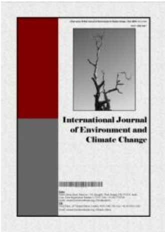

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Influence of Commonly Available Food sources on Extension of Vase Life of Gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to investigate the effect of commonly available food sources in extending the vase life of cut gladiolus. It was carried out at Floricultural Research Station, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar during 2020-2021. The preservatives used were Sugar (10, 20g), Coconut water (25, 50%), Sprite (50, 100 ml), Honey (5, 10%) and control (Distilled water) in Completely randomized design with nine treatments. Highest water uptake (22.62, 14.62, 11.29 g), transpirational loss of water (20.82, 13.00, 10.28 g), Water balance (6.80, 6.41, 6.01 g), Fresh weight change (106.69, 98.73, 89.36 %), lowest optical density (0.037, 0.042, 0.054 nm) on 2nd, 4th and 6th day of vase life respectively, minimum number of days to first floret opening (1.69 days), maximum diameter of basal floret (10.33 cm) and longevity of basal floret

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(2.63 days), highest number of florets opened on spike when basal floret is fresh (2.33), number of florets opened per spike at the end of the vase life (10.89) and highest vase life (9.33 days) was recorded in treatment sprite 100 ml. Based on these findings it can be inferred that Sprite 100 ml can be used as an effective food source alternative to chemical preservatives to enhance the vase life of cut gladiolus.

Keywords: Gladiolus; food sources; sprite; vase life; florets; sugars.

1. INTRODUCTION

Due of its exceptional beauty, gladiolus has become quite famous in many regions of the world. "Queen of bulbous flowers" is another name for it. *Gladiolus grandiflorus* L. is a member of the Iridaceae family and the Ixoideae subfamily, with its origin in South Africa. Gladiolus has been planted in Greece since antiquity. Pliny the Elder gave the gladiolus the name. Gladiolus, which means "sword" in Latin, it is also known as the "Sword Lily" or "Corn Lily."

Gladiolus can be grown at an altitude of 2400 meters, blooming from October to March in plains and June to September in hills [1]. It's a pretty simple plant to grow, and it's also good for bedding and exhibition. Spikes can be utilized in Ikebana flower arrangements because of their vertical growth. The flower spikes are used in bouquets and as decorations in the home. In the past, they were also employed for therapeutic purposes. Cut flower utilization is rapidly increasing around the globe. People are fascinated towards their wide range of colours, beauty and fragrance. In such case extending the vase life of cut flowers is gaining importance which is a limiting factor for cut flowers. Many commercial preservatives are available in the market which are not commonly and easily available and not environment safe. Major factor in prolonging the vase life of cut flowers is availability of energy source in the vase solution which is obtained by incorporating an appropriate food source in the vase solution. Mostly sugars are used as a food source, Which acts as a respiratory substrate and replaces the depleted natural carbohydrates and avoids the breakdown of other organic compounds [2]. Sugar, Coconut water, Honey and sprite have sugars in either monosaccharides or disaccharides form which acts as respiratory substrate, energy source helping in extending the vase life of cut flowers. Sugar (Sucrose), Honey - 53.3% of reducing sugars [3], Coconut water- 3.24 % reducing sugars [4] and Sprite - 10 g of total sugars per 100 ml [5].In this study an attempt has been made to investigate few commonly and easily available food sources to enhance the vase life of cut gladiolus.

2. MATERIALS AND METHODS

2.1 Experimental Site

The study was conducted at Floricultural Research Station, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. Situated at an altitude of 542.3 m above mean sea level on 78^{o} 29 ' east longitude and 17^{o} 19' North latitude. The flowers were held at ambient room temperature (average mean temperature of 26^{o}c, maximum relatively humidity 89% and minimum of 42%).

2.2 Plant Materials

Cut flowers of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima were obtained from Floricultural Research station, Rajendranagar. Spikes were cut with the help of secateurs when basal two buds started showing colour, immediately after harvesting cut spikes were kept in bucket containing water. To start the experiment all the leaves were removed and slant cut was given at the base of spikes under distilled water. Fresh weight of spikes was recorded and the spikes were placed in vase bottles containing 250 ml of preservative vase solution. Later the vase bottles were plugged with sterilized cotton to avoid evaporation of solution.

