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The Impact of Wet and Dry Cold Storage Supplementary with Spraying Medicinal Essential Oils on Quality and Longevity of Ageratum Hostonianum Cut Flowers.

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ABSTRACT

This investigation was conducted to study the effect of wet and dry cold storage (at 4°C for 6 days) and spraying flowers before storage with essential oils of Peppermint and Clove at: zero(control),1 and 2ml/L on *Ageratum Hostonianum* "Blue Horizon" cut flowers aiming for keeping quality and longevity during two successive seasons of 2013 and 2014. The results indicated that, spraying flowers with oils ,either stored wet or without storage, increased vase life and water uptake when compared with dry stored flowers. Vase life was increased significantly when flowers stored wet compared with non-stored flowers. Additionally, flowers sprayed with Peppermint oil (2ml/L) before wet cold storage, increased in vase life, water uptake and maximum increase in fresh weight in the two seasons. During cold storage period, flowers stored wet and sprayed with 2ml/L Peppermint oil were maintained the highest values of total chlorophyll content and the lowest values of fresh weight loss during storage period as compared with the flowers stored dry. A significant decrease in total chlorophyll values induced with dry cold storage after 6th days in vase life period. According to these results, it could be recommended that spraying *Ageratum hostonianum* flowers with Peppermint or Clove essential oils at (1 or 2ml/L) before wet cold storage or without storage resulted in extending the vase life and keeping quality.

Keywords: *Ageratum Hostonianum* L., wet and dry cold storage, essential oils, peppermint oil, clove oil, vase life.

INTRODUCTION

Ageratum hostonianum L. cv. Blue Horizon (commonly known as floss flower) is belonging to family Asteraceae and an upcoming new potential cut flower. Popularity, it is grown as annual flowers in gardens for its attractive blue flowers. Blue horizon cultivar is the tallest among ageratum species (approximately 30 inches/76cm tall with a spread of 8 inches/20cm) therefore; it is suitable for using as cut flower and source to the desirable blue color of the bouquets.

Ageratum flowers have sensitively petals and short vase life. The major problems supplementary with using ageratum as cut flower are disability to transport and decreasing the flower quality during the cold storage transportation period resulting in shorting vase life. Cold storage methods greatly influenced on the postharvest quality and longevity of many flowers species. There are two methods of cold storage: wet (in DI water or holding solutions) and dry (transport and shipment in boxes). Many authors recommended the wet cold storage method for handling many flowers. Hettiarachchi and Balas (2005) suggested the wet cold storage for delaying inflorescence senescence, prolonging vase life and postharvest keeping quality of Gloriosa superba L.flowers. Also, Dole *et al.* (2009) reported the same results on cut lupine stems. Besides, some flower species have the same response in vase life and quality when cold stored wet or dry (Shahri *et al.* (2011) on *Ranunculus asiaticus* L. and Waithaka *et al.(*2001) on *Polianthes tuberosa* L. Dole *et al.* (2009) reported that, dry or wet storage at a low temperature had a similar effect on vase life of cut *Dahlia, Linaria, Poppy, Rudbeckia, Trachelium,* and *Zinnia* flowers.

In general, the most important problems in postharvest physiology of cut flowers, are the vascular blockage and growth of bacteria and fungus during and after cold storage (van Doorn 1997, Halevy and Mayak 1981).

In the last years, there is a global trend to use natural products in resistant microorganisms. Therefore, the natural essential oils and their constituents and derivatives are considered safe and environmentally desirable with antimicrobial properties and consequently, increasing the postharvest quality and extending vase life of cut flowers (Solgi *et al*., 2009, Burt, 2004).

The main function of Peppermint and Clove essential oils in keeping quality and extending vase life after cold storage is acting against microorganisms such as bacteria and fungi either in preservative solution or by spraying cut stems. This function is attributed to its composition high levels of menthol, menthone and phenolic compounds such as eugenol, thymol and carvacrol. The main constituents of the peppermint oils was menthol (28-42%) and menthone (18-28%) (Iscan et al., 2002). Nassar *et al*.,(2007) and Alma *et al*.,(2007) stated that the major components of clove oil were eugenol (71.56 %) and eugenol acetate (8.99 %). Antimicrobial activity of eugenol is correlated to its ability to permeabilize the cell membrane and interact with proteins. The eugenol's action of the cytoplasmic membrane has been demonstrated in previous studies as increased transport of potassium and ATP out of the cell (Walsh *et al*., 2003; Gill and Holly, 2006a; Hemaiswarya and Doble, 2009). The chemical compound of eugenol contains hydroxyl group. It is thought to bind to and affect the properties of proteins, thereby contributing to eugenol's inhibitory effect at sub-lethal concentrations. Consistent with this, eugenol has proven to inhibit the activity of the following enzymes: histidine decarboxylase, ATPase, amylase, and protease (Gill and Holley,2006b; Wendakoon and Morihiko,1995;Thoroski, 1989). Nermeen, (2012) stated that vase solutions containing essential oils (cumin,anise,geranium and lavender) prolonged the vase life of rose cut flowers and kept their quality.

Industrial cut flowers either exportation or locally handling, provide substantial revenue from both

the local and foreign currency. For this purpose, the objective of this study was to evaluate the influence of cold storage methods and essential oils (Peppermint and Clove) on keeping quality and postharvest performance of Ageratum Hostonianum flowers (as novel cut flowers).

