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Maintain Postharvest Quality of Nectarine Fruits by Using Some Essential Oils

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ABSTRACT

Some essential oils were tested to maintain post harvest quality of 'Florda 7/2' nectarine. The treatments included control(distilled water)and concentrations 2ml/l for each of Lemongrass, Thyme, Rosemary, Lavender, Bergamot, Pepper mint, Dill and Coriander essential oils .The fruits were stored for 4 weeks at 0 °C and 90–95% R H .Fruits assessed weekly to determine the changes in fruit quality characteristics during cold storage and after 5 days as market-life. Results showed that weight loss, total soluble solids, total sugars content and respiration rate increased whereas, firmness, total acidity, vitamin C and total phenols decreased by increasing storage and marketing periods. All the treatments helped to minimize the quality loss of nectarine in varying periods of cold storage, while untreated fruits lost their marketable quality after 5days from cold storage. All treatments during cold storage and market life periods decreased decay, weight loss and delayed the changes in firmness, total acidity, total soluble solids, vitamin C, total sugars, total phenols and respiration rate compared with control. The study suggests that use essential oils especialley Bergamot oil exhibited the best results in maintenance of overall quality parameters and promise to get a product safe and healthy, especially to produce organic nectarines, during shipping and marketing, thus extending post- harvest life of nectarines.

Key words: Nectarine; essential oils; decay and quality

Introduction

Nectarine fruits exposed to the fungal diseases, grey mold caused by(*Botrytis cinerea*) and Rhizopus rot caused by (*Rhizopus stolonifer*) and blue mold caused by (*Penicillium expansum*) (Zhang *et al*., 2007).Due to the consumer's concerns over the safety of fruits containing synthetic chemicals, a lot of attention has been paid to naturally derived compounds or natural products (Alzoreky and Nakahara *et al*.,2003).Recently, use of natural components such as natural extract or herbal oils is one of the healthiest and safest methods to control postharvest diseases, essential oils include extensive secondary metabolites, which in most cases have antimicrobial, fungicidal antioxidant and bio-regulating properties. (Asghari *et al*., 2009). Recent experiments show that some essential oils are effective for reduce decay, quality maintenance and essential improvement post-harvest life of many fruits reported by Serrano *et al.* (2005) on Eugenol, Thymol oils, Valero *et al.*(2006) on Thyme and Lemongrass, Abdolahi *et al*.(2010) on Thyme, Fennel and Summer savory oils ,Bosquez-Molina *et al.,* (2010) of Thymol, Carvacrol, Eugenol and Menthol oils, (Rabiei *et al*., 2011)on Thyme and Lavender oils, (Mohammadi and Aminifard, 2012) on Anise, Ammi, Ziziphora and Cinnamon oils,(Hassani *et al*.,2012)on Thyme and Cinnamon oils,(Mohammadi *et al.,* 2012)on Fennel, Anis, Peppermint and Cinnamon oils,Zeng *et al.* (2012) on Clove oil, Mohamed and El-Badawy (2013) on Thyme and Clove oils, Mpho *et al*. (2013) on Lemongrass and Salimi *et al*. (2013) on basil ,wild mint and ajowan oils.

In this regard, Lemongrass (*Cymbopogon citratus* L.) oil was reported to be antifungal activity against several plant pathogens (Tzortzakis and Economakis, 2007, Abd-AllA *et al*., 2011and Hyun *et al*., 2015)and reduced the incidence diseases, weight loss, loss of fruit firmness and showed acceptable texture and higher overall acceptance during cold storage at market shelf conditions of avocado fruits (Mpho *et al*., 2013). Thyme (*Thymus capitates* L.) oil has been used as plant diseases of several fruits (Tzortzakis and Economakis, 2007, Abd-AllA *et al*., 2011 and Hyun *et al*., 2015) and greatly preserved the amount of vitamin C, maintain quality of the orange fruit (Fatimi *et al*., 2011). Bergamot (Citrus bergamia) oil decreased decay ,weight loss and delayed the changes in firmness, titratable acidity, total soluble solids, vitamin c ,anthocyanin content and respiration rate during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al* .,2014).Peppermint*(Mentha piperita* L.)oil used to reduce decay rates and greatly preserved the amount of vitamin C, increased acidity and maintain quality of the orange fruit (Fatimi *et al*.,2011) and showed positive effects on titrable acidity, total soluble solids, weight loss percentage, increased their storage life of plum fruits (Aminifard and Mohammad,2013). Rosemary (*Rosmarinus officinalis* L.) oil is used as antioxidant activity (Bicchi *et al*., 2000) and has antimicrobial properties (Almela *et al.,* 2006). Lavender (*Lavandula hybrida*) oil,

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Dill oil (*Anethum graveolens* L.) and Coriander oil (*Coriandrum sativum* L.) showed antibacterial and high antifungal activity against different bacteria and fungi strains (Şerban *et al*., 2011).

Therefore, The purpose of the study was to evaluate the effectiveness of essential oils of Lemongrass ,Thyme, Rosemary, Lavender, Bergamot, Pepper mint, Dill and Coriander for prolong the postharvest life and maintaining the quality parameters of Florda 7/2 ˈnectarine**.**

Material and Methods

Fruit material:

`Florda 7/2 ˈnectarines (*Prunus persica* (L.) Batsch) fruits were obtained from a private orchard (Maba farm) in Alexandria road district, Giza Governorate. Fruits were harvested at optimal time in the last week of April 2014 and 2015 in the full color stage and the physicochemical properties evaluated at harvest time as average values at the two seasons. Weight of fruit 105 g; total soluble solids (TSS) [11.06 &11.00%] firmness [15.30 &15.80 (lb/in^2)]; titratable acidity (TA) [1.03 &1.100 %]; Vit.C. [4.70 & 5.60 mg/100 g fresh weight (F.W)] ; total sugars [37.20&36.77mg/ g F.W.] ; anthocyanin content [20.10&19.44 mg./100 g. F.W.] ; total phenols [0.645&0.680mg./ g. F.W] and respiration rate[23.45&23.10ml CO2 /kg/h] in the first and second seasons, respectively. The fruits were delivered on the same day to the laboratory, fruits homogenous in color, size and absence of defects. Non-defective `Florda 7/2 'nectarines were selected, washed with fresh water, air-dried, and used in the postharvest treatments.

Source of plant essential oils:

Pure-grade (not containing synthetic chemicals and/or non-natural components,99-100% pure)of the essential oils Lemongrass oil, Thyme, Rosemary, Lavender, Bergamot, Pepper mint, Dill and Coriander were purchased from Cairo Company for oils and aromatic extractions CID, Egypt. These essential oils were stored in dark bottles at 4ºC until used in the experiments.

