The Role of Essential Oils in Maintaining Physiological Quality and Vase Life of Cut *Ruscus aculeatus* Branches.

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ABSTRACT

The study explores how natural plant extracts serve as eco-friendly antimicrobial substitutes for chemical preservatives like 8-hydroxyquinoline (8-HQ) to prolong the vase life of *Ruscus aculeatus* cut branches. The researcher at the University of Duhok carried out her study from January to March 2022 to examine how different essential oils and their mixtures affect postharvest longevity. The researcher applied various solutions including distilled water, 8-HQ, and essential oils at 300 µg/mL to the cut branches. The control treatment with water produced the shortest vase life of 20 days while the combination of thyme alone and thyme with clove resulted in the longest vase life of 61 days. The essential oils also influenced other postharvest traits: The 8-HQ treatment achieved the greatest fresh and dry weights but clove treatment produced the highest carbohydrate concentration at 16.32%. The highest chlorophyll content was found in mixtures of clove and lavender essential oils while treatments with thyme resulted in the greatest water retention. The research demonstrates that essential oils function as sustainable and effective preservatives which lengthen the vase life of *Ruscus aculeatus* while providing an eco-friendly replacement for harmful chemicals in the floral industry.

Keyword: *Ruscus aculeatus*, Volatile oil extracts, Vase life, Postharvest longevity, Essential oils

INTRODUCTION

Ruscus aculeatus, a member of the lily family, this evergreen, semi-woody ground cover is predominantly native to northwest Africa, with a likely native range extending to southern Spain. Ruscus shares a relationship with numerous Asparagus species, popular for their cut foliage, and features semi-glossy, dark green, and thornless foliage known as cladodes or cladophylls. Develops flowers in the centre of the cladode with presence in the upper as well as lower surfaces. Bright red fruits (berries) also enhanceits aesthetic value. The stems of *R. aculeatus* are extremely good for floral arrangements since they are very appropriate for linear materials. They are used most as filler elements or as greens for festive Christmas arrangements, particularly when they come along with their bright red berries. Fresh or dry, *R. aculeatus* proved to have extreme durability**[14]**. Although having an inclination

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toward woodiness, the cut foliage would play substantial roles in floral design, either embellishing the arrangement itself or the vase it is housed in. Its postharvest longevity makes it commercially quite desirable. The world is experiencing a strong surge in demand for potted foliage plants and cut leaves intended for indoor decoration **[18]**.

Postharvest quality and vase life are significantly influenced by factors such as temperature, relative humidity, light, air velocity, and ethylene concentration. Additional contributors include the composition of the holding solution, microbial contamination (the primary cause of reduced vase life), and water quality**[4]**. Researchers are looking into more natural alternatives to chemical preservatives since the latter usually raise environmental and safety concerns. Recent studies mostly investigate the efficacy of different chemical compounds mixed together in vase solutions to improve the life of cut flowers. Though 8-HQ is most used in practice, it is also very expensive and highly hazardous, causing skin, eye, and respiratory irritations.

Research in its recommendations for sucrose and 8-HQS treatment varied between short-term treatment or addition to the holding solution as well as in the concentration used according to the treatment method.**[9]** found that the use of sucrose overlapping with 8-HQS extended the flowering life of Rosa hybrida rose flowers, Dianna variety, to 7 days versus the use of 8-HQS alone, reaching only 3 days. The natural chemical compounds extracted from various aromatic and medicinal plants, commonly known as essential oils, are extensively utilized in preventing the proliferation of microorganisms in the vase solution. As a result, the longevity of the flowers in the vase is prolonged**[9].**

Carnation cut flowers are generally affected by the water in vases, where in bacteria are known to attack and destroy the flowers' longevity and appearance **[17].** In vase solutions, microorganisms such as bacteria, yeasts, and molds proliferate, causing blockage of the xylem at the cut ends, thereby greatly restricting water uptake. They are most popularly known for their bacteriostatic activity in solutions of sucrose, indeed, for extending vase life**[10].** Further including 8-hydroxyquinoline sulfate (8-HQS), silver thiosulfate (STS) and glycolic acid (GIA) in treatments, depending on the species and cultivars, proved to be useful **[8].**

