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Short Research Article

Extending the Vase Life of Cut Gerbera (*Gerbera jamesonii* Bolus ex. Hook) cv. Savannah by Using Locally Available Floral Preservatives under Ambient Storage

K. C. Bhanu Murthy[1*], P. Prashanth[2] and R. Chandrasekhar[3]

[1]Dept. of Floriculture and Landscape Architecture, College of Horticulture, Dr. Y. S. R. Horticultural University, Rajendranagar, Hyderabad, Telangana (500 030), India
[2&3]Dept. of Floriculture and Landscape Architecture, College of Horticulture, Dr. Y. S. R. Horticultural University, Mojerla, Hyderabad, Telangana (500 030), India

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Correspondence to

**E-mail*: k.c.bhanumurthy1989@gmail.com

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Abstract

A laboratory trial was carried out to investigate the effectiveness of different locally available floral preservatives on extension of vase life of cut gerbera cv. Savannah under ambient storage condition. All the cut gerberas were precooled at 5 °C for 6 hours and followed by pulsing with sucrose at 20%+sodium hypochlorite at 50 ppm for 12 hours and then kept in locally available preservative floral solutions i.e. sugar, commercial vinegar, lime (*Citrus aurantifolia*) juice, commercial bleach (calcium hypochlorite-$CaOCl_2$) and neem (*Azadirachta indica*) extract at different concentrations in combination with 4% sucrose. Using the solution of neem extract at 1% coupled with 4% sucrose significantly maintained water relations and reduced scape bending curvature as compared to all other treatments. Total soluble solids in flower stalk and anthocyanin content in ligules of cut gerberas kept in neem extract at 1%+4% sucrose solution were also highest i.e. (10.08 °Brix) and (5.83 mg Congo Red g^{-1} f wt) respectively. The cut gerberas held in solution of neem extract at 1%+sucrose at 4% recorded lowest optical density (0.041) which was attributed with lowest microbial count (4.26×10^5 cfu ml^{-1}) and resulted in highest vase life (11.76 days) compared to control (4.53 days) which recorded highest microbial count (8.99×10^6 cfu ml^{-1}).

1. Introduction

Gerbera (*Gerbera jamesonii* Bolus ex. Hook.) belongs to Asteraceae family, the largest family of flowering plants and is one of ten popular cut flowers in the world, according to global trends in floriculture (Soad et al., 2011). It is in considerable demand in both domestic and export market. The blooms are attractive, suitable for any type of floral arrangements and are available in different shades and hues. Besides floral arrangements, gerbera is widely used in bouquets and also in dry flower crafts.

Keeping quality is an important parameter for evaluation of cut flower quality for both domestic and export markets. Most floral preservatives contain germicides, ethylene synthesis inhibitors, growth regulators, mineral compounds and carbohydrates that are essential to extend the vase life of cut flowers (Mutui, 2002). Sucrose is widely used in floral preservatives, which acts as a food source of respiratory substrate and delays the degradation of proteins, improves the water balance of cut flower. Treatment of flowers with solutions containing sucrose (5-15%) improves the vase life of carnation and *Gladiolus* sp. (Mor et al., 1981). The vase life of gerbera cv. Dune flowers were significantly increased by addition of 6% sucrose in preservative solution (Mousa et al., 2009).

The major postharvest problem in gerbera is short vase life because of its hollow nature of flower stalk (scape) with bigger sized capitulum on top. The physiological loss in weight is very fast due to the hollowness of scape and also overweight of flower head, the scape gets bend after harvest called as scape bending (Prashanth et al., 2007). Moreover, cut gerberas are sensitive to microbial contamination at the stem end and causes water imbalance in xylem vessels that shortens their vase life (Balestra et al., 2005). Proper harvesting, postharvest handling and use of suitable floral preservatives improve keeping quality of cut gerberas by maintaining the turgidity of scapes. Several attempts have been made to prolong the vase life of cut gerberas by using commercial floral preservatives viz. Florissant, Chrysal, Bloom life, Petal life, Rose life etc. However, these preservatives are costly and out of reach for most of small scale cut flower growers, hence the use of locally available floral preservatives viz. sugar, commercial vinegar (acetic acid 4-5%), lime (*Citrus aurantifolia*) juice has citric acid content of 4-6%, commercial bleach (calcium hypochlorite-$CaOCl_2$) which contains active ingredient of 15-20% chlorine and neem (*Azadirachta indica*) extract would be handy and cheaper. Commercial vinegar and lime juice lowered the pH of the vase solution and allow the stems to uptake the solution more easily (Thwala et al., 2013) whereas commercial bleach (Tsegaw et al., 2011) and neem extract (Chandrasekhar and Gopinath, 2000) have antimicrobial properties, which results in extension of vase life of cut flowers. In this context, the objective of this study was to investigate the effect of locally available floral preservatives in combination with sucrose at different concentrations on extension of vase life of cut gerberas.