Main compounds of essential oils:

Bergamot oil is consists of a volatile fraction (93–96%), whose main components are limonene (40%), linalool (8%) and linalyl acetate (28%) (Remano *et al*., 2005) and consists of a non-volatile fraction (4–7%) as pigments, waxes, and above all coumarins (citropten)and psoralens (bergapten and Bergamottin) (Guerrini *et al*., 2009) & Lemongrass oil consists of a-citral (46.05%) b-citral (37.64%**)** &Thyme oil consists of 12.62% β-Ocimene,10.56% Thymol,8.5% α-Phellandrene and 6.85% Carvacrol (Abdolahi *et al*.,2010)&Rosemary oil Consists of Eucalyptol 36.3%, α-Pinene 15.34%,Camphor 12.52%,β-Pinene 10.96% & Lavender oil main components are β-Linalool32.39% and Linalyl acetate31.03%& Dill oil main components are α-Phellandrene 41.5%,Carvone 22.99%,Limonene 22.24% & Coriander oil main components are β-Linalool50.35%, P-Cymene28.81%, α-Pinene11.99% and Peppermint oil main components are Menthone 31.01%,Menthol 19.56%, Eucalyptol 9.62% (Şerban *et al*.,2011).

Essential oils treatment:

Treatments with essential oil, Lemongrass, Thyme, Rosemary, Lavender, Bergamot, Pepper mint, Dill and Coriander oils were performed by dissolving the requisite amounts of each oil (2 ml/L) in 23 ml of 0.05 % tween-80 and then mixing with 975 ml of water. Nectarines were sprayed with the solutions of each oil using a hand-sprayer and air dried at room temperature (Hadizadeh *et al.*, 2009). Another set of un-treated fruits was sprayed with distilled water and served as control treatment.

Storage conditions:

Fruits from each coated treatment were transferred to egg carton trays with 30 holes, three trays were used for each particular treatment and placed in three performed cartoon boxes, as box to determine decay, the second to determine weight loss and the third for fruit analysis. Each box contained one tray contained with 30 fruits was replicated three times, and the experiment was repeated twice (2014 and 2015 seasons).Nectarine fruits were subjected randomly to one of the tested essential oils and stored at 0ºC and the relative humidity (RH) of 90-95% for 28 days in laboratory of refrigeration Agriculture Development Systems (ADS) project in the Faculty of Agriculture, Cairo University.

Determination of physical and chemical properties:

Fruit samples in all experimented treatments were subjected to series of quality evaluation during cold storage and aftermarket life period (5 days)**.**

Decay percentage:

The percentage of disordered fruits included all of the spoiled fruits resulted from rots, fungus, bacterial and pathogens were assessed and the defects were calculated as follows:

$$\text{Decay \%} = \frac{\text{No. of fruit decay}}{\text{No. of fruit at the beginning of storage}} \times 100$$

Weight loss percentage:

The difference between the initial weight of the fruits and that recorded at the date of sampling was translated as weight loss percentage and calculated as follows:

$$\text{Weight loss \%} = \frac{\text{Weight loss in (g.)}}{\text{The initial weight of the fruits at the beginning of storage (g.)}} \times 100$$

Fruit Firmness (lb/in^2):

It was measured on the two opposite sides of apricot fruit samples by using a hand Magness Taylor pressure tester (lb/in^2).

Total Soluble Solids (TSS) %:

Fresh of replicated fruits were ground in an electric juice extractor for freshly prepared juice. Soluble solids content was measured using Digital rafractometer PR32 (0.32% Atago Palete ATago.CO .LTD. Japan.

Total Acidity (TA) %:

Total acidity (expressed as malic acid %) was determined by titrating 5-ml juice with 0.1N sodium hydroxide using phenolphthalein as indicator (A.O.A.C., 2000).

Vitamin C (mg/ 100 g. F. W.):

It was measured using 2, 5-6 dichlorophenol indophenols' method described by A.O.A.C. (2000).

Total sugars (mg/g F.W.):

By using the phenol-sulphuric acid method according to Dubois *et al*. (1956).

Total phenols (mg /g F .W):

By using folin – ciocalteu calorimetric method (Swain and Hillis, 1959) at the wave length of 725 nm, standard curve from p-hydroxyl benzoic acid was used to calculate the amount of phenols as mg per g fresh weight.

Anthocyanin content (mg./100 g. F.W.):

Anthocyanin content was determined in skin of fruit according to the method described by Yilids and Diken (1990).

Respiration rate:

Individual fruits for each treatment were weighed and placed in 2-liter jars at room temperature (25°C ± 1). The jars were sealed for 3 h with a cap and a rubber septum. Air samples of the headspace were removed from the septum with a syringe and injected into Servomex Inst. Model 1450C (Food Pack Gas Analyzer) to measure oxygen content and carbon dioxide production. Respiration rate was evaluated at harvest day and during cold storage period (4 weeks) .Respiration rate was calculated as ml CO_2 /kg/h (Lurie and Pesis, 1992).

Marketing life:

After 4 weeks storage period,10 fruits of each replicate treatments were kept at (25°C ± 1) for 5 days, 75% RH in room temperature as marketing life to simulate the market condition, quality measurements as physiochemical properties of fruits were studied.

Experimental design and statistical analysis:

All results of physiochemical parameters were performed in triplicate using completely randomized factorial design. Data were analyzed with the Analysis of variance (ANOVA) procedure of MSTAT-C program. When significant differences were detected, treatment means were compared by LSD range test at the 5% level of probability in the two investigated seasons (Snedecor and Cochran, 1980).

Results and Discussion

Decay percentage:

