

EFFECT OF POSTHARVEST TREATMENTS WITH SALICYLIC ACID AND CHITO-CARE ON NAVEL ORANGE FRUITS QUALITY AND STORABILITY COMPARED WITH THE COMMERCIAL POSTHARVEST FUNGICIDE TREATMENT

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ABSTRACT

This study was carried out during two successive seasons 2010-2011 and 2011-2012 on Navel orange at fruit handling department, horticulture research institute, Giza, Egypt. Fruits were harvested at maturity stage from a private orchard in El-Fayoum governorate, Egypt. At the laboratory, fruits were dipped in 200 or 300 ppm of Salicylic acid or 10000 or 20000 ppm of Chito-care or the combination between the two doses from each compound. Other fruits were dipped in 1500 ppm of Imazalil, the commercial postharvest treatment to be used as control. Fruits were stored at 10°C and 85-90 R.H. for up to six months. Fruits were examined monthly intervals to determine the effect of these treatments on fruit physical and chemical properties. Results cleared that, weight loss and decay percentage, total soluble solids and total soluble sugars contents of orange fruits increased while fruit firmness, total acidity and vitamin C contents decreased gradually and significantly with the increasing of storage periods. Peel fruit color changed directly from green yellow to yellow with the increasing of storage periods. Postharvest treatments with either Salicylic acid or Chito-care significantly decreased weight loss, decay incidence, fruit firmness deterioration rate, the change of peel color, the decreasing rate of total acidity and vitamin C contents of orange fruits compared with the commercial postharvest treatment during storage. On the other side, there were no clear trends concerning the effect of these treatments on total soluble solids and total soluble sugars contents of orange fruits during storage. Moreover, the higher doses either alone or in combination with the other compound had the priority. In briefly we can conclude that, orange fruits postharvest treatments with any of the examined compounds with the higher dose to reduce postharvest decay incidence during transportation process or cold storage could be a successful alternative to reduce the using of fungicide on orange fruits and to reduce its bad effects on consumer healthy and the environment.

Keywords: Citrus – Navel Orange - Postharvest – Salicylic acid – Chito-care.

INTRODUCTION

Orange industry is an important for Egyptian National income. Orange Planted area in Egypt reached 57589 feddans in 2011, while produced area reached 55853 feddans producing 1152965 tons of orange fruits according to the statistics of Ministry of Agriculture, Egypt (2012). Although orange occupies the greatest planted area among all citrus grown fruit area in Egypt, the exportation of fresh orange fruits to foreign markets are still limited compared with the produced quantity. Therefore, any effort

directed towards maintaining fruit quality and reducing postharvest losses are importance for increasing our National income. There is a worldwide trend to explore new alternatives that control postharvest pathogenic diseases, giving priority to methods that reduce disease incidence and avoid negative and side effects on human health as a result of the excessive application of synthetic fungicides. In addition, the emergence of fungicide-resistant strains of microorganisms and the continuous rigorous regulation of fungicide use and disposal has reduced the possibility to conceive control strategies based on chemicals (Johnson and Sangchote, 1994). Salicylic acid and its derivatives used widely to enhance fruits postharvest life by controlling their firmness. Salicylic acid has been documented to enhance flesh firmness of harvested peaches during storage (Yan *et al.* 1998; Li and Han, 1999; Wang *et al.* 2006), and banana fruits during ripening (Srivastava & Dwivedi, 2000). Postharvest application with salicylic acid significantly reduced decay incidence of sweet cherry fruits during storage compared with that of the untreated fruits (Yao and Tian, 2005). Also, reduced the quality loss in peaches (Wang *et al.* 2007). Solaimani *et al.* (2009) found that, Application of exogenous methyl salicylate vapor on kiwifruits led to prevent the softening process of fruit flesh, kept ascorbic acid content and firmness during 5 months storage. Kazemi, *et al.* (2011) illustrated that, apple fruit weight loss significantly decreased in all salicylic acid concentrations, (0, 1.5, 3 mM) for 5 min, in comparison with control. Also, the results showed that fruits treated with salicylic acid solution for 5 minutes had higher firmness, total acidity (TA), and lower total soluble solids (TSS) than fruits that treated in control. Barakat, *et al.* (2012) found that, weight loss and decay incidence of orange fruits and total soluble solids contents of orange fruit juice were increased gradually and significantly with the increasing of storage period. On contrary total acidity and ascorbic acid contents of orange fruit juice were decreased with the increasing of storage period. They also added that, orange fruits firmness decreased gradually and significantly while color changed directly from green yellow to yellow with the prolongation of storage periods. Tareen *et al.* (2012) illustrated that, postharvest treatments with salicylic acid at 2.0 mmol L⁻¹ concentration significantly exhibited less weight loss, higher flesh firmness, increased TSS, higher TA and ascorbic acid contents, higher peel luminosity and decreased a* values of peach fruits compared with other treatments including control. Du *et al.* (1997) mentioned that Chito-care significantly decreased post-harvested spoilage of peach, 'Housui' pear and kiwi fruit. They also added that, Chito-care-coated peach and 'Shinko' pear were markedly firmer and less mature at the end of storage. Kittur *et al.* (2001) demonstrated that, lower reducing sugars than the untreated fruits were found in banana fruits treated with Chito-care at the end of the storage period. Romanazzi *et al.* (2002) reported that, decay incidence of Chito-care coated grapes was less than that of the uncoated grapes. Chien *et al.* (2007) mentioned that, weight losses of citrus fruit increased continuously during storage. They also added that, weight loss associated with coating treatments was slower than that of the uncoated citrus fruit compared with the control fruits. The same trend was recorded by Zhou *et al.* (2008) on coated pear

