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The Effect of Sugar Concentration on the Freshness of Chrysanthemum *(Chrysanthemum morifolium)*

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ABSTRACT

This study investigates the effect of sugar solution concentrations on the freshness retention of cut flowers, specifically Chrysanthemum (Chrysanthemum morifolium). By utilizing varying sugar concentrations (0%, 10%, 20%, and 30%) in experiment over four days, the research aims to assess how sugar, a non-electrolyte, influences decay rates. Results indicate that higher sugar concentrations significantly prolong the freshness of both flower types by providing energy and regulating osmotic pressure. However, excessive sugar can promote microbial growth, potentially accelerating decay. Statistical analyses using SPSS revealed that sugar concentration affects decay rates, with the 9.09% concentration yielding the most favorable results. The findings underscore the importance of optimizing sugar concentrations in preservative solutions to extend the shelf life of cut flowers while managing microbial activity effectively. This research contributes valuable insights into post-harvest flower management, highlighting sugar's critical role in maintaining floral quality.

Keywords: Sugar solution, Freshness retention ,Cut flowers, Microbial growth,Osmotic pressureconsist

1. INTRODUCTION

The freshness of cut flowers plays a crucial role in the floriculture industry, as it significantly affects the quality and visual appeal of flowers. One widely applied technique for extending the freshness of cut flowers is adding certain substances to the preservative solution, such as sugar,

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which acts as a non-electrolyte solution. Sugar serves as an energy source for the cut flowers, helping to maintain their metabolic activity. By providing an additional energy supply, the flowers can stay fresh longer, delaying the wilting process and preventing senescence.[1] This study uses varying concentrations of sugar at 10%, 20%, and 30% to evaluate its effect on the longevity of aster (Aster spp.) and chrysanthemum (Chrysanthemum spp.) flowers. Chrysanthemums, or mums, belonging to the Asteraceae family, come in a variety of colors and shapes, making them popular for floral arrangements and decorations. Chrysanthemums are known for their long-lasting beauty and deep symbolism in various cultures. Although chrysanthemums have a longer lifespan than some other cut flowers, the metabolism within the flower tissues continues after cutting, requiring special care to maintain their freshness. Adding sugar to the preservative solution is an effective approach to keeping chrysanthemums' appearance fresh and aesthetic for as long as possible.[2]

The use of external holding solutions, particularly sugars combined with antimicrobial agents, can have a positive effect on prolonging the vase life of cut flowers. The concentration of sugar required in the holding solution varies depending on the type of flower being treated, with most flowers requiring a sugar concentration of 2%. However, some flowers may require higher concentrations, up to 4-6%, while others may be damaged if treated with concentrations higher than 1%.[3] The concentration of sugar in the preservative solution can significantly affect its effectiveness in maintaining the freshness of flowers. At low concentrations (around 10%), sugar can provide sufficient energy to slow down the aging process. However, at higher concentrations (20% and 30%), in addition to serving as an energy source, sugar can also affect the osmotic pressure of the solution. If the osmotic pressure of the solution is too high, the flowers will have difficultyabsorbing water, potentially accelerating the wilting process. Therefore, it is essential to determine the optimal sugar concentration to balance between providing energy and the osmotic effect.[4]

Previous studies have shown that adding sugar to preservative solutions can significantlyextend the shelf life of cut flowers. The quality of cut flowers and their postharvest longevity depend on factors that can delay the aging process. Handling conditions, the environment, plant hormone performance, carbohydrate content, and water relations are the main factors that play a crucial role in the regulation of cut flower senescence. Postharvest techniques and technologies continuously strive to regulate senescence factors, improve the quality of cut flowers, and extend their shelf life.[5] The use of sugar to slow down flower aging is also related to the activity of certain enzymes involved in carbohydrate metabolism. One such enzyme, invertase, converts sucrose into glucose and fructose, which are more easily absorbed as energy sources by the flower cells. This activity is crucial for maintaining cellular function and reducing aging symptoms such as wilting and petal color changes. However, using sugar in preservative solutions also poses a risk of increasing the growth of microorganisms, which can accelerate stem decay. Therefore, adding antimicrobial agents, such as silver nitrate or citric acid, to the solution is recommended to inhibit the growth of harmful microorganisms. The combination of sugar and antimicrobial agents can have a synergistic effect in extending the freshness of cut flowers.[6]

