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Effect of Essential Oils, Ethanol and Methanol to Extend the Vase-life of Carnation (*Dianthus caryophyllus* L.) Flowers

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ABSTRACT

In this study we investigated the effect of some essential oils, ethanol and methanol as novel and old antimicrobial agents (respectively) in extending the vase-life of Carnation (*Dianthus caryophyllus* L.) flowers. Cut flowers of carnation were kept in solution containing essential oils of Thyme, Black cumin and Peppermint (50 and 100 mgL^{-1}), ethanol, methanol (4, 7 and 10%) and control. Data showed just solution containing ethanol 7% could increase flower longevity than control. Vase life and flower fresh weight losses in solution containing essential oils didn't have significantly difference than control, ethanol and methanol. Maximum solution uptake was observed for flower kept in solution containing ethanol 4%. Totally our results suggest the application of ethanol and methanol in preservative solutions for carnation flowers.

Key Words: cut flower, essential oils, preservative solution, solution uptake

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) is an important cut flower in the world. According UN, world carnation trade was valued at $498 million in 2007. The postharvest longevity of flowers is of critical importance in determining the value of the crop. Adopting proper harvesting and post-harvest techniques can reduce about 20-40% post harvest loss of cut-flowers (Chandrashekhar and Gopinath 2004). There are some researches that have been applied different chemicals in extending vase life of carnation (Segliea et al. 2011, Macnish et al. 2008, Serrano et al. 2001), but a new worldwide trend is to explore alternatives that control postharvest diseases, giving priority to decay-preventing methods with a minimal effect on human health and environment (Bautista-Banos et al. 2006).

Essential oils are natural products taken from plant materials that, due to their antibacterial, antifungal, antioxidant and anticarcinogenic properties can be used as natural additives in many crops (Teissedre et al. 2000). Many authors mention usefulness or no detrimental effects on horticultural product quality parameters when essential oils are used after harvest (Hegazi and Gun 2009, Solgi et al. 2009, Martinez-Romero et al. 2007, Tzortzakis 2007). The major constituents of the used essential oils are phenolic compounds (Bounatirou et al. 2007, Sharififar et al. 2007).

Thyme (*Thymus vulgaris*) essential phenolic oil has been counted to have antibacterial, antimycotic and antioxidative properties (Deans et al. 1987, Deans et al. 1993). Its majority components were thymol, carvacrol also borneol (Jakiemiu et al. 2010), Essential oils of Black cumin (*Bunium persicum*) also have strong anti-bacterial effects. This feature could be resulted from the relatively high amount of terpinenes and cumin aldehyde in the essential oil (Moghtader et al. 2009). Menthol is the main component of Peppermint (*Mentha piperita*). The essential oils of it show strong antibacterial activity (Işcan et al. 2002, Ernestt and Pittler 2001, Awang 1998).

In many flowers, one of the reasons for senescence is closely linked to ethylene evolution (Borochov and Woodson 1989). Ethanol (Heins and Blakely 1980) and methanol (Petridou et al. 1999) have been examined successfully in prolonging the vase life of cut carnations and chrysanthemum flowers by inhibiting ethylene biosynthesis (Heins and Blakely 1980, Wu et al. 1992, Petridou et al. 2001) and their antimicrobial effects.
In this study, we investigated the effects of some essential oils as safe preservative solutions and ethanol and methanol as chemicals preservative solutions to compare effects of them on vase-life, flower fresh weight losses, solution uptake and stomatal conductance in postharvest of Carnation flowers.

MATERIALS AND METHODS

Essential oils from Thyme (*Thymus vulgaris*), Black cumin (*Bunium persicum*) and Peppermint (*Mentha piperita)* were hydro distilled in a Clevenger's type apparatus for 6 hours at the laboratory of Ornamental plants, Department of Horticultural Science, Faculty of Agriculture, Ferdowsi University of Mashhad-Iran. The extracted oils were dried over anhydrous sodium sulphate to remove traces of moisture then stored in a

