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INVESTIGATION OF POST-HARVEST SHELF LIFE OF TUBEROSE *(POLIANTHES TUBEROSA* LINN.) UNDER DIFFERENT VASE SOLUTIONS

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ABSTRACT

The present study investigates the postharvest shelf life of tuberose (*Polianthes tuberosa* Linn.) under various vase solution treatments to determine their effectiveness in enhancing floral longevity and quality. A Factorial Completely Randomized Design was used to assess fifteen therapy combinations that included citric acid, hydrogen peroxide, aspirin, tulsi extract, and tea extract at three concentrations (2%, 4%, and 6%). At regular intervals, important metrics such as solution uptake, transpiration loss, floret opening, flower diameter, turbidity, pH, and sensory characteristics were evaluated. The physiological and aesthetic performance of cut spikes was found to be highly impacted by chemical kind and concentration. With better hydration, less senescence, improved floret opening, greater floral diameter, lower turbidity, and longer vase life, aspirin especially at 6% proved to be the most beneficial. Because of their increased turbidity and decreased moisture, natural extracts showed moderate to low effectiveness. The most promising and cost-effective preservative for extending the life and aesthetic appeal of tuberose vases was found to be 6% aspirin.

***Key words*:** Quality, Shelf life, Solution uptake, Transpiration, Turbidity, Vaselife.

Introduction

Ornamental horticulture has grown to be a vital part of the global floriculture sector, making a substantial contribution to both economic growth and aesthetic improvement. Tuberose (*Polianthes tuberosa* Linn.) is a highly sought-after ornamental crop for bouquets, garlands, floral decorations, essential oil extraction, and perfume production because of its exquisite floral spikes, high yield, long-lasting cut flowers, and intensely sweet fragrance. Tuberose is a perennial bulbous plant that is commonly grown in tropical and subtropical areas and flowers nearly year-round. It is a member of the Asparagaceae family (Sirohi *et al.*, 2017). The species, which is native to Mexico, has seen centuries of domestication and selection, leading to a number of aromatic and decorative cultivars with notable genetic diversity (Kumar *et al*., 2021). Single-flowered varieties typically have 2n = 60 chromosomes, but double-flowered cultivars exhibit more diversity, ranging from 2n = 50–54, 60, and even up to 120, reflecting complex polyploidy and structural rearrangements (Karihaloo, 2019). Variations in floral size, floret count, smell strength, and overall decorative appeal are all influenced by these genetic variations.

With a total coverage of 24.98 Mha and production levels of 113.97 MT for loose flowers and 102.08 MT for cut flowers in 2023–2024, the cultivation area of tuberose has grown significantly in recent years (Ministry of Agriculture & Farmers Welfare, 2023–2024). Tuberose fields produce about 8–10tonnes of bulbs per acre for

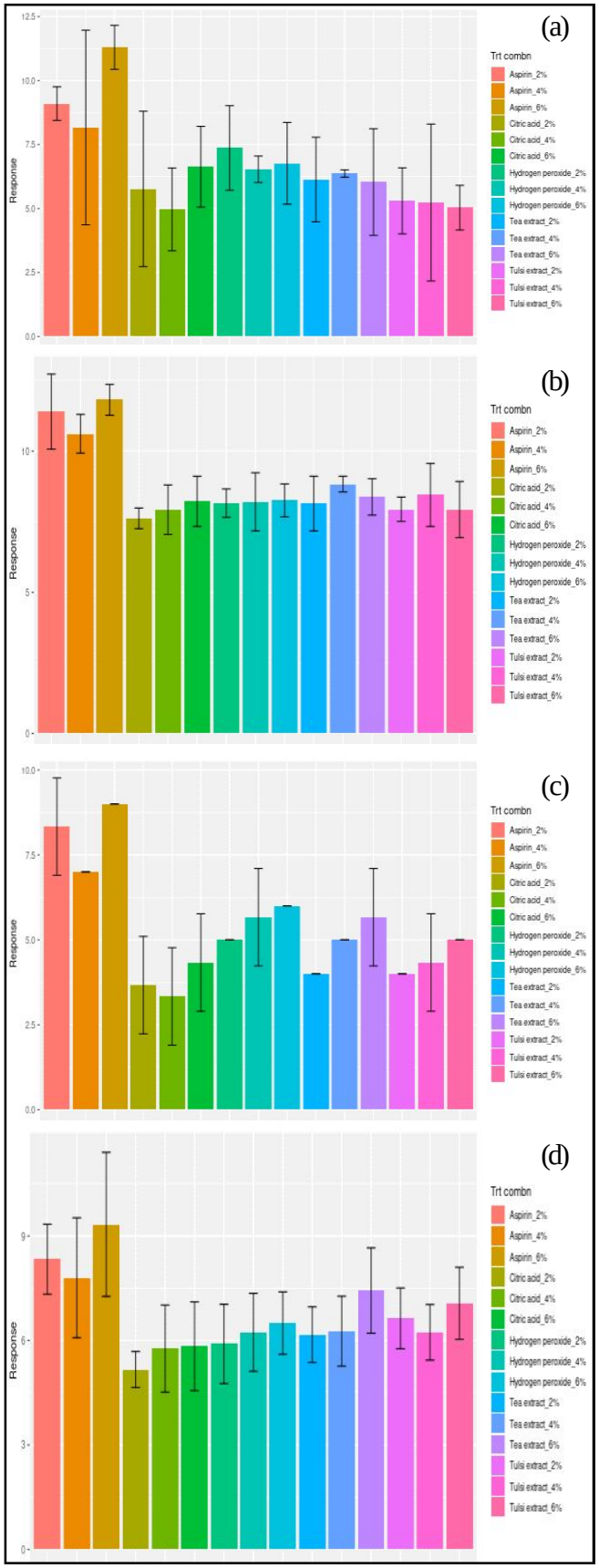

Fig. 1: Effect of Different Vase Solution Treatments on (a) Solution Uptake (b) Floret Opening (c) Vase Life and (d) Overall Acceptability of Tuberose.

Table 1: Details of the Experimental Design for Evaluating the Effect of Preservative Chemicals and Concentrations on Vase Life of Tuberose (*Polianthes tuberosa* Linn.) cv. Arka Prajwal.

Particulars	**Details**
Crop	Tuberose (*Polianthestuberosa* Linn.) cv. ArkaPrajwal
Experimental design	Factorial Completely Randomized Design (CRD)
Number of factors	2
Factor A (Level)	**5- Preservative Chemicals** 1. Citric acid 2. H_2O_2 (Hydrogen peroxide) 3. Aspirin 4. Tulsi extract 5. Tea extract
Factor B (Level)	**3- Concentration** 1. 2 % 2. 4% 3. 6%
Number of treatments	15
Number of replications	3
Number of flower stalk per bottle	2

commercial sale or multiplication, making them an important economic component in addition to floral production (Kumar., 2017). The floriculture sector is starting to investigate a new, sustainable idea in tandem with advancements in postharvest preservatives: using senesced decorative flowers as sources of biologically active substances (Paul *et al.*, 2021). Even senesced petals of tuberose flowers preserve a rich profile of volatile chemicals with antibacterial, antifungal, and therapeutic potential, despite the fact that these flowers are usually thrown away after they lose their freshness (Babarabie *et al.*, 2017). In addition to adding to tuberose's distinctive scent, these volatiles have been shown to alleviate rheumatic discomfort, sleeplessness,

Fig. 2: Initial Day Observations Showing the Effect of Various Vase Solution Treatments on Physiological and Aesthetic Parameters of Tuberose (*Polianthes tuberosa* Linn.).