2.3 Experimental Design

The treatments were laid out in Completely randomized Design and each treatment was replicated three times. Two spikes were used for each replication. Treatment details are as follows, T_1 **:** Sugar - 10 g/l, T_2 **:** Sugar - 20 g/l, T_3 **:** Coconut Water - 25%, T_4 **:** Coconut Water - 50%, T_5 **:** Sprite - 50 ml/l, T_6 **:** Sprite -100 ml/l, T_7 **:** Honey - 5%, T_8 : Honey - 10%, T_9 **:** Control (Distilled water).Even though many soft drinks are present in market, based on transparency and availability in market sprite has been chosen for present study.

3. RESULTS AND DISCUSSION

3.1 Water Uptake (g)

On days 2nd, 4th, and 6th, T_6 - Sprite 100 ml had the highest water uptake (22.62, 14.62, 11.29 g) of all the treatments, followed by T_2 - Sugar 20 g (20.34, 12.56, 9.29 g). T_4 - Coconut water 50 %, on the other hand, had the lowest water intake (13.21, 6.83, 3.10 g) on the 2nd, 4th, and 6th days of vase life, respectively (Table 1). Sprite is carbonated water that is acidic in nature and contains 10 g of sugar per 100 millilitres. Low pH combined with osmotic potential due to sugars may have resulted in maximum water uptake in Sprite 100 ml (T_6). The findings of Saleem *et al.* [6], who found that carbonated water has a positive impact on water absorption, support these findings.

3.2 Transpirational Loss of Water (g)

Treatment T_6 - Sprite 100 ml recorded maximum transpirational loss of water (20.82, 13.00, 10.28 g) followed by T_2 - Sugar 20 g (18.84, 11.26, 9.59 g) on 2nd, 4th, 6th day of vase life. High amounts of water uptake by sprite 100 ml (T_6) might be resulted in high transpirational loss of water by the same treatment. Whereas, T_7 - Coconut water 50% recorded minimum transpirational loss (13.01, 7.09, 4.42 g) on 2nd, 4th and 6th days (Table 1).

3.3 Water Balance (g)

Among all the treatments T_6 - Sprite 100 ml recorded maximum water balance of (6.80, 6.41, 6.01 g) followed by T_2 - Sugar 20 g (6.50, 6.30, 4.61 g) respectively on 2nd, 4th, 6th day of vase life. Whereas T_4 - Coconut water 50% (DW) recorded minimum water balance (5.20, 4.74, 3.68 g) and on 2nd, 4th and 6th day of vase life period of cut gladioli (Table 2). Results explains the declining trend from day 1 to last day of vase life.

Parenthesis represents original values. The data were analyzed statistically after uniform addition of a base value 5.0.

3.4 Fresh Weight Change (%)

T_6 - Sprite 100 ml had recorded the highest fresh weight change percentage on days 2nd, 4th, and 6th (106.69, 98.73, 89.36 %) of all the treatments, followed by T_2- Sugar 20 g (102.64, 95.42, 87.12 %). T_4- Coconut water 50% recorded the lowest fresh weight change percentage (92.03, 79.51, 64.01%) during the 2nd, 4th and 6th days of vase life (Table 3). Treatment Sprite 100 ml (T_6) had a low pH along with sugars, which might have resulted in maximum water uptake and food reserves (energy source) by spike, respectively, and this might have aided in obtaining maximum fresh weight change values when compared to other treatments. Saleem et al. [6] found that carbonated water had a beneficial impact on relative fresh weight, which supports these findings.

3.5 Optical Density of Vase Solution (480 nm)

Significantly lowest optical density values (0.037, 0.042, 0.054 nm) were recorded with T_6 - Sprite 100 ml followed by T_5 - Sprite 50 ml (0.043, 0.052, 0.067 nm) on 2nd, 4th and 6th day of vase life respectively. T_4 - Coconut water 50% recorded highest optical density values (0.099, 0.194, 0.234) on 2nd, 4th, 6th days (Table 3). The lowest optical density values recorded by Sprite 100 ml (T_6) might be due to its efficiency in controlling the microbial population in vase solution when compared to other treatments because, pH of sprite is 3.24 [7], at which the growth of most of microbes is restricted.

