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# Efficiency of Essential Oils, Citric Acid, Malic Aid and Nickel Reduced Ethylene Production and Extended Vase Life of Cut Lisianthus Flowers

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## ABSTRACT

Short postharvest vase life is one of the most important problems on the cut flowers. In this study we investigated the effect of some essential oils, citric acid, malic aid and nickel in extending the vase-life of lisianthus (*Eustoma grandiflorum* Mariachii. cv. Blue) flowers. The treatments were distilled water, nickel (0, 1 and 2 mM), essential oils of thyme (*Thymus vulgaris*) (50, 100 and 150 mg $L^{-1}$), citric acid (0, 100 and 150 mg $L^{-1}$) and malic aid (0, 1.5 and 2.5 mM). Results showed that solution containing 2 mM nickel+2.5 mM malic acid and 150 mg $L^{-1}$ essential oils of Thyme could increase flower longevity as compared to control. The results also revealed that malic acid and nickel treatments increased cut-flower water absorption while decreasing ACC-oxidase (Aminocyclopropanecarboxylate oxidase) activity and premeability together with total delay of senescence and peroxidation of lipids. Chlorophyll content and ACC-oxidase activity in the cut flower in solution containing citric acid and essential oils were not significantly different than control. It is suggested the application of nickel, essential oils of Thyme and malic aid in preservative solutions for *Lisianthus* flowers maintained the vase life of flowers for a longer period.

**Key words:** Cut flower, essential oils, preservative solution

## INTRODUCTION

Ethylene is a plant hormone which is important for many aspects of plant physiology including fruit ripening and enhanced flower senescence (Yang and Hoffman, 1984; Kazemi *et al*., 2010). Flower senescence is a developmental change leading to permeability of petal cells and accelerated the decrease in cell membrane fluidity (Chakrabarty *et al*., 2009). Cut flower have highly sensitive to ethylene, a rise in ethylene production that accelerates senescence has been found in cut flowers (Mayak and Halevy, 1980; Farokhzad *et al*., 2005; Hojjati *et al*., 2007). Inhibitors of ethylene biosynthesis reduced cut flowers senescence (Da Silva, 2003; Kader, 2003; Khan *et al*., 2003; El-Tayeb *et al*., 2006; Ansari and Misra, 2007; Mahdavian *et al*., 2007; Mba *et al*., 2007; Canakci, 2008; Shi and Zhu, 2008; Joseph *et al*., 2010). Ni is a anti-ethylene features and can impede ethylene production (Zheng *et al.*, 2006; Wood and Reilly, 2007). MA is a well known organic acid that can reduced senescence and the number of bacteria in the solution (Kazemi *et al.*, 2010). Essential Oils (EOs) are also used as flavoring agents in food industry. Numerous studies have reported the antimicrobial activity and chemical composition of essential oils (Tepe *et al.*, 2004; Kordali *et al.*, 2005). Thyme (*Thymus vulgaris*) essential phenolic oil has been counted to have antibacterial, antimycotic and antioxidative properties (Deans and Ritchie, 1987; Deans *et al.*, 1993). In this study, the preservative effects of some essential oils, malic acid and nickel and their interaction on the vase life of cut Rose flowers were studied.

## MATERIALS AND METHODS

**Plant material:** The experiment was started May 1, 2011 and chlorophyll content, vase life and ACC-oxidase activity were measured. This study was on the effect of some essential oils, malic acid and nickel treatments on vase life of Lisianthus cut flowers. Cut flowers were harvested in half-open stage from local commercial greenhouses (Mahallat, Arak, Iran), in the morning and transported with appropriate covers immediately. Cut flower stems of Lisianthus (*Eustoma grandiflorum* Mariachii cv. Blue) (40 cm in length) were placed in solution containing nickel (0, 1 and 2 mM), essential oils of thyme (*Thymus vulgaris*) (50, 100 and 150 mg $L^{-1}$), citric acid (0, 100 and 150 mg $L^{-1}$) and malic aid (0, 1.5 and 2.5 mM) after cutting. Distilled water was used for the controls and placed in chambers at 19°C. The relative humidity was about 70% while 14 h photoperiod was maintained using fluorescent lamps with a light intensity of 15 μmol $m^{-2}$ $sec^{-1}$ at the top of the corolla.

**Vase life:** The vase life of the inflorescence was terminated when 50% of the open flowers wilted.

**Chlorophyll content measurement:** Total chlorophyll (a+b) content was measured by chlorophyll meter (SPAD-502, Minolta Co. Japan) which is presented by SPAD value. Average of 3 measurements from different spots of a single leaves was considered.

**Determination of ACC-oxidase activity:** ACC oxidase (ACO) activity was measured as based on the method of Moya-Leon and John (1994).

**Microbe population:** Test microbe population were isolated from vase solutions of Lisianthus by measuring to the method described by Zagory and Reid (1986).

**Water uptake and fresh weight:** The volume of water uptake was calculated by subtracting the volume of water evaporated from a control bottle without cut flowers from the amount of water decreased in bottles containing flowers. The fresh weight of the cut flowers also measured in initial day and terminal day of experiment.

**Experimental design and statistical analysis:** Experiment was arranged in a factorial test with complete randomized design with six replications. Analysis of variance was performed on the data collected using the General Linear Model (GLM) procedure of the SPSS software Version 16, IBM Inc. The mean separation was conducted by Tukey analysis in the same software ($p = 0.05$).