2. Materials and Methods

The present study was carried out in laboratory conditions at the Department of Floriculture, College of Horticulture, Mojerla from December 2013 to May 2014. Cut gerbera flowers of cultivar Savannah were obtained from a commercial polyhouse located 15 km away from laboratory. The flowers were harvested when the ray florets at 3/4th opened stage in the morning hours between 7 and 8 am, wrapped in craft paper in groups and translocated vertically under dry condition to the laboratory within an hour. The cut flowers were immediately unpacked, sorted based on quality of capitulum and stalk length to 40 cm each in order to maintain uniformity within the replications. The flower scapes were precooled at 4±2 °C by placing in precooling chamber and then scapes were placed in the pre-conditioning solution i.e. sucrose at 20%+sodium hypochlorite (NaOCl) at 50 ppm for pulsing at ambient temperature (22±2 °C). All the treatments were replicated thrice with completely randomized design with 15 flowers per treatment.

After completion of pulsing, flower scapes were placed in glass bottles containing 250 ml of preservative solution's i.e. sugar at 2% (T_1), sugar at 4% (T_2), commercial vinegar at 2% (T_3), commercial vinegar at 4% (T_4), lime (*Citrus aurantifolia*) juice at 2% (T_5), lime (*Citrus aurantifolia*) juice at 4% (T_6), commercial bleach (calcium hypochlorite-$CaOCl_2$) at 50 ppm (T_7), commercial bleach (calcium hypochlorite-$CaOCl_2$) at 100 ppm (T_8), neem (*Azadirachta indica*) extract at 2% (T_9), neem (*Azadirachta indica*) extract at 4% (T_{10}), control (T_{11}) with distilled water and for treatments T_3 to T_{10}, 4% sucrose was supplemented and evaluated their vase life for the rest of the experimental period. All treatments were replicated thrice for confirmation of results and also same set of treatments were ran for biochemical analysis simultaneously. The experimental flowers were held in the laboratory at ambient room temperature (22±2 °C), 60 to 70% relative humidity and 40 W/84 cool white fluorescent tubes for maintaining 12 hours photoperiod.

2.1. *Observations recorded*

Physiological parameters viz., water relations-water uptake (g/f), transpirational loss of water (g/f), fresh weight change (%) were recorded according to Venkatarayappa et al. (1981), physical parameters like scape bending curvature in degrees given by Van Doorn and De Wittie (1994) at an interval of two days, biochemical parameters viz., total soluble solids in flowers stalk (°Brix), anthocyanin content in mg Congo Red/ gram fresh weight of ligules based on the method given by Rutland (1968), optical density of vase solution (at 480 nm) at an interval of three days, vase life according to Abadi et al. (2013) and microbial count given by Bleeksma and Van Doorn (2003) were determined. The data recorded were statistically analyzed as per method described by Panse and Sukhatme (1989).

3. Results and Discussion

3.1. *Water relations*

All the treatments showed higher water uptake and increment in weight initially and began to decrease thereafter. However, from day 4, water uptake was no longer effective to increase the fresh weight of the flowers and the weight began to drop. Data presented in (Table 1). indicated that the treatment neem extract at 1% supplemented with 4% sucrose recorded significantly highest water uptake (9.36 g/f), transpirational loss of water (9.31 g/f). The fresh weight change registered was also highest (94.84%) whereas the control (distilled water) showed a rapid loss of weight of flowers with poor water uptake and continued throughout the experiment. Generally, declining of water uptake by flowers when placed in holding solution is due to vascular blockage particularly at stem base due to growth of microbes. However, better water relations in treatment neem extract at 1%+4% sucrose might be due to its antimicrobial property, which has prevented growth of microbes which in turn inhibited the plugging of water conducting tissues. Moreover, the sucrose treatment also played its role in registering good water relations in cut gerberas, as sucrose acts as a respiratory substrate and as an osmolite.

3.2. *Scape bending curvature*

It is vivid from the Table 1 that cut gerberas held in treatment with neem extract at 1%+4% sucrose recorded lowest scape bending curvature (4.16 degree) followed by sugar at 4% (6.04 degree) whereas control (distilled water) registered highest (29.47 degree). Neem extract at 1% supplemented with

4% sucrose was most effective in controlling scape bending curvature which might be due to positive water relations that resulted in higher turgidity of scapes, delayed senescence and also might have prevented vascular occlusion by reducing the microbial growth in vase solution due to antimicrobial properties.

