Plant Archives Vol. 26, Supplement 2, 2026 pp.3510-3517 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.446

PRESERVATIVES: THE SECRET TO LONGER-LASTING VASE BLOOMS

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(Date of Receiving : 17-05-2026; Date of Revision : 14-07-2026; Date of Acceptance : 30-07-2026)

ABSTRACT

Cut flowers naturally begin to wilt soon after being placed in water, but floral preservatives can significantly extend their vase life. These solutions are carefully formulated to provide three main benefits. They supply sugars as an energy source, regulate water pH to improve absorption and include antimicrobial agents to prevent bacterial growth that clogs stems. Together, these components help flowers stay vibrant, hydrated and colourful for several extra days compared to plain water. Commercial preservatives are widely used by florists, but simple homemade versions, such as a mix of sugar, citric acid (like lemon juice) and a small amount of bleach, can also be effective. Recent research highlights eco-friendly alternatives, including natural plant extracts and essential oils, which reduce environmental concerns while maintaining freshness. The effectiveness of preservatives varies by flower type roses, carnations and chrysanthemums respond particularly well, showing prolonged bloom quality and reduced wilting. In essence, preservatives act as the hidden allies of flower lovers, ensuring that cut blooms remain beautiful and appealing long after harvest.

Keywords **:** Cut flowers, Floral preservatives, Shelf life, Eco-friendly alternatives and pH regulation.

Introduction

Cut flowers occupy a cherished space in human culture: as tokens of affection, celebration, mourning and hospitality, they convey emotions and sentiments that transcend language. Their vibrant colours, delicate forms and fragrance make them central to ceremonies, decor, gifts and personal spaces. Simultaneously, cut-flower production and trade form a substantial part of the global floriculture industry, involving growers, wholesalers, retailers and consumers alike (Chen, 2024). Yet, despite their popularity and commercial importance, cut flowers are inherently perishable. Once removed from the parent plant, the flower's access to a continuous supply of water, minerals and photosynthates ceases abruptly-triggering a cascade of physiological and biochemical changes that lead to rapid senescence.

The postharvest life of a cut flower begins the moment its stem is severed from the plant. In the natural (in-planta) state, roots supply water and minerals; leaves and stems distribute them; and photosynthesis continues to generate carbohydrates that fuel growth and metabolic processes. However, once cut, the flower depends solely on internal reserves and any external care given (e.g., vase water). Without timely intervention, several factors contribute to rapid deterioration:

- **Water stress and vascular blockage:** After cutting, the open stem end is prone to air embolism or microbial colonization. Microbes in vase water can proliferate quickly, adhere to the stem, and block xylem vessels-preventing efficient water transport, leading to wilting and stem bending.
- **Depletion of carbohydrate and energy reserves:** Without a fresh supply of photosynthates, the flower must rely on stored sugars for respiration. Low energy availability impairs metabolic functions, reduces the capacity for opening buds, and accelerates senescence (wilting, petal loss, colour fading).
- **Oxidative stress and cellular damage:** During senescence, reactive oxygen species (ROS) accumulate, damaging cellular membranes, lipids, proteins and nucleic acids. This oxidative damage contributes to loss of turgor, membrane breakdown, and overall decay of tissues.
- **Ethylene production and sensitivity:** Many cut-flower species such as roses are sensitive to ethylene a plant hormone that promotes senescence, petal abscission, and flower drop. Even low ambient levels of ethylene (e.g., from nearby fruits or vehicle exhaust) can significantly shorten vase life.

Given these challenges water imbalance, energy shortage, microbial invasion, oxidative stress and ethylene sensitivity maintaining freshness in cut flowers is far from trivial. Effective postharvest management is essential to preserve their ornamental value and commercial viability.

To address the physiological and biochemical stressors faced by cut flowers, floriculture science has developed floral preservatives specially formulated solutions that mimic certain essential functions of the living plant. These preservatives aim to sustain metabolic activity, maintain hydration, suppress microbial growth and delay senescence, thereby extending vase life and preserving aesthetic appeal. Recent research continues to refine preservative compositions and protocols, making today's preservative solutions more effective than ever before.