Due to various environmental and human health threats posed by synthetic agents, there is an increased focus on the use of natural alternatives. Various herbal extracts and essential oils have been foreseen as viable substitutes for this need, bearing antimicrobial, antioxidant, antibacterial, and antifungal characteristics. Essential oils from aromatic and medicinal plants could remain potential preservative solutions against bacterial and fungal pathogens **[16,2,13,3].** Natural products are safer and comparatively cheaper to create a win-win situation confronting environmental and economic issues **[11].**

MATERIAL AND METHODS

From January 13 to March 13, 2022, this experiment was carried out in the horticulture department's laboratory for aromatic and medicinal plants at the College of Agricultural Engineering Sciences, University of Duhok. In order to enhance and extend the vase life of Ruscus cut branches, the goal was to compare natural extracts with 8-hydroxyquinoline as a chemical substance. Natural extracts were tested for their antimicrobial qualities against certain bacteria and fungi, as well as their safety and environmental friendliness. Ruscus cut branches were harvested from the plastic house at the Nursery University of Duhok in the early morning When plants displayed glossy green leaves, they were promptly arranged upright in

buckets partially filled with tap water and then transported at laboratory conditions with a temperature of 20 ± 2 °C and humidity of 60 ± 5%.

In the laboratory, only intact leaves were selected and assessed to ensure consistent appearance, then 3 cm from the foliage base was removed in addition to the leaves that will be attached to the treatment solutions and to a uniform length of 30 cm, with the freshly cut branch ends promptly placed in a plastic bottle containing 150 mL of vase solution to ensure optimal hydration and preservation.

Treatments include the following: control (distilled water), 8-HQ, lavender, thyme, clove, and eucalyptus essential oils and their combination at a concentration of 300 $\mu g \cdot mL^{-1}$ (12 treatments in total).

Three replicates were used per treatment, each replicate containing three fresh branches, for a total of 108 branches. The measured traits of this study were vase life (days), dry weight (gm), fresh weight (gm), lost water (gm), total chlorophyll, and carbohydrate (%). The experiment followed a factorial design within a completely randomized framework, and the data were processed and analyzed using SAS software, and graphs were drawn using Excel software, and the comparisons were performed with the LSD test.

RESULTS

Table (1) shows that the application of some volatile extracts, like water, 8-HQ, lavender, thyme, clove, eucalyptus, thyme + clove, thyme + eucalyptus, thyme + lavender, clove + eucalyptus, clove + lavender, and eucalyptus + lavender, which were used alone or with their combination, improved some parameters of Ruscus leaves. About the vase life parameter, the significant longest day of the leaves reached (61.0) days when using the volatile extracts containing thyme alone and the mixture of thyme + clove compared with all treatments except the treatment containing clove extraction, which reached (59.0) days. While the leaser day for the vase life reached (20.0) days when used with water as a preservative.

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Table (1). effect of some volatile oil extracts on the vase life and some parameters of Ruscus leaves.

Treatments	vase life (day)	Dry weight (gm)	Fresh weight (gm)	lost water (gm)	Total Chlorophyl (mg/100 gm fresh weight)	carbohydrate (%)
H_2O	20.0^{e}	10.15^{ab}	28.52^{bc}	71.20^{b-d}	46.13^{bc}	12.56^{bc}
8-HQ	28.3^{e}	11.14^{a}	33.93^{a}	68.45^{b-d}	53.43^{a}	13.23^{b}
Lavender	24.67^{e}	8.34^{b-d}	30.64^{ab}	65.80^{cd}	49.33^{ab}	11.59^{cd}
Thyme	61.0^{a}	7.39^{cd}	28.45^{bc}	79.03^{a-c}	41.10^{cd}	13.74^{b}
Clove	59.0^{ab}	7.22^{cd}	27.37^{bc}	89.87^{a}	39.10^{d}	16.32^{a}
Eucalyptus	48.67$^{b.d}$	9.04^{bc}	25.79^{c}	73.33^{b-d}	49.30^{ab}	12.01^{cd}
Thyme+clove	61.0^{a}	8.70^{bc}	27.84^{bc}	81.08^{ab}	42.27^{cd}	8.36^{f}
Thyme+Eucalptu	54.3^{a-c}	8.53^{b-d}	29.12^{bc}	81.67^{ab}	41.85^{cd}	9.16^{ef}
Thyme+Lavender	54.3^{a-c}	9.16^{bc}	27.61^{bc}	86.79^{a}	44.70^{bc}	9.91^{e}
clove+Eucalptus	47.0^{cd}	5.29^{e}	25.28^{c}	64.53^{d}	49.575^{ab}	9.32^{ef}
Clove+Lavender	42.67^{d}	6.68^{de}	25.47^{c}	70.85^{b-d}	53.42^{a}	11.29^{d}
Eucalptuse+Lavender	44.5^{cd}	8.33^{b-d}	27.24^{bc}	67.46^{cd}	49.83^{ab}	9.03^{ef}

