EVALUATE RESPONSE OF PEACH FRUITS TO COATING TREATMENTS DURING COLD STORAGE

NAHLA M. R. HASAN, SHUKRI H. S. BANI and SARFARAZ F. A. AL-BAMARNY
College of Agricultural Engineering Sciences, University of Duhok, Kurdistan Region-Iraq

(Received: August 28, 2022; Accepted for Publication: November 28, 2022)

ABSTRACT

Dixired mature peach fruits (*Prunus persica* L. Batsch.) were collected from trees grown in one privet orchard in Malhamban village, Mangesh District, Duhok governorate, Kurdistan region/Iraq. Fruit samples of Dixired peaches were placed in plastic bags (perforated and none perforated) and stored at 1±1˚C and 85-90%RH for 30 days to evaluate effect of three factors (polyethylene perforated and none perforated bags, fruit coating with three concentrations of wild mint extracts (0, 30 and 60%) and three concentrations of paraffin wax (0, 5 and 10%) on postharvest physiology and quality changes. Studied parameters were (TSS, total sugar, fruit decay, fruit firmness, ascorbic acid C, Acidity, and fruit juice percentage). The results showed that none perforated bags were significant effect on increase only fruit firmness. Fruit waxing (10%) cause significant increase each of firmness, ascorbic acid, acidity and juice percentage, but cause significant decrease only decay percentage. Mint concentration (60%) significantly surpassed on other concentrations in fruit ascorbic acid only. Tri interaction between three studied factors was significantly increased all studied parameters.

Key Words: *Peach fruits, perforating, Waxing, coating with mint extract*

INTRODUCTION

Peach (*Prunus persica* L. Batsch.) is one of the most important stone fruit grown under subtropical and temperate climate. It is known as a species of Prunus that bears an edible juicy fruit and it is a deciduous tree belonging to the family "Rosasea". It is a delicious fruits but highly deterioration fruit and has a short shelf life under surround conditions. Dixired is a high chilling cultivar of peach that grows well under temperate conditions and attains physiological maturity in the months of mid of May to mid of June, when the atmospheric temperature is not very high, which leads to fruit firming **(Bani, 2012).**

The Persians brought peaches from PRC and passed to Romans; it is still possible to find significant hereditary variations among peaches species in the mountainous regions of central Asia from the SHAN region in China to Iraqi Kurdistan, through Turkmenistan, Afghanistan, Iran and Iraqi Kurdistan. This type of fruit has been planted from ancient periods, and currently has many super cultivars (**Martinez *et al.*, 2003 and Bani, 2012).**

The use of perforated bags was recommended by **Emond *et al.* (1991); Fishman *et al.* (1996).** The highly penetrable micro-perforated bags are most opportune for packaging because highly respirations produce **(Scetar *et al*., 2010).**

Various concentrations of $CaCl_2$, wax emulsion and encasing in polyethylene perforated or none perforated closed bags containing $KMnO_4$ as an ethylene absorbent when putted in perforated cartons and transfused for 36h, showed that 6 or 7% wax emulsion had grandest influence in delaying ripening (by 11 days) and caused in the lowest weight loss as compared with control over-ripe stage (by 9 days).

Anyhow, the treatment of wax emulsion also resulted in the lowest TSS content 14.8% after transportation following 6% wax emulsion treatment, compared with 18.8% in control treatments **(Yuniarti and Suhardi, 1992).**

In Israel polyethylene perforated and none perforated sealed packaged putted in low temperature at 14^{o}C for 21 days and then at 20^{o}C for 4 days when applied to mango fruits "Tommy Atkins" during storage, showed no decay until opening in non perforated bags and then rotted rapidly. Data obtained on shelf life, weight losing, and retention of ascorbic acid

Sarfaraz F. A. AL-Bamarny; nahla.hassan@uod.ac; sarfaraz.fatah@uod.ac

indicated that cool chamber was an optimal storage method **(Pal, 1998).**

Mir *et al*., (2018) showed that the influence of different levels of aeration on quality of peach fruits under storage conditions of refrigerated. The results deduced that packaging of peach fruits in Low-density polyethylene bags containing of ethylene absorber (5g kg^{-1}) + 4 perforations was the most effective treatment for elongation of storage for best quality of peach fruits.