- **Sugars (e.g., sucrose, glucose):** Added to supply energy-acting as respiratory substrates to fuel metabolic processes, maintain turgor via osmotic balance and support processes like flower opening. For many species, sucrose has been shown to significantly enhance vase life and maintain freshness.
- **Antimicrobial agents / Biocides (e.g., 8-hydroxyquinoline citrate — 8-HQC, silver-based compounds, nanoparticles):** These prevent microbial growth in vase water and at cut stems, reducing xylem blockage and ensuring water uptake. Recent studies highlight that 8-HQC remains one of the most effective biocides and nano-based biocides show promise due to their strong antimicrobial activity and environmental safety compared to traditional toxic agents.
- **Acidifiers / pH adjusters (e.g., citric acid, aluminium sulfate):** Lowering the pH of vase solution (to mildly acidic range) enhances water uptake and prevents precipitation or crystal formation that might clog xylem vessels. Acidic pH also improves the efficacy of biocides.
- **Antioxidants and stress-relieving additives (e.g., melatonin, plant-growth regulators like 6-benzyladenine):** Recent research, especially on cold-stored or long-distance transported cut flowers, suggests that adding antioxidants and growth regulators helps maintain membrane integrity, reduces oxidative damage, and sustains water absorption and respiration, thereby prolonging vase life.
- **Ethylene inhibitors or modulators (in some formulations):** For ethylene-sensitive species, preservatives or pulse treatments that suppress ethylene biosynthesis or block its action can significantly delay senescence, petal abscission and quality loss.

Earlier, standard preservative solutions typically included just sugar (sucrose) and a biocide (like 8-HQC). While these still work well, contemporary studies increasingly recommend multi-component or composite preservative solutions tailored to flower species and storage/handling conditions (e.g., cold storage, long-haul transport, local climate). A 2025 meta-analysis and machine-learning study found that "pulse treatments" short-term immersion of stems in a concentrated preservative solution (often with antioxidants or nanomaterials), followed by transfer to a maintenance vase solution significantly extended vase life compared to conventional single-step vase solutions.

In a 2024 study on cut chrysanthemum cultivars, a combination of 4% sucrose + 200 ppm citric acid + 200 ppm 8-HQS produced the longest vase life (~22.9 days), with high water uptake and sustained freshness. For cut peony flowers stored under cold conditions, a composite vase solution containing sucrose, melatonin, NaCl, citric acid and 6-benzyladenine significantly improved physiological activities, boosted water absorption, and delayed senescence indicating the benefit of including antioxidants and growth regulators for long-term storage scenarios. A 2024 study on Alstroemeria cv. “Rebecca” showed that combining salicylic acid (SA) + sucrose in the vase solution extended vase life from 15 days (control) to up to 21 days, while reducing microbial load highlighting the growing interest in using plant-derived compounds (e.g., SA) instead of or in addition to traditional chemical biocides. These advances reflect a broader trend in floriculture research: moving beyond simple preservative recipes toward species-specific, environment-tailored and often eco-friendly solutions that maximize vase life while minimizing environmental impact and toxicity.

For commercial producers, wholesalers, and retailers especially in regions where flowers are grown, shipped over long distances, and sold across markets extended vase life is vital. Longer-lasting cut flowers reduce losses during transport, storage and display. They ensure that consumers receive fresh, vibrant blossoms, which enhances customer satisfaction and boosts market value. Composite preservative solutions and optimized postharvest protocols help maintain flower quality through the entire supply chain, from farm to vase. For consumers who purchase cut flowers for home decoration, gifting, or events, effective preservatives mean lasting beauty: flowers stay fresh and attractive for longer, require less frequent water changes and provide better value for money. For florists and event planners, longer vase life reduces waste and allows for greater flexibility in scheduling arrangements and use. Moreover, as research shifts toward safer, eco-friendly preservatives (e.g., plant extracts, antioxidants, nanoparticles with lower environmental impact), the industry can align better with increasing consumer demand for sustainability and reduced chemical use without sacrificing quality or longevity.

