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ORIGINAL ARTICLE

Potential of Increasing the Vase Life and Improvement of some Physiological Characteristics of *Alstroemeria* Cut Flowers by Using Non-Harmful Compounds Environmentally

Mehrdad Babarabie[*1,2], Hossein Zarei[1], Feryal Varasteh[1]

[1]Department of Horticulture, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

[2]Young Researchers and Elite Club, Gorgan Branch, Islamic Azad University, Gorgan, Iran

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KEYWORDS

Alstroemeria;
Natural compounds;
Non-hazardous;
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ABSTRACT: In this study, the concentrations of 25, 375 and 500 ml L^{-1} of Cola+ 2000 mg L^{-1} of peppermint essence and concentrations of 30, 45 and 60 ml L^{-1} of apple extract +2000 mg L^{-1} rosemary essence on *Alstroemeria* cut flowers (Cv. balance) were investigated to verify the use of natural ingredients in flowers preservative solutions. This experiment was conducted in the laboratory of Gorgan University of Agricultural Sciences and Natural Resources, in 2014. Results showed that the interaction of cola with peppermint essence and apple extract with rosemary essence at above concentrations increase the vase life of flower, flower diameter and anthocyanin at significantly level of %1. The highest amount of vase life was related to concentration of 500 ml L^{-1} of cola (15 days), while vase life in control treatment (distilled water) was 9 days. The highest flower diameter was recorded in apple extract (45 ml L^{-1}) + Rosemary essence (2000 mg L^{-1}). The highest amount of anthocyanin was obtained in cola treatments of 500 ml L^{-1}+ essence of peppermint, 30 and 45 ml L^{-1} of apple extract+ rosemary essence. Besides, flowers treated by 375 ml L^{-1} of cola + peppermint essence had the highest chlorophyll content. Generally, the results showed that treatments used in this experiment, as accessible compounds are healthy and non-hazardous for the environment, appropriate to increase the vase life of *Alstroemeria* cut flowers.

INTRODUCTION

Regardless of pre-harvest elements that are effective on vase life of cut flowers, there are other factors that reduce the vase life of flowers and accelerate their decay [1].Using carbohydrates to increase the vase life of

* Corresponding author: antoniyom_3000@yahoo.com (M. Babarabie).

flowers is a common practice, but using sugar alone will provide a food source for the growth of microorganisms. A major problem post harvesting the flowers is the growth of bacteria in preservative solutions which cause blocking the vascular system of stems and flowers. Previously, materials such as silver nitrate and sulfate hydroxy quinolin citrat were used as antimicrobial substance to increase the vase life of flowers; but the use of natural materials has more into consideration in recent years, due to environmental pollution and its danger for humans [2]. A research on the effects of nanosilver on vase life of *Alstroemeria* flowers showed that the use of 15 mg L^{-1} of nanosilver resulted in vase life increasing and fresh weight of *Alstroemeria* [3]. On the other hand, thymol and carvacrol at the concentration of 150 mg L^{-1} with 6% sucrose had the greatest effect on increasing vase life of *Gladiolus* flowers [4]. Natural compounds can be a good alternative to chemicals. In general, many different materials in chemical preservative solutions of cut flowers are found in essential oils and extract plant and fruit extracts or some soft drinks [5]. Hydrocarbons and ketones, aldehydes, ethers etc. are combinations of different essential oils from medicinal plants [6]. Different types of carbohydrates and organic acids can also be found in beverages, including soft drinks as well as fruit juices such as apple juice [5]. Rosemary and peppermint are in the family of mints with aromatic compounds [6]. Most species of medicinal, aromatic are highly antimicrobial and the most important species are the thymus, oregano, mint, rosemary, etc. [7]. In order to control of microorganisms in the vase solution this compound is used.

In examination of the effects of essential oils of thyme, caraway and peppermint on the *Alstroemeria* flower, treatment with 100 mg L^{-1} of essential oil peppermint increased the solution uptake and fresh weight of flowers [8]. Furthermore, the use of 900 mg L^{-1} of peppermint essential oil, increased vase life and fresh weight of *Lilium* flower [9]. In a study, the use of 25% of rosemary extract increased the chlorophyll and flower diameter of *Chrysanthemum* flower [10].

