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IMPROVING POSTHARVEST CHARACTERISTICS AND ARTIFICIAL COLORING OF MUMS (*Dendranthema grandiflorum*, Ram.) CUT SPIKES

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ABSTRACT

The aim of this research was to study the influence of some plant growth regulators, as well as some edible colors as a pulsing solution in the postharvest characteristics of Mums cut spike. Five pulsing treatments were used, as two plant growth regulators (GA_3 and Kin) with one fixed concentration for each one (25 and 5 mg/L, respectively) plus two pulsing times (1 and 2 hours) for each, beside the control (distilled water) were applied. Each pulsing treatment was trans-located into nine treatments of the dyeing solutions, since two edible colors {Ponceau 4R (red) and Brilliant blue (blue)} with two concentrations (3 and 6 g/L.) for two dyeing time (2 and 3 hours), plus the control (distilled water). Results indicated that the combinations between GA_3 for 1 or 2h with the two edible dyes increased the vase life and had the upper hand than using kin in most of the cases in that respect. Since, the highest vase life of 26.00 days was recorded eight times, most of them for the superior previous combinations. Also, the combination between GA_3 for 2h and 6 g/L blue dye for 3h was more effective in increasing the change of fresh weight values, comparing with most of the other interaction, especially from the beginning of the experiment till the 8th day. The maximum change of water uptake values (46.49 and 44.85 ml/100 g FW/2day) were recorded for the combinations of GA_3 for 2h + 6 g/L blue dye for 3hours, and kin for 1h + 3 g/L red dye for 3h, respectively. In addition, the combinations between GA_3 pulsing period and the dyeing treatments were more effective in reducing the water loss and increasing water balance comparing with the kin pulsing with the same dyeing treatments in most of the cases. The interactions among the blue dye at 6 g/L for 3h and each of the plant growth regulators type and pulsing time, significantly increased the total chlorophylls content and the total sugar % than all the other interactions. Finally, the least average of bacterial count obtained by using GA_3 for 2h plus 6 g/L blue dye for 3h when compared with the other treatments.

Keywords: Mums, GA_3, Kin, chrysanthemum, *Dendranthema*, Edible dyes, Postharvest.

INTRODUCTION

Mums (*Dendranthema grandiflorum* Ram.) belong to family Asteraceae and it is one of the most popular and commercial cut flowers that grown on longer scale in the world, Anjum *et al*. (2007).

Furthermore, it is ranked as the second most economically important cut flower in the world after rose, Kafi and Ghahsareh (2009). Mums bloom comes in a huge variety of shapes and sizes and in a wide range of colors in addition to the traditional yellow, other popular colors are white, purple, and red. But, in the fall and winter seasons especially in Egypt, there is no more colors variation in Mums cut flowers. Whereas, the color which widespread in this period is the white one. Coloring the inflorescences with edible dyes can really enhance the value of the flowers and helps the farmers in earning more from their production. It can also provide a great variety of colures for aesthetic beautification, Liu *et al*., (2004), Zhang *et al*., (2004) on *Dendranthema grandifloram*, Patil and Dahduk (2008) on *Pinpinella monoica* and Viradia *et al*., (2015) on *Polianthes tuberosa*. The cost benefit ratio was more after dyeing the flowers than that of white flowers, Patil and Dahduk (2007). Cut flowers vase life is mainly affected by two main factors, namely ethylene which accelerates the senescence of many flowers and microorganisms that cause vascular blockage and thus reduce the vase life of cut flowers Zencirkiran (2010).

Short postharvest vase life is one of the most important problems in cut flower production because flowers cannot adapt to an inappropriate environmental condition such as high temperature, low humidity, ethylene induced senescence, etc. So the use of chemicals can be a good solution for these problems. One of the efficient ways to overcome postharvest loss and deterioration of cut flowers is to treat them with various chemicals such as biochemical and plant growth regulators instantly after harvest. Growth regulators in the pulsing solutions are recommended to prolong the postharvest longevity, Rubinowska *et al*., (2012). Also, cytokinin and gibberellic acid have been reported in several studies to improve the postharvest vase life of many cut flowers. In this regard some growth regulators such as Kinetin (synthetic cytokinin) and gibberellic acid (GA_3) were used as pulsing solutions and seemed to prolong flowers longevity.

The aim of this investigation was to study the influence of some edible dyes in making diversity in Mums cut flowers colors especially in the period of the autumn and winter in Egypt instead of the white color. Also, in the same time, trying to improve quality and postharvest characteristics of Mums cut flowers.

MATERIALS AND METHODS

This research was carried out at the postharvest Laboratory of the Vegetable and Floriculture Department, Faculty of Agriculture, Mansoura University, Egypt, during 2014-2015 seasons to study the influence of some plant growth regulators and edible dyeing in the pulsing solutions on postharvest characteristics and chemical constituents of Mums cut spikes.

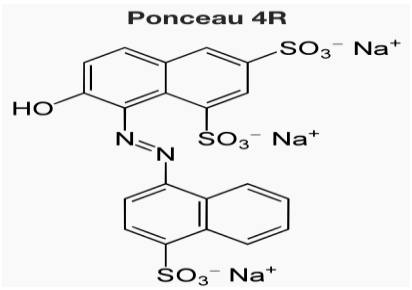
1. Plant Material:

Mums (*Dendranthema grandiflorum* Ram., cv. "Flyer") family Asteraceae. Cut spikes were obtained from a well-known commercial orchard at El-Kanater El-Khyrea, Egypt. Uniform spikes were cut in the early morning, and warped in polyethylene, then quickly transported to the laboratory. They are selected when ¾ of the flowers are fully developed and 80 cm length. The spikes were precooled by placing them in cold water for 30 min. Then, it was recut at 5cm from the end

of the stem and the leaves on the lower third part of the stems were also removed. Mums spikes were weighted and their original fresh weight was recorded.

2. Pulsing solutions and natural dyeing treatments:

Two growth regulators gibberellic acid (GA_3) and 6-furfuryladenine (kinetin) with fixed concentration for each of them (25 mg/L GA_3 and 5mg/L kin) respectively, with two pulsing time (1 and 2h) plus the distilled water for 1h (as control) were examined. Each of the previous pulsing treatments (5 treatments) subjected to nine dyeing treatments. As, two edible coloring agents, Ponceau 4R and Brilliant blue dyes {fig (1), shows the chemical structure of each dye} with two concentrations (3 and 6g/L) with two dyeing times (2 and 3h) for each of them were evaluated. Dyes solutions temperature was adjusted to 40°C.



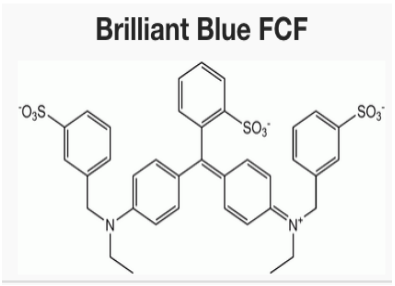


Fig (1): Chemical structure of ponceau 4R (Red dye) and Brilliant Blue (Blue dye), which used in the dyeing treatments.

3. Holding solution:

After the end of the pulsing and dying periods, Mums cut spikes were held till the end of the experiment in holding solutions (cylinder 100 ml) under lab conditions, fluorescent light about 1000 lux, temperature of 24°C ± 2 and relative humidity between 60-70% as follows: Each treatment from the nine dyeing solutions was held in preservative solution contained 10 % sucrose + 150 ppm 8-HQS + 150 ppm citric acid plus a fixed concentration from the two edible dyes (0.5 g/L).