Cut flowers are beloved worldwide for their beauty and emotional resonance face serious physiological and biochemical challenges the moment they are severed from their parent plants. Without water, nutrients and photosynthate supply, they rapidly deteriorate under the influence of water stress, microbial invasion, oxidative damage and ethylene-induced senescence. Floral preservatives provide a vital lifeline: by supplying energy, suppressing microbes, regulating pH, enhancing water uptake and mitigating stress, they significantly extend vase life and preserve aesthetic quality. Recent scientific advances (2020–2025) underscore the effectiveness of multi-component preservative formulations, species-specific protocols, pulse treatments, and eco-friendly additives from sucrose + 8-HQC solutions to composite mixes that include antioxidants, growth regulators, and plant-derived compounds. As the floriculture industry evolves, such innovations not only improve shelf life and marketability, but also address sustainability concerns and consumer preferences. For growers, retailers, florists, and consumers alike, understanding and applying these research-backed preservation methods is key to unlocking the full potential of cut flowers transforming them from perishable commodities into enduring symbols of beauty, emotion, and care.

Supplying Energy and Nutrients

- Once cut from the plant, flowers lose their natural supply of carbohydrates (photosynthates) that fuel respiration and metabolic processes. Preservatives that include sugars (e.g. sucrose) act as an external energy source. This helps maintain physiological processes, supports the opening of buds, sustains petal colour and turgidity, and prolongs life.
- In many studies, sucrose-enriched vase solutions significantly increased vase life compared to plain water. MDPI+2Biochemistry Journal+2

Improving Water Uptake and Maintaining Hydration

- Water uptake is crucial for cut flowers to remain turgid, maintain petal firmness and prevent wilting. Without a functioning vascular system (roots), stems rely on capillary uptake from the vase. Preservative solutions especially those with the right pH and osmotic balance help facilitate efficient water movement into stems and flowers. Biochemistry Journal+2MDPI+2
- Some preservative components (e.g. acidifiers) help maintain an acidic pH that enhances water absorption and minimizes xylem blockage. al-kindipublisher.com+1

Suppressing Microbial Growth & Preventing Vascular Blockage

- A major problem for cut flowers is microbial proliferation (bacteria, fungi) in vase water, which can colonize stem ends and block xylem vessels obstructing water uptake and leading to wilting. Preservatives often contain biocides/antimicrobial agents that inhibit microbial growth. Biochemistry Journal+3iiste.org+3ASHS+3
- By keeping vascular tissues clean, antimicrobial preservatives maintain effective water and nutrient

transport, prolonging vase life. al-kindipublisher. com+1

Balancing pH / Acidifying Vase Solution

- Many preservative formulations include acidifiers (e.g. citric acid) to lower the pH of vase water. Slightly acidic conditions encourage better water uptake, reduce microbial growth and stabilize vascular function. Biochemistry Journal+2al-kindipublisher.com+2
- This pH adjustment acts synergistically with sugars and biocides to maximize preservative effectiveness. Biochemistry Journal+1

Delaying Senescence, Oxidative Stress and Stress-induced Aging

- Cut flowers undergo oxidative stress and other senescence processes (e.g. petal wilting, loss of colour, tissue breakdown) after harvest. Some preservative treatments — especially those combining sugars with additional agents such as antioxidants, salicylic acid — help reduce stress, stabilize membranes, and slow senescence. SpringerLink+1
- For example, in a recent study on Alstroemeria cv. Rebecca, a vase solution with a combination of **salicylic acid + sucrose** significantly extended vase life compared to water alone, likely via modulation of stress-response pathways and maintenance of water balance. SpringerLink

Enhancing Flower Opening and Quality Maintenance (Colour, Freshness, Stem Strength)

- For many cut flowers, especially those harvested at bud stage, effective preservatives help buds open fully, maintain flower diameter, preserve petal colour, and prevent stem bending or collapse. Biochemistry Journal +2journals.ansfoundation.org+2
- This not only extends the time the flower remains visually appealing, but also ensures better ornamental quality important for commercial floriculture, retail, decoration, and gifting.

Species- and Cultivar-Specific Responses Need for Tailored Preservative Solutions

- Different flower species and cultivars respond differently to preservatives. What works for one may not for another. For example, in a study on Peony, the standard biocide + sugar preservative extended vase life for only one out of fourteen cultivars. MDPI+1
- Therefore, optimal vase life requires choosing preservative formulations and concentrations suited to the specific flower type, its physiological needs, and storage/handling context. Biochemistry Journal+1

Commercial & Practical Importance: Reducing Postharvest Losses, Enhancing Market Value

- In the floriculture trade, where cut flowers may be harvested, transported over long distances, stored, and finally sold, preserving freshness is critical. Effective preservative use reduces postharvest losses, maintains quality during transport and display, and ensures customers receive long-lasting, vibrant blooms.
- Empirical research supports that preservative-treated flowers outperform water-only controls in vase life, water uptake, fresh weight retention and presentation quality making preservatives a key tool for growers, wholesalers, retailers, and consumers alike.