## RESULTS AND DISCUSSION

The results showed that in comparison to the control, the concentrations of Ni, MA and essential oils of thyme prolonged the vase life cut lisianthus flowers while all concentrations citric acid

Table 1: Mean comparisons of chlorophyll content, vase life and ACC-oxidase activity in Ni, MA and essential oils of thyme treatments and their interaction

| Ni (mM) | MA (mM) | Vase life (day) | Total chlorophyll (SPAD reading) | ACC-oxidase activity (nmol $h^{-1}$ $mL^{-1}$) | Water uptake (mL $flower^{-1}$) | Colony count (CFU $mL^{-1}$) |
|---|---|---|---|---|---|---|
| 0 | 0.0 | 7 | 3.00 | 59.35 | 75.00 | 680 |
| | 1.5 | 10 | 4.21 | 43.11 | 100.00 | 210 |
| | 2.5 | 12 | 8.16 | 30.00 | 135.00 | 97 |
| 1 | 0.0 | 7 | 3.02 | 32.35 | 60.00 | 171 |
| | 1.5 | 9.5 | 4.00 | 30.80 | 75.00 | 210 |
| | 2.5 | 11 | 6.89 | 29.68 | 90.00 | 200 |
| 2 | 0.0 | 12 | 4.09 | 20.14 | 70.00 | 187 |
| | 1.5 | 13 | 5.00 | 20.00 | 110.00 | 179 |
| | 2.5 | 15 | 7.68 | 15.78 | 130.00 | 170 |
| **Essential oils of thyme** | | | | | | |
| *Thymus vulgaris* (mg $L^{-1}$) | 50 | 9 | 4.00 | 65.11 | 80.00 | 168 |
| | 100 | 11 | 4.86 | 60.35 | 85.00 | 179 |
| | 150 | 14 | 5.00 | 57.45 | 85.00 | 97 |
| **F-test probabilities** | | | | | | |
| Ni | 0.03 | 0.01 | 0.40 | 0.03 | 0.01 | |
| MA | 0.01 | 0 | 0.03 | 0.001 | 0.00 | |
| Citric acid | 0.07 | 0.1 | 0.06 | 0.05 | 0.05 | |

The citric acid which was not effective on most variables, was omitted from first part to avoid an unnecessary complicated table

were not effective significantly ($p<0.05$). Holding Lisianthus cut flowers in vase solutions containing 2 mM Ni+2.5 mM MA and 150 mg $L^{-1}$ essential oils of Thyme significantly increased their vase life and delayed flower senescence compared to flowers either held in distilled water (Table 1). Jamali and Rahemi (2011) reported that treatment with Ni significantly extends the vase life carnation. Ions of Ni, have an inhibitory effect on ACO by forming an enzyme-metal complex (Smith and Woodburn, 1984). On the other hand, the nitrogen cycle within plants can be affected by Ni (Bai *et al*., 2006) and this element have beneficial influence on rigidity of protein structures (Wood and Reilly, 2007) which might increase the total resistance of plants against senescence (Jamali and Rahemi, 2011). Similarity, Kazemi *et al*. (2010, 2011b) found that application of MA on cut flower increased in vase life and enzyme antioxidant activity. 2.5 mMMA caused an increase in water uptake by flowers while Ni treatment alone was not effective significantly($p<0.05$). A 2.5 mM MA and 150 mg $L^{-1}$ essential oils of Thyme caused a linear reduction in the colony count, from 680 CFU $mL^{-1}$ in 0 levels to 97 and 97 CFU $mL^{-1}$ in 2.5 mM MA and 150 mg $L^{-1}$ essential oils, respectively.

Anjum *et al*. (2001) reported adding a suitable germicide in vase water can prevent the growth of microbes and increased water uptake. This result was in agreement with the report of Kazemi *et al*. (2011c) that showed the treatment of MA reduced microbial population in vase solution of carnation cut flowers and increased water uptake in carnation cut flowers. The results indicate that 2.5 mM MA and 1.5 mM and its combination with treatment caused a significant increase in SPAD value ($p = 0.05$). Application of citric acid and Ni had no significant effect (Table 1). ACO activity in the cut flower decreased with increased Ni and MA concentrations treatments while citric acid had no significant effect ($p<0.05$). The results indicate that the treatment by 2.5 mM MA+2 mM Ni improved membrane permeability by decreasing ACO activity in compared to control ($p<0.05$). Nickel (Ni) as an essential element, plays different roles in completion of plant life cycle (Wood and Reilly, 2007). It has been demonstrated that this element has anti-ethylene features and can impede its production (Zheng *et al.*, 2006). Similarity, in agreement with present result Kazemi *et al.* (2011a) showed that treatment with MA decreased the level of Anthocyanin leakage and ACO activity.

## CONCLUSION

The present study found that use of disinfectants improve water conductance by preventing bacterial growth and producing occlusions. Result showed that treatment with Ni, MA and essential oils of Thyme extends the vase life of cut carnation flowers. MA reduced chlorophyll total degradation and preserved chlorophyll total content. These findings are similar to previous results (Jamali and Rahemi, 2011; Kazemi *et al.*, 2011b-c).

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