# Evaluation of Commercial Viability of Eco-friendly Alternatives to Traditional Floral Foam and Their Effects on Vase Life of Five Species of Cut Flowers

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Keywords. floral design, floriculture, florist, sustainability

Abstract. **Increasingly, consumers are indicating that they would be willing to pay a premium for floral designs from a more sustainable floral provider. During the past several years, more environmentally sustainable floral foams and foam alternative media have been developed as an eco-friendly alternative to traditional floral foams comprised of phenol-formaldehyde plastics. Phenol-formaldehyde foam breaks down into microplastics, which ends up in landfills, soils, and waterways—including the planet's oceans—if not disposed of properly. Eco-friendly foam alternatives are made from natural materials such as basalt minerals and coconut (*Cocos nucifera*) fiber (coir). The objective of this study was to investigate eco-friendly floral substrates for their commercial viability in the floral industry by analyzing the vase life of five of the most commonly use cut flower species in traditional vs. eco-friendly foam alternatives. Flowers selected for the experiment included 'Freedom' rose (*Rosa* hybrid), 'Orange Queen' alstroemeria (*Alstroemeria* hybrid), 'Atlantis Yellow' chrysanthemum (*Dendranthema grandiflorum*), 'Pink Nelson' carnation (*Dianthus caryophyllus*), and 'Million Star' baby's breath (*Gypsophila paniculate*). The flowers were selected based on their importance to the floral industry with regard to their overall volume of use in floral arrangements and volume of production. The findings from this study indicate the traditional phenol-formaldehyde–based floral foam maintained vase life longer for a majority of the flowers tested when compared with basalt floral fiber medium and coir pouches. However, the basalt floral fiber medium maintained a vase life of more than 7 days for all flowers tested, indicating it is an adequate medium to use in retail floral design production. The coir pouch did not maintain the customer-expected vase life of 7 days for all but one of the cultivars tested. This indicates that coir pouches are generally not suitable for traditional everyday retail floral design use, but could potentially be acceptable for special occasion designs in which the consumer prefers or specifies a more sustainable approach and/or can accept a shorter vase life.**

Before the invention of floral foam, florists did their arranging straight into vases or pots of water using chicken wire or metal pins under the water line to secure the stems in place (Campbell 1888; Williams 1872). Additional mechanics, such as clumps of dampened moss fastened with string or wire to wooden laths, were common. In the past, florists often relied on materials that were in abundance in their immediate vicinity, such as sawdust from sawmills, pine (*Pinus* sp.) needles from nearby evergreen forests, and straw from farms, to secure stems and as media for design. Novelty floral designs occasionally used melons (Cucurbitaceae) as the container and moisture source (Campbell 1888; Williams 1872).

First created in the 1950s, floral foam, a phenol-formaldehyde–based foam, quickly became established as an essential tool in modern floral design. Floral foam enabled floral design to move in extraordinary directions as the process of arranging became simpler and faster (Smithers-Oasis 2023a). Phenol-formaldehyde foam is now used globally in the floral industry as a medium to support stems in floral arrangements while also acting as a water source. Research has found traditional phenol-formaldehyde foam breaks down into microplastics, which end up in landfills, soils, and waterways—including Earth's oceans—if not disposed of properly (Trestrail et al. 2019).

Recent studies have found that when phenol-formaldehyde microplastics enter a water ecosystem, marine life ingests fragments via grazing, shredding, or filter feeding (Trestrail et al. 2019). Once ingested, the polymer leaches toxic phenolic compounds, such as petroleum-based plastic pollutants, that eventually reach endocrine systems or the gills' oxygen exchange surfaces of marine life (Trestrail et al. 2019).

Increasingly, consumers are indicating they would be willing to pay a premium for floral designs created from a more sustainable floral provider (Etheredge et al. 2023). A recent study investigating consumer perceptions of sustainable environmental attributes incorporated into floral provider business models found that a majority of those surveyed were willing to pay up to 10% more for floral designs made from eco-friendlier floral providers that incorporate sustainable attributes in their business (Etheredge et al. 2023). In recent years there has been a renewed interest in historical floral techniques by modern-day floral designers as business models change to become more sustainable.

In the past several years, more environmentally sustainable floral foams and foam alternative media have been developed as an eco-friendly alternative to traditional floral foams comprised of phenol-formaldehyde plastics. Eco-friendly foam alternatives are comprised of natural materials such as basalt minerals and coconut (*Cocos nucifera*) fiber (coir). Basalt fiber floral foam is derived from natural volcanic basalt rock with a bio-based binder and is reusable for growing plants from cuttings and seeds. Basalt foam resembles traditional phenol-formaldehyde foam in shape and size, can be cut into smaller segments, and is soaked in water before use in the same manner phenol-formaldehyde foam is soaked.