Results in table (1) clear that decay percentage of control fruits was increased significantly with prolonged storage period. All treatments significantly reduced the decay of nectarine fruits .The lowest values for decay percentage were obtained as a result of treating the fruits with Bergamot oil at 0 °C for 28 storage days followed by Lemongrass oil and Thyme oil then Rosemary oil, Pepper mint oil, Lavender oil Dill oil and Coriander oil treatments in descending order as compared with the control treatment which have the highest decay % in both seasons. Looking to the interaction effect between the tested storage periods and post-harvest treatments with essential oils, it is obvious that all essential oils had the lowest decay percentage at 28 days storage in both seasons .This decreasing in decay percentages of treated samples was probably due to increase defense by essential oils on surface of fruits and its effects of on delaying pathogenic infection where the main components in essential oils (terpenes, terpenoids) play a major role in the antimicrobial/biological effect of essential oils (Bakkali *et al*., 2008)**.** Also, the active component of essential oils contain more phenol compounds had a great antifungal activity (Abdolahi *et al*.,2010)and phenol compounds could affect the enzymes responsible for spore germination of fungi (Nychas ,1995) and have also been recognized as bioactive components (Tabassum *et al*., 2013),this leading to improve storability and extend market life of nectarine fruits **.**Previous studies reported the beneficial effects of using some essential oils Thyme and Lemongrass oils on peaches (Valero *et al*. ,2006), Lemongrass oil used against gray mold of apple fruit (Tzortzakis and Economakis ,2007) and significantly reduced the incidence diseases of avocado fruits (Mpho *et al*., 2013),Thyme and Clove oils had significant effects on fungal growth on apricot (Hassani *et al*., 2012),Lavender, Dill, Rosemary, Peppermint and Coriander oils showed antibacterial and high antifungal activity against different bacteria and fungi strains (Şerban *et al*., 2011),Basil, Wild mint and Ajowan oils decreased decay during 60 days cold storage on Rasha grape (Salimi *et al*., 2013). Also, Aminifard and Mohammadi (2013) demonstrated that Black caraway, Fennel and Peppermint essential oils inhibited the infection of plum fruits by *B. cinerea* of plum fruits. Bergamot oil decreased decay during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al.,* 2014).Thyme, Oregano, and Lemongrass showed good inhibitory effects against microorganisms (Hyun *et al.*, 2015) on cabbages.

Table 1: Effect of essential oils on decay %of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	0.00	3.90	6.90	15.60	20.80	10.84	0.00	3.20	5.95	13.93	19.60	8.53
Coriander oil	0.00	1.12	1.60	4.00	5.70	2.48	0.00	0.80	1.50	3.75	5.30	2.24
Dill oil	0.00	0.95	1.40	3.40	5.20	2.19	0.00	0.66	1.20	3.10	4.95	2.01
Lavender oil	0.00	0.76	1.10	3.00	4.70	1.91	0.00	0.55	0.75	2.85	4.40	1.69
Pepper mint oil	0.00	0.46	0.90	2.80	4.30	1.69	0.00	0.30	0.66	2.55	3.50	1.29
Rosemary oil	0.00	0.35	0.65	2.50	3.80	1.46	0.00	0.20	0.47	2.30	3.10	1.25
Thyme oil	0.00	0.15	0.32	2.10	3.50	1.21	0.00	0.10	0.25	2.00	2.66	1.09
Lemongrass oil	0.00	0.10	0.22	1.90	2.95	1.03	0.00	0.05	0.15	1.75	2.65	0.92
Bergamot oil	0.00	0.00	0.00	1.60	2.65	0.85	0.00	0.00	0.00	1.35	2.30	0.73
Mean	0.00	0.86	1.45	4.10	5.95		0.00	0.65	1.21	3.73	5.38	
L.S.D. at 5%	Treatments (T) = 0.03 Storage period (P) = 0.04 Interaction(T)x (P) =0.05						Treatments (T) = 0.02 Storage period (P) = 0.03 Interaction (T)x (P) = 0.05					

Weight loss percentage:

Table (2) showed that loss in fruit weight was increased significantly as storage period advanced. The highest loss of weight was obtained at the end of storage. (Davarynejad *et al*., 2013). Normally, the weight loss occurs during the fruit storage due to its respiratory process, the transference of humidity and some processes of oxidation (Ayranci and Tunc, 2003).The present data reveal that essential oils recorded the lowest significant percentage of fruit weight loss in both seasons as compared with the control which gave the highest significant percentage of weight loss. The arrangement was Bergamot oil, Lemongrass oil, Thyme oil, Rosemary oil ,Pepper mint oil , Lavender oil ,Dill oil then Coriander oil in decreasing order. As for the effect of interaction between the tested post-harvest treatments and storage periods, the lowest value for weight loss in nectarine fruits at different sampling time of storage was connected with postharvest spraying the fruits with all essential oils compared with control in both seasons. Also, decay damage in control fruits leading to loss of water and ultimately fruit weight loss. According to results, the reducing of water and weight loss by essential oils can be attributed to controlling of decay and its damages and act as coatings as permeable barrier against oxygen, carbon dioxide, moisture, thereby reducing respiration, water loss and oxidation reaction rates

(Baldwin *et al*., 1999). Also, essential oils could be work as barrier water loss and protecting fruit skin and delaying dehydration and therefore less weight loss occur in these treated nectarines during storage .The positive effect of essential oils in reduction of weight loss in different crops were reported by Mohammadi and Aminifard (2012) of Anise, Ammi, ziziphora and Cinnamon oils on peach, Hassani *et al.,* (2012) of Thyme and Clove essential oils on apricot fruits , Salimi *et al*.(2013) of Basil ,Wild Mint and Ajowan oils on Rasha grape and Mpho *et al*.(2013)of Lemongrass on avocado fruits. Also, Aminifard and Mohammadi (2013) demonstrated that Black caraway, Fennel and Peppermint essential oils decreased weight loss percentage of plum fruits. Bergamot oil decreased weight loss during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al* .,2014).

Table 2: Effect of essential oils on weight loss %of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	0.00	3.25	6.10	8.73	13.20	6.25	0.00	3.70	5.90	7.90	12.50	6.00
Coriander oil	0.00	1.40	2.40	2.98	3.51	2.16	0.00	1.74	2.10	2.60	3.00	1.88
Dill oil	0.00	1.20	2.00	2.70	2.95	1.85	0.00	1.48	1.78	2.43	2.87	1.71
Lavender oil	0.00	1.00	1.84	2.54	2.70	1.69	0.00	1.22	1.58	2.23	2.55	1.51
Pepper mint oil	0.00	0.35	1.55	2.20	2.35	1.46	0.00	1.00	1.30	1.90	2.20	1.28
Rosemary oil	0.00	0.15	1.35	1.78	2.00	1.22	0.00	0.89	1.15	1.65	1.87	1.11
Thyme oil	0.00	1.95	1.00	1.43	1.80	0.98	0.00	0.55	0.88	1.20	1.65	0.85
Lemongrass oil	0.00	1.60	0.75	1.15	1.55	0.76	0.00	0.20	0.45	0.95	1.35	0.59
Bergamot oil	0.00	0.70	0.39	0.78	1.15	0.49	0.00	0.08	0.22	0.60	0.66	0.31
Mean	0.00	1.28	1.93	2.70	3.46		0.00	1.20	1.70	2.38	3.18	
L.S.D. at 5%	Treatments (T) = 0.05 Storage period (P) = 0.04 Interaction(T)x (P) =0.10						Treatments (T) = 0.06 Storage period (P) = 0.05 Interaction(T)x (P) = 0.12					