3.6 Days to First Floret Opening (Days)

Minimum days to first floret opening was recorded with T_6- Sprite 100 ml (1.69 days) which was at par with T_2 - Sugar 20 g (1.72 days). Maximum days to first floret opening was recorded with T_4- Coconut water 50% (2.99 days) (Table 4). Kofranek and Halevy [8] has reported that sugars promote bud opening and retard flower senescence. Sprite 100 ml treatment (T_6) might have hastened the first floret opening by providing the required amount of food source in efficient manner and additionally because of presence of citric acid in sprite it might helped in efficient intake of sugars through better water intake when compared to other treatments.

3.7 Diameter of Basal Floret (cm)

There was a significant difference in the diameter of basal floret among the cut gladiolus spikes treated with different floral preservatives. Diameter of basal florets was recorded maximum in T_6- Sprite 100 ml (10.33 cm) which was at par with T_2 - Sugar 20 g (10.16 cm) followed by T_1 - Sugar 10 g (9.86 cm) (Table 4). Sprite 100 ml (T_6) was able to maintain high levels of water balance which might have resulted in high turgidity of cells further favoring increase in diameter of the florets. While lowest diameter of basal floret was recorded with T_4 - Coconut water 50% (7.30 cm) (Table 4). Similar results were obtained by Mehraj *et al*. [9] by using lemon juice + sucrose. Organic acid present in lemon juice is citric acid [10] in the same manner sprite also has citric acid [11] and sugar as its constituents, which might have played their role in positive water potential resulting in increase in diameter of florets.

3.8 Longevity of Basal Floret (Days)

T_6- Sprite 100 ml recorded the maximum longevity of basal floret (2.63 days) followed by T_2 - Sugar 20 g (2.40 days) and minimum longevity of basal floret was recorded in T_4- Coconut water 50% (0.80 days) (Table 4). Longevity of florets will be more when there is good water conductivity and controlled microbial growth in vase solution. Sprite 100 ml (T_6) might have reduced the bacterial count in the vase solution due to the presence of citric acid and it might have supplied the necessary sugars as basic metabolites, thereby enhancing the longevity of basal floret.

Table 1. Effect of commonly available food sources on water uptake (g/spike) and transpirational loss of water (g/spike) and fresh weight change (%) during vase life period of gladiolus cv. Swarnima

Treatments (T)	Water Uptake (g)				Transpirational loss of water (g)			
	Day 2	Day 4	Day 6	Day 8	Day 2	Day 4	Day 6	Day 8
T_1 - Sugar 10 g	19.77	11.76	8.67	4.67	18.29	10.66	9.23	5.60
T_2 - Sugar 20 g	20.34	12.56	9.29	6.53	18.84	11.26	9.59	7.30
T_3 - Coconut water 25%	15.12	8.13	7.49	4.03	14.43	7.79	8.46	5.24
T_4 - Coconut water 50%	13.21	6.83	3.10	0.00	13.01	7.09	4.42	0.00
T_5 - Sprite 50 ml	19.13	11.53	8.10	4.32	17.73	10.43	8.81	5.42
T_6 - Sprite 100 ml	22.62	14.62	11.29	6.99	20.82	13.00	10.28	7.39
T_7 - Honey 5%	16.11	8.61	7.44	4.15	15.17	7.81	8.33	5.26
T_8 - Honey 10%	16.89	10.18	7.84	4.32	15.79	9.60	8.75	5.52
T_9 - Control	14.19	6.98	3.14	0.00	13.76	7.17	4.45	0.00
Mean	17.48	10.15	7.36		16.42	9.43	8.03	
S.E (m)±	0.10	0.12	0.14		0.13	0.09	0.15	
CD at 5 %	0.30	0.38	0.42		0.39	0.27	0.25	

Table 2. Effect of commonly available food sources on water balance (g/spike) during vase life period of gladiolus *(Gladiolus grandiflorus* L.) cv. Swarnima