Received for publication 24 Jul 2023. Accepted for publication 22 Sep 2023.

Published online 8 Nov 2023.

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This study was facilitated by an American Floral Endowment Educational Grant.

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https://doi.org/10.21273/HORTTECH05292-23

**Units**

| To convert U.S. to SI, multiply by | U.S. unit | SI unit | To convert SI to U.S., multiply by |
|---|---|---|---|
| 2.54 | inch(es) | cm | 0.3937 |
| (°F − 32) ÷ 1.8 | °F | °C | (°C × 1.8) + 32 |

Although basalt-based floral foam is not suitable for home composting, it is marine safe because it breaks down into natural materials over time (Smithers-Oasis 2023b).

Coir floral pouches are an expandable floral pouch medium derived from natural components and finely shredded organic coir. The coir mixture is encased in a membrane that is made using plant-based starches. Coir floral pouches are environmentally friendly, biodegradable, and compostable, allowing the medium to avoid entry into landfills (OshunPouch 2023).

Eco-friendly floral media present the best, currently available, sustainable alternatives to traditional phenol-formaldehyde–based plastic foam. However, as a result of the newness of these products, no research has been conducted on how long cut flowers will last in these novel media compared with traditionally used phenol-formaldehyde foam.

Vase life is the amount of time cut flowers stay alive and remain visibly pleasing after being arranged in a floral design. Although the amount of time cut flowers can remain looking fresh in a floral arrangement varies greatly depending on the cut flower cultivar, typically, customers expect flowers within a floral arrangement to last at least 7 d (Ranwala 2009). Vase life can vary depending on the type of floral arrangement being created. Some designs created for special events, such as for weddings, are only expected to last for 12 to 24 h (Faloon 2021).

The objective of this study was to investigate eco-friendly floral substrates for their commercial viability in the floral industry by analyzing the vase life of five of the most commonly use cut flower species in traditional vs. eco-friendly foam alternatives.

## Materials and methods

**Floral media preparation.** The floral media compared in the study were phenol-formaldehyde floral foam (Oasis Standard Floral Foam Maxlife; Oasis Floral Products, Kent, OH, USA), basalt fiber foam (FibreFloral Design Media, Oasis Floral Products), and coir floral pouches (OshunPouch; New Age Floral, Sudbury, MA, USA). Floral media were soaked in room-temperature tap water (pH, 7.58), according to each of their instructional directions, in a clean stainless-steel sink until fully saturated. Floral media were placed into size-appropriate floral containers. The phenol-formaldehyde and basalt fiber foams were placed in 10.5-inch-long × 4.5-inch-wide × 2-inch-high plastic containers. The coir pouch was placed in round 6-inch-diameter × 2-inch-high plastic containers. About 1 inch of standing tap water always remained in each container to ensure all floral media remained properly hydrated.

**Flowers used.** Flowers were received from a commercial floral wholesale provider within 2 d of harvest, in Mar 2023, from a South American commercial cut flower farm. The room in which the experiment took place had the air temperature set at 68 °F, with an average 11.4 $\mu mol \cdot m^{-2} \cdot s^{-1}$ light available for 12 $h \cdot d^{-1}$ at 50% to 60% relative humidity. Flowers selected for the experiment included 'Freedom' rose (*Rosa* hybrid), 'Orange Queen' alstroemeria (*Alstroemeria* hybrid), 'Atlantis Yellow' chrysanthemum (*Dendranthema grandiflorum*), 'Pink Nelson' carnation (*Dianthus caryophyllus*), and 'Million Star' baby's breath (*Gypsophila paniculata*). The flower species were selected based on their importance to the floral industry as a result of their overall volume of use in floral arrangements and volume of production (Loyola et al. 2019).

Stems of each species were cut to a uniform length of ~12 inches. Cut stems were inserted ~2 inches into each floral medium.

**Experimental design.** A comparative analysis experimental design approach was taken for this study. Five stems of the same flower species were placed into the same container of floral medium for each of the five flower species and three media. Ten containers of floral media for each medium type and 50 flowers of each species were used in each replication, for a total of three replications. The experimental design was based on past research investigating the vase life of cut flowers (Elgimabi 2011; Kalinowski et al. 2022). The experimental design of past studies was modified to include floral media for the purposes of this study.

