Effect of Some Preservative Solutions on Vase Life of *Helianthus annuus*

Samar E. Hussein
Antoniadis Research Branch, Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., Agricultural Research Center, Alexandria, Egypt

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ABSTRACT: This experiment was carried out during two successive seasons of (2020-2021) on Sunflower *Helianthus annuus* cut flowers at Antoniades Research Branch, Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., ARC, Alexandria, Egypt. To study the effect of some preservative solutions on vase life of *Helianthus* annuus. Completely randomized designed (CRD) experiment with three replicates for each treatments were conducted as follow: control (distilled water), Silver thiosulphate (STS) (0.06 and 0.08 mM +Sucrose 3%), Nano-silver thiosulphate (NST) at (5 and 7.5 mg/l +Sucrose 3%), 8-hydroxyquinoline sulphate (8-HQS) at (200 mg/l +Sucrose 2%), Mint oil at (50 and 75 mg/l +Sucrose 3%) and Thyme oil at (50 and 75 mg/l +Sucrose 3%). In both seasons, results showed that all seasons treatments increased fresh weight, water uptake, vase life, flower diameter, and chemical characters such as Chlorophyll a, chlorophyll b, total chlorophyll, carotene pigments, carbohydrates, total sugars, and reducing sugars when compared to control. However, NST at (7.5) mg/l, STS at 0.08 mM, thyme oil 75 mg/l and mint oil 75 mg/l were more successful than other treatments in improving quality parameters.

Keywords: *Helianthus annuus, nano sliver, Sunflower, vase life, pulsing solutions, cut flowers, essential oils, chemical characters*

INTRODUCTION

Among horticultural exports, cut flowers are one of the most important sources of national wealth. Commercial floriculture has long been recognized as an economic industry that generates jobs and significant foreign exchange in a variety of places across the world. Egypt, with its favorable environmental circumstances, might be a good source of cut flowers for both domestic and international markets. There are a variety of decorative cultivars of the frequently farmed sunflower (*Helianthus annuus* L.). Cut flowers, potted plants, and gardens are all popular uses for ornamental sunflowers (Kaya *et al.*, 2012). As a result, the ornamental sunflower's breeding is dependent on its application. Breeding for acceptable plant architecture and morphology, floral performances, blossom length, and other features is a common feature of all ornamental sunflowers (Atlagi *et al.*, 2005). The annual cultivated sunflower is *Helianthus annuus* L. The Helianthus genus had 67 species. Helianthus is derived from the Greek words "helios" and "anthos," which mean "sun" and "flower," respectively. The annual sunflower is a member of the Asteraceae family, which is the biggest flowering plant family (Parmeshwar, 2010). As a result of breeding operations for the cut flower industry, new varieties of attractive sunflowers have been developed. Because of its unusual shape and many hues of flowers, these cultivars have made the sunflower a well-known commodity in flower arrangements, adding energy and activity to the environment. There is minimal research on postharvest technologies for this species when grown for decorative purposes because it is a new product in the floriculture marketplace (Nascimento *et al.*, 2019). Sunflower (*Helianthus annuus* L.) is a relatively new crop among world field crops, and it is unique in that it has a wide range of applications. It's been used as an oilseed crop, confection, and bird seed, and more recently as an ornamental plant for home gardens and cut flowers in a variety of colours (Schoellhorn *et al.*, 2003). The decorative sunflower (*Helianthus annuus* L.) has marketing value as a cut flower and ornamental plant due to the beauty of its inflorescence, which comes in a variety of shapes and colours that correspond to a wide range of customer tastes (Baldotto and Baldotto 2015). Sunflower crops have a short growing cycle and hence provide a quick return on investment. It also has a high level of propagation, control, and photosynthetic efficiency. Sunflower is one of the most widely grown crops, adapting well to a variety of settings (Da Silva *et al.*, 2018).

