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ORIGINAL ARTICLE

The Effect of Non-Harmful Compounds Environmentally (*Eucalyptus* and *Rosa damascena* essences) on Vase Life and Some Physiological Characteristics of *Gerbera* Cut Flowers

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KEYWORDS

Gerbera;
Healthy compounds;
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ABSTRACT: In this study, *Gerbera* (*Cv. alain ducasse*) cut flowers were treated with essences of *Eucalyptus* and *Rosa damascena* at a concentration of 200 mg l^{-1} and their effects on the vase life of flowers and some qualitative characteristics were evaluated. This research was a completely randomized design with factorial arrangement. Maximum vase life was obtained for flowers treated with the *Eucalyptus* essence (10 days) and the lowest vase life was related to the control (7 days). The maximum fresh weight, solution uptake, bent neck reduction were related to the *Eucalyptus* treatment and the maximum stem diameter was obtained with the *R. damascena* essence treatment. In addition, the total soluble solids in the treatment with herbal essences were increased compared to the control; however, no significant difference between them was observed. Overall, for increasing the vase life and qualitative characteristics of *Gerbera* cut flowers, eucalyptus and *R. damascena* essences can be used in the vase solution. Treatments used in this experiment, as accessible compounds are healthy and non-hazardous for the environment, appropriate to increase the vase life of *Gerbera* cut flowers.

INTRODUCTION

Gerbera jamesoniioni cut flowers is one of the most important cut flowers in the world and one of the world's top ten flowers [1]. Despite the popularity of *Gerbera* flowers, these flowers have a short vase life, which is mostly because of wilting occurs [2].

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Stem end blockage is an important factor in lack of balance between water uptake and its loss from cut flowers [3]. There are three types of stem end blockage for cut flowers. Microbial type is resulted by bacteria activity and its production. Physiological type is resulted by wound [2] and physical type is due to formation of air bubbles [4]. In addition to the blockage, microorganisms can secrete pectolytic enzymes and toxic compounds or produce ethylene; hence, accelerate senescence [5]. The vase life of cut flowers increases by a variety of antimicrobial compounds such as silver thiosulfate and hydroxy quinoline citrate [6]. In recent years, the use of silver thiosulfate has been limited. Since silver as a heavy metal is toxic for the environment. Therefore, researchers tend to find new safe or less toxic materials to protect and enhance the vase life of cut flowers [7].

Herbal essences are safe, natural and environmentally friendly materials. The essences are chemically complex that different types of chemical compounds including hydrocarbons, alcohols, ketones, etc. involved in their combination [1]. Herbal essences due to high levels of phenolic compounds exhibit strong antimicrobial effects against some risk factors [8].

Essential oils are complex chemical compounds found in plant. These materials are chemically heterogeneous and mixture of different compounds. Essential oils are generally belonging to terpenes chemical group. Essential oils are volatile substances, are usually insoluble in water or hardly dissolve, but they are solvable in alcohol and other organic solvents. These compounds usually have spicy smell and taste and their specific weight is often less water [9]. Antimicrobial effect of essential oils depends on hydrophobic property and solubility in cytoplasmic membrane of microorganisms. Essential oils change the permeability of the microorganism's membrane and cause the lack of protons, phosphate and potassium inside the cell. Effects of essential oils against gram-positive bacteria are greater than Gram-negative bacteria, but some essential oils such as thyme and clove essential oils are effective against both types of bacteria. Low pH increases hydrophobic of some essential oils such as thyme and phenolic compounds of oleuropein [10].

The essences of thyme, cinnamon, parsley, mint [11], *Eucalyptus* [12] have an inhibitory effect on pathogens growth. Kavoosi et al., in their study on *Tuberose* cut flowers used *Eucalyptus* essences at concentrations of 25, 50, 75 and 100 mg l^{-1} stated that *Eucalyptus* essences increased the vase life [13]. Treatment of tomato and strawberry with cumin and *Eucalyptus* essences reduces product spoilage and breathing, maintains firmness, and increases the shelf life of fruit [12]. Hejazi and Gan reported the use of 500 mg l^{-1} of essences of australian laurel and cinnamon increases the vase life of *Gladiolus* cut flowers [14].

Rosa damascena is the most important species of rose for the production of perfumes, essences and rose water, used as aromatic substances in perfumes and cosmetics industries, as well as its medicine effect used in the pharmaceutical industry [15]. The petals of this plant contain flavonoid and essence. The most important plant flavonoid compound contains anthocyanins and essences such as *citronellol*, linalool, geraniol, *farnesol* and terpenes [16]. The searches conducted on the effects of essences and extracts of *R. damascena* on vase life of cut flowers have not been reported.