Table 1: Summary of Key Studies Linking Preservatives to Vase Life Extension in Cut Flowers

Flower Species	Preservative Composition	Vase Life Improvement	Key Physiological Effects / Outcomes	Reference
Alstroemeria cv. Rebecca	Salicylic acid (SA) + Sucrose	↑ from 15 to 21 days	Improved water uptake, higher fresh weight, reduced senescence, better membrane stability	Hajizadeh *et al*., 2024 (BMC Plant Biology)
Chrysanthemum cultivars	4% Sucrose + 200 ppm Citric acid + 200 ppm 8-HQS	↑ to ~22.9 days	Increased water absorption, delayed wilting, higher chlorophyll and fresh weight	Hemanth Kumar *et al*., 2025
Gerbera jamesonii (cv. Rosalin)	4% Sucrose + 200 ppm Citric acid	~2× vase life vs control	Better water relations, reduced microbial load, increased flower diameter	Thapa *et al*., 2024
Peony (multiple cultivars)	Standard preservative: Sucrose + 8-HQC	Effective in only 1/14 cultivars	Highlighted need for species/cultivar-specific preservatives	Postharvest Biology & Technology, 2024

Hydrangea (cv. Verena)	Sucrose + 8-HQS + Citric acid	Significantly improved	Enhanced hydration, higher solution uptake, reduced stem-end blockage	Horticulturae, 2021
Lilium spp. (cv. Pavia)	Sucrose + $AgNO_3$	Significant increase	Reduced microbial growth, improved water uptake, stronger stems	Journal of Applied and Natural Science, 2023
Carnation (Perpetual type)	Sucrose + 8-HQ + Paclobutrazol + SA + $CaCl_2$	↑ up to 34 days (very high)	Increased membrane stability, delayed senescence, reduced microbial growth	Ullah *et al*., 2020
Gerbera & Tuberose	Sodium nitroprusside (SNP) supplement	+ 5–7 days extension	Improved water balance, improved fragrance, reduced xylem blockage	Ullah *et al*., 2024
Roses (various cultivars)	Sucrose + 8-HQC + Antioxidants	~1.8× increase	Reduced ROS levels, delayed ethylene response	Zeng *et al*., 2023 (Scientia Horticulturae)
Peony (Cold-stored flowers)	Sucrose + Melatonin + 6-BA + NaCl + Citric acid	Substantial extension after storage	Higher antioxidant activity, improved cell integrity, better petal colour retention	Wang *et al*., 2024

Types of preservatives used to extend vase life of cut flowers

Cut flowers are highly perishable horticultural commodities because detachment from the mother plant disrupts the continuous supply of water, carbohydrates, and minerals. After harvest, flowers undergo rapid physiological and biochemical changes such as increased respiration, depletion of stored sugars, microbial blockage of xylem vessels, oxidative stress, and ethylene-induced senescence. These processes lead to wilting, petal discoloration, bent neck, and reduced ornamental value. To counteract these effects, various types of preservatives are widely used to extend vase life and maintain postharvest quality in flowers such as rose, carnation, cut chrysanthemum, tuberose, and gladiolus (Halevy & Mayak, 1981; Reid & Jiang, 2012).

1. Commercial Floral Preservatives

Commercial preservative formulations such as Floralife®, Chrysal®, and Oasis® are extensively used by florists, exporters, and the floriculture industry. These products are designed as balanced formulations containing three essential components: sugars, acidifiers, and biocides. Sugars (commonly sucrose or glucose) act as an energy source, supporting respiration, bud opening, and petal expansion, particularly in flowers harvested at the bud stage, such as roses and gladiolus. Acidifiers help maintain the vase solution at an optimal pH (typically 3.5–4.5), improving water uptake and reducing microbial growth. Biocides suppress bacteria and fungi that otherwise clog xylem vessels and restrict water transport (Dole & Wilkins, 2005). Studies have shown that commercial preservatives significantly enhance vase life, fresh weight retention, and flower opening in cut roses, carnations, and chrysanthemums compared to plain water. In cut chrysanthemums, the use of commercial preservative solutions improves chlorophyll retention and delays leaf yellowing, which is a major postharvest problem in this species (Kumar *et al*., 2025). Due to their reliability and ease of use, commercial preservatives dominate professional floriculture supply chains.