Table 2: Treatment Details and Preparation of Vase Solutions for Evaluating the Effect of Different Preservative Chemicals and Concentrations on Tuberose (*Polianthes tuberosa* Linn.) cv. ArkaPrajwal.

Tr.	Treatment Details	Composition / Preparation
T_0	Control	4% sucrose + 4 g in 200 ml H_2O
T_1	Citric acid @ 2%	4 g in 200 ml H_2O + 4 g sucrose
T_2	Citric acid @ 4%	8 g in 200 ml H_2O + 4 g sucrose
T_3	Citric acid @ 6%	12 g in 200 ml H_2O + 4 g sucrose
T_4	H_2O_2 @ 2%	20 ml in 180 ml H_2O + 4 g sucrose
T_5	H_2O_2 @ 4%	40 ml in 160 ml H_2O + 4 g sucrose
T_6	H_2O_2 @ 6%	60 ml in 140 ml H_2O + 4 g sucrose
T_7	Aspirin @ 2%	2 tablets in 200 ml H, O + 4 g sucrose
T_8	Aspirin @ 4%	4 tablets in 200 ml H_2O + 4 g sucrose
T_9	Aspirin @ 6%	6 tablets in 200 ml H_2O + 4 g sucrose
T_{10}	Tulsi extract @ 2%	15 ml extract in 485 ml H_2O (30 ppm) + 4 g sucrose
T_{11}	Tulsi extract @ 4%	30 ml extract in 470 ml H_2O (60 ppm) + 4 g sucrose
T_{12}	Tulsi extract @ 6%	60 ml extract in 440 ml H_2O + 4 g sucrose
T_{13}	Tea extract @ 2%	20 ml extract (30 g in 500 ml H_2O) in 180 ml H, O + 4 g sucrose
T_{14}	Tea extract @ 4%	40 ml extract in 160 ml H_2O + 4 g sucrose
T_{15}	Tea extract @ 6%	60 ml extract in 140 ml H_2O + 4 g sucrose

Fig. 3: Final Day Assessment of the Effects of Various Vase Solution Treatments on the Postharvest Physiological and Quality Parameters of Tuberose (*Polianthes tuberosa* Linn.).

and influenza (Rani & Singh, 2013).

Building on this notion, Ghosh *et al.*, (2014) found that extracts from senesced tuberose blossoms demonstrated significant antibacterial action against a variety of bacterial species, underscoring the unrealized potential of floral waste. These results imply that postharvest biomass, which is typically thought of as waste, can be transformed into eco-friendly plant protectants, botanical extracts, or natural antibacterial agents. Singh *et al.*, (2018) stated that the floriculture industry, such value addition is in line with contemporary concepts of waste reduction, circular bioeconomy, and sustainable resource use, providing a hopeful transition toward more economically and ecologically sound production systems.

Materials and Method

The experiment entitled "Investigation of Post-Harvest Shelf Life of Tuberose (*Polianthes tuberosa* Linn.) under Different Vase Solutions" was conducted during the year 2025-2026 , commencing from the month of August, in the Horticultural Laboratory. The study aimed to evaluate the effect of various vase solutions on extending the post-harvest shelf life and maintaining the quality of cut tuberose flowers. The experiment was carried out under controlled laboratory conditions, where freshly harvested tuberose spikes were subjected to different preservative treatments to assess parameters such as solution uptake, transpiration loss, floret opening, and overall vase life (Fig. 2 & 3). The study was carried out at the Horticultural Laboratory, GD Goenka University, Sohna, Haryana, which is geographically located at latitude of 28.24° N and a longitude of 77.07° E, at an elevation of approximately 200 meters above mean sea level. The region experiences a subtropical climate characterized by hot summers, moderate monsoon rainfall, and mild winters. During the study period, the average temperature ranged from 28°C to 33°C, with an average relative humidity of around 70%. The laboratory provided a controlled environment suitable for post-harvest investigations, ensuring accurate monitoring of physiological and quality parameters of the tuberose spikes under various vase solution treatments (Table 1 & 2).

Table 1 outlines theexperimental design used to evaluate the effect of different preservative chemicals and their concentrations on the vase life and postharvest quality of tuberose (*Polianthes tuberosa* Linn.) Arka Prajwal's CV. The study used a Factorial Completely Randomized Design (CRD) with two factors: Factor B with three concentrations (2%, 4%, and 6%) and Factor A with five preservative chemicals (Citric acid, Hydrogen

Table 3: Parameters Recorded and Their Methods of Observation in Tuberose (*Polianthes tuberosa* Linn.) cv. Arka Prajwal.

Sr.	Parameter	Observation Days	Formula / Method Used	Description / Purpose
1.	Solution Uptake (ml/stalk)	2nd, 4th, 6th, and 8th days	Solution Uptake (ml) = $V_1 - V_2$ where, V_1= Initial volume (ml) of vase solutionV, = Final volume (ml) after each observation	Determines the rate of water absorption by the cut spikes. Higher uptake indicates better turgidity, hydration, and freshness of the flower stalks.
2.	Transpiration Loss (ml/stalk)	2nd, 4th, 6th, and 8th days	Transpiration Loss (ml) = $W_1 - W_1$ where, W_1= Initial weight (g) of bottle with solution and flower stalks W_2= Final weight (g) (1 g = 1 ml water loss)	Measures water loss due to evaporation and transpiration. Controlled transpiration ensures longer vase life and delayed wilting.
3.	Percentage of Floret Opening (%)	Regular intervals (until senescence)	% Floret Opening = (No. of florets opened per spike / Total no. of florets per spike) × 100	Evaluates the effect of vase solution on the number and percentage of florets opened. Uniform and gradual opening reflects better ornamental quality.
4.	Flower Diameter (cm)	2nd, 4th, 6th, and 8th days	% Change in Flower Diameter = $((D_t - D_i) / D_i) \times 100$ where, D_i= Initial flower diameter (cm) D_t = Diameter at later observation days	Assesses the turgidity and hydration status of the florets. Higher diameter indicates better freshness and water balance.
5.	Turbidity of Vase Solution (NTU)	2nd, 4th, 6th, and 8th days	% Increase in Turbidity = $((T_2 - T_1) / T_1) \times 100$ where, T_1 = Turbidity (NTU) on 2nd dayT_2= Turbidity on later observation days	Measured using a digital nephelometer to determine clarity and microbial load of vase water. Lower turbidity indicates lesser bacterial contamination and better vase hygiene
6.	Sensory Evaluation (0–10 Hedonic Scale)	2nd, 4th, 6th, and 8th days	Hedonic Scale (0–10):10 – Excellent8–9 – Very Good 6–7 – Good4–5 – Fair2–3 – Poor0 – Wilted	Based on color, freshness, shape, petal retention, and overall acceptability of florets. Higher sensory score signifies superior aesthetic and market quality.

peroxide, Aspirin, Tulsi extract, and Tea extract). To assure statistical reliability, their combination resulted in 15 treatment sets, each of which was reproduced three times. To ensure uniformity in observations, two identical flower stalks were added to each bottle in each replication. This design made it possible to thoroughly assess the impact of individual and combined chemicals and concentrations on extending vase life and maintaining the freshness of cut tuberose spikes.