In this study, the effect of various sugar concentrations on aster and chrysanthemum flowers will be analyzed to determine whether there is a significant difference in the freshness retention of both. Factors such as tissue structure, type of metabolism, and water requirements of each flower type may affect the study's outcome. It is hoped that this study can provide a deeper understanding of the role of sugar in extending the life of cut flowers and help determine the optimal sugar concentration to maintain the beauty and freshness of aster and chrysanthemum flowers. Research on the effect of adding sugar as a non-electrolyte solution on the freshness retentionof cut flowers, such as aster and chrysanthemum, is an important effort to maintain the

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beauty of flowers for a longer period. Aster (Asteraceae) and chrysanthemum (Chrysanthemum) are popular ornamental flowers with high economic value. Aster has star-like petals, while chrysanthemum offers various shapes and colors, making it a top choice in flower decorations. Although both flowers experience quality degradation after being cut, post-harvest treatments such as soaking in a sugar solution can help prolong their freshness.[7]

Adding sugar to the preservative solution serves as an energy source to support the respiration and metabolism of the flowers. Sugar provides sufficient energy to maintain cellular activity, thus delaying wilting.[8] Higher sugar concentrations, such as 20-30%, have been shown to effectively extend freshness longer compared to lower concentrations. Additionally, sugar acts as an osmoregulator, helping to regulate osmotic pressure within the flower tissues, maintaining water balance and cellular flexibility. Chrysanthemum, in particular, shows a positive response to soaking in various sugar concentrations. Higher concentrations can extend freshness by providing more energy for cellular metabolism. However, if the sugar concentration is too high, the osmotic pressure may become too great, hindering the flower from absorbing water optimally, thus accelerating wilting. Therefore, determining the optimal concentration is crucial to balance the energy provision and osmoticregulation effects.[9]

The addition of antimicrobial agents to the sugar solution can also enhance treatment effectiveness. Substances such as silver nitrate or citric acid can inhibit the growth of microorganisms that accelerate flower stem decay. The combination of sugar and antimicrobial agents provides a synergistic effect in extending the lifespan of cut flowers. This is important because using sugar without additional preservatives may increase microbial growth.[10] Using sugar also reduces ethylene production, a hormone that accelerates aging and petal shedding. By inhibiting ethylene production, flowers can retain their structure longer. Moreover, enzymes such as invertase that convert sucrose into glucose and fructose facilitate the flowers' absorption of the needed energy, reducing aging symptoms like wilting and color changes.[11] The objectives of this study are to determine the effect of sugar solution concentration on the decay rate of chrysanthemums and asters,to compare the decay duration of chrysanthemums and asters with and without the addition of a sugar solution and to analyze how non-electrolyte solutions affect microorganism activity during the decay process.

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

This study employed a laboratory experimental method with a completely randomized design (CRD) to observe the effect of sugar solution as a non-electrolyte on the decay of cut flowers. The samples used were aster and chrysanthemum flowers, cut simultaneously to ensure uniformity. The treatments involved immersing the flowers in sugar solutions with various concentrations (0%, 9.09%, 16.6%, and 23.07%), while the control group was immersed in water without any sugar solution. Observations were conducted daily over several days until the flowers showed signs of decay. The measured parameters included changes in visual quality (color, wilting, and damage)and the flowers' freshness duration.

The study period was from October 18 to October 28, 2024, with observations carried out over a span of 4 days (4 x 24 hours). The research took place at Universitas Negeri Medan. Data collection involved using experimental data as the primary data, supplemented by a literature review of previous studies from various journals and available books.

This study utilized various tools and materials to examine the impact of sugar solution concentration on the freshness of cut flowers. The tools employed during the experiments included a beaker for mixing and

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accurately measuring the sugar solution, a stirring rod to ensure thorough dissolution of sugar in water, a graduated cylinder for precise measurement of the solution volume, and plastic cups to hold the sugar solution for each treatment.

The materials selected for the study were chrysanthemums (Chrysanthemum morifolium) and asters (Aster spp.), chosen for their aesthetic appeal and economic significance in the floriculture industry. Sugar served as the energy source to help prolong the flowers' freshness, while water acted as both the solvent for the sugar and the medium in which the flowers were placed. The combination of these tools and materials aimed to yield precise and meaningful results in assessing the effect of sugar solution on the freshness of cut flower.

