Effect of some chemicals and essential oil extracts on keeping quality and vase life of cut carnation (*Dianthus caryophyllus* L.)

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ABSTRACT : This experiment was carried out during two successive seasons of (2017 and 201^) on Carnation (*Dianthus caryophyllus,* L.) cv. "Big Mama" cut flowers at laboratory of the Plant Production Department, Faculty of Agriculture Saba Basha, Alexandria University, to study the effect of some chemicals and essential oil extracts on keeping quality and vase life of carnation cut flowers. Completely randomized block designed experiment with three replicates treatments for each as follow: control (distillated water), Nano-silver thiosulphate (NST) at (2.5, 5, 7.5 and 10 mg/l), Eucalyptus oil at (25, 50 and 75 mg/l), Mint oil at (25, 50 and 75 mg/l) and 8-hydroxyquinoline sulphate (8-HQS) at (250, 300, 350 and 400 mg/l). Results showed that Nano-silver thiosulphate (NST) at 10 mg/l gave the highest mean values of the physical characters as dry weights (g), floret diameter, vase life, and decrease the number of bacteria, also, Nano-silver thiosulphate (NST) at 10 mg/l gave the best results of chemical compositions as total sugars (%), reducing sugars (%), non-reducing sugars (%),total soluble solids percentage and total carbohydrate percentage as compared with control treatment, which gave the lowest mean values of the all physical and chemical composition during both seasons.

Keywords: Carnation (*Dianthus caryophyllus* L.), preservative solutions, vase life, physical character, chemical composition

INTRODUCTION

Carnation (*Dianthus caryophyllus,* L.) belongs to family Caryophyllaceae and is one of the most popular cut flowers in the world. It is native to the Mediterranean region, southern Europe and central Asia (Basiri *et al.*, 2011).

In addition, it is one of the most important flowers in the world wide floriculture commerce, and hundreds of cultivars of carnation are grown everywhere in the world. Dianthus is a genus that has about 300 species of annual, biennial and perennial in the Caryophyllaceae family (Tanase *et al*., 2012).

Today's commercial carnations are the product of more than 200 years breeding, carnations of present day flower year around, and have a wider color range, large flower size and sturdier stems than their wild families (Sharma *et al*., 2013).

Vase life is a yardstick for the longevity of cut flowers and is an important target for improving flower characteristics, whether by chemical treatments or by plant breeding. Maintaining good quality of cut flowers and extending the vase life are considered important to meet the consumer preference. Vase life of cut flowers is mainly affected by two main factors, namely ethylene which accelerates the senescence of many flowers, and microorganisms especially fungi and bacteria that grow in the vase solution, block the stem end and limit water uptake by the flowers, besides the production of chemical compounds that cause vascular blockage and thus reducing the vase life of cut flowers (Hashemabadi *et al.,* 2015). Cut flowers are short-lived and are prone to rapid

deterioration. Shortening vase life of cut flowers could be attributed to destruction of the transport vessels of the stem after cutting, hence, the inability of the stem to absorb water due to blockage may be leading to excessive water loss and short supply of carbohydrates to support respiration. It has been stated that microbial contamination, the cause of vascular occlusion, is the most limiting factor in longevity of cut flowers (Kazemi *et al*., 2011). Thus, with the aim of promoting the vase life of cut flowers, chemicals with antimicrobial effects such as silver nitrate, aluminium sulphate and 8-hydroxyquinoline sulphate, have been applied in vase solutions (Lv *et al*., 2010).

Nowadays with respect to the high competition in the market, there is more concern about postharvest life of cut flowers. It is obvious that cut flowers are facing wounding, water deficit, microbial contamination and oxidative stresses during the postharvest life. According to the scientific findings, the postharvest life of different ornamental cut flowers could be affected by the application of various chemicals as preservatives (Prashanth *et al*., 2010; Danaee *et al*., 2013 and Ardebili *et al*., 2013). The use of chemicals as the most primitive method of controlling postharvest diseases has been limited because of carcinogenesis, long-term degradation, pollution and their effects on food (such as toxicity and the induction of bad smells), human health, it is better to identify and use natural alternatives to extend the vase life of cut flowers and to ensure the health of products, as well as the health of buyers and sellers (Khosravi *et al*., 2015). Silver nanoparticles represent one of the most extensively studied nanomaterial's, which have fascinated scientists due to their unique optical, catalytic, sensing and antimicrobial properties (Wu *et al*., 2012). Silver nanoparticles are especially attractive for their antimicrobial sterilization features among the nanoparticles (Solgi, 2014). Because of their high surface area to volume ratio, nanometer-sized silver (Ag^{+}) particles (NS) are considered to inhibit bacteria and other microorganisms more strongly than Ag in various oxidation states, Ag, Ag^{+}, Ag^{2+}, Ag^{3+} (Furno *et al.*, 2004).

