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REVIEW ARTICLE **OPEN ACCESS**

Effect of Botanicals on vase life of cut flowers: A Review

Dishaben K. Patel[1*], Chawla, S. L.[2] and Gawade Nagesh Vithu[3]
[1 & 3] Ph.D. Scholar, Junagadh Agricultural University, Junagadh, Gujarat, India.
[2] Associate Professor, Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India.
*Corresponding author email: disha7954@gmail.com

ABSTRACT
Vase life is most attractive and economic components of cut flowers. Longer vase life of cut flowers is preferred in flower cultivation and marketing as good quality trait for retailers and consumers. The postharvest longevity of cut flowers has a critical importance in determining the value of the flower crop. Yearly 20 – 40 per cent of the cut flowers are lost due to improper post harvesting handling. Longevity of flower shelf life has been influenced by various biotic and a biotic factors. Vase life of cut flower reduces due to microbes that block flower stock xylem vessels thereby reduces rate of water supply to flower. It can be improved using different preservatives substances. Inclusion of various antimicrobial compounds such as botanicals extracts and essential oils are expanding the vase life of cut flowers. Botanical extracts are natural, safe and inexpensive compounds are always crucial in this respect for large scale applications. Natural plant extracts have come into prominence now a day. Some natural plant extracts (Thyme oil, Rosemary oil, Geranium oil, Eucalyptus oil, Mint oil, Ajowan oil, Savory oil, Coriander oil, Dill oil, Artemisia oil, fruit and leaf extracts) have strong antimicrobial properties against some pathogens, due to high levels of phenolic compounds. For instance, Thyme essential oil was tested and positive responses were reported in case of gerbera, narcissus, chrysanthemum, alstroemeria, rose and carnation cut flowers vase life longevity.
Keywords: *Vase life, cut flower, essential oil, microbes.*

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INTRODUCTION

Floriculture is gaining importance throughout the world and is now considered as one of the country's sunrise industry both of cut flowers as well as loose flowers. The area under flower crops in India has increased to 3,28,000 ha with the production of 5,93,000 million cut flower stems [1]. Flower production is one of the strategies in horticulture sector in many countries of the world. Flower production has been started few years ago in India and becoming new area of growth and transformation plant of the country. Floriculture has great social and economic advantages. In recent years, the cut flowers trade increased many folds in domestic as well as in the international markets. The beauty of the flower lies with the freshness of the flowers for longer time without losing its aesthetic value. All along the marketing channel, there is enormous loss in the value of cut flowers which could be 50 per cent of the farm value [2]. The main products include cut flowers. However, flower production is influenced by various a biotic and biotic factors. Like other horticultural crops cut flowers need proper post-harvest management operations. This is because of the fact that vase life or duration of cut flowers is one of the most important post-harvest issues in flower industry. Hussen and Yassin [3] reported that the 10-30% losses due to post-harvest damage in rose cut flowers emphasizing post-harvest loss as main problem of floriculture. Hence, keeping freshness and other quality characters of cut flowers requires clear understanding and management of factors that lead to the decline of the products. Cut flowers post-harvest life is affected by plant genetic, environment, agronomic and chemical factors. In addition water stress and microorganisms that grow in vase solution affect duration of cut flowers. Because of such problems different growers use different environmental friendly materials and techniques in order to prolong vase life of cut flowers and to ensure quality as well as healthy of sellers and buyers.

The cut flowers are deprived of their natural resources of water and nutrients after being detached from the mother plant, as a result all life processes are at the expense of reserved food materials. Hence,

addition of chemical preservatives to the cut flowers is recommended to continue its physiological processes so that the longevity of the flowers can be extended by more number of days [4]. Nearly 20-40 per cent of the cut flowers are lost due to improper post- harvest handling. These post- harvest losses can be reduced by adopting suitable post-harvest techniques namely temperature management during storage and following strict sanitation procedures in the grading and packing rooms. Further vase life can be doubled by the judicious use of floral preservatives in the vase solutions. of greater significant importance in cut flowers is the maintenance of turgidity [5]. As cut flowers, unlike most agricultural commodities are harvested before they are fully developed, they are expected to continue their growth in consumers home. Then they are likely to be deprived of their metabolites normally negligible under the conditions under which they are regularly held [6]. This necessitates addition of carbohydrates in the holding solutions.