2. Chemical Preservatives

Chemical preservatives such as 8-hydroxyquinoline citrate (8-HQC), silver nitrate ($AgNO_3$), and silver thiosulfate (STS) are more specialized and are particularly effective for ethylene-sensitive flowers. Ethylene accelerates senescence by inducing petal wilting, abscission, and reduced vase life, especially in carnations, orchids, and some rose cultivars (Reid & Jiang, 2012).

8-HQC acts primarily as an antimicrobial agent and metal chelator, preventing microbial proliferation in vase solutions and maintaining xylem conductivity. When combined with sucrose, 8-HQC significantly improves vase life, water uptake, and antioxidant enzyme activity in roses, lilies, and gladiolus (Zeng *et al*., 2023). Silver-based compounds such as $AgNO_3$ and STS function as ethylene action inhibitors by blocking ethylene receptors at the cellular level. STS is particularly effective in carnations, where it delays petal in-rolling and senescence, extending vase life by several days (Halevy & Mayak, 1981).

Despite their effectiveness, concerns over environmental toxicity and disposal of silver residues have limited their widespread use, encouraging research into safer alternatives.

3. Homemade Preservative Solutions

For household and small-scale use, homemade preservative solutions provide a simple, affordable, and practical approach to extending vase life. These solutions generally consist of three basic ingredients: sugar, an acidifying agent, and a disinfectant. Sugar supplies carbohydrates required for respiration and flower opening, especially in bud-harvested flowers like roses and gladiolus. Acidifiers such as citric acid or lemon juice lower the pH of the vase solution, enhancing water uptake and reducing microbial growth. A small amount of bleach (sodium hypochlorite) acts as a biocide to control bacterial populations (Nowak & Rudnicki, 1990).

Research has demonstrated that properly balanced homemade solutions can significantly improve vase life in flowers such as tuberose, chrysanthemum, and gladiolus compared to plain water. However, incorrect concentrations may cause phytotoxicity or excessive microbial growth, making these solutions less consistent than commercial formulations. Nevertheless, they remain popular for domestic use due to their low cost and accessibility.

4. Eco-Friendly and Natural Preservatives

In recent years, eco-friendly alternatives have gained attention as sustainable options for postharvest flower management. These include plant extracts, essential oils, organic acids, and natural signaling molecules such as salicylic acid. Essential oils derived from clove, thyme, cinnamon, and eucalyptus exhibit strong antimicrobial and antioxidant properties, reducing microbial blockage and oxidative stress in cut flowers (Sharma *et al*., 2023).

Salicylic acid and nitric oxide donors have been shown to enhance antioxidant enzyme activity, maintain membrane stability, and delay senescence in roses, gerberas, and tuberose. Such treatments improve water relations and reduce ethylene production without the environmental risks associated with synthetic chemicals (Hajizadeh *et al*., 2024; Ullah *et al*., 2024). These natural preservatives align with the growing demand for environmentally safe and sustainable floriculture practices.

Mechanism of Action

Preservatives play a vital role in extending the vase life of cut flowers by supporting their physiological and biochemical functions after harvest. Once flowers are detached from the mother plant, they are deprived of their continuous supply of water, carbohydrates, and minerals. This disruption accelerates senescence processes such as increased respiration, carbohydrate depletion, microbial blockage of xylem vessels, and loss of cell turgidity. Floral preservatives are therefore used to compensate for these deficiencies and maintain postharvest quality. Their effectiveness is primarily based on three essential functions: providing an energy source, acidifying the vase solution to enhance water uptake, and suppressing microbial growth (Halevy & Mayak, 1981; Dole & Wilkins, 2005).