For improving the longevity of cut flowers, several solutions were used as pulsating or preservative solutions. Those chemicals are very expensive and the most dangerous preservative for humans, causing irritation to the skin, eyes, and respiratory tract. Using natural items as safe materials in vase solutions did not receive much attention (Mohamed, 2015). For large-scale applications, an appropriate approach for vase life extension that uses easy-to-use, natural, safe, and economical ingredients is always critical (Soleimany-Fard *et al.*, 2013). Essential oils (EOs) are natural products derived from plant materials that can be utilized as natural additions to a variety of crops because to their antibacterial, antifungal, antioxidant, and anticarcinogenic qualities (Teissedre and Waterhouse, 2000).

Silver nanoparticles are one of the most studied nanomaterials, with unique optical, catalytic, sensing, and antibacterial capabilities that have captivated scientists (Wu *et al.*, 2012). Among the nanoparticles, silver nanoparticles are particularly appealing because of their antibacterial sterilization properties (Solgi, 2014). Nanometer-sized silver (Ag+) particles (NS) are thought to suppress bacteria and other microorganisms more effectively than Ag in various oxidation states, Ag, Ag+, Ag2+, Ag3+, because of their high surface area to volume ratio (Furno *et al.*, 2004).

This research examined the effects of several materials as preservative solutions that are both effective and safe for humans and the environment silver thiosulphate (STS), Nano-silver thiosulphate (NST), 8-hydroxyquinoline sulphate (8-HQS), Mint oil, and Thyme oil). The goal of this study was to use essential oils and certain treatments to enhance the vase life of sunflowers, And also, to determine the most effective concentration among the components used in the production of the highest quality cut flowers with the longest vase life.

MATERIALS AND METHODS

The present study was conducted at Antoniades Research Branch, Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., ARC, Alexandria, Egypt during the two successive seasons of 2020 and 2021 in June.

Preparation of cut flowers

Cut flowers *Helianthus annuus* L. cultivar "Sunbright Supreme" gotten from a well-known commercial nursery arly in the morning, at a consistent length and weight was then wrapped in a polyethylene sheet and swiftly transported to the laboratory, where it was kept at ambient temperature with normal relative humidity and lit by a white fluorescent lamp. All stems were cut back even to 40 cm and the leaves of the lower third part of stems were removed in order to avoid contamination in solutions of postharvest treatments as recommended by (Khimani *et al.*, 2005). For 24 hours, clipped flowers were placed in plastic containers with pulsating liquids containing various chemicals.

Compounds used in the experiments

- Control (distilled water) control cut flowers were pulsed in 1Liter tap water at the same time of the other treatments.
- Silver thiosulphate (STS) at 0.06 and 0.08 mM + 3% sucrose.
- Nano-silver thiosulphate (NST) at 5 and 7.5 mg/l.
- 8-hydroxyquinoline sulphate (8-HQS) at 200 mg/l + 2% sucrose.
- Mint oil at 50 and 75 mg/l + 3% sucrose.
- Thyme oil at 50 and 75 mg/l + 3% sucrose.

Pulsing solutions

For 24 hours, the flowers were pre-treated with pulsing solutions made from different treatments of Silver thiosulphate (STS) (0.06 and 0.08 mM + 3% sucrose), Nano-silver thiosulphate (NST) at (5 and 7.5 mg/l + 3% sucrose), 8 hydroxyquinoline sulphate (8-HQS) at (200 mg/l + 2% sucrose), Mint oil at (50 and 75 mg/l + 3% sucrose), and Thyme oil at (50 and 75 mg/l + 3% sucrose).

Holding solutions

The flowers were moved to Vases which contained 300 ml of distilled water to calculate the vase life and the tested parameters. Every three days, the water in the vases was replenished, and roughly 1 cm of the stems were clipped. Vases were exposed every day at night to light from a white fluorescent lamp for 12 hours and during the day were exposed to daylight. The room temperature was (33°±1 °C) for first experiment, while for the second (25°±1 °C), relative humidity (R.H.) was about (60- 70%).

Experimental layout

The treatments were arranged in a Completely randomized designed (CRD) experiment with three replicates for each treatment each replicate consisted of one glass bottle (vase) in which (3 cut sunflowers) were placed. Then each treatment was represented by 9 cut flowers/ treatment.