Keeping quality is an important parameter for evaluation of cut flower quality, for both domestic and export markets. Addition of chemical preservatives to the holding solution is recommended to prolong the vase- life of cut flowers. All holding solutions must essentially contain two components *viz*., sugar and germicides. The sugars provide a respiratory substrate, while the germicides control harmful bacteria and prevent plugging of the conducting tissue [4]. Two major factors which play a dominant role in postharvest physiology of the cut flowers are supply of carbohydrates and water balance in the stem. Sugars are the source of energy for respiration, which maintains turgidity, plays an important role in the flower freshness. Sucrose treatment leads to an increase in the mechanical rigidity of the stem, which is due to cell wall thickening and lignification of vascular tissues [7]. Cut flowers are more complex which require special attention in developing, handling techniques. These cut flowers are sensitive to microbial contamination at the same base or in the vase solution, shortening their vase life [8, 9].

As we have a variety of aromatic crops which are the source of natural essential oils. We can substitute their action instead of synthetics. Essential oils are organic in nature, safe and environmentally friendly, those have strong anti- microbial properties against some pathogens. The main constituents of essential oils are phenolic and mono-terpenic compounds. The anti-microbial mechanism is due to synthetic inhibition of DNA, RNA, proteins and polysaccharides. Essential oils also contain high level of phenolic compounds such as carvacrol, thymol and eugenol [10]. Many authors reported as essential oil extends vase life of many cut flowers. Essential oils are extracted from different parts of aromatic plants by various methods. They considered as input for many industries. Essential oils produced from such plants can be alternative input for flower industry in the country because of their antimicrobial activity and environmentally friendly. However, even though there is a wider opportunity to use aromatic plants extracts, there is limited information concerning essential oil utilization as alternative in vase life longevity of cut flowers in the country. Therefore, the aim of this study paper is to review effect of essential oil on vase life of cut flowers in India for further understanding and information provision for users.

CUT FLOWER

Cut flowers are fresh very perishable parts of plants such as blooms or inflorescences and some attached plant materials cultivated in protective structure. They are used for decorative purposes and used during weddings and funerals, gifts on occasions and in times of illness, and at holidays and to beautify homes and public places. The most important thing in cut flower handling is its post harvest treatments to prolong vase life [3]. Different cut flowers types evaluated according to their fitness to different quality parameters considered by customers or consumers at each marketing stages. Cut flowers evaluated based on their water up take, transpiration rate, water balance, increase or decrease in fresh weight, vase life, and anatomical traits [11, 12, 13, 14].

Vase life of cut flower

Vase life is post harvest duration of a cut flower and it varies among species and cultivars [15]. It is one of the quality traits as it represents amount of time spent and the conditions that flowers experience while in transit from farm to end user. The longevity of cut flowers is one of the main challenges of floriculture industry [16]. This is because of the fact that vase life of cut flower consideration as a quality criterion. Flower vase life depends up on many factors such as post harvest treatments in flower industry are mainly designed to maintain flower freshness and to extend its vase life until the final utilization by end users. In addition to controlling and maintaining cut flower quality, keeping its longevity is another mandatory in flower markets as short postharvest vase life is one of the most important problems of the cut flowers [11]. Thus, the techniques of prolonging the vase-life of cut flowers have to be given special attention as they play great role for growers, traders and final users. The use of preservative compounds in the vase solution is one of the common methods to extend the vase life of cut flowers [17]. Because of

this, herbal extracts and essential oils as preservative compounds becoming popular in prolonging vas life of cut flower.

WHAT IS BOTANICAL?

A botanical is a plant or plant part valued for its medicinal or therapeutic properties, flavour and scent. Botanicals can extract from the different plants.

Different types of botanicals used in vase life of cut flowers:

Essential oils, coconut water, coconut milk, sour orange *e*xtract, apple fruit extract, leaf extracts of *Psidium guajava,* leaf extracts of Piper betel, leaf extracts of *Jatropha curcas etc.*

How the botanicals are beneficial in cut flower vase life?