MATERIALS AND METHODS

1. Plant materials:

This study was conducted in Mansoura Horticulture Research Station, Horticulture Research Institute, Agriculture Research Center.Egypt during February 2013 and 2014 seasons. Uniform cut flowers of Ageratum Hostonianum L. cv. Blue Horizon were obtained from Mansoura Research farm. Flowers were cut early morning at the commercial stage of cutting (when two or three florets were tightly opened). Immediately, flowers were placed in buckets partially filled with tap water and transported within an hour to the laboratory. Flowers were graded according to inflorescence head size and stem length. Stems were recut under water to 35cm±5. Leaves were removed leaving only the two upper-most leaves on the stems.

2. Medicinal essential oils:

Peppermint (*Mentha Piperita* L.) and Clove (*Syzygium aromaticum*) oils were obtained from AL-Gomhorya Pharmaceuticals - Medicinal Plants Production Company, Mansoura, Egypt.

3. Pulsing solution:

Citric acid (150ppm) + Silver thiosulfate STS (AgS_2O_3 1:4M/L prepared according to Reid et.al.1980b) +5% sucrose.

4. Vase solutions: Citric acid (150ppm) + 2% sucrose.

5. Treatments:

Flower stems were sprayed with Peppermint and Clove oils, each at three concentrations of 0, 1 and 2ml/L plus 0.1ml/ L Tween20 as a surfactant and Left them to dry for an hour in the laboratory atmosphere. At that time, the flowers were divided into three groups (each group includes all essential oil treatments) and treated as follow:

First group: Wet Storage

Flowers in each treatment were placed in 500 ml conical containing 250 ml of the pulsing solution and immediately wrapped with Kraft and polyethylene bags. Conicals were transferred to the cold storage room at 4° C and 95% RH for 6 days. After storage period, flower stems were weighted (original weight) and placed in conical flasks contains 250ml vase solution till the end of the experiment.

Second group: Dry Storage

Flowers were placed in 500 ml conical containing 250 ml of pulsing solution for 24hr. After pulsing period, flowers were weighted and wrapped with Kraft and polyethylene bags and placed in carton boxes (41.5 x 31.5 x 6.5 cm) and stored at 4°C and 95% RH for 6 days. After storage period, flower were weighted, cut the end of each stem (3cm) and placed in conical flasks contains 250ml vase solution till the end of the experiment.

Third group: without Storage

Flowers were placed in 500 ml conical containing 250 ml of pulsing solution for 24hr. After pulsing period, flowers were reweighted and placed in conical flasks containing 250ml vase solution until the end of the experiment.

6. Measurements:

Vase life (days):

Vase life of each flower stem was determined as number of days from harvest day to the day when flower wilt, bent neck occurred, change in the color or when the flowers lost 25% of their original fresh weight.

Maximum increase in fresh weight (%):

The original fresh weight was measured in 1st day vase life. Every 2days each stem was weighted to estimate the change in the fresh weight until the experiment end. The percentage of maximum increase in fresh weight was calculated in both seasons by subtracting the original fresh weight.

Fresh weight loss during storage pariod (%).

It was calculated by the formula of [(fresh weight after storage period – fresh weight of the first day) /fresh weight of the first day] × 100.

Water uptake (ml/flower).

It was measured every 2 days by direct measurement of the decrease in the solution volume.

Water balance (±g /flower/2 days).

It was calculated as the difference between water uptake and loss.

Chemical analysis:

-Total chlorophyll content was calorimetrically determined as described by Lichtenthaler and Wellburn (1983).

-Total sugars contents (%) was determined according to James (1995).

Statistical analysis:

The experiment was done in the frame of factorial in two factors in completely randomized design with 3 replicates. Each replicate was contained three stem flowers.

Data of treatment means were compared using least significant difference (LSD) method as mentioned by Gomez and Gomez (1984) at 5 % significance level. All statistical analyses were performed using analysis of variance technique by means of CoStat Computer Software.

RESULTS

1. Effect of cold storage methods:

Flower quality:

Table (1) revealed that wet cold stored flowers significantly increased in vase life (13.02 and 12.84 days) as compared with dry cold stored flowers (6.58 and 8.49 days) during the two seasons, respectively. On the other hand, wet cold stored flowers had not significant differences in vase life values compared with non-stored flowers in two seasons. Vase life values significantly decreased after dry cold stored period compared with the other treatments.

The percentage of maximum increase in fresh weight after wet cold storage was the highest values amongst the other cold storage methods. Regarding the effect of dry cold storage on the maximum increase in fresh weight, data presented in Table (1) indicates that dry stored flowers significantly increased the fresh weight compared with the non-stored flowers in both seasons.

Table (1):Effect of cold storage methods, spraying with Peppermint and Clove essential oils and their interactions on Vase life (days) and Maximum increase in fresh weight (%) after 6 days vase life of *Ageratum hostonianum*, at 2013 and 2014 seasons.

Oil treatments (B)	Vase life (days)				Maximum increase in fresh weight (%)			
	2013							
	Storage methods(A)							
	Without	Wet	Dry	Means	Without	Wet	Dry	Means
Control	10.22	10.89	6.00	9.04	7.72	8.30	7.81	7.94
Peppermint 1ml/L	12.89	13.33	6.33	10.85	6.97	8.88	8.13	7.99
Peppermint 2ml/L	14.11	15.55	7.33	12.33	7.37	10.14	9.20	8.90
Clove 1ml/L	12.67	12.11	7.00	10.59	3.78	8.90	9.09	7.26
Clove 2ml/L	14.00	13.22	6.22	11.15	4.45	9.61	8.72	7.59
Mean	12.78	13.02	6.58		6.06	9.17	8.59	
LSD (0.05) A		0.36				0.42		
B		0.47				0.55		
A*B		0.81				0.95		
	2014							
Control	10.66	11.22	7.11	9.67	6.92	8.31	7.85	7.69
Peppermint 1ml/L	12.00	12.89	8.33	11.07	5.45	8.90	7.93	7.43
Peppermint 2ml/L	14.56	15.00	10.00	13.19	5.73	12.39	11.04	9.72
Clove 1ml/L	11.99	12.33	9.00	11.11	3.47	9.86	10.13	7.82
Clove 2ml/L	13.44	12.78	8.00	11.41	4.30	11.47	8.65	8.14
Mean	12.53	12.84	8.49		5.17	10.18	9.12	
LSD (0.05) A		0.31				0.69		
B		0.40				0.90		
A*B		0.69				1.55		