fruits. Chien *et al.*(2007) mentioned that, decay incidence of citrus fruit increased continuously during storage. They also added that, decay incidence associated with coating treatment was less than that of the uncoated citrus fruit compared with the control fruits. Wang *et al.*(2007) reported that, postharvest treatments with 2% Chito-care significantly reduced weight loss percentage, decay incidence, colour change and total acidity contents of mango fruits during storage compared with untreated fruits. On the other hand, these treatments significantly increased total soluble solids contents of mango fruits during storage compared with untreated fruits. The same results were mentioned by Zhu *et al.*(2008) on mango fruits. Moreover, they added that, these treatments significantly increased ascorbic acid (V. C.) contents of mango fruits during storage compared with untreated fruits. The aim of this research is to study the influence of salicylic acid and Chito-care to maintain "Navel" Orange fruits quality and to reduce postharvest losses during cold storage compared with the commercial postharvest fungicide treatment.

MATERIALS AND METHODS

This study was carried out during two successive seasons 2010-2011 and 2011-2012 on Navel orange.

Fruit Material, Post harvest Treatments, and Storage Regime:

Navel orange fruits (*Citrus sinensis* Osbeck) were harvested at maturity stage according to Abd El-Hafeez (1998) in the second week of December during the two seasons from a private orchard in El-Fayoum governorate, Egypt. Fruits were directly transported to the laboratory at Fruit Handling Department, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. Fruits were washed, air dried and subjected to the following treatments by dipping for 5 minutes: -

1- Treated with 1500 ppm of Imazalil, the commercial postharvest as control (A), 2 & 3- Treated with 200 or 300 ppm of Salicylic acid (S1- S2), 4 & 5- Treated with 10000 or 20000 ppm of Chito-care (K1-K2), 6- Treated with 300 ppm Salicylic acid with 20000 Chito-care (S2K2), 7- Treated with 200 ppm Salicylic acid with 10000 Chito-care (S1K1), 8- Treated with 200 ppm of Salicylic acid with 20000 ppm Chito-care (S1K2), 9- Treated with 300 ppm Salicylic acid with 10000 ppm Chito-care (S2K1).

Then all fruits were air dried again, waxed and packed in carton boxes in one layer and stored at 10°C and 85-90 R.H. Each treatment had 6 boxes each box had 20 fruits, three boxes were used in order to determine weight loss and decay percentage while the other boxes were used in order to determine the other physical and chemical properties.

Measurements:-

At one month intervals, Samples (3 replicates each had 6 fruits) of each treatment were taken for the following some physical and chemical properties determinations.