Holding treatment could be summarized as follow:

1- Cut spikes (25 flowers) which dipped in distilled water (control) as a dyeing solution, were placed in a holding solution consisted of 10 % sucrose + 150 ppm 8-HQS + 150 ppm citric acid.
2- Cut spikes (100 flowers) which dipped in the previous dyeing solution treatments, were held in solution supplemented with 10 % sucrose + 150 ppm 8-HQS + 150 ppm citric acid + 0.5 g/L ponceau 4R dye as a fixed concentration.
3- Cut spikes (100 flowers) which dipped in the previous dyeing solution treatments, were held in solution supplemented with 10 % sucrose + 150 ppm 8-HQS + 150 ppm citric acid + 0.5 g/L Brilliant blue dye as a fixed concentration.

4. Experimental Design:

Five GR x nine dyes= forty five treatments in the present work were arranged in a factorial experiment in complete Randomized design (CRD). Each treatment had five replicate and each one had one spikes.

5. Data recorded:

A- Post harvest characteristics:

1. The vase life (days):

The vase life of Mums cut flower spikes (days) was evaluated, and was judged to have ended when 50% or more of the flowers on an inflorescence were deemed unattractive. Cho *et al*. (2001).

2. Change in fresh weight % :

The change in fresh weights of cut Mums spikes were measured every four days during vase life. The original fresh weight was measured immediately after cutting flowers and before the immersing in the pulsing solutions. He *et al*. (2006).

3. Maximum increase of fresh weight (%):

The percentage of maximum increase in fresh weight was calculated in all experiment by subtracting the original fresh weight from the maximum weight of the spike and multiplying it by 100.

4: Water relation measurements:

Change in water uptake (ml/100 g FW/4day):

Water uptake (ml /100 g FW/4days) recorded at 4^{th}, 8^{th} … days, during the shelf life periods.

Water loss (ml/ 100 g FW/4day):

Water loss every 4days was calculated as the difference between change in fresh weight every 4 days and amount of water uptake every 4 days, during the shelf life periods

Water balance (ml/100 g FW/4day):

Water balance = (water uptake – water loss) was recorded at 4^{th}, 8^{th} … days, during the shelf life periods.

B. Chemical constituents contents:

B1. Total chlorophylls contents:

Total chlorophyll (mg/gm. F.W) in leaves was recorded on the 7^{th} day during the shelf life period. Chlorophyll content was estimated by the method described by Goodwine (1965).

B2. Total sugars contents:

Total sugar was recorded on the 7th day during the shelf life period. For estimation of total sugar as the method described by, Hedge and Hofreiter (1962).

C. Bacterial counts:

Averages of Bacterial Counts (C.F.U /ml) were determined in the keeping solutions after 3 days. Where 1 ml taken from each sample and diluted by using sterilized distilled water from the first dilution to sixth dilution. After that 1 ml of each fourth, fifth and sixth

dilution were inoculated in petri dishes on media consisting of Peptone 5 g, Beef extract 3 g, NaCl 5 g, Agar 15 g, distilled water 1000 ml and pH 6.8 – 7.2, Atlas (1997) then it incubated for 72 hours at 30°C and the colonies have been counted according to Allen (1959) procedure.

5. Statistical Analysis:

All data obtained were subjected to statistical analysis according to Gomez and Gomez (1984). Treatment means were compared by L.S.D. at 5% test. and combined analysis of the two seasons were calculated according to Steel and Torrie (1980).

RESULTS

1. Vase life (days):

As for effect of pulsing solutions on the vase life, data in Table (1) cleared that using GA_3 at 25 mg/L for 2 or 1h as a pulsing solution for Mums cut spikes significantly tabulated the longest vase life values of 25.63 and 25.04 days, respectively when compared with all of the other treatments. In the same time, the treatments of kin at 5 mg/L for 1 or 2h recorded significant increase vase life which resulted in 24.44 and 24.74 days, respectively when compared with the control. These results are in agreement with the results obtained by Ahmadi and Hassani (2015) on rose regarding GA_3 effect. El-Saka (1992) on tuberose and bird of paradise respecting kin and GA_3 effect.

Generally, it was noticed that the control (distilled water) recorded the lowest vase life value of 22.22 days, between all the plant growth regulators treatments. On the other side, influence of the dyeing treatments in that parameter was shown in the same Table (1), and it was notice that insignificant differences were shown between using the blue dye at 6 g/L for 2 or 3h, 3 g/L for 3h and the control treatments in that respect. But, the blue dye at 6 g/L for 3h still higher than all of the other cases in enhancing the Mums cut spikes vase life, since it was 25.07 days. In addition, the shortest vase life value of 23.73 days was recorded for dyeing solution fortified with the red dye at 3g/L for 2h, followed by red dye at 6 g/L for 3h and blue dye at 3 g/L for 2h, since they were 24.00 and 24.13 days, respectively.

Table (1): Effect of pulsing and dyeing treatments and their interaction on vase life (days) of Mums cut spikes.

Pulsing treatments (A) / Dyeing treatments (B)		Control (D.W.)	25 mg/ L GA_3		5 mg/ L kin		`Means of (B)
		1h	1h	2h	1h	2h	
Control (D.W. without dyeing)		٢١.٣٣	٢٥.٣٣	٢٤.٦٧	٢٦.٠٠	٢٥.٣٣	24.53
3 g/L red dye	٢h	٢٠.٦٧	٢٤.٦٧	٢٦.٠٠	٢٣.٣٣	٢٤.٠٠	٢٣.٧٣
	3h	٢٢.٦٧	٢٤.٦٧	٢٥.٣٣	٢٤.٦٧	٢٦.٠٠	٢٤.٦٧
6 g/L red dye	٢h	٢٢.٦٧	٢٦.٠٠	٢٥.٣٣	٢٣.٣٣	٢٥.٣٣	٢٤.٥٣
	3h	٢٢.٦٧	٢٣.٣٣	٢٥.٣٣	٢٤.٠٠	٢٤.٦٧	٢٤.٠٠
3 g/L blue dye	٢h	٢٢.٦٧	٢٤.٦٧	٢٦.٠٠	٢٢.٦٧	٢٤.٦٧	٢٤.١٣
	3h	٢٢.٠٠	٢٦.٠٠	٢٦.٠٠	٢٤.٦٧	٢٤.٦٧	٢٤.٦٧
6 g/L blue dye	٢h	٢٢.٦٧	٢٤.٦٧	٢٦.٠٠	٢٥.٣٣	٢٣.٣٣	٢٤.٤٠
	3h	٢٢.٦٧	٢٦.٠٠	٢٦.٠٠	٢٦.٠٠	٢٤.٦٧	٢٥.٠٧
Means of (A)		22.22	٢٥.٠٤	٢٥.٦٣	٢٤.٤٤	٢٤.٧٤	
L.S.D at 5%		A (0.83)		B (1.11)		AB (2.48)	

As for the interaction effects data in Table (1) revealed that the combinations between GA_3 for 1 or 2h with the two edible dyes increased vase life and had the upper hand than using kin in the most cases in that respect. Since the highest vase life of 26.00 days was recorded eight times, most of them for the superior previous combinations. Data also indicated that the shortest vase life of 20.67 days was obtained when chrysanthemum cut spikes were treated with the combination of distilled water pulsing treatment + 3 g/L from the red dye for 2h. Generally, the interactions between the pulsing treatments using GA_3 and the dyeing solutions using the two edible colors (red or blue) were more effective in that regard, comparing with the combination of kinetin or control pulsing treatments and the studied dyes.

2. Change in fresh weight % :

Data in Table (2) showed that the combination between 25 mg/L GA_3 for 2h and 6 g/L blue dye for 3h was more effective in increasing the change of fresh weight value, comparing with most of the other interactions, especially from the beginning of the experiment till the 8th day. Followed by, the combination of 5 mg/L kin for 1h and 6 g/L red dye for 3h. Generally, the combination between the distilled water as a pulsing solution (without any growth regulators) and most of the dyeing treatments produced lower values for that respect, as comparing with most of the other combinations. Moreover, these effects were more obvious on the 8th day of the shelf life period.