Herbal essential oils are natural compounds that are known as secondary metabolites which have powerful effect on pathogens control and their antimicrobial impact is proven as well. These compounds increases the vase life of cut flowers and their use is becoming widespread recently (Sharififar *et al*., 2007 and Svircev *et al*., 2007). The application of 8-HQS increased the vase life as well as the fresh weight (percentage of initial) of the cut flowers, whereas 8-HQS treatment prevented growth of the microorganisms in xylem vessels of the cut flower stems and maintained water uptake. However, the 8-HQS treatment was more effective when sucrose was coupled with it (Pun and Ichimura, 2003).The aim of the present study was to: 1) extend the vase life and keeping quality of Carnation (*Dianthus caryophyllus* L.) cut flowers by using different pulsing and holding solutions, 2) compare the effect of the used pulsing, holding solutions with essential oils and nano Silver thiosulfate on prolonging vase life of Carnation cut flowers, and 3) determining the best concentration of the above mentioned solutions to achieve the longest vase life.

MATERIALS AND METHODS

Two separate experiments were conducted in the Plant Production Department, Faculty of Agriculture, Saba Basha, Alexandria University in January, 2017 and 2018 on Carnation (*Dianthus caryophyllus* L. cv. Big) Mama cut flowers to study the effect of some chemicals and essential oil extracts on keeping quality and vase life of carnation cut flowers. The experiment lasted one month.

Cut flowers materials and preparation

The cut flowers used for this investigation, Carnation (*Dianthus caryophyllus,* L. cv. "Big Mama") were obtained from a well-known commercial nursery in Alexandria. Cut flowers were cut from the field in early morning after harvested wrapped with polyethylene sheet, and then quickly moved to the experiment room, of an average temperature of (19°±1 °C) for first and second experiments and light from a white fluorescent lamp for 12 hours.

Experimental Design

The experiment was designed as completely randomized design with three replicates.

The treatments were conducted as follows:

- Control
- Nano-silver (2.5, 5, 7.5 and 10 mg/l)
- Eucalyptus oil (25, 50 and 75 mg/l)
- Mint oil (25, 50 and 75 mg/l)
- 8 hydroxyqunon (250, 300, 350 and 400 mg/l)

Nano-silver thiosulphate (NST)

1) Dissolve 0.079g $AgNO_3$ in 500 ml of deionized water
2) Dissolve 0.462g $N_2S_2O_3$-H_2O in 500 ml of deionized water
3) Pour $AgNO_3$ solution into $N_2S_2O_3$-$5H_2O$ solution while stirring

The concentration of silver nanoparticles is 0.463 ml/l .

The silver thiosulfate (STS) prepared as described by Gorin *et al.* (1989).

Pulsing solutions

The flowers were given pre-treatments of pulsing solutions which freshly prepared at the start of experiments from (different concentrations of eucalyptus oil and mint 1 Liter of distilled water contained 1% sucrose) in containers for 24 hours.

Holding solutions

The flowers were moved to glass containers (vases) which contained 300 ml of distilled water to calculate the vase life and the tested parameters. The water in the vases replacement and also about 1 cm of the stems was cut every 3 days. 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 about (19°±1 °C) for the first and the second experiments.

Data recorded

The collected data was:

A) Physical characters:

- Total dry weight (g).
- Vase life (days).
- Bacterial counts (colonies/ ml)
- Flower diameter (cm)

B) Chemical analysis

- Total soluble solids (TSS %): in the extracted juice of carnation petals were measured by a hand refractometer (Brix % 20° C) as reported by Lacey *et al*. (2001).
- Total carbohydrates (%): were determined in the stems and petals of the best treatment of the two compounds. Samples were taken on day 1, 3 and 5 and separated by a high performance liquid chromatography (HPLC) fitted with a differential refractometer to detect fructose, glucose and sucrose in the different samples (Moon-Soo *et al*., 2001).
- Total sugars content in flowers (%):
  It was calculated in dry flowers at the beginning and every 4 days, sugars were extracted from five grams of flowers, the total sugars were determined colorimetrically using phenol and sulphuric acid according to (Malik and Singh, 1980).
- Reducing sugar (%) were determined by Nelson arsenate – molybdate colorimetric method (Dubois *et al*., 1956).
- Non-reducing sugar (%) were calculated by the difference between total sugars and reducing sugar.

Statistical analysis

All the data collected were subjected to statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using L.S.D. test at 0.05 level of significant.

RESULTS AND DISCUSSION

A) Physical characters

The effect of some chemicals and essential oil extracts on dry weight (g), vase life period (days) and bacterial counts (colonies/ ml) of carnation (*Dianthus caryophyllus* L.) cv. “Big Mama” cut flowers are presented in Table (1). Results showed that applied concentrations of nano-silver at 10 mg/l recorded the maximum values of dry weight (15.39 and 16.92 g), followed by eucalyptus oil at 75 mg/l (14.31 and 15.73 g), 8- hydroxyqunon at 350 mg/l (13.51 and 16.50 g) and mint oil at 75 mg/l (13.52 and 14.90 g), during both seasons, respectively, as compared with the control treatment which recorded the minimum values of dry weight (10.09 and 11.09 g).