Table 2 summarizes the composition and preparation of the vase solution treatments formulated to evaluate the effects of different preservative chemicals and concentrations on the postharvest quality of tuberose (*Polianthestuberosa* Linn.) cv. Arka Prajwal. Five preservatives citric acid, hydrogen peroxide, aspirin, tulsi extract, and tea extract were combined at three different concentrations (2%, 4%, and 6%) to create a total of fifteen treatments (T_0–T_1). A solution of 4% sucrose in 200 milliliters of distilled water served as the control (T_0). In order to offer a consistent energy source, 4 g sucrose was also added to all other treatments. Preservative concentrations were standardized by adjusting the quantities of solute or extract added to 200 ml of water. For instance, hydrogen peroxide (T_4–T_4) ranged from 20 ml to 60 ml, citric acid treatments (T_1–T_5) ranged from 4 g to 12 g, and tulsi and tea extracts were made similarly in graded amounts. To find the best combination for extending vase life, preserving freshness, and inhibiting microbiological development in cut tuberose spikes, this treatment framework allowed for a methodical assessment of various preservatives and concentration levels.

Table 3 summarizes the key parameters recorded to evaluate the impact of different vase solution treatments on the postharvest performance of Tuberose (*Polianthes tuberosa* Linn.) cv. ArkaPrajwal. In order to evaluate the physiological behavior and aesthetic quality of the spikes, six important parameters were measured at

Table 4: Effect of different preservative solutions and concentrations on solution uptake (ml) of tuberose at different observation intervals.

FACTOR-A	**SU D2**	**SU D4**	**SU D6**	**SU D8**
Aspirin	17.37 ± 1.60^{a}	14.87 ± 1.94^{a}	11.86 ± 1.72^{b}	9.52 ± 1.60^{a}
Citric acid	13.20 ± 0.77^{d}	10.24 ± 0.88^{c}	14.87 ± 1.94^{a}	5.79 ± 1.05^{cd}
Hydrogen peroxide	14.69 ± 0.62^{b}	12.06 ± 0.64^{b}	14.87 ± 1.94^{a}	6.89 ± 0.60^{b}
Tea extract	13.91 ± 0.80^{c}	10.70 ± 0.75^{c}	14.87 ± 1.94^{a}	6.18 ± 0.56^{bc}
Tulsi extract	12.93 ± 0.53^{d}	10.01 ± 0.34^{c}	14.87 ± 1.94^{a}	5.19 ± 0.70^{d}
CD (A)	0.51	0.79	1.17	0.74
SE(m)	0.18	0.27	0.41	0.26
SE(d)	0.25	0.38	0.57	0.36
FACTOR-B	**SU D2**	**SU D4**	**SU D6**	**SU D8**
2%	14.35 ± 1.79^{b}	11.80 ± 2.02^{a}	14.63 ± 1.31^{b}	6.73 ± 1.55^{ab}
4%	13.70 ± 1.20^{c}	10.86 ± 1.49^{b}	12.29 ± 1.46^{c}	6.25 ± 1.41^{b}
6%	15.21 ± 2.20^{a}	12.07 ± 2.53^{a}	15.87 ± 2.00^{a}	7.15 ± 2.29^{a}
CD (B)	0.39	0.61	0.91	0.57
SE(m)	0.14	0.21	0.31	0.20
SE(d)	0.19	0.3	0.45	0.28
A × B	**SU D2**	**SU D4**	**SU D6**	**SU D8**
Aspirin - 2%	17.53 ± 0.51^{b}	15.23 ± 0.29^{a}	12.23 ± 0.96	9.10 ± 0.26^{b}
Aspirin - 4%	15.47 ± 0.12^{c}	12.90 ± 0.92^{b}	9.83 ± 0.55	8.17 ± 1.53^{bc}
Aspirin- 6%	19.10 ± 0.10^{a}	16.47 ± 2.07^{a}	13.50 ± 0.40	11.30 ± 0.35^{a}
Citric acid - 2%	13.03 ± 0.61^{hij}	10.57 ± 0.25^{efg}	15.23 ± 0.29	5.77 ± 1.22^{efgh}
Citric acid - 4%	12.67 ± 0.50^{ij}	9.53 ± 0.55^{g}	12.90 ± 0.92	4.97 ± 0.65^{h}
Citric acid - 6%	13.90 ± 0.72^{efgh}	10.63 ± 1.25^{defg}	16.47 ± 2.07	6.63 ± 0.64^{de}
Hydrogen peroxide- 2%	14.60 ± 0.20^{cde}	12.43 ± 0.49^{bc}	15.23 ± 0.29	7.37 ± 0.67^{cd}
Hydrogen peroxide- 4%	14.13 ± 0.15^{efg}	11.97 ± 0.99^{bcd}	12.90 ± 0.92	6.53 ± 0.21^{def}
Hydrogen peroxide- 6%	15.33 ± 0.60^{cd}	11.77 ± 0.25^{bcde}	16.47 ± 2.07	6.77 ± 0.64^{de}
Tea extract - 2%	13.47 ± 0.31^{ghi}	10.90 ± 0.72^{def}	15.23 ± 0.29	6.13 ± 0.67^{defgh}
Tea extract- 4%	13.70 ± 1.06^{fgh}	10.07 ± 0.45^{fg}	12.90 ± 0.92	6.37 ± 0.06^{defg}
Tea extract- 6%	14.57 ± 0.57^{def}	11.13 ± 0.76^{cdef}	16.47 ± 2.07	6.03 ± 0.84^{efgh}
Tulsi extract- 2%	13.10 ± 0.36^{hij}	9.87 ± 0.42^{fg}	15.23 ± 0.29	5.30 ± 0.52^{fgh}
Tulsi extract- 4%	12.53 ± 0.31^{j}	9.83 ± 0.06^{fg}	12.90 ± 0.92	5.23 ± 1.23^{gh}
Tulsi extract- 6%	13.17 ± 0.74^{hij}	10.33 ± 0.25^{fg}	16.47 ± 2.07	5.03 ± 0.35^{h}
CD (A×B)	0.88	1.36	-	1.28
SE(m)	0.30	0.47	0.70	0.44
SE(d)	0.43	0.67	1	0.63

SU D2 - Solution uptake on day 2 ; SU D4- Solution uptake on day 4 ; SU D6- Solution uptake on day 6 ; SU D8- Solution uptake on day 8

regular intervals (the second, fourth, sixth, and eighth days). Freshness and vase life were directly impacted by solution uptake, which examined the efficiency of water absorption, and transpiration loss, which showed moisture loss through evaporation. To determine how preservatives affected flower opening and ornamental presentation, the percentage of flowers that opened was noted. Turgidity and hydration condition were indicated by flower diameter. A digital nephelometer was used to measure turbidity in order to assess water clarity and microbiological development; lower results indicated a cleaner vase environment. Visual attractiveness, petal hardness, and general freshness were evaluated through sensory analysis using a 0–10 Hedonic Scale. When taken as a whole, these characteristics offered a thorough foundation for evaluating how well various preservation treatments maintained the quality and durability of cut tuberose spikes.

Statistical analysis

The experimental data were analyzed using a Factorial Completely Randomized Design (CRD) to evaluate the effects of preservative chemicals (Factor A) and concentrations (Factor B) on postharvest parameters of Tuberose cv. Prajwal Arka. Software called Resin and Grapes was used for statistical analysis (KAU). Strong

Table 4.1: Effect of different preservative solutions and concentrations on transpiration loss (g) of tuberose at different observation intervals.