Table (2): Effect of interaction between pulsing and dyeing treatments on change of fresh weight (%) of Mums cut spikes.

Pulsing treatments (A)	Dyeing treatments (B)		4th	8th	12th	16th	20th	24th
	Dyes	Dyeing time						
Control (distilled water) 1hour	Control (DW without dyeing)		6.30	3.80	-2.90	-4.77	-2.27	—
	3 g/L red dye	2h	2.97	4.87	0.63	-1.70	-3.20	—
		3h	4.23	1.97	-0.43	-4.00	-2.33	—
	6 g/L red dye	2h	7.20	2.20	1.73	-3.13	-3.60	—
		3h	3.70	4.77	0.93	-2.13	-2.50	—
	3 g/L blue dye	2h	3.17	4.17	-0.03	-2.37	-2.07	—
		3h	1.67	2.10	-0.20	-2.80	-1.90	—
	6 g/L blue dye	2h	4.17	5.33	-3.03	-5.10	-5.33	—
		3h	6.00	3.33	2.73	-5.33	-5.60	—
25 mg/L GA_3 1 hour	Control (DW without dyeing)		7.77	5.30	1.87	-1.70	-4.13	-3.43
	3 g/L red dye	2h	6.37	3.57	-1.17	-4.53	-3.83	-2.10
		3h	7.53	7.20	-0.57	-6.47	-3.30	-3.07
	6 g/L red dye	2h	6.67	3.97	0.63	-3.53	-2.37	-3.70
		3h	6.70	6.80	0.17	-6.13	-4.07	—
	3 g/L blue dye	2h	-0.50	1.53	٠.٠٠	-1.83	-0.77	-1.33
		3h	1.80	0.50	2.13	0.50	-1.03	-2.20
	6 g/L blue dye	2h	6.50	0.23	-0.73	-2.27	-2.17	-1.60
		3h	5.63	1.47	1.27	-1.40	-3.73	-2.30
25 mg/L GA_3 2 hours	Control (DW without dyeing)		8.90	6.27	-0.20	-2.70	-1.97	-3.60
	3 g/L red dye	2h	8.67	7.47	0.33	-4.47	-2.50	-4.47
		3h	9.13	4.63	0.57	-2.50	-4.53	-6.86
	6 g/L red dye	2h	11.17	1.77	1.00	-2.37	-1.87	-2.03
		3h	9.70	5.33	-1.73	-3.97	-2.80	-5.93
	3 g/L blue dye	2h	5.20	0.83	1.30	-8.53	-1.60	-2.83
		3h	5.10	0.50	0.40	-0.37	-1.50	-6.60
	6 g/L blue dye	2h	7.93	0.43	-4.17	-1.57	-2.13	-2.93
		3h	11.70	9.17	2.30	1.23	-0.93	-1.67
5 mg/L kin 1 hour	Control (DW without dyeing)		5.03	3.30	0.73	-1.10	-1.83	-2.03
	3 g/L red dye	2h	7.63	7.93	-2.07	-9.33	-5.47	—
		3h	9.37	7.83	-1.67	-7.10	-2.47	-3.20
	6 g/L red dye	2h	9.67	7.53	-1.40	-9.23	-3.23	—
		3h	9.87	8.07	0.10	-6.47	-2.33	-3.50
	3 g/L blue dye	2h	6.23	2.93	0.73	-4.23	-2.57	—
		3h	3.73	2.27	0.73	-1.60	-2.20	-1.73
	6 g/L blue dye	2h	5.10	2.87	-0.17	-2.47	-1.87	-2.00
		3h	7.10	3.13	-0.77	-5.60	-3.17	-2.40
5 mg/L kin 2 hours	Control (DW without dyeing)		6.40	0.90	0.03	-1.10	-0.20	-0.93
	3 g/L red dye	2h	10.83	7.40	0.17	-6.33	-2.53	-5.03
		3h	11.03	5.03	-0.83	-4.60	-2.00	-4.60
	6 g/L red dye	2h	10.80	6.37	-1.40	-5.43	-1.57	-4.53
		3h	8.87	6.57	0.77	-1.97	-1.63	-2.73
	3 g/L blue dye	2h	12.90	-0.70	3.20	-2.63	-8.30	-2.27
		3h	3.60	0.43	1.13	1.67	-1.67	-1.50
	6 g/L blue dye	2h	4.07	3.40	0.23	-1.60	-3.60	—
		3h	0.53	0.80	0.57	-1.50	-1.97	-1.93
L.S.D at 5%			5.37	3.66	2.56	3.46	2.70	2.75

3. Maximum increase of fresh weight (%):

The effect of the pulsing solutions on the maximum increase of fresh weight % was studied and shown in Table (٣). It was obvious that all the pulsing solutions increased the maximum increase of chrysanthemum cut spikes fresh weight % than the control one (distilled water). But, it was clear that the highest significant value of 29.81% tabulated when 25 mg/L GA_3 was added in the pulsing solution for ٢hours, when compared with most of the other treatments. In the same time, the treatment of kin at 5 mg/L for 1h came in the second order, as it was 29.05 %. Similar findings were obtained by Emami *et al*., (2011) on *Lilium lonngiflorum* and Ahmadi and Hassani (2015) on rose regarding (GA_3) effect and Zhang *et al*., (2009) on Lily

cut flowers, Cheng *et al*., (2010) on gladiolus respecting (kin) effect.

Also, the data in details revealed that the fresh weight gained maximum increase percentage with using all the blue dye treatments than the control or the red dye ones, since it ranged from 30.31 to 34.65%. However, the lowest values for this parameter (14.33, 19.54, 21.07, 22.45 and 26.13 %) were recorded when used 3 g/L red dye for 2h, 6 g/L red dye for 3h, control (distilled water without dyeing) and 3 g/L red dye for 3h, respectively and insignificant difference was found between them.

From the recorded data in Table (3) it could be concluded that the interaction among GA_3 at 25 mg/L for 2h and the blue dye at 6 g/L for 3h or the combination of 5 mg/L kin for 1h and the blue dye at 6 g/L for 3h, significantly tabulated the maximum increase of fresh weight to 45.77 and 43.47 %, respectively, when compared with most of the other combinations. The weakest value of this character (11.03 %) recorded for chrysanthemum cut spikes which pulsed for 1h in 25 mg/L GA_3 solution and dyed with 3 g/L from the red dye for 3h.

Table (3): Effect of pulsing and dyeing treatments and their interaction on maximum increase in fresh weight (%) of Mums cut spikes.

Pulsing treatments (A) / Dyeing treatments (B)		Control (D.W.)	25 mg/L GA_3		5 mg/L kin		Means of (B)
		1h	1h	2h	1h	2h	
Control (DW without dyeing)		١٧.٦٠	١١.٤٠	١٥.٩٧	٢٣.٤٠	٣٧.٠٠	٢١.٠٧
3 g/L red dye	٢h	١٦.٨٣	١١.٠٣	١٢.٩٧	١٥.١٧	١٥.٦٧	١٤.٣٣
	3h	١٩.٥٠	٣٩.٤٧	٣٨.٣٧	١٨.٣٧	١٤.٤٩	٢٦.١٣
6 g/L red dye	٢h	٢٢.٤٠	٢٢.٠٣	٣٠.٨٣	٢٤.٢٧	١٢.٧٠	٢٢.٤٥
	3h	٢٠.٧٧	١١.٥٧	٢٣.٧٠	١٨.٧٠	٢٢.٩٧	١٩.٥٤
3 g/L blue dye	٢h	١٤.٩٠	٣٥.٨٣	٣١.٩٧	٣٩.٠٣	٢٩.٨٠	٣٠.٣١
	3h	٢١.٩٧	٢١.٤٠	٣٧.٣٧	٣٧.٠٣	٤٢.٥٣	٣٢.٠٦
6 g/L blue dye	٢h	٢١.٢٠	٣٢.٩٧	٣١.٣٣	٤٢.٠٣	٣٥.٦٣	٣٢.٦٣
	3h	٢٢.٣٧	٢٦.٠٧	٤٥.٧٧	٤٣.٤٧	٣٥.٥٧	٣٤.٦٥
Means of (A)		١٩.٧٣	٢٣.٥٣	٢٩.٨١	٢٩.٠٥	٢٧.٤٣	
L.S.D at 5%		A (3.97)		B (5.33)		AB (11.99)	

