prepared by adding 1 g of powdered dried leaves to 10 ml of sterile distilled water .

Ogundipe et al. (1999) recorded that phenolic compounds in *Hibiscus sabdariffa* has significant antimicrobial activities against gram positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis* and *Bacillus cereus*) and gram negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*).

The extracts from *Hibiscus sabdariffa* are the most potent against *Staphylococcus aureus* and have greatest activity against *E. coli* as found by Metwali (2003).

The strongest antibacterial activity was found in the water extract of *Hibiscus sabdariffa* as reported by Garcia et al. (2006).

The aim of this work was to examine the ornamental plant *Coleus blumei* which root easily in the water, and some antimicrobial plants such as, *Ocimum basilicum*, *Lawsonia inermis* and *Hibiscus sabdariffa* as alternative treatments to the chemical compounds effective on extending the postharvest life of a *Gladiolus* spikes .

MATERIALS AND METHODS

Gladiolus cut spikes (cv. Rose supreme) were obtained from a commercial nursery, Alexandria, Egypt . uniform spikes with stem length of 100 cm , six leaves per spikes and the first floret on the spike was at the beginning of the opening stage were used.

The spikes were placed in glass containers with one litre tap water at room temperature of 30 -31 °C and 60 - 70 % relative humidity during the experiments.

The following treatments were used :

- 1- Tap water as a control .
- 2- Adding a branch (20 cm) of *Coleus blumei* .
- 3- Adding a branch (20 cm) of *Ocimum basilicum* (basil, sweet basil).
- 4- Adding 0.5 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle).
- 5- Adding 1.0 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle).
- 6- Adding Adding 1.5 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle).
- 7- Adding 5 % sucrose.
- 8- Adding a branch (20 cm) of *Coleus blumei* + 5 % sucrose.
- 9- Adding a branch of *Ocimum basilicum* (20 cm) + 5 % sucrose.
- 10 - Adding 0.5 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle) + 5 % sucrose.
- 11 - Adding 1.0 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle) + 5 % sucrose.

12 - Adding 1.5 g of powdered dried sepals of *Hibiscus sabdariffa* (roselle) + 5 % sucrose.

13 - Adding 0.5 g of powdered dried leaves of *Lawsonia inermis* (henna) + 5 % sucrose.

14 - Adding 1.0 g of powdered dried leaves of *Lawsonia inermis* (henna) + 5 % sucrose.

15 - Adding 1.5 g of powdered dried leaves of *Lawsonia inermis* (henna) + 5 % sucrose.

16 - Adding 250 ppm 8 - hydroxyquinoline (8-HQ) + 5 % sucrose .

17 - Adding 50 ppm silver nitrate.

18 - Adding 25 ppm sodium hypochlorite.

19 - Adding 50 ppm sodium hypochlorite.

20 - Adding 100 ppm sodium hypochlorite.

Experimental layout and statistical analysis

The Experimental layout was a complete randomized block design. It consisted of twenty treatments , each treatment was replicated three times, every replicate consisted of three glass containers , one spike was used in each glass (20 T x 3 R x 3 G x 1 S = 180 spikes) .

The data were statistically analysed as means and were compared using L.S.D. at 5 % according to Steel and Torrie (1982) .

Recorded data

- 1- Number of the opened florets per spike on the fourth day.
- 2 - Floret diameter : The diameter of the third floret on the spike was measured at full opening stage (cm).
- 3 - Spike longevity : the vase life of *Gladiolus* cut spike (days) was determined when the seventh floret in the spike wilted.
- 4 - Floret opening percentage : mean percentage of opened florets from all the florets on the spike at the end of vase life.
- 5 - Chlorophyll content : Total chlorophyll (SPAD unit) was determined in the leaves at the end of vase life with SPAD instrument as described by Yadava (1986).
- 6 - Water uptake : The weight of absorbed holding solution (g) was recorded as the difference between the weight of jars with spikes stem at the beginning of experiment and at the end of vase life.
- 7 - Bacteria in vase solution : The samples of the vase solutions at the end of flower longevity for each treatment were taken (1 ml) , ten- fold serial dilutions were made by pipetting out 1 ml of the preservative solutions into 9 ml of a distilled water .One ml of each of the diluted solutios was taken and mixed in Petri dishes were used as replicates for each treatment . Plates were incubated at 30 for two days and the colonies appearing on the plates were counted.