FACTOR-A	**TL2**	**TL4**	**TL6**	**TL8**
Aspirin	9.49 ± 1.95^{c}	11.90 ± 1.72^{d}	14.70 ± 1.82^{e}	18.09 ± 2.11^{d}
Citric acid	13.94 ± 0.61^{a}	16.41 ± 0.53^{ab}	19.56 ± 0.70^{b}	23.06 ± 1.04^{a}
Hydrogen peroxide	12.42 ± 0.60^{b}	15.34 ± 0.42^{c}	17.86 ± 0.95^{d}	21.04 ± 0.83^{c}
Tea extract	13.66 ± 1.02^{a}	16.08 ± 0.97^{b}	18.87 ± 0.55^{c}	22.02 ± 0.70^{b}
Tulsi extract	14.04 ± 0.71^{a}	16.81 ± 0.45^{a}	20.21 ± 0.73^{a}	23.17 ± 0.79^{a}
CD (A)	0.63	0.45	0.53	0.56
SE(m)	0.22	0.15	0.18	0.19
SE(d)	0.31	0.22	0.26	0.27
FACTOR-B	**TL2**	**TL4**	**TL6**	**TL8**
2%	12.66 ± 1.94^{b}	15.14 ± 2.02^{b}	18.17 ± 2.28^{b}	21.19 ± 2.11^{b}
4%	13.58 ± 1.26^{a}	16.11 ± 1.29^{a}	19.07 ± 1.51^{a}	22.63 ± 1.38^{a}
6%	11.89 ± 2.45^{c}	14.67 ± 2.41^{c}	17.47 ± 2.51^{c}	20.61 ± 2.58^{c}
CD (B)	0.49	0.35	0.41	0.43
SE(m)	0.17	0.12	0.14	0.15
SE(d)	0.24	0.17	0.2	0.21
A×B	**TL2**	**TL4**	**TL6**	**TL8**
Aspirin- 2%	9.37 ± 0.40^{g}	11.53 ± 0.06^{h}	14.07 ± 0.61^{g}	17.67 ± 0.47^{g}
Aspirin- 4%	11.73 ± 0.45^{f}	14.00 ± 0.56^{g}	17.00 ± 0.40^{f}	20.67 ± 0.15^{f}
Aspirin- 6%	7.37 ± 0.74^{h}	10.17 ± 0.51^{i}	13.03 ± 0.25^{h}	15.93 ± 0.64^{h}
Citric acid- 2%	14.23 ± 0.51^{ab}	16.27 ± 0.58^{bcde}	19.63 ± 1.00^{bc}	22.50 ± 0.66^{cd}
Citric acid- 4%	14.27 ± 0.55^{ab}	16.80 ± 0.53^{abc}	19.90 ± 0.26^{b}	24.20 ± 0.50^{a}
Citric acid- 6%	13.33 ± 0.32^{bcd}	16.17 ± 0.40^{cde}	19.13 ± 0.67^{bcd}	22.47 ± 0.85^{cd}
Hydrogen peroxide- 2%	12.27 ± 0.29^{def}	14.97 ± 0.06^{f}	18.17 ± 0.40^{e}	20.47 ± 0.74^{f}
Hydrogen peroxide- 4%	13.00 ± 0.53^{cde}	15.57 ± 0.35^{def}	18.57 ± 0.95^{de}	21.87 ± 0.45^{de}
Hydrogen peroxide- 6%	12.00 ± 0.53^{ef}	15.50 ± 0.50^{ef}	16.83 ± 0.21^{f}	20.80 ± 0.66^{f}
Tea extract- 2%	13.43 ± 1.33^{bc}	16.00 ± 0.79^{de}	18.97 ± 0.46^{cde}	22.10 ± 0.72^{de}
Tea extract- 4%	14.13 ± 1.10^{ab}	17.03 ± 0.42^{ab}	18.80 ± 0.85^{cde}	22.57 ± 0.15^{cd}
Tea extract- 6%	13.40 ± 0.79^{bc}	15.20 ± 0.66^{f}	18.83 ± 0.49^{cde}	21.40 ± 0.60^{ef}
Tulsi extract- 2%	14.00 ± 0.44^{abc}	16.93 ± 0.42^{abc}	20.03 ± 0.31^{b}	23.20 ± 0.53^{bc}
Tulsi extract- 4%	14.77 ± 0.51^{a}	17.17 ± 0.25^{a}	21.10 ± 0.26^{a}	23.87 ± 0.29^{ab}
Tulsi extract- 6%	13.37 ± 0.29^{bc}	16.33 ± 0.15^{bcd}	19.50 ± 0.00^{bc}	22.43 ± 0.76^{cd}
CD (A×B)	1.09	0.77	0.92	0.97
SE(m)	0.38	0.27	0.32	0.34
SE(d)	0.53	0.38	0.45	0.48

TL.2 – Transpiration loss on day 2; TL.4 – Transpiration loss on day 4; TL.6– Transpiration loss on day 6; TL.8 – Transpiration loss on day 8

treatment influence was indicated by the ANOVA findings, which revealed significant differences ($p < 0.05$) for both components and their interaction. Treatment means were separated and compared using Duncan's Multiple Range Test (DMRT). A better understanding of treatment performance was made possible by the simultaneous evaluation of main and interaction effects made possible by this factorial design. Significant conclusions on the impact of various preservative solutions and concentrations on tuberose vase life and quality were supported by the statistical methods, which validated the accuracy and dependability of the results.

Result and Discussion

Solution Uptake

Solution uptake in tuberose spikes was significantly influenced by chemical treatments, concentration levels, and their interaction, showing strong treatment effects on hydration. Aspirin consistently showed the maximum uptake, particularly at 6%, which is indicative of enhanced xylem permeability and decreased microbial obstruction from salicylic acid. Tulsi extract and citric acid exhibited the least amount of absorption, most likely as a result of biological components or acidity limiting water flow (Ahmed *et al.*, 2023; Talukdar & Barooah, 2011).

Table 4.2: Effect of different preservative solutions and concentrations on number of florets opened in tuberose at different observation intervals.