3.3. Total soluble solids of flower stalk (TSS)

Data in (Figure 1). revealed that total soluble solids in stalk of gerbera flowers were increased up to 3rd day in all treatments except control (distilled water) and then from day 3 onwards decreased throughout the experiment. The treatment neem extract at 1%+sucrose at 4% recorded highest TSS (10.08 ^{o}Brix), this could be due to hydrolysis of starch and sucrose, might have led to increase in TSS content of flower stalk during early stages of vase life. Whereas, the decrease in TSS content in flower stalk towards the end of vase life might be due to their maximum utilization because of increased respiration rate.

3.4. Anthocyanin content of ligules

From the recorded data in (Figure 2). we noticed that neem extract at 1% supplemented with 4% sucrose recorded lowest anthocyanin content (4.89 mg Congo Red g^{-1} f wt) whereas control (distilled water) recorded highest anthocyanin content (5.83 mg Congo Red g^{-1} f wt) followed by lime juice at 2%+4% sucrose (5.65 mg Congo Red g^{-1} f wt) without any significant difference. Anthocyanin content of cut gerbera flowers was decreased initially which might be due to dilution of anthocyanin in the expanding cells, while increase in anthocyanin content in later stage might be due to accumulation of oxidative products of polyphenols which enhanced the intensity of petal colour (Dhekney et al., 2000).

3.5. Optical density

Data in (Table 2). indicated that the lowest optical density was recorded with neem extract at 1% (0.041) as compared with all other treatments whereas control (distilled water) registered highest optical density value (0.088). Lowest optical density in neem extract at 1%+4% sucrose might be due to its antimicrobial activity that acts as a biocide in vase solution and resulted in reduced microbial growth which led to lowest turbidity of vase solution.

3.6. Vase life

Data presented in (Table 2). revealed that the highest vase life was recorded in treatment neem extract at 1% supplemented with 4% sucrose (11.76 days) followed by sugar at 4% (10.08 days) whereas control (distilled water) registered significantly lowest vase life period (4.53 days). Sucrose helps in maintaining water balance and turgidity. Hence, addition of sucrose and also antimicrobial nature of neem extract might have increased water relations which inturn enhanced the vase life of cut gerberas.

3.7. Microbial population in vase solution

At the end of vase life, lowest microbial population was recorded with treatment neem extract at 1%+sucrose at 4% (4.26×10^5 cfu ml^{-1}) because of antimicrobial nature of components present in neem extract and inhibited microbial growth as compared to other treatments. Whereas control (distilled water) registered highest microbial count (9.11×10^6 cfu ml^{-1}) as presented in (Table 2).

Table 1: Effect of postharvest application of locally available preservatives on water relations and scape bending curvature during vase life period of cut gerbera cv. Savannah under ambient condition

Treatments	Water relations			Scape bending curvature (degree)
	Water uptake (g/f)	Transpirational loss of water (g/f)	Fresh weight change (%)	
T_1: Sugar 2%	7.89^d	8.44^b	81.56^d	11.49^d
T_2: Sugar 4%	8.84^b	9.16^a	90.59^b	6.04^b
T_3: Commercial vinegar 2%	8.37^c	8.40^b	83.92^c	8.37^c
T_4: Commercial vinegar 4%	7.77^d	7.68^c	80.77^d	11.67^d
T_5: Lime juice 2%	7.95^d	7.52^d	79.46^d	12.09^d
T_6: Lime juice 4%	7.71^d	7.61^c	80.27^d	11.90^d
T_7: Commercial bleach 50 ppm	8.55^b	8.57^b	85.54^c	7.80^c
T_8: Commercial bleach 100 ppm	7.82^d	7.75^c	81.03^d	11.58^d
T_9: Neem extract 1%	9.36^a	9.31^a	94.84^a	4.16^a
T_{10}: Neem extract 2%	8.42^c	7.90^c	84.99^c	8.07^c
T_{11}: Control (Distilled water)	5.65^e	6.68^e	78.40^e	29.47^e
SEm±	0.13	0.11	0.86	0.45
CD (p=0.01)	0.38	0.32	2.42	1.26

Values are the mean of three replications; Values with same alphabets did not differ significantly