Water relations:

With regard to water uptake by Ageratum flowers after different cold storage methods, data in Table (2) showed that flowers after wet cold storage significantly increased water uptake comparing with non-stored flowers during the two seasons (36.13 and 37.97 ml/flower respectively). Also it is observed in the same table that flowers which were stored dry absorbed less amount of water during the vase life.

For the effect of cold storage methods on water balance during the vase life, it is noticeable that the flowers which were stored wet, their water balance began to decline after the fourth day (fig.1). On the contrary, the flowers that did not stored or stored dry, their water balance began to decline after the second day in the first and second seasons.

Total chlorophyll content and fresh weight loss during cold storage period:

Data presented in table (3) show that total chlorophyll and fresh weight of cut ageratum flowers increased when stored wet compared with dry stored flowers which led to a negative effect on chlorophyll content and fresh weight during storage period in the two seasons respectively.

Total chlorophyll and total sugar contents after 6 days vase life:

It was obvious from data in Table (4) that cut flowers without storage maintained had a high total chlorophyll and total sugar contents in their tissues during 6 days in vase period in both seasons (2.05 mg/g and 4.89 mg/g in the first season and 1.96 mg/g and 4.96 mg/g in the second season respectively). Flowers stored wet showed a significant increase in these attributes compared with dry stored flowers.

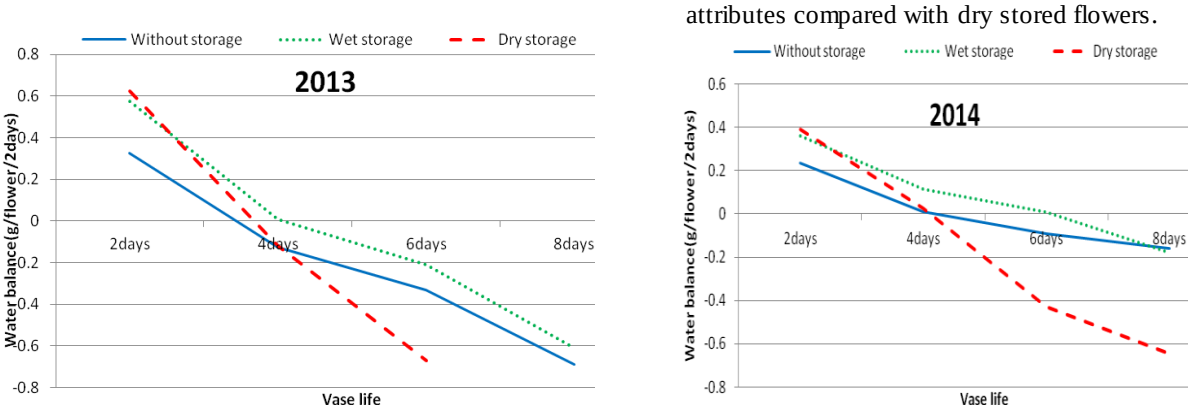

Fig (1): Effect of cold storage methods on Water balance (g/flower/2days) of *Ageratum hostonianum* cut flowers during two seasons (2013 and 2014).

Table (2): Effect of cold storage methods, spraying with Peppermint and Clove essential oils and their interactions on Total water uptake (ml/flower) of *Ageratum hostonianum*, at 2013 and 2014 seasons.

Oil treatments (B)	Total water uptake (ml/flower) 2013 Storage methods(A)				2014			
	Without	Wet	Dry	Means	Without	Wet	Dry	Means
Control	27.65	30.40	15.16	24.40	31.13	31.65	17.43	26.74
Peppermint 1ml/L	30.52	27.83	15.43	24.59	32.63	31.31	18.90	27.62
Peppermint 2ml/L	38.96	43.25	17.46	33.22	41.61	44.52	23.57	36.57
Clove 1ml/L	35.18	36.73	22.41	31.44	32.76	37.88	27.72	32.78
Clove 2ml/L	30.84	42.44	24.66	32.65	31.97	44.51	30.69	35.72
Mean	32.63	36.13	19.02		34.02	37.97	23.66	
LSD (0.05) A		0.99				1.27		
B		1.28				1.64		
A*B		2.21				2.85		

Table (3): Effect of cold storage methods, spraying with Peppermint and Clove essential oils and their interactions on Total chlorophyll (mg/g) and Fresh weight loss (%) after 6 days cold storage of *Ageratum hostonianum*, at 2013 and 2014 seasons.