Fruit extracts contain malic acid, citric acid and fructose and coconut water & milk contain auxins, gibberellins, cytokinins and sugar to improve the vase life of cut flowers. High polyphenols and anthocyanins content are act as antioxidants. They make the solution more acidic. They slow down the ethylene production also prevent the growth of microorganisms.

Essential oils

Essential oils also called volatiles are aromatic oil liquids extracted from various aromatic plant materials such as flowers, seeds, leaves, bark, wood, fruits and roots. It is used as odorants, flavorants, and pharmaceutical ingredients. Essential oil is safe and environmentally friendly natural plant product that has strong antimicrobial properties against some pathogens [18]. Due to expansion and establishment of the food, soft drinks, alcoholic drinks, pharmaceuticals and cosmetics industry and various chemical industries essential oil demand has been increasing worldwide. The amount of essential oils found in these plants can be anywhere from 0.01 per cent to 10 per cent of the total. Essential oils have great role in floriculture industry because of its environmental friendly properties and its antimicrobial properties in prolonging cut flowers freshness and post harvest durations.

Why use of essential oils in vase life of cut flowers?

Essential oils are organic natural substances that are not only safe but also eco-friendly. Essential oils because of their antibacterial, antifungal, antioxidant and anti-carcinogenic properties can be used as natural additives in many foods. Lavender oil, *Thyme* oil and *Geranium* oil are effective against particular bacteria and fungi. The levels of essential oils and their compounds are necessary to inhibit microbial growth in vase solution.

RESULTS

According to Sardoei *et al*. [19], post-harvest vase life longevity and maintaining good quality include major post-harvest practices in floriculture so as to make products deliver to customers with acceptable quality. Different preservatives have been used in various flower companies. Positive response of botanicals and essential oil addition to vase solution with respect to cut flower water up take, its relative fresh weight and freshness of flower has been reported. Longest time, petal water content and relative water content in vase life of *Lisianthus* cut flower with *Thyme* at 50 ppm and with *Zataria multiflora* 200 ppm and *Echinophora platyloba* 100 ppm essential oils reported. Therefore, one can easily understand that botanicals and essential oil from diversified aromatic and medicinal plants has been used in different flower production and post-harvest handling of cut flower that might be because of the antimicrobial properties of the plant extracts. This may be best alternative instead of chemical substances. Another finding on post-harvest vase life treatment of rose, gerbera, gladiolus, carnation, *Alstromeria*, tuberose and chrysanthemum cut flowers resulted as botanicals and essential oils.

Rose

Thakur *et al.* [20] noticed that the application of one ppm turmeric oil increased the vase life, fresh weight, water uptake, and 50% slow bud opening in rose cv. Poison. Higher fresh weight and water uptake in cut flowers have been known to influence continuity and higher rate of metabolic process that are required for maintenance of flower turgidity, freshness and enhanced vase life [21]. The retention in fresh weight was a result of higher total water uptake by the cut spikes owing to increased vase life and maintained cellular integrity. The maximum vase life (12.44 days), minimum microbial count (6.77 log 10 CFU/ml) and microbial growth rate (4.72 log 10 CFU/ml) were recorded with citric acid 300 mg/l in cut rose flower [22]. Shanan [23] observed that the maximum vase life (7.80 days), water uptake (0.88 ml/g), minimum bacteria count (5.30 CFU/ml) and fungi count (2.00 CFU/ml) with treatment of *Lavender* EO and minimum transpiration rate (0.35 ml/g) with *Geranium* EO in rose cv. Grand.

Mehraj [24] that sucrose with lemon juice solution is a common and effective preservative solution for cut roses which is able to extend the vase life of cut roses. Jitareerat *et al*. [25] studied the efficiency of plant extracts from various herbs (*Piper*, *Annona*, *Curcuma*, Tobacco and Galanda) to control microbes isolated from holding solution of rose. Extract concentrations of 0 (control), 1, 3, 5, 7 or 10 per cent (w/v) were

examined. *Piper* extract in all concentrations showed complete inhibition of microbial growth. Two herbal extracts 1 per cent *Piper* and 3 per cent *Annona*, were studied for micro-organisms growth in holding solution and maintenance the quality of cut rose at 20°c and 85 per cent RH. The results showed that 1 per cent *Piper* extract completely inhibited microbial growth in holding solution, delayed bent neck and ethylene production and maintained freshness of leaves. According to Nermeen [11] use of different concentrations especially 25 and 50 mg/l of lavender, geranium, cumin and anise essential oils emulsified in water showed promising prospects for prolonging the vase life of rose cut flowers , increasing their fresh weight for the first two days, increasing the water uptake and reducing both water loss and transpiration rate.