The chemical solutions of 8-HQS at 100 or 200 mg/l with 4% sucrose lowered the flower weight loss and increased dry weight percentage and longevity of cut flowers to highest values and also resulted in the highest

soluble sugars and anthocyanin pigment in petals of flowers (Ibrahim *et al.,* 2011). Also, Banaee *et al.* (2013) reported that 8-HQS increased vase life, dry weight, wet weight, flower diameter, mean absorbed preservative solution, and quality score.

This may be due to the role of sucrose in providing the required energy for survival of flowers and affecting the structure of the flower cell walls and delays aging through this and causing an increase in the dry weight and water retention. Compounds extending the vase life of cut flowers on the prevention of dry weight loss by preventing the degradation of carbohydrates (Dashtbany and Hashemabadi, 2015).

On the other sides, the best result in this regard was obtained from the treatment of 8- hydroxyqunon at 400 mg/l (28.65 days) which was effective in extending vase life period in the first season and 8- hydroxyqunon at ٣٥٠ mg/l (31.69 days) in the second one, followed by the treatment of 10 mg/ l nano-silver (28.42 and 31.25 days), eucalyptus oil at 75 mg/l (25.02 and 27. 52 days),and mint oil at 75 mg/l (24.25 and 26.67 days) during both seasons, respectively, as compared with the control treatment (19.57 and 21.52 days).

Similar effect was obtained by nano-silver at 10 mg/l which due enhanced shelf life of the cut flowers compared to the control. This may be due to the positive effect of NS treatments to inhibit bacterial growth in the vase solution and at the cut surface stems during shelf life period. The fresh weight of cut flowers diminished as they approach the aging step. This may be related to the reduction of water absorption and the loss through petals and leaves turgidity. The current findings support this idea, Hashemabadi (2014) and Basiri *et al.* (2011) showed that the silver nano-particles treatment inhibited bacterial growth in the preservative solution and enhanced vase life of cut carnation. Many authors indicated the role of NS in prolonging shelf life of cut flowers as confirmed by Liu *et al.* (2009) and Solgi *et al.* (2009) on gerbera cultivars, Lü *et al.* (2010) and Hatami *et al*. (2013) on rose and Roshani *et al.* (2016) on cut carnation.

Due to the huge side-effects of chemicals, essential oils have been considered as suitable alternatives for keeping the vase-life of cut flowers mainly owing to the availability and environment-friend nature of these bio-chemicals (Ebrahimzadeh *et al*., 2017).

On the other hand, from the recorded data in Table (1), it can be concluded that treatment of 10 mg/ l nano-silver recorded a decrease in number of bacteria (22.91and 24.80), followed by 7.5 mg/l nano-silver (25.06 and 27.56) in the two seasons of experiment, as well as, 8-hydroxyqunon at 350 mg/l (24.06) in the first season and 8-hydroxyqunon at 400 mg/l (27.29) in the second season, respectively, in vase solution as compared to other treatments under study and control. Such increase was highly significant with the two seasons. On the other side, the maximum average of bacterial count was recorded by control treatment (61.87, 77.33, 68.05, 85.07) in the first and second seasons, respectively.

In accordance with the previous gains, Furno *et al*. (2004) affirmed that silver nanoparticle (SNP) as a pulse treatment for cut flowers has demonstrated importance as an anti-bactericidal agent that could kill 650 species of bacteria in water. It seems to get be some benefit in reducing bacteria from using 8-HQC at 400 mg/l but gerbera flowers showed a phenomenon of stem damage (stem under the water solution became brown after just 1 or 2 days), and the toxicity of 8-HQC for other gerbera variety was discovered in previous study as well (De Witte *et al.,* 2014).

Some researchers reported that essential oil components attack cell wall and react with enzymes responsible for synthesis of cell wall and as a result causing pathogen death (Sharma and Tripathi, 2008).

Table (1). Effect of some chemicals and essential oil extracts on dry weight (g), vase life (days) and bacterial counts (colonies/ ml) of *Dianthus caryophyllus,* L. cv. "Big Mama" during 2017 and 2018 seasons