**Experiment monitoring and evaluation.** Flower quality was monitored every 12 h and evaluated using methods from past studies investigating cut flower vase life longevity (Aalifar et al. 2020; Clark et al. 2010; Jones and Hill 1993). Stems were ended when 50% of the flower wilted or petals had dropped, had turned brown or discolored, had neck bending or drooping; and/or evidenced drying, general stem decline, or mold growth of any kind for each flower species (Aalifar et al. 2020; Clark et al. 2010; Jones and Hill 1993; Kalinowski et al. 2022).

Water levels for each container were checked and replenished daily, at the same time flower quality was monitored. The experiment took place on the Mississippi State University (Mississippi State, MS, USA) campus in the floral design laboratory under the same environmental conditions.

**Data analysis.** Data were analyzed using analysis of variance tests, post hoc least significant difference (LSD) tests, Duncan's multiple range test, and frequency statistics.

## Results and discussion

Analysis of variance tests indicated that the type of floral media used in each design had a significant impact on the vase life of all five cut flower species tested. Post hoc LSD, Duncan's multiple range test, and frequency statistics were used to determine where the differences occurred (Table 1).

**Findings for rose.** A significant difference was found among all three floral media (Table 1). 'Freedom' roses remained alive the longest in phenol-formaldehyde foam (average, 9.5 d) compared with basalt floral fiber (average, 8.8 d) and coir pouches (average, 6.6 d). Previous research found 'Freedom' roses to have an average vase life of 8.5 to 13.1 d in water free of floral preservatives (Moody et al. 2014; Ranwala 2022). As the expected vase life by most customers is 7 d, both the phenol-formaldehyde foam and basalt fiber foam were found to be adequate media for use in retail floral arrangements in which roses are used (Ranwala 2009).

**Findings for carnation.** Differences were found among the three media (Table 1). 'Pink Nelson' carnations remained alive the longest in phenol-formaldehyde foam (average, 18.0 d) compared with basalt floral fiber (average, 16.6 d) and coir pouches (average, 11.2 d). Previous research has found carnations to have an average vase life of between 13.0 and 20.7 d in water free of floral preservatives (Dehestani-Ardakani et al. 2022; Onozaki 2018). All three media were found to provide substantially greater than the 7-d

Table 1. Analysis of variance and frequency statistics for five cut flower species tested within each of three floral media.[i]

| Species and medium | N | Minimum vase life (d) | Maximum vase life (d) | Avg vase life (d) | Avg vase life | | |
|---|---|---|---|---|---|---|---|
| | | | | | df | F value | P value |
| Freedom rose | | | | | 2 | 193.51 | 0.001* |
| Phenol foam | 150 | 6.3 a[ii] | 12.6 a | 9.5 a | | | |
| Basalt fiber foam | 150 | 6.0 a | 11.6 a | 8.8 b | | | |
| Coir pouch | 150 | 3.6 b | 9.3 b | 6.6 c | | | |
| Pink Nelson carnation | | | | | 2 | 159.60 | 0.001* |
| Phenol foam | 150 | 9.0 a | 21.0 a | 18.0 a | | | |
| Basalt fiber foam | 150 | 10.3 a | 20.6 a | 16.6 b | | | |
| Coir pouch | 150 | 5.0 b | 20 a | 11.28 c | | | |
| Orange Queen alstroemeria | | | | | 2 | 1723.77 | 0.001* |
| Phenol foam | 150 | 12.0 a | 13.0 a | 12.2 a | | | |
| Basalt fiber foam | 150 | 7.0 a | 14.0 a | 12.7 a | | | |
| Coir pouch | 150 | 1.0 b | 13.0 a | 2.6 b | | | |
| Atlantis Yellow chrysanthemum | | | | | 2 | 279.54 | 0.001* |
| Phenol foam | 150 | 10.6 a | 16.3 a | 13.4 a | | | |
| Basalt fiber foam | 150 | 5.6 b | 17.6 ab | 12.8 b | | | |
| Coir pouch | 150 | 3.0 c | 14.6 ac | 6.3 c | | | |
| Million Star baby's breath | | | | | 2 | 236.90 | 0.001* |
| Phenol foam | 150 | 5.0 a | 15.3 a | 11.5 a | | | |
| Basalt fiber foam | 150 | 5.6 a | 14.0 b | 9.8 b | | | |
| Coir pouch | 150 | 4.0 a | 8.6 c | 6.7 c | | | |

[i] Average over three replications.
[ii] Means followed by the same letter are not significantly different at $P \leq 0.05$ using Duncan's multiple range test.
* Significant at $P \leq 0.05$.

minimum retail vase life for carnations (Ranwala 2009).