Means with same letter for each Colum are not significantly different at 5% level based on Duncan's Multiple Rang Test.

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However, the dry weight and fresh weight maximum value of these characters were to reach (11.14 g, 33.93 g), respectively, when the use of preservative 8-HQ. Also, the maximum value of chlorophyll was reached (53.43 and 53.42 mg/100 g of fresh weight) when the use of lavender alone and clove + lavender, respectively, was applied. While the minimum weight for dry and fresh leaves and chlorophyll was to reach (5.22, 25.28, and 39.10) g when the use of the preservative containing water, thyme + lavender, and clove, respectively. In addition, the water loss and carbohydrate gave the highest value reach (89.87) and (16.37), respectively. When used with the volatile extracts containing cloves alone, these treatments were significantly compared with all treatments, while the lowest value for water loss and carbohydrate reach (64.58) and (8.30) was seen with the use of the preservative containing cloves + eucaleptuse and thyme + cloves, respectively.

The figure (1) showed that the different preservations were used for evaluating the longevity of the vase life of the Ruscus leaves. The longest days for the vase life reach (61.0) days when using the preservation containing thyme alone and thyme + clove. Also, the second longest vase life (59.0 days) when using the clove alone as a preservation. This treatment was significantly compared with water preservation, which was used as a control treatment and which gives the shortest days for vase life (20.0 days).

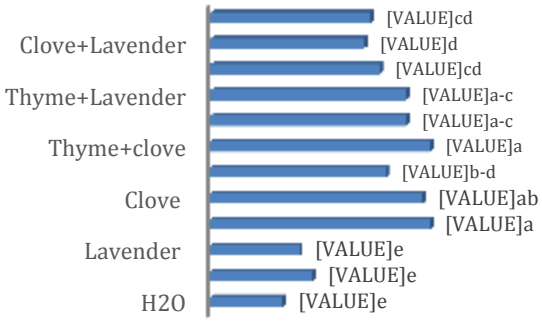

figure (1). effect of some volatile oil extracts on the vase life (day) of ruscus leaves.

The results in figure (2) showed that all preservative solutions demonstrated a notable impact on dry weight in this experiment. The preservative 8-HQ recorded the greatest dry weight value reached (11.14) mg. Also, the second greatest value of dry weight (10.15 mg) was when using the water as a preservative. While the lowest value (5.29) mg showed when treated, the leaves of Ruscus by clove + eucalyptus as the preservative.

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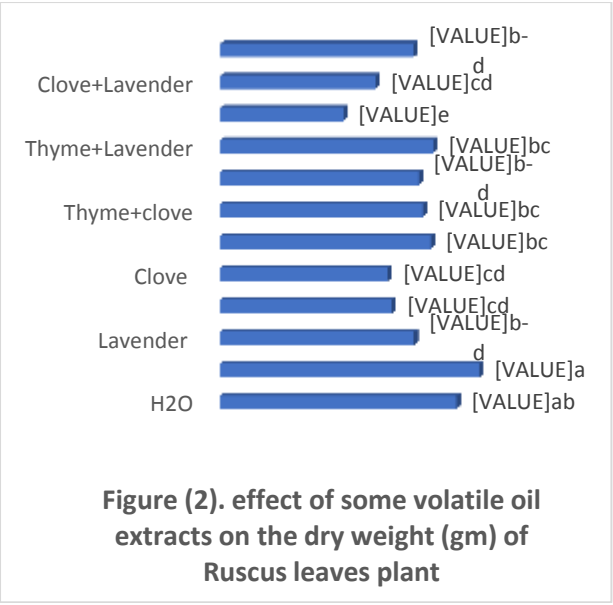

Figure (2). effect of some volatile oil extracts on the dry weight (gm) of Ruscus leaves plant

The results in the figure (3) showed that the preservation 8-HQ gave the greatest fresh weight of Ruscus leaves (33.93 g), and the second highest value was (30.46 g) when lavender oil extracts were used as a preservative solution. While the lowest fresh weight was recorded when using clove + eucalyptus and clove + lavender (25.28 g and 24.47 g, respectively).