Sugars, particularly sucrose, are a key component of most floral preservatives and serve as an immediate source of energy for cut flowers. Carbohydrates are required to sustain respiration, promote bud opening, and support petal expansion. After harvest, endogenous carbohydrate reserves are rapidly exhausted, especially in flowers harvested at the bud stage such as roses, carnations, and gladiolus. Supplementing the vase solution with sugars delays carbohydrate depletion, improves flower diameter, enhances colour development, and maintains petal firmness. Studies have consistently shown that sugar-containing preservatives significantly extend vase life and improve the aesthetic quality of cut roses and chrysanthemums compared to flowers held in water alone (Nowak & Rudnicki, 1990; Reid & Jiang, 2012).

Acidification of the vase solution is another critical function of floral preservatives. Acidifying agents such as citric acid or aluminum sulfate reduce the pH of the solution to an optimal range, generally between 3.5 and 4.5. A lower pH improves water uptake by preventing the formation of air embolisms and enhancing hydraulic conductivity in the xylem. Moreover, acidic conditions suppress the growth of bacteria and fungi that proliferate in neutral or alkaline water. Improved water relations help maintain cell turgidity, prevent stem bending, and delay wilting. In cut chrysanthemums and roses, acidified vase solutions have been reported to reduce leaf yellowing and maintain overall freshness (Dole & Wilkins, 2005).

The third essential function of preservatives is microbial control through the use of biocides. Microorganisms in vase water rapidly multiply and form biofilms that block the vascular tissues at the cut stem end, severely restricting water uptake. Biocidal compounds such as 8-hydroxyquinoline citrate (8-HQC), silver nitrate, silver thiosulfate, or chlorine-based compounds effectively inhibit microbial growth and maintain xylem functionality. By preventing vascular blockage, biocides ensure continuous water transport to the petals and leaves, thereby delaying dehydration and senescence (Halevy & Mayak, 1981; Reid & Jiang, 2012).

Together, the combined action of sugars, acidifiers, and biocides directly interacts with flower physiology to slow down aging processes, maintain hydration, and preserve cellular integrity. As a result, flowers such as roses, carnations, and chrysanthemums treated with preservatives exhibit firmer petals, more vibrant colours, and extended vase life compared to untreated controls. Thus, floral preservatives are indispensable tools in postharvest flower management, enhancing both the longevity and ornamental value of cut flowers.

Benefits and Limitations of Floral Preservatives

Floral preservatives offer clear benefits by extending the vase life of cut flowers, improving bloom quality and reducing wilting, which makes arrangements more appealing and long-lasting. They work by nourishing flowers, maintaining hydration and preventing microbial growth in stems. However, there are limitations: many synthetic preservatives raise environmental concerns due to chemical residues that may affect disposal and sustainability. Additionally, the cost and accessibility of commercial formulations can be a challenge, especially for small-scale users or households, making homemade or eco-friendly alternatives more attractive. In essence, preservatives are highly effective for freshness but must be balanced with environmental and economic considerations.

Future Directions in Floral Preservatives

Future developments in floral preservatives are moving toward more sustainable and eco-friendly solutions. Ongoing research focuses on biodegradable and natural preservatives, such as plant extracts and essential oils, which can replace synthetic chemicals while still maintaining freshness and vase life. In addition, the floriculture industry is adopting sustainable practices, including reducing chemical waste, promoting environmentally safe disposal and encouraging the use of green alternatives to support long-term ecological balance. At the consumer level, there is growing awareness and interest in DIY (Do It Yourself, Home-made Preservative) trends, with people experimenting with homemade preservative solutions using simple ingredients like sugar, lemon juice and household disinfectants. Together, these directions highlight a shift toward balancing effectiveness with sustainability, ensuring that cut flowers remain vibrant while minimizing environmental impact.

Conclusion

Preservatives are essential allies for both florists and flower lovers, as they play a crucial role in extending the vase life of cut flowers, maintaining bloom quality and reducing wilting. By nourishing flowers, improving water uptake, and preventing microbial growth, they ensure that floral arrangements remain fresh and vibrant for longer periods. However, while their effectiveness is undeniable, it is equally important to balance this with sustainability. The growing use of eco-friendly and biodegradable alternatives highlights the need to reduce environmental impact while still preserving beauty. In essence, preservatives safeguard freshness today, but their future lies in combining effectiveness with environmentally responsible practices.

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