The collected data:

Sunflowers vase life (days):

The number of days on the vase until the petals wilt and the stem collapses was regarded as the end of the vase life of sunflowers. (Clark *et al.*, 2010).

Total fresh weight (g):

The average fresh weight of fresh stems carrying leaves and the flowers was calculated (Barakat, 2013).

Water uptake (g):

The volume of water uptake was calculated by subtracting the volume of water evaporated from a control bottle without cut flowers and the amount of water decreased in bottles containing flowers (Zamani *et al*., 2011).

Total dry weight (g):

At the fading stage the cut flowers were oven dried at 75 ℃ for 48 hours.

Flower diameter
The flower diameter was measured in centimeter at the full opening stage. The average was calculated and recorded.

Chemical analysis:
Chlorophyll (chlorophyll a, b and total) (mg/ g fresh weight) were determined in fresh leaves of sun flower, chlorophyll was determined according (Dawood, 1993). and Carotenoids content in Flowers (mg/100g FW) were determined calorimetrically in 5 g of the fresh petals according to the method described by (Alan, 1994). and reducing sugars content (mg g-1 dry weight) according to Miller (1959) at the end of the vase life of the control. Total sugar content in flowers (%) was calculated in dry flowers. Sugar were extracted from five grams of flowers and the total sugars were determined colorimetrically using phenol and sulphuric acid according to (Malik and Singh, 1980). Reducing sugar (%) was determined by Nelson arsenate – molybdate colorimetric method (Dubois *et al.*, 1956).

Statistical analysis
Data collected from the current research were statistically analyzed and comparison between means was done according to Duncan Multiple Range Test at probability level 05.0 (Little and Hills, 1978)

RESULTS
A)Physical characters

1-1 Total fresh weight
The effect of some chemicals and essential oil extracts on total fresh weight (g) of sunflower (*Helianthus annuus* L.) cut flowers are presented in Table (1). Results, generally, showed that all used treatments significantly increased the total fresh weight compared to control from initial time, 5 days, 8 days, 12 days and after 15 days. Results showed that concentrations of nano-silver thiosulphate at 7.5 mg/l applied on total fresh weight (g) recorded the maximum values of total fresh weight after 15 days (48.77 and 51.77 g), followed by STS 0.08 mM (47.55 and 50.55 g), thyme oil at 75mg/l (45.89 and 48.56 g), STS at 0.06 mM (45.29 and 48.29 g), 8 HQS (45.08 and 48.03 g) and nano-silver thiosulphate at 5 mg/l (44.14 and 47.14 g), during both seasons, respectively, as compared with the control treatment which recorded the minimum values of total fresh weight (42.43 and 45.43 g).

1-2 Total dry weight
Results in table (1) showed that all preservative solution had significant effect on total dry weight in the two experiments (2020-2021). Nano-silver thiosulphate at 7.5 mg/l (16.25-16.06) and STS 0.08 mM (15.83- 15.56) resulted in the greatest total dry weight for the first and second experiments, respectively. The lowest total dry weight was obtained by control (14.16-13.12g) for the first and second experiments, respectively

Table (1): Effect of some preservative solutions on total fresh and dry weight (g) of *Helianthus annuus* cut flowers in the two seasons of (2020-2021).

