THE EFFECTIVENESS OF PREHARVEST FOLIAR SPRAY OF SOME BIOLOGICAL MATERIALS ON KEEPING QUALITY OF VALENCIA ORANGE FRUITS DURING COLD STORAGE

EL ZAYAT, H. E., FATMA E. IBRAHIM and SAHAR M. A. EL ETREBY

Hort. Res. Ins., Fruit Handling Department, ARC, Giza, Egypt.

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Abstract

This experiment was conducted during two successive seasons, 2012 and 2013, on 15 years old "Valencia" orange trees at a private orchard. Two plant bio stimulants (Lena tonik, Licorice extracts) and GA_3 were sprayed during different fruit growth stages. Five separate treatments, GA_3 at 100 ppm, Lena tonik at 0.50 and 0.75 cm / L and Licorice extract at 0.2 and 0.4 % plus distilled water as control were applied, monthly from June till September. Fruits were picked at maturity stage and all fruit quality parameters were determined at harvest and at two weeks interval during storage for 6 weeks at 4°C and 90% to 95 % relative humidity. Measured fruit quality parameters included weight loss percentage, firmness; peel color, eating quality, total soluble solids contents, titratable acidity content and Vitamin C content. GA_3 treatment caused an obvious delay in fruit ripening processes compared to other treatments and control. Fruits treated with GA_3 had the highest value of firmness and TSS content least values of color development at harvest. Moreover, these fruits in addition to those treated with Lena tonik had the lowest weight loss incidence and the less firmness deterioration rate and delaying senescence incidence during cold storage. After 6 weeks of cold storage, Licorice treated fruits had the best taste followed by Lena tonik, while GA_3 treatment had the lowest one, but with acceptable note of taste. All treatments of biostimulants proved their usefulness in keeping "Valencia" orange fruit quality during cold storage. Licorice extract can be used for its effectiveness in keeping fruit quality and its cheap price in case other materials are unavailable.

INTRODUCTION

Citrus fruits production in Egypt occupies the first rank among fruit crops, with a production of about 4 million tons, of which 3.3 million tons which are oranges. Valencia orange production is distinguished among other oranges cultivars in Egypt, especially for juice production and for export purposes, (F.A.O., 2012).

Applications of plant growth substances as GA_3 and biostimulants may help in increasing orange trees tolerance to biotic and abiotic stresses thus boosting their yield and maintaining supreme fruit quality attributes. The use of biostimulants is recommended in modern farming for their positive effect on environment safety, by avoiding chemical pesticides, and for their synergistic impact on plant growth and fungal or insect control. Gibberellins are naturally occurring hormones, which promote

plant cell elongation for their involvement in increasing cell wall plasticity and stimulation of cell division (Calvo, *et al.*, 2014).

Gibberellins are plant growth substances whose beneficial actions on orange orchards are well documented. Baghdady *et al.*, (2014) found that foliar sprays of Valencia trees with GA_3 (15 or 25 ppm) increased fruit set percentage, yield and some fruit quality parameters. Washington navel orange in South Africa was treated generally by GA_3 in mid January, and the same treatment was practiced on Valencia orange in Australia, in early January to delay ripening, decrease fruit aging and fruit creasing (Tugwell, *et al.*, 1996).

Licorice (*glycyrrhiza glabra*) extract has attracted attention to its possible use as a plant biostimulant; the raw herb contains 8.13 % protein, 0.53 % fat, 6.8 % moisture, 24.48 % fibers, 47.11 % carbohydrates and 3.56 % silica (Badr *et al*, 2013). It comprises many biologic compounds such as, glycerrhzel, glescerzin and other compounds having similar effects like growth regulators, to improve vegetative and flowering characteristics. Hamadah, *et al.*, (2012) mentioned that, foliar application of Licorice extract on potato plants increased significantly plant length, dry weight and gave a higher marketable yield compared to control.

Another recent useful biostimulants product is Lena tonik, which contains phenolic compounds, (2.13 g/L Sodium ortho – nitrophenolate, 2.81 g/L Sodium Para – nitrophenolate and 0.94 Sodium 5 nitroquaicholate) and acts by its ability of penetrating into plant structure directly and bestows vitality and capacity for absorbing and assimilating water and nutrients. More recent studies prove that Lena Tonik positively affects various processes controlling plant growth, development and productivity. Plants treated with Lena Tonik (nitrophenolates) have greater inhibition of IAA oxidase which ensures a higher activity of naturally synthesized auxins (Djanaguiraman, *et al.*, 2005).

This experiment aims at assessing the effect of the above-mentioned biostimulants and GA_3 as preharvest foliar sprays, on the quality of "Valencia" orange fruits at harvest and their attitude during cold storage.

MATERIALS AND METHODS

This experiment was carried out during two successive seasons, 2012 and 2013, on 15 years old Valencia orange (*citrus sinensis* L.) trees cultivar. Trees were grown on a sandy soil at 5 x 5 meter apart at a private orchard nearly 70 km south of Cairo on the desert Cairo – Alex road. All trees were subjected to the same horticultural practices already applied in the farm according to the Agriculture ministry recommendations.

The experiment comprised six treatments as follows:-

1- Gibberellic acid (GA_3) at 100 ppm.

2- Lena tonik at 0.50 cm/L.

3- Lena tonik at 0.75 cm/L.

4- Licorice extracts at concentration 0.2%.

5- Licorice extracts at concentration 0.4%.

6- Water as control.

Licorice extract preparation:-

Licorice root pieces were grounded in a powder form and quantity of 100 gram was mixed with one liter of distilled water for 15 minutes at 50ºc in a mixer to get the required concentrations of 0.2% and 0.4 % as described by Babilie, *et al.*, 2015.

Applications of these materials were practiced by foliar sprays for four times, at monthly intervals, from June till September. Six rows each has ten trees were selected for these treatments, each treatment has one rows.

Fruits were picked at the maturity stage, when more than 3/4 of the fruit surface has turned to yellow and TSS/acid ratio reached more than 9:1 in average for all treatments according to Wordowski *et al*, 1995. Picked fruits were transported to fruit handling department laboratory, Horticulture Research Institute. Fruits were washed, air dried, sorted and packed in carton boxes of 5 kg, each one considered as one replicate. Each treatment consisted of three replicates. All fruits were stored at 4 ºC and (R.H. 90 %) up to six weeks.

All treatments fruit quality parameters were measured at 2 week intervals during cold storage. A representative sample, each had 9 fruits, were taking out from these treatments at each period.

Physical attributes:-

1- Peel color:

Fruit peel color was measured by taking the average of two measurements on two opposite points on each fruit equator with a Minolta colorimeter (Minolta Co. Ltd., Osaka, Japan) based on the CIELAB color system. Hue angle values were recorded according to McGuire (1992).

2- Firmness (gm/cm^2):

Firmness was measured by texture analyzer (LERA) the resistance of the fruit to the penetration of the needle probe 0.7 cm in diameter for a depth of 5 cm inside the fruit – firmness expressed in gm/cm^2.

3- Weight loss (%):

Specific cartons were destined for the calculation of this parameter. Fruits were weighed at two weeks intervals for each treatment during the cold storage and the loss in fruit weight was recorded and calculated as a percentage from the initially weighed according to the following equation:

Weight loss (%) = [(Initial weight – weight at sampling date)/ Initial weight] X100

4- -Eating quality:

This attribute was estimated during the 2nd season only according to a subjective scale of four grades, V. Good, Good, acceptable and poor (unacceptable), according to sugars, acidity and juiciness and presence or absence of strange odors.

Chemical attributes:-

1-Total soluble solids (TSS %):

This parameter was measured by using a hand refractometer according to A.O.A.C. (1995).

2-Titratable acidity (%):

Titratable acidity of the fruit juice was expressed as a percentage of citric acid according to A.O.A.C. (1995).

3- Vitamin C content:

Vitamin C content was evaluated as cited in the official methods A.O.A.C. (1995).

Experimental design:

A complete randomized block design was used and the data were statistically analyzed according to Snedecor and Cochran (1990). Means were compared using L.S.D. at 5% level.

RESULTS AND DISCUSSION

1- Effect of GA_3, Lena tonik and Licorice extracts on Orange peel color during cold storage:-

Table (1) displays that GA_3 treated fruit had the least peel color development either at harvest or after 6 weeks in cold storage. Data also indicated that, all other preharvest treatments significantly reduced fruit color differentiation during fruit growth and maturation in the two seasons in this investigation in comparison with control fruits which reached a more advanced stage of maturity than all treatments fruits. This effect of GA_3 in delaying maturity was sustained by similar results of (McDonald *et al.,* 1987) after treating Grapefruits with GA_3. These results also in accordance with those mentioned by Ladaniya (1997) who indicated that spraying Nagpur mandarins with GA_3 at 10, 15 or 20 ppm at fruit color break stage delayed color development of fruits

after harvest. Other treatments (Lena tonik and Licorice) had lesser values of hue angle. Peel color of Lena tonik treated fruits were higher than those of Licorice especially in 2nd season and that indicates a certain effect of Lena tonik in promoting fruit growth and delaying senescence. This trend was repeated in the 2nd season. Results also indicated that, over 6 weeks of cold storage color changed slowly but significantly till 4th week in cold storage, as hue angle at harvest was 78.15 to reach 75.55 after 4 weeks, and to turn to more yellowness after 6 weeks (73.67). This trend was also noticed clearly in the 2nd season.

Table 1. Effect of GA_3, Lena tonik and Licorice extracts on Valencia Orange peel color (Hue angle) during cold storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	78.02	74.87	73.69	71.97	74.64
GA_3 100 ppm	79.34	77.83	77.49	74.50	77.29
Licorice 0.2 %	76.53	76.29	75.08	73.74	75.41
Licorice 0.4 %	78.70	76.14	75.72	74.06	76.16
Lena tonik 50 cm / L	78.47	74.87	74.51	73.81	75.42
Lena tonik 75 cm / L	77.84	77.05	76.83	73.92	76.41
M	78.15	76.18	75.55	73.67	
LSD at 5 % level	A	B	A*B		
	1.475	1.204	2.949		
2nd season					
Control	76.09	74.82	73.73	71.52	74.04
GA_3 100 ppm	82.92	82.47	81.20	76.29	80.72
Licorice 0.2 %	78.73	76.66	76.57	70.72	75.67
Licorice 0.4 %	80.01	78.78	76.72	72.37	76.97
Lena tonik 50 cm / L	78.37	76.17	75.27	74.05	75.97
Lena tonik 75 cm / L	78.11	77.44	76.36	74.13	76.51
M	79.04	77.72	76.64	73.18	
LSD at 5 % level	A	B	A*B		
	1.205	0.984	2.410		

2- Effect of GA_3, Lena tonik and Licorice extracts on fruit firmness gm/cm^2 during cold storage:-

As displayed in Table (2), fruits picked from trees treated with Lena tonik at 50 ppm followed by that's treated with GA_3 had the highest initial firmness values at harvest in both seasons compared with the other treatments. On the other hand, fruits from trees treated with Licorice at .0.2% had the lowest initial firmness values at harvest. Moreover, data also cleared that, orange fruits decreased gradually and significantly with prolonging of storage period to reach its minimum values at the end of storage period. However, fruits of GA_3 treatment followed by fruits of both Lena tonik treatments had the slowest softness rate in both seasons. On contrast, Licorice treatment at 0.2 % doses had the least values of firmness at the end of storage period during the two seasons in this work.

This result could be explained by the effect of Lena Tonik in accumulating dry matter in the fruits (Przybysz, *et al*., 2014). Moreover, these results agree with those of Gerlândia da Silva, *et al*., (2013) who stated that applying GA_3 as foliar spray on Delta Valencia orange resulted in the highest values of firmness at the end of 28 days storage at 2ºC. Licorice sprays plants stimulate more actively towards maturity processes due to of its chemical components having similar effect as plant growth stimulators. El-Sagan (2015) found that applying Licorice on cucumber plants, improved growth and yield parameters and accelerated growth and metabolism. Therefore, it can be said that Licorice accelerated maturity processes in orange fruits and that fruits were in a more advanced stage of maturity than GA_3 and Lena tonik.

Table 2. Effect of GA_3, Lena tonik and Licorice extracts on firmness gm/cm^2 during cold storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	221.8	220.2	209.5	180.0	207.88
GA_3 100 ppm	254.4	232.8	227.1	214.9	232.30
Licorice 0.2 %	207.9	206.3	203.5	190.1	201.95
Licorice 0.4 %	239.3	224.1	206.2	199.4	217.25
Lena tonik 50 cm / L	264.2	208.4	206.0	200.8	219.85
Lena tonik 75 cm / L	231.0	225.4	222.1	206.8	221.33
M	236.43	219.53	212.40	198.67	
LSD at 5 % level	A	B	A*B		
	1.743	1.423	3.486		
2nd season					
Control	215.0	166.0	160.3	145.7	171.75
GA_3 100 ppm	225.7	221.0	212.0	174.7	208.35
Licorice 0.2 %	204.0	193.3	185.7	147.7	182.68
Licorice 0.4 %	231.7	189.7	173.7	151.0	186.53
Lena tonik 50 cm / L	230.0	219.7	184.7	164.3	199.68
Lena tonik 75 cm / L	226.7	220.7	212.0	164.7	206.03
M	222.18	201.73	188.07	158.02	
LSD at 5 % level	A	B	A*B		
	1.858	1.517	3.715		

3 – Effect of GA_3, Lena tonik and Licorice extracts on fruit weight loss % during cold storage:-

Data in Table (3) indicated that all treatments decreased fruit weight loss during cold storage compared with control fruits. Fruits from GA_3 treated trees followed by those from treated with Lena tonik 50 cm / L had the lowest percentage of weight loss incidence during cold storage. This result could be explained by the known and confirmed effect of GA_3 in stimulating growth and slowing senescence processes (Baghdady, *et al*., 2014). This result is consistent with the reports of Ghazzawy, *et al*., (2013) indicating that preharvest application of GA_3 on Barhee date palm, led to the least weight loss of fruits during 45 days of storage at 0 ºC . It seams that Licorice extracts promoted a pronounced higher acceleration of maturity

processes, and consequently, fruits of these treatments suffered the highest weight loss % and significantly higher than all other treatments except control fruits. These results are supported by El-Sagan (2015), who mentioned that application of Licorice accelerated growth and metabolism of cucumber.

These results displayed clearly the beneficial effect of GA_3 which natural bio stimulants, while Lena Tonik and Licorice extracts came last in decreasing weight loss incidence of orange during cold storage.

Table 3. Effect of GA_3, Lena tonik and Licorice extracts on fruit weight loss % during cold storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	0.00	1.93	3.56	6.92	3.10
GA_3 100 ppm	0.00	2.51	3.42	4.11	2.51
Licorice 0.2 %	0.00	1.88	3.94	5.16	2.75
Licorice 0.4 %	0.00	2.13	4.17	5.32	2.91
Lena tonik 50 cm / L	0.00	2.08	3.65	4.45	2.55
Lena tonik 75 cm / L	0.00	2.51	4.75	4.63	2.97
M	0.00	2.17	3.92	5.10	
LSD at 5 % level	A	B	A*B		
	0.1838	0.1500	0.3675		
2nd season					
Control	0.00	4.85	6.82	8.54	5.05
GA_3 100 ppm	0.00	4.55	5.31	6.23	4.02
Licorice 0.2 %	0.00	5.23	6.55	7.25	4.76
Licorice 0.4 %	0.00	4.94	6.54	7.92	4.85
Lena tonik 50 cm / L	0.00	3.91	5.66	6.57	4.04
Lena tonik 75 cm / L	0.00	4.29	5.45	6.81	4.14
M	0.00	4.63	6.06	7.22	
LSD at 5 % level	A	B	A*B		
	0.2324	0.1898	0.4649		

4 – Effect of GA_3, Lena tonik and Licorice extracts on TSS contents during cold storage:-

Data in Table (4) clearly show that fruits picked from trees treated with GA_3 had the lowest TSS contents in both seasons in this investigation. While both Lena Tonic concentrations retarded maturity because of its prolonging effect on the Juvenility and growth phase according to the work of (Djanaguiraman, *et al.*, 2005). Przybysz, *et al.*, (2014) mentioned that the effect of Lena Tonik in increasing TSS is due to raising the intensity of photosynthesis and transpiration due to enhancing stomatal conductance and chlorophyll content in the plant′s leaves. Both concentration of Licorice were more active in stimulating maturity process, as their fruits had a higher TSS contents values with significant differences compared to other treatments. If biological treatments were compared to control fruits, which had the highest TSS contents at end of storage during the two seasons in this work. It can be concluded that GA_3, Lena Tonik and Licorice had a beneficial effect in delaying senescence incidence which lead to reduce

TSS contents variation, but Licorice recorded a smaller impact in that respect, yet still, much better than control.

Table 4. Effect of GA_3, Lena tonik and Licorice extracts on TSS contents during cold storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	10.60	10.67	11.23	12.17	11.17
GA_3 100 ppm	9.30	9.80	10.10	10.23	9.86
Licorice 0.2 %	9.37	9.83	10.33	11.40	10.23
Licorice 0.4 %	10.07	10.97	11.00	11.53	10.89
Lena tonik 50 cm / L	9.57	9.92	10.24	10.53	10.07
Lena tonik 75 cm / L	9.60	9.81	10.52	10.83	10.19
M	9.75	10.17	10.57	11.12	
LSD at 5 % level	A	B	A*B		
	0.0862	0.0704	0.1724		
2nd season					
Control	9.20	10.40	10.93	12.07	10.65
GA_3 100 ppm	8.54	9.84	9.91	10.20	9.62
Licorice 0.2 %	8.50	9.63	10.07	11.07	9.82
Licorice 0.4 %	8.20	9.67	10.03	11.50	9.85
Lena tonik 50 cm / L	8.63	9.65	10.25	10.98	9.88
Lena tonik 75 cm / L	9.77	10.00	10.58	11.03	10.35
M	8.81	9.87	10.30	11.14	
LSD at 5 % level	A	B	A*B		
	0.2465	0.2013	0.4931		

5 - Effect of GA_3, Lena tonik and Licorice extracts on Acidity contents of fruits during cold storage:-

It's clear from Table (5) that acidity percentage of fruits significantly decreased gradually during cold storage. Fruits from GA_3 treatment recorded the highest values at harvest and at the end of cold storage during the two seasons in this experiment. On the other hand, both Lena tonik treatments had similar results and gave acidity values close to fruits of GA_3 treatment, with no noticeable differences between both used concentrations in both seasons. Baghdady, *et al*., (2014) noticed that, applying GA_3 at 15 and 25 ppm among other biological materials on "Valencia" orange trees in Behera Governorate, once at full bloom, produced fruits having a higher acidity at harvest than other treatments and control. These results indicated a certain delay in maturity by GA_3. Both concentration of Licorice extract, gave approximately the same results in both seasons, but with the lowest acidity percentages with in significant differences in comparison with GA_3 and Lena Tonik fruits. Applying Licorice extract to Pear trees monthly from January to July, in addition to treatments of moringa and zeatins, and garlic extract, resulted in fruits with lower acidity at harvest than fruits of other treatments. It seems that Licorice contents of isoflavones and saponins had certain positive boosting effect on fruit growth and maturity. GA_3 and Lena Tonik treatments resulted in fruits with the highest values of

acidity in both seasons, followed by both Licorice treatments while control had the lowest values of acidity. Maturation processes were more active in control fruits while these processes were affected and slowed down in different degrees by the used biological materials. Szot, *et al.*, (2014) indicated that strawberry plants treated with Lena Tonik resulted in a clear increase in acidity of fruits.

Table 5. Effect of GA_3, Lena tonik and Licorice extracts on total Acidity % during cold storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	1.08	0.97	0.93	0.83	0.95
GA_3 100 ppm	1.15	1.05	1.04	0.94	1.05
Licorice 0.2 %	1.09	1.00	0.96	0.86	0.98
Licorice 0.4 %	1.09	1.03	0.98	0.87	0.99
Lena tonik 50 cm / L	1.13	1.03	1.02	0.91	1.02
Lena tonik 75 cm / L	1.14	1.04	1.03	0.92	1.03
M	1.11	1.02	0.99	0.89	
LSD at 5 % level	A	B	A*B		
	0.0688	0.0561	0.1375		
2nd season					
Control	1.16	1.05	0.96	0.85	1.01
GA_3 100 ppm	1.32	1.24	1.09	0.93	1.15
Licorice 0.2 %	1.17	1.12	0.98	0.87	1.04
Licorice 0.4 %	1.21	1.14	1.02	0.89	1.07
Lena tonik 50 cm / L	1.27	1.15	1.05	0.91	1.10
Lena tonik 75 cm / L	1.28	1.16	1.06	0.92	1.11
M	1.24	1.14	1.03	0.90	
LSD at 5 % level	A	B	A*B		
	0.0668	0.0545	0.1335		

6 - Effect of GA_3, Lena tonik and Licorice extracts on Vitamin C. content (mg/100g F.W.) of fruit content during cold storage:-

It's clear from Table (6) that Vitamin C. content was higher in all fruits of treatments than control fruits in both seasons. Among all treatments fruits, GA_3 treatment fruits significantly had the highest starting values in both seasons under this work. The high value of Vitamin C. caused by GA_3 treatment can be explained by its ability to decrease the anabolism rate of this vitamin during cold storage, compared to other treatments as cited by Bakry, (2007). Licorice treatment fruits had relatively higher Vitamin C. content than Lena Tonik treatment fruits during the first season. On contrast, Lena Tonik treatment fruits had relatively higher Vitamin C. content than Licorice treatment fruits during the second season in this experiment. During cold storage Vitamin C. decreased generally in this experiment and fruits lost about 15 – 20 % of their Vitamin C. content, till the end of cold storage. These results were in agreement with Ben-Abdelaali, (2010), who mentioned that Vitamin C content decreased during cold storage. GA_3 treatment delayed the senescence phase in fruits of maturity, keeping a high level of anabolic metabolism and its effect was highly

noticeable, compared to Licorice and Lena Tonik treatments, which had also a pronounced effect in delaying the loss of internal nutrients and Vitamins of fruits. It is worthwhile mentioning that Vitamin C content decreases in fruit with high temperature and the rate of this loss is reduced by preharvest spraying GA_3 and bio-stimulant compounds and cold storage.

Table 6. Effect of GA_3, Lena tonik and Licorice extracts on Vitamin C (mg/100 g F.W.) during cold Storage in 2012 and 2013 seasons.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
1st season					
Control	78.20	72.50	71.40	68.00	72.53
GA_3 100 ppm	94.70	88.20	86.00	84.00	88.23
Licorice 0.2 %	86.30	77.20	72.40	70.10	76.50
Licorice 0.4 %	85.30	78.00	74.20	72.00	77.38
Lena tonik 50 cm / L	82.00	78.70	76.40	74.70	77.95
Lena tonik 75 cm / L	83.10	81.80	78.00	75.00	79.48
M	84.93	79.40	76.40	73.97	
LSD at 5 % level	A	B	A*B		
	2.014	1.644	4.027		
2nd season					
Control	81.00	75.50	70.67	68.57	73.94
GA_3 100 ppm	96.17	92.20	88.77	82.33	89.87
Licorice 0.2 %	84.60	78.30	74.33	70.68	76.98
Licorice 0.4 %	85.83	79.17	74.40	72.24	77.91
Lena tonik 50 cm / L	89.67	80.67	77.77	74.26	80.59
Lena tonik 75 cm / L	92.33	84.83	80.73	76.41	83.58
M	88.2667	81.7783	77.7783	74.0817	
LSD at 5 % level	A	B	A*B		
	2.015	1.645	4.029		

7- Effect of GA_3, Lena tonik and Licorice extracts on eating quality of orange fruits during cold storage:-

As its clear from Table (7), eating quality was just acceptable at start, because of high acidity and relatively low TSS contents, but this attribute improved with the progress of storage in time. By the end of 6 weeks, it was found that fruits of both Licorice treatments had the best eating quality among all treatments, and this may be explained by their highest content of TSS contents and their lowest content of acidity among all treatments. Both Lena Tonik treatments occupied second rank in eating quality. On contrast, GA_3 treated fruits occupied the last rink in eating quality among all treatments however, it was better than control fruits. It is worth noting that control fruits had the best note among all treatments after 4 weeks of cold storage. It seems that some undesirable ripening processes and senescence reactions have occurred after additional two weeks in cold store and caused a low note of taste.

Table 7. Comparison of taste notes during the whole period of the storage.

Treatments (A)	Storage period per weeks (B)				
	Harvest	2	4	6	M
Control	4.5	6.4	7.1	5.5	5.87
GA_3 100 ppm	4.8	5.2	5.5	6.2	5.42
Licorice 0.2 %	5.2	5.2	5.7	6.7	5.69
Licorice 0.4 %	5.2	5.4	5.9	7.3	5.94
Lena tonik 50 cm / L	6.1	5.5	6.2	6.4	6.04
Lena tonik 75 cm / L	5.9	6.2	6.2	6.2	6.13
M	5.29	5.64	6.10	6.36	

The scale of taste grades-Excellent (10-8), Good (7.9 – 6), Acceptable (5.9 – 4.5), Poor (unacceptable, unmarketable) (>4.5).

CONCLUSION

The application of GA_3 and Lena Tonik, Licorice was beneficial for enhancing keeping quality of Valencia orange fruits during their growth on trees when compared to control fruits. This was well displayed and evidenced by in their postharvest life in cold storage. Gibberellic acid followed by Lena Tonik caused the most delay in the transition to senescence, and this was evident by all quality criteria. Licorice extracts caused a relatively similar beneficial effect as Lena Tonik, but it encourages a higher rate of maturity presses regarding the internal quality of the fruit with fruits having more sugars, less acidity and the best taste note. It is recommended to use these plant biostimulants on Valencia orange farms, especially the by applying material as Licorice, if both GA_3 and Lena Tonik are not available or not affordable.

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تأثير الرش ببعض المواد الحيويه قبل الحصاد لتحسين مواصفات جودة ثمار البرتقال الفالنشيا أثناء التخزين المبرد

حمدى السيد الزيات – فاطمه عصمت ابراهيم – سحر محمد على الاتربى

معهد بحوث البساتين – قسم بحوث تداول الفاكهه – مركز البحوث الزراعيه – الجيزه – مصر.

أجريت هذه الدراسة خلال عامى 2012 – 2013 على أشجار البرتقال الفالنشيا عمر 15 عاما. واستخدمت مستخلصات المنشطات الحيويه النباتيه (الليناتونيك – العرقسوس) مع الجبرلين. تم رش الاشجار (عشرة اشجار لكل معاملة) اربعة مرات خلال فترة نمو الثمار بدأ من يونيو وحتى سبتمبر بمعدل مرة واحدة شهريا لمعرفة تأثيرهذة المركبات على جودة الثمار عند الجمع وأثناء التخزين المبرد . كانت المعاملات عبارة عن الجبريلين بتركيز100 جزء فى المليون والليناتونيك بتركيز0.50 و 0.75 سم / لتر والعرقسوس بتركيز 0.2 و 0.4 % بالاضافه الى الرش بالماء المقطر(المعاملة القياسية). تم قطف الثمار فى مرحلة إكتمال النمو حيث تم فرز الثمار لاستبعاد الثمار التالفة والمشوهة ثم خزنت الثمار على درجة حرارة 4 درجة مئويه و 90 الى 95 % رطوبة نسبية لمدة ستة اسابيع. تم خلال التخزين فحص الثمار دوريا كل اسبوعين وذلك لتحديد تاثير هذة المعاملات على خصائص الجودة للثمار (الفقد فى الوزن – الصلابه – لون القشرة – جودة الطعم – المواد الصلبه الذائبه الكليه – الحموضه الكليه – فيتامين ج) .

أدت المعامله بالجبريلين الى تاخير نضج الثمارعلى الاشجار مقارنة بالمعاملات الاخرى والكنترول حيث سجلت الثمار المعاملة بالجبريلين أعلى قيم للصلابه وأقل قيم لتطور اللون وكذلك النسبه المئويه للمواد الصلبه الذائبه. كذلك كان لمعامله الثمار اثناء النمو بالليناتونيك تاثيرا مشابها لتاثير الجبريلين الا انه كان بدرجه أقل من تاثير الجبريلين.

وبعد 6 أسابيع من التخزين كانت الثمار المعامله بالعرقسوس الأفضل طعما يليها الثمار المعاملة بالليناتونيك ثم المعاملة بالجبريلين حيث كانت نوعا ما مقبولة الطعم ويرجع ذلك لتأثير الجبريلين على نضج الثمار.

أثبتت كل المعاملات تأثيرها الفعال فى المحافظه على جودة ثمار البرتقال الفالنشيا أثناء التخزين المبرد . حيث يمكن إستخدام مستخلص العرقسوس لتأثيره الفعال بالإضافه الى رخص ثمنه. فى حالة قلة الامكانيات الماديه للحصول على المادتين الأخريين.