Treatments (T)	Water balance (g)			
	Day 2	Day 4	Day 6	Day 8
T_1 - Sugar 10 g	6.48 (1.48)	6.10 (1.10)	4.44 (-0.56)	4.07 (-0.93)
T_2 - Sugar 20 g	6.50 (1.50)	6.30 (1.30)	4.61 (-0.39)	4.23 (-0.77)
T_3 - Coconut water 25%	5.69 (0.69)	5.31 (0.31)	4.03 (-0.97)	3.79 (-1.21)
T_4 - Coconut water 50%	5.20 (0.20)	4.74 (-0.26)	3.68 (-1.32)	0.00
T_5 - Sprite 50 ml	6.40 (1.40)	6.23 (1.23)	4.29 (-0.71)	3.90 (-1.10)
T_6 - Sprite 100 ml	6.80 (1.80)	6.41 (1.41)	6.01 (1.01)	4.60 (-0.40)
T_7 - Honey 5%	5.94 (0.94)	5.70 (0.70)	4.11 (-0.89)	3.89 (-1.11)
T_8 - Honey 10%	6.10 (1.10)	5.84 (0.84)	4.09 (-0.91)	3.91 (-1.09)
T_9 - Control (DW)	5.43 (0.43)	4.81 (-0.19)	3.73 (-1.27)	0.00
Mean	6.06 (1.06)	5.71 (0.71)	4.54 (-0.46)	
S.E (m)±	0.13	0.05	0.12	
CD at 5 %	0.39	0.16	0.38	

Table 3. Effect of commonly available food sources on Fresh weight change (%) and optical density of vase solution (480 nm) during vase life period of gladiolus *(Gladiolus grandiflorus* L.) cv. Swarnima

Treatments (T)	Fresh weight change (%)				Optical density (nm)			
	Day 2	Day 4	Day 6	Day 8	Day 2	Day 4	Day 6	Day 8
T_1 - Sugar 10 g	101.12	93.18	85.63	76.12	0.054	0.068	0.098	0.102
T_2 - Sugar 20 g	102.64	95.42	87.12	80.79	0.065	0.075	0.101	0.108
T_3 - Coconut water 25%	94.19	86.69	73.64	65.16	0.093	0.158	0.169	0.172
T_4 - Coconut water 50%	92.03	79.51	64.01	0.00	0.099	0.194	0.234	0.00
T_5 - Sprite 50 ml	99.98	92.12	84.19	72.14	0.043	0.052	0.067	0.068
T_6 - Sprite 100 ml	106.69	98.73	89.36	86.31	0.037	0.042	0.054	0.057
T_7 - Honey 5 %	94.32	87.13	80.07	68.32	0.071	0.093	0.142	0.161
T_8 - Honey 10 %	98.67	90.37	82.41	70.62	0.083	0.101	0.152	0.169
T_9 - Control (DW)	93.16	80.17	68.04	0.00	0.079	0.100	0.121	0.00
Mean	98.08	89.25	79.38		0.069	0.098	0.126	
S.E (m)±	0.218	0.053	0.047		0.001	0.001	0.002	
CD at 5 %	0.654	0.161	0.142		0.004	0.004	0.007	

3.9 Number of Florets Opened on Spike When Basal Floret if Fresh

The floral preservative solution T_6- Sprite 100 ml recorded the maximum number of florets opened when basal floret is fresh (2.33) and it was at par with T_2- Sugar 20 g (2.23), T_1- Sugar 10 g (2.20). Least number of florets opened was recorded with T_4- Coconut water 50% (0.36) (Table 4). The acidic composition and sugars of Sprite 100 ml (T_6) have helped in high water uptake, water balance and provided energy required for the florets to open in maximum number. These reports are in accordance with the reports of [12] High petal sugar status and water balance in flowers is suggested to improve bud opening.