Firmness:

As shown in Table (3) the highest significant values of fruit firmness obtained from Bergamot oil, Lemongrass oil, Thyme oil, Rosemary oil, Pepper mint oil , Lavender oil ,Dill oil and Coriander oil treatments in descending order as compared with the control treatment in both seasons. Fruit firmness decreased gradually and significantly with the progress of cold storage in both seasons, a result supported the finding of Davarynejad *et al*. (2013). In addition, all essential oils maintained on highest firmness for nectarines in this respect with regard to the effect of the interaction during the different periods of storage in two seasons of study .Essential oils work as a protective layer of against different bactria and fungi and therefore stopped up of damaged fruits (Şerban *et al*.,2011).It also maintained of cell wall carbohydrate metabolism during storage which associated with decreased susceptibility to infection by fungal pathogens and therefore improves quality, but firmness in control probably decreased by fungal infection due to hydrolyze pectin and cell wall break down by progress of time. Also, The faster reduction in texture in control samples might also be due to accelerated ripening process during storage periods which mainly occurs because of degradation of the middle lamella of the cell wall .Present findings were consistent with that Some essential oils had significant efficacy on firmness of table grape fruit (Abdolahi *et al*., 2010),bananas (Maqbool *et al*.,2010)and plum (Díaz–Mula *et al*., 2011), avocado fruits (Mpho *et al*., 2013) and Crimson seedless grape (Abd Elwahab *et al* .,2014).

Table 3: Effect of essential oils on firmness (lb/in^2) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	15.30	11.70	9.400	7.700	5.000	9.82	15.80	12.00	10.20	7.33	6.43	10.35
Coriander oil	15.30	13.50	13.00	12.50	11.83	13.23	15.80	14.00	13.70	13.23	12.87	13.92
Dill oil	15.30	13.70	13.30	12.80	12.20	13.46	15.80	14.20	14.00	13.53	13.17	14.14
Lavender oil	15.30	14.00	13.50	13.10	12.50	13.68	15.80	14.40	14.30	13.83	13.47	14.36
Pepper mint oil	15.30	14.20	13.80	13.40	12.70	13.88	15.80	14.70	14.50	14.03	13.67	14.54
Rosemary oil	15.30	14.40	14.00	13.70	13.10	14.10	15.80	14.80	14.70	14.23	13.87	14.68
Thyme oil	15.30	14.60	14.30	14.00	13.40	14.32	15.80	15.20	14.90	14.40	14.20	14.90
Lemongrass oil	15.30	14.80	14.43	14.10	13.70	14.48	15.80	15.40	15.10	14.70	14.40	15.08
Bergamot oil	15.30	15.00	14.50	14.50	14.00	14.65	15.80	15.60	15.30	14.90	14.70	15.26
Mean	15.30	13.99	13.36	12.87	12.05		15.80	14.48	14.08	13.36	12.97	
L.S.D. at 5%	Storage period (P) = 0.09 Treatments (T) = 0.06 Interaction(P)x (T) = 0.13						Storage period (P) = 0.07 Treatments (T) = 0.03 Interaction(P)x (T) = 0.12					

Total soluble solids (TSS):

Total soluble solids content of stored fruits as recorded in Table (4) were gradually and significantly increased with the extend of storage period during 2014 & 2015 seasons,It reaching the maximum values at the end of storage period (28 days) as previously detected by Davarynejad *et al* .(2013). Un treated fruits had the highest an increase in fruit content of TSS %, meanwhile Bergamot oil treatment had the lowest increase in TSS content as compared with the other treatments .Evaluating the interaction effect between storage periods and the tested treatments, data show that the interactions of four weeks cold storage period, registered the lowest values of fruit total soluble solids percentage with Bergamot oil treatment in both seasons. that probably related to delay in metabolic activity and reduced respiration rate and vital process, thus reducing the loss of TSS during storage. In control fruits as the increase of microbial spoilage, degradation of fruits and over senescence led to an increase respiration rate and metabolic activity. These results are in agreement with some essential oils positively affected on total soluble solids, such as Anise, Ammi, Ziziphora and Cinnamon oils on peach fruits (Mohammadi and Aminifard ,2012), Funnel and Thyme oils (Abdolahi *et al*., 2010) and Basil ,Wild mint and Ajowan oils (Salimi *et al*.,2013) on table grape fruit. Hassani *et al*. (2012) reported that Thyme oil had significant effect on apricot fruit quality retention as total soluble solids. Also, Aminifard and Mohammadi (2013) demonstrated that Black Caraway, Fennel and Peppermint essential oils showed positive effects on fruit quality characteristics such as total soluble solids of plum fruits. Also, Bergamot oil delayed the changes in total soluble solids during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al*., 2014).

Table 4: Effect of essential oils on TSS % of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	11.06	13.93	14.96	16.70	18.83	15.10	11.00	13.25	14.70	15.85	17.70	14.50
Coriander oil	11.06	12.82	12.93	13.49	13.82	12.82	11.00	12.43	12.76	13.25	13.54	12.60
Dill oil	11.06	12.67	12.72	13.23	13.60	12.66	11.00	12.28	12.56	12.98	13.23	12.41
Lavender oil	11.06	12.46	12.66	13.00	13.43	12.52	11.00	12.00	12.33	12.76	12.99	12.22
Pepper mint oil	11.06	12.20	12.43	12.92	13.28	12.38	11.00	11.96	12.10	12.56	12.82	12.09
Rosemary oil	11.06	11.99	12.29	12.74	12.96	12.21	11.00	11.83	11.95	12.39	12.65	11.96
Thyme oil	11.06	11.78	12.00	12.55	12.72	12.02	11.00	11.66	11.78	12.00	12.34	11.76
Lemongrass oil	11.06	11.58	11.84	11.99	12.33	11.76	11.00	11.45	11.56	11.88	12.12	11.60
Bergamot oil	11.06	11.34	11.65	11.85	12.00	11.58	11.00	11.20	11.44	11.62	11.87	11.43
Mean	11.06	12.31	12.61	13.16	13.66		11.00	12.01	12.35	12.81	13.25	
L.S.D. at 5%	Treatments (T) = 0.05 Storage period (P) = 0.03 Interaction(T)x (P) = 0.11						Treatments (T) = 0.06 Storage period (P) = 0.03 Interaction(T)x (P) = 0.13					

Total acidity:

Data tabulated in Table (5) showed that fruit acidity significantly decreased as the storage period extended till the end of storage period 28 days. Similarly Davarynejad *et al*. (2013) on apricot detected a decrease in acidity of fruits during storage. All essential oils treatments delayed the decrease in concentrations of titratable acidity. Moreover, it could be noticed that control treatment gave the lowest value of acidity in both season. As for the combined effect of storage period and postharvest oils treatments on total acidity, Bergamot oil treatment was the most effective in decreasing titratable acidity during the two seasons of study. Fruits treated with essential oils showed higher retention of juice acidity during storage. This could be due to the delaying in physiological ageing and alteration in metabolism, which ultimately resulted in higher retention of acidity. Also, slowing down the nectarine respiration rate by essential oils coating could explain the delay in the use of organic acid in the enzymatic reactions of respiration. Meanwhile, decrease TA in control fruits had high changes of acidity probably due to high respiratory rate and therefore acids consumption quickly and related to increases in metabolic activity. These results are in line with those obtained by Mahajan *et al.* (2010) suggesting that organic acids were used in respiratory process. Essential oil decreased respiration rate (Abd Elwahab *et al*.,2014).Mohammadi and Aminifard (2012) concluded that the fruits treated with Cinnamon oil had a greater titratable acidity. Peppermint oil increased acidity of the Valencia orange fruit(Fatimi *et al*.,2011).Also,Hassani *et al*.(2012) reported that Thyme oil had significant effect on fruit quality retention as with titratable acidity.Aminifard and Mohammadi(2013) demonstrated that Black Caraway, Fennel and Peppermint essential oils showed positive effects on titrable acidity, total soluble solids of plum fruits. Bergamot oil delayed the changes in titratable acidity during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al*., 2014).

Table 5: Effect of essential oils on total acidity% of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	1.030	0.640	0.581	0.500	0.411	0.632	1.100	0.712	0.566	0.522	0.501	0.680
Coriander oil	1.030	0.790	0.742	0.720	0.681	0.792	1.100	0.874	0.788	0.773	0.765	0.860
Dill oil	1.030	0.820	0.783	0.751	0.730	0.822	1.100	0.908	0.820	0.802	0.797	0.885
Lavender oil	1.030	0.850	0.824	0.792	0.762	0.851	1.100	0.929	0.846	0.835	0.825	0.907
Pepper mint oil	1.030	0.880	0.855	0.823	0.787	0.875	1.100	0.957	0.871	0.856	0.848	0.926
Rosemary oil	1.030	0.910	0.878	0.845	0.818	0.896	1.100	0.975	0.898	0.887	0.876	0.947
Thyme oil	1.030	0.940	0.913	0.886	0.859	0.925	1.100	1.033	0.925	0.915	0.907	0.976
Lemongrass oil	1.030	0.970	0.945	0.927	0.885	0.951	1.100	1.033	0.956	0.949	0.937	0.995
Bergamot oil	1.030	0.100	0.979	0.959	0.928	0.979	1.100	1.070	0.979	0.975	0.960	1.017
Mean	1.030	0.866	0.833	0.800	0.762		1.100	0.943	0.850	0.834	0.824	
L.S.D. at 5%	Treatments (T) = 0.026 Storage period (P) = 0.023 Interaction(T)x (P) = 0.052						Treatments (T) = 0.036 Storage period (P) = 0.031 Interaction(T)x (P) = 0.074					

Vitamin C:

Acquired results indicated that with ending of storage period, Vit. C content reduced in all postharvest treatments in both season. (Table 6). Means for weekly intervals show that fruit vitamin C content was gradually decreased and significantly with the progress of storage and reached the lowest significant level at the end of storage period compared with fruits at harvest .Also, Davarynejad *et al*. (2013) on apricot fruits obtained similar results **.**Minimum decrease of Vit. C content was observed in Bergamot, Lemongrass, Thyme, Rosemary, Pepper mint, Lavender oil, Dill oil and Coriander oil treatments in descanding order. Interaction data show significant differences between various treatments and storage period, the highest Vit. C content was obtained from nectarine fruits treated with essential oils treatments compared to control fruit. The maximum retention of Vitamin C was observed with essential oils treatments because these treatment reduced the oxidation in the fruits as the main compounds of oils had antioxidant properties and inhibited damage which causing oxidation of ascorbic acid, this result agree with Lin *et al*. (2008) who found that the decrease in vitamin C level was associated with reduced capability of preventing oxidative damage and with the incidence of physiological disorders during storage. Meanwhile, degradation of vitamin C was highes in control fruits probably due to physiological disorders, decay, and weight loss. Also, high respiration rate of control fruits which rapid the deteriorative oxidation reaction of vitamin C and so, vitamin C declined to the lowest level of possible sharply in control fruits. These results are similar to that reported on some essential oils were effective in maintaining ascorbic acid as Thyme and Clove oils of orange (Zeng *et al.,* 2012; Mohamed and El Badawy,2013), Basil ,Wild mint and Ajowan oils of Rasha grape during 30 and 60 days cold storage(Salimi *et al*.,2013).Also, Thyme and Peppermint essential oils have been used to greatly preserved the amount of vitamin C.(Fatimi *et al*.,2011) .Bergamot oil delayed the changes in vitamin c during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al* .,2014).

Table 6: Effect of essential oils on Vit .C (mg/100 g. F.W.) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	4.70	3.70	3.20	2.60	2.00	3.24	5.60	4.70	3.40	3.00	2.30	3.80
Coriander oil	4.70	4.62	4.58	4.53	4.47	4.41	5.60	5.54	5.47	5.42	5.38	5.21
Dill oil	4.70	4.60	4.55	4.50	4.43	4.47	5.60	5.51	5.43	5.40	5.32	5.30
Lavender oil	4.70	4.57	4.52	4.48	4.40	4.49	5.60	5.47	5.40	5.37	5.26	5.35
Pepper mint oil	4.70	4.55	4.49	4.46	4.37	4.51	5.60	5.43	5.36	5.32	5.22	5.38
Rosemary oil	4.70	4.52	4.47	4.43	4.34	4.53	5.60	5.40	5.33	5.29	5.16	5.42
Thyme oil	4.70	4.50	4.45	4.40	4.30	4.55	5.60	5.37	5.30	5.25	5.00	5.45
Lemongrass oil	4.70	4.46	4.43	4.36	4.10	4.58	5.60	5.33	5.26	5.20	4.70	5.48
Bergamot oil	4.70	4.65	4.60	4.56	4.52	4.60	5.60	4.70	5.50	5.46	5.42	5.51
Mean	4.70	4.46	4.36	4.25	4.10		5.60	5.36	5.16	5.07	4.86	
L.S.D. at 5%	Treatments (T) = 0.04 Storage period (P) = 0.02 Interaction(T)x (P) = 0.07						Treatments (T) = 0.03 Storage period (P) = 0.01 Interaction(T)x (P) = 0.05					

Total sugars:

The effect of different post harvest treatments of essential oils on total soluble sugars content of stored ‘Florda 7/2’ nectarine fruits are presented in Table (7).It clearly showed that total soluble sugars increased

gradually and significantly with extending of storage period as previously detected by Davarynejad *et al* . (2013) However, control treatment resulted in higher and faster increase in total soluble sugars during cold storage than that occurred in fruits treated with post harvest treatments at the two seasons of this study. In this respect essential oils treatments Bergamot ,Lemongrass, Thyme, followed by Rosemary ,Pepper mint then Lavender ,Dill oil and Coriander in descending order gave the lowest values of total sugars as compared with the control treatment in both seasons .Moreover, the effect of interaction revealed that at the end of storage period (28 days), fruits were of the postharvest treatment Bergamot oil showed the lowest values of total sugars than all other treatments in the first and second seasons. Concerning the total soluble sugars of fruits at storage period, it is evident the at all postharvest essential oils treatments decline increases in total soluble sugars, whereas, the control gave the highest content of total sugars in both seasons. The increase in sugars content of control fruits could be due to ripening process that led to the transformation of some carbohydrates components as starch to sugars by the enzymatic activities (Karemera and Habimana, 2014). High respiration of control fruit which converts stored sugars into energy and advances ripening. The post harvest treatments of essential oils keep on total sugars from rapid increasing during cold storage that may be related with slow respiration rate and therefore, it can delay the use of total sugar in the enzymatic reactions of respiration. Also,oils had high levels of antioxidant enzymes and defense mechanisms from high ripening during storage , so leading to improve storability of nectarines. The present results provided supporting evidence that treated tomato fruits with Origanum oil helped to delay ripening and preserve fruit quality(Tzortzakis *et al*., 2011).Also, Tea tree oil-treated raspberries maintained on sugars compared to untreated fruit (Wang ,2003). Bergamot oil delayed the changes in total sugars during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al* .,2014) .

Table 7: Effect of essential oils on total sugars (mg/g F.W.) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	37.20	45.07	48.41	51.72	55.57	47.59	36.77	44.81	46.63	49.77	53.43	46.28
Coriander oil	37.20	41.98	43.12	44.22	45.66	42.44	36.77	41.50	42.45	43.65	44.00	41.67
Dill oil	37.20	41.65	42.64	43.99	44.76	42.05	36.77	40.99	41.84	42.99	43.86	41.29
Lavender oil	37.20	41.30	42.17	43.39	44.15	41.64	36.77	40.69	41.44	42.10	43.23	40.85
Pepper mint oil	37.20	40.94	41.96	42.95	43.79	41.37	36.77	39.12	40.77	41.98	42.92	40.31
Rosemary oil	37.20	40.60	41.47	42.19	43.04	40.90	36.77	38.80	39.90	41.55	42.64	39.93
Thyme oil	37.20	39.90	40.89	41.79	42.59	40.47	36.77	38.35	39.19	40.22	41.00	39.11
Lemongrass oil	37.20	38.60	39.55	40.43	41.38	39.43	36.77	37.88	38.13	38.75	39.77	38.26
Bergamot oil	37.20	37.70	38.20	39.00	39.80	38.38	36.77	37.00	37.70	38.56	38.95	37.80
Mean	37.20	40.86	42.05	43.30	44.53		36.77	39.90	40.89	42.17	43.31	
L.S.D. at 5%	Treatments (T) = 0.05 Storage period (P) = 0.03 Interaction(T)x (P) = 0.09						Treatments (T) = 0.04 Storage period (P) = 0.01 Interaction(T)x (P) = 0.06					

Total phenols:

Results illustrated in table (8) showed that there was significant decrease in total phenols content as the storage period prolonged. Similar result was obtained by Davarynejad *et al*. (2013)on apricot as the total phenols levels at the initial of the storage period were higher than the end ones just for the all treatments .Moreover, the present data reveal that the highest values of total phenols were recorded for nectarines treated with post harvest treatments of essential oils in descending order Bergamot ,Lemongrass ,Thyme , Rosemary ,Pepper mint , Lavender oil ,Dill oil and Coriander oil compared with untreated fruits which had the lowest significant means of total phenols at the end of storage period in both seasons of study .Concerning the effect of the interaction between the tested postharvest treatments and storage period, the lowest values for total phenols was rapidly decreased in control compared with treated fruits. During storage, decrease level of total phenols might be due to breakdown of cell structure at senescence stage (Ghasemnezhad *et al.*, 2010). It was assumed that the effect of oils treatments on maintain of total phenol content can be attributed to delay in senescence process. Phenol compounds are responsible for the flavor and color of fruits (Jeong *et al.,* 2008) and act as antioxidants (Robarts *et al*., 1999). Poly phenol oxidize (PPO) activity is responsible for the browning of tissues fruits through oxidation of phenolic compounds (Zhang and Zhang, 2008).It is evident that all postharvest treatments gave the lowest decrease in total phenols with the advancing of storage period compared with the control fruits this may be that oxidized phenols are more active with decayed fruits. Postharvest essential oils treatments kept on the total phenolics content as essential oils containing more phenolic compounds had a great antifungal activity and could be used as a benefit and safe tool for preservation of table grape (Abdolahi *et al*.,2010). It’s worthwhile to point that most of the antimicrobial activity in essential oils appears to be

associated with interactions between phenol compounds (Nuchas and Tassou ,2000). The maximum retention in phenol compounds can be inferred by the reduced respiration, softening and acidity loss with post harvest essential oils treatments. Essential oils reduced the PPO activity (Abdolahi *et al*.,2010). Post harvest essential oils treatments decreased losses total phenols that may be due to delay oxidation of phenol substances through Poly phenol oxidize (PPO) activity and this led to improve storability of nectarine fruits .Previous studies suggested that the increase of the phenol compounds resulted in the increase of the antioxidant activity by Basil essential oil, which in consequence stimulated plant defense mechanisms in sweet cherry (Tzortzakis *et al*., 2011). Also ,Essential oils and their natural compounds in most of plants are used as antioxidant substances (Omidbaigi, 2005) .Also, Wang *et al*. (2007) found that strawberries treated with Thymol, Menthol, or Eugenol oils maintained better fruit quality with higher levels of phenolics.

Table 8: Effect of essential oils on total phenols (mg/ g. F.W.) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons .

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	0.645	0.274	0.230	0.211	0.160	0.304	0.680	0.300	0.265	0.220	0.180	0.329
Coriander oil	0.645	0.356	0.314	0.280	0.243	0.367	0.680	0.382	0.342	0.303	0.270	0.395
Dill oil	0.645	0.387	0.345	0.318	0.282	0.395	0.680	0.393	0.373	0.335	0.301	0.416
Lavender oil	0.645	0.409	0.386	0.347	0.319	0.421	0.680	0.424	0.404	0.374	0.332	0.442
Pepper mint oil	0.645	0.458	0.427	0.386	0.338	0.450	0.680	0.485	0.458	0.403	0.364	0.478
Rosemary oil	0.645	0.495	0.459	0.419	0.387	0.481	0.680	0.526	0.486	0.432	0.406	0.506
Thyme oil	0.645	0.534	0.498	0.457	0.449	0.516	0.680	0.567	0.519	0.491	0.468	0.545
Lemongrass oil	0.645	0.570	0.526	0.509	0.478	0.545	0.680	0.608	0.558	0.520	0.517	0.576
Bergamot oil	0.645	0.612	0.584	0.536	0.520	0.579	0.680	0.649	0.607	0.572	0.549	0.611
Mean	0.645	0.455	0.418	0.384	0.352		0.680	0.481	0.445	0.405	0.376	
L.S.D. at 5%	Treatments (T) = 0.026 Storage period (P) = 0.012 Interaction(T)x (P) = 0.051						Treatments (T) = 0.029 Storage period (P) = 0.014 Interaction(T)x (P) = 0.057					

Anthocyanin content:

As shown in Table (9) anthocyanin content was significantly increased with prolonging cold storage periods. This result was in agreement with obtained by Hen *et al.*(2004). The control treatment showed the highest values of anthocyanin content, meanwhile the essential oils treatments gave the lowest concentration of anthocyanin pigments.The interaction between treatments and storage period were significant**.** Nectarine fruits treated with essential oils as Bergamot oil, Lemongrass oil ,Thyme oil , Rosemary oil ,Pepper mint oil , Lavender oil ,Dill oil and Coriander oil delayed fruits ripening and senescence which indicated as decrease in color development and the fruits become less redness than that of untreated fruits becomes redder and darker along the storage time. Thus, retard ripening and the senescence exemplified by lower rates of color change, demonstrates the effectiveness of essential oils as Origanum oil helped to delay ripening and preserve fruit quality (Tzortzakis *et al*., 2011).A similar effect was observed for some essential oils had significant efficacy on anthocyanin content as Thymol oil gave the lowest values of anthocyanin content during 15 days cold storage of strawberry (Atress *et al*.,2010).Bergamot oil delayed the changes in anthocyanin content during 6weeks cold storage of Crimson seedless grape (Abd Elwahab *et al* .,2014).

Table 9: Effect of essential oils on anthocyanin content (mg./100 g. F.W.) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	20.10	23.97	25.85	27.68	29.94	25.51	19.44	22.75	24.98	27.44	29.45	24.81
Coriander oil	20.10	21.99	22.40	22.82	23.82	22.23	19.44	21.72	22.18	22.54	22.98	21.77
Dill oil	20.10	21.77	22.29	22.67	23.27	22.02	19.44	21.40	21.96	22.20	22.56	21.51
Lavender oil	20.10	21.43	21.86	22.42	22.96	21.75	19.44	21.23	21.79	21.95	22.33	21.35
Pepper mint oil	20.10	21.25	21.62	21.90	22.76	21.53	19.44	20.99	21.38	21.58	21.91	21.06
Rosemary oil	20.10	20.93	21.23	21.67	22.43	21.27	19.44	20.60	21.09	21.23	21.57	20.79
Thyme oil	20.10	20.74	20.95	21.55	21.89	21.05	19.44	20.36	20.79	20.97	21.17	20.55
Lemongrass oil	20.10	20.58	20.76	20.98	21.46	20.78	19.44	20.07	20.45	20.57	20.84	20.27
Bergamot oil	20.10	20.20	20.46	20.70	20.94	20.48	19.44	19.78	20.00	20.34	20.65	20.04
Mean	20.10	21.43	21.94	22.49	23.27		19.44	20.99	21.62	22.09	22.61	
L.S.D. at 5%	Treatments (T) = 0.03 Storage period (P) = 0.01 Interaction(T)x (P) = 0.06						Treatments (T) = 0.04 Storage period (P) = 0.01 Interaction(T)x (P) = 0.07					

Respiration Rate:

It can be seen from (Table 10) that there was a noticeable decrease in values of rate of respiration at end cold storage period (28days) compared with the initial respiration rate values at harvest day in all postharvest treatments during the two seasons of investigation. All essential oils treatments tended to have the effective role in reducing the rate of respiration of nectarine fruits. Meanwhile, control fruits had the highest respiration rate with significant differences were observed between them .Interaction data show significant reduced respiration rate by all essential oils treatments, retard softening and slow down various compositions, which are all changes associated with ripening (Kader,1986).The reduction in respiration rate by essential oils treated fruits during cold storage could be oils work as coating are barrier to O2 and CO2 , modifying internal atmospheres and slowing down the respiration rate of fruit (Debeaufort *et al.,*1998). Inhibition of fruit respiration may be caused by essential oil Funnel and Thyme coating of Tabarzeh grape (Abdolahi *et al.,* 2010). Bergamot oil decreased respiration rate during 6 weeks cold storage of Crimson seedless grape (Abd El wahab *et al.,* 2014).

Table 10: Effect of essential oils on respiration rate (ml CO_2 /kg/h) of ‘‘Florda 7/2’ Nectarine fruits during 4weeks of storage at 0 °C during two seasons.

Treatments (T)	Season 2014						Season 2015					
	Storage period in week (P)						Storage period in week (P)					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Control	23.45	2.73	3.00	3.60	3.95	7.34	23.10	2.40	2.76	3.10	3.65	7.00
Coriander oil	23.45	1.94	1.99	2.15	2.22	6.35	23.10	1.86	1.96	2.06	2.19	6.23
Dill oil	23.45	1.88	1.94	1.98	2.00	6.25	23.10	1.79	1.76	1.82	1.87	6.06
Lavender oil	23.45	1.72	1.79	1.89	1.95	6.16	23.10	1.62	1.70	1.75	1.80	5.99
Pepper mint oil	23.45	1.63	1.69	1.80	1.84	6.08	23.10	1.50	1.64	1.69	1.75	5.93
Rosemary oil	23.45	1.54	1.60	1.72	1.79	6.02	23.10	1.42	1.51	1.62	1.72	5.87
Thyme oil	23.45	1.43	1.49	1.54	1.66	5.91	23.10	1.33	1.39	1.46	1.52	5.76
Lemongrass oil	23.45	1.31	1.39	1.42	1.47	5.80	23.10	1.16	1.27	1.30	1.34	5.63
Bergamot oil	23.45	1.10	1.21	1.29	1.35	5.68	23.10	1.00	1.15	1.18	1.20	5.53
Mean	23.45	1.69	1.78	1.93	2.02		23.10	1.56	1.68	1.77	1.89	
L.S.D. at 5%	Treatments (T) = 0.03 Storage period (P) = 0.01 Interaction(T)x (P) = 0.05						Treatments (T) = 0.04 Storage period (P) = 0.02 Interaction(T)x (P) = 0.08					

Marketing life.