**Findings for alstroemeria.** A difference was found when comparing the coir pouch vase life (average, 2.6 d) to floral fiber (average, 12.7 d) and phenol-formaldehyde foam (average, 12.2 d) (Table 1). No difference was found in vase life between the basalt and phenol-formaldehyde foam floral fiber. Past research found alstroemeria to have an average vase life to be between 11.8 and 13.3 d in water free of floral preservatives (Kabari and Solimandarabi 2019; Zencirkiran and Mengüç 2003). Both basalt fiber foam and phenol-formaldehyde foam were found to be adequate media for use in retail floral arrangements in which alstroemeria are used (Ranwala 2009). The researchers observed the relatively quick decline of alstroemeria in the coir pouches was a result of wilting, which appeared to be from the flowers' inability to take in enough water to stay properly hydrated.

**Findings for chrysanthemum.** Analysis of variance tests indicated a difference among all media types (Table 1). 'Atlantis Yellow' chrysanthemum remained alive the longest in phenol-formaldehyde foam (average, 13.4 d) compared with basalt floral foam (average, 12.8 d) and coir pouches (average, 6.3 d). Past research found the vase life for chrysanthemums varies depending on the cultivar. Chrysanthemums can have a vase life between 4 and 16 d, depending on the cultivar when placed in water free of floral preservatives (Baskaran et al. 2010). The phenol-formaldehyde foam and basalt fiber foam were found to be adequate media for use in retail floral arrangements in which chrysanthemum are used (Ranwala 2009).

**Findings for baby's breath.** Differences were found among all three media types (Table 1). 'Million Star' baby's breath remained alive the longest in phenol-formaldehyde foam (average, 11.5 d) compared with basalt floral fiber (average, 9.8 d) and coir pouches (average, 6.7 d). Past research found baby's breath had an average vase life of 10.9 d in water free of floral preservatives (Khenizy et al. 2014). The phenol-formaldehyde foam and basalt fiber foam were found to be adequate media for use in retail floral arrangements in which baby's breath are used (Ranwala 2009).

## Conclusion

The findings from this study indicate the traditional phenol-formaldehyde–based floral foam maintained vase life longer for a majority of the flowers tested compared with basalt floral fiber medium and coir pouches. However, the basalt floral fiber medium maintained a vase life of more than 7 d for all flowers tested, indicating basalt floral fiber is an adequate medium in which retail floral designs can be designed (Ranwala 2009). The coir pouch did not maintain the customer-expected vase life of 7 d for all but 'Pink Nelson' carnations. Although 'Pink Nelson' carnations maintained an average vase life of 11.2 d in the coir pouch, observations made by the researchers noted that, although the 'Pink Nelson' carnations within the coir pouch opened, they did not appear to open as fully compared with the carnations placed in the other media. This indicates that coir pouches are not suitable for traditional everyday retail floral design use. However, many special floral events, such as weddings, only require some floral arrangements to remain alive for 12 to 24 h (Faloon 2021). The results from this study indicate that coir pouches are suited more adequately for short-term special-event floral design work. The coir pouches underperformed compared with the other media, possibly because the cut flowers were unable to remain properly hydrated as a result of their stems becoming blocked or clogged with the fine particles of the shredded coir mixture, hindering

the flow of water through the flowers' vascular system.

Additional research investigating other floral species commonly used and specialty cut-flower cultivars in basalt floral fiber and coir pouches is recommended. Also, research investigating the cause for early flower decline in coir pouches compared with other floral media is suggested.

## References cited


Aalifar M, Aliniaeifard S, Arab M, Mehrjerdi MZ, Daylami SD, Serek M, Woltering E, Li T. 2020. Blue light improves vase life of carnation cut flowers through its effect on the antioxidant defense system. Front Plant Sci. 11:511. https://doi.org/10.3389/fpls.2020.00511.

Baskaran V, Jayanthi R, Janakiram T, Abirami K. 2010. Evaluation of post harvest quality of some cultivars of chrysanthemum. J Hortic Sci. 5(1):81–83. https://doi.org/10.24154/jhs.v5i1.510.

Campbell E. 1888. Practical hints on floral work, p 104150. In: Blanc A, McFarland JH (eds). Floral designs. Series I. A handbook for cut-flower workers and florists. A. Blanc and J.H. McFarland Publishing, Philadelphia, PA, USA.