4. Change in water uptake (ml/100g FW/4days):

Data in Table (4) showed that in the start of the experiment (4th day) the combination of 25 mg/L GA_3 for 2h + ٦ g/L blue dye for 3h significantly tabulated the highest amount in water uptake, of 39.32 ml/100g FW/4days when compared with all of the other interactions. Also, it was observed that the highest change of water uptake values was gained on the 4th day from the beginning of the vase life, and a gradual decline in the amount of the absorbed solution was continued up to the end of the vase life period. The maximum change of water uptake (46.49 and 44.85 ml/100g FW/4day) were recorded when combinations of ٢٥ mg/L GA_3 for 2h + 6 g/L blue dye for 3h and 5 mg/L kin for 1h + 3 g/L blue dye for 3hours. Moreover, these two combinations still giving the higher amount of water uptake until the 20th day from the beginning of the shelf life period comparing with many of the other combinations.

Generally, by taking the summation of the water uptake for each plant growth regulators (GA_3 and kin for the two examined period) and the control one in the superior 4th day, it could be noticed that the plant growth regulators had the upper hand in that respect than the dyeing type concentration and period. Since, the control gained the lowest value.

Table (4): Effect of interaction between pulsing and dyeing treatments on change of water uptake (ml/100g FW/4days) of Mums cut spikes.

Pulsing treatments (A)	Dyeing treatments (B)		4th	8th	12th	16th	20th	24th
	Dyes	Dyeing time						
Control (distilled water) 1hour	Control (D.W. without dyeing)		٣٣.٩٩	١٧.٩٠	١٥.٧١	٨.٥٩	٥.٠٧	—
	3 g/L red dye	2h	٣٥.٨٩	١٨.٢١	١٣.٣١	٧.٣٥	٦.١٠	—
		3h	٣٩.٢٠	١٦.٨٤	١٢.٦١	٨.٩٣	٦.٢٠	—
	6 g/L red dye	2h	٣١.٢٧	١٤.٩٠	١٠.٨٨	٧.٩٢	٥.٩٤	—
		3h	٣٣.٠٨	١٦.٢٣	١٣.٠٩	٨.٢٩	٥.٨٤	—
	3 g/L blue dye	2h	٣٧.١٢	١٦.٨٦	١٢.٥١	٦.٣١	٥.٣٧	—
		3h	٣٢.٩٠	١٤.١٧	١١.٣١	٥.٩٢	٥.٠١	—
	6 g/L blue dye	2h	٣١.٢٩	١٤.٤٥	١٢.٢٠	٦.٧٨	٦.٦٣	—
		3h	٢٩.١٥	١٦.٠٧	١٠.٨٧	٥.٧١	٦.٣١	—
25 mg/L GA_3 1 hour	Control (D.W. without dyeing)		٤٣.٨٤	٢٤.٧٢	١٥.٩٨	٥.٦٨	٤.٥٠	٣.١٥
	3 g/L red dye	2h	٤٢.٩١	٢٠.٩٩	١٥.٠٢	٦.٩٦	٦.١٠	٣.٤٤
		3h	٤١.٤١	١٨.٢٣	١٤.٣٢	٩.٠٢	٧.١٤	٣.٤٥
	6 g/L red dye	2h	٤٢.٣٣	١٧.٠١	١٣.٥٥	٧.٩٨	١٠.٥٣	٣.١٨
		3h	٤٠.٢٩	١٧.٥٥	١١.٨٣	٦.٠٣	٦.٦٥	٢.٤٣
	3 g/L blue dye	2h	٤٠.٠٦	١٧.٠٠	١٦.١٠	١١.٨٠	٨.٦٩	٥.٢٥
		3h	٣٧.٦٣	١٧.٥١	١٦.١٤	١٠.٤٦	٨.٠٦	٥.٤٧
	6 g/L blue dye	2h	٣٦.٠٧	٢٠.٦٢	١٦.٦٧	٨.٥٠	٧.٠٤	٤.٤١
		3h	٣٨.٥٦	١٤.٩٠	١٢.١٨	٦.٩٥	٤.٧١	٣.٧٠
25 mg/L GA_3 2 hours	Control (D.W. without dyeing)		٤٤.٦٤	٢١.٨٦	١٨.٥١	٩.٥٧	٧.٥٥	٤.٨٨
	3 g/L red dye	2h	٤٢.٥٠	٢٠.١٢	١٦.٧٩	٧.٦٤	٦.١٢	٢.٨٢
		3h	٣٩.٥٧	١٧.٩٠	١٢.٦٦	٥.٢٥	٥.٥٢	٢.٧١
	6 g/L red dye	2h	٤٢.٦٨	٢٤.٨٦	١٦.٥٢	٨.١٤	٨.٣٠	٣.٦٠
		3h	٣٩.٦٦	١٩.٩٠	١٣.٨٧	١٠.٠٢	٨.٦٨	—
	3 g/L blue dye	2h	٤٢.٩٩	١٨.٤٣	١٨.٢٩	١٠.٣٠	٩.٩٢	٣.٨٦
		3h	٣٧.٤٦	٢٣.١٥	١٥.٣٦	١١.٢٨	٨.٧١	٥.٧٤
	6 g/L blue dye	2h	٣٨.٢٤	١٤.٥٩	١٣.٤١	٩.٠٣	٨.٤٥	٣.٤١
		3h	٤٦.٤٩	٢٥.٧٩	١٨.٨٨	١٣.٠١	١١.٥٥	٥.٦١
5 mg/L kin 1 hour	Control (D.W. without dyeing)		٤٠.٩٣	٢٢.٤٨	١٧.٧٥	١١.٠٤	٨.٣٤	٤.١٧
	3 g/L red dye	2h	٤٠.٥٦	٢٠.٥٦	١٥.٣٢	٥.٧٨	٧.٧٤	—
		3h	٤١.٩٨	١٩.٦٥	١٤.٨١	٧.٢٣	٥.٨٨	٢.٣٣
	6 g/L red dye	2h	٤٠.٤٦	١٧.١٤	١٠.٢٣	٦.٣٧	٧.٤٢	—
		3h	٤١.٩٢	١٨.٩٢	١٤.٦٤	٨.٦٤	٩.٤٨	٢.٧٧
	3 g/L blue dye	2h	٤٤.٢١	٢٢.٥٢	١٤.٣٥	٩.٤١	٨.٦٩	—
		3h	٤٤.٨٥	٢٣.١٦	١٨.٧٥	١١.٥٢	١٠.٣٤	٢.٧٦
	6 g/L blue dye	2h	٤٠.٨٤	٢٠.٤٣	١٣.٩١	٨.٠٩	٦.٩٧	٤.٦٠
		3h	٣٩.٤٧	١٩.٧٥	١١.٨٤	٦.٠٦	٥.٦١	٤.٩٧
5 mg/L kin 2 hours	Control (D.W. without dyeing)		٤٣.٨٠	٢٣.٠٥	١٧.٨٤	٩.٥٢	٨.٨٦	٥.٦١
	3 g/L red dye	2h	٤٠.٥٢	١٥.١٤	١٢.٠٠	٥.٥٧	٤.٩٧	٢.٨٢
		3h	٤٣.١٥	٢٠.٧٨	١٤.٣٧	٧.٦٨	٤.٦٣	٤.٣٩
	6 g/L red dye	2h	٤٢.٠٧	١٨.٧٧	١٢.٨٣	٧.٢١	٦.٦١	٤.٢٤
		3h	٤٢.٤٨	١٥.٦٤	١٢.٠٥	٧.٥٢	٦.٤٦	٤.٦٢
	3 g/L blue dye	2h	٤٠.٩٢	١٨.٤٦	١٣.٥١	٧.٠٩	٥.٤٥	٠.٧٥
		3h	٣٦.٢٨	١٧.٦٣	١٣.٦٦	٨.٧٧	٧.٣٩	٢.٧٤
	6 g/L blue dye	2h	٣٨.٩٥	٢٤.١١	١٦.٦٩	٦.٩٦	٩.٥٥	—
		3h	٤٢.٠٤	٢٠.١٢	١٥.٢٧	٩.٨٨	٨.٥٠	٦.٢٤
L.S.D at 5%			4.70	5.82	4.32	3.25	3.70	3.07