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refrigerator in the dark at 4°C until use (European Pharmacopoeia procedure 1983). Tween-20 0.1% v/v was used to dissolve the oils to preparing as preservative solutions (Arouiee et al. 2007). Carnations (*Dianthus caryophyllus* L.) flowers were grown in standard greenhouse conditions in Tehran, Iran. Flowers were harvested at the commercial opening stage (the petals forming an angle of 120° with the base of the calyx) (Serrano et al. 2001) and after 24 hours were transported to Mashhad city. Cut flowers were taken to laboratory and immediately were recut under water to length of 50 cm. Two separate sets of experiments were conducted in a completely randomized design. In the first set, the effect of three concentrations of 4, 7 and 10% of ethanol and methanol as preservative solution was studied. The second set included investigating the effect of two concentrations of 50 or 100 mgL^{-1} essential oils of Thyme (*Thymus vulgaris*), Black cumin (*Bunium persicum*) and Peppermint (*Mentha piperita*). Initial fresh weights were recorded at the start of experiment and then flowers were placed in glass vases filled with the preservative solutions (about 500 ml). Parafilm was wrapped around the stems and over the top of the vases to restrict solution loss only to the flower. The flowers were kept under standard environmental conditions (temperature 19-20°C, day length 12 h, cool-white fluorescent light with photosynthetically active photon flux density of 15 μ mol $m^2s^{-1,}$ RH 60–70%). Vase life of each flower was considered terminated when the number of deteriorated petals surpassed the number of the opened ones. Flower fresh weight losses and solution uptake changes were measured every other days of vase life period (van Meeteren 1978, Pompodakis et al. 2004). stomatal conductance were measured by Poremeter two times of vase life period. Each treatment included eight flowers (replications). Means between treatments were compared with Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Solution containing ethanol 7% could extend the vase life than control. However there was no significant difference ($P<0.05$) among other treatments and control (Table 1).

Maximum solution uptake was observed for flower kept in solution containing ethanol 4% (61.49 mLg^{-1}) than control and solution containing thyme and peppermint essential oils $50mgL^{-1}$ but no significant difference ($P<0.05$) were found among other treatments (Table 1).

Flower fresh weight losses only in solution containing ethanol 7% had significant difference ($P<0.05$) than control and others didn't show (Table 1).

Table 1. Effect of different concentrations of essential oils, ethanol and methanol on vase-life, solution uptake, flower fresh weight losses and stomatal conductance of Carnation (*Dianthus caryophyllus* L.) flowers.

Treatments		Vase-life (days)	solution uptake [(1)]	Flower fresh weight losses [(2)]	stomatal conductance [(3)]
Control		4 b	33.76 b	23.65 a	4 b
Ethanol	4%	10 ab	61.49 a	15.95 ab	8.32 ab
	7%	11 a	38 ab	13.20 b	6.45 ab
	10%	8 ab	44.6 ab	13.95 ab	6 ab
Methanol	4%	7 ab	40.37 ab	17.64 ab	5.2 b
	7%	9 ab	42.43 ab	15.19 ab	5.3 b
	10 %	7 ab	38.58 ab	15.51 ab	5.93 ab
Thyme ess. oi.	50mg L^{-1}	9 ab	33.1 b	14.8 ab	9.4 ab
	100 mg L^{-1}	7 ab	37.25 ab	17.77 ab	7.6 ab
Peppermint ess. oi.	50mg L^{-1}	6 ab	32.95 b	19.33 ab	7.55 ab
	100 mg L^{-1}	6 ab	40.68 ab	21.14 ab	10.76 ab
Black cumin ess. oi .	50mg L^{-1}	6 ab	41.27 ab	19.61 ab	6.75 ab
	100 mg L^{-1}	6 ab	38.47 ab	16.95 ab	20.23 a

Values are mean of eight replication ±SD. Mean separation among treatments was done by Duncan test at $p\leq0.05$. Means followed by different letters are significantly different.

(1) mLg^{-1}

(2) gg^{-1}

(3) mmolbar/m^2

The highest stomatal conductance (20.23 mmolbar/m^2) was obtained with solution containing black cumin essential oils 100 mgL^{-1} than Control, solution containing Ethanol 4% and 7%, however no significant difference ($P<0.05$) were observed among other treatments (Table 1).

Fig. 1. Shows trend of preservative solution losses of Carnation (*Dianthus caryophyllus* L.) cut flowers on four days that it shows amount of solution uptake by Carnation cut flowers. Preservative solution losses shown declining trend in all of treatments. The most solution losses observed on the second day especially in solution containing ethanol 4%, Peppermint essential oils 100 mgL^{-1} and black cumin essential oils 50 mgL^{-1}. The solution containing ethanol 10% also on the third day showed the most solution losses (Fig 1).