Other materials such as soft drinks and juices have different properties and combinations [11]. Carbonated beverages are usually made from materials such as sugar, citric acid, carbon dioxide, phosphoric acid, etc. Apple juice also contains substances such as glucose, fructose, malic acid etc. [5].

7Up soft drink increases the vase life of *Sunflower*, *Marigold* and *Rose* [12]. Investigations indicated that *Lilium* flower treatment with 100 mg L^{-1} of citric acid increased flower diameter and longevity of flowers [13]. *Alstroemeria* flower from the family of *Amaryllidaceae* is among the top ten flowers of the world. One of the factors effective on the vase life of flowers is their genetics, which vary greatly among varieties of the same species in the flowers. For example, the vase life of *Alstroemeria* cut flowers in *Rosario* and Pink Panther varieties are 17 and 8 days, respectively [1].

The purpose of this study was to evaluate the use of commercial cola soft drinks and peppermint essential oils + apple fruit extract and rosemary essential oils in vase solution of *Alstroemeria* cut flowers (Cv. Balance) to delay the senescence, increase of longevity and maintain the quality traits during vase life and replacing them with dangerous chemicals extrusion.

MATERIALS AND METHODS

This experiment was conducted in the laboratory of Gorgan University of Agricultural Sciences and Natural Resources, in 2014. *Alstroemeria* flowers were picked from Azin Behesht of Isfahan when the buds were being colored and were transferred to a controlled laboratory environment including temperature of 22 ± 2°C, relative humidity of 60 ±5% and 12 h of light with 850 lux lighting. The experiment was conducted with a factorial arrangement in a completely randomized design. In

order to facilitate the analysis results, treatment with symptoms was abbreviated as follows:

S250, S375, S500: Cola soft drinks at concentrations of 250 ml L^{-1}, 375ml L^{-1} and 500 ml L^{-1}, respectively.

M2: Peppermint essential oils at concentration of 2000 mg L^{-1}.

A30, A45, A60: Apple fruit extract at concentrations of 30 ml L^{-1}, 45 ml L^{-1} and 60 ml L^{-1}.

R2: Rosemary essential oils: at concentration of 2000 mg L^{-1}.

Cola soft drink with the brand of Pepsi with properties such as 10% of sugar, 150 mg L^{-1} of benzoic acid, 10 mg L^{-1} of sodium, pH 2.9 etc. was purchased and the majority of gas was discharged to prevent a possible obstruction of vascular blocking. Apples were extracted using a juicer [14]. The pH of apple juice was measured using pH meter which's amount was 9.3 and its Brix was measured by a manual refractometer and its amount was 10.2. Plant essences were also purchased from Parvin Extract Company of Isfahan. Distilled water was used as control treatment**.** During the experiment, the vase life, flower diameter, the anthocyanins and chlorophyll were measured. The vase life of flowers was calculated on a daily basis with respect to wilting and 50% loss of petals and leave [15]. The diameter flowers were recorded every 4 days with a digital caliper and chlorophyll content of leaves was measured using chlorophyll meter model of Hansatech (CL-01) [16]. To measure the anthocyanins every 4 d 0.5 gr of petals were weighted from every repetition and with 5 ml acidified methanol (99% acidified methanol and 1% hydrocheloric acid) were Pulverizedin a mortar. The samples were measured after 24 h of exposure in the refrigerator and centrifuged for 15 min at 3500 rpm and absorption amount was calculated with a spectrophotometer at a wavelength of 520 nm [17].

This experiment was conducted with factorial arrangement and a completely randomized design. For data analysis from the experiment SAS software was used and the means comparison was calculated using the LSD test.

RESULTS

The effect of treatment on vase life of flowers was significant at level of 1% (Table 1). The effects of treatment, time and interaction of treatment and time on the flower diameter and anthocyanins were significant at level of 1%. Besides, the effect of treatment and time on chlorophyll was significant at the level of 1% but their interaction effect was not significant (Table 2).