5. Change of water loss (ml/100g FW/4days):

As for the interaction between pulsing and dyeing treatments on change of water loss (ml/100 g FW/٤days), data in Table (5) cleared that the negative combinations in maximizing the water loss of chrysanthemum cut spikes were 5 mg/L kin for 1h + 3 g/L for 2 or 3h from the blue dye, 5 mg/L kin for 2h + 6 g/L for 2 or 3h from blue dye and the same growth regulator without using any dyeing substance [control (distilled water)], since they tabulated higher amounts of water loss during the shelf life comparing with most of the other interactions. This means that GA_3 had the upper hand in all combination with the dyeing treatment than the Kin one, since the first one was more effective in reducing the water loss from the spikes comparing in the most cases. Also, it could be noticed that an increment in the water loss amounts from the cut spikes

started in the beginning of the experiment on the 4th day in the most of cases, and then it started to decrease gradually with increasing the vase life period. The positive combinations in decreasing water loss recorded for the interaction between 25mg/L GA_3 for 2h + 6 g/L blue dye for 3h, the same plant growth regulators (GA_3) with the same pulsing time + 6 g/L red dye for 3h, 5 mg/L Kin for 1h + 6g/L red dye for 3h and 5 mg/L Kin for 2h + 3 g/L blue dye for 2h during most of the vase life days.

Table (5): Effect of interaction between pulsing and dyeing treatments on change of water loss (ml/100 g FW/4days) of Mums cut spikes

pulsing treatments (B)	Dyeing treatments (B)		4th	8th	12th	16th	20th	24th
	Dyes	Dyeing time						
Control (distilled water) 1hour	Control (D.W. without dyeing)		٦٣.٠	٢٨.٠٤	٣٨.٣٠	٣٤.٤٢	٢٢.٢٥	—
	3 g/L red dye	2h	٨٠.٨	٢٦.٢١	٢٢.٢٦	١٧.٣٣	١٩.٢١	—
		3h	٧٩.٢	٣٠.١٠	٢٥.٥٤	٢٧.٥٣	٢٠.٤٦	—
	6 g/L red dye	2h	٤٦.٢	٢١.١٠	١٤.٢٤	١٨.٧٤	١٩.٠١	—
		3h	٦٨.١	٢١.٨٦	٢١.٠٦	١٨.٣٠	١٦.٤٢	—
	3 g/L blue dye	2h	٨٥.٩	٢٦.٨٢	٢٤.٧٤	١٨.٢٤	١٧.٣٨	—
		3h	٦٣.٧	٢١.٥٦	٢٠.٨٧	١٧.٠١	١٤.٣٢	—
	6 g/L blue dye	2h	٥٤.٢	١٥.٣٠	٢٦.٨٩	٢٣.٩٥	٢٩.٧٢	—
		3h	٥١.٨	٢٥.٢٢	١٤.٥٠	٢٣.٢٧	٣١.٧٨	—
25 mg/L GA_3 1 hour	Control (D.W. without dyeing)		٦٣.٠	٢٥.٨٥	٢٠.٤١	١١.٠٠	١٣.٠٠	١٢.٨٧
	3 g/L red dye	2h	٥٩.٩	١٨.١١	١٨.٩٢	١٦.١٤	١٤.٦٠	١٣.٢٢
		3h	٤٧.٦	١٦.٤٥	١٥.٦٥	١٣.٦٥	١٣.٢٤	١٥.٣٤
	6 g/L red dye	2h	٨٥.٦	٤٠.٧٩	٢٦.٢٧	٢٠.٨٠	١٥.٢٧	١٣.٣٩
		3h	٤٩.١	١٦.٢٧	١٧.٤٣	١٧.٤٧	١٧.٤٥	١٥.٩٠
	3 g/L blue dye	2h	٦٤.٢	٢٨.٥٧	٢٤.٨٨	١٧.١٨	١٨.٢٩	١٤.٢٩
		3h	٥٧.٤	٢٨.٨١	٢٦.٣٣	١٧.٩٩	١٥.٨٢	١٣.١٣
	6 g/L blue dye	2h	٤٥.٤	٣١.٦٨	٢٠.٥٩	١٤.٢٣	١٣.٨٩	١٢.١٨
		3h	٦٩.٧	٢٠.٦٧	٣١.٣٩	٢٥.٨٥	٩.٩٨	١٢.٢٣
25 mg/L GA_3 2 hours	Control (D.W. without dyeing)		٥٩.٩	٢٣.٥٠	١٩.٨٤	١٣.٢٧	١١.٨٢	١١.٦٨
	3 g/L red dye	2h	٩٦.٠	٣٤.١٦	٣٥.٨٧	٢٨.٧٣	٢٣.٣٣	١٤.٣٠
		3h	٥٨.١	١٤.٣٢	١٩.٧٣	١٦.٨٥	١٦.٧٩	١١.٦٨
	6 g/L red dye	2h	٨١.٧	٣٨.٠٥	٢٦.٣١	٢٠.٤٨	١٩.٤٢	١٥.٩٧
		3h	٣٥.٧	١٤.٧٨	١٦.٧٦	١٤.٧٩	٢١.٨٠	—
	3 g/L blue dye	2h	٨٥.١	٣٠.١٤	١٢.٠٦	٢٤.٤٣	٢٠.٥٥	١٠.٠٨
		3h	٨٠.٦	٤٩.١٠	٣٣.٧٥	٢٠.٩٩	٢٠.٧٣	١٧.٣٥
	6 g/L blue dye	2h	٥١.٧	٢٢.٥٧	٢٣.٠٣	١٨.٩٨	١٩.١٠	١٠.٢٨
		3h	٣٣.٩	٨.٧٠	١٦.٤	٩.٩٨	١٦.٧٩	١٠.٠٨
5 mg/L kin 1 hour	Control (D.W. without dyeing)		٨٣.٦	٣٧.٣٤	٣٢.٨٧	٢٣.١٦	٢٠.٩٤	١٣.٣٥
	3 g/L red dye	2h	٥٣.٣	١٥.٤١	١٧.٧٥	٢٠.٧٦	٢٣.٠٨	—
		3h	٥٠.٣	١٣.٩١	١٨.٧٧	١٨.٢٨	١٢.٢٥	٩.٦٦
	6 g/L red dye	2h	٤٦.٧	١٠.١٦	١٤.٦٧	٢٠.٧٣	١٧.٠٥	—
		3h	٤١.٧	٩.٨٩	١٥.٨١	١٦.٢٤	١٤.٢٣	٨.٨٩
	3 g/L blue dye	2h	١٠٠.٦	٤٣.٠٨	٢٧.٣١	٣٣.٥٢	٣١.٠٣	—
		3h	١٠٣.٢	٤٥.٥١	٣٦.٧٢	٢٤.٥٣	٢٧.٤٤	١٢.٢٩
	6 g/L blue dye	2h	٩٢.٢	٣٩.٠٧	٢٩.٩٣	٢٣.٩٧	٢١.٢٩	١٨.٦١
		3h	٦٣.٥	٢٧.٧٦	٢٠.٤٦	٢١.٢٢	١٨.٤٩	١٨.٥٦
5 mg/L kin 2 hours	Control (D.W. without dyeing)		١٠٦.٤	٥٤.٩٦	٤٣.٣٤	٣٤.٤٦	٢٩.١٠	١٨.٣٤
	3 g/L red dye	2h	٤٦.٦	٩.٠٢	١٣.٤٠	١٥.٤٠	١٠.٨٧	١٣.٨٢
		3h	٧٠.٥	٢٦.٨٦	٢٤.٨٢	٢٢.٧٨	١٣.٥٧	٢٤.٢٤
	6 g/L red dye	2h	٥١.١	١٦.٨٤	١٩.١٥	٢٠.٤٢	١٥.١٧	١٨.٧٧
		3h	٦٢.٥	١٢.٦٠	١٤.٨٢	١٢.٨٦	١١.٦١	٨.٥٨
	3 g/L blue dye	2h	٢٨.٢	١٨.٥٥	٩.١٤	٨.٦٢	١٤.٠٢	٣.٣٩
		3h	٥١.٧	٢٦.٠٣	١٨.٣١	١٠.٠٠	١٣.٦٧	٧.٢٨
	6 g/L blue dye	2h	١٠٧.٦	٥٤.١٩	٣٦.١٣	٢١.٦٠	٣٨.٤٩	—
		3h	١٣٠.٥	٥٠.٣٧	٣٧.١٥	٣١.٥٢	٢٩.٥٤	٢٥.٥٢
L.S.D at 5%			25.61	13.00	12.66	11.41	١٠.٤٦	12.09