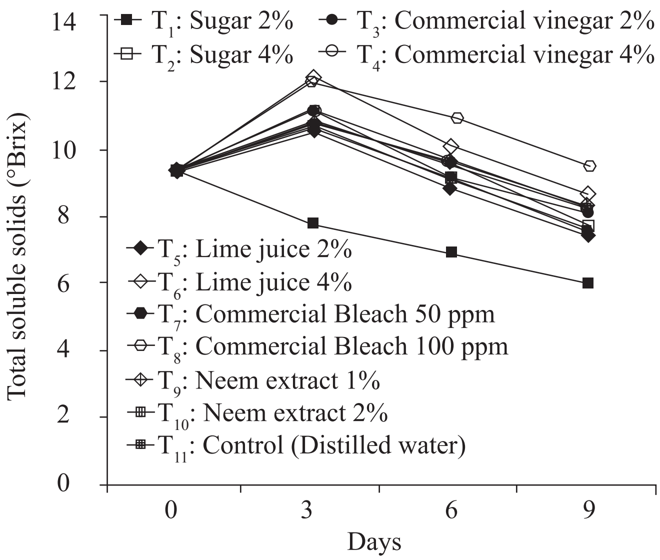

Figure 1: Effect of postharvest application of locally available preservatives on total soluble solids (°Brix) of cut gerbera cv. Savannah under ambient storage

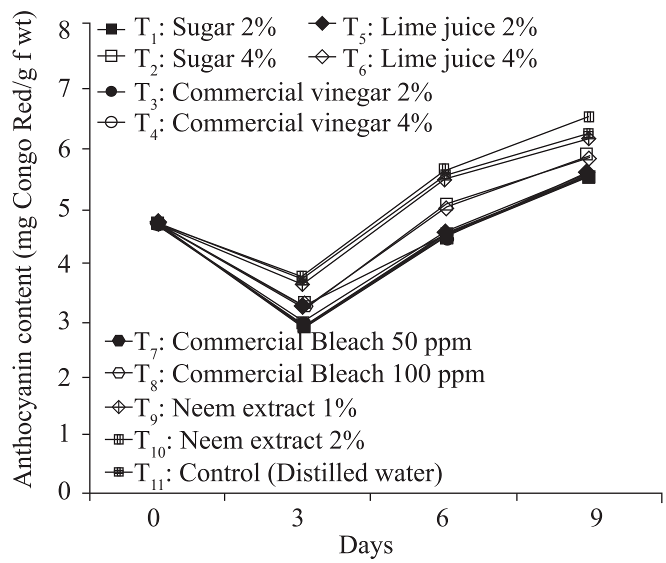

Figure 2: Effect of postharvest application of locally available preservatives on anthocyanin content (mg Congo Red g f wt^{-1}) of cut gerbera cv. Savannah under ambient storage

Table 2: Effect of postharvest application of locally available preservatives on optical density, microbial count in vase solution (cfu ml^{-1}) and vase life period of cut gerbera cv. Savannah under ambient condition

Treatments	Optical density	Vase life (days)	Microbial count	
			0th day	12th day
T_1: Sugar 2%	0.054^{c}	7.93^{d}	3.21×103^{b}	6.53×106^{c}
T_2: Sugar 4%	0.047^{b}	10.08^{b}	2.42×103^{a}	4.88×105^{a}
T_3: Commercial vinegar 2%	0.054^{c}	8.46^{c}	3.01×103^{b}	5.57×106^{b}
T_4: Commercial vinegar 4%	0.062^{d}	7.74^{d}	3.52×103^{c}	6.71×106^{c}
T_5: Lime juice 2%	0.064^{d}	7.44^{d}	3.71×103^{c}	7.11×106^{c}
T_6: Lime juice 4%	0.064^{d}	7.60^{d}	3.64×103^{c}	6.92×106^{c}
T_7: Commercial bleach 50 ppm	0.053^{c}	8.94^{c}	2.83×103^{b}	5.01×106^{b}
T_8: Commercial bleach 100 ppm	0.062^{d}	7.82^{d}	3.41×103^{b}	6.64×106^{b}
T_9: Neem extract 1%	0.041^{a}	11.76^{a}	1.96×103^{a}	4.26×105^{a}
T_{10}: Neem extract 2%	0.061^{d}	8.53^{c}	2.96×103^{b}	5.23×106^{b}
T_{11}: Control (Distilled water)	0.088^{e}	4.53^{e}	4.45×103^{d}	8.99×106^{d}
SEm±	0.001	0.21	0.23	0.22
CD (p=0.01)	0.004	0.62	0.68	0.67

Values are the mean of three replications, Values with same alphabets did not differ significantly

4. Conclusion

Neem (*Azadirachta indica*) extract at 1% supplemented with 4% sucrose is most effective locally available preservative which can be successfully used to extend the vase life of cut gerberas as it is biocidal in nature that prevented microbial growth which causes vascular blockage.

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