8 - Fungi in vase solution : The same method for bacteria count was used using only four fold serial dilutions .

RESULTS AND DISCUSSION

1 – Number of the opened florets per spike on the fourth day

The highest number of fully opened florets per spike (8.5) on the fourth day of longevity was recorded by the spikes treatment of 1.5 g / l roselle + 5 % sucrose followed by those of 8- hydroxyquinoline +5 % sucrose, 1.0 and 1.5 g / l roselle (7.6) compared to the control treatment (7.0). On the other hand, application of all concentration of henna (0.5, 1.0 and 1.5 g/l) + 5 % sucrose and also 0.5 g / l roselle , 5 % sucrose , branch of *Coleus blumei* + sucrose, 1.0 g roselle + sucrose and 100 ppm sodium hypochlorite decreased the number of opened florets per spike on the 4th day (Table 1).

2 - Floret diameter

The diameter of the third floret on *Gladiolus* spike was significantly increased by adding one branch of either *Coleus* or *Ocimum* to the holding solution compared to the control (11.3, 11.4 and 10.3 cm. respectively). All concentration of roselle, i.e 0.5,1.0 1.5 g/l with or without sucrose significantly increased the diameter (11.6, 11.2 , 11.0 ,11.2,10.9 and 11.4 cm. respectively, as well as 1.5 g/l of powdered dried henna(11.0 cm) as shown in Table (1). The treatments of 50 and 100 ppm. sodium hypochlorite and silver nitrate also significantly increased the diameter of the third floret compared with the control (11.3,11.3 and 10.3 cm) . This result agrees with the finding of Singh and Sharma(2003) on *Gladiolus*.

3 – Spike longevity(vase life)

Data in Table (1) indicated that adding all chemicals used or the antimicrobial plants as alternative treatments to the holding solution of *Gladiolus* increased the vase life compared with tap water except 8 – hydroxyquinoline with 5 % sucrose . Adding 1.5 g / l of powdered dried henna with 5 % sucrose was the most effective treatment for increasing the vase life (10.6 days) followed by 1.0 g/l of henna + 5% sucrose (10.3 days) and then 1.0 g/l of roselle + 5 % sucrose (10 days) and 0.5 g / l roselle (10 days). Adding one branch of *Coleus* or *Ocimum* with or without sucrose did not differ significantly from the control (8.0, 8.3,8.6,8.0 and 7.3 days respectively) . Application of silver nitrate at 50 ppm and 100 ppm sodium hypochlorite increased significantly spike longevity compared with the control (9.3,9.6 and 7.3 days respectively). This result agrees with those found by Sheikh and John (2005) and Sharma and Davi, 2005.

4 - Floret opening percentage

All concentrations of roselle 0.5,1.0 or 1.5 g/l + 5 % sucrose improved the floret opening percentage and differed significantly from the control (93.5 , 89.2,89 and 72 % respectively). The most beneficial treatments were found from adding the *Coleus* or *Ocimum* branch , 1.0 or 1.5 g/l roselle , 25 ppm sodium hypochlorite or 8-HQ + sucrose (97.6 , 85.8, 91.5, 100 , 90 and 83.6 % , respectively) (Table 1). This result agrees with the results of Khenizy (2004) on *Gladiolus*.

5 - Chlorophyll content

The treatment of 50 ppm silver nitrate , 0.5,1.0,1.5 g / l roselle and *Coleus* or *Ocimum* branch did not differ significantly from the control , while the other tested treatments decreased the leaf chlorophyll content (Table 1) .

This result may be due to increasing both respiration rate and ethylene production and thus cause chlorophyll degradation as suggested by Van Doorn and Woltering (1991).

6 - Water uptake

The greatest solution uptake was obtained using 1.5 and 1.0 g / l roselle + sucrose compared to the control (180,175 and 63.3 g, respectively). Water uptake was also high for spikes kept in water containing a *Coleus* or *Ocimum* branch, 0.5, 1.0, 1.5 g/l roselle, 1.5 g/l henna + sucrose, 50ppm silver nitrate and 25, 50, 100 ppm sodium hypochlorite (93.6, 90, 100, 106.6, 86.6, 83.3, 150, 100 and 140 g respectively) (Table 1). This result may be due to reducing bacteria and fungi growth and improving water uptake as reported by Gowda and Gowda(1990) on *Gladiolus*.