6. Change in water balance (ml/100g FW/4 day):

According to data in Table (6) it was noticed that the maximum water balance for most of the interaction treatments was recorded from the 8th to 16th day from the beginning of the vase life. Moreover, combinations of 25 mg/L GA_3 for 2h + 6g/L blue dye for 3h, 5 mg/L Kin for 1h + 3 or 6g/L red dye for 2 or 3h, especially on the 8th day. In contrary, the lowest water balance values tabulated on the 4th days from the beginning of the experiment when the interactions of 5 mg/L Kin for 1h + 3g/L blue dye for 2 or 3h, 5 mg/L Kin for 2h + the control (without dyeing), and 5 mg/L Kin for 2h + 6g/L blue dye for 2 or 3h.

Table (6): Effect of interaction between pulsing and dyeing treatments on change of water balance (ml/100 g FW/4days) of Mums cut spikes.

pulsing treatments (B)	Dyeing treatments (B)		4th	8th	12th	16th	20th	24th
	Dyes	Dyeing time						
Control (distilled water) 1hour	Control (D.W. without dyeing)		-29.0	-10.15	-22.60	-25.83	-17.19	—
	3 g/L red dye	2h	-44.9	-8.00	-8.95	-9.98	-13.10	—
		3h	-40.0	-13.27	-12.92	-18.60	-14.26	—
	6 g/L red dye	2h	-15.0	-6.21	-3.37	-10.82	-13.08	—
		3h	-35.0	-5.63	-7.97	-10.01	-10.55	—
	3 g/L blue dye	2h	-48.8	-9.96	-12.23	-11.93	-12.01	—
		3h	-30.8	-7.39	-9.56	-11.09	-9.32	—
	6 g/L blue dye	2h	-22.9	-0.84	-14.69	-17.17	-23.09	—
		3h	-22.6	-9.15	-3.63	-17.56	-25.48	—
25 mg/L GA_3 1 hour	Control (D.W. without dyeing)		-١٩.١	-1.13	-4.43	-5.32	-8.50	-9.72
	3 g/L red dye	2h	-١٦.٩	2.88	-3.90	-9.18	-8.50	-9.79
		3h	-٦.٢	1.78	-1.33	-4.63	-6.09	-11.90
	6 g/L red dye	2h	-43.5	-18.93	-10.94	-11.28	-12.11	-12.02
		3h	-٨.٨	1.27	-5.59	-8.76	-10.80	-13.47
	3 g/L blue dye	2h	-٢٤.١	-11.57	-8.78	-5.38	-7.95	-9.04
		3h	-١٩.٨	-11.31	-10.19	-7.53	-7.75	-7.66
	6 g/L blue dye	2h	-٩.٤	-11.07	-3.93	-5.73	-6.85	-7.77
		3h	٤.٦	0.11	-2.85	-9.49	-4.74	-10.20
25 mg/L GA_3 2 hours	Control (D.W. without dyeing)		-15.3	0.62	-1.33	-3.70	-4.27	-6.79
	3 g/L red dye	2h	-53.5	-14.04	-19.08	-21.09	-17.21	-11.48
		3h	-18.6	3.58	-4.10	-11.60	-11.28	-8.97
	6 g/L red dye	2h	-39.0	-13.18	-9.79	-12.34	-11.12	-12.36
		3h	-30.1	-0.77	-5.86	-15.83	-13.11	—
	3 g/L blue dye	2h	-42.1	-11.71	-14.10	-12.91	-10.63	-6.22
		3h	-43.2	-25.95	-15.00	-9.71	-12.03	-11.62
	6 g/L blue dye	2h	-13.4	-7.97	-9.62	-9.96	-10.65	-6.87
		3h	٦.٦	8.31	0.12	-3.28	-5.27	-8.53
5 mg/L kin 1 hour	Control (D.W. without dyeing)		-42.7	-14.86	-15.12	-12.12	-12.60	-9.19
	3 g/L red dye	2h	-12.8	5.15	-2.39	-14.98	-15.34	—
		3h	-8.3	5.75	-3.96	-11.05	-6.37	-7.33
	6 g/L red dye	2h	-6.3	6.52	-4.44	-14.35	-9.63	—
		3h	0.2	9.03	-1.18	-7.61	-4.75	-6.12
	3 g/L blue dye	2h	-56.3	-20.56	-12.96	-24.11	-22.34	—
		3h	-58.3	-22.35	-17.84	-14.23	-17.58	-9.53
	6 g/L blue dye	2h	-51.3	-18.65	-16.02	-15.89	-14.33	-14.0
		3h	24.1	-8.1	-8.62	-15.16	-12.87	-13.59
5 mg/L kin 2 hours	Control (D.W. without dyeing)		-62.6	-31.92	-25.50	-21.45	-17.55	-12.73
	3 g/L red dye	2h	-6.1	6.12	-1.40	-9.83	-5.90	-11.00
		3h	-27.4	-6.08	-10.45	-15.10	-8.94	-19.85
	6 g/L red dye	2h	-9.0	1.93	-6.32	-13.21	-8.57	-14.55
		3h	-20.0	3.04	-2.77	-5.34	-5.15	-5.96
	3 g/L blue dye	2h	12.7	-0.09	4.38	-1.53	-8.57	-2.64
		3h	-15.4	-8.40	-4.65	-1.22	-6.27	-4.54
	6 g/L blue dye	2h	-68.6	-28.39	-19.44	14.65-	-28.94	—
		3h	-84.0	-30.25	-21.87	-21.64	-21.04	-19.28
L.S.D at 5%			24.25	10.12	8.26	10.04	٨.٣٥	9.45

B. Chemical constituents contents:

B1. Total Chlorophylls content:

Regarding the effect of pulsing solutions on total chlorophylls content, the results presented in Table (7) indicated that using GA_3 at 25 mg/L for the longer time (2h) significantly resulted in the highest total chlorophylls content. Followed by using the same growth regulator (GA_3) for 1h and kin at 5 mg/L for 2h, since they recorded 0.43 mg/gm. F.W of total chlorophylls. In contrary, the control one (distilled water), significantly tabulated the lowest value in that parameter. These results were in agreement with the results obtained by Emami *et al.*, (2011) on Lilium and Ahmadi and Hassani (2015) on rose respecting (GA_3) treatment.