2.2. Research Procedure

The procedures followed in this study were as follows: First, 100 ml of water was measured into each graduated cylinder. Then, granulated sugar was weighed using an analytical balance, with amounts of 10 grams, 20 grams, and 30 grams for each sample. The sugar was subsequently added to the plastic cups containing water and mixed thoroughly until dissolved. To promote better absorption of the solution, the ends of the chrysanthemums and asters' stems were cut. Each stem was then placed in a separate plastic cup, with each cup labeled to indicate the flower being tested. Lastly, observations were made, and any changes in the flowers were recorded throughout the course of the experiment.

3. RESULTS AND DISCUSSION

3.1. Analysis of Characterization Results

Based on the experiments conducted, the number of flower petals that experienced decay or damage was observed at intervals of every 6 hours, and the results of the observations obtained can be seen in Figure 1.

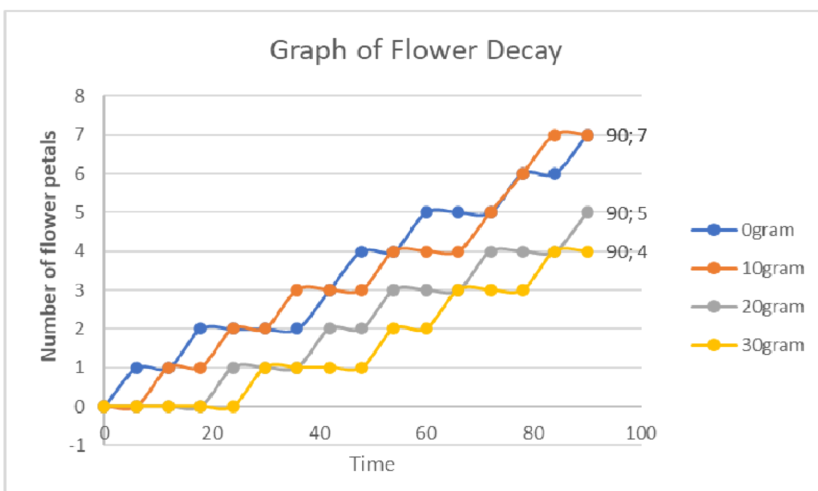

Figure 1. Graph of the Number of Decayed Chrysanthemum Petals

Figure 2. The chrysanthemum flower before being place in the sugar solution

Figure 3. The chrysanthemum flower after being left in the sugar

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Based on the research findings, although chrysanthemums have different structures, sugar concentration is highly effective for both flower types. Aster, being more delicate, may require a lower concentration compared to chrysanthemums, which have a stronger stem structure. This study is also supported by research from Budiarto, which suggests that the appropriate sugar concentration for each flower type should consider factors such as tissue structure and water requirements. Overall, the use of sugar in preservative solutions for cut flowers shows promising results in extending freshness, which can be used to determine the optimal concentration to improve the quality of cut flowers in the floriculture industry.[12]

3.2 Data Analysis Using SPSS

- *SPSS Normality Test*

  The normality test is intended to determine whether the obtained data is normally distributed or not. The primary data obtained from the observations is the number of flower petals that experienced decay every 1 x 6 hours of observation can be seen in Table 2.

Table 2. Test of Normality

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	SOLUTIONS	Statistic	df	Sig.	Statistic	df	Sig.
KELOPAK	Q1	.191	16	.122	.947	16	.437
	Q2	.119	16	.200*	.947	16	.446
	Q3	.172	16	.200*	.906	16	.100
	Q4	.213	16	.052	.870	16	.027

*. This is a lower bound of the true significance.

In the SPSS output table, it can be seen that the Sig values for Q1-Q3 are greater than 0.05 (normal), which indicates that the obtained data is normally distributed. However, for Q4, the value is less than 0.05 (not normal), which means that the data does not meet the normality requirement.

- *Homogeneity Test of Data*

  The homogeneity test is conducted to determine whether the obtained data is homogeneous or not. The normality test must first be satisfied (normal) before proceeding with the ANOVA analysis can be seen in Table 3.