Chrysanthemum

Bidarigh [26] observed that the maximum vase life (15.73 days) with treatment of 0.3 % *Myrtus* EO, maximum water uptake (5.40 ml/g FW) with 0.3 % *Geranium* EO and minimum bacteria in vase solution (55.00 colonies per 10 ml agar) with treatment of 0.3 % *Eucalyptus* EO in chrysnthemum cut flowers. Bazaz *et al*. [27] found maximum vase life (14.71 days) and relative fresh weight (74.21g/stem) in treatment of *Thyme* EO @ 100 mg/l used in chrysanthemum cut flowers.

Dashtbany *et al*. [28] reported that the maximum vase life (18.41days), water absorption (5.74 ml/g FW) and dry matter (32.41 %) were achieved in 5 cm stem splitting + 10 % *Geranium* essential oil while the maximum fresh weight (20.06 g) was obtained in 5 cm stem splitting + 8 % *Geranium* extract compared to other treatments. Davood *et al*. [29] studied the effect of *Artemisia* oil on vase- life of cut chrysanthemum (*Dendranthema grandiflorum* L. cv. 'white'). The treatments comprised of *Artemisia* oils in four levels 0, 10, 30 and 50 per cent. Comparison of means showed the longest vase life and lowest fresh weight loss in 30 per cent *Artemisia* oil with ten days and 4.09 g respectively.

Carnation

Bayat *et al.* [11] reported the maximum vase life (16.4 days) and minimum colony count (121.00 CFU/ml) noted with treatment of lavender oil @ 150 mg/l whereas the maximum relative solution uptake (1.08 ml) and relative fresh weight (1.06 g) were obtained with the treatment of *Thyme* oil @ 50 mg/l. The maximum vase life (15.60 days & 16.80 days) cv. Farida and Madam, respectively and minimum reduction percentage of flower fresh weight (8 %) were observed with treatment of dill EO (50 mg/l) in carnation flowers [30]. Yeganeh Basiri *et al*. [31] concluded that 25 per cent rosemary was the best treatment and increased vase life of cut flowers until twenty four days in laboratory conditions. Observations indicated that rosemary treatments with its antimicrobial effect inhibited the growth of microorganisms in vase solution and with increasing water uptake considerably extended the vase life of cut flowers of carnation.

Gerbera

Kilic and Cetin [32] noted the maximum vase life (21.00 days) with treatment of sage extract (50 µl/100 ml) and the maximum water uptake (0.88 ml/day) with treatment of balm extract (50 µl/100 ml) in gerbera flowers. In addition, a positive effect of thyme essential oil was reported in post-harvest handling of gerbera cut flower longevity related to the concentration of 4000 mg/l of thymol. Solgi *et al.* [33] reported that the use of essential oils of *Zataria multiflora* and *Thymus vulgaris* as well as their active ingredients in the preservative solution increase the vase life of gerbera cut flowers. For instance, Nahrabadi *et al*. [34] reported that *Eucalyptus* and *Rosa damascena* essences and combination of them at 200 mg/l with 4% sucrose increased the vase life and some qualitative traits of *gerbera* cut flowers.

Anthurium

Agampodi and Jayavaradena [35] reported that the maximum vase life (20.70 days) and average solution uptake (1.56 ml/day/stem) were recorded with 50 % coconut water in anthurium cut flowers.