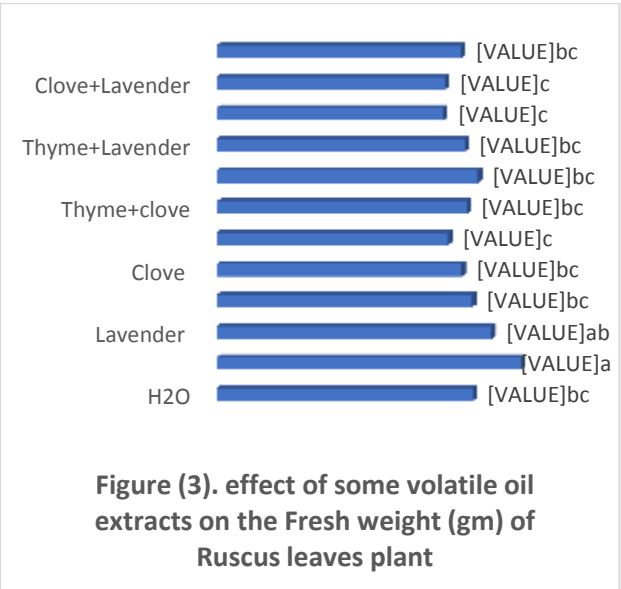

Figure (3). effect of some volatile oil extracts on the Fresh weight (gm) of Ruscus leaves plant

The figure (4) showed that the loss of water is affected by volatile oil extracts and their combination. The highest loss of water observed was with clove preservation (89.87 g) and thyme + lavender (86.79 g) compared with clove + eucalyptus, which gives the lowest result of water lost (64.53 g) and lavender preservation (65.80 g) in Ruscus leaves.

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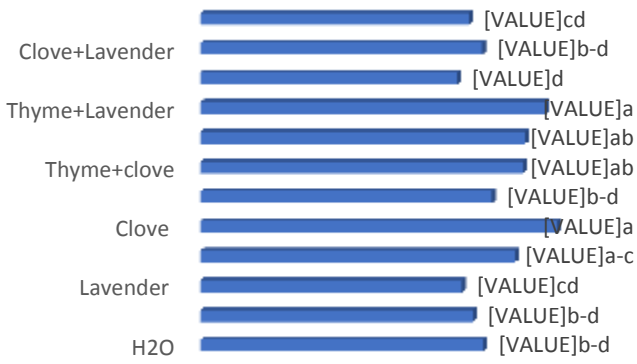

Figure (4). effect of some volatile oil plant extracts on the lost water (gm) of Ruscus leaves

The data in figure (5) showed that the total chlorophyll of Ruscus leaves had a significant effect from volatile oil plant extract as the holding preservative solution. 8-HQ and clove + lavender solutions significantly gave a maximum value (53.43 and 53.42 mg/100 gm of fresh weight of total chlorophyll) compared with most of the other treatments. The minimum value of chlorophyll was related to clove solution (39.10 mg/100 fresh weight of Ruscus leaves).

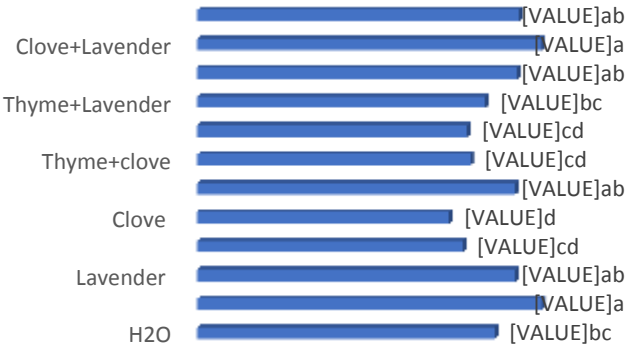

Figure (5). effect of some volatile oil plant extracts on the Total Chlorophyl (mg.per 100 gm fresh weight) of Ruscus leaves

The findings presented in Figure (6) indicated a statistically significant difference between the volatile oil plant extracts and their effect on the total carbohydrate rate in Ruscus leaves. The total carbohydrate was in a higher value with the treatment of clove oil extract, which reached 16.32%, while the lowest value was with the treatment of clove + thyme, which reached 8.36%.