Oil treatments (B)	Total chlorophyll after cold storage (mg/g) 2013 Storage methods(A)			Fresh weight loss during cold storage (%)		
	Wet	Dry	Means	Wet	Dry	Means
Control	1.75	1.69	1.72	2.02	-4.16	-1.07
Peppermint 1ml/L	2.28	1.46	1.87	3.12	-7.18	-2.03
Peppermint 2ml/L	2.85	1.24	2.05	3.26	-5.18	-0.96
Clove 1ml/L	2.31	1.35	1.83	2.03	-12.20	-5.08
Clove 2ml/L	2.99	1.26	2.13	5.11	-8.21	-1.55
Mean	2.44	1.40		3.11	-7.39	
F.test) A		***			***	
LSD (0.05) B		0.04			0.02	
A*B		0.06			2.18	
2014						
Control	1.68	1.73	1.71	3.08	-14.06	-5.49
Peppermint 1ml/L	2.32	1.51	1.92	5.05	-18.20	-6.58
Peppermint 2ml/L	2.95	1.28	2.12	5.27	-16.01	-5.37
Clove 1ml/L	2.35	1.38	1.87	4.08	-22.06	-8.99
Clove 2ml/L	3.01	1.29	2.15	6.05	-19.30	-6.63
Mean	2.46	1.44		4.70	-17.93	
		***			***	
(F.test) A		0.06			0.02	
LSD (0.05) B		0.08			3.48	
A*B						

2. Effect of spraying with essential oils:

Flower quality:

Data presented in Table (1) indicated that flowers sprayed with either Peppermint or Clove oil significantly increased in vase life compared with unsprayed flowers (control). Interestingly, flowers sprayed with Peppermint oil at 2ml/L gave a more pronounced effect on vase life (12.33 & 13.19 days respectively in the two seasons) when compared with either unsprayed flowers or with flowers sprayed with Clove oil in the two seasons. In concerning with the effect of spraying ageratum cut flowers with essential oils on maximum increase in fresh weight, data in table (1) showed a significant increase in fresh weight when flowers sprayed with Peppermint oil at 2ml/L during two seasons. Generally, spraying with Peppermint oil gave the highest values in vase life and fresh weight when compared with the control during the two seasons.

Water relations:

Generally, spraying flowers with essential oils led to a significant increase in water uptake comparing with the control exception of peppermint oil concentration of 1ml/L, it was not significant (table2). With regard to the effect of spraying with essential oils on water balance, the Peppermint oil treatments were the best compared to the other treatments (fig.2).

Total chlorophyll contents and fresh weight loss during cold storage period:

As regarding in Table (3), spraying flowers with peppermint or clove oil significantly increased the total chlorophyll contents compared with the control in the two seasons. Moreover, as apparent from the same table, spraying flowers with peppermint oil at (2ml/L) had the lowest values in fresh weight loss as compared with the control or the other essential oil treatments. While spraying flowers with clove oil at (2ml/L) had the highest values in fresh weight loss in the two seasons respectively.

Total chlorophyll and total sugar contents after 6 days vase life:

Spraying ageratum cut flowers with essential oils significantly increased the total chlorophyll and total sugar contents comparing with non- sprayed flowers in both seasons,. Spraying flowers with 2ml/L Peppermint oil significantly increased the total chlorophyll and total sugar contents comparing with other essential oil treatments in both seasons (Table 4).

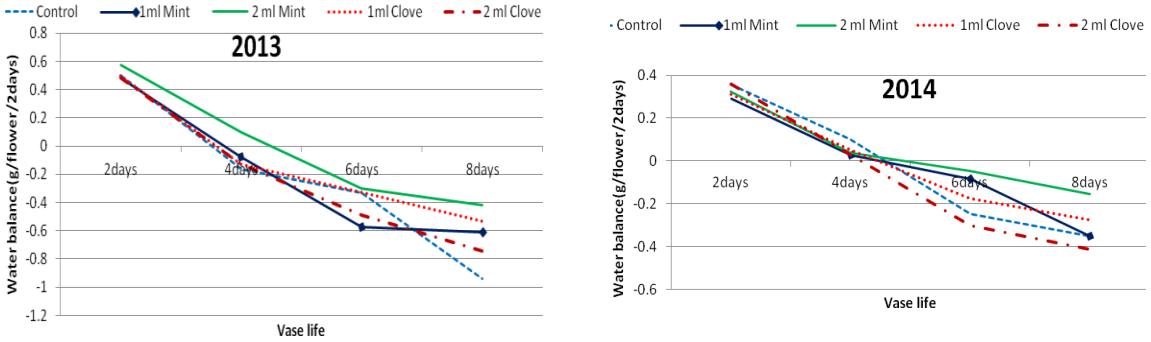

Fig (2): Effect of spraying with Peppermint and Clove essential oils on Water balance (g/flower/2days) of *Ageratum hostonianum* cut flowers during two seasons (2013 and 2014).

3.Effect of interactions between cold storage methods and spraying with essential oils:

Flower quality:

With regards to the effect of interactions between cold storage methods and spraying with essential oils, data in Table (1) referred that, spraying flowers with Peppermint oil at (2ml/L) before wet cold storage significantly had the longest vase life (15.55 & 15.0 days respectively in the two seasons) comparing with all other treatments unless flowers without storage and treated with the same oil which had non- significant parameter during the second season.

Additionally, data presented in Table (1) showed that flowers without storage and spraying with Peppermint or Clove oil at (2ml/L) had a significant increased in vase life compared with the other non-stored flowers during the two seasons.

Maximum increase in fresh weight (%) was obtained with the different storage methods and the increase values varied among the different oil treatments. Data presented in Table (1) clearly indicated that the maximum and significant increase in fresh weight (%) during vase period was obtained from flowers which had sprayed with Peppermint or Clove oil at (2ml/L) and stored wet as compared with the other storage methods. On the other hand, non-stored flowers significantly decreased in fresh weight during vase period compared with the flowers stored dry or wet.