7 - Bacteria in vase solution

Used chemicals and medicinal plants effectively controlled bacterial growth and decreased significantly the count of bacteria except the treatments of adding a *Coleus* branch , 5 % sucrose ,0.5 g/l roselle and 0.5 g/l henna +5% sucrose as shown in Table (1) .

This result was confirmed by the finding of Metwali (2003) and Garcia *et al.* (2006). They found the strongest antibacterial activity in the water extract of *Hibiscus sabdariffa*, and was also in harmony with the result of Malekzadogh (1968), who obtained a strong antibacterial activity of an aqueous extract of henna leaves. The antibacterial activity of the henna is due to the natural naphthoquinone products alkannin and shikonin and their derivatives as found by Habal *et al.* (2007).

Aqueous-methanolic extract of *H. sabdariffa* was found to contain cardiac glycosides, flavonoids, saponins and alkaloids. It exhibited antibacterial activities against *Staphylococcus aureus*, *Bacillus stearothermo -philus*, *Micrococcus luteus* as reported by Tolulope (2007).

Table 1 : Effect of different holding solutions on post harvest quality characteristics of cut *Gladiolus* spikes cv. Rose Supreme ¹⁾.

Treatments	Number of florets opened 4 th day	Floret diameter (cm.)	Vase life (days)	Floret opening percentage%	Chlorophyll content (SPAD)	Water uptake (ml.)	Bacteria count (x10 ⁻⁶)	Fungi count (x10 ⁻⁴)
Control	7.0 cde	10.3 f	7.3 f	72.0 de	52.0 ab	63.3 hi	6 a	3 ab
Branch <i>Coleus blumei</i>	7.3 bcde	11.3 b	8.6 cdef	97.6 a	47.9 abcd	93.6 def	5 ab	3 ab
Branch <i>Ocimum basilicum</i>	7.0 cde	11.4 ab	8.0 ef	86.8 abc	51.1 abc	90.0 efg	3 cd	4 a
0.5g/l roselle	6.0 fg	11.2 bc	10.0 abc	66.2 e	47.2 bcd	100.0 de	5 ab	3 ab
1.0 g/l roselle	7.6 abc	10.9 d	9.0 bcde	91.5 ab	48.6 abcd	106.6 cd	2 de	2 bc
1.5 g/l roselle	7.6 abc	11.4 ab	8.6 cdef	100.0 a	52.6 a	116.6 c	1 e	2 bc
5% sucrose	6.0 fg	10.0 g	9.0 bcde	67.0 e	38.0 fg	45.0 j	5 ab	4 a
Branch <i>Coleus</i> +5% sucrose	6.0 fg	10.6 e	8.0 ef	69.9 e	26.1 i	40.0 j	4 bc	3 ab
Branch <i>Ocimum</i> +5% sucrose	6.6 def	10.3 f	8.3 def	79.0 cd	31.1 h	53.3 ij	3 cd	2 bc
0.5g/l roselle+5% sucrose	7.5 bcd	11.6 a	8.5 def	93.5 a	41.1 ef	150.0 b	3 cd	3 ab
1.0 g/l roselle +5% sucrose	6.0 fg	11.2 bc	10.0 abc	89.2 abc	29.9 hi	175.0 a	3 cd	3 ab
1.5 g/l roselle +5% sucrose	8.5 a	11.0 cd	8.8 cde	89.0 ab	31.3 h	180.0 a	2 de	1 c
0.5 g/l henna+5% sucrose	6.0 fg	9.9 g	8.0 ef	72.6 de	39.8 ef	66.6 hi	5 ab	3 ab
1.0 g/l henna +5% sucrose	5.3 g	9.3 i	10.3 ab	65.3 e	34.8 gh	76.6 gh	3 cd	2 bc
1.5 g/l henna +5% sucrose	6.0 fg	11.0 cd	10.6 a	66.3 e	33.4 gh	86.6 efg	4 bc	1 c
5% sucrose+250ppm 8-HQ	8.0 ab	9.6 h	7.3 f	83.6 bc	31.7 h	66.6 hi	4 bc	3 ab
50ppm silver nitrate	6.6 def	10.8 de	9.3 abcde	72.8 de	49.4 abc	83.3 fg	2 de	1 c
25ppm sodium hypochlorite	6.5 ef	10.0 g	8.0 ef	90 ab	47.0 cd	150.0 b	4 bc	2 bc
50ppm sodium hypochlorite	7.0 cde	11.3 b	8.0 ef	72.4 de	44.2 de	100.0 de	4 bc	3 ab
100ppm sodium hypochlorite	6.0 fg	11.3 b	9.6 abcd	64.3 e	40.3 ef	140.0 b	2 de	2 bc
LSD 0.05	1.0*	0.3*	1.51*	6.5*	5.0*	16.3*	1.6*	1.3*