FACTOR-A	**Floret opened D2**	**Floret opened D4**	**Floret opened D6**	**Floret opened D8**
Aspirin	4.78 ± 0.83^{a}	8.00 ± 0.87^{a}	9.22 ± 0.83^{a}	8.11 ± 0.93^{a}
Citric acid	1.89 ± 0.60^{d}	4.00 ± 0.71^{d}	5.11 ± 0.78^{d}	3.78 ± 0.67^{e}
Hydrogen peroxide	3.11 ± 0.60^{b}	5.56 ± 0.53^{b}	6.67 ± 0.71^{b}	5.56 ± 0.53^{b}
Tea extract	2.44 ± 0.53^{c}	5.00 ± 0.87^{c}	6.11 ± 0.78^{c}	4.89 ± 0.78^{c}
Tulsi extract	2.33 ± 0.71^{cd}	4.67 ± 0.71^{c}	5.78 ± 0.67^{c}	4.44 ± 0.53^{d}
CD (A)	0.48	0.41	0.41	0.38
SE(m)	0.16	0.14	0.14	0.13
SE(d)	0.23	0.2	0.2	0.19
FACTOR-B	**Floret opened D2**	**Floret opened D4**	**Floret opened D6**	**Floret opened D8**
2%	2.53 ± 1.25^{b}	4.87 ± 1.55^{c}	6.07 ± 1.79^{b}	5.00 ± 1.81^{b}
4%	2.73 ± 0.96^{b}	5.27 ± 1.33^{b}	6.33 ± 1.29^{b}	5.07 ± 1.33^{b}
6%	3.47 ± 1.25^{a}	6.20 ± 1.57^{a}	7.33 ± 1.50^{a}	6.00 ± 1.69^{a}
CD (B)	0.37	0.31	0.31	0.29
SE(m)	0.13	0.11	0.11	0.10
SE(d)	0.18	0.15	0.15	0.14
A×B	**Floret opened D2**	**Floret opened D4**	**Floret opened D6**	**Floret opened D8**
Aspirin- 2%	4.67 ± 0.58	7.67 ± 0.58	9.33 ± 0.58^{a}	8.33 ± 0.58^{b}
Aspirin- 4%	4.00 ± 0.00	7.33 ± 0.58	8.33 ± 0.58^{b}	7.00 ± 0.00^{c}
Aspirin- 6%	5.67 ± 0.58	9.00 ± 0.00	10.00 ± 0.00^{a}	9.00 ± 0.00^{a}
Citric acid- 2%	1.67 ± 0.58	3.67 ± 0.58	4.67 ± 0.58^{g}	3.67 ± 0.58^{gh}
Citric acid- 4%	1.67 ± 0.58	3.67 ± 0.58	4.67 ± 0.58^{g}	3.33 ± 0.58^{h}
Citric acid- 6%	2.33 ± 0.58	4.67 ± 0.58	6.00 ± 0.00^{ef}	4.33 ± 0.58^{f}
Hydrogen peroxide- 2%	2.67 ± 0.58	5.00 ± 0.00	6.00 ± 0.00^{ef}	5.00 ± 0.00^{e}
Hydrogen peroxide- 4%	3.33 ± 0.58	5.67 ± 0.58	6.67 ± 0.58^{cde}	5.67 ± 0.58^{d}
Hydrogen peroxide- 6%	3.33 ± 0.58	6.00 ± 0.00	7.33 ± 0.58^{c}	6.00 ± 0.00^{d}
Tea extract- 2%	2.00 ± 0.00	4.00 ± 0.00	5.33 ± 0.58^{fg}	4.00 ± 0.00^{fg}
Tea extract- 4%	2.33 ± 0.58	5.00 ± 0.00	6.00 ± 0.00^{ef}	5.00 ± 0.00^{e}
Tea extract- 6%	3.00 ± 0.00	6.00 ± 0.00	7.00 ± 0.00^{cd}	5.67 ± 0.58^{d}
Tulsi extract- 2%	1.67 ± 0.58	4.00 ± 0.00	5.00 ± 0.00^{g}	4.00 ± 0.00^{fg}
Tulsi extract- 4%	2.33 ± 0.58	4.67 ± 0.58	6.00 ± 0.00^{ef}	4.33 ± 0.58^{f}
Tulsi extract- 6%	3.00 ± 0.00	5.33 ± 0.58	6.33 ± 0.58^{de}	5.00 ± 0.00^{e}
CD (A×B)	-	-	0.7	0.66
SE(m)	0.29	0.24	0.24	0.23
SE(d)	0.4	0.34	0.34	0.32

Floret.opened D2- Floret opened on day 2; Floret.opened D4 - Floret opened on day 4; Floret.opened D6- Floret opened on day 6; Floret.opened D8- Floret opened on day 8

Stronger preservative solutions improve turgor and hydration, as seen by the general rise in uptake with concentration. Day 6's non-significant interaction implies that spontaneous physiological decline is more important for mid-vase hydration (Fig. 1). Overall, maintaining high uptake and postponing hydration-related senescence were best achieved with 6% aspirin (Table 4).

Transpiration Loss

Transpiration loss was significantly influenced by chemicals, concentrations, and their interactions throughout the vase life. Due to salicylic acid-induced partial stomatal closure and delayed senescence, aspirin consistently caused the least amount of loss. The greatest losses were seen in tulsi and citric acid, which may have been caused by increased stomatal activity or metabolic stimulation by natural substances (Baidya *et al*., 2020; Sirohi *et al*., 2017). Transpiration was decreased by higher concentrations, especially 6%, and the greatest losses were observed in 4% treatments. The combined effect of chemical type and dose is highlighted by the significant A×B interaction, which ranges from maximum loss in Tulsi 4% to minimum loss in Aspirin 6% (Table 4.1). All things considered, aspirin at 6% worked best to reduce water loss and preserve freshness.

Table 4.3: Effect of different preservative solutions and concentrations on floret diameter (mm) of tuberose at different observation intervals.

FACTOR-A	**Floret diameter D2mm**	**Floret diameter D4 mm**	**Floret diameter D6 mm**	**Floret diameter D8 mm**
Aspirin	34.89 ± 0.78^{a}	36.33 ± 1.32^{a}	35.11 ± 1.54^{a}	33.78 ± 1.09^{a}
Citric acid	28.67 ± 1.00^{c}	27.78 ± 1.09^{c}	25.67 ± 1.00^{d}	23.67 ± 1.00^{e}
Hydrogen peroxide	32.00 ± 1.32^{b}	31.22 ± 1.39^{b}	29.33 ± 1.22^{b}	27.33 ± 1.22^{b}
Tea extract	28.56 ± 1.24^{c}	27.56 ± 1.24^{c}	26.56 ± 1.24^{c}	25.44 ± 1.13^{c}
Tulsi extract	28.22 ± 1.39^{c}	27.33 ± 1.50^{c}	26.11 ± 1.36^{cd}	24.78 ± 0.97^{d}
CD (A)	0.57	0.48	0.48	0.5
SE(m)	0.20	0.16	0.16	0.17
SE(d)	0.28	0.23	0.23	0.24
FACTOR-B	**Floret diameter D2 mm**	**Floret diameter D4 mm**	**Floret diameter D6 mm**	**Floret diameter D8 mm**
2%	29.40 ± 3.11^{c}	28.80 ± 3.86^{c}	27.47 ± 3.96^{c}	26.07 ± 4.11^{c}
4%	30.33 ± 2.58^{b}	29.80 ± 3.30^{b}	28.20 ± 3.17^{b}	26.80 ± 3.30^{b}
6%	31.67 ± 2.55^{a}	31.53 ± 3.66^{a}	30.00 ± 3.89^{a}	28.13 ± 3.83^{a}
CD (B)	0.44	0.37	0.37	0.39
SE(m)	0.15	0.13	0.13	0.13
SE(d)	0.22	0.18	0.18	0.19
A×B	**Floret diameter D2 mm**	**Floret diameter D4 mm**	**Floret diameter D6 mm**	**Floret diameter D8 mm**
Aspirin- 2%	34.67 ± 0.58	35.67 ± 0.58^{b}	34.67 ± 0.58^{b}	33.67 ± 0.58^{b}
Aspirin- 4%	34.33 ± 0.58	35.33 ± 0.58^{b}	33.67 ± 0.58^{c}	32.67 ± 0.58^{c}
Aspirin- 6%	35.67 ± 0.58	38.00 ± 0.00^{a}	37.00 ± 0.00^{a}	35.00 ± 0.00^{a}
Citric acid- 2%	27.67 ± 0.58	26.67 ± 0.58^{gh}	24.67 ± 0.58^{j}	22.67 ± 0.58^{l}
Citric acid- 4%	28.67 ± 0.58	27.67 ± 0.58^{f}	25.67 ± 0.58^{hi}	23.67 ± 0.58^{k}
Citric acid- 6%	29.67 ± 0.58	29.00 ± 0.00^{e}	26.67 ± 0.58^{g}	24.67 ± 0.58^{ij}
Hydrogen peroxide- 2%	30.67 ± 0.58	29.67 ± 0.58^{e}	28.00 ± 0.00^{f}	26.00 ± 0.00^{fg}
Hydrogen peroxide- 4%	32.00 ± 1.00	31.33 ± 0.58^{d}	29.33 ± 0.58^{e}	27.33 ± 0.58^{e}
Hydrogen peroxide- 6%	33.33 ± 0.58	32.67 ± 0.58^{c}	30.67 ± 0.58^{d}	28.67 ± 0.58^{d}
Tea extract- 2%	27.33 ± 0.58	26.33 ± 0.58^{hi}	25.33 ± 0.58^{ij}	24.33 ± 0.58^{jk}
Tea extract- 4%	28.33 ± 0.58	27.33 ± 0.58^{fg}	26.33 ± 0.58^{gh}	25.33 ± 0.58^{ghi}
Tea extract- 6%	30.00 ± 0.00	29.00 ± 0.00^{e}	28.00 ± 0.00^{f}	26.67 ± 0.58^{ef}
Tulsi extract- 2%	26.67 ± 0.58	25.67 ± 0.58^{i}	24.67 ± 0.58^{j}	23.67 ± 0.58^{k}
Tulsi extract- 4%	28.33 ± 0.58	27.33 ± 0.58^{fg}	26.00 ± 0.00^{ghi}	25.00 ± 0.00^{hij}
Tulsi extract- 6%	29.67 ± 0.58	29.00 ± 0.00^{e}	27.67 ± 0.58^{f}	25.67 ± 0.58^{gh}
CD (A×B)	-	0.82	0.82	0.86
SE(m)	0.34	0.29	0.29	0.30
SE(d)	0.49	0.4	0.4	0.42