Eucalyptus has more than 700 species. This plant has many uses in pharmaceutical, perfume and industry and has antimicrobial properties. The major components of its essential oil are cineole, alpha-pinene and farnesyl acetate [17].

To compare the chemical and physical treatments nano silver and thyme, lavender and *Eucalyptus* essential oils in preservative solution of *Gerbera* cut flowers were used [1]. The results indicated that *Eucalyptus* essential oil (25 mg L^{-1}) compared to nanosilver (3 and 5 ml L^{-1}) increased vase life. Besides, Mirdehghan et al. used silver nitrate and Savory, Ajwain, thyme essential oils on *Rose* cut flowers. They reported that although silver nitrate inhibited the production of ethylene, but essential

oils reduced wilting of flowers and leaves. Essential oils could be used in preservative solution of cut flowers, without any harmful effects of chemical compounds [18].

The purpose of this study was to investigate the effect of essence of *Eucalyptus* and *R. damascena* on vase life and some qualitative traits of *Gerbera* cut flowers to delay the senescence, increase of longevity and replacing them with dangerous chemicals extrusion.

MATERIALS AND METHODS

Gerbera flowers, *Alain ducasse* cultivar, were purchased from the greenhouse of Mr. Banaie located in Pakdasht, Tehran, and were transported to the laboratory of the Faculty of Shariati Tehran in a good packaging (rackets and cellophane). Cut flowers were recut with the length of 30 cm. Treatments include *Eucalyptus* essence and *Rosa damascena* essence at concentration of 200 mg L^{-1}. Distilled water was used as control treatment. Plant essences were purchased from Barij Essence Company. To determine the best concentration and its use in this experiment, at first one pre-test was performed based on some other investigation of the essences of *Eucalyptus* and *R. damascena* at concentrations of 50, 100 and 200 mg L^{-1} and the concentration of 200 mg L^{-1} was chosen.

This experiment was to increase the quality and vase life of *Gerbera* cut flowers in laboratory conditions with temperatures during the experiment period of 20 ± 2 ° C, humidity of 60 ± 5% and a light intensity of 400 lux using fluorescent lamps with a photoperiod of 12 h. Measured traits included vase life, fresh weight, stem diameter, total soluble solids, solution uptake and bent neck. To measure the vase life of flowers, some items including the petal wilting after 50%, and the bent neck were considered (19). To measure the fresh weight, a digital scale was used on days 1, 3, 5, 7 and 9. For this purpose, in each replication a flower to measure the fresh weight and flower diameter were selected and evaluated until the end of the experiment. For measure the stem diameter, a digital caliper on days 1, 3, 5, 7 and 9 was used. For measurement of total soluble solids, 0.5 g of petals was separated and pulverized in a mortar and its extract was obtained after crushing it. Then, Brix degree of obtained extract was read by a handle refractometer on days 1, 3, 5, 7 and 9 manually. Solution uptake was measured per replications using a graduated cylinder on days 2, 4, 6, 8 and 10. Measurement of the bent neck were performed using a conveyor through an angle difference between the stem and the vertical line on days 2, 4, 6, 8 and 10 and the results were recorded.

This experiment was in a factorial design based on a completely randomized design with 3 replications. Data were analyzed using SAS software, graphs were drawn using Excel software, and the comparisons were performed with LSD test.

RESULTS

Analysis of variance showed that the treatment effect on vase life was significant (P<0.01) at the 1% level (Table 1). The effects of treatment, time and interaction between treatment and time on fresh weight, total soluble solids, solution uptake and bent neck were significant at 1% level. The effect of treatment and time on stem diameter was significant, but interaction between treatment and time was no significant (Table 2).

Table 1. ANOVA of treatment on vase life of cut *Gerbera*

S.O.V	df	Vase life
Treatment	2	7 ^{ns}
Error	6	1.66
Cv	-	15.49

^{ns} no significant differences

Table 2. ANOVA of effect treatment and time on measured traits of cut Gerbera

S.O.V	df	Fresh weight	Stem diameter	Total soluble solid	Solution uptake	Bent neck
Treatment	2	45.75*	0.004^{ns}	0.31**	799.13**	137.91**
Time	4	392.93**	0.02**	4.36**	87.06**	13.73**
Treatment*Time	8	50.16**	0.002^{ns}	0.08**	22.07**	6.19**
Error	30	9.36	0.002	0.005	1.12	0.65
Cv	-	18.9	7.65	5.24	5.16	14.72

** Significant differences at 1%, * Significant differences at 5%

Vase life

The results of comparison of data mean showed that the maximum and minimum of vase life were related to *Eucalyptus* essence (10 day) and control (7 day), respectively (Figure 1).