Treatments	Total Fresh weight (g) (initial time)		Total Fresh weight (g) (5) days		Total Fresh weight (g) (8) days		Total Fresh weight (g) (12) days		Total Fresh weight (g) (15) days		Total Dry weight (g)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control	51.18 e	61.79 g	75.70 i	83.17 g	71.25 i	81.80 i	51.93 g	67.18 i	42.43 i	45.43 i	14.16 h	13.12 d
STS 0.06 mM + 3% sucrose	51.34 c	63.18 e	78.12 g	85.43 d	74.48 d	83.54 f	54.83 d	69.37 f	45.29 d	48.29 d	15.08 d	15.46 b
STS 0.08mM +3% sucrose	51.84 a	63.92 a	81.29 b	86.28 b	76.88 b	85.73 b	57.23 b	71.43 b	47.55 b	50.55 b	15.83 b	15.56 a
NST 5 mg/l +3% sucrose	51.35 c	63.33 d	80.61 c	85.78 c	73.82 e	83.65 e	54.81 d	69.38 f	44.14 f	47.14 f	14.71 e	15.55 b
NST 7.5 mg/l +3% sucrose	51.85 a	63.74 b	83.12 a	86.78 a	77.66 a	86.44 a	57.35 a	71.57 a	48.77 a	51.77 a	16.25 a	16.06 a
8-HQS 200 mg/l +2% sucrose	51.54 b	63.41 d	79.52 e	85.76 c	73.24 f	84.28 d	56.14 c	69.55 d	45.08 e	48.03 e	15.05 d	15.47 b
M 50 mg/l +3% sucrose	51.26 d	63.04 f	77.08 h	85.17 f	74.51 d	82.83 h	56.19 c	68.53 h	43.86 g	46.86 g	14.61 f	15.45 b
M 75 mg/l +3% sucrose	51.55 b	63.62 c	78.57 f	85.35 e	72.33 h	82.92 g	53.93 f	69.47 e	43.24 h	46.24 h	14.41 g	14.74 c
T 50 mg/l +3% sucrose	51.37 c	63.16 e	78.53 f	85.18 f	73.14 g	83.48 f	56.14 c	69.28 g	43.81 g	46.81 g	14.61 f	15.25 b
T 75 mg/l +3% sucrose	51.54 b	63.60 c	79.94 d	86.28 b	76.18 c	85.64 c	54.17 e	69.75 c	45.89 c	48.56 c	15.28 c	15.28 b
L.S.D.(0.05)	**0.0754**	**0.0863**	**0.0654**	**0.0663**	**0.0741**	**0.0744**	**0.0616**	**0.0683**	**0.0901**	**0.0903**	**0.0616**	**0.2852**

STS: Silver thiosulphate, **NST**: Nano-silver thiosulphate, **8-HQS**: 8-hydroxyquinoline sulphate, **M**: Mint oil, **T**: Thyme oil and **L.S.D**: least significant difference at 0.05 level of probability

1-3 Water uptake (g)

Data concerning the effect of some preservative solutions on water uptake of *Helianthus annuus* sun flower cut flowers in the first and second experiment in June (2020-2021), are listed in Table (2). Data in general showed that all treatments increased water uptake compared with control. In addition, after 15 days of nano sliver thiosulphate application at 7.5 mg/l, STS at 0.08mM and thyme oil at (75mg/l) were more effective on increasing water uptake than other treatments.

1-4 Vase life (days)

The effect of some preservative solutions on vase life of *Helianthus annuus* in the first and second experiments, data show in Table (2) all the cut sunflowers had a significant difference in their coordinating age compared to the control. The flowering life is 16.30-16.64 days for the flowers treated with nano-silver thiosulphate concentration of 7.5 mg/l. While it reached the lowest at 8.96-9.06 days at the flowering age of flowers that hadn't been treated (control).

1-5 Flower diameter (cm)

Data presented in Table (3) showed that all treatments with different concentrations promoted flower diameter of *Helianthus annuus* sunflower. Treatment of 7.5 mg/l nano-silver thiosulphate gave the biggest sunflowers diameter at 5^{th} day (10.55 and 11.17 cm), followed by 75 mg/l thyme oil (9.45 and 10.37 cm) and 8-hydroxyquinoline at 200 mg/l (9.16 and 10.14 cm), respectively, as compared with the other treatments under study and control.

Table (2): Effect of some preservative solutions on Water uptake (g) and vase life (days) of *Helianthus annuus* cut flowers in the two seasons of (2020-2021).