Floret.diameter.D2.mm – Floret diameter on day 2 ; Floret.diameter.D4.mm – Floret diameter on day 4 ; Floret.diameter.D6.mm – Floret diameter on day 6 ; Floret.diameter.D8.mm – Floret diameter on day 8

Turbidity

Turbidity differed significantly among treatments and concentrations, with tea extract producing the highest values due to tannins and phenolics that favor microbial growth and suspended particles. Chawla *et al*., (2020); Kumari *et al*., (2018) showed that because of its excellent solution clarity and antibacterial action, aspirin retained the lowest turbidity. Although chemical type was more important than concentration, higher concentrations enhanced turbidity across treatments. On Days 4 and 6, there were notable interaction effects, with Aspirin 6% exhibiting the lowest turbidity and Tea 6% the highest. Day 8 saw a stabilization of the differences. These findings demonstrate that aspirin is the best medication for reducing microbial activity and preserving clear vase solutions (Table 4.4).

Floret Diameter

Floret diameter was significantly affected by both

Table 4.4: Effect of different preservative solutions and concentrations on turbidity (NTU) of vase solution in tuberose at different observation intervals.

FACTOR-A	**Turbidity Day4 NTU**	**Turbidity Day6 NTU**	**Turbidity Day8 NTU**
Aspirin	7.23 ± 0.93^{e}	7.69 ± 1.02^{e}	7.78 ± 1.46^{e}
Citric acid	13.38 ± 1.00^{c}	13.88 ± 1.45^{c}	14.48 ± 1.58^{c}
Hydrogen peroxide	10.32 ± 0.61^{d}	11.26 ± 0.97^{d}	11.18 ± 1.05^{d}
Tea extract	30.52 ± 3.25^{a}	32.25 ± 3.06^{a}	33.01 ± 3.89^{a}
Tulsi extract	17.69 ± 1.24^{b}	18.37 ± 1.73^{b}	19.65 ± 2.10^{b}
CD (A)	1.08	1.28	1.77
SE(m)	0.37	0.44	0.61
SE(d)	0.53	0.63	0.87
FACTOR-B	**Turbidity Day4 NTU**	**Turbidity Day6 NTU**	**Turbidity Day8 NTU**
2%	14.74 ± 7.36^{c}	15.55 ± 7.94^{b}	15.90 ± 8.15^{b}
4%	15.91 ± 8.38^{b}	16.91 ± 8.67^{a}	17.58 ± 9.29^{a}
6%	16.82 ± 9.66^{a}	17.61 ± 10.11^{a}	18.18 ± 10.41^{a}
CD (B)	0.83	0.99	1.37
SE(m)	0.29	0.34	0.48
SE(d)	0.41	0.48	0.67
A×B	**Turbidity Day4 NTU**	**Turbidity Day6 NTU**	**Turbidity Day8 NTU**
Aspirin- 2%	7.12 ± 0.21^{lm}	7.45 ± 0.31^{i}	7.74 ± 0.93
Aspirin- 4%	8.29 ± 0.54^{kl}	8.92 ± 0.51^{hi}	9.38 ± 0.43
Aspirin- 6%	6.28 ± 0.33^{m}	6.71 ± 0.09^{i}	6.22 ± 0.14
Citric acid- 2%	12.56 ± 0.51^{hi}	12.60 ± 1.14^{fg}	12.94 ± 1.14
Citric acid- 4%	12.94 ± 0.16^{gh}	14.75 ± 1.54^{f}	15.23 ± 1.41
Citric acid- 6%	14.63 ± 0.21^{fg}	14.30 ± 0.92^{f}	15.28 ± 1.16
Hydrogen peroxide- 2%	10.10 ± 0.47^{jk}	11.21 ± 0.47^{g}	10.78 ± 0.63
Hydrogen peroxide- 4%	9.85 ± 0.30^{jk}	10.59 ± 1.25^{gh}	10.68 ± 1.44
Hydrogen peroxide- 6%	11.01 ± 0.22^{ij}	11.99 ± 0.69^{g}	12.07 ± 0.33
Tea extract- 2%	27.55 ± 1.39^{c}	29.48 ± 2.26^{c}	30.10 ± 0.33
Tea extract- 4%	30.53 ± 2.90^{b}	32.31 ± 1.36^{b}	33.80 ± 4.63
Tea extract- 6%	33.48 ± 2.34^{a}	34.98 ± 2.80^{a}	35.15 ± 4.29
Tulsi extract- 2%	16.38 ± 0.68^{ef}	17.00 ± 1.05^{e}	17.96 ± 1.19
Tulsi extract- 4%	17.96 ± 0.22^{de}	18.01 ± 0.73^{de}	18.78 ± 0.93
Tulsi extract- 6%	18.72 ± 1.15^{d}	20.10 ± 1.68^{d}	22.20 ± 0.47
CD (A×B)	1.87	2.21	-
SE(m)	0.65	0.77	1.06
SE(d)	0.91	1.08	1.5

chemicals and concentration levels, with interaction effects becoming significant from Day 4. Deb., (2018); Elshereef, (2015) stated that because of their involvement in maintaining membrane integrity and turgor, aspirin and hydrogen peroxide consistently produced the greatest diameters. Smaller florets were produced by citric acid, tulsi, and tea extract, most likely as a result of acidity or biochemical interference with petal expansion. Across treatments, increasing the concentration to 6% improved floret size. Aspirin 6% produced the largest diameter in the A×B interaction, while low-concentration natural extracts produced the smallest (Table 4.3). Therefore, the best aspirin dosage for preserving bigger florets over the course of the vase life was 6%.