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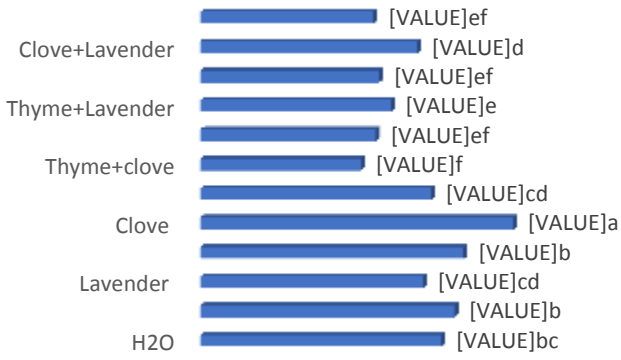

Figure (6). effect of some volatile oil plant extracts on the Total carbohydrate (%) of Ruscus leaves

Discussion

There is abundant evidence in this study that essential oils could conserve *Ruscus aculeatus* cut-branch vase life and improve its postharvest parameters in a sustainably desirable manner. The essential oils obtained from thyme, clove, lavender, and eucalyptus were seen to exhibit significant antimicrobial and preservative effects, promoting the vase life and physiological attributes of the branches.

The highest vase life was obtained at 61 days when thyme was just alone or partnered with clove, which was much over control treatment with distilled water (20 days). This is in accordance with previous research revealing that essential oils also that have antimicrobial properties suppress the growth of microbes in the vase solution, thereby leading to reduced vascular blockage and improved water uptake **[8,13].** Also, clove oil alone gave impressive results at 59 days, which shows its great antimicrobial activity that has been reported in other research studies on cut flowers like gladiolus and gerbera **[6,2, 1].**

It was the chemical preservative 8-HQ that gave rise to fresh and dry weights that were highest, amounting to 33.93 g and 11.14 g respectively, thus proving its best capability in maintaining physiological integrity. Lavender oil has also proven promising in fresh weight for that matter with 30.46 g indicating its possibility as one of the nature's alternative to synthetic chemical preservatives. These results are in agreement with earlier findings regarding the role that essential oils play in structural integrity preservation concerning their capacity to reduce microbial contamination and oxidative stress **[16].**

The intervention given all alone with clove indicated the maximum total amount of chlorophyll (53.43 mg/100 g and 53.42 mg/100 g, respectively). This means that both treatments significantly reduced chlorophyll degradation, which is one of the markers for postharvest quality. According to **[2],** the ability of oils to maintain chlorophyll content depends on the antioxidant ability of oils that alleviate the oxidative damage during storage.

Clove oil results show the maximum water loss (89.87 g) and carbohydrate content (16.32%), indicating its role in enhancing metabolic activity with low water loss. These results also confirm the reports of similar findings from cut flower studies showing reduced carbohydrate loss with essential oils due to inhibited microbial activity in the vase solutions **[13,11]).** In contrast, combinations of clove and eucalyptus proved to be effective in reducing their respective water loss values, implying synergism in the clove and eucalyptus combination that may decrease transpiration rates.

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Essential oils are wholly the other good side of environmentally friendly, unlike chemical preservatives such as 8-HQ, which are hazardous to human health and pollute the environment **[8,11].** Essential oils provide a sustainable strategy for the floral industry, reducing the dependence on harmful chemicals and improving postharvest quality.

Conclusion

The current study demonstrates that essential oils are promising natural alternatives to synthetic preservatives for enhancing the vase life and postharvest traits of cut branches of *Ruscus aculeatus.* Thyme oil alone or in combination with clove gave the best results for vase life extension, while lavender oil was most effective for chlorophyll retention. Clove oil proved to be the most potent in keeping carbohydrates due to its antimicrobial activity.

It could be thus concluded that essential oils have the potential to become sustainable alternatives for the floral industry, delivering a low ecological footprint and safety compared to chemical preservatives, such as 8-HQ. Future studies should focus on optimizing essential oil concentrations and different combinations for various species to further support and confirm their application in a broader range of floral crops.

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