Treatments	Dry weight (g)		Vase life (days)		Bacterial counts (colonies/ ml)	
	2017 season	2018 season	2017 season	2018 season	After 15 days	After 25 days
					2017 season	2018 season
					5d	15d
Control	10.09^{j}	11.09^{h}	19.57^{g}	21.52^{g}	61.87^{a}	77.33^{a}
Nano-silver 2.5 mg/l	11.22^{i}	12.33^{g}	20.71^{f}	22.45^{fg}	30.95^{fg}	39.02^{fg}
Nano-silver 5 mg/l	12.79^{f}	13.71^{f}	23.01^{d}	25.31^{d}	27.85^{h}	35.11^{h}
Nano-silver 7.5 mg/l	13.85^{d}	15.22^{cd}	25.57^{b}	28.13^{b}	25.06^{i}	31.60^{i}
Nano-silver 10 mg/l	15.39^{a}	16.92^{a}	28.42^{a}	31.25^{a}	22.91^{i}	28.44^{j}
Eucalyptus 25 mg/l	11.58^{h}	13.74^{f}	20.26^{f}	22.28g	37.48^{c}	46.89^{c}
Eucalyptus 50 mg/l	12.87^{f}	14.15^{ef}	22.51^{de}	24.76^{de}	33.73^{e}	42.17^{e}
Eucalyptus 75 mg/l	14.31^{c}	15.73^{bc}	25.02^{b}	27.52^{bc}	30.36^{g}	37.95^{g}
Mint 25 mg/l	10.97^{i}	11.86^{gh}	19.64^{g}	21.60^{g}	39.34^{b}	49.17^{b}
Mint 50 mg/l	12.19^{g}	13.41^{f}	21.82^{e}	24.00^{e}	35.40^{d}	44.5^{d}
Mint 75 mg/l	13.52^{de}	14.90^{de}	24.25^{c}	26.67^{c}	31.86^{f}	39.83^{f}
8-hydroxyqunon 250 mg/l	10.94^{i}	13.36^{f}	20.88^{f}	25.52^{d}	34.17^{de}	42.72^{e}
8-hydroxyqunon 300 mg/l	12.16^{g}	14.85^{de}	23.21^{d}	28.36^{b}	30.76^{fg}	38.44^{fg}
8-hydroxyqunon 350 mg/l	13.51^{e}	16.50^{ab}	25.45^{b}	31.69^{a}	24.06^{i}	31.14^{i}
8-hydroxyqunon 400 mg/l	15.01^{b}	12.03^{g}	28.65^{a}	22.97^{f}	27.68^{h}	34.60^{h}
LSD (0.05)	**0.33**	**0.80**	**0.84**	**0.97**	**1.34**	**1.41**

Data presented in Table (2) showed that all treatments with different concentrations promoted flower diameter of carnation cut flower. Treatment of 10 mg/l nano-silver thiosulphate gave the biggest carnation florets diameter (13.79 and 13.48 cm), followed by 7.5 mg/l nano-silver (12.41 and 12.13 cm) and 8-hydroxyqunon at 350 mg/l (12.28 and 12.36 cm), respectively, as compared with the other treatments under study and control.

In harmony to the present results, Ichimura *et al.* (2002) showed that an increase in flower diameter was observed when 20 g of sucrose/L + 200 mg of HQS/L were used in the pulsing solution.