Treatments	Water uptake (g) (2) days		Water uptake (g) (5) days		Water uptake (g) (8) days		Water uptake (g) (12) days		Water uptake (g) (15) days		Vase life (days)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control	25.06 h	28.09 g	52.05 j	56.57 e	40.23 j	48.64 e	25.78 f	38.12 e	15.51 h	14.65 c	8.96 e	9.06 e
STS 0.06 mM + 3% sucrose	26.26 e	30.19 e	64.41 f	58.03 cd	43.52 e	51.09 cd	28.06 c	38.61 d	16.48 f	15.08 c	11.83 d	11.76 d
STS 0.08 mM + 3% sucrose	26.85 b	31.17 b	68.73 b	63.06 a	46.61 a	53.49 a	30.57 a	43.44 a	19.32 b	18.64 a	15.73 a	15.43 b
NST 5 mg/l + 3% sucrose	26.43 d	30.49 d	63.08 i	58.07 cd	41.61 i	51.27 c	26.64 e	38.82 cd	19.08 c	16.28 b	13.30 bc	13.63 c
NST 7.5 mg/l + 3% sucrose	27.21 a	31.52 a	69.26 a	63.02 a	46.43 b	53.51 a	30.06 a	43.58 a	19.89 a	18.69 a	16.30 a	16.46 a
8-HQS 200 mg/l + 2% sucrose	26.45 d	30.64 c	64.12 g	58.02 cd	43.45 f	51.41 c	28.03 c	38.61 d	16.82 e	16.40 b	13.86 bc	13.93 c
M 50 mg/l + 3% sucrose	25.92 g	30.19 e	64.63 e	57.43 d	42.06 h	50.74 d	26.50 e	38.74 d	16.04 g	16.17 b	10.86 d	11.73 d
M 75 mg/l + 3% sucrose	26.76 c	30.07 f	67.05 c	58.30 c	45.5 c	52.38 b	29.27 b	40.14 b	16.80 e	16.18 b	14.16 b	14.06 c
T 50 mg/l + 3% sucrose	26.08 f	30.06 f	63.37 h	57.82 cd	42.60 g	51.11 cd	27.62 d	39.09 c	18.25 d	16.07 b	11.86 d	11.63 d
T 75 mg/l + 3% sucrose	26.22 e	31.08 b	65.09 d	60.45 b	43.75 d	53.41 a	29.17 b	43.27 a	19.26 b	18.52 a	12.96 c	13.73 c
L.S.D.(0.05)	**0.0470**	**0.0944**	**0.0439**	**0.6495**	**0.0529**	**0.4638**	**0.3207**	**0.3151**	**0.0674**	**0.9169**	**0.9644**	**0.8706**

STS: Silver thiosulphate, **NST**: Nano-silver thiosulphate, **8-HQS**: 8-hydroxyquinoline sulphate, **M**: Mint oil, **T**: Thyme oil and **L.S.D**: least significant difference at 0.05 level of probability

Table (3): Effect of some preservative solutions on Flower diameter (cm) of *Helianthus annuus* cut flowers in the two seasons (2020-2021)

Treatments	Flower diameter (cm)									
	0		5 days		8 days		12 days		15 days	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Control	7.02 g	6.74 i	7.09 b	6.84 j	5.75 j	5.42 i	4.17 h	4.07 j	2.94 j	2.84 j
STS 0.06 mM + 3% sucrose	7.94 cdef	7.46 h	8.46 ab	8.47 g	6.90 g	6.97 g	5.12 e	5.16 h	3.66 g	3.74 h
STS 0.08 mM + 3% sucrose	9.48 ab	9.93 b	7.15 b	9.47 d	8.47 b	8.89 b	6.84 b	7.17 b	5.27 c	5.67 c
NST 5 mg/l + 3% sucrose	8.05 cde	7.65 g	8.47 ab	8.37 h	5.29 f	7.31 f	5.74 d	5.76 f	4.47 f	4.75 f
NST 7.5 mg/l + 3% sucrose	9.95 a	10.87 a	10.55 a	11.17 a	8.85 a	9.65 a	7.16 a	7.55 a	5.66 a	6.15 a
8-HQS 200 mg/l + 2% sucrose	8.57 bcd	9.38 c	9.16 ab	10.14 c	7.78 d	8.66 c	6.27 c	6.76 c	4.74 e	5.56 d
M 50 mg/l + 3% sucrose	6.96 fg	6.47 j	7.43 ab	7.46 i	5.99 i	6.05 h	4.37 g	4.65 i	3.03 i	3.17 i
M 75 mg/l + 3% sucrose	7.65 def	8.75 f	9.13 ab	8.95 f	7.64 e	7.57 e	6.25 c	6.07 e	4.95 d	4.81 e
T 50 mg/l + 3% sucrose	7.54 efg	8.88 e	8.03 ab	9.14 e	6.53 h	7.57 e	4.83 f	5.66 g	3.28 h	4.15 g
T 75 mg/l + 3% sucrose	8.93 bc	8.97 d	9.45 ab	10.37 b	7.86 c	8.17 d	6.24 c	6.48 d	5.45 b	5.94 b
L.S.D.(0.05)	**0.9349**	**0.0798**	**0.7981**	**0.0523**	**0.0342**	**0.1770**	**0.0377**	**0.0304**	**0.0506**	**0.0340**

