

## Effect of Some Natural Oils and Salicylic Acid on Fruit Quality of Valencia Orange During Storage

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**Abstract:** Several postharvest treatments were performed on Valencia orange fruits prior to storage under cold storage at  $10^{\circ}\text{C} \pm 1^{\circ}\text{C}$ , with 85-90% RH for 60 days throughout 2013 and 2014 seasons: camphor oil (10% v/v), jasmine oil (200 ppm), salicylic acid (0.3g/l), camphor oil (10% v/v) + jasmine oil (200 ppm), camphor oil (10% v/v) + salicylic acid (0.3g/l), jasmine oil (200 ppm) + salicylic acid (0.3g/l), camphor oil (10% v/v) + jasmine oil (200 ppm) + salicylic acid (0.3g/l), imazalil (1500ppm) and control (water). With concern to quality attributes, Valencia fruits treated with camphor oil + jasmine oil + salicylic acid and camphor oil + jasmine oil had lower weight loss (%) in the first and second seasons, respectively compared to the control fruits. Treatments of jasmine oil solely or in combination with salicylic acid significantly decreased fruits decay (%) during 2013 and 2014 seasons, respectively. Fruits treated with camphor oil + salicylic acid in the first season and jasmine oil as single treatment in the second season resulted in firmer than the control fruits. In the 2013 season, fruits treated with jasmine oil as single had higher content of juice (%) and during the season of 2014, different treatments had no effect on fruit juice content. Valencia fruits treated with IMZ and salicylic acid as individual treatments achieved the higher content of TSS in the first season. While in the second season, it was observed that camphor + jasmine oil + salicylic acid treatment recorded a significant highest TSS content than the control treatment. Different postharvest treatments significantly decreased acidity (%) in comparison with the control treatment in the first season and in the second season, fruits treated with jasmine oil + salicylic acid had a significant the highest content of total acidity comparing with the other treatments. Salicylic acid as a single treatment in the first season recorded the highest significant TSS/acidity ratio compared with the control treatment. Results of the second season reveal that, coating fruits with jasmine oil as a single treatment produced higher value of TSS/acidity ratio. Throughout 2013 season, the different postharvest treatments had no significant effect on ascorbic acid content. Meanwhile, during 2014 season, treatment with camphor oil + jasmine oil + salicylic acid achieved the highest significant content of ascorbic acid compared with the control treatment. From the above mentioned results of the present study, it can be recommended that the most effective treatments in maintaining quality properties of Valencia orange fruits for 60 days were jasmine oil (200 ppm) as single treatment comparing to Imazalil and control treatments.

**Key words:** Camphor • Jasmine oil • Salicylic acid • Imazalil • Valencia orange • Cold storage

### INTRODUCTION

Citrus is the leading fruit crop occupying the first rank among economic fruit crops in Egypt as well as all over the world. Citrus fruits suffer from relatively high losses during the harvesting and handling chain, i.e., unideal postharvest treatments (storage conditions and coating material) in addition to pathological infections which play a prime role in this increasing crop losses and deterioration of quality after harvest [1]. The development

and use of alternative postharvest control options involving natural plant extracts have become important, since it is perceived as being environmentally safer and more acceptable to the general public [2]. Recently, researchers have shown an interest in the application of non-toxic alternatives such as, essential oils including camphor and jasmine oil [3, 4]. Salicylic acid (SA) is an endogenous signal molecule which plays pivotal roles in regulation stress responses and plant development including heat production and disease resistance [5].

Synthetic fungicides, such as, Imazalil, Thiabendazole and sodium ortho-phenyl phonate have been used traditionally to control postharvest diseases (as storage low temperatures) is an effective method for preserving quality and extending shelf life [6, 7]. Therefore, the main goal of this study is to investigate the effect of emulsifying Valencia orange fruits with camphor oil, jasmine oil, salicylic acid either as single treatments or combined with the others and Imazalil, as a chemical fungicide on Valencia fruits keeping quality attributes during cold storage (10 °C, with 85-90% RH).

## MATERIALS AND METHODS

The present work was carried out on Valencia orange fruits during 2013 and 2014 seasons. Valencia orange fruits were harvested at maturity stage according to Kader [8] and directly transferred to the laboratory at the Agricultural Development System (ADS) project, Faculty of Agriculture, Cairo University. Defective fruits including wounded and other physiological and pathogenic disorders were excluded. The rest of uniform fruits were washed with tap water, immersing with the following treatments for 10 minutes. (10%) camphor oil, (200 ppm) jasmine oil, (0.3g/l) salicylic acid, camphor oil+jasmine oil, camphor oil+ salicylic acid, jasmine oil+salicylic acid, camphor oil+jasmine oil+salicylic acid, (1500ppm) Imazalil (IMZ) for 3 minutes and control (water immersed). After immersing, fruits of each treatment were air dried and packed in one layer inside well aerated carton boxes 30x40x12cm and stored at 10±1°C, with 85-90% RH. Each treatment was comprised five boxes (10 fruits/box), three for weight loss and decay studies and the rest boxes for samples analysis. The following characteristics were assessed at the beginning of the storage and after 60 days.

**Weight Loss%:** It was calculated as the following equation:

$$\text{Fruit weight loss \%} = \frac{\text{Initial weight} - \text{weight after 60 days}}{\text{Initial weight}} \times 100$$

**Fruit Decay%:** It was determined by counting the number of decay fruits (with either pathological or physiological disorders) through 60 days and expressed as a percentage of the initial number of fruits per each sample (replicate) for each treatment. Fruit firmness expressed as lb/inch<sup>2</sup>, fruit juice was extracted and

weighed then calculated as percentage of fruit weight for each treatment, TSS expressed as percentage [9]. Total acidity (%) was determined in fruit juice as citric acid content as described in AOAC [9]. TSS/total acidity ratio was calculated and ascorbic acid (Vitamin C) content as mg/100 ml juice was determined as described in AOAC [9].

**Statistical Analysis:** Randomized complete block design as one factor experiment was used for treatments arrangement and the least significant difference test (L.S.D) at 5% level was used to differentiate means according to Snedecor and Cochran [10].

## RESULTS AND DISCUSSION

**Fruit Weight Loss (%):** Results as shown in Table (1) reveal that, in the 2013 season, treatment with camphor oil+jasmine oil+salicylic acid followed by camphor oil+salicylic acid treatment decreased Valencia fruit weight loss (%) to lower values (10.82 and 11.49%, respectively) as compared with the other treatments. While, during 2014 season, fruits treated with camphor oil+jasmine oil or camphor oil+jasmine oil+salicylic acid had lower weight loss (%) (15.62 and 15.69%, respectively) without significant differences compared to the control fruits. Weight loss is mainly regulated by respiration, transpiration and metabolic activities of the fruits. SA have been reported to close stomata which resulted in suppressed respiration rate and minimized weight loss of fruits under cold storage [11, 12]. In this respect, jasmine oil, MeJA and camphor oil reduced the weight loss of Baladi orange and Cara cara' navel orange fruits during the cold storage [13, 3].

**Fruit Decay (%):** According to Table (1), it can be notice that, treatments of jasmine oil solely or Imazalil significantly decreased fruits decay (%) (10%) in the first season in comparison with the control treatment (20%). Meanwhile, during the second season, it was observed that using jasmine oil in combination with salicylic acid and as a single treatment significantly reduced decay (%) of Valencia fruits (10 and 20%, respectively) compared with control fruits (40%). MeJA treatment inhibits the green mould, increasing fruits chilling tolerance and induce the expression of pathogenesis-related protein (small polypeptides HSP)[14 -17].

SA enhanced chilling tolerance and reduced fungal decay of banana, peach and pomegranate fruits [18-20].

Table 1: Effect of some postharvest treatments on fruit weight loss (%), decay (%), firmness (lb/inch<sup>2</sup>) and juice (%) of Valencia orange fruits stored at 10 °C±1, with 85-90% RH after 60days during 2013 and 2014 seasons.

Treatments	Fruit weight loss (%)		Fruit decay (%)		Fruit firmness (lb/inch <sup>2</sup> )		Juice content (%)	
	2013	2014	2013	2014	2013	2014	2013	2014
10% Camphor oil (CA)	12.90 a	17.33 ab	20.00 b	30.00 b	16.85 ab	15.78 ab	39.53 a	21.22 b
200 ppm Jasmine oil (JA)	11.78 ab	16.45 abc	10.00 c	20.00 c	16.90 ab	16.40 a	43.11 a	32.44 a
0.3g/l Salicylic acid (SA)	12.89 a	17.37 ab	20.00 b	20.00 c	16.75 ab	16.05 a	37.04 a	33.60 a
Camphor oil + Jasmine oil	12.31 ab	15.62 c	20.00 b	30.00 b	16.90 ab	16.18 a	28.34 b	37.67 a
Camphor oil + Salicylic acid	11.49 ab	16.08 bc	20.00 b	30.00 b	16.95 a	16.15 a	38.86 a	35.64 a
Jasmine oil + Salicylic acid	11.89 ab	15.81 c	30.00 a	10.00 d	16.80 ab	15.68 ab	40.46 a	30.87 a
Camphor oil + Jasmine oil + Salicylic acid	10.82 b	15.69 c	20.00 b	30.00 b	16.68 b	16.23 a	41.84 a	35.71 a
1500 ppm Imazalil	11.70 ab	17.76 a	10.00 c	30.00 b	16.80 ab	16.33 a	40.52 a	38.97 a
Control (water)	12.12 ab	16.60 abc	20.00 b	40.00 a	16.75 ab	15.05 b	37.88 a	36.34 a

Means in the same column followed by the same letter (s) are not significantly different at 5% probability

Table 2: Effect of some postharvest treatments on total soluble solids (%), acidity (%), TSS/Acidity ratio and ascorbic acid (mg/100ml juice) of Valencia orange fruits stored at 10°C±1, with 85-90% RH after 60days during 2013 and 2014 seasons

Treatments	Total soluble solids (%)		Acidity content (%)		TSS/Acidity ratio		Ascorbic acid (mg/100ml juice)	
	2013	2014	2013	2014	2013	2014	2013	2014
10% Camphor oil (CA)	11.65 de	10.55 e	1.28 b	0.99 bcd	9.171 cd	10.62 bcd	27.20 a	26.35 ab
200 ppm Jasmine oil (JA)	12.05 cd	11.07 ab	1.17 b	0.93 d	10.32 ab	11.94 a	26.35 a	25.50 ab
0.3g/l Salicylic acid (SA)	13.09 ab	10.84 b-e	1.22 b	1.01 bc	10.90 a	10.76 bc	27.20 a	22.10 b
Camphor oil + Jasmine oil	11.94 d	10.59 de	1.26 b	1.04 b	9.459 bc	10.16 cd	25.50 a	21.25 b
Camphor oil + Salicylic acid	10.74 e	11.06 ab	1.26 b	0.96 cd	8.483 cd	11.51 ab	28.05 a	23.80 ab
Jasmine oil + Salicylic acid	11.90 d	10.93 bc	1.28 b	1.12 a	9.269 cd	9.76 d	28.90 a	27.20 ab
Camphor oil + Jasmine oil + Salicylic acid	12.24 bcd	11.25 a	1.18 b	0.99 bcd	10.30 ab	11.39 ab	26.35 a	29.75 a
1500 ppm Imazalil	13.25 a	10.85 bcd	1.23 b	1.02 bc	10.80 a	10.67 bcd	24.65 a	25.50 ab
Control (water)	12.98 abc	10.74 cde	1.54 a	0.99 bcd	8.447 d	10.79 bc	24.65 a	22.10 b

Means in the same column followed by the same letter (s) are not significantly different at 5% probability

**Fruit Firmness:** Results of fruits firmness as affect by different postharvest treatments are presented in Table (1), it is clear that, in the first season, fruits treated with camphor oil+salicylic acid and jasmine oil as single treatment respectively were non-significant firmer (16.95 and 16.90 lb/inch<sup>2</sup>) than the control treatment (16.75 lb/inch<sup>2</sup>). During the second season, fruits coating with jasmine oil alone significantly resulted in firmer (16.40 lb/inch<sup>2</sup>) than the control fruits (15.05 lb/inch<sup>2</sup>). Higher firmness in treated fruits by jasmine oil or salicylic acid compared with control fruits might be attributed to the reduced hydrolysis of soluble starch [21]. Zaghoul *et al.* [4] on Navel orange and Korkar [22] on Kitt mango fruits indicated that fruit firmness was increased by jasmine oil and salicylic acid treatments compared with the control treatment during the cold storage.

**Fruit Juice Content (%):** Results illustrated in Table (1) clearly indicate that in the 2013 season, fruits treated with jasmine oil as single followed by camphor oil+ jasmine oil+salicylic acid had higher content of juice (%) (43.11 and 41.84%) without significant differences in compared

with the control treatment (37.88%). However, during the season of 2014, different treatments had no effect on fruit juice content.

**Total Soluble Solids Content (%):** The computed results (Table, 2) gave an indication that in the first season, Valencia fruits stored at 10°C for 60 days and treated with IMZ and salicylic acid as individual treatments achieved the higher content of TSS (13.25 and 13.09%, respectively). In the second season, it was observed that camphor + jasmine oil + salicylic acid treatment recorded a significant highest TSS content (11.25%) and that treated by jasmine oil treatment alone (11.07%) than the control treatment (10.74%). These results are in conformity with the finding by Jin *et al.* [23] on peach and by Gameel [24] on Eureka lemon fruits. They disclosed that TSS content was increased with different jasmine oil treatments during cold storage. In the present study, higher levels of total soluble solids in Valencia fruits treated with jasmine oil treatments may be due to protective O<sub>2</sub> barrier reduction of oxygen supply on the fruit surface which inhibited respiration [25].

**Total Acidity Content (%):** It is quite clear from Table (2) that, different postharvest treatments significantly decreased acidity (%) of Valencia fruits during the first season in comparison with the control treatments (1.54%). While during the second season, it was noticed that, fruits treated with jasmine oil+salicylic acid had a significant the highest content of total acidity (1.12%) comparing with the other treatments. These results are in line with those reported by Jin *et al.* [23] on peach fruits, since total acidity was increased by jasmine oil under cold storage. Organic acids such as citric acid are primary substrates for respiration and the reduction in acidity is expected in highly respiring fruits and coating treatments reduce respiration rates and therefore delay the utilization of organic acids during the cold storage [26].

**TSS/Acidity Ratio:** Table (2) clearly indicate that, treatment with salicylic acid as a single treatment in the first season had the highest significant TSS/acidity ratio (10.90) followed by single treatments of IMZ and jasmine oil (10.80 and 10.32, respectively) compared with the control treatment (8.447). Results of the second season reveal that, coating fruits with jasmine oil as a single treatment and that camphor oil+salicylic acid treatment produced higher value of TSS/acidity ratio (11.94 and 11.51, respectively) in compared with the other treatments. These results are in disagreement with the result obtained by Gameel [24] who observed that, the used concentrations of jasmine oil had no significant on TSS/acidity ratio of Eureka lemon fruits during the cold storage period.

**Ascorbic Acid Content (mg/100ml Juice):** Results presented in Table (2) show that, throughout 2013 season, the different postharvest treatments had no significant effect on ascorbic acid content of Valencia fruits during the cold storage and the highest content was produced from fruits treated with jasmine oil+salicylic acid (28.90 mg/100ml juice). Meanwhile, during 2014 season, treatment with camphor oil+jasmine oil+salicylic acid achieved the highest significant content of ascorbic acid (29.75 mg/100ml juice) compared with the control treatment (22.10 mg/100ml juice). The obtained results are in harmony with those of Gameel [24] on Eureka lemon who found that, jasmine oil increased ascorbic acid contents during the cold storage. Also, salicylic acid significantly delayed the decline ascorbic acid content of Hayward kiwifruit compared with the control fruits during the cold storage [27].

## CONCLUSION

Generally, from the above mentioned results it could be concluded that the most effective treatments in maintaining quality properties of Valencia orange fruits after 60 days were jasmine oil (200 ppm) as single treatment comparing to Imazalil and control treatments.

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