Water relations:

Flowers sprayed with Peppermint or clove oil at (2ml/L) before wet cold storage significantly increased in water uptake compared with the other treatments (Table 2). As for the effect of essential oils on water uptake of cold stored dry flowers, was the least in water uptake among vase life. Non-sprayed flowers which stored dry had the lowest value in water uptake when compared with the other treatments in the two seasons (15.16ml/flower and 17.43ml/flower respectively). Considering the effect of interaction between essential oils and cold storage methods on water balance, results indicated that flowers sprayed with peppermint or clove oil at 2ml/L concentration before wet cold storage had the highest water balance until the sixth day in vase life (fig.4). On the other hand, flowers sprayed with peppermint or clove oils and stored dry (fig.5) or not stored (fig.3) were declined in water balance after the second day in a vase period.

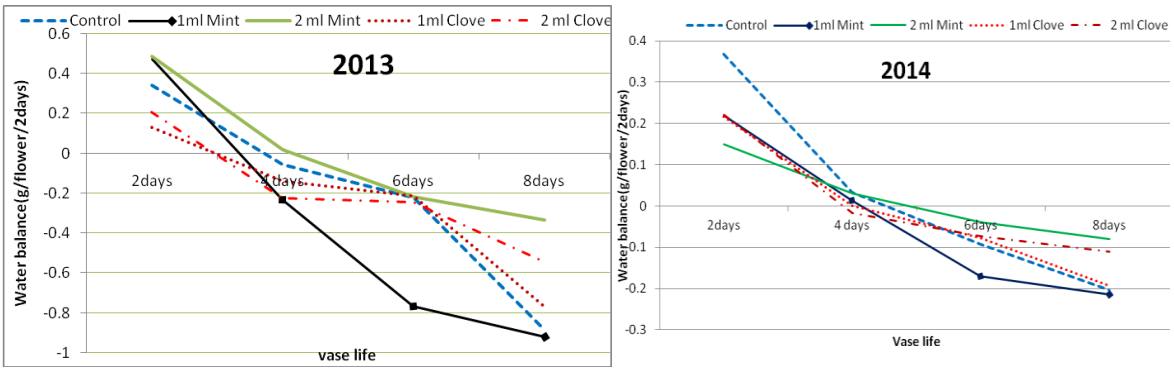

Fig (3): Effect of spraying with Peppermint and Clove essential oils on Water balance (g/flower/2days) of *Ageratum hostonianum* cut flowers (without storage) during two seasons (2013 and 2014).

Total chlorophyll contents and fresh weight loss during cold storage period:

The statistical analysis in Table (3) showed that the Ageratum cut flowers which sprayed with Clove or Peppermint oil at (2ml/L) showed a significant increase in total chlorophyll content and decrease in fresh weight loss during wet cold storage period as compared with the other wet cold storage treatments during the two seasons. Conversely, the same two essential oils treatments were the lowest in total chlorophyll content when flowers stored dry. Also, either Clove or Peppermint oil at (2ml/L) treatments had the highest values in fresh weight loss during the dry storage period (Table 3).

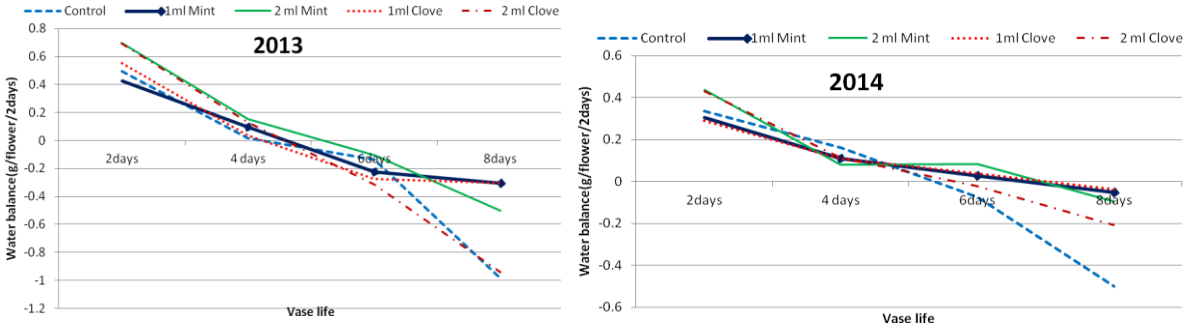

Fig (4): Effect of spraying with Peppermint and Clove essential oils on Water balance (g/flower/2days) of *Ageratum hostonianum* cut flowers (after Wet cold storage) during two seasons (2013 and 2014)

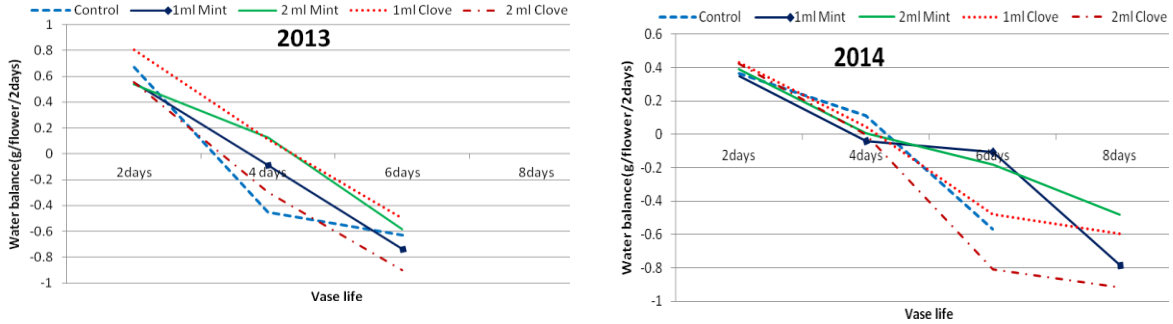

Fig (5): Effect of spraying with Peppermint and Clove essential oils on Water balance (g/flower/2days) of *Ageratum hostonianum* cut flowers (after Dry cold storage) during two seasons (2013 and 2014).