Table 3. Tests of Homogeneity of Variaces

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
KELOPAK	Based on Mean	1.288	3	60	.287
	Based on Median	1.249	3	60	.300
	Based on Median and with adjusted df	1.249	3	51.785	.302
	Based on trimmed mean	1.293	3	60	.285

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In the SPSS output table, it can be seen that the significance value of the data is 0.285, or P Value > 0.05 (normal), which indicates that the obtained data is homogeneous.

- *Anova Test*

ANOVA test was conducted in Table 4. It can to determine whether there is a significant effect between sugar concentration and the number of flower decays based on the obtained data.

Table 4. Anova Test

ANOVA

KELOPAK

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	39.797	3	13.266	3.688	.017
Within Groups	215.813	60	3.597		
Total	255.609	63			

In the SPSS output table, it can be seen that the significance value of the one-way ANOVA test is 0.17, or P Value < 0.05 (normal), which means that the concentration of sugar in the solution affectsthe decay of the flower samples. The higher the sugar concentration in the solution, the less likely the flower petals are to decay. This finding is consistent with research by Eka Susila and Jonni in 2021, which examined the impact of sugar solutions with varying concentrations of electrolyte solutions on the freshness of cut chrysanthemums (Chrysanthemum sp). Their study found significant differences in the freshness of flowers soaked in sugar solutions combined with non-electrolyte solutions at different concentrations, based on factors such as flower freshness duration, length of decaying stems, number of flowers still blooming, wilting, and dropping. The study concluded that the higher the concentration of the non-electrolyte solution, the longer the flowers' freshness was maintained, which supports the results of the present study.

Therefore, this analysis contributes to determining more effective flower care and enhancing the understanding of the significant role sugar plays in extending the shelf life of cut flowers.[13] The prolonged freshness of chrysanthemums is evident when soaked in a sugar solution compared to plain water. The difference in results occurs because using a sugar solution with a precisely adjusted concentration, such as three tablespoons per liter of water, shows better results in maintaining the aesthetic quality and petal integrity of flowers over a longer period. Aster flowers exhibit a similar response, where adding sugar helps maintain cellular water levels, delay wilting, and extend freshness, especially when combined with other preservatives like ascorbic acid.[14] In general, sugar plays an essential role in delaying decomposition, maintaining cell structure, and keeping metabolism active in cut flowers. [15] Other studies also state that adding a concentration of sugar with two tablespoons of vinegar per liter of distilled water can extend the vase life of Chrysanthemum cut flowers. This supports the research that states sugar plays an important role in plants as a substance for respiration; adding sucrose to the vase water effectively improves the vase life of cut flowers. The coefficient of variation (CV) of 6.98% indicates that the dataset is more stable or consistent and has lower relative variability.[16] These effects include reducing oxidative stress, which can accelerate aging. However, it is important to carefully regulate sugar concentration because excessive amounts can

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increase the growth of microorganisms in the solution, speeding up decay. Sugar concentrations of 10%, 20%, and 30% yield varied results, with lower concentrations typically effective in maintaining freshness without excessively increasing the risk of microbial.

4. CONCLUSION

The concentration of the sugar solution significantly impacts the rate of decay in chrysanthemum waste. Depending on the interaction between sugar and microorganisms, sugar solutions at specific concentrations can either accelerate or slow down the decay process. The decay of chrysanthemum waste with the addition of sugar solution shows a notable difference in decay time compared to those without sugar. The addition of sugar tends to speed up the decay process due to increased microbial activity. Non-electrolyte solutions, such as sugar solutions, can influence microbial activity during decay. Sugar serves as an easily accessible energy source, which can enhance the metabolic rate of microorganisms and accelerate the decay process.

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Based on the research conducted, further testing is necessary with solution concentrations that have a narrower range of differences to ensure the accuracy of the data regarding the impact of sugar concentration on flower longevity. It is also important to note that this experiment was carried out on only one plant variety; future studies should include several different plant varieties to determine whether the effect of sugar concentration on flower durability can be generalized across all plant types.

We would also like to extend our gratitude to all those who contributed to this research. The study on the effect of sugar concentration on flower freshness offers valuable insights for the floriculture industry and is expected to provide a foundation for future research. We hope the findings of this study will be beneficial in developing techniques for the care of cut flowers, thereby improving the quality and aesthetic appeal of flowers in various applications.

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