¹⁾ Values in the same column not followed by the same letter are significantly different at the 5% level of probability .

*,significant at P=0.05 .

8 - Fungi in vase solution

Only the holding solutions containing 1.5 g/l roselle + 5 % sucrose, 1.5 g/l henna + 5% sucrose and 50 ppm silver nitrate inhibited the growth of fungi and decreased significantly their count, while the other treatments had no significant effects in this concern (Table 1).

It is suggested that the increase in vase life with 1.0, 1.5 g/l roselle with or without 5 % sucrose and 1.5 g/l henna + 5 % sucrose may be due to reducing bacteria and fungi growth and improving water uptake as reported by Gowda and Gowda (1990). Thus, it is recommended to use these treatments for extending the vase life of *Gladiolus* spikes as alternative treatments to the chemical compounds.

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الملخص العربي

تأثير بعض المواد الكيماوية و الطبيعية على مدة بقاء شمرايخ الجلادبولس الزهريه المقطوفة

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تم مقارنة تأثير إضافة المواد الكيماوية و الطبيعية لإطالة عمر النورات المقطوفة لنبات الجلادبولس صنف Rose Supreme للوصول إلى مواد آمنة و غير سامة للإنسان و غير ملوثة للبيئة .

و قد استخدمت المواد الكيماوية الآتية : ٥٠ جزء في المليون نترات فضة ، ٢٥٠ جزء في المليون ٨ - هيدروكسي كينولين + ٥ % سكروز ، هيبوكوريد الصوديوم بتركيز ٢٥ ، ٥٠ ، ١٠٠ جزء في المليون .

و استخدمت أيضا بعض المواد الطبيعية و هي : إضافة فرع من نبات الكوليس ، إضافة فرع ريحان كلا بمفرده او بالإضافة إلى السكروز بتركيز ٥ % ، مسحوق سبلات الكركديه الجافة بتركيز ٠,٥ ، ١ ، ١,٥ جرام / لتر بمفردهم او بالإضافة للى السكروز بتركيز ٥ % ، مسحوق أوراق الحنة الجافة بتركيز ٠,٥ ، ١ ، ١,٥ جم / لتر مضاف له السكروز بتركيز ٥ % . بجانب السكروز بمفرده (٥ %)

و تم تقييم جودة الأزهار المقطوفة من حيث : مدة بقاء الأزهار بالأيام ، قطر الزهرة (سم) ، عدد الأزهار المتفتحة في اليوم الرابع ، النسبة المئوية لتفتح الزهيرات في نهاية التجربة ، تقدير الكلوروفيل و كمية الماء الممتص (جم) عدد البكتيريا و الفطريات في ماء اتية الحفظ . و لقد أظهرت النتائج أن إضافة ١ جرام / لتر مسحوق كركديه المضاف له السكروز بتركيز ٥ % لماء الاتية قد أطالت من عمر الأزهار المقطوفة و أدت إلى زيادة في قطر الزهرة و نسبة تفتح الزهيرات و كمية الماء الممتص بنسب مئوية كما خفضت مضمونيا من عدد البكتريا في محلول لواتي الحفظ (الفلزات) مما يتضح معه إمكانية استخدامها كبديل للمركبات الكيماوية في إطالة عمر أزهار الجلادبولس المقطوفة.