Total chlorophyll and total sugar contents after 6 days vase life:

Data recorded in Table (4) revealed that flowers sprayed with Peppermint oil at 2ml/L were significantly increased in total chlorophyll and total sugar contents in the two seasons. Flowers without storage which sprayed with Peppermint or Clove oil at 2ml/L gave a high value in the same characters. The lowest value in both total chlorophyll and total sugar contents resulted in sprayed flowers with essential oils before cold dry storage.

Table (4): Effect of cold storage methods, spraying with Peppermint and Clove essential oils and their interactions on Total chlorophyll (mg/g) and Total Sugar contents (mg/g) after 6 days vase life of *Ageratum hostonianum*, at 2013 and 2014 seasons.

Oil treatments (B)	Total chlorophyll (mg/g)				Total Sugar contents (mg/g)			
2013								
	Storage methods(A)							
	Without	Wet	Dry	Means	Without	Wet	Dry	Means
Control	1.59	1.63	0.96	1.39	4.25	4.30	3.12	3.89
Peppermint 1ml/L	1.93	1.96	1.22	1.70	4.83	4.90	3.19	4.31
Peppermint 2ml/L	2.45	2.70	1.53	2.22	5.55	5.32	3.66	4.84
Clove 1ml/L	1.90	1.65	1.22	1.59	4.50	4.37	3.24	4.04
Clove 2ml/L	2.38	1.84	1.30	1.84	5.29	4.39	3.32	4.33
Mean	2.05	1.96	1.25		4.89	4.66	3.31	
LSD (0.05) A		0.09				0.10		
B		0.11				0.13		
A*B		0.19				0.22		
2014								
Control	1.5	1.58	1.01	1.36	4.45	4.49	3.28	4.07
Peppermint 1ml/L	1.80	1.90	1.32	1.68	4.80	5.13	3.36	4.43
Peppermint 2ml/L	2.38	2.63	1.46	2.16	5.43	5.60	3.74	4.92
Clove 1ml/L	1.8	1.55	1.31	1.55	4.58	4.57	3.45	4.20
Clove 2ml/L	2.29	1.80	1.36	1.82	5.52	4.63	3.53	4.56
Mean	1.96	1.89	1.29		4.96	4.88	3.47	
LSD (0.05) A		0.06				0.07		
B		0.07				0.09		
A*B		0.12				0.15		

DISCUSSION

Postharvest longevity and keeping quality after cold storage of many cut flower species may be influenced by the methods of cold storage. Data presented in our work indicated that the wet cold storage of *Ageratum* cut flowers prolonged vase life and maintained the flower quality. This may be due to less transpiration of wet cold stored flowers resulting in more fresh weight of the cooled flowers. On the other hand, flowers stored dry became under water stress had high negative value of water potential. Consequently, lost some water and osmotic change took place within the flower tissues, resulting in some modifications in the water potential, increasing the respiration rate and then increasing in fresh weight loss. As these flowers were taken out the refrigerator, the

senescence process continued and flowers died quickly. These results corroborate with the observations on *Gloriosa superba* L.flowers by Hettiarachchi and Balas (2005). They reported that wet cold storage has the prospective to be used for delaying inflorescence senescence, prolonging vase life and postharvest keeping quality. Dole et al. (2009) reported that, wet storage for 1 or 2 weeks maintained the consumer longevity of cut lupine stems compared with non-stored stems. Also,Rudnicki et al.(1989) recommended wet storage for Carnations. On the other hand, Bosma and Dole (2002) reported that dry cold storage may be lead to increase the senescence of *Campanula* medium flowers comparing with wet cold storage. Reduced metabolic processes at low temperatures has been suggested to sustain the rate of blooming in flowers such as Amaryllis, Consolida and Nerine (Gul et al., 2007 and Shahri et al., 2009).

Regarding the effect of spraying *Ageratum hostonianum* cut flowers with essential oils, the results of the study indicated that flowers sprayed with the peppermint or clove oil at (2ml/L) before wet cold storage at (4^oC for 6 days) increased in water uptake and maximum increased in fresh weight during vase period resulting in prolonging the vase life. These results may be attributed to increasing in water flood through stem vessels which leads to a high water balance and flower quality which avoids from early wilting and reflecting on vase life prolong. It depends on the efficiency of the water flow within the vascular bundles of the flower stem which may be blogged by microorganisms especially bacteria and fungus. Essential oils have strong antimicrobial properties against some pathogens and bacteria because of high levels of menthol, menthone and phenolic compounds such as carvacrol, thymol and eugenol. Işcan *et al*.,(2002) and Sartoratto *et al*. (2004) reported that the main constituents of the peppermint oils was menthol (28-42%) and menthone (18-28%).They showed that all of the peppermint oils screened strongly inhibited plant pathogenic microorganisms. Nassar *et al*.,(2007) and Alma *et al*.,(2007) stated that the major components of clove oil were eugenol (71.56 %) and eugenol acetate (8.99 %). Additionally, Neeraj *et al*.,(2013) concluded that the essential oil of M. piperita L. was rich in many secondary metabolites such as tannins, phenols, steroids, flavonoids and volatile oils which had anti microbial properties. The antimicrobial mechanism of some essential oils is due to synthetic inhibition of DNA, RNA, protein and carbohydrates (Xia *et al*., 1995; Gogoi *et al*., 1997). Abd-El-Khair and Omima (2006) concluded that treated Navel orange fruits with some medicinal plant extracts (lemon grass, Lantana, Eucalyptus) kept on fruits quality under cold storage condition and in stimulate marketing period.

Similar results were found by Solgi *et al*. (2009) on *Gerbera*. They reported that thymol, carvacrol and thyme oil in combination with 6% sucrose had a positive effect on the vase life. Also, Kazemi (2012) reported that essential oils applications had significant effect on the vase life of Argyranthemum flowers. Nermeen (2012) stated that vase solutions containing essential oils (cumin,anise,geranium and lavender) significantly prolonged the vase life of Rose cut flowers, increased fresh weight and water uptake and decreased the water loss and respiration rate. Halevy and Mayak (1981) demonstrated that vase life of Rose, Gypsophila, Gerbera, Carnation and Chrysanthemum was improved significantly with germicide solution.

So, improvement vase life by using essential oils, as a new organic antibacterial agent, might be due to their role in inhibiting the microbial growth and preventing bacterial plugging. Nermeen (2012) reported that essential oils inhibited the growth of microbial organisms and caused an enhancement of conductivity within the xylem vessels. The same results were obtained by Nermeen *et al*., (2010) on Carnation and Bazaz and Tehranifar (2011) on Alstromeria.

The physical conditions that improve the action of essential oils are low temperature, low oxygen levels and low pH (Burt,S. 2004). So, the positive effect of peppermint and clove oils may be increased during cold storage and this attributed to increase their antimicrobial activities and that reduced bacterial population and resulted in increase vessel conductivity and water uptake. Consequently, spraying stems with peppermint or clove oil before wet cold storage making a layer coating on whole stem wall, thereby controlling the gas exchange, resulted in reducing water loss and respiration during storage period.

CONCLUSION

In conclusion, it could be recommended to spray *Ageratum Hostonianum* L. Blue Horizon cut flowers with peppermint or clove oil at 2ml/L before wet cold storage (at 4^oC for 6 days) to decrease the fresh weight loss and maintenance the total chlorophyll content during storage period. Moreover, the same treatments led to increase the flowers longevity and keep quality after storage.

REFERENCES

Abd-El-Khair H. and Omima, M. Hafez, (2006). Effect of Aqueous Extracts of Some Medicinal Plants in Controlling the Green Mould Disease and Improvement of Stored"Washington"Navel Orange Quality.J.of Appl.Sci.Res.,2(10):664-674.

Alma M.H., Ertas M., Nitz S. and Kollmannsberger H. (2007). Essential oil content, Turkish Clove," BioResources 2(2), 265-269.

Bazaz A.M. and A. Tehranifar (2011) Effect of ethanol, methanol and essential oils as novel agents to improve vase-life of Alstroemeria flowers. J. Biol. Environ. Sci. 5 (14), 41-46,

Bosma,T. and Dole,J.M. (2002). Postharvest Handling of Cut Campanula medium Flowers. Hort.Sci. 37(6):954-958.

Burt, S. (2004). Essential oils: Their antibacterial properties and potential applications in foods. Int. J. Food Microbio., 94: 223-253.

Dole J. M., Z. Viloria, F. L. Fanelli, and W. Fonteno (2009). Postharvest Evaluation of Cut Dahlia, Linaria, Lupine, Poppy, Rudbeckia, Trachelium, and Zinnia. HortTechnology July–September 19(3).

Gill A. O., Holley R. A. (2006a). Disruption of Escherichia coli, Listeria monocytogenes and Lactobacillus sakei cellular membranes by plant oil aromatics. Int. J. Food Microbiol. 108, 1–910.1016/j.ijfoodmicro.2005.10.009

Gill A. O., Holley R. A. (2006b). Inhibition of membrane bound ATPases of Escherichia coli and Listeria monocytogenes by plant oil aromatics. Int. J. Food Microbiol. 111, 170–17410.1016/j.ijfoodmicro.2006.04.046.

Gogoi, P., P. Baruah and S.C. Nath (1997). Antifungal activity of essential oil of Litsea cubeba. Pres. J. Essent. Oil. Res., 9, 213-215.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures For Agriculture Research. John Wiley and Sons, Inc, New York.

Gul F., I.Tahir and S. M.Sultan (2007). Effect of Storage Temperature on Postharvest Performance of Amaryllis belladonna L. cv. Rosea Scapes. J. Plant Biol., 34: 43-47

Halevy A.H. and S.Mayak (1981). Senescence and postharvest physiology of cut flowers, Part 2. Hort. Rev. 3:59-143.

Hemaiswarya S., Doble M. (2009). Synergistic interaction of eugenol with antibiotics against Gram negative bacteria. Phytomedicine 16, 997–100510.1016/j. phymed.04.006.

Hettiarachchi M.P. and J. Balas (2005). Storage Performance of Gloriosa superba L. as a Potential Cut Flower Species in Europe. Acta Hort. 683, ISHS 2005.

Işcan G., N. Kirimer, M. Kurkcuoglu, K.H.C. Baser and F. Demirci (2002). Antimicrobial screening of *Mentha piperita* essential oils. J. of Agricultural and Food Chemistry 50, 3943-3946

James C.,S.(1995). Analytical Chemistry of Food, pp.117-120. Blackie Academic & Professional, London.

Kazemi M. (2012). Effect of some chemicals on keeping quality and vase life of Argyranthemum flowers. Asian J. of Plant Sciences 11 (2):87-90.

Lichtenthaler,H.K.: and A.R. Wellburn (1983). Determinations of total carotenoids and chlorophylls a snd b in leaf extracts in different solvents. Biochem. Soc. Trans. 11,591-592.

Nassar M. I., Ahmed H. Gaara, Ahmed H. El-Ghorab, Abdel-Razik H. Farrag, Hui Shen,Enamul Huq and Tom J. Mabry (2007). Chemical Constituents of Clove (Syzygium aromaticum, Fam. Myrtaceae) and their Antioxidant Activity. Rev. Latinoamer. Quím. 35/3: 47-57.