Rathore, *et al*., (2009) observed that fruit putted either in polyethylene bags alone, or coating with combination of different type of Wax and other treatments, fruit packed in polyethylene bags played a very important role to control the weight loss and encourage other compositional changes such as TSS, acidity and ascorbic acid of mango fruits at ambient temperature during storage.

Beeswax coatings and Calcium chloride dipping had substantially reduced the physiological loss in weight and significantly maintained the TSS, total acidity and ascorbic acid of nectarine fruits. It also significantly increased nectarine fruit decay and increased marketability as well **(Seleshi *et al*, 2019).**

Mints extract significantly reduced the percentage of weight loss, decay percentage, and carotene content in both seasons, TSS, in the second season, and total acidity of orange fruits. A concentration of 40% mint extract reduced the percentage of juice and increased the percentage of total sugar to 8.36% as compared with 48.47% and 8.18% respectively in second season with control treatment **(Al-Shammary, 2005).**

Conserving new fruits after picking and conserving their quality for longer times till marketing is one of the greater quandaries of most fruits including peach. This case interrogates the utilize of correct conservation and ideal storage conditions. So, the aim of the study was, therefore to appraise the possibility of paraffin wax coating, wild mint extract coating and type of storage bags to prolong the storage of peach fruits as delineated by their physical and chemical properties and sensory traits.

MATERIALS AND METHODS

A total of 378 Dixired peach fruits were collected at morning from privet orchard at Malhamban village located at East Northern of Duhok city, Kurdistan region, Iraq. The fruits of Dixired peaches were neatly selected, based on regularity at the maturity phase, volume, color, shape and free from mechanical damages and infection by biological factors that used for this investigate. Picked fruits were transported to the Laboratory College of Agricultural Engineering Sciences and putted in cold room to lower temperature (1 ±1 ºC. Fruit samples were surface dried by cotton cloth and randomly divided to six groups.

Dixired peach fruits distributed according to three studied factors and their replicates. The Dixired fruits were randomly putted in polyethylene bags with a capacity of 2 kg, (7 fruits bag^{-1}) for each replicate and three replicates for each treatment, polyethylene bags were divided into two groups, perforated and none perforated bags. The paraffin wax emulsion was prepared according to **Hassan *et al.* (2014)** with slight modification, using 12.5ml and 25 ml of paraffin wax dissolved in 100 ml of distilled water plus 200 ml ethanol for each concentration 5% and 10% respectively. Then, 300 and 600 g of the fresh wild mint (*Mentha longifolia* L.) for 30, 60% concentrations respectively were used.

All peach fruits were putted in cold room at 1±1°C with 85-90% relative humidity for one month to study peach fruit behavior during storage period in cold storage. Sampling for physic-chemical analysis was worked after one month (15.7.2022) of cold storage. These physico-chemical properties and sensory traits were analyzed:

1- Fruit Total Soluble Solids (TSS %): Table Refractometer (2 WAJ-chin made) was used for this purpose.

2- Fruit Total Sugar (%); it was determined according to Lane and Eynon method which was described by **Joslyn (1970).**

3- Fruits Decay (%): Any abnormal sign on fruits of decay were counted. Fruit decay percentage was calculated according of total fruit number **(Abd-Elghany *et al*., 2012).**

4- Fruit Flesh Firmness (Lb/ cm^2): Filed pressure testers was used for determine of fruit firmness by plunger of 7.8 mm in diameter.

5- Ascorbic Acid (mg. $100ml^{-1}$ juice): It was calculated by titration method using 2,6-dichlorophenol indophenols pigment as described by **Pearson (1976)**.

6- Fruit Total Acidity (%): The total acidity of peach fruits was determined according to **Garner, *et al*. (2008)** by titration with sodium hydroxide (0.1 N) with 10ml of fruit juice using phