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SENESCENCE OF ROSE FLOWERS 2- REGULATION AGING AND PROLONG THEIR VASE LIFE

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ABSTRACT: This study was carried out in a laboratory of Plant Physiology, Faculty of Agriculture, Al-Azhar University, Nasr city Cairo, Egypt during 2013 – 2016 A.D to comparison between *Rosa hybrida* L. cultivars (Anna and Gold strike cvs.) reported that Anna cv. have the short-longevity vase life (early senescence) and Gold strike cv. which have long-longevity (late senescence). The effect of exogenous sucrose (Suc), ethanol (Eth), ethanol + sucrose (Eth+Suc), salicylic acid (SA), 5-sulfosalycilic acid (5-SSA), silver thiosulphate (STS) and benzyladenine (BA) on the longevity of vase life for two cut rose flowers (Anna and gold strike cvs.) was investigated. Some physiological and biochemical traits such as water relations (water uptake, water loss and relative fresh weight), stability membrane, electrolyte leakage, chlorophyll a,b and carotenoids, lipid peroxidation, thiobarbituric acid reactive substances (TBARS), hydrogen peroxide (H_2O_2), peroxidase (POD), superoxide dismutase enzyme (SOD) activity and endogenous hormones *i.e*. indole acetic acid (IAA), cytokinin (CKs), gibberellic acid (GA3) and abscisic acid (ABA) were measured. Results reported that, the vase life evidently all treatments were better treated, 1mM SA, 6% Eth, 6% Eth + 2% Suc recorded vase life valued 7,6 and 6 days, respectively with Anna cv. compared with their control (4 days), while Gold strike cv. with same better treated recorded 12,11 and 11 days, respectively when compared with control (8 days). Results reported that ethanol 6% + 2% sucrose and salicylic acid at 1 mM reduced lipid peroxidation and consequently prolonged membrane integrity, antioxidant enzymes (POD and SOD) activity observed was dramatically in two cultivars. While, water relations (water uptake, water loss and relative fresh weight) was better for the best treatments compared to control. Also pigments of photosynthetic and membrane stability were more stable with the best treatments compared with untreated plants. Furthermore, the levels of CKs, IAA and GA3 were increased in treated plants, while, ABA decreased in both cut 'Anna and Gold strike' rose flowers compared untreated plants. Overall, the results suggest that SA and combination of ethanol + sucrose increase vase life by improving the antioxidant system and endogenous growth hormones and reducing oxidative stress damages during rose flower senescence. In general, Gold strike cv. was more responsive than Anna cv. to proposed transactions. On the other hand, the lowest coefficients were STS, 5-SSA and BA treatments.

Key words: Vase life, salicylic acid, sucrose, ethanol, antioxidant, IAA, CKs, GA3 and ABA.

INTRODUCTION

Rose (*Rosa hybrida* L.), one of the valuable cut flowers, belongs to the *Rosaceae* family which has dedicated fourth ranking of production **(Butt, 2003)**. Egypt is one of the countries classified as the most appropriate environmental conditions, the soil, climate and trained labors to produce cut flower crops for local markets and for export. However, the short vase life could be one of the most important reasons for inability of florists to develop an appreciable to use market in Egypt. Petals senescence commonly is accompanied by morphological, biochemical deterioration as declining protein concentration, membrane

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damage, and an increase in protease activity (**Arora *et al.,* 2007**). Furthermore, it was also confirmed that reactive oxygen species (ROS) is involved in plant tissues **(Dhindsa *et al.,* 1981)**. The first part of this study, was reported that the vase life in Anna cv. was early senescence (short-longevity, 4 days) when compared with Gold strike cv. recorded late senescence (long-longevity, 8 days). Gold strike showed better for water relation (water uptake, water loss and relative fresh weight), photosynthetic pigments constancy, membrane stability as well, also less oxidative products as H_2O_2 and TBARS and have appearing of defense system by antioxidant enzymes as POD and SOD activity. Furthermore, it was clearly better endogenous hormones as GA3, CKs and IAA, when compared with ABA in Anna cv. **(El-Nabarawy *et al.,* 2018)**. Earlier studies reported that preservation solution for delaying senescence and extending flower vase life contain germicides, ethylene synthesis inhibitors, growth regulators, some mineral compounds, and carbohydrates that are essential for extending the vase life of cut flowers **(Halevy and Mayak, 1981).** Sulfosalicylic acid as salicylate derivatives in vase solution was most effective in extending flower vase life of cut gladiolus. Salicylates increased vase life by increasing reactive oxygene species (ROS) scavenging activity of the gladiolus cut flowers **(Ezhilmathi *et al.,* 2007)**. In recent years, SA has been the focus of intensive research due to its function as an endogenous signal mediating local and systemic plant defense responses against pathogens. It has also been found that SA plays a role during the plant response to abiotic stresses such as drought, chilling heavy metal toxicity, heat and osmotic stress. SA appears to be, just like in mammals an "effective therapeutic agent" for plants **(Marina and Javier, 2011).** Cut rose flower has short vase life that relates to the ethylene production and causes wilting, bent neck and vascular blockage by air and microorganisms **(Van Doorn, 1997).** All this confirms the fact that SA is a natural, cheap, safe, and a biodegradable compound which is a suitable alternative for conventional chemical treatments to prolong vase life of cut rose flowers **(Abdolmaleki *et al.,* 2015).** The treatment with distilled water (as a control) gave the shortest vase life period that was characterized by poor water relations in association with lower water uptake (probably due to growth of microbes and vascular blockage), high rate of transpiration and water loss, as noticed by **Mehraj *et al*. (2016).** Preservative and anti-ethylene compounds (biocide and germicide) such as ethanol prevent vascular blockage **(Singh and Tiwari, 2002).** Ethanol is one of the anti-ethylene compounds that reduces ethylene activity and increases vase life of cut flowers **(Farrokhzad *et al.,* 2005).** Furthermore, ethanol and acetaldehyde with *Allamanda cathartica* var. Grandiflora showed that delayed leaves chlorosis and extended vase life **(Umbese, *et al.,* 2010).** Carbohydrate one of the preservatives solutions to delay the senescence and provide a respiratory substrate. However, carbohydrate especially sucrose cause growth and increased in bacterial amounts, existing in preservative solution, which tend to embolism of cut flower xylem vessel **(Kaltaler and Steponkus, 1976).** In present study (senescence flowers of roses: 1-Comparison between Anna and Gold strike cvs.) reported that Anna cv. have the short-longevity vase life (early senescence) and Gold strike cv. which have long-longevity (late senescence). In this part of the study, was to investigate an attempt to regulate and delay aging in both Anna and Gold strike cvs. Rose flowers by chemical holding treatments including Suc, Eth, Eth+Suc, SA, 5-SSA, STS and BA. In general, SA, Eth and Eth+Suc recorded better of the vase life compared with other treatments. Furthermore, Gold strike cv. was move responsive than Anna cv. to proposed transactions. On the other hand, the lowest coefficients were Suc, STS, 5-SSA and BA treatments.

MATERIALS AND METHODS

Plant Material

Rosa hybrida L. cultivars used in the investigation were Anna and Gold strike cvs. in open bud stage cut in the early morning, from a local commercial greenhouse (Floramix Farm, El-Mansuria District-Giza-Egypt), wrapped in Kraft paper in groups and transported with appropriate covers immediately to laboratory of Plant Physiology, Faculty of Agriculture, Al-Azhar University, Nasr city Cairo, Egypt during 2013 – 2016 A.D. Keep only five upper leaves of each flowery stem, and the stems were placed in vases after re-cutting (removing about 10 cm) in the air. Two stems (subsamples) from each

cultivar were placed in a jar containing 350 ml, three jars from each cultivar were untreated and treated by chemical preservatives, Suc (1, 2 and 3%), Eth (4, 6 and 8%), Eth+Suc (4+2, 6+2, 8+2 and 10+3, respectively), SA (0.5, 1.0 and 2.0 mM), 5-SSA (250, 500 and 750 µM), STS (5, 10 and 15 ppm) and BA (5, 10 and 15 µM). The experiments maintained under condition 23-25°C/ 60-70% Relative humidity and with light intensity (1000 µw/cm^2 in 12 hours' photoperiods) supplied from white fluorescent tubes.

Measurement of Vase Life

Vase life was recorded as the number of days on vase (according to **Liao *et al.*, 2000).**

Measurement of water relation

Water uptake, water loss, water balance and relative fresh weight was measured according to **El-Quesni *et al.* (2009)**.

Electrolyte leakage (EL)

Ion leakage was determined as electrical conductivity (EC%) according to **Hassanein *et al.* (2012)**.

Membrane stability index (MSI)

For determination of cell membrane stability (MSI) was estimated from the formula: MSI = [1-EC1/EC2] x100. (**Sairam and Tyagi, 2004**).

Determination of chlorophyll a, b and total carotenoid concentrations

Chlorophyll a (Chl-a), Chlorophyll b (Chl-b) and total carotenoids (Cx+c) levels (Methanol solvent) were calculated according to the formulas of **Lichtenthaler and Wellburn (1985)**.

Chl-a =15.65 A666 - 7.340 A653

Chl-b =27.05 A653 - 11.21 A666

Cx+c = 1000 A470 - 2.860 Ca - 129.2 Cb/245.

Determination hydrogen peroxide (H_2O_2)

H_2O_2 determination of leaves and petals tissue determined using the extinction coefficient 0.28 µM−1 cm−1 and amount expressed as nmol g−1 f.W were calculated according to **Velikova *et al.* (2000)**.

Determination of thiobarbituric acid reactive substance (TBARS concentration) and measurement level of lipid peroxidation: Thiobarbituric acid-reactive substances (TBARS) were measured in plant homogenate using the method of **Ohkawa *et al.* (1979).**

Determination of Antioxidant Enzymes Activity

Tissue preparation for enzymatic antioxidants

fresh leaves and petals samples (0.2 g) were ground in liquid N_2 and homogenized in an ice-bath in 4 ml homogenizing solution containing 50 mM potassium phosphate buffer and 1% (*W/V*) polyvinylpyrrolidone (pH 7.8). The homogenate was centrifuged at 14000 rpm at 4˚C for 10 min and the resulting supernatant was used for enzyme assays.

Determination of peroxidase (POD)

POD activity was measured according the method of **Chance and Maehly (1955)**.

Determination of superoxide dismutase (SOD) activity

SOD activity was measured according the method of **Beyer and Fridovich (1987).**

Determination of endogenous hormones

IAA, CKs, GA3 and ABA were measured by the injection of the extract into a reverse phase HPLC, with a methanol gradient in 0.6% acetic acid according to **Chen and Yang (2005).**

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) and significant differences among means were calculated by Duncan's multiple range test ($p \leq 0.05$). All data were analyzed statistically by one-way ANOVA using the Co-Stat program version 6.3 (**Costat, 1990**).

RESULTS AND DISCUSSION

Vase Life

Results regarding rose flowers average longevity is tabulated in Table 1. Gold Strike cv. has showed longer vase life than Anna cv. for control and all the treatments. Also, the best treatments which significantly increased vase life in Gold strike cv. Were SA at 1mM which recorded 12 days pursue by 11 days with 0.5Mm SA, 6% Eth and 2% Suc + 6% Eth treatments and besides that it decreased floret abscission

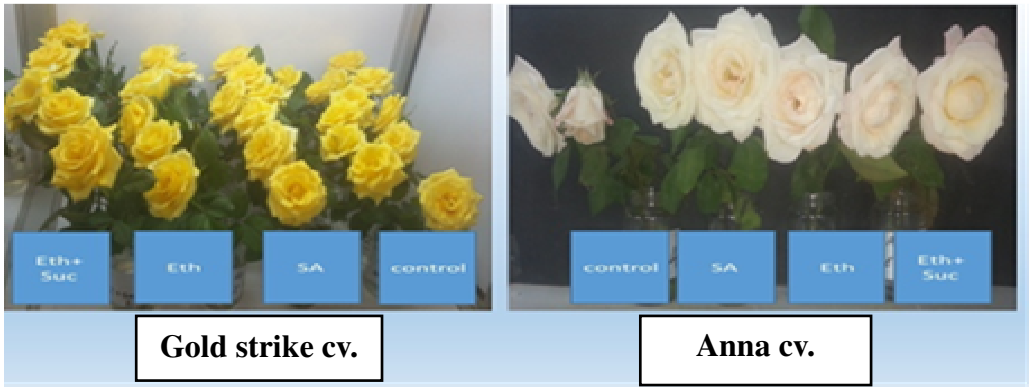

Fig. 1. Effect of different preservative solutions (Suc, Eth, Eth+Suc, SA, 5-SSA, STS and BA) on vase life (days) of cut 'Anna and Gold strike' rose flowers

Table 1. Effect of different preservative solutions (Suc, Eth, Eth+Suc, SA, 5-SSA, STS and BA) on vase life (days) of cut 'Anna and Gold strike' rose flowers

Treatment	Vase life (day)	
	Anna cv.	Gold strike cv.
Untreated	4	8
Suc		
1%	4	6
2%	4	7
3%	3	6
Eth		
4%	5	9
6%	6	11
8%	4	8
Suc + Eth		
2% Suc + 4% Eth	5	9
2% Suc + 6% Eth	6	11
2% Suc + 8% Eth	5	7
3% Suc + 10 Eth	3	5
SA		
0.5 mM	5	11
1 mM	7	12
2 mM	5	9
5-SSA		
250 µM	5	9
500 µM	5	9
750 µM	4	8
STS		
5 ppm	3	5
10 ppm	4	5
15ppm	3	4
BA		
5 µM	5	7
10 µM	5	8
15 µM	4	6

as compared to control (8 days). The better treatments were observed in Anna cv. with SA at 1mM followed by ethanol 6% which recorded 7 and 6 days, respectively when compared with the control (4 days). While, minimum vase life was recorded with all concentrations of sucrose (Suc) at 1,2 and 3%, ethanol (Eth) at 4 and 8%, sucrose + ethanol (Suc+Eth) at Suc 2% + Eth 4%, 2 Suc 2% + Eth 8% and Suc 3% + Eth10%, salicylic (SA) at 0.5 and 2 mM, 5-sulphosalyciclc acid (5-SSA) at 250,500 and 750 µM, silver thiosulphate (STS) at 5,10 and 15 ppm and benzyladenine (BA) at 5,10 and 15 µM on both cultivars. Vase life was improved by using SA in vase solutions. SA extended vase-life of cut rose flowers by regulating water uptake. Also, adding SA to vase water has previously been shown to extend the longevity of cut *Rosa* flowers (**Capdeville *et al*., 2003; Ping *et al.*, 2004).** Additionally, **Fan *et al.* (2008)** showed that the treatment of salicylic acid extended the vase life and improved flower quality with reduced respiration rate delay senescence and decrease lipid peroxidation, malondialdehyde (MDA) concentration, in addition **(Han, 2003; Yamane *et al.,* 2005)** came to similar findings. Our results with ethanol treatment, confirmed by other researches (**Farrokhzad *et al*., 2005; Sharif-Hossain *et al*., 2007**). Also, vase solutions include 6% (Eth) ethanol showed increase in vase life on *Alstroemeria* compared to the control **(Kiaseh and Yadegari, 2016)**. Treatment of cut carnation flowers with low concentrations of ethanol increases their vase life significantly **(Heins, 1980; Wu *et al.,* 1992). Podd and Staden (2004)** stated that carnation flower senescence was delayed by ethanol. Low concentrations of ethanol significantly increased the vase life of cut carnation flowers **(Serrano *et al*., 1991; Mayak and Triosh, 1993).** Moreover, **Pun *et al.* (1999)** reported that ethanol (4 and 6%) increased the vase life of' carnation flowers and cultivars showed variable response to ethanol treatment about to vase life increment.

They also mentioned that treatment with 4% ethanol inhibited ethylene production as well as sensitivity to ethylene and responsive to ethanol. For ethanol and sucrose treatment, sucrose at 2% showed that vase solution (containing 2% sucrose) prolonged the vase life of cut clematis **(Je-drzejuk *et al.,* 2016)**. The ethanol may act as an energy source or reduce the requirement for carbohydrates in the flower. Sucrose was not supplied to the flowers with the ethanol in the holding-solution, but when added in preliminary experiments, no benefit was obtained **(Mayak and Kofranek, 1976)**.

Effect of Treatments

Water uptake of flowers

The perusal of data, Table 2 indicated that, the SA 1mM and 6% Eth+2%Suc treatments showed significant influence on water uptake in both 'Anna and Gold strike' cvs. compared with control (untreated flowers). The highest uptake was observed in Anna cv. which recorded 12.11 and 10.83 ml/flower but for Gold strike cv. the values were 9.53 and 8.36 ml/flower compared with control which recorded (9.11 and 7.45 ml/ flower) at 3-4 and 7-8 days during their vase life with Anna and Gold strike cvs., respectively. Solution uptake amounts SA-treated in Gerbera cut flowers were significantly more than control. The results agree with **Vahdati *et al.* (2012)** who showed that SA enhancing water uptake and relative fresh weight of cut flowers. The improvement in vase life of cut flowers treated by SA may be due to antimicrobial activity (inhibiting vascular blockage), increases the water uptake **(Mori *et al.,* 2001)** and decrease in transpiration rate **(Mei-hua *et al.,* 2008)**, maintance enhancing water balance of cut flowers. The results agree with **Hamidi-Imani *et al.* (2013)** who showed that ethanol improved solution uptake of cut Rose (*Rosa hybrida* L. cv. 'Avalanche').

Also, **Nematollah-Sani *et al.* (2010)** found that the 6% of ethanol had positive effect on water uptake in *Anthurium andreanum* cut flowers. Ethanol in higher level increased solution uptake compared to the control in cut Carnation (*Dianthus caryophyllus* L.) as reported by **Asgari and Moghadam (2015)**.

Water loss of flowers

During the entire period of observation transpiration water loss in the flowers was found to have profound influence by 1mM SA and 6% Eth treatments in both 'Anna and Gold strike' cvs. Table 2, exhibited significant influence on water loss which recorded maximum in Anna cv. at 3-4 days during vase life which recorded (10.10 and 9.98 ml/flower) compared with control which recorded (8.57 ml/flower). Whereas

Table 2. Effect of the best treatments (1mM SA, 6% Eth and 6% Eth + 2% Suc) on water relations (water uptake, water loss, water balance and relative fresh weight) for 'Anna and Gold strike' cvs of cut rose flowers during their vase life

Treatment	Anna cv.				Gold strike cv.			
	Vase life/day				Vase life/day			
	1-2	3-4	5-6	7-8	1-2	3-4	5-6	7-8
Water uptake (ml/flower)								
Untreated	12.05	9.11	-	-	13.27	10.00	9.02	7.45
1mM SA	13.01	12.11	-	-	15.37	14.32	11.33	9.53
6% Eth	13.17	10.73	-	-	14.73	13.63	10.21	8.36
6% Eth + Suc 2%	13.89	10.83	-	-	16.11	10.52	10.01	8.25
LSD 5%				2.98				
Water loss (ml/flower)								
Untreated	13.45	8.57	-	-	14.23	9.95	8.52	7.15
1mM SA	11.66	10.10	-	-	13.93	12.22	11.65	9.53
6% Eth	12.57	9.98	-	-	13.23	12.12	9.07	8.66
6% Eth + Suc 2%	14.39	9.04	-	-	15.96	11.67	8.35	6.26
LSD 5%				4.29				
Water balance (ml/flower)								
Untreated	-1.4	0.54	-	-	-0.96	0.05	0.5	0.3
1mM SA	1.35	2.01	-	-	1.44	2.1	-0.32	0
6% Eth	0.6	0.75	-	-	1.5	1.51	1.14	-0.3
6% Eth + Suc 2%	-0.5	1.79	-	-	0.15	-1.15	1.66	1.99
LSD 5%				-2.6				
Relative fresh weight (%)								
Untreated	103.60	97.80	-	-	105.50	98.50	98.30	95.00
1mM SA	106.50	97.40	-	-	108.40	100.90	101.90	98.10
6% Eth	108.70	101.30	-	-	112.10	102.10	100.40	89.40
6% Eth + Suc 2%	105.74	104.22	-	-	108.80	99.89	102.29	97.20
LSD 5%				LSD 5%				

water loss, recorded (9.53 and 8.66 ml/ flower) for both treatments at 7-8 days during vase life compared with control in the same days which recorded (7.15 ml/flower) with Gold strike cv. The results agree with **Lu *et al.* (2010)** who reported that the water loss of cut rose flowers increased significantly after harvest with SA treated. On the other hand, it was assumed that the effect of SA treatment which caused lower water loss could be due to the increasing water uptake **(Raskin, 1992)** as well as decrease in transpiration rate **(Mei-hua *et al.*, 2008)**.

Water balance of flowers

The perusal of data in Table 2, water balance at 3-4 days during vase life, 1mM SA and 6% Eth + 2% Suc treatments showed more positive water balance in Anna cv. which recorded (2.01 and 1.79 ml/flower) compared to control which recorded (0.54 ml/flower). While, with Gold strike cv. at 7-8 days during vase life, more positive water balance with 6% Eth + 2% Suc was detected on Gold strike cv. which recorded (1.99 ml/ flower) compared with control which recorded (0.3 ml/flower). The results are similar with **Lu *et al.* (2010)** who showed that the water balance decreased significantly and reduction in the water balance during vase period. Also, **Soleimany-Fard *et al.* (2013)** showed that SA treatment had the highest amount of water balance and control treatment had the lowest water balance concentration during vase life.

Relative fresh weight (RFW) of flowers

During the entire period of observation on Table 2. Vase life was RFW on both 'Anna and Gold strike' cvs. cut flower was found the maximum relative fresh weight with 6% Eth + 2% Suc and 6% Eth treatments which recorded (104.22 and 101.30% respectively) at 3-4 days in Anna cv. compared to control was recorded (97.80%). While, in Gold strike cv. recorded maximum RFW with 1mM SA and 6% Eth + 2% Suc was recorded (98.10 and 97.20%) at 7-8 days. compared to control which recorded (95.00%). The results confirmed by **Bayat and Aminifard (2017)** reported that SA treated with *Alstroemeria peruviana, Gerbera jamesonii, Lilium asiaticum, Rosa hybrida* and *Polianthes tuberose* influenced significantly on RFW. Results are in line with those of **Hajizadeh *et al.* (2012)** who reported that RFW of flowers had a decreasing trend during vase life and the lowest value was observed in control at the end of vase life in *Rosa hybrid* cv. Black magic. The increment in RFW at initial vase life days could be due to the higher solution uptake during the early storage time as supported by **Seyf *et al.* (2012)** who found that because of more water absorption, aluminum treated flowers of cut rose 'Boeing' had more RFW than control. The declined RFW during prolonged storage time might be due to high water loss and the declining solution uptake salicylic acid can be decreased pH of vase solution and consequently, the growth and proliferation of bacteria was reduced, which led to increase water uptake **(Raskin, 1992).** Furthermore, **Kazemi and Ameri (2012)** showed that the treated cut Gerbera flowers with SA had the highest levels of RFW during vase period.

Effect of Treatments on Membrane Stability and Electrolyte Leakage

Membrane stability index (MSI)

The maximum MSI were detected under 1 mM SA, 6% Eth and 6% Eth + 2% Suc treatment, which recorded (65.5, 62.16 and 59.99% respectively) in leaves. While, recorded (75.79, 76.18 and 76.64% respectively) in petals in to Anna cv. treated at 4th day, Table 3. Also, so well recorded in Gold strike cv. treated (72.44, 65.21 and 72.41%, respectively) in leaves (78.53, 76.46, and 79.12% respectively) in petals. The results agree with **Mei-hua *et al.*, (2008)** showed that SA can extend the vase life of cut flowers with increase membrane stability.

Electrolyte leakage (EL)

Data depicted the results at 4th day of vase life indicate that decreasing E.L were detected under treated by 1 mM SA, 6% Eth + 2% Suc and 6% Eth respectively compared to control on both 'Anna and Gold strike' cultivars cut Rose flowers. E.L values, Table 3 which recorded in Anna treated on leaves (33.49, 36.84 and 32.01% respectively) compared to control (38.89%).

Table 3. Effect of best treatments (1mM SA, 6% Eth, 6% Eth + 2% Suc) on membrane stability and electrolyte leakage of cut 'Anna and Gold strike' Rose flowers during their vase life

Cultivar	Anna						Gold strike					
Membrane stability index (%)												
Plant organ	**Leaves**			**Petals**			**Leaves**			**Petals**		
Vase life/day	0	4	8	0	4	8	0	4	8	0	4	8
Control	70.53	61.11	56.5	81.2	71.05	61.1	72.65	64.92	45.11	86.72	75.43	63.83
1mM SA	-	65.5	55.86	-	75.79	74.03	-	72.44	50.07	-	78.53	61.39
6% Eth	-	62.16	55.97	-	76.18	63.4	-	65.21	48.87	-	76.46	57.22
6% Eth + 2% Suc	-	59.99	51.39	-	76.64	74.33	-	72.41	54.33	-	79.12	65.34
Electrolyte leakage (%)												
Control	29.47	38.89	43.5	25.8	33.57	40.9	27.35	35.07	54.88	13.29	28.95	38.89
1mM SA	-	33.49	41.15	-	24.21	35.97	-	31.93	50.79	-	24.47	33.61
6% Eth	-	36.84	42.03	-	23.82	41.6	-	33.13	53.55	-	26.54	42.78
6% Eth+2% Suc	-	32.01	40.61	-	25.67	36.59	-	29.36	46.67	-	23.88	34.66
LSD 5%	LSD Leaves 0.05 = 7.029 & LSD Petals 0.05 = 9.02											

Also, was recorded on petals (24.21, 23.82 and 25.67%, respectively) compared with control (33.57%). But it recorded in Gold strike cv. treated on leaves (31.93, 33.13 and 29.36% respectively) compared with control (35.07%) also showed lowest E.L. with better treated as SA, (Eth +Suc) and Eth (24.47, 26.54 and 23.88%, respectively) compared to control (28.95%) in petals. These results are in agreements with **Rahmani *et al.* (2015)** who reported that SA significantly increased flower membrane stability and anthocyanins amount at the biochemical level, senescence is associated with changes in membrane fluidity and leakage of ions in several different flowers. **Rao *et al.* (1997)** suggested that SA can generate H_2O_2 and inflicting oxidative damage to membranes and proteins. Also, **Jaleel *et al.* (2007**) in *Catharanthus Roseus* and **Yusuf *et al.* (2007**) in *Brassica juncea*. Also, **Rao *et al.* (2012)** reported that, the membrane stability index of maize plants was, mostly, highly significantly increased in response to the treatment with SA and drought stress. Foliar application of SA decreased electrolyte leakage of leaves. So that, electrolyte leakage of leaves, indicating cell membrane damage is simply because membrane lipid peroxidation in the presence of reactive oxygen species.

Effect of Treatments on Pigments (Chlorophylls and Carotenoids)

Both cultivars showed a linear decrease in all pigments over time during the vase life (Table 4). The previous treatments lead to a considerable delay in degradation of Chl a, b and carotenoids compared to control in both the cultivars Anna and Gold strike cv. The highest pigments stability index was maintenance with 1mM SA, 6% Eth + 2% Suc when recorded (112.65 and 106.90%) on Anna cv. compared with control (73.86%). Same results were observed with Gold strike cv. (134.32 and 149.58%) respectively, compared with control (95.45%). While for pigments degradation index chlorophyll a and b recorded lowest breakdown with SA 1mM, 6% Eth+2% Suc at 4th day. Furthermore, carotenoids recorded same percentage of stability on both

Table 4. Effect of best treatments (1mM SA, 6% Eth and 6% Eth + 2% Suc) on chlorophyll A, B and carotenoids of cut 'Anna and Gold strike' Rose flowers during their vase life

Pigment	Chl. (A) mg/g.F.W					Chl. (B) mg/g.F.W					Cx+c. mg/g.F.W				
Cultivar	Anna		Gold strike			Anna		Gold strike			Anna		Gold strike		
Vase life/day	0	4	0	4	8	0	4	0	4	8	0	4	0	4	8
Untreated	12.89	9.52	11.86	11.32	10.9	3.06	1.14	1.52	1.41	1.52	2.69	2.43	3.39	3.05	1.9
1mM SA	12.89	14.52	11.86	15.93	15.15	3.06	1.72	1.52	1.32	0.88	2.69	3.37	3.39	4.12	4.24
6% Eth	12.89	12.33	11.86	10.66	8.36	3.06	1.24	1.52	0.86	0.64	2.69	2.7	3.39	3.19	2.63
6% Eth + 2% Suc	12.89	13.78	11.86	17.74	16.61	3.06	3.62	1.52	1.7	1.86	2.69	2.84	3.39	4.68	4.19
LSD 5 %			1.864					1.552					1.079		
Pigments stability index (%)															
Vase life/days	0	4	0	4	8	0	4	0	4	8	0	4	0	4	8
Untreated	100	73.86	100	95.45	91.91	100	37.25	100	92.76	100.00	100	90.33	100	89.97	56.05
1mM SA	100	112.65	100	134.32	127.74	100	56.21	100	86.84	57.89	100	125.28	100	121.53	125.07
6% Eth	100	95.66	100	89.88	70.49	100	40.52	100	56.58	42.11	100	100.37	100	94.10	77.58
6% Eth+2% Suc	100	106.90	100	149.58	140.05	100	118.30	100	111.84	122.37	100	105.58	100	138.05	123.60
Pigments degradation index (%)															
Vase life/days	0	4	0	4	8	0	4	0	4	8	0	4	0	4	8
Untreated	100	26.14	100	4.55	8.09	100	62.75	100	7.24	0.00	100	9.67	100	10.03	43.95
1mM SA	100	-12.65	100	-34.32	-27.74	100	43.79	100	13.16	42.11	100	-25.28	100	-21.53	-25.07
6% Eth	100	4.34	100	10.12	29.51	100	59.48	100	43.42	57.89	100	-0.37	100	5.90	22.42
6% Eth+2% Suc	100	-6.90	100	-49.58	-40.05	100	-18.30	100	-11.84	-22.37	100	-5.58	100	-38.05	-23.60

Anna and Gold strike cvs., with SA 1mM, Eth + Suc with (121.53 and 138.05%), respectively compare as control (89.97%) in Gold strike cv., while recorded (125.28 and 105.58%), respectively compared with control (90.33%) with Anna cv. The application of SA 1mM, 6% Eth + 2% Suc increased chlorophyll a concentration.

The concentration of chlorophyll *a* was higher than chlorophyll b at any time throughout the vase life. These findings are similar to previous results **(Jamali and Rahemi, 2011; Kazemi *et al*., 2011 a,b).** It has been shown that leaves chlorophyll concentration decreases during senescence (**Tang *et al*., 2005; Ferrante *et al*., 2009; Guiboileau *et al*., 2010).** The greatly increased chlorophyll concentration by sucrose in auxin-induced growth of Tulip stem segments, may be caused by delaying of senescence, increased chlorophyll biosynthesis or retarded chlorophyll degradation. It is well known that sugars prevent senescence of cut flowers and vegetables, Sucrose improved the postharvest life of cut flowers of Limonium **(Doi and Reid, 1995),** Liatris **(Han, 2001),** *Eustoma grandiflorum* **(Cho *et al.*, 2001)**, and many other species. Sucrose supply increased longevity and inhibited chlorophyll degradation of Broccoli (*Brassica oleracea*) branchlets **Irving and Joyce (1995)**.

Effect of Treatments on Oxidative Production (H_2O_2 and TBARS)

The perusal of data in Table 5 showed that the concentration of oxidative compounds such as free non-radicals based on oxygen, as well as

Table 5. Effect of treatments (1mM SA, 6% Eth and 6% Eth + 2% Suc) on hydrogen peroxide (H_2O_2) and thiobarbituric acid reactive substances (TBARS) in leaves and petals of cut 'Anna and Gold strike' Rose flowers

Treat. \ Cultivar	H_2O_2 (nmol/g F.W)					TBARS (nmol/g F.W)				
	Vase life/ day	Anna		Gold strike		Vase life/ day	Anna		Gold strike	
		Leaves	Petals	Leaves	Petals		Leaves	Petals	Leaves	Petals
Untreated	0	19.30	15.54	21.71	21.96	0	30.68	37.70	36.14	26.13
	4	19.38	33.54	22.51	47.26	8	33.70	30.89	36.66	27.77
1mM SA		20.16	19.26	24.14	21.73		40.87	31.36	34.48	38.84
6% Eth	4	20.22	17.92	22.06	25.31	8	41.18	36.82	42.12	57.56
6% Eth + Suc 2%		22.85	27.38	23.69	39.03		24.65	44.62	37.13	59.44
LSD 5 %			4.60					3.09		

H_2O_2, decreased in petals at 4th day during vase life whereas the highest decrease (17.92 nmol/g F.W) was observed with 6% Eth for Anna cv. and (21.73 nmol/g F.W) for Gold strike cv. with 1mM SA treatment when compared with control (33.54 and 47.26 nmol/g F.W) for Anna and Gold strike cvs. respectively. **Singh *et al.* (2008)** suggested that an increase in endogenous H_2O_2 levels and a decrease in anti-oxidant enzyme activities, may be partly responsible for initiating senescence in rose petals. In contrast, **Rao *et al.* (1997)** reported that treatment of leaves with 1 mM SA for 8 hr., significantly enhanced H_2O_2 levels compared with leaves treated with water. Plants treated with SA have previously been shown to accumulate H_2O_2 **(Chen *et al.*, 1993; Fauth *et al.*, 1996)**. However, these studies have provided detailed information concerning the pattern of H_2O_2 accumulation in plants treated with SA 1mM. While, non-significance increased for H_2O_2 in leaves treatments compared with control at same day. Second produced from oxidative products was estimated. TBARS is usually used as an index of aging and physiological resistance. Researchers believe that treatments with extending compounds of the longevity can reduce physiological stress imposed on cut flowers and increase post-harvest life by reducing the accumulation of TBARS **(Jin *et al.*, 2006).** TBARS concentration has been observed where was recorded lowest of TBARS concentration in leaves for Anna and Gold strike cvs. in finally vase life (4th and 8th day) with SA 1mM and 6% Eth + 2% Suc. which recorded (24.65 and 34.48 nmol/g FW) respectively compared with control which recorded (33.70 and 36.66 nmol/g F.W) during vase life for both Anna and Gold strike cvs., respectively. The results showed that, Anna cv. was positively affected by treatment compared to Gold strike cv. Similar with **Zamani *et al.* (2011)** showed that the use of salicylic acid and glutamine increased the vase life of cut rose flowers via decreasing the amount of TBARS. Confirmed by **Kazemi *et al.* (2018)** reported that the effect of 3 mM SA treatment on MDA concentration increased significantly when compared to control. Additionally, **Heidarnezhadian *et al.* (2017)** they indicate that 1.5 mM SA with Gerbera cut flowers caused significant decrease TBARS concentration compared to control. In contrast, **Mei-hua (2008)** in Gerbera which showed that added SA decreased MDA level. Earlier studies by **Panavas and Rubinstein (1998) and Fukuchi-Mizutani *et al.* (2000)** showed that TBARS concentration has been related with an expansion in cell film penetrability and senescence in Daylily and Rose. It is important to mention that reduced lipid peroxidation and retained membrane stability have been demonstrated to be inversely proportional with flower senescence **(Hatamzadeh *et al.*, 2012)**.

Our results coincide with **Hossain *et al.* (2006)** in Gladiolus flowers. Electrolyte leakage is often used as a parameter for determining tissue damage as the loss of membrane's selective permeability. **Bartoli *et al.* (1995)** loss of membrane integrity is the final and irreversible phase of senescence associated with membrane lipid peroxidation. In contrast, **Paulin *et al.* (1986)** found that lipid peroxidation (TBARS) increased after full bloom and the maximum increasing for TBARS was recorded in senescence stage. Lipid peroxidation and membrane stability were inversely proportional, and closely associated with flower senescence. Similar profiles had been observed in Chrysanthemum petal senescence by **Bartoli *et al.* (1995).** Treated flowers with SA maintained a significantly lower level of lipid peroxidation at over vase life stages. Lipid peroxidation is mediated by reactive oxygen species (ROS) **(Kellog, 1975).**

Effect of on Antioxidant Defiance Systems

Peroxidase POD activity

The Peroxidase were reported to simultaneously decrease in Anna cultivar with all treated SA 1mM, 6% Eth and 6% Eth + 2% Suc compared with untreated cut flowers on leaves and petals, Table 6. SA 1mM, 6% Eth and 6% Eth + 2% Suc treated was recorded on leaves (64.94, 116.88 and 87.01% respectively) at 4^{th} in Anna cv. compared with untreated cut flowers (164.94%). but recoded decreased (186.05, 162.79 and 146.51% for the three treatments respectively) on petals compared untreated cut flowers (318.61%) in the same day. While, in Gold strike cv. was recorded (43.48, 84.68 and 99.28% for the three treatments respectively) on leaves compared with untreated cut flowers (50.73%). Though, increase recorded on petals (154.80, 154.80 and 132.88%, respectively) compared untreated cut flowers (113.70%). The results indicated that treatment SA1mM reduced the activity of POD, in all tissues in both cultivars compared with untreated cut flowers. The results agree with **Kazemi *et al.* (2018)** showed that SA treatment also resulted in high activity of both catalase and POD.

Also, similar with **(Panavas and Rubinstein, 1998)** reported that an increase in POD activity in petals may strengthen vascular cells, which remain functional during the later stage of senescence. Activity of POD was increased during senescence of *Phalaenopsis* cut flowers **(Tewari *et al.*, 2009).** Plant cells presumably regulate H_2O_2 levels by coordinating activities of $H_2O_2^-$ generating enzymes Such as SOD and $H_2O_2^-$ degrading enzymes Such as POD (**Creissen *et al.*, 1994; Van Camp *et al.*, 1994).**

Table 6. Effect of best treatments (1mM SA, 6% Eth and 6% Eth + 2% Suc) on peroxidase (POD) and superoxide dismutase (SOD) enzyme activity in leaves and petals of cut 'Anna and Gold strike' Rose flowers

Cultivar / Treat.	POD					SOD			
		Anna		Gold strike		Anna		Gold strike	
	0	Leaves	Petals	Leaves	Petals	Leaves	Petals	Leaves	Petals
Vase life/day		4	4	8	8	4	4	4	8
Untreated	100	164.94	318.61	50.73	113.70	144.16	49.19	124.82	348.09
1mM SA	100	64.94	186.05	43.48	154.80	128.57	44.01	131.39	286.26
6% Eth	100	116.88	162.79	84.78	154.80	157.79	50.49	159.85	245.04
6% Eth + Suc 2%	100	87.01	146.51	99.28	132.88	237.66	54.37	192.70	210.69
LSD 5 %			1.44				21.98		

Superoxide dismutase (SOD) activity

The results indicated that the SA treated has reduced the activity of SOD, in more tissues in both cultivars compared with untreated cut flowers, Table 6. However, the highest SOD enzyme activity on leaves of Gold strike cv. which recorded (131.39%, 159.85% and 192.70%) for 1mM SA, 6% Eth and 6% Eth + 2% Suc respectively, compared with untreated cut flowers which recorded (124.82%). Similar with **Abri *et al.* (2013)** maintained that on rose cut flowers showed that POD activity declined during flower vase life. Also, **Ezhilmathi *et al.* (2007)** showed that SOD activity declined during during senescence in carnation petals. On the other hand, SA is not believed to influence peroxidases enzyme **(Hammond-Kosack and Jones, 1996).** While, with Anna cv. was highest enzyme activity which recorded (157.79 and 237.66%) with 6%Eth and 6%Eth +2%Suc respectively in leaves compared with untreated cut flowers (144.16%) in same day. These results indicated that POD is involved in the senescence of Rose flowers because it catalyzes the decomposition H_2 O_2^- POD enzyme uses H_2O_2 as a substrate for several reactions and its specific activity increases in both rose cultivars. Earlier studies, H_2O_2 in plant cells is produced by the dismutation of O_2^- by SOD localized in chloroplasts, cytosol, and mitochondria. Since the primary role of SOD is to generate H_2O_2 **(Van Camp *et al.,* 1994).** H_2O_2 levels are related to the changes in SOD activity. Because SA enhanced H_2O_2 levels are closely related to increased SOD activities, we investigated whether SA mediated inactivation of $H_2O_2^-$ degrading enzymes may have also contributed to elevated H_2O_2 levels in leaves treated with SA **(Rao *et al*., 1997)**. Our observations that leaves treated with SA have enhanced SOD activities suggest increased production of O_2^- in SA treated leaves. Similarly results indicate in gladiolus by **Bartoli *et al.* (1995)** and Daylily by **Panavas and Rubinstein (1998)** during senescence. To prevent the free radical propagation effect, the body uses antioxidants to stop the biochemical chain reaction. Antioxidants are compounds that dispose of reactive oxygen species by scavenging them, suppressing their formation, or opposing their actions **(Cesari *et al.,* 2004).** Also, **Kazemi *et al.* (2018)** showed that preharvest and postharvest SA application prolonged the vase life of cut Roses through improving CAT and POD activity, and decreasing lipid peroxidation. Antioxidant mechanisms are complex and multifactorial. Antioxidants include the enzymes like GPX, SOD, and CAT different studies have shown that flower vase life is modulated by antioxidant **(Baker *et al.,* 1978)**. SA treated with Anthurium flowers maintained higher activities of CAT and SOD, compared to control flowers. SA is a well-known phenol that can prevent ACC-oxidase activity that is the direct precursor of ethylene and decrease ROS with increase enzyme antioxidant activity **(Ansari and Misra, 2007; Mahdavian *et al*., 2007; Mba *et al*., 2007)**. The protective function of SA includes the regulation of ROS and antioxidant enzymes **(Khan *et al.,* 2003; Shi and Zhu, 2008).** Similarly, **Kazemi *et al.* (2011c)** and **Kazemi and Shokri (2011)** showed that pretreatment with SA decreased the level of lipid peroxidation induced by paraquat oxidative stress in cut flowers. Also, the previous studies which showed that addition of 5-SSA in holding solution had positive effect on vase life and quality of cut flowers **(Fariman and Tehranifar, 2011).** The treatment with salicylic acid significantly extends the vase life**, Kazemi *et al.* (2011a)** and **Kazemi *et al.* (2011 c)** showed that the treatment of salicylic acid increase SOD activity**.** In general**,** Alteration in antioxidants activity Such as POD and SOD during post-harvest life of cut flowers have been shown **(Giannopolitis and Ries, 1997).**

Endogenous Hormones Concentration

GA3 concentration

The level of GA3 showed a different instance between two Rose cultivars 'Anna and Gold strike' in the floral tissue during vase life after application 1mM SA, 6% Eth and 6% Eth + 2% Suc. In general, GA3 highest amount on Gold strike cv. compared Anna, in untreated and treated cut flowers. The highest amount of GA3 level was observed with 1mM SA which recorded (216.91 and 605.67 µg/g F.W) at the finally vase life 4th day for Anna cv. and 8th day for Gold strike cv. respectively compared with untreated flowers (8.62 and 181.37 µg/g F.W) at

the same days with both cultivars respectively, Table 7. Earlier studies, GA3 can inhibit many other processes, such as RNA and protein breakdown, that may be associated with senescence, GA3 may also delay senescence in petals and petioles (**Rhodes, 1980**). Also, the gibberellin is a general regulator of floral development **(Pharis and King, 1985).** In *Arabidopsis,* gibberellin promotes petals and stamens development (**Cheng *et al.,* 2004).** GA3, an active form of gibberellins plays many roles in regulation of plant growth, flowering, cell division and elongation. GA3 promotes the flowering of *Eustoma grandiflorum* **(Kawabata *et al.,* 2009**).

CKs concentration

The level of CKs showed a different instance between two Rose cultivars 'Anna and Gold strike' in the floral tissue during vase life after application 1mM SA, 6% Eth and 6% Eth + 2% Suc, Table 7. 1mM SA recorded the highest amount of CKs level (26.01 µg/g F.W) at 4th day in Anna compared with their control (0.60 µg/g F.W). But the best treatments in Gold strike cv. were 6% Eth + 2% Sucrose which recorded (44.12 µg/g F.W) at 8th day as compared with the control (2.83 µg/g F.W). The results confirmed by (**Hunter *et al*., 2004; Tripathi and Tuteja, 2007**) with Daffodil (*Narcissus pseudonarcissus* 'Dutch Master') they reported that Sucrose mediated increases in cytokinin's may be responsible for the delay of senescence of Daffodil (*Narcissus pseudonarcissus* 'Dutch Master'). Addionally**, Mayak and Halevy, (1970)** found that in leaves, there are some inverse correlations between endogenous cytokinin and senescence. For example, longer lived varieties of roses contain more cytokinin than short-lived varieties. Earlier studies, **(Tavares and Kende, 1970)** they reported that cytokinin maintained protein by retarding the rate of breakdown rather than enhancing the rate of synthesis. **Van Staden and Dimalla, (1980)** found that cytokinin levels are lower in detached flowers. Also, **Thimann (1980)** suggested that cytokinin's play an important role in controlling many of the processes that contribute to plant senescence. Additionally, **Buchanan-Wollaston (1997)** postulated that cytokinins, either directly or indirectly via a signaling pathway, inhibited the transcription of senescence associated genes. About the action of cytokinin's it has been suggested that they act in synergy or in antagonism with other signals, leaves senescence is usually correlated with a decrease in cytokinin's in the leaves **(Nooden *et al*., 1997**).

IAA concentration

The level of IAA exhibited a different pattern between two Rose cultivars 'Anna and Gold strike' in the floral tissue during vase life after application salicylic acid at 1 mM, 6% Eth and 6% Eth + 2% Suc, Table 7. The highest amount of IAA level showed with SA at 1 mM which recorded (60.02 and 268.10 µg/g F.w) at 4th and 8th day compared with control (27.42 and 40.70 µg/g F.w) at the same days in both cultivars Anna and Gold strike respectively during their vase life. The results similar with **(Ding *et al.,* 1999).** The level of indole acetic acid (IAA) increases during flower development in *Coffea arabica* **(Schuch *et al.,* 1994)** and *Polianthes tuberosa***.** IAA induced ethylene production knowledge of the regulation of ethylene biosynthesis during senescence of vegetative tissues is limited. Vegetative tissues usually produce very little ethylene. Typically, the rate of ethylene synthesis is primarily regulated by auxin **(Imaseki *et al.,* 1975)**. On the other hand, **Jiang, *et al.* (2010)** stated that an appropriate amount of IAA appears to be necessary for inflorescence differentiation, and a stable GA3 and ABA level for crown formation. These findings will do good to the manipulation of flowering process.

ABA concentration

The level of ABA proffered a different plate between two Rose cultivars 'Anna and Gold strike' in the floral tissue during vase life application 1mM SA, 6% Eth and 6% Eth + 2% Suc, Table 7. The 6% Eth + 2% Suc. treated which recorded the lowest amount of ABA level (14.30 and 14.58µg/g F.W) and compared as control (20.44 and 14.46 µg/g F.W) in Anna 4th day and 8th day Gold strike cvs., respectively. Earlier studies, since ABA is known to accelerate petals senescence in ethylene-insensitive flowers **(Tripathi and Tuteja, 2007; Zhou *et al.,* 2005; Panavas *et al.,* 1998, Hunter *et al*., 2004)** it appears that the Sucrose effects on flower senescence were also mediated at least

Table 7. Effect of the best treatments (1mM SA, 6% Eth and 6% Eth + 2% Suc) on endogenous hormones (GA3, CKs, IAA and ABA) in floral tissues of cut 'Anna and Gold strike' Rose flowers

cvs.	Treatment	Vase life/days	Endogenous hormones (µg/g F.w)			
			GA3	CKs	IAA	ABA
Anna	Untreated	0	21.55	10.22	143.00	17.14
		4	8.62	0.60	27.42	20.44
	1mM SA	4	216.91	26.01	60.02	17.05
	6% Eth		6.15	20.98	28.98	15.37
	6% Eth + 2% Suc		118.36	19.07	52.51	14.30
Gold strike	Untreated	0	225.06	2.27	36.96	15.16
		8	181.37	2.83	40.70	14.46
	1mM SA	8	605.67	31.89	268.10	38.35
	6% Eth		12.03	2.81	39.33	15.64
	6% Eth + 2% Suc		131.70	44.12	55.70	14.58
LSD 5 %			12.93	2.11	7.43	1.89

in part by a reduction of ABA concentrations in outer tepals. In ethylene sensitive flowers, sugar supply delays petal senescence by modulating ethylene signaling pathway (**Pun and Ichimura, 2003; Hoeberichts *et al.,* 2007).** Therefore, as it has already been described in the regulation of leaves senescence **(Leon and Sheen, 2003; Wingler *et al.,* 1998**), it appears that there is a crosstalk between sugars and hormones in the regulation of tepal senescence both in ethylene-sensitive and insensitive flowers. Addition, the effects of hormonal levels on inflorescence differentiation have not been explored, although it has been suggested that GA3 is required for flowering of a short-day *Chrysanthemum* plant **(Sumitomo *et al.,* 2009)** the roles, if any, of ABA and cytokinin in floral transition and inflorescence differentiation and development have yet not to be defined. Moreover, higher ABA concentration were trend in short-lived cultivars compared to long-lived cultivars **(Halevy and Mayak, 1975).** ABA levels increase during the senescence of some flowers **(LePage-Degivry *et al.,* 1991).** Also, **(Mayak and Halevy, 1972; Eze *et al.,* 1986**) which found that the ABA concentration of both rose and carnation petals was found to increase only late in the senescence process and was associated with large decreases in water potential.

This was in accordance with **Wei *et al.* (2003)** reported the ABA is present in higher amounts in naturally senescing petals. Also, addition **Hunter *et al.* (2004)** that ABA is a natural regulator of petal senescence in flowers. Previous reports by **Arora *et al.* (2007)** showed that ABA might be the possible cause and hormonal trigger of the accelerated senescence of ethylene insensitive gladiolus flowers. Additionally, **Zhong and Ciafre (2011)** showed that an exogenous application of ABA induced and advanced natural petal senescence resulting in the loss of membrane permeability, discoloration and in-rolling of cut Iris flowers, and suggested a direct role of ABA in upregulation of early steps of ethylene-independent petal senescence.

Conclusion

It can be concluded that a significant improvement in vase life cut of *Rosa hybrida* L. cultivars 'Anna and Gold strike' Rose flowers was occurred when treated with showed the maximum flowers longevity (7 and 12 days) with 6% Eth + 2% Suc and 1mM SA compared as untreated flower (4 and 8 days) in Anna and Gold strike cvs., respectively. Also, 6% Eth + 2% Suc and SA at 1 mM showed the better for water relations (water uptake, water loss and relative fresh weight), photosynthetic pigments concentration, membrane stability as well also less oxidative products as H_2O_2 and have appearing of defense system by antioxidant enzymes as POD and SOD activity in more treatments. Furthermore, the levels of CKS, IAA and GA3 were increased in treated plants, while, ABA decreased in both cut 'Anna and Gold strike' rose flowers compared untreated. In general, the results suggest that SA and combination of Eth + Suc increases vase life by improving the antioxidant enzymes system, endogenous growth hormones during rose flower senescence. Also, Gold strike cv. was move responsive than Anna cv. to proposed transactions. On the other hand, the lowest coefficients were STS, 5-SSA and BA treatments.

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شيخوخة أزهار الورد ٢- تنظيم شيخوختها وإطالة فترة بقاءها

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تمت هذه الدراسة بمعمل فسيولوجيا النبات – كلية الزراعة – جامعة الأزهر بالقاهرة خلال الفترة من ٢٠١٣ إلى ٢٠١٦ بهدف المقارنة بين صنفين من الورد التابع لزهور القطف وهما الصنف انا (مبكر الشيخوخة) والصنف جولد إستريك (متأخر الشيخوخة). تم دراسة تأثير تركيزات مختلفة من السكروز، الإيثانول، السكروز مع الإيثانول ، حمض السالسليك، حمض ٥-سالفوسالسليك ، كبريتات الفضة وبنزيل أدينين على إطالة عمر الزهرة ، وقد سُجلت بعض القياسات والتقديرات الفسيولوجية والكيماوية لكلا الصنفين مثل العلاقات المائية (إمتصاص الماء، التغيّر النسبى فى الوزن الرطب، وفقدان الماء والتوازن المائى)، ثبات الأغشية، التسرب الأيونى، صبغات البناء الضوئى (كلوروفيل أ، ب والكاروتنويدات)، حامض الثيوباربتيوريك كمنتج ثانوى لأكسدة الليبيدات، فوق أوكسيد الهيدروجين كناتج للشوارد الحرة، النشاط الإنزيمي لكل من إنزيم البيروكسيديز وإنزيم سوبر أكسيد ديسميوتيز وكذلك التغيّر فى مستوي الهرمونات الداخلية مثل (الجبرلين، السيتوكينين، إندول حمض الخليك وحمض الأبسيسيك)، وأظهرت النتائج أن أفضل المعاملات في إطالة عمر الزهرة بعد القطف كان (السالسليك تركيز ١مل مولر، الإيثانول ٦%، ومخلوط الإيثانول ٦% + السكروز ٢%) حيث سجلت (٧ و٦ و ٦ يوم) للصنف آنا مقارنة بالكنترول (٤ يوم) بينما سجلت (١٢ و ١١ و ١١ يوم) للصنف جُولد إستريك مقارنة بالكنترول (٨ يوم) علي التوالي. وأيضا أظهرت النتائج أن التسرب الأيوني، ومعدل هدم الكلوروفيل، النشاط الإنزيمي لإنزيم البيروكسيديز وإنزيم سوبر أوكسيد ديسموتيز، ثيوباربيتوريك، فوق أوكسيد الهيدروجين كان أُقل لكلا الصنفين مع السالسليك (١مل مولر) والإيثانول ٦% + السكروز ٢% مقارنة بالكنترول، أما العلاقات المائية (إمتصاص الماء، التغيّر النسبى فى الوزن الرطب، وفقدان الماء والتوازن المائى)، ثبات الأغشية وصبغات البناء الضوئي فكانت أفضل وأكثر ثباتا وكذلك مستويات كلا من حمض الجبرليك، السيتوكينين، واندول حمض الخليك كانت أعلي والعكس مع حمض الأبسيسيك كان مستواه أقل مقارنة بالكنترول. على العموم من هذه النتائج اقترح أن معاملات السالسيليك و السكروز مع الأيثانول تزيد عمر الزهرة عن طريق تنشيط المواد المضادة للأكسدة والهرمونات المنشطة للنمو الداخلية وتقليل الشوارد الحرة المؤكسدة والمدمرة خلال مرحلة شيخوخة الورد. كذلك لوحظ أن الصنف جُولد إستريك كان الأكثر إستجابة للمعاملات المقترحة من الصنف آنا، ومن جهة أخري كانت المعاملات (حمض ٥-سالفوسالسليك، كبريتات الفضة وبنزيل أدينين) أقل المعاملات تأثيراً.

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