For the effect of the dyeing solutions in that respect, results showed in Table (7) pointed that most of the dyeing solutions treatments increased the total chlorophylls content of Mums cut spike leaves comparing with the control. Furthermore, the blue dye at 6 g/L for 3h treatment was more effective in this regard and significantly gave the maximum value of 0.52 mg/gm. F.W for total chlorophylls. Followed by the red dye at 6 g/L for 3h and the blue dye at 3 g/L for 3h as they recorded 0.48 and 0.47 mg/gm. F.W., respectively. Generally, it was notice that using the two dyeing colors at a lower concentration (3 g/L) for a shorter time (2h) had a negative effect on total chlorophyll content.

The interactions between the blue dye at 6 g/L for 3h and all of pulsing treatments significantly were more effective in increasing total chlorophylls content of Mums cut spike leaves in comparison with all the other interaction treatments. In addition, all the interactions between the red dye at 3 g/L for 2h and all the pulsing solution decreased this parameter than all the other cases, especially the combination between this dye (red at 3 g/L for 2h) and the control pulsing (distilled water) one, since it was 0.33 mg/gm. F.W.

Table (7): Effect of pulsing and dyeing treatments and their interaction on total chlorophyll content mg/gm. F.W in leaves after 7 days from treatments of Mums cut spikes.

Pulsing treatments (A) / Dyeing treatments (B)		Control (D.W.)	25 mg/L GA_3		5 mg/L kin		Means of (B)
		1h	1h	2h	1h	2h	
Control (D.W. without dyeing)		٠.٣٨	٠.٤٠	٠.٤١	٠.٣٨	٠.٤٠	٠.٣٩
3 g/L red dye	٢h	٠.٣٣	٠.٣٥	٠.٣٦	٠.٣٤	٠.٣٦	٠.٣٥
	3h	٠.٤٢	٠.٤٤	٠.٤٦	٠.٤٣	٠.٤٥	٠.٤٤
6 g/L red dye	٢h	٠.٣٨	٠.٤٠	٠.٤٠	٠.٤٠	٠.٤٠	٠.٤٠
	3h	٠.٤٧	٠.٤٨	٠.٥٠	٠.٤٧	٠.٤٩	٠.٤٨
3 g/L blue dye	٢h	٠.٣٦	٠.٣٧	٠.٣٩	٠.٣٧	٠.٣٨	٠.٣٧
	3h	٠.٤٥	٠.٤٧	٠.٤٨	٠.٤٥	٠.٤٨	٠.٤٧
6 g/L blue dye	٢h	٠.٤٠	٠.٤٢	٠.٤٢	٠.٤٢	٠.٤٣	٠.٤٢
	3h	٠.٥٠	٠.٥١	٠.٥٣	٠.٥١	٠.٥٢	٠.٥٢
Means of (A)		٠.٤١	٠.٤٣	٠.٤٤	٠.٤٢	٠.٤٣	
L.S.D at 5%		A (0.003)		B (0.004)	AB (0.009)		

B2. Total sugars % :

Data presented in Table (8) indicated that pulsing solutions of GA_3 or kin for the longer time (2h) resulted in the highest total sugars % of Mums cut spike leaves than the other treatments. Furthermore, pulsing solution, of GA_3 at 25 mg/L for 2h was more effective in this regard and significantly gave a maximum value (21.17 %) of total sugar %. On the other side, the control one significantly recorded the lowest total sugar %. These results were in agreement with the results obtained by Singh *et al.,* (2008) on gladiolus respecting (GA_3) treatment.

Table (8): Effect of pulsing and dyeing treatments and their interaction on total sugar % in leaves after 7 days from treatments of Mums cut spikes.

Pulsing treatments (A) / Dyeing treatments (B)		Control (D.W.)	25 mg/L GA_3		5 mg/L kin		Means of (B)
		1h	1h	2h	1h	2h	
Control (D.W. without dyeing)		17.42	17.86	18.21	17.65	18.00	١٧.٨٣
3 g/L red dye	٢h	١٨.١٥	١٨.٥٢	١٨.٩٢	١٨.٣٢	١٨.٧٣	١٨.٥٣
	3h	٢١.٠٥	٢١.٥١	٢١.٨٩	٢١.٣٢	٢١.٧٣	٢١.٥٠
6 g/L red dye	٢h	١٩.٦٢	٢٠.٠٠	٢٠.٣٩	١٩.٧٤	٢٠.١٦	١٩.٩٩
	3h	٢٢.٧٦	٢٣.١٤	٢٣.٥٣	٢٣.٣١	٢٣.٣٧	٢٣.٢٢
3 g/L blue dye	٢h	١٨.٨١	١٩.١٢	١٩.٤٧	١٨.٩٣	١٩.٣٣	١٩.١٣
	3h	٢١.٩٨	٢٢.٣٦	٢٢.٦٨	٢٢.١٥	٢٢.٥١	٢٢.٣٣
6 g/L blue dye	٢h	٢٠.٣٨	٢٠.٧١	٢١.١٤	٢٠.٤٨	٢٠.٩٣	٢٠.٧٣
	3h	٢٣.٥٩	٢٣.٩٨	٢٤.٣٢	٢٣.٧٣	٢٤.١١	٢٣.٩٥
Means of (A)		٢٠.٤٢	٢٠.٨٠	٢١.١٧	٢٠.٦٣	٢٠.٩٩	
L.S.D at 5%		A (0.0٦)		B (0.0٦)	AB (0.١)		

In addition, all the dyeing solutions treatments increased the total sugar % comparing with the control. Furthermore, using the two dyeing colors at the higher concentration (6 g/L) and time (3h) significantly gave the maximum total sugar % comparing with all of the other treatments. But, it was clearly observed that the blue dye was more effective and had the upper hand in that respects comparing with the red dye one. The interaction among the blue dye at 6 g/L for 3h and all the pulsing solutions significantly recorded the highest total sugar % than all of the other interactions. Followed by the red dye at the same concentration and the same time with all the pulsing solutions. The weakest interactions in that parameter were recorded for the

combination between all the pulsing solutions without using any dyeing treatment, since it ranged from 17.42 to 18.21%.

C. Bacterial counts:

The results tabulated in Table (9) revealed that the least average (30 x 10^2 and 84 x 10^2 C.F.U/ml) of bacterial count obtained by using GA_3 for 2h plus 6 g/L blue dye for 3h and 5 mg/L Kin for 2h plus 6 g/L red dye for 2h respectively, when compared with the other treatments.

On the other hand, the maximum average (43 x10^7 C.F.U/ml) of the bacterial count was recorded for the interaction between the control pulsing solutions (distilled water) plus 3 g/L blue dye for 2h.