Meanwhile, the Rosemary essential oil significantly increased the flower diameter. The study results of Karimi *et al*. (2011) showed that the treatments of 600 and 800 mgl^{-1}. Rosemary essential oil increased the cut rose diameter that is consistent with their study.

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Table (2). Effect of some chemicals and essential oil extracts on flower diameter (cm) of *Dianthus caryophyllus,* L. cv. "Big Mama" during 2017 and 2018 seasons

Treatments	Floret diameter (cm)									
	2017 season					2018 season				
	0	5d	10d	15d	20d	0	5d	10d	15d	20d
Control	8.61^{e}	9.04e	7.72e	6.17e	4.94^{fgh}	8.74^{fg}	8.84^{h}	7.60^{h}	6.08^{h}	4.86^{ij}
Nano-silver 2.5 mg/l	9.57^{d}	10.05d	8.58d	6.86d	5.49^{efd}	9.72^{de}	9.82^{f}	8.45^{f}	6.75^{f}	5.40^{fgh}
Nano-silver 5 mg/l	10.63^{c}	11.17c	9.53c	7.62c	6.10^{bcd}	10.80^{c}	10.91^{d}	9.38^{d}	7.50^{d}	6.20^{cde}
Nano-silver 7.5 mg/l	11.81^{b}	12.41b	10.59b	8.47b	6.78^{b}	11.99^{b}	12.13^{b}	10.43^{b}	8.34^{b}	6.67^{bc}
Nano-silver 10 mg/l	13.13^{a}	13.79a	11.77a	9.41a	7.53^{a}	13.33^{a}	13.48^{a}	11.59^{a}	9.27^{a}	7.41^{a}
Eucalyptus 25 mg/l	8.94^{e}	9.38e	7.97e	6.38e	5.57^{cdef}	8.94^{f}	9.38^{g}	8.06^{g}	6.45^{g}	5.82^{ef}
Eucalyptus 50 mg/l	9.93^{d}	10.42d	8.86d	7.09d	5.45^{def}	9.95^{d}	10.42^{e}	8.96^{e}	7.17^{e}	5.73^{ef}
Eucalyptus 75 mg/l	10.03^{c}	11.58c	9.85c	7.87c	6.30^{bc}	11.06^{c}	11.58^{c}	9.96^{c}	7.96^{c}	6.37^{bcd}
Mint 25 mg/l	8.06^{f}	8.47f	7.18f	5.75f	4.43^{h}	7.63h	8.47^{i}	7.28^{i}	5.82^{i}	4.65^{j}
Mint 50 mg/l	8.96e	9.41e	7.99e	6.39e	4.92^{fgh}	8.47^{g}	9.41^{g}	8.09^{g}	6.47^{g}	5.17^{ghi}
Mint 75 mg/l	9.96^{d}	10.45d	8.88d	7.10d	5.68^{cde}	9.42^{e}	10.45^{e}	8.99^{e}	7.17^{e}	5.75^{ef}
8-hydroxyqunon 250 mg/l	8.58^{e}	9.01e	7.66ef	6.12e	4.72^{gh}	9.77^{de}	10.01^{f}	8.61^{f}	6.88^{f}	5.50^{fg}
8-hydroxyqunon 300 mg/l	9.54^{d}	10.01d	8.51d	6.81d	5.24^{def}	10.86c	11.13^{d}	9.57^{d}	7.65^{d}	6.12^{de}
8-hydroxyqunon 350 mg/l	11.77^{b}	12.28b	10.51b	8.41b	6.72^{b}	12.07^{b}	12.36^{b}	10.63^{b}	8.50^{b}	6.80^{b}
8-hydroxyqunon 400 mg/l	10.59^{c}	11.12c	9.46c	7.56c	5.83^{cde}	8.80^{fg}	9.01^{h}	7.74^{h}	6.19^{h}	4.95^{hij}
LSD(0.05)	**0.48**	**0.52**	**0.48**	**0.38**	**0.73**	**0.41**	**0.28**	**0.24**	**0.19**	**0.49**