STS: Silver thiosulphate, **NST**: Nano-silver thiosulphate, **8-HQS**: 8-hydroxyquinoline sulphate, **M**: Mint oil, **T**: Thyme oil and **L.S.D**: least significant difference at 0.05 level of probability

A) Chemical characters

Results of Table (4) showed that all types of treatments, exhibited, highly significant effects on the studied Chlorophyll a 1.24-1.27, Chlorophyll b 1.14-1.06 and total chlorophyll 2.39-2.33. Nano silver thiosulphate (75mg/l) have properties to effectively increase target activity in the two seasons compared to control (0.63-0.65, 0.43-0.44 and 1.06-1.07, respectively)

Carotene pigments (mg/g)

Table (4) showed that Nano sliver thiosulphate 7.5mg/l (6.49-6.59), STS 0.08mM (6.40-6.43), thyme oil 75 mg/l (6.20-6.17) and mint oil 75 mg/l (5.89-5.76) had high significant results compared to control treatment.

Carbohydrates %

As for the treatment of nano sliver thiosulphate in Table (5) it showed that, the higher concentration 7.5 mg/l (2.27-2.15) significantly increase the Carbohydrates % compared to control and the lowest one (control) (1.75-1.78) in two seasons.

Total sugars (%)

Data are presented in Table (5). It has been found that all studied materials had remarkable significant effect on increasing vase life compared to control in both experiments. In addition, nano sliver thiosulphate at (7.5 mg/l) (3.22-3.28), STS at (0.08 mM)(3.23-3.27), thyme oil at (75 mg/l) (3.27-3.17) and mint oil at (75 mg/l) (3.13-3.11) in two experiments were more effective on increasing total sugars(%) than other treatments.

Reducing sugars (%)

Results in Table (5) showed that, the concentrations of nano sliver thiosulphate at 7.5 mg/l (0.106), significantly decreased the reducing sugars content compared to control in the first seasons. And mint oil at 75 mg/l (0.07) in the second season. And also data showed that the highest significant reduction in sugar content was obtained at control treatments in both seasons (1.39-1.36).

Table (4): Effect of some preservative solutions on chlorophyll a, chlorophyll b, total chlorophyll and carotene pigments (mg/g) of *Helianthus annuus* sunflower cut flowers in the two seasons of (2020-2021).

Treatments	Chlorophyll a		Chlorophyll b		Total chlorophyll		Carotene pigments (mg/g)	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Control	0.63 h	0.65 h	0.43 i	0.44 h	1.06 e	1.07 j	2.94 f	3.16 f
STS 0.06 mM + 3% sucrose	0.81 f	0.82 f	0.63 g	0.64 f	1.44 de	1.45 g	5.50 d	5.38 d
STS 0.08 mM + 3% sucrose	1.12 b	1.14 b	1.05 b	1.07 a	2.18 ab	2.23 b	6.40 ab	6.43 a
NST 5 mg/l + 3% sucrose	0.87 e	0.88 e	0.73 f	0.73 e	1.60 cd	1.61 f	5.56 d	5.53 cd
NST 7.5 mg/l + 3% sucrose	1.24 a	1.27 a	1.14 a	1.06 a	2.39 a	2.33 a	6.49 a	6.59 a
8-HQS 200 mg/l + 2% sucrose	0.96 d	0.97 d	0.83 e	0.84 d	1.79 bcd	1.82 e	5.65 d	5.59 cd
M 50 mg/l + 3% sucrose	0.71 g	0.71 g	0.52 h	0.54 g	1.71 bcd	1.26 i	5.09 e	4.95 e
M 75 mg/l + 3% sucrose	1.05 c	1.07 c	0.93 d	0.92 c	1.98 abc	2.00 d	5.89 c	5.76 c
T 50 mg/l + 3% sucrose	0.74 g	0.75 g	0.63 g	0.64 f	1.37 de	1.39 h	4.97 e	5.00 e
T 75 mg/l + 3% sucrose	1.13 b	1.12 b	0.96 c	0.97 b	2.09 ab	2.09 c	6.20 b	6.17 b
L.S.D.(0.05)	0.034	0.038	0.025	0.031	0.437	0.039	0.236	0.251