T_6R_1 T_9R_1

Fig 1. Number of florets opened when basal floret is fresh in best treatment (T_6) Sprite 100ml and Control (T_7)

Table 4. Effect of commonly available food sources on flowering parameters during vase life period of gladiolus (*Gladiolus grandiflorus* L.) cv Swarnima

Treatments (T)	Days to first floret opening (days)	Diameter of basal floret (cm)	Longevity of basal floret (days)	Number of florets opened per spike when basal floret is fresh	Number of florets opened at the end of the vase life	Vase life (days)
T_1 - Sugar 10 g	1.75	9.86	2.30	2.20	10.01	8.80
T_2 - Sugar 20 g	1.72	10.16	2.40	2.23	10.41	9.08
T_3 - Coconut water 25%	1.93	7.76	1.48	0.76	6.70	6.25
T_4 - Coconut water 50%	2.99	7.30	0.80	0.36	4.56	5.50
T_5 - Sprite 50 ml	1.76	9.60	2.26	2.13	9.32	8.63
T_6 - Sprite 100 ml	1.69	10.33	2.63	2.33	10.89	9.33
T_7 - Honey 5%	2.00	8.55	1.80	1.43	9.22	8.17
T_8 - Honey 10%	1.84	9.30	1.99	1.76	9.31	8.41
T_9 – Control	2.81	7.50	1.02	0.63	6.39	6.17
Mean	2.15	8.84	1.40	1.53	8.53	8.52
S.E (m)±	1.31	0.06	0.03	0.04	0.05	0.07
CD at 5 %	0.04	0.18	0.10	0.12	0.15	0.22

3.10 Number of Florets Opened per Spike at the end of the Vase Life

The effect of different treatments on number of florets opened by the end of the vase life was significantly different. Among all the treatments significantly maximum number of florets opened at the end of vase life (10.89) was recorded in T_6- Sprite 100 ml followed by T_2- Sugar 20 g (10.41). Whereas, the minimum number of florets opened per spike was recorded in T_4- Coconut water 50% (4.56) (Table 4). Wiathakar et al. [13] reported that the opening of gladiolus florets was accompanied by an increase in fresh weight, dry weight and carbohydrate concentration in the perianth. According to Siegelman *et al.* [14] when a rose flower begins to open, the flower's respiration rate increases, indicating that the flower opening process is linked to energy consumption. Sugars will help to meet some of the energy requirements. When compared to other treatments, Sprite 100 ml (T_6) might have provided ample sugars for florets to open and it is evident from Table 4. that Sprite 100 ml (T_6) had maintained maximum fresh weight when compared to other treatments directing towards more number of floret opening.

3.11 Vase Life of Spike (Days)

Observations on vase life varied significantly with different treatments. Vase life of gladiolus spikes varied from 9.33 days to 5.50 days. Maximum vase life (9.33 days) was recorded with T_6 - Sprite 100 ml followed by T_2 - Sugar 20 g (9.08 days), and minimum vase life was recorded in T_4 - Coconut water 50% (5.50 days) (Table 4). Extending the vase life of cut flowers, requires continuous flow of water without interruption, maximum water balance, fresh weight, reduced microbial load in vase solution. Sprite 100 ml (T_6) led to efficient maintenance of all these parameters, this resulted in maximum vase life of cut gladiolus. Mehraj et al. [9] by using lemon juice + sucrose recorded similar results in gladiolus. Organic acid present in lemon juice is citric acid [15] in the same manner Sprite also has citric acid [11]. Hence, composition of citric acid and sugars in sprite might have aided in extension of vase life of gladiolus spikes when compared to other treatments directly by improving the water uptake, water balance, fresh weight and reduced microbial load.

4. CONCLUSION

It can be concluded from the present study that among all the locally available food sources studied, sprite 100 ml maintained good water conductivity and recorded highest vase life of 9.33 days with high water uptake (22.62, 14.62, 11.29 g), transpirational loss of water (20.82,13.00,10.28 g), Water balance (6.80, 6.41, 6.01 g), Fresh weight change (106.69, 98.73, 89.36%), lowest optical density (0.037, 0.042, 0.054 nm), minimum number of days to first floret opening (1.69 days), maximum diameter of basal floret (10.33 cm) and longevity of basal floret (2.63 days), highest number of florets opened on spike when basal floret is fresh (2.33), number of florets opened per spike at the end of the vase life (10.89) when compared to other treatments. Hence this treatment can be used as an food source in vase solution, alternative to chemical preservatives.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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