Gladiolus

As per the results obtained by Marandi *et al*. [16] the maximum vase life (20.00 days), fresh weight (85.10 %) and solution uptake (2.70 cm^3) when treatment containing ajowan EO (500 ppm) in gladiolus flowers. The role of *thyme*, *savory* and *ajowan* essential oils as alternative input to chemical substance for extending vase life of gladiolus cut flowers studied and essential oils recommended with regards to alternative to compounds containing silver and chemical preservatives. *Thyme* essential oil widely used in research works evaluating its effect on vase life of cut flowers. Hegazi and Gan [36] revealed that the maximum vase life (14.33 days), water uptake (220.00 ml) and minimum spike fresh water losses (34.52 %) while minimum microbial count (488.00 CFU/ml) and spike base rot (1.10 cm) were observed in application of clove oil @ 500 ppm in gladiolus flowers.

Tubrose

Lad [37] reported that the maximum vase life (11.30 days), fresh weight (198.40 g), solution uptake (40.43 ml) and opening of florets (27.63 %) were achieved in common salt @ 500 mg/l which was followed by coconut water @ 20 % in tuberose cut flower. Motaghayer and Ashari [38] reported that the maximum vase life (5.11 days) was recorded with citric acid 450 mg/l in tuberose cv. Gol Dorosht. Nair *et*

at. [39] used 25 per cent coconut tender nut water as a natural floral preservative in cut flowers. Tuberose flowers spikes cv. Double had a vase life of 13 days compared to the 6 days in the control. Thangaraj and Borah [40] investigated the effect of different levels of common salt (250 to 3000 ppm) on vase life of tuberose stems. The effects were positive up to 1000 ppm for per cent floret opening (80.55 per cent). 250 ppm for days to shriveling (5.00 days) and 1000 ppm for vase life (12.25 days).

Marousky [41] suggested the role of sucrose in floral preservative as an "anti-desiccant". He also reported that sucrose caused decrease in stomatal opening and thereby maintained fresh weight. Das and Barman [42] observed that the vase life of tuberose cv. Single was longer. When cut spike kept in 0.4 per cent sucrose solution. De and Barman [43] studied on the effect of s talk lengths (30, 45, 60, 75 and 100 cm), stage of harvest and different concentration of sucrose (0, 2, 4, 6, 8, 10 and 12 per cent) on cut spike of tuberose and they found that 75 cm floral stalk length, spike with creamy white buds and one floret opened and 8 per cent sucrose as holding solutions were beneficial for lengthening vase life and improving diameter of florets.

Alsroemeria

Babarabei *et al*. [14] reported that the maximum vase life (14.00 and 15.00 days) and flower diameter (25 mm) were recorded with 30 and 45 ml apple fruit extract concentration, respectively in cut alstroemeria cv. Balance. Furthermore, Babarabie *et al*. reported that *rosemary* and *peppermint* essential oils having higsh 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 of *Alstroemeria* cut flowers. The effect of different concentrations of ethanol (4, 7, 10 per cent), methanol (4, 7, 10 per cent), as pulse treatments and some essential oils (50 or 100mg/l) Pepper mint (*Mentha piperata* L.), thyme (*Thymus vulgaris* L.) and black cumin (*Bunium persicum* (Boiss).B. Fedtsch) on vase life of *Alstroemeria peruviana* were compared. The results showed that essential oils could extend the vase life. The greatest longevity of vase life was related to 50mg/l of thyme [44].

Narcissus

Shahi *et al.* [45] recorded the maximum vase life (30.33 days) and minimum unopened bud (6.94 %) with treatment of 4.00 ml/l sour orange extract whereas the maximum relative fresh weight (126.61 %) and water uptake (2.00 g) were noted with concentration of 2.5 ml/l sour orange extract in narcissus cut flower.

Lisianthus

The effect of some essential oils, citric acid, malic acid and nickel extended the vase life of lisianthus *(Eustoma grandiflorum* Mariachii. cv. Blue) flowers was studied by Mahsen *et al*. [46]. The treatments were distilled water, nickel (0, 1 and 2mM), essential oils of thyme (*Thymus vulgaris*), (50, 100 and 150 mg/l), citric acid (0, 100 and 150mg/l) and malic acid (0, 1.5 and 2.5 mM). Results showed that solution containing 2mM nickel + 2.5mM malic acid and 150mg/l essential oils of Thyme could increase flower longevity as compared to control.