Table (9): Average of total bacterial counts (CFU/ml) of different treatments under study:

Sample	Number	Log number	Sample	Number	Log number
control (DW) for 1h + 3g/L red dye for 2h	31 x 10^5	6.49	25mg/L GA_3 for 2h + 3g/L blue dye for 2h	25.8 x 10^6	7.41
25mg/L GA_3 for 1h + 3g/L red dye for 2h	40 x 10^7	8.60	5mg/L kin for 2h + 3g/L blue dye for 2h	10.5 x 10^6	7.03
5mg/L kin for 1h + 3g/L red dye for 2h	20 x 10^5	6.31	25mg/L GA_3 for 2h + 3g/L blue dye for 3h	65 x 10^5	6.81
control (DW) for 1h + 3g/L red dye for 3h	26 x 10^6	7.42	5mg/L kin for 2h + 3g/L blue dye for 3h	13 x 10^5	6.11
25mg/L GA_3 for 1h + 3g/L red dye for 3h	11 x 10^6	7.06	25mg/L GA_3 for 2h + 6g/L blue dye for 2h	11 x 10^7	8.04
5mg/L kin for 1h + 3g/L red dye for 3h	23 x 10^5	6.36	5mg/L kin for 1h + 6g/L blue dye for 2h	75 x 10^5	6.88
25mg/L GA_3 for 1h + 6g/L red dye for 2h	83 x 10^6	7.92	control (DW) for 1h + 3g/L blue dye for 2h	43 x 10^7	8.63
5mg/L kin for 2h + 6g/L red dye for 2h	84 x 10^2	3.92	25mg/L GA_3 for 2h + 6g/L blue dye for 3h	30 x 10^2	3.48
25mg/L GA_3 for 1h + 6g/L red dye for 3h	64 x 10^4	5.81	5mg/L kin for 2h + 6g/L blue dye for 3h	27 x 10^6	7.44
5mg/L kin for 1h + 6g/L red dye for 3h	40 x 10^5	6.60	control (DW) for 1h + 3g/L blue dye for 2h	96 x 10^6	7.98
25mg/L GA_3 for 1h + control(without dyeing)	12 x 10^3	4.08	25mg/L GA_3 for 2h + control(without dyeing)	48 x 10^4	5.68
5mg/L kin for 1h + control(without dyeing)	18 x 10^4	5.26	control (DW) for 1h + control(without dyeing)	74 x 10^6	7.87
control (DW) for 1h + control(without dyeing)	74 x 10^6	7.87			

DISCUSSIONS

The main reasons for the short vase life and the weakest postharvest characteristics of the cut flowers is due to some factors, one of the most important is occlusions located mainly in the basal stem end probably caused by growth of microbes and vascular blockage and increase in water loss by leaves transpiration, Alimordi *et al*., (2013). Plant growth regulators such as GA_3 and Kin play an important role in prolonging the vase life, increase the fresh weight of flower branches, soluble protein content, and protective enzyme activity in the petal, decrease the accumulation of malondialdehyde (MDA) in the petal, maintain the stability of cell membrane of 'Sorbonne' Lily cut flowers. Also, it was more effective in preventing leaf yellowing Zhang *et al*., (2009). Moreover, GA_3 stimulating reaction may be due to the fact that gibberellins improving carbohydrate and protein accumulation in the leaves and petals Faraji *et al*., (2011). In addition, GA_3 decreases or delay the chlorophyll degradation and increased water uptake and fresh weight of the cut flowers Hatamzadeh *et al*., (2012). Also, Mohammadi *et al*., (2013) stated that GA_3 stimulating the activity of superoxide dismutase enzyme which led to increasing the anthocyanin pigment content. The main initial effect of kinetin was on increasing water uptake, as kinetin slowed down processes associated with both senescence and stress (RNase activity and dry weight reduction), and maintained petal turgidity for an extended period Mayak and Halevy (1974). Zheng *et al*. (2008) studied the Physiological effects of kinetin on senescence of *Dianthus caryophyllus* cut flowers and indicated that kin could improve the water balance, increasing fresh weight, inhibition of peroxidase (POD) activity, delay the degradation rate of protein and enhancement of malondialdehyde (MDA) content during vase life of the cut flowers. As for using the edible dyes in artificial coloring many authors studied the influence of it in artificial coloring on many cut flowers, and they found that these dyes did not affect the vase life of these cut flowers comparing with the control treatments Kumar *et al*., (2003) on tuberose, Liu *et al*., (2004) on

chrysanthemum, Patil and Dahduk (2007) on candytuft. Also, Patil and Dahduk (2008) on *Pinpinella monoica* cut flowers indicated that the color shade which obtained in inflorescences was directly dependent on the dye concentration and time of immersion. As, when the time of immersion and dye concentration increased, the colors shades on the inflorescences increased also.

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تحسين صفات ما بعد الحصاد والتلوين الصناعي لازهار الاراولا المقطوفة

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اجريت هذه الدراسة في معمل قسم الخضر والزينة كلية الزراعة- جامعة المنصورة خلال الموسمين ٢٠١٤ و ٢٠١٥ . ويهدف هذا البحث لدراسة تاثير بعض منظمات النمو والصبغات القابلة للاكل كمحاليل للغمس على صفات ما بعد الحصاد لزهرة الاراولا، حيث تم استخدام اثنان من منظمات النمو (حامض الجبرليك والكينتين) بتركيز واحد ثابت لكل منهما (٢٥ ملجم/لتر و٥ ملجم/لتر على التوالي) بالاضافة الى مدتين للغمس (١، ٢ ساعة) لكل منهما بالاضافة الى معاملة الكنترول (ماء مقطر)، كل معاملة غمس تم نقلها لتسع معاملات من محاليل الصبغ حيث تم استخدام صبغتان Ponceau 4R (red) و Brilliant blue (blue) بتركيزين لكل منهما (٣ و٦ جم/لتر) ولمدتي غمس بالصبغ (٢ و ٣ ساعة) بالاضافة الى معاملة الكنترول.

يمكن تلخيص نتائج الدراسة كما يلي:

١. ادى التفاعل بين معاملة حامض الجبرليك بتركيز ٢٥ ملجم/لتر لمدة ساعة و٢ ساعة مع كلا الصبغتين الى زيادة فترة بقاء الشماريخ الزهرية في محاليل الحفظ بالمقارنة بمعظم المعاملات حيث وصلت الى ٢٦ يوم.

٢. ادت المعاملة باستخدام حامض الجبرليك ٢٥ ملجم/لتر لمدة ٢ ساعة مع ٦ جم/لتر من الصبغة الزرقاء لمدة ٣ ساعة الى زيادة قيم التغير في الوزن الطازج بالمقارنة مع معظم التفاعلات الاخرى خصوصا ابتداءاً من بداية التجربة وحتى اليوم الثامن.

٣. اكبر زيادة في قيمة الماء الممتص (٤٦.٤٩ و ٤٤.٨٥ مل/ ١٠٠ جم وزن طازج/٢ يوم) سجلت بمعاملتي التفاعل حامض الجبرليك ٢٥ ملجم/لتر لمدة ٢ ساعة + ٦ جم/لتر من الصبغة الزرقاء لمدة ٣ ساعات وكينتين ٥ ملجم/لتر لمدة ساعة + ٣جم/لتر صبغة حمراء لمدة ٣ ساعة على التوالي.

٤. اقل نسبة ماء مفقود واكبر توازن مائي تم الحصول عليهما من معاملات التفاعل بين مدتي الغمس بحامض الجبرليك ومعاملات الصبغات بالمقارنة مع استخدام معاملات الكينتين مع نفس معاملات الصبغات في معظم الحالات.

٥. تم الحصول على اعلى محتوى من الكلوروفيل الكلي والسكريات الكلية من خلال التفاعل بين كلا منظمي النمو والصبغة الزرقاء بتركيز ٦ جم/لتر لمدة غمس٣ ساعات.

٦. اقل متوسط للعد البكتيري تم الحصول عليه باستخدام حامض الجبرلين لمدة غمس ٢ ساعة + ٦ جم/لتر من الصبغة الزرقاء لمدة غمس ٣ ساعات.

يوصى باستخدام معاملات التفاعل بين منظم النمو حامض الجبرليك بتركيز ٢٥ ملجم/لتر وغمس لمدة ساعتين مع الصبغة الزرقاء بتركيز ٦ جم/لتر وغمس لمدة ثلاث ساعات للحصول على اطول فترة بقاء واعلى زيادة للوزن الطازج واقل نسبة ماء مفقود واكبر توازن مائي وكذلك للحصول على اعلى محتوى من الكلوروفيل الكلي والسكريات الكلية واقل نشاط بكتيري عند حفظ ازهار الاراولا المقطوفة.