B) Chemical analysis

Data in Table (3) illustrate that the most successful treatment was nano silver thiosulphate at 10 mg/l as it achieved the maximum values of total sugars percentage of carnation cut flowers (2.30 and 2.53 %), followed by 8-hydroxyqunon at 350 mg/l (2.11 and 1.69 %), eucalyptus oil at 75 mg/l (1.91 and 2.10 %) and mint oil at 75 mg/l (1.82 and 2.00 %), during both seasons, respectively, as compared with the control treatment (1.60 and 1.76 %). Also, data represented in Table (3) exhibited that nano silver thiosulphate at 10 mg/l had significantly the highest values of reducing sugars percentage (1.30 and 1.43 %), followed by eucalyptus oil at 75 mg/l (1.26 and 1.38 %), nano silver thiosulphate at 7.5 mg/ l (1.17 and 1.28 %), 8-hydroxyqunon at 350 mg/l (1.17 and 0.97 %) and mint oil at 75 mg/l (1.02 and 1.13 %), during both seasons, respectively, as compared with the control treatment (0.78 and 0.85 %).

In the other hand, the results tabulated in Table (3) revealed that holding solution contained 10 mg/ l nano silver thiosulphate highly significantly increased non-reducing sugars percentage (1.00 and 1.09 %), followed by 8-hydroxyqunon at 350 mg/l (0.94 and 0.74 %) and nano silver thiosulphate at 7.5 mg/ l (0.92 and 0.98 %) during both seasons, respectively, as compared with the control treatment (0.82 and 0.94 %). Elgimabi (2014) mentioned that the combination of sucrose 7% +$AgNO_3$ 30% was significantly superior to the rest of combinations in retarding the chlorophyll as well as the carbohydrate degradation of *Rosa damascena.* Prashant *et al.* (2010) cited that the translocate sugars accumulated in the flowers increase the osmotic concentration and improve the sugar (total and reducing sugars) concentration and maintain turgidity.

According to data presented in Table (4), flowers treated with 10 mg/l nano silver thiosulphate significantly increased total soluble solids percentage (12.93 and 13.10 %), followed by 8-hydroxyqunon at 350 mg/l (12.03 and 12.20 %), nano silver thiosulphate at 7.5 mg/ l (11.64 and 11.79 %), eucalyptus oil at 75 mg/l (11.13 and 11.28 %), and mint oil at 75 mg/l (10.47 and 10.60 %), during both seasons, respectively, as compared with the control treatment (8.48 and 8.59 %). In contrast, Moradi *et al*. (2012) reported that application of 4 mg/l nano silver thiosulphate with 3% sucrose resulted in the highest amount of TSS in cut carnation 'Cream Viana'. It seems that due to the antibacterial activity of thymol and therefore less occlusion of vessels, the absorption of sucrose was performed better via the vase solution which can be a reason to the increase of petals total soluble solids compared to the control. In a study, the use of 100 mgl^{-1} thyme essential oil with 1% sucrose led to the increase of the *Alstroemeria*'s petals total soluble solids (Mir Saeed Ghazi *et al*., 2013). Also, data presented in Table (4), flowers treated with 10 mg/l nano silver thiosulphate significantly increased total carbohydrate percentage (5.65 and 6.92 %), followed by nano silver at 7.5 mg/ l (5.42 and 6.22 %) and 8-hydroxyqunon at 350 mg/l (5.01 and 5.60 %), during both seasons, respectively, as compared with the control treatment (3.71 and 5.09 %). This result was consistent with the observation of Van Doorn (2004) who found that petal carbohydrate contents are one of the most crucial factors influencing the postharvest life of cut flowers. It is proposed that there is a positive correlation between the levels of endogenous sugars and the time to petal wilting. In addition, the senescence process of cut flowers is regulated by phytohormones and correlated with the carbohydrate status of the petals.