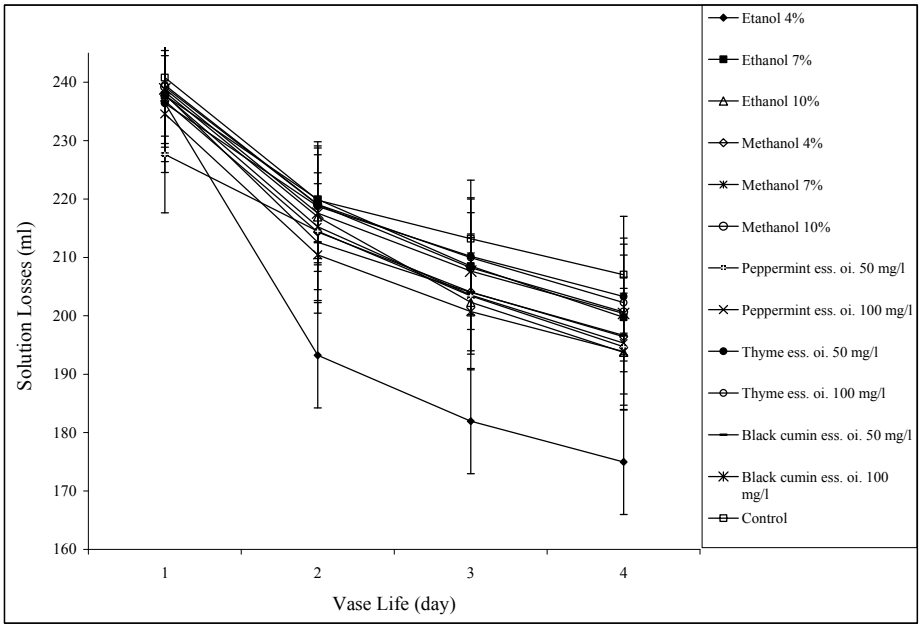

Figure 1. Effects of different concentrations of ethanol, methanol and solutions containing of essential oils on solution losses (ml) during four days of Carnation (*Dianthus caryophyllus* L.) flower's vase life.

Totally in this research was shown, application of solutions containing of essential oils on carnation cut flowers traits in comparison with ethanol, methanol and control had approximately same effects (especially vase life and flower fresh weight losses) however solution containing black cumin essential oils 100 mgL^{-1} was more effective than control and some concenterations of alcohols (stomatal conductance).Solution containing ethanol 7% showed the lowest flower fresh weight losses and also the longest vase life. Many research shows with decreasing flower fresh weight losses, vase life will increase. In C3 crops when stomatal conductance reduces, water-use efficiency will increase (Lawlor and Mitchell 1991) so vase life must be longer in cut flowers but in our research the lowest stomatal conductance obtained with control that had the lowest vase life. Among of solutions containing of essential oils, except black cumin essential oils 100 mgL^{-1} others had no prefer than ethanol, methanol and control. Essential oils are very effective antimicrobial agents, which inhibited the microbial growth and prevented bacterial plugging of water conducting tissues so they should increase vase life of cut flowers but we don't achieve to this result in our experiment maybe due to their concentrations, or not included other preservative such as sucrose in vase solution. There are some new researches that show essential oils can improve vase life on some cut flowers such as gerbera (Solgi et al. 2009) and *Gladiolus hybrid*a (Hegazi and Gan 2009). Shanan et al. (2010) also reported some natural essential oils increase vase life of carnation flowers. As there was no enough data and information about effects of essential oils on postharvest of cut flowers, so we couldn't represent a suitable comparison between our researches with other's researches.

Between two kinds of alcohols, approximately there isn't significance difference on measured traits. In despite of methanol by its antimicrobial effects and ethanol by decreasing of ethylene production or sensitivity to ethylene and also as an antimicrobial compound can prolong some cut flowers vase life (Heins and Blakely 1980, Wu et al. 1992). Darras et al. (2010) reported 100 and 200 mg/l methanol did not extend vase life of cut *Viburnum inflorescences* and some researches have shown that high concentrations of alcohol

have negative effects on extension of some cut flowers vase life (Petridou et al. 2001) but in our research we didn't obtain same result.

CONCLUSIONS

We conclude that application of essential oils in measured traits especially vase life than control have less effect or similar effect. Totally alcohols show better performance than essential oils and are more effective and economical so among of treatments we suggest ethanol 7% and methanol 4% in preservative solutions to increase of vase life of Carnation flowers.

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