Table 1. Variance analysis the effect of treatment on vase life of Alstroemeria cut flowers

S.O.V	df	Vase life
Treatment	2	10.71^{**}
Error	12	0.16
Cv	-	3.15

** Significant differences at 1%

Table 2. Variance analysis the treatment and time on measured characteristics of Alstroemeria cut flowers

S.O.V	df	Flower diameter	Anthocyanin	Chlorophyll
Treatment	6	90.62^{**}	$.002^{**}$	10.18^{**}
Time	2	300.99^{**}	$.073^{**}$	17.57^{**}
Treatment*Time	12	6.35^{**}	$.001^{**}$	0.86^{ns}
Error	42	5.09	0.0002	1.11
Cv	-	9.58	9.09	13.53

** Significant differences at 1%, ns no significant differences

Vase life

There was a significant difference between various concentrations of cola soft drink + peppermint essence in increasing the vase life of flowers (Figure 1). So that concentration of 500 ml L^{-1} had the most effect (15 days). Besides, the use of apple extract + rosemary essence has significantly increased the vase life of *Alstroemeria* flowers.

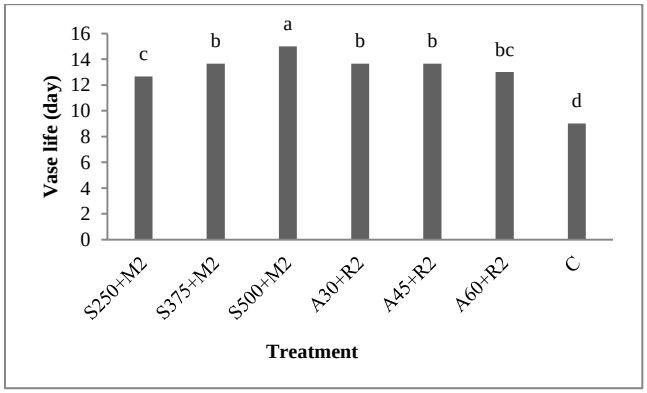

Figure 1. Effect of preservative solutions on vase life of *Alstroemeria* cut flowers

S250: cola soft drink (250 ml L^{-1}), S375: cola soft drink (375 ml L^{-1}), S500: cola soft drink (500 ml L^{-1}), M2: peppermint essence (2000 mg L^{-1}), A30: apple fruit extract (30 ml L^{-1}), A45: apple fruit extract (45 ml L^{-1}), A60: apple fruit extract (60 ml L^{-1}), R: rosemary essence (2000 mg L^{-1}).

Flower diameter

Forty-five ml L^{-1} of apple extract + rosemary essence had the highest diameter (Figure 2). However, there was no significant difference between 30 and 60 ml L^{-1} concentrations. Besides, the use of cola soft drink in difference concentrations + peppermint essence led to significant diameter increase. The changing process of diameter flower through time indicated that the highest flower diameter was obtained in the 6th day (Table 3).

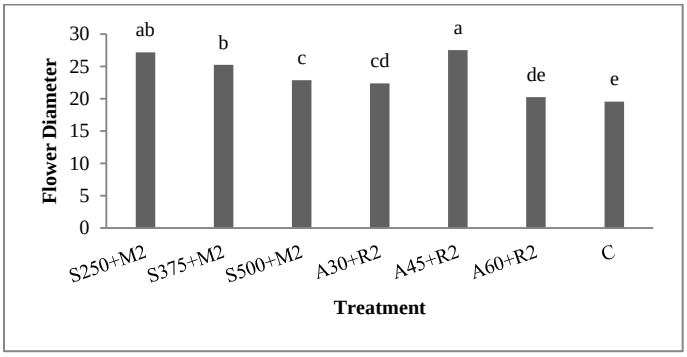

Figure 2. Effect of preservative solutions on flower diameter of *Alstroemeria* cut flowers

S250: cola soft drink (250 ml L^{-1}), S375: cola soft drink (375 ml L^{-1}), S500: cola soft drink (500 ml L^{-1}), M2: peppermint essence (2000 mg L^{-1}), A30: apple fruit extract (30 ml L^{-1}), A45: apple fruit extract (45 ml L^{-1}), A60: apple fruit extract (60 ml L^{-1}), R: rosemary essence (2000 mg L^{-1}).