Clark EMR, Dole JM, Carlson AS, Moody EP, McCall IF, Fanelli FL, Fonteno WC. 2010. Vase life of new cut flower cultivars. HortTechnology. 20(6):1016–1025. https://doi.org/10.21273/HORTTECH.20.6.1016.

Dehestani-Ardakani M, Gholamnezhad J, Alizadeha S, Meftahizadeh H, Ghorbanpourc M. 2022. Salicylic acid and herbal extracts prolong vase life and improve quality of carnation (*Dianthus caryophyllus* L.) flowers. S Afr J Bot. 150:1192–1204. https://doi.org/10.1016/j.sajb.2022.09.028.

Elgimabi ME. 2011. Vase life extension of rose cut flowers (*Rosa hybrida*) as influenced by silver and sucrose pulsing. Am J Agric Biol Sci. 6(1):128–133. https://doi.org/10.3844/ajabssp.2011.128.133.

Etheredge CL, DelPrince J, Waliczek TM. 2023. US consumer perceptions & willingness to pay for sustainable environmental practices in the floral industry. https://floralmarketingfund.org/product/sustainable-practices/. [accessed 7 Jul 2023].

Faloon S. 2021. Making a wedding bouquet and keeping it fresh. https://www.ehow.com/how_7734796_making-wedding-bouquet-keeping-fresh.html. [accessed 14 Jul 2023].

Jones RB, Hill M. 1993. The effect of germicides on the longevity of cut flowers. J Am Soc Hortic Sci. 118(3):350–354. https://doi.org/10.21273/JASHS.118.3.350.

Kabari SFM, Solimandarabi MJ. 2019. Improving alstroemeria vase life by plant extracts and 8-hydroxyquinoline sulfate. J Ornam Plants. 9(1):1–11. https://doi.org/20.1001.1.22516433.2019.9.1.1.4.

Kalinowski J, Moody EP, Dole JM. 2022. Improving hydration and vase life of cut zinnia. Sci Hortic. 293:110661. https://doi.org/10.1016/j.scienta.2021.110661.

Khenizy AM, Abd El-Moneim AM, Abdel-Fattah GH. 2014. Effects of natural extracts on vase life of gypsophila cut flowers. Sci J Flowers Ornam Plants. 1(1):1–16. https://doi.org/10.21608/SJFOP.2014.4000.

Loyola CE, Dole JM, Dunning R. 2019. South and Central America cut flower production and postharvest survey. HortTechnology. 29(6):898–905. https://doi.org/10.21273/HORTTECH04484-19.

Moody EP, Dole JM, Barnes J. 2014. Refining postharvest handling procedures increased cut rose vase life. HortTechnology. 24(6):676–685. https://doi.org/10.21273/HORTTECH.24.6.676.

Onozaki T. 2018. Breeding of carnations (*Dianthus caryophyllus* L.) for long vase life. Breed Sci. 68(1):3–13. https://doi.org/10.1270/jsbbs.17091.

OshunPouch. 2023. What is OshunPouch made of? https://oshunpouch.com/. [accessed 18 May 2023].

Ranwala A. 2009. How to conduct fresh cut flower vase life experiments. Floralife. 11(9):1–2.

Ranwala A. 2022. Vase life study results of cut roses with flower food. https://floralife.com/2022/01/26/vase-life-study-results-of-cut-roses-with-flower-food/. [accessed 15 Jul 2023].

Smithers-Oasis. 2023a. About us. https://www.smithersoasis.com/about/. [accessed 18 May 2023].

Smithers-Oasis. 2023b. FibreFloral design media safety data sheet. https://oasisfloral.com.au/wpcontent/uploads/2021/12/FibreFloralTM_Design_Media_SDS.pdf. [accessed 18 May 2023].

Trestrail C, Walpitagama M, Hedges C, Truskewycz A, Miranda A, Wlodkowic D, Shimeta J, Nugegoda D. 2019. Foaming at the mouth: Ingestion of floral foam microplastics by aquatic animals. Sci Total Environ. 705:1–13. https://doi.org/10.1016/j.scitotenv.2019.135826.

Williams H. 1872. Window gardening (4th ed). Henry T. William Publisher, New York, NY, USA.

Zencirkiran M, Mengüç A. 2003. Cold storage of *Alstroemeria pelegrina* 'Ostara'. N Z J Crop Hortic Sci. 31(3):255–259. https://doi.org/10.1080/01140671.2003.9514259.