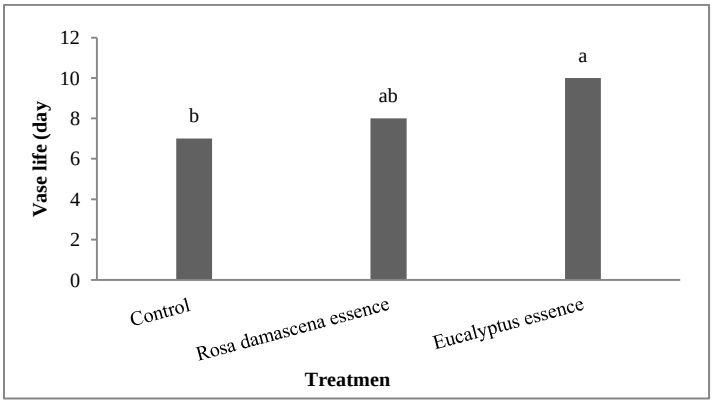

Figure 1. Effect of Eucalyptus and *R. damascene* essence on vase life of *Gerbera* cut flowers

Fresh weight

The results of mean comparison of data showed that the maximum fresh weight was observed in treatments of *Eucalyptus* essence (Table 3). Trend of weight changes showed that it was rising until the third day but after that, it was placed in the descending mode (Figure 2).

Table 3. Mean comparison the effect of *Eucalyptus* and *Rosa damascena* on measured traits of *Gerbera* cut flowers

Treatment	Fresh weight	Stem diameter	Total soluble solids	Solution uptake	Bent neck
Control	16.54^{ab}	.60^{ab}	1.22^{b}	14.85^{c}	9.10^{a}
Rosa damascena	14.29^{b}	.61^{a}	1.47^{a}	18.10^{b}	3.73^{b}
Eucalyptus Essence (200 mg)	17.73^{a}	.58^{b}	1.47^{a}	28.80^{a}	3.66^{b}

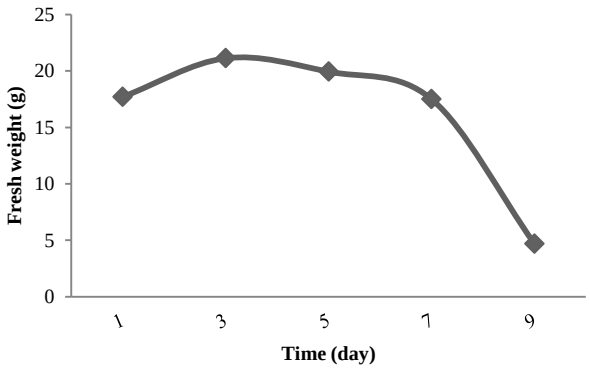

Figure 2. Changing process of fresh weight of *Gerbera* cut flowers during the experiment

Stem diameter

The results of mean comparison of data showed that the maximum stem diameter was related to the treatments of *R. damascena* essence (Table 3). In addition, the trend of stem diameter changes showed that the maximum stem diameter was obtained until the fifth day and then stem diameter was declined (Figure 3).

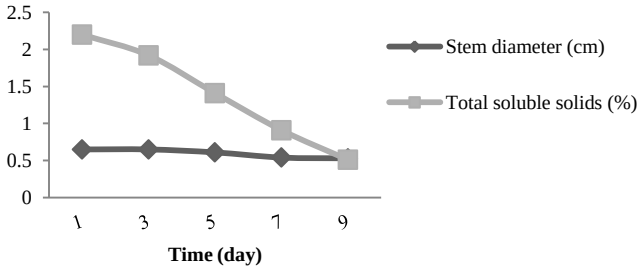

Figure 3. Changing process of stem diameter and total soluble solids of *Gerbera* cut flowers during the experiment

Total soluble solids

The mean comparison of data showed eucalyptus and *R. damascena* essences increased petals total soluble solids compared to the control (Table 3). Moreover, measured total soluble solids decreased after the first day to the last day (Figure 3).

Solution uptake

The results of the mean comparison of data showed that the maximum and minimum of solution uptake were obtained in the *Eucalyptus* essence treatment and control (Table 3). Trend of changes of solution uptake showed that the solution uptake by flowers increased until four days and after that, it was placed in the descending mode (Figure 4).