Table 3. Effect of changing process of measured characteristics of *Alstroemeria* cut flowers during the experiment

Time (day)	Flower diameter	Anthocyanin	Chlorophyll
2	16.54[c]	0.12[c]	8.58[a]
6	33.08[a]	0.23[a]	8.01[a]
10	21.05[b]	0.21[b]	6.79[b]

The dissimilar letters in each column indicate significant differences between them

Anthocyanins

The highest amount of anthocyanins was related to the cola treatment (500 ml L^{-1}) + peppermint essence, apple extract (30 and 45 ml L^{-1}) + rosemary essence and the lowest were observed in the control treatment (Figure 3). The changing process of anthocyanins through time showed that the highest amount was obtained in the 6th day (Table 3).

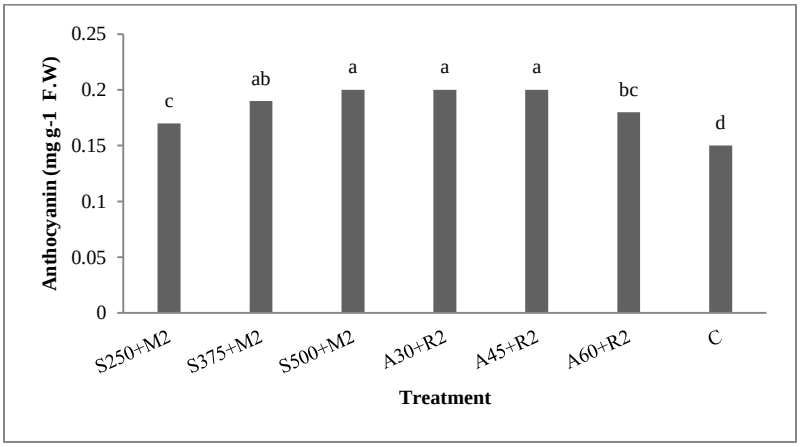

Figure 3. Effect of preservative solutions on anthocyanin of *Alstroemeria* cut flowers

S250: cola soft drink (250 ml L^{-1}), S375: cola soft drink (375 ml L^{-1}), S500: cola soft drink (500 ml L^{-1}), M2: peppermint essence (2000 mg L^{-1}), A30: apple fruit extract (30 ml L^{-1}), A45: apple fruit extract (45 ml L^{-1}), A60: apple fruit extract (60 ml L^{-1}), R: rosemary essence (2000 mg L^{-1}).

Leaf chlorophyll

Figure 4 indicated the effects of different treatments in leaf chlorophyll. The results of mean comparison indicated that the highest and the lowest amounts of chlorophyll were observed in cola soft drink (375 ml L^{-1}) + peppermint essence and control treatment, respectively**.** The changing process of chlorophyll through time indicated that the highest amount was obtained in the 2nd day (Table 3).