STS: Silver thiosulphate, **NST**: Nano-silver thiosulphate, **8-HQS**: 8-hydroxyquinoline sulphate, **M**: Mint oil, **T**: Thyme oil and **L.S.D**: least significant difference at 0.05 level of probability

Table (5): Effect of some preservative solutions on carbohydrates %, total sugars (%), and reducing sugars (%) of *Helianthus annuus* sunflower cut flowers in the two seasons of (2020-2021).

Treatment	**Carbohydrates %**		**Total sugars (%)**		**Reducing sugars (%)**	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**
Control	1.75 f	1.78 f	1.73 f	1.75 f	1.39 a	1.36 a
STS 0.06 mM + 3% sucrose	1.76 f	1.82 e	2.58 de	2.59 e	0.22 b	0.22 c
STS 0.08 mM + 3% sucrose	2.05 b	2.07 b	3.23 a	3.27 ab	0.104 c	**0.10 d**
NST 5 mg/l + 3% sucrose	1.80 e	1.83 e	2.93 bc	2.87 d	0.19 bc	0.24 c
NST 7.5 mg/l + 3% sucrose	2.27 a	2.15 a	3.22 a	3.28 a	0.106 c	0.09 d
8-HQS 200 mg/l + 2% sucrose	1.85 d	1.85 de	2.03 abc	3.03 c	0.11 c	0.13 d
M 50 mg/l + 3% sucrose	1.30 de	1.79 f	2.48 e	2.50 e	0.29 b	0.35 b
M 75 mg/l + 3% sucrose	1.94 c	1.87 d	3.13 ab	3.11 bc	0.103 c	0.07 d
T 50 mg/l + 3% sucrose	1.75 f	1.78 f	2.81 cd	2.76 d	0.26 b	0.22 c
T 75 mg/l + 3% sucrose	2.03 b	1.97 c	3.27 a	3.17 abc	0.10 c	0.14 d
L.S.D.(0.05)	**0.0380**	**0.0309**	**0.243**	**0.141**	**0.102**	**0.068**

STS: Silver thiosulphate, **NST**: Nano-silver thiosulphate, **8-HQS**: 8-hydroxyquinoline sulphate, **M**: Mint oil, **T**: Thyme oil and **L.S.D**: least significant difference at 0.05 level of probability

DISSCUSSION

Many bacterial strains and other microbes are known to be more resistant to nanometer-sized silver (Ag+) particles (NS) than silver in various oxidation states (Ag0, Ag1, Ag2). Because of their unique and high surface area to-volume ratios, Ag+, Ag2+, and Ag3+) 23, 24, volume ratio NS is frequently used as a novel antibacterial agent. Utilized in medicine, textiles, water purification, and other related applications NS pulse therapy, according to (Liu *et al.*, 2009), suppressed bacterial growth in the vase fluid and on the clipped stem of Gerberas that have been chopped at the ends. The use of NS to trim sunflowers was investigated in this study.

There was a considerable effect in extending vase life (Table 2) due of its ability to prevent bacteria from growing in the vase. During the vase time, it is recommended to apply the solution to the cut stem ends.