1- Methods of determining physical properties:

1.1- Weight loss percentage: it was calculated as a percentage of the average loss in fruit weight for different treatments, separately, at examined date in relation to the initial weight at the beginning of the experiment.

1.2- Decay percentage: Fruits affected with either pathological or physiological disorders were counted and calculated as percentage.

1.3- Fruits Firmness: These values were determined using Lfra Texture Analyser in 5 mm depth and 0.2 mm /second speed, for measuring firmness of Orange, These values were determined by taking the firmness value of six fruits by two sides and the average of the fruit firmness was calculated as (g/sq. cm).

1.4- Peel color: These values were estimated in six fruits by using hunter colorimeter model DP9000. (Hue angle) were determined and the values were calculated according to Mc Gjuire (1992).

2- Chemical properties:

2.1- Total soluble solids (T.S.S.) contents: T.S.S. contents of fruits were determined by abbe-digital refractometer.

2.2- Total acidity percentage: Total acidity content was determined according to A.O.A.C. (1990).

2.4- Ascorbic acid content (Vitamin C): Ascorbic acid was determined according to (Lucas, 1944).

2.5- Total soluble sugars: It was calculated as described by Association of Official Agriculture Chemistry (A.O.A.C, 1990).

Statistical analysis: the obtained data were statistically analyzed as complete randomized factorial design. Means were compared by Duncan's multiple range tests at the level of 5% probability according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Weight loss and Decay percentage:-

Data illustrated in tables (1 & 2) indicated that, weight loss and decay percentage of orange fruits were increased gradually and significantly with the increasing of storage periods during the two seasons in this work. Data also cleared that, all the examined postharvest treatments significantly decreased weight loss and decay incidence of orange fruits compared with the commercial postharvest treatment during the two seasons in this work. Moreover, data also illustrated that, postharvest treatment with the high concentration of Chito-care (20000 ppm) followed by the combination between the high concentration of Chito-care (20000 ppm) and Salicylic acid (300 ppm) during the first season and the high concentration of Salicylic acid (300 ppm) during the second season were the most effective treatments in

this aspect. On the other hand, orange fruits treated with the commercial postharvest treatment had the highest weight loss and decay percentage during the two seasons in this work.

These results are in agreement with those obtained by Chien *et al.* (2007) and Barakat, *et al.* (2012), they illustrated that, weight loss and decay percentage of citrus fruits were increased gradually and significantly with the increasing of storage periods. Also these results are in harmony with those obtained by Yao and Tian, (2005) on sweet cherry fruits, Wang *et al.*(2007) on peach fruits, Kazemi, *et al.*(2011) on apple fruits and Tareen *et al.*(2012) on peach fruits. They demonstrated that, post-harvest application with salicylic acid significantly reduced decay and weight loss incidence of fruits during storage compared with that of the untreated fruits. Moreover, these results are in line with those demonstrated by Du *et al.*(1997) on peach, 'Housui' pear and kiwi fruits, Romanazzi *et al.*(2002) on grape fruits, Chien *et al.*(2007) on citrus fruits, Wang *et al.*(2007) on mango fruits, Zhou *et al.*(2008) on pear fruits, and Zhu *et al.*(2008) on mango fruits. They mentioned that, postharvest treatments with Chito-care significantly reduced decay and weight loss incidence of fruits.

Table No (1):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Weight Loss Percentage of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season (2009-2010)										
0	0	0	0	0	0	0	0	0	0	0
1	3.26	3.17	1.35	2.85	0.49	2.57	3.96	2.69	3.1	2.604
2	7.77	4.89	5.15	4.89	2.35	4.29	5.94	6.92	4.5	5.189
3	12.8	8.65	13.44	8.83	3.58	7.05	11.38	10	5.2	8.989
4	17.2	17.86	20.05	13.04	5.68	9.2	15.84	16.15	6.1	13.45
5	23	18.27	22.22	18.47	8.53	11.78	20.54	21.15	8.1	16.9
6	27.6	25.93	25.47	24.45	13.22	15.58	25.74	26.92	12.5	21.93
Means	13.1	11.25	12.53	10.36	4.836	7.21	11.91	11.98	5.643	
Second season (2010-2011)										
0	0	0	0	0	0	0	0	0	0	0
1	4.81	3.69	3.44	4.33	3.18	5.31	4.98	4.45	4.12	4.257
2	6.84	6.41	6.18	7.57	5.22	9.66	8.63	6.43	8.51	7.272
3	11.64	9.64	8.5	13.94	8.28	12.47	17.49	13.98	12.17	12.01
4	12.1	11.95	10.8	15.83	10.57	13.21	19.37	15.06	15.45	13.82
5	17.6	15.43	13.55	19.62	12.22	14.43	22.25	19.71	22.35	17.46
6	23.68	18.23	15.81	22.94	15.2	16.63	24.6	22.15	23.88	20.35
Means	10.95	9.336	8.326	12.03	7.81	10.24	13.9	11.68	12.35	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				0.015		0.0132		0.0396		
Values, Second season				0.014		0.012		0.036		

Notes:- A= Imazail, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

Table No (2):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Decay Percentage of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season										
0	0	0	0	0	0	0	0	0	0	0
1	2.28	0	0	0	0	0	0	0	0	0.253
2	4.17	4.17	0	0	0	2.08	4.16	6.25	4.16	2.777
3	8.33	6.25	0	8.33	0	6.25	8.33	8.33	6.25	5.786
4	10.4	8.33	4.16	10.41	2.08	8.33	14.58	12.5	10.41	9.023
5	14.6	12.5	6.25	16.66	6.25	10.41	16.66	16.66	14.58	12.73
6	25	18.75	16.66	22.91	18.75	25	27.08	25	25	22.68
Means	9.25	7.143	3.867	8.33	3.869	7.439	10.12	9.82	8.629	
Second season										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	2.08	0	0	0	0	0	0	0	0	0.231
4	4.17	4.17	2.08	8.33	0	0	4.16	6.25	4.16	3.702
5	14.58	8.33	6.25	10.41	2.08	6.25	12.5	10.41	8.33	8.793
6	22.91	16.66	12.5	20.83	10.41	14.58	16.66	20.83	18.75	17.13
Means	6.249	4.166	2.976	5.653	1.784	2.976	4.76	5.356	4.463	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				0.0122		0.0108		0.0324		
Values, Second season				0.006		0.005		0.015		

Notes:- A= Imazalil, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

2- Fruits Firmness:

Data presented in table (3) indicated that, orange fruit firmness was decreased gradually and significantly with the increasing of storage period during the two seasons in this work. Data also cleared that, all the postharvest treatments significantly, with some exceptions, two treatments during the first season and one treatment during the second season, reduced the deterioration rate of orange fruit firmness compared with the commercial postharvest treatment during the two seasons in this work. However, there was no clear trend concerning these effects, while fruits treated with the low dose of salicylic acid followed by those treated with the high doses of salicylic acid and chito-care high doses had the highest fruit firmness values during the first season. On the other side, fruits treated with the combination between the high dose of salicylic acid and the low dose of chito-care followed by those treated with the combination between the low dose of salicylic acid and the high dose chito-care had the highest fruit firmness values during the second season. On the other hand, orange fruits treated with the commercial postharvest treatment had the lowest fruit firmness values during the two seasons in this work.

These results are in line with those mentioned by Barakat, *et al.* (2012) who demonstrated that, orange fruits firmness was decreased gradually and significantly with the prolongation of storage periods. Also

these results are in harmony with those demonstrated by Yan *et al.*(1998) on peach fruits, Li and Han,(1999) on peach fruits, Srivastava & Dwivedi,(2000) on banana fruits, Wang *et al.*(2006 & 2007) on peach fruits, Solaimani *et al.*(2009), on kiwifruit fruits, Kazemi, *et al.*(2011) on apple fruits and Tareen *et al.*(2012) on peach fruits. They reported that, postharvest treatments with salicylic acid significantly exhibited higher flesh firmness of fruits during storage.

3 - Peel fruit color:

Data presented in table (4) indicated that, peel fruit color, (represented as hue angle value) was changed directly from green yellow to yellow with the increasing of storage periods during the two seasons in this work. Also these results showed that, all the postharvest treatments significantly reduced the change rate of peel color compared with that treated with the commercial postharvest treatment during the two seasons in this work. Moreover, data also cleared that, orange fruits treated with the combination between the high dose of salicylic acid and chito-care followed by those treated with the high dose of salicylic acid had the less peel color change rate during the two seasons in this work. On contrast, orange fruits treated with the commercial postharvest treatment had the highest peel color change rate.

Table No (3):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Firmness (g/c²) of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season (2009-2010)										
0	293	293	293	293	293	293	293	293	293	293
1	222	258	252	222	261	244	214	219	220	235
2	219	235	225	220	218	241	211	216	219	223
3	190	221	223	212	216	218	229	211	213	215
4	142	139	152	146	153	143	139	147	153	147
5	125	130	140	119	137	129	127	130	132	130
6	116	111	127	110	118	120	115	121	123	118
Means	187	189	202	188	199	198	190	191	193	
Second season (2010-2011)										
0	287.7	287.7	287.7	287.7	287.7	287.7	287.7	287.7	287.7	287.7
1	259.3	262.3	261	262.7	268.3	251.3	254.7	260	281	262.3
2	244.7	238	251	230	244	239.3	243.3	244.3	247.7	242.5
3	224	223.3	221.7	225.7	212.3	211	215.7	216	227.3	219.7
4	138	143.7	184	148	143	141.7	149.7	145	174	151.9
5	108.3	123.7	132.7	123	122.3	127.7	125.7	102.7	132	122
6	77.66	88.33	93.33	96	105	111	109	94.33	105.3	97.78
Means	191.4	195.3	204.5	196.1	197.5	195.7	197.9	192.9	207.9	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				11.5		10.14		30.42		
Values, Second season				5.18		4.57		13.71		

Notes:- A= Imazalil, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

Table No (4):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Peel Colour of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season										
0	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1
1	66	66.5	70	69.8	67.2	69.9	68.2	69	69.4	68.45
2	63.2	61.3	66	65	65.4	67	66.2	63	64	64.56
3	62.2	61	65	64.6	63.7	65	64	61.8	62.6	63.32
4	60.2	60	63	62	63	63.6	61	60.9	61.8	61.72
5	60	60.2	62.8	61.2	62.2	62.4	60	61	60.8	61.18
6	59.8	64	61.9	62.4	60.8	62	60.4	60.3	61.8	61.49
Means	63.1	63.3	65.54	65.01	64.63	65.71	64.27	63.73	64.36	
Second season (2010-2011)										
0	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22
1	64.13	64.62	71.92	71.01	68.92	72.38	63.43	69.28	68.26	68.22
2	61.29	60.4	64.78	63.7	64.57	63.4	63.9	62.88	62.79	63.08
3	59	60.89	63.02	61.13	61.69	63.14	61.33	62	64	61.8
4	58	63	59	61	61	63	59	61	63	60.89
5	59	64	61	60	60	61	58	60.3	61.69	60.55
6	59.22	66.19	62.43	63.45	61.69	59.37	58.74	59.69	60.37	61.24
Means	61.27	63.9	64.34	64.07	63.73	64.36	61.8	63.34	64.05	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				0.0086		0.0076		0.0228		
Values, Second season				0.0105		0.0093		0.0279		

Notes:- A= Imazalil, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

These results are in harmony with those obtained by Barakat, *et al.*(2012) who illustrated that, orange fruits color gradually changed from green yellow to yellow with the increasing of storage periods. Also these results are in harmony with those mentioned by Tareen *et al.*(2012) who illustrated that, postharvest treatments with salicylic acid significantly decreased a* values of peach fruits compared with other treatments including control. On the other side, these results are in agreements with those found by Wang *et al.*(2007) and Zhu *et al.*(2008) they reported that, postharvest treatments with Chito-care significantly reduced color change rate of mango fruits during storage compared with untreated fruits.

4- Total Soluble Solids (T.S.S.), Total Acidity (TA), Vitamin C and Total Soluble Sugars contents:-

Data presented in tables (5, 6, 7 and 8) showed that, total soluble solids and total soluble sugars contents of orange fruits were increased gradually and significantly with the increasing of storage periods during the two seasons in this work. On contrary, total acidity and vitamin C contents of orange fruits were decreased gradually and significantly with the increasing of storage periods during the two seasons in this work. Data also cleared that, all the examined postharvest treatments had effect on total soluble solids, total acidity, vitamin C and total soluble sugars contents of stored orange fruits during the first season in this work. While in the second season this

trend was clear in case of total soluble solids and total soluble sugars contents, on contrast, these treatments significantly reduced the decreasing rate of total acidity and vitamin C contents of orange during storage compared with those treated with the commercial postharvest treatment.

These results agree with those found by Barakat, *et al.*(2012) who demonstrated that, total soluble solids contents of orange fruits increased while total acidity and vitamin C contents of orange fruits decreased gradually and significantly with the increasing of storage periods. Also these results partially are in harmony with those demonstrated by Kazemi, *et al.*(2011) and Tareen *et al.*(2012) they demonstrated that, peach fruits postharvest treated with salicylic acid had significantly higher TA and ascorbic acid contents compared with other treatments including control. Moreover, these results agree with those obtained by Du *et al.*(1997) who mentioned that, Chito-care significantly increased TA contents of peach and 'Shinko' pear fruits at the end of storage.

Table No (5):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on TSS Contents of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season (2009-2010)										
0	10.1	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13
1	11.3	11.1	11.7	11.2	11.53	11.13	10.87	11	11.3	11.23
2	12.3	11.63	11.9	12.06	11.63	12	11.67	11.83	11.8	11.87
3	12.3	12	12.16	12.23	11.47	12.16	12.36	12.13	11.9	12.08
4	12.3	12.2	12.36	12.53	11.86	12.5	12.57	12.4	12.5	12.36
5	12.1	12.47	12.7	12.67	11.93	12.7	12.33	12.03	12.7	12.41
6	11.8	12.13	12.53	12.83	12.83	12.23	12.13	12.73	12.1	12.37
Means	11.8	11.67	11.93	11.95	11.63	11.84	11.72	11.75	11.78	
Second season (2010-2011)										
0	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
1	11.9	11.3	10.8	10.4	11.4	10.6	10.9	10.7	10.8	10.98
2	12.3	12.4	12.1	11.2	12	11.7	11.4	11.3	12	11.82
3	12.56	12.8	12.5	12.2	12.1	12.4	12.3	12.5	12.2	12.4
4	12.1	12.5	12.9	12.8	12.6	12.2	12.3	11.4	12.5	12.37
5	11.2	11.6	11.8	11.4	11.1	11.2	10.9	11	11.2	11.27
6	10.16	10.6	11.13	11.03	10.6	10.53	10.3	10.23	10.53	10.57
Means	11.49	11.63	11.63	11.32	11.43	11.26	11.19	11.05	11.35	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				N.S		0.48		N.S		
Values, Second season				N.S		0.41		N.S		

Notes:- A= Imazalil, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

On contrast, these results disagree with those mentioned by Kazemi, *et al.*(2011) who illustrated that, apple fruits postharvest treated with

salicylic acid solution for 5 minutes had lower TSS than untreated fruits. Also, disagree with Tareen *et al.*(2012), who suggested that, postharvest treatments with salicylic acid significantly increased SSC contents of peach fruits during storage compared with control fruits. Also, these results disagree with those obtained by Du *et al.*(1997) who mentioned that, Chito-care significantly decreased TSS contents of peach and 'Shinko' pear fruits at the end of storage. Moreover, these results disagree with those mentioned by Wang *et al.*(2007) and Zhu *et al.*(2008) they obtained that, Chito-care significantly increased TSS and decreased TA contents of Mango fruits during storage compared with untreated fruits. Moreover, these results disagree with those found by Kittur *et al.* (2001) demonstrated that, lower reducing sugars than the untreated fruits were found in banana fruits treated with Chito-care at the end of the storage period.

Table No (6):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Total Acidity Contents of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season										
0	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
1	0.98	1.02	1.08	1.12	1.04	1.09	1.1	1.06	1.01	1.056
2	0.83	0.96	1.02	1.02	0.9	0.98	0.91	0.92	0.87	0.934
3	0.75	0.83	0.88	1.04	1.02	1.04	0.96	0.92	0.84	0.92
4	0.8	0.77	0.85	0.91	0.92	0.98	0.91	0.94	0.88	0.884
5	1.06	0.76	0.87	0.9	0.81	0.89	0.81	0.88	0.85	0.87
6	0.7	0.4	0.47	0.49	0.41	0.47	0.4	0.44	0.41	0.466
Means	0.89	0.833	0.894	0.939	0.884	0.934	0.883	0.893	0.85	
Second season (2010-2011)										
0	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109
1	0.853	0.81	0.853	0.939	0.853	0.917	0.789	0.874	0.96	0.872
2	0.768	0.768	0.811	0.896	0.832	0.789	0.746	0.832	0.81	0.806
3	0.682	0.725	0.747	0.789	0.747	0.768	0.725	0.768	0.811	0.751
4	0.533	0.618	0.661	0.725	0.725	0.704	0.661	0.704	0.747	0.675
5	0.405	0.512	0.576	0.64	0.661	0.618	0.597	0.597	0.704	0.59
6	0.277	0.363	0.448	0.49	0.341	0.405	0.405	0.448	0.49	0.407
Means	0.661	0.701	0.744	0.798	0.753	0.759	0.719	0.762	0.804	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				0.072		0.064		0.192		
Values, Second season				0.043		0.038		0.114		

Notes:- A= Imazalil, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

Salicylic acid (As) can decrease respiration through inhibition of ethylene biosynthesis or action, In addition it cause decrease respiration rate and reduce fruit weight losses by closing stoma. Our results also suggested that firmness caused by (SA) with inhibited activity of A Co. coating fruits with chito-care solutions can reduce respiration rate and ethylene production and increase internal O₂ concentration it also interacts with the membrane of cells to alter cell permeability, in addition fruits become more firmer with less decayed.

Table No (7):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on V-C Contents of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season (2009-2010)										
0	64.4	64.43	64.43	64.43	64.43	64.43	64.43	64.43	64.43	64.43
1	51.7	55.33	52	55	56.6	53	56	48.67	44.66	52.55
2	47.5	50.93	45.33	43.73	49.33	45.07	49.6	47.2	47	47.3
3	45.3	38.67	41.33	41	42.33	42	40.33	46.33	47.33	42.74
4	33.8	34.67	33	35	34.33	34.67	35.33	36	38	34.98
5	33.8	34.17	33.37	34.17	32.13	32.23	33.5	32.17	33.33	33.21
6	30.1	30.9	33.8	31.9	31.5	31.17	30.3	31.07	30.66	31.27
Means	43.8	44.16	43.32	43.6	44.38	43.22	44.21	43.7	43.63	
Second season (2010-2011)										
0	69.41	69.41	69.41	69.41	69.41	69.41	69.41	69.41	69.41	69.41
1	49.13	46.85	51.42	49.14	50.54	44.57	47.99	43.42	49.73	48.09
2	46.66	42.93	45.26	44.33	46.66	48.48	47.83	44.53	46.13	45.87
3	39.74	45.56	45.14	42.12	44.8	43	43.73	43.06	42.66	43.31
4	35.38	36.35	41.81	42.35	39.39	39.98	36.72	37	39.26	38.69
5	30.44	29.33	34.66	39.55	37.77	39.21	34.33	31.23	38.1	34.96
6	25.33	23.99	26.66	26.66	29.33	26.66	25.96	27.47	28.32	26.71
Means	42.3	42.06	44.91	44.79	45.41	44.47	43.71	42.3	44.8	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				N.S		0.916		N.S		
Values, Second season				2.316		2.042		N.S		

Notes:- A= Imazail, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

Table No (8):- Effect of Postharvest Treatments with Salicylic acid and Chito-care on Total Sugar Contents of Navel Orange Fruits during cold storage.