Number of Florets Opened

Floret opening was significantly influenced by chemicals and concentrations, with interaction effects emerging from Day 6, indicating stronger treatment impact as vase life progressed. Because aspirin may maintain membranes, promote bud growth, and reduce ethylene, it opened the greatest amount of florets (Ezz., 2018; Kumar *et al*., 2022). Citric acid created the fewest openings because its acidity limited hydration and metabolism, whereas hydrogen peroxide and tea extract produced intermediate openings. Increased concentrations, particularly 6%, promoted greater floret opening in all treatments. Aspirin 6% produced the largest opening in the A×B interaction, while low-concentration

Table 4.5: Effect of different preservative solutions and concentrations on ph of vase solution in tuberose at different observation intervals.

FACTOR-A	**pH Day4**	**pH Day6**	**pH Day8**
Aspirin	5.83 ± 0.07^{d}	5.93 ± 0.08^{d}	6.09 ± 0.10^{c}
Citric acid	5.30 ± 0.21^{e}	3.75 ± 0.06^{e}	4.17 ± 0.04^{e}
Hydrogen peroxide	6.19 ± 0.04^{b}	6.12 ± 0.06^{c}	6.01 ± 0.06^{d}
Tea extract	6.51 ± 0.05^{a}	6.78 ± 0.09^{a}	6.98 ± 0.05^{a}
Tulsi extract	6.02 ± 0.06^{c}	6.30 ± 0.04^{b}	6.58 ± 0.07^{b}
CD (A)	0.05	0.06	0.04
SE(m)	0.02	0.02	0.02
SE(d)	0.03	0.03	0.02
FACTOR-B	**pH Day4**	**pH Day6**	**pH Day8**
2%	6.02 ± 0.35^{a}	5.82 ± 1.10^{a}	6.00 ± 0.99^{a}
4%	5.98 ± 0.44^{b}	5.76 ± 1.05^{b}	5.95 ± 1.01^{b}
6%	5.91 ± 0.49^{c}	5.75 ± 1.11^{b}	5.95 ± 0.99^{b}
CD (B)	0.04	0.04	0.03
SE(m)	0.01	0.02	0.01
SE(d)	0.02	0.02	0.02
A×B	**pH Day4**	**pH Day6**	**pH Day8**
Aspirin- 2%	5.84 ± 0.05^{d}	6.04 ± 0.04	6.21 ± 0.05^{e}
Aspirin - 4%	5.85 ± 0.08^{d}	5.87 ± 0.03	6.05 ± 0.02^{fg}
Aspirin- 6%	5.79 ± 0.07^{d}	5.90 ± 0.05	6.01 ± 0.05^{fgh}
Citric acid- 2%	5.54 ± 0.08^{e}	3.77 ± 0.03	4.19 ± 0.03^{i}
Citric acid- 4%	5.28 ± 0.05^{f}	3.80 ± 0.05	4.14 ± 0.04^{i}
Citric acid- 6%	5.08 ± 0.03^{g}	3.69 ± 0.04	4.19 ± 0.03^{i}
Hydrogen peroxide- 2%	6.15 ± 0.03^{b}	6.13 ± 0.02	6.08 ± 0.02^{f}
Hydrogen peroxide- 4%	6.23 ± 0.02^{b}	6.12 ± 0.06	5.99 ± 0.03^{gh}
Hydrogen peroxide- 6%	6.20 ± 0.03^{b}	6.10 ± 0.10	5.96 ± 0.05^{h}
Tea extract- 2%	6.54 ± 0.04^{a}	6.85 ± 0.08	6.93 ± 0.04^{b}
Tea extract- 4%	6.53 ± 0.03^{a}	6.74 ± 0.02	7.03 ± 0.04^{a}
Tea extract- 6%	6.46 ± 0.05^{a}	6.75 ± 0.14	6.97 ± 0.04^{ab}
Tulsi extract- 2%	6.02 ± 0.08^{c}	6.31 ± 0.04	6.60 ± 0.07^{cd}
Tulsi extract- 4%	5.98 ± 0.08^{c}	6.27 ± 0.02	6.53 ± 0.02^{d}
Tulsi extract- 6%	6.04 ± 0.01^{c}	6.32 ± 0.04	6.61 ± 0.10^{c}
CD (A×B)	0.09	-	0.08
SE(m)	0.03	0.03	0.03
SE(d)	0.04	0.05	0.04

citric and tulsi extracts produced the least opening (Table 4.2). Thus, the best aspirin dosage for encouraging floral show was 6% (Fig. 1).

pH

The pH of vase solutions was significantly affected by chemicals and concentrations, with interaction effects notable on Days 4 and 8. Citric acid maintained the lowest pH (3.75–5.30), while the polyphenols in tea and tulsi extracts created alkaline solutions. By keeping the pH close to neutral, aspirin and hydrogen peroxide promoted hydration and decreased microbial activity (Ikram *et al*., 2012; Verma & Shukla., 2015). Greater solute dissociation was indicated by a fall in pH with increasing concentration. Citric acid had the lowest pH at 6%, while tea had the highest at 4% (Fig. 1). Aspirin and citric acid provided greater stability than natural extracts, and keeping the pH between 4 and 6 was shown to be optimal for freshness (Table 4.5).

Vase Life

Chemical treatments significantly influenced vase life, though concentration alone showed no statistical effect. Concentration behaved differently within each chemical, according to a substantial A×B interaction (Table 4.6). Shil *et al*., (2017); Singh & Sisodia., (2017) showed that due to improved water intake, delayed senescence, and decreased microbial obstruction, aspirin provided the longest vase life (11.28 days), particularly at 6% (11.82 days). Tulsi and citric acid produced lower longevity

Table 4.6: Effect of different preservative solutions and concentrations on vase life of cut tuberose spikes.

FACTOR-A	Vase life days
Aspirin	11.28 ± 0.62^{a}
Citric acid	7.92 ± 0.37^{c}
Hydrogen peroxide	8.20 ± 0.26^{bc}
Tea extract	8.45 ± 0.39^{b}
Tulsi extract	8.11 ± 0.40^{c}
CD (A)	0.31
SE(m)	0.11
SE(d)	0.15
FACTOR -B	**Vase life days**
2%	8.65 ± 1.46
4%	8.80 ± 1.03
6%	8.92 ± 1.53
CD (B)	-
SE(m)	0.08
SE(d)	0.12
A×B	**Vase life days**
Aspirin- 2%	11.40 ± 0.54^{a}
Aspirin- 4%	10.61 ± 0.28^{b}
Aspirin- 6%	11.82 ± 0.22^{a}
Citric acid- 2%	7.62 ± 0.15^{e}
Citric acid- 4%	7.92 ± 0.35^{de}
Citric acid- 6%	8.22 ± 0.36^{d}
Hydrogen peroxide- 2%	8.16 ± 0.20^{de}
Hydrogen peroxide- 4%	8.20 ± 0.41^{d}
Hydrogen peroxide- 6%	8.25 ± 0.23^{d}
Tea extract- 2%	8.14 ± 0.39^{de}
Tea extract- 4%	8.83 ± 0.11^{c}
Tea extract- 6%	8.38 ± 0.26^{cd}
Tulsi extract- 2%	7.94 ± 0.17^{de}
Tulsi extract- 4%	8.45 ± 0.45^{cd}
Tulsi extract- 6%	7.93 ± 0.40^{de}
CD (A×B)	0.54
SE(m)	0.19
SE(d)	0.26

because of turbidity or acidity-related stress, whereas hydrogen peroxide and tea extract had moderate results (Fig. 3). Chemical type continued to be the most important determinant, even if larger concentrations marginally extended vase life (Khongwir *et al*., 2017; Motaghayer *et al*., 2009). Aspirin consistently outperformed other medications in terms of prolonging vase life (Fig. 1).