Concerning the effect of market period for 5 days at (25°C) and 75% RH on nectarine fruits parameters data presented in (Table 11&12) showed a significant increase in parameters of decay,weight loss % and TSS %, total sugars content, anthocyanin content and respiration rate in control fruits .Meanwhile, firmness, acidity, Vitamin C and total phenols were decreased in control fruits at room temperature in the two seasons. Marketing life is most influenced by contamination with microorganisms. Fruits treated by essential oils enhanced storage life of nectarine fruits by controlling their fungal rotting and had the best marketability that might be due to reduce decay and little change in quality characters of the fruits compared to control fruits, which resulted in minimum physiological changes as reduction of respiration rate which help in reducing loss in weight and maintaining changes in acidity, soluble solids, total sugars, anthocynin and total phenols contents and has high texture and Vitamin C so, delaying the ripening process with a minimum quality loss and longer market life after 5 days from cold storage .The obtained results of essential oil treatments on extending the market life of nectarine are in harmony with those of Serrano *et al.*(2005)of Eugenol, Thymol oils on sweet cherry, and Valero *et al.* (2006) of Thyme and Lemongrass on table grape and(Abdolahi *et al*., 2010)of Thyme, Fennel and Summer savory oil on table grape and Bosquez-Molina *et al.,* (2010) of Thymol, carvacrol, Eugenol and Menthol oils on papaya and Rabiei *et al*.(2011)of Thyme and Lavender essential oils on apple**.**Also,Mohammadi and Aminifard.(2012) of Anise, Ammi, Ziziphora and Cinnamon oils on peach,(Mohammadi *et al.,* 2012) of Fennel, Anis, Peppermint and Cinnamon oils on strawberry, Zeng *et al.,* 2012 of clove oil; Mohamed and El-Badawy(2013) of Thyme and Clove oils on navel orange and Mpho *et al*.(2013) of Lemongrass avocado fruits. Also,Aminifard andMohammadi(2013) demonstrated that Black caraway, Fennel and Peppermint essential oils increased their storage life on plum fruits.

Table 11: Effect of essential oils on market life of ‘‘Florda 7/2’ Nectarine fruits parameters for 5days at 25 °C during 2014 season.

Treatments (T)	Decay %	Weight loss %	Firmness (lb/in^2)	TSS %	Total acidity %	Vit .C (mg/ 100 g. F.W.)	Total sugars (mg/ g. F.W.)	Total phenols (mg/ g. F.W.)	Anthocyanin (mg./100 g. F.W.)	Respiration rate (ml CO2 /kg/h)
Control	23.26	19.36	4.00	19.20	0.382	1.50	59.45	0.113	31.99	4.99
Coriander oil	7.53	6.86	10.60	15.23	0.664	3.09	46.99	0.234	24.90	2.29
Dill oil	6.93	6.32	11.00	15.00	0.716	3.26	46.37	0.267	24.54	2.20
Lavender oil	6.34	5.96	11.40	14.87	0.735	3.47	45.86	0.295	24.00	1.99
Pepper mint oil	5.85	5.42	12.00	14.56	0.758	3.68	44.87	0.317	23.85	1.93
Rosemary oil	5.32	4.83	12.40	13.89	0.809	3.89	44.54	0.365	22.97	1.88
Thyme oil	4.87	4.54	12.80	13.70	0.828	4.00	43.76	0.437	22.65	1.74
Lemongrass oil	4.54	4.00	13.00	13.50	0.857	4.16	42.45	0.457	21.98	1.53
Bergamot oil	3.95	3.45	13.40	13.20	0.898	4.30	41.16	0.506	21.43	1.40
L.S.D. at 5%	0.06	0.05	0.08	0.37	0.058	0.08	0.07	0.054	0.10	0.62

Table 12: Effect of essential oils on market life of ‘‘Florida 7/2’ Nectarine fruits parameters for 5days at 25 °C during 2015 season.

Treatments (T)	Decay %	Weight loss %	Firmness (lb/in^2)	TSS %	Total acidity %	Vit .C (mg/ 100 g. F.W.)	Total sugars (mg/ g. F.W.)	Total phenols (mg/ g. F.W.)	Anthocyanin (mg./100 g. F.W.)	Respiration rate (ml CO2 /kg/h)
Control	21.45	18.94	4.50	18.89	0.401	2.00	57.89	0.145	31.26	4.75
Coriander oil	6.94	6.43	11.00	14.83	0.735	4.05	46.27	0.266	23.45	2.25
Dill oil	6.43	5.86	11.60	14.58	0.756	4.20	45.57	0.286	22.97	1.96
Lavender oil	5.98	5.36	11.90	14.20	0.787	4.38	45.18	0.318	22.67	1.91
Pepper mint oil	5.69	4.99	12.30	13.95	0.806	4.67	44.27	0.349	22.54	1.87
Rosemary oil	4.98	4.45	12.70	13.75	0.839	4.84	43.65	0.389	21.89	1.79
Thyme oil	4.56	3.90	13.00	13.46	0.868	5.04	43.00	0.457	21.45	1.58
Lemongrass oil	3.87	3.47	13.50	13.32	0.887	5.17	41.45	0.488	20.87	1.39
Bergamot oil	3.45	2.45	13.90	12.78	0.919	5.25	40.23	0.529	20.70	1.29
L.S.D. at 5%	0.08	0.07	0.14	0.38	0.084	0.10	0.09	0.091	0.32	0.10

Conclusion:

In the present study, it was found that application of essential oils (Bergamot, Lemongrass ,Thyme, Rosemary, Pepper mint, Lavender, Dill and Coriander)are eco-friendly, safe alternative sources to chemical compounds. Essential oils especially Bergamot oil maintained the quality parameters as delayed in the changes in the losses of weight, firmness and vitamin C and acidity, soluble solids ,total sugars content ,total phenols ,anthocynin content ,respiration rate, decreased the decay and extended post harvest life of `fruits. Essential oils could be employed to`Florda 7/2 'nectarine fruits in organic culture and intended for long distance shipping for export.

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