Neeraj T.; A. Parakash and Y. Seema, (2013) Antimicrobial Activity and Medicinal Values of Essential Oil of Mentha Piperita L. Intern. J. of Engin and Innov. Tech. (IJEIT) Vol. 2, Iss. 8, February. ISO 9001:2008 Certified

Nermeen T.Shanan (2012). Application of essential oils to prolong the vase life of Rose (Rosa hybrid L. cv. "Grand") cut flowers. J. Hort. Sci. & Ornamen. Plants. 4 (1): 66-74.

Nermeen T.Shanan, Emara, Kh. S. and Barakat, S.,Olfat, (2010) Prolonging Vase Life of Carnation Flowers Using Natural Essential Oils and its Impact on Microbial Profile of Vase Solutions. *Aust. J. Basic & Appl. Sci., 4(8): 3559-3574*

Rudnicki R. M., D. M. Gozczynska and R. Tomaz (1989). Bud opening and long term storage of spray carnations. Acta Hort. 261:265-270

Reid M.S., J.L. Paul, M.B. Farhoomand, A.M. Kofranek and G.L. Staby (1980b). Pulse treatments with silver thiosulfate complex extend the vase life of cut carnations.J Amer Soc Hort Sci 105:25-27

Sartoratto A., A.L.M. Machado, C. Delarmelina, G.M. Figueira, M.C.T. Duarte and V.L.G. Rehder (2004). Composition and antimicrobial activity of essential oils from aromatic plants used in Brazil. Braz. J. Microbiol. Vol. 34(4): 1517-1520.

Shahri W., I. Tahir, S. T. Islam and M. A. Bhat (2011). Effect of dry and wet storage at cool temperatures on the post-harvest performance of Ranunculus asiaticus L. flowers. Frontiers of Agriculture in China Sept., Vol. 5, Iss. 3, 382-387.

Shahri W., I.Tahir and F.Gul (2009). Effect of Dry and Wet Storage at Cool Temperatures on Postharvest Performance of Consolida ajacis cv. Violet Blue Spikes. J. Plant Biol., 36: 5-9

Solgi M., M. Kafi, T.S. Taghavi and R. Naderi (2009). Essential oils and silver nanoparticles (SNP) as novel agents to extend vase-life of gerbera (*Gerbera jamesonii* cv. 'Dune') flowers. Post. Biol .Tec. 53:155-158.

Thoroski J. (1989). Eugenol induced inhibition of extracellular enzyme production by Bacillus cereus. J. Food Prot. 52, 399–403

van Doorn, W.G. (1997). Water relations of cut flowers. Hort. Rev. 18:1–85.

Walsh S. E., Maillard J. Y., Russell A. D., Catrenich C. E., Charbonneau D. L., Bartolo R. G. (2003). Activity and mechanisms of action of selected biocidal agents on Gram-positive and -negative bacteria. J. Appl. Microbiol. 94, 240–24710.1046/j.1365-2672.2003.01825.

Waithaka K., M. S. Reid and L. L. Dodge (2001). Cold storage and flower quality of cut tuberose (Polianthes tuberose L.). Hort. Sci. & Biotechnol. 76(3): 271-275.

Wendakoon C. N., Morihiko S. (1995). Inhibition of amino acid decarboxylase activity of Enterobacter aerogenes by active components in spices. J. Food Prot. 58, 280–283

Xia, Z.G., J.X. Yang and P.T.Li (1995) Study on antifungal mechanism of Listea cubeba oil in Candia albicans. Bull. Human. Med. Univ., 20, 107-108.

تأثير التخزين البارد الرطب والجاف مع الرش بالزيوت الطبية على جودة أزهار الأجيراتم وعمرها بالفازة.

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أجرى هذا البحث لدراسة تأثير الرش بزيت النعناع والقرنفل (١ & ٢ مللى/لتر) قبل التخزين البارد الجاف والرطب على درجة ٤ درجة مئوية لمدة ٦ أيام على جودة أزهار الأجيراتم المقطوفة وعمرها بالفازة وذلك فى موسمى ٢٠١٣ و ٢٠١٤ . وأشارت أهم النتائج الى زيادة كل من عمر الأزهار بالفازة والامتصاص الكلى سواء عند التخزين الرطب أو بدون تخزين مقارنة بالأزهار التى خزنت جافة. عمر الأزهار بالفازة زاد معنويا عند التخزين الرطب مقارنة بالأزهار الغير مخزنة. الأزهار التى تم رشها بزيت النعناع أو القرنفل بتركيز (٢ مللى/لتر) قبل التخزين الرطب أدى ذلك الى زيادة معنوية فى عمرها بالفازة والامتصاص الكلى للماء والنسبة المئوية لأقصى زيادة فى الوزن فى الموسمين. أثناء فترة التخزين البارد الأزهار التى خزنت رطبة وتم رشها بزيت النعناع أو القرنفل بتركيز (٢ مللى/لتر) احتفظت بأعلى محتوى من الكلوروفيل وكانت أقل الأزهار فقدا للوزن أثناء فترة التخزين مقارنة بالازهار التى خزنت جافة . النقص المعنوى فى محتوى الأزهار من الكلوروفيل الكلى أثناء حياتها بالفازة حدث فى الأزهار التى خزنت جافة. وبناء على النتائج المتحصل عليها يتم التوصية برش الأزهار بزيت النعناع أوالقرنفل بتركيز (١ & ٢ مللى/لتر) قبل التخزين الرطب فى محلول الحفظ وذلك للمحافظة على جودة الأزهار وزيادة عمرها فى الفازة.