Storage period	Postharvest treatments									
	A	S1	S2	K1	K2	S2K2	S1K1	S1K2	S2K1	Means
First season										
0	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11
1	9.01	8.88	9.36	8.96	9.22	8.90	8.69	8.80	9.58	9.04
2	9.86	9.30	9.44	9.66	9.30	9.60	9.33	9.46	10.06	9.56
3	9.86	9.62	9.73	9.78	9.17	9.73	9.88	9.70	10.14	9.73
4	9.88	9.76	9.89	10.02	9.49	10.00	10.04	9.92	10.65	9.96
5	9.70	9.97	10.16	10.13	9.54	10.16	9.86	9.62	10.77	9.99
6	9.46	9.70	10.02	10.26	10.26	9.78	9.70	10.18	10.26	9.96
Means	9.41	9.33	9.53	9.56	9.30	9.47	9.37	9.40	9.94	----
Second season (2010-2011)										
0	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63
1	10.14	9.57	9.15	8.81	9.72	8.98	9.25	9.12	9.21	9.328
2	10.45	10.54	10.3	9.49	10.22	9.97	9.69	9.57	10.17	10.04
3	10.68	10.88	10.65	10.37	10.28	10.51	10.48	10.65	10.4	10.54
4	10.25	10.65	10.93	10.88	10.71	10.36	10.45	9.66	10.59	10.5
5	9.49	9.86	10.05	9.69	9.43	9.52	9.26	9.32	9.55	9.574
6	8.64	9.35	9.57	9.57	9.01	8.95	8.75	8.69	8.95	9.053
Means	9.754	9.926	9.897	9.634	9.714	9.56	9.501	9.377	9.643	
LSD Values at 5% level										
Studied factors				Treat.		St. Per		Interaction		
Values, First season				0.089		0.078		0.234		
Values, Second season				0.099		0.087		0.261		

Notes:- A= Imazail, S= Salicylic acid 200 ppm, S2= Salicylic acid 300 ppm, K1= Chito-care 10000 ppm, K2= Chito-care 20000 ppm, Storage period by months.

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تأثير المعاملة بحمض الساليسليك و الشيتوكلر بعد الحصاد علي جودة ثمار البرتقال "ابوسرة" وقدرتها التخزينيه مقارنة با لاستخدام التجارى للمبيدات الفطريه

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أجريت هذه الدراسة خلال موسمي 2010-2011، و 2011-2012 على ثمار البرتقال أبو سره بمعمل قسم بحوث تداول الفاكهه بمعهد بحوث البساتين – مركز البحوث الزراعيه حيث تم حصاد الثمار من مزرعه خاصه بمحافظة الفيوم وفي المعمل تم معاملة الثمار بالنقع في محلول حمض الساليسليك بتركيز 200 أو 300 جزء في المليون او الشيتوكلرتركيز 10000 أو 20000 جزء في المليون او بكل منهما معا وذلك لمدة 5 دقائق كما تم اجراء المعاملة القياسية للمقارنه - الايمازليل كمعاملة كيميائية بتركيز 1500 جزء في المليون. وبعد تحفيف الثمار تم تخزين الثمار المعاملة والغير معاملة على درجة (10°م ورطوبة نسبية 90-95 %) ثم تم فحص الثمار كل شهر لتحديد تأثير هذه المعاملات على الخواص الطبيعية والكيميائية للثمار خلال فترة التخزين. وأوضحت النتائج ان معاملة الثمار بأى من المركبات المختبرة كان له أثر فعال في تقليل ظهور الاعراض المرضية وفقد الوزن في الثمار كم ادت الى تقليل معدل الفقد في صلابة الثمار وكذلك تاخير ظهور التلويين الكامل للثمار وبالمثل كان لهذه المعاملات دور فعال في تقليل معدل النقص في محتوى الثمار من الحموضة الكلية وكذلك فيتامين ج بينما لم يكن لها تأثير واضح على كل من محتوى الثمار من المواد الصلبة الذائبة والسكريات الذائبة الكلية. الا ان التركيز الاعلى من كلا من المركبين وكذلك استخدامهما معا كان الاكثر فعالية في تحقيق هذه النتائج. ومما سبق يمكن القول ان معاملة ثمار البرتقال بعد الحصاد باى من المركبين بالتركيز الاعلى للحد من تقليل ظهور اعقان الثمار اثناء عمليات الشحن او التخزين المبرد يمكن ان يكون بديلا ناجحا للحد من استخدام المبيدات الفطريه التخليقية لهذا الغرض ومن ثم تقليل اضرارها على الصحة العامة للمستهلكين وكذلك تقليل اضرارها على البيئه.

قام بتحكيم البحث

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