Sensory Parameters

Chemical treatments and concentrations significantly affected sensory parameters including color, freshness, shape, petal retention, and overall acceptability, though their interaction was non-significant. Due to its capacity to postpone senescence and preserve hydration, aspirin received the highest marks. Citric acid had the lowest grade because of its high acidity, which causes early tissue dryness, whereas tea, tulsi, and hydrogen peroxide offered moderate visual quality retention (Kumar *et al*., 2020; Kumar., 2012). All treatments showed enhanced sensory scores at higher concentrations (2–6%). Aspirin at 6% continuously offered the best aesthetic quality and maximum approval throughout vase life, despite non-significant interactions (Table 4.7).

Conclusion

From the conducted experiment of post-harvest shelf life of tuberose (*Polianthestuberosa* Linn.) in different vase solutions showed that concentration and chemical treatment had a significant impact on both physiological and cosmetic quality. The most successful therapy was aspirin (acetylsalicylic acid) at 6%, which greatly increased solution uptake, decreased transpiration loss, maintained pH, improved floret opening and diameter, and prolonged vase life. Salicylic acid, which enhances water absorption, postpones senescence, stabilizes cell membranes, and inhibits microbial development, is responsible for its efficacy. While citric acid decreased microbial activity but limited floral development because of its high acidity, hydrogen peroxide provided minor benefits by preserving solution purity.Despite their inherent antibacterial qualities, tulsi and tea extract caused poor hydration and increased turbidity, which shortened the vase life. Aspirin received the top ratings for color, freshness, petal retention, and general attractiveness in the sensory examination. As a result, 6% aspirin is suggested as a cost-effective and effective tuberose preservative.

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Table 4.7: Effect of different preservative solutions and concentrations on sensory parameters of cut tuberose spikes during vase life.

FACTOR-A	Color	Freshness	Shape appearance	Petal retention	Overall acceptability
Aspirin	8.56 ± 0.86^{a}	8.37 ± 1.02^{a}	8.58 ± 0.66^{a}	8.47 ± 1.01^{a}	8.49 ± 0.89^{a}
Citric acid	5.61 ± 0.63^{c}	5.60 ± 0.59^{c}	5.27 ± 0.69^{c}	5.32 ± 0.69^{d}	5.59 ± 0.49^{c}
Hydrogen peroxide	6.24 ± 0.59^{b}	6.29 ± 0.66^{b}	6.28 ± 0.58^{b}	5.90 ± 0.90^{cd}	6.21 ± 0.45^{b}
Tea extract	6.59 ± 0.59^{b}	6.76 ± 0.83^{b}	6.54 ± 0.72^{b}	6.56 ± 0.95^{bc}	6.62 ± 0.71^{b}
Tulsi extract	6.73 ± 0.48^{b}	6.69 ± 0.89^{b}	6.63 ± 0.66^{b}	6.89 ± 0.81^{b}	6.64 ± 0.48^{b}
CD (A)	0.53	0.62	0.58	0.83	0.45
SE(m)	0.19	0.21	0.20	0.29	0.16
SE(d)	0.26	0.3	0.28	0.4	0.22
FACTOR-B	**Color**	**Freshness**	**Shape appearance**	**Petal retention**	**Overall acceptability**
2%	6.43 ± 1.20^{b}	6.32 ± 1.04^{b}	6.41 ± 1.22^{b}	6.29 ± 1.30^{b}	6.44 ± 1.14^{b}
4%	6.55 ± 1.04^{b}	6.54 ± 0.80^{b}	6.51 ± 1.16^{b}	6.43 ± 1.21^{b}	6.46 ± 0.83^{b}
6%	7.26 ± 1.16^{a}	7.36 ± 1.48^{a}	7.06 ± 1.37^{a}	7.16 ± 1.49^{a}	7.23 ± 1.31^{a}
CD (B)	0.41	0.48	0.45	0.64	0.35
SE(m)	0.14	0.17	0.15	0.22	0.12
SE(d)	0.2	0.23	0.22	0.31	0.17
A×B	**Color**	**Freshness**	**Shape appearance**	**Petal retention**	**Overall acceptability**
Aspirin- 2%	8.43 ± 0.68	8.17 ± 0.25	8.17 ± 0.50	8.20 ± 0.35	8.33 ± 0.40
Aspirin- 4%	8.07 ± 1.01	7.63 ± 0.65	8.37 ± 0.31	7.93 ± 0.93	7.80 ± 0.69
Aspirin- 6%	9.17 ± 0.75	9.30 ± 1.21	9.20 ± 0.72	9.27 ± 1.27	9.33 ± 0.83
Citric acid- 2%	5.27 ± 0.45	5.43 ± 0.31	5.03 ± 1.01	4.90 ± 0.78	5.17 ± 0.21
Citric acid- 4%	5.43 ± 0.68	5.90 ± 0.40	5.33 ± 0.40	5.33 ± 0.76	5.77 ± 0.50
Citric acid- 6%	6.13 ± 0.55	5.47 ± 0.97	5.43 ± 0.78	5.73 ± 0.40	5.83 ± 0.51
Hydrogen peroxide- 2%	5.67 ± 0.42	5.90 ± 0.20	6.10 ± 0.44	5.93 ± 1.42	5.90 ± 0.46
Hydrogen peroxide- 4%	6.40 ± 0.61	6.20 ± 1.00	6.37 ± 0.92	5.73 ± 0.98	6.23 ± 0.45
Hydrogen peroxide- 6%	6.67 ± 0.21	6.77 ± 0.35	6.37 ± 0.47	6.03 ± 0.42	6.50 ± 0.36
Tea extract- 2%	6.23 ± 0.32	6.03 ± 0.32	5.90 ± 0.66	5.87 ± 0.35	6.17 ± 0.32
Tea extract- 4%	6.27 ± 0.38	6.57 ± 0.45	6.50 ± 0.50	6.53 ± 1.36	6.27 ± 0.40
Tea extract- 6%	7.27 ± 0.35	7.67 ± 0.60	7.23 ± 0.21	7.27 ± 0.40	7.43 ± 0.49
Tulsi extract- 2%	6.53 ± 0.38	6.07 ± 0.67	6.87 ± 0.50	6.53 ± 0.25	6.63 ± 0.35
Tulsi extract- 4%	6.60 ± 0.26	6.40 ± 0.17	5.97 ± 0.64	6.63 ± 0.15	6.23 ± 0.32
Tulsi extract- 6%	7.07 ± 0.67	7.60 ± 0.87	7.07 ± 0.25	7.50 ± 1.30	7.07 ± 0.42
CD (A×B)	-	-	-	-	-
SE(m)	0.32	0.37	0.35	0.49	0.27
SE(d)	0.45	0.53	0.49	0.7	0.39

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