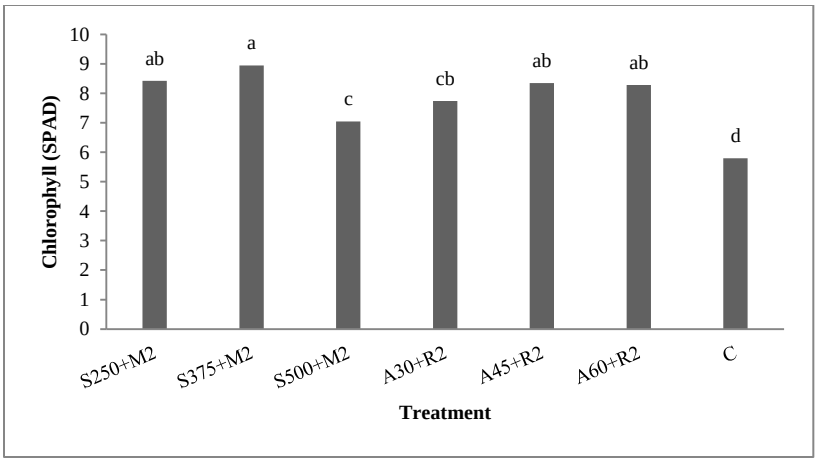

Figure 4. Effect of preservative solutions on chlorophyll of *Alstroemeria* cut flowers
S250: cola soft drink (250 ml L^{-1}), S375: cola soft drink (375 ml L^{-1}), S500: cola soft drink (500 ml L^{-1}), M2: peppermint essence (2000 mg L^{-1}), A30: apple fruit extract (30 ml L^{-1}), A45: apple fruit extract (45 ml L^{-1}), A60: apple fruit extract (60 ml L^{-1}), R: rosemary essence (2000 mg L^{-1}).

DISCUSSION

The vase life of flowers increased by the interaction of apple extract and rosemary essence besides to the interaction of cola soft drink and peppermint essence. The apple extract has a relatively high amount of sugar and an acidic pH [14] which can increase the vase life of *Alstroemeria* by supplying its required carbohydrate and prevent the growth of microorganisms in the vase solution. Furthermore, the rosemary essence will cause a decrease in microorganisms of the solution due to having an anti-microbe property. In this case, 45 ml L^{-1} apple extract results in delaying wilt and increases the vase life of *Orchids* [18], which is in accordance to the results of this research. Cola soft drinks also due to acidic pH and high sugar and peppermint essence due to antimicrobial agents, increase the vase life of flowers. As it was stated, one of the ingredients of carbonated beverages is citric acid and phosphoric acid. In one experiment, by using of citric acid at a concentration of 160 mg L^{-1} the vase life of *Lisianthus* cut flowers was increased to 31 days (19). This can make the effect of citric acid in the soft drink significant in increasing the vase life of *Alstroemeria* flowers. Using 300 mg L^{-1} peppermint essence in carnation, petals' wilt was delayed (20).

Flower diameter is a good indicator for opening. Using citric acid increases the flower diameter of *Rose* [21]. In this study, the interaction of cola drinks and peppermint essence and the interaction of apple extract with *Rosemary* essence, increased flower diameter. One of the reasons for the increase the flower diameter is the absorption of carbohydrates in the preservative solution. High sugar and acidic compounds in soft drinks and relatively high carbohydrates in the apple extract can maintain quality traits such as flower diameter and make water to balance in cut flowers.

Reduction the anthocyanins increases sensitivity to oxidative stress and flowers will be senescence [22]. Results of the conducted studies on rose flowers showed that anthocyanins increased the bud stage to full opening and then decreased in the senescence time [23]. Reducing the activity of the phenylalanine ammonia lyaseenzyme (PAL) which is the main ingredient of phenolic compounds such as anthocyanins in the senescence process reduces the amount of anthocyanins [22].

Rosemary and peppermint essential oils having high antimicrobial effect reduce the amount of microorganisms in the solution and increase the freshness and quality of flower color and prevent the discoloration and reduction of pigment in the petals. The results of experiment confirm this theory. Anthocyanins of gladiolus cut flowers increased by rosemary extract [24]. Using apple extract and rosemary essence increased anthocyanins of *Alstroemeria* cut flowers [25]. It is consistent with our results.

The results showed that the amount of leaf chlorophyll has increased by using soft drink and peppermint essence. One of the major problems of *Alstroemeria* in postharvest is the yellowing of leaves, which reduces the quality of its appearance [26]. In sensitivity field to ethylene there has not been a positive and significant effect reported yet and chemical compounds of anti-ethylene are used more. But it can relatively maintain the leaf color. In investigation the effect of rosemary extract on *Chrysanthemum* cut flowers it was found that 25% of rosemary extract protect the chlorophyll [10]. The results of this study are consistent with the current research results.

CONCLUSIONS

Natural and simple compounds can be used as preservative solutions for flowers because these materials are easily available to the public, and more importantly, they do not have a damaging environmental effect. 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.

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