DISCUSSION

The beauty of the cut flowers lies with the freshness of the flowers for longer time without losing its aesthetic value. Most of the cut flowers are highly perishable due to high respiration rate and excessive weight loss. Enhancement of vase life of cut flowers is an important area in horticultural research. The vase life of cut flowers is limited by some factors such as senescence, weight loss, decay & air emboli Many bacteria (*Pseudomonas, Enterobactor, Erwinia, Bacillus, Corynebacteria, Aeromonas, Acetinobacter & Flarobacterium sp*.), Fungi (*Botrytis cinerea, Mucor hiemalis, Pencillium, Rhizopus, Verticillium, Aspergillus & Alternaria sp*.) and Yeast (*Candida sp., Rhodolorula rubra & Saccharomyces sp*.) contaminate vase water. These microorganisms also secrete enzymes which dissolve the cell wall, causing blockage of xylem vessels. To prevent these microorganisms, floral preservatives are used in pulsing, vase and bud opening formulation to improve vase-life, size and colour of flowers. Among these factors decay caused by micro-organisms, which found in high level in a water and or sucrose solutions used by growers, wholesalers and consumers to hydrate the cut flowers, is one of the most important factors affect the vase life of cut flowers.

Mode of action of essential oils on bacteria

An important characteristic of essential oils and their components is their hydrophobicity, which enable them to partition the lipids of the bacterial cell wall and mitochondria, disturbing the cell structures and rendering them more permeable. Essential oils successfully inhibit microbial respiration and increase the plasma membrane permeability, which results in death of bacterial cells after massive ion leakage. Phenolic compound effect the microbial structure, causing swelling as a result of its increased permeability. Increases in cytoplasmic membrane permeability appear to be a consequence of the loss of the cellular pH gradient and decreased ATP levels resulting in the death of the cell. It also interferes with

membrane function (electron transport, nutrient uptake, protein, nucleic acid synthesis and enzyme activity).

Thus, active phenolic compounds might have several invasive targets which could lead to the inhibition of microorganisms. An alcohol potentially acts as protein denaturing agents and dehydrating agents. Terpens alter membrane properties and functions by increasing membrane permeability and fluidity. Aldehydes are known to possess powerful antimicrobial activity. It has been proposed that an aldehyde group conjugated to a carbon to carbon, double bond is a highly electronegative arrangement. Such electronegative compounds may interfere in biological processes involving electron transfer and react with vital nitrogen components, e.g. proteins and nucleic acids and therefore inhibit the growth of the microorganisms.

Osman *et al*. [47] reported the main components of essential oils of *Thymus argaeus* and were linalool, terpenol, linalooyl acetate and thymol. Anti-oxidant activity of extract was determined by radical-scavenging method. The anti-microbial activities of the extracts and essential oil showed inhibitory activities against thirteen bacteria and two yeasts.

CONCLUSION

Essential oil is extracted from aromatic and medicinal plants. India is a country rich in such plants diversity. Recently aromatic and medicinal plants got special attention national wise because of their botanicals and essential oil importance for various industrial uses. Performances of different plants were being studied among which varieties have been released and registered. On the other hand, different domestic and exotic companies engaged in essential oil distillation and marketing sector. Abyssinia essential oil private limited company, Arty herbal private limited company and Tabor essential oil private limited company are some of the companies working on herbs and essential oil businesses. As indicated in this review paper many authors reported as plant extracts are noble alternative for longevity and quality of many types of cut flowers. *Thyme*, *rosemary*, *geranium*, *coriander*, *Artemisia* and *mint* account some of the aromatic and medicinal plants whose essential oils were tested and resulted in positive responses in post-harvest treatment of cut flowers. Essential oil is being an alternative input in green houses that can reduce cost of importing materials substances that can be used for prolonging vase life of cut flowers. However, despite herbs for essential oil as well as flowers largely being produced in India, there is no research output and no information available concerning botanicals and essential oil utilization and its impacts on cut flowers vase life in the country. Therefore, the importance of essential oil for vase life longevity of cut flowers in flower industry has to be supported by national research system in collaboration with commercial growers in order to find out cost effective and environmentally friendly alternative essential oils preservatives.

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