Table (3). Total sugars, reducing sugars and non-reducing sugars (%) as affected by some chemicals and essential oil extracts on carnation cv. "Big Mama" cultivars during 2017 and 2018 seasons

Treatments	Total sugars (%)						Reducing sugars (%)						Non-reducing sugars (%)					
	2017 season			2018 season			2017 season			2018 season			2017 season			2018 season		
	5d	10d	15d	5d	10d	15d	5d	10d	15d	5d	10d	15d	5d	10d	15d	5d	10d	15d
Control	0.91^{ef}	1.32^{fg}	1.60^{gh}	0.99^{fg}	1.44^{d}	1.76^{gh}	0.43^{f}	0.62^{f}	0.78^{g}	0.49^{i}	0.68^{fg}	0.85^{gh}	0.46^{bc}	0.66^{bc}	0.82^{c}	0.47^{c}	0.72^{bc}	0.94^{b}
Nano-silver 2.5 mg/l	0.94^{e}	1.34^{ef}	1.67^{ef}	1.02^{ef}	1.47^{d}	1.84^{ef}	0.52^{d}	0.75^{d}	0.95^{cdefg}	0.58^{fg}	0.82^{d}	1.04^{de}	0.40^{dc}	0.57^{cd}	0.72^{def}	0.44^{cd}	0.63^{cd}	0.79^{bc}
Nano-silver 5 mg/l	1.08^{c}	1.49^{cd}	1.86^{cd}	1.14^{cd}	1.63^{c}	2.04^{cd}	0.58^{c}	0.84^{c}	1.05^{bcde}	0.64^{de}	0.92^{c}	1.16^{c}	0.44^{bc}	0.64^{bc}	0.80^{cd}	0.49^{bc}	0.70^{bc}	0.88^{bc}
Nano-silver 7.5 mg/l	1.16^{b}	1.65^{b}	2.07^{b}	1.27^{b}	1.84^{b}	2.27^{b}	0.64^{b}	0.93^{b}	1.17^{abc}	0.72^{bc}	1.02^{b}	1.28^{b}	0.50^{ab}	0.71^{ab}	0.92^{ab}	0.55^{b}	0.78^{ab}	0.98^{b}
Nano-silver 10 mg/l	1.29^{a}	1.84^{a}	2.30^{a}	1.41^{a}	2.02^{a}	2.53^{a}	0.72^{a}	1.04^{a}	1.30^{a}	0.80^{a}	1.14^{a}	1.43^{a}	0.56^{a}	0.76^{a}	1.00^{a}	0.61^{a}	0.88^{a}	1.09^{a}
Eucalyptus 25 mg/l	0.86^{fg}	1.24^{gh}	1.55^{hi}	0.95^{gh}	1.36^{ef}	1.70^{h}	0.57^{c}	0.81^{c}	1.02^{cdef}	0.62^{ef}	0.89^{c}	1.11^{cd}	0.29^{f}	0.42^{f}	0.53^{h}	0.32^{fg}	0.46^{f}	0.58^{fg}
Eucalyptus 50 mg/l	0.96^{de}	1.38^{ef}	1.72^{e}	1.06^{e}	1.51^{d}	1.89^{e}	0.63^{b}	0.90^{b}	1.13^{abcd}	0.69^{cd}	0.99^{b}	1.24^{b}	0.33^{ef}	0.47^{ef}	0.59^{gh}	0.36^{ef}	0.51^{ef}	0.65^{ef}
Eucalyptus 75 mg/l	1.07^{c}	1.53^{c}	1.91^{c}	1.18^{c}	1.68^{c}	2.10^{c}	0.70^{a}	1.00^{a}	1.26^{ab}	0.77^{ab}	1.10^{a}	1.38^{a}	0.37^{de}	0.52de	0.66^{efg}	0.40^{de}	0.57^{de}	0.72^{de}
Mint 25 mg/l	0.83^{g}	1.18^{h}	1.47^{j}	0.90^{h}	1.29^{f}	1.62^{i}	0.46^{ef}	0.65^{ef}	0.82^{fg}	0.51^{hi}	0.72^{ef}	0.92^{fg}	0.35^{def}	0.51^{def}	0.65^{fg}	0.40^{de}	0.56^{de}	0.71^{de}
Mint 50 mg/l	0.92^{ef}	1.31^{fg}	1.64^{fg}	1.00^{efg}	1.34^{de}	1.80^{fg}	0.51^{d}	0.73^{d}	0.91^{defg}	0.56^{gh}	0.80^{d}	1.02^{e}	0.40^{dc}	0.57^{cd}	0.72^{def}	0.44^{cd}	0.56^{de}	0.80^{cd}
Mint 75 mg/l	1.02^{cd}	1.42^{de}	1.82^{d}	1.12^{d}	1.60^{c}	2.00^{d}	0.57^{c}	0.81^{c}	1.02^{cdef}	0.62^{ef}	0.90^{c}	1.13^{c}	0.45^{bc}	0.64^{bc}	0.81^{cd}	0.49^{bc}	0.70^{bc}	0.89^{bc}
8-hydroxyqunon 250 mg/l	1.03^{c}	1.48^{cd}	1.71^{e}	0.83^{i}	1.20^{g}	1.36^{k}	0.52^{d}	0.75^{d}	0.95^{cdefg}	0.41^{j}	0.60^{h}	0.78^{h}	0.40^{dc}	0.57^{cd}	0.75^{cde}	0.32^{fg}	0.58^{de}	0.59^{fg}
8-hydroxyqunon 300 mg/l	1.15^{b}	1.64^{b}	1.90^{c}	0.92^{h}	1.31^{f}	1.52^{j}	0.58^{c}	0.84^{c}	1.35^{a}	0.52^{ghi}	0.66^{g}	0.87^{g}	0.45^{bc}	0.64^{bc}	0.84^{bc}	0.35^{ef}	0.64^{cd}	0.66^{ef}
8-hydroxyqunon 350 mg/l	1.28^{a}	1.83^{a}	2.11^{b}	1.03^{ef}	1.46^{d}	1.69^{hi}	0.65^{b}	0.94^{b}	1.17^{abc}	0.52^{hi}	0.74^{e}	0.97^{ef}	0.50^{ab}	0.72^{ab}	0.94^{bc}	0.40^{cd}	0.72^{bc}	0.74^{de}
8-hydroxyqunon 400 mg/l	0.93^{e}	1.33^{efg}	1.54^{ij}	0.74^{j}	1.06^{h}	1.22^{l}	0.47^{e}	0.67^{e}	0.89^{efg}	0.37^{j}	0.54^{i}	0.70^{i}	0.36^{de}	0.52^{de}	0.67^{efg}	0.29^{g}	0.52^{ef}	0.54^{g}
LSD(0.05)	**0.07**	**0.10**	**0.06**	**0.06**	**0.09**	**0.07**	**0.03**	**0.05**	**0.23**	**0.06**	**0.05**	**0.07**	**0.06**	**0.09**	**0.10**	**0.06**	**0.10**	**0.11**

Table (4). Total soluble solids (TSS %) and total carbohydrates (%) as affected by some chemicals and essential oil extracts on carnation cv. "Big Mama" cultivars during 2017 and 2018 seasons

Treatments	TSS (%)						Total carbohydrate (%)					
	2017 season			2018 season			2017 season			2018 season		
	5d	10d	15d	5d	10d	15d	5d	10d	15d	5d	10d	15d
Control	5.43^{i}	6.79i	8.48^{h}	5.97^{i}	7.16^{i}	8.59^{g}	4.64^{bc}	2.96^{e}	3.71^{ef}	3.25^{f}	4.07^{cd}	5.09^{de}
Nano-silver 2.5 mg/l	6.03^{g}	7.54g	9.43^{ef}	6.63^{fgh}	7.96^{g}	9.55^{f}	5.15^{bc}	3.29^{d}	4.12^{d}	3.62^{d}	4.27^{cd}	5.04^{de}
Nano-silver 5 mg/l	6.70^{e}	8.38e	10.47^{d}	7.37^{de}	8.84^{e}	10.61^{d}	5.72^{bc}	3.66^{c}	4.58^{c}	4.02^{c}	4.74^{bc}	5.60b
Nano-silver 7.5 mg/l	7.45^{c}	9.31c	11.64^{b}	8.19^{bc}	9.82^{c}	11.79^{b}	6.36^{abc}	4.07^{b}	5.42^{a}	4.47^{b}	5.29^{ab}	6.22^{b}
Nano-silver 10 mg/l	8.28^{a}	10.35a	12.93^{a}	9.10^{a}	10.92^{a}	13.10^{a}	6.84^{ab}	4.52^{a}	5.65^{a}	4.97^{a}	5.86^{a}	6.92^{a}
Eucalyptus 25 mg/l	5.77^{h}	7.21h	9.02^{fg}	6.34^{ghi}	7.61^{h}	8.83^{g}	4.62^{bc}	2.93^{e}	3.67^{ef}	3.22^{fg}	3.80^{de}	4.49^{f}
Eucalyptus 50 mg/l	6.41^{f}	8.01f	9.78^{e}	7.05^{ef}	8.46^{f}	10.15^{e}	8.47^{a}	3.26^{d}	4.08^{d}	3.58^{de}	4.22^{cd}	4.98^{de}
Eucalyptus 75 mg/l	7.12^{d}	8.91d	11.13^{c}	7.83^{cd}	9.40^{d}	11.28^{c}	5.71^{bc}	3.62^{c}	4.53^{c}	3.98^{c}	4.70^{bc}	5.54^{c}
Mint 25 mg/l	5.43^{i}	6.78i	8.48^{h}	6.63^{fgh}	7.15^{i}	8.58^{g}	3.99^{c}	2.46^{g}	3.19^{g}	2.80^{h}	3.30^{e}	3.89^{g}
Mint 50 mg/l	6.03^{g}	7.53g	9.42^{ef}	6.63^{fgh}	7.95^{g}	9.54^{f}	4.43^{bc}	2.73^{f}	3.54^{f}	3.11^{g}	3.67^{de}	4.33^{f}
Mint 75 mg/l	6.70^{e}	8.37e	10.47^{d}	7.36^{de}	8.83^{e}	10.60^{d}	4.93^{bc}	3.15^{d}	3.94^{de}	3.46^{e}	4.08^{cd}	4.82^{e}
8-hydroxyqunon 250 mg/l	5.61^{hi}	7.02hi	8.77^{gh}	6.85^{efg}	8.23^{fg}	9.88^{ef}	4.57^{bc}	2.92^{e}	3.52^{f}	3.56^{de}	3.20^{e}	4.96^{de}
8-hydroxyqunon 300 mg/l	6.24^{fg}	7.79fg	9.75^{e}	7.62^{d}	9.14^{de}	10.64^{d}	5.07^{bc}	3.25^{d}	4.06^{d}	3.96^{c}	4.67^{bc}	5.18^{d}
8-hydroxyqunon 350 mg/l	7.70^{b}	9.63b	12.03^{b}	8.47^{b}	10.16^{b}	12.20^{b}	6.27^{abc}	4.01^{b}	5.01^{b}	4.41^{b}	5.20^{ab}	5.60b
8-hydroxyqunon 400 mg/l	6.93^{de}	8.66de	10.83^{cd}	6.17^{hi}	7.41^{hi}	8.89^{g}	5.64^{bc}	3.60^{c}	4.51^{c}	3.21^{fg}	3.78^{de}	4.47^{f}
LSD(0.05)	**0.24**	**0.30**	**0.44**	**0.54**	**0.33**	**0.43**	**2.50**	**0.16**	**0.27**	**0.13**	**0.76**	**0.29**

CONCLUSION

In conclusion, the present study demonstrates that flowers treated with 10 mg/l nano silver significantly increased total dry weight, vase life, florte diameter, total sugars (%), reducing sugars (%), non-reducing sugars (%), TSS (%), total carbohydrates (%) and decrease number of bacteria as compared with control treatment which gave the lowest mean values of the all physical and chemical composition during both experiments.

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الملخص العربي

تأثير بعض المواد الكيماوية ومستخلصات الزيوت العطرية علي القدرة الحفظية وعمر أزهار القرنفل المقطوفة

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أجريت هذه الدراسة بقسم الإنتاج النباتي بكلية زراعة سابا باشا، خلال موسمين متتاليين (٢٠١٨،٢٠١٧) لدراسة تأثير بعض المواد الكيميائية ومستخلصات الزيوت العطرية علي القدرة الحفظية وعمر أزهار القرنفل المقطوفة (*Dianthus caryophyllus,* L. cv. "Big Mama"). تصميم التجربة قطاعات كاملة العشوائية بثلاث مكررات وكانت المعاملات عبارة عن الكنترول (الماء المقطر)، نانو سلفر ثيوسلفات (٢.٥، ٥، ٧.٥، ١٠ ملليجرام/ لتر)، زيت الكافور(٢٥، ٥٠، ٧٥ ملجم /لتر)، زيت النعناع (٢٥، ٥٠، ٧٥ ملجم /لتر)، ٨–هيدروكسي كينولين السلفات (٢٥٠، ٣٠٠، ٣٥٠، ٤٠٠ ملجم /لتر)، وأبقى علي درجة حرارة الغرفة (١٩±١°). وقد أظهرت النتائج التي تم الحصول عليها أن النانو سلفرثيوسلفات بمعدل ١٠ مجم/ لتر سجل أفضل النتائج حيث أعطي أعلي متوسط قيم لكل من الصفات الفيزيائية مثل الوزن الجاف، فترة حياة الزهرة، قطر الزهرة واقل عدد للبكتريا، وكذلك أعلى القيم للصفات الكيميائية مثل السكريات الكلية (٪)، المختزلة، غير المختزله، (٪) للمواد الصلبة الذائبة الكلية، (٪) للكربوهيدرات الكلية، مقارنة بمعاملة الكنترول التي أعطت أقل القيم خلال كلا الموسمين، علي التوالي.