NST reduced bacterial growth and so increased vase life in individuals with cut gerberas (Liu *et al.*, 2009). Exogenous delivery of sugars, such as sucrose, is widely recognised. Many flowers will not wilt if they are given sugar or glucose solutions. Although the reason for this improvement is unknown, it is likely that Sucrose supplementation is beneficial on several levels. Sucrose can serve as an energy source (Moalem-Beno *et al.*, 1997) as well as an osmotic regulator (Bieleski, 1993)., playing a part in the blooming of flowers (Table 3)and the following water balance 30th regulation Sugars in the vase solution. On the other hand, if not used in conjunction with an effective antibacterial agent, it has the potential to promote bacterial growth obstructing xylem vessels (Van Doorn, 1997), (Ranwala *et al.*, 2009). and dissolved sugars impedie xylem vessels (Van Doorn, 1997) and (Ranwala *et al.*, 2009). Therefore, Sucrose is combined with an antibacterial agent. Microorganisms that grow inside flower stems and hinder water uptake may be to blame for the loss of solution uptake by flowers. The blooms eventually wilt as a result of this. Controlling microbial activity in cut flowers is one way to do this (Chanasut *et al.*, 2003).

Silver thiosulfate increases water absorption (Table 2). Similarly, (Geng *et al.*, 2009) found that silver thiosulfate had the intended effect on the vase life and quality of lilies by killing germs and improving water relations. (Gandaby *et al.*, 2008) found that lily cut flowers treated with 0.08 mM benzyl adenine and 0.06 mM silver thiosulfate increased their aqueous absorption. Putrescine's negligible effect on solution absorption can be attributed to the low rates used in this experiment.

The effect of thyme essential oil on the vase life of cut flowers has been studied extensively. Many studies have a results are in agreement, more or less with this study, that thyme essential oil improves the vase life and quality of cut flowers after harvest. Thyme, mint, and eugenol have been shown to extend the vase life of chrysanthemum cut flowers by (Jafarpour et al., 2015) and (Hashemi et al., 2013)

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الملخص العربي

تأثير بعض محاليل الحفظ على إطالة عمر أزهار عباد الشمس في الفازة

سمر السيد حسين

فرع بحوث الزهور ونباتات الزينة وتنسيق الحدائق بأنطونيادس – معهد بحوث البساتين – مركز البحوث الزراعية – الإسكندرية – مصر

تم إجراء هذه الدراسة في فرع بحوث الزهور ونباتات الزينة وتنسيق الحدائق بأنطونيادس على مدار موسمين متتاليين (2020–2021) هدفت هذه الدراسة إلى تحديد تأثير بعض محاليل الحفظ على إطالة عمر أزهار عباد الشمس في الفازة. صممت التجربة بشكل عشوائي كامل من خلال 10 معاملات (كنترول) – ثيوسلفات الفضة بتركيزين (0.06 –0.8 ملي مولار +3% سكروز)– نانو سيلفر (5– 7.5 مجم/لتر + 3% سكروز) – 8 هيدروكسي كينولين سلفات (200مجم/لتر +2% سكروز) –زيت النعناع بتركيزين (50 –75 مجم/لتر + 3% سكروز) – زيت الزعتر بتركيزين (50–75 مجم/لتر+ 3% سكروز) . أظهرت النتائج في كلا الموسمين أن جميع المعاملات أدت إلى زيادة ملحوظة في الوزن الطازج وأمتصاص الماء وعمر الزهرة والخصائص الكيميائية مثل الكلورفيل أ والكلورفيل ب والكلورفيل الكلي ونسبة الكاروتين والكربوهيدرات والسكريات الكلية والمختزلة مقارنة بالكنترول . وقد كانت أفضل النتائج في معاملات نانو سيلفر بتركيز 7.5 مجم/لتر +3% سكروز وثيوسلفات الفضة بتركيز 0.08 ملى مولار و زيت الزعتر بتركيز 75 مجم/لتر + 3% سكروز و زيت النعناع بتركيز 75 مجم/لتر + 3% سكروز في تحسن جودة أزهار عباد الشمس مقارنة بالكنترول.