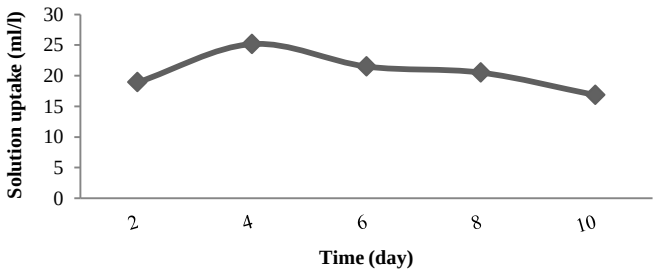

Figure 4. Changing process of solution uptake of *Gerbera* cut flowers during the experiment

Bent neck

The results of the mean comparison of data showed that the maximum and minimum of bent neck were obtained in the control treatment and *Eucalyptus* essences, respectively (Table 3). In addition, the bent neck had an upward trend over the time (Figure 5).

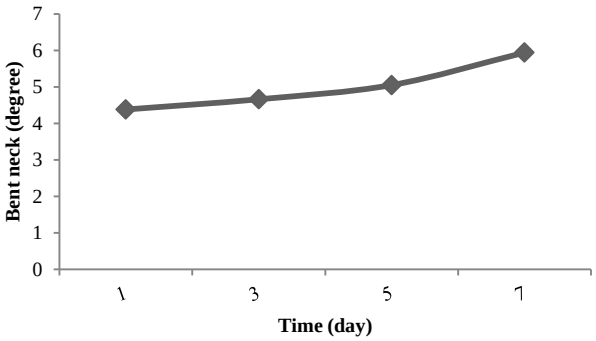

Figure 5. Changing process of bent neck of *Gerbera* cut flowers during the experiment

DISCUSSION

The results showed that the essences of *Eucalyptus* and *R. damascena* increased vase life, fresh weight and solution uptake of *Gerbera* that was in accordance with Kavoosi et al.'s [13]. They reported that the use of *Eucalyptus* essence in the protective solution increased the vase life, fresh weight and solution uptake of tuberose cut flowers. One of the major problems of cut flowers is their short life. Therefore, the uses of methods that preserve the quality and increase the vase life of flowers have a special status. One of the common methods to maintain cut flowers is the use of different preservative solution [20]. In this research, we used essences of *Eucalyptus* and *R. damascena*.

Microorganisms that grow in water containers cause the closure of the vascular system and reduce the quality of cut flowers that consequently, solution uptake and fresh weight of flower are also reduced. Antimicrobial effect of essential oils depends on hydrophobic property and solubility in cytoplasmic membrane of microorganisms. Essential oils change the permeability of the microorganism's membrane and cause the lack of protons, phosphate and potassium inside the cell. Effects of essential oils against gram-positive bacteria are greater than Gram-negative bacteria, but some essential oils such as thyme and clove essential oils are effective against both types of bacteria. Low pH increases

hydrophobic of some essential oils such as thyme and phenolic compounds of oleuropein [10]. In this study, the positive performance of herbal essences can be attributed to their antimicrobial activity that these characteristics are associated to the phenolic compounds and alcohols, aldehydes, ketones and hydrocarbons [5].

By increasing storage time, stem diameters and flower diameter reduced. The results showed that *R. damascena* caused maintenance the diameter of flower stem, but *Eucalyptus* essence reduced stem diameter. The use of ajowan essence in the vase solution of *Rose* cut flower caused to maintain stem diameter; however the thyme essence reduced stem diameter (18). Therefore, it seems that the effect of herbal essences on the stem diameter is different.

The changes trend of total soluble solids of petals showed that the used treatments did not prevent early decline of total soluble solids, although the essences of *Eucalyptus* and *R. damascena* slightly increased the value of this parameter. The presence of soluble carbohydrates in petals reduces the water potential and thus enhances the solution uptake [21].

One of the major post-harvest problems of *Gerbera* cut flowers is bent stem and on the other word is bent neck [22]. The results indicated that the use of essences of *Eucalyptus* and *R. damascena* could reduce neck bent effects. One factor, which can cause bent neck, is the vascular occlusion caused by bacteria and losing the water balance in the cut flower. The essences used in this study have reduced bent neck by unblocking vascular probably due to their antimicrobial activity.

CONCLUSIONS

Overall, the essences of *Eucalyptus* and *R. damascena* has increased the vase life and measured qualitative characteristics in the *Gerbera* cut flower. *Eucalyptus* essence was more effective than *R. damascene* essence. Thus, the use of other herbal essences and extracts as natural antimicrobial compounds can be studied in cut flowers preservative solution. Although substances such as essential oils are complex compositions, but using them in preservative solutions of cut flowers because of the facilities and the capacity to produce them in large quantities in the country of Iran as well as the lack of risk is justified. It is also recommended that the essences of *Eucalyptus* and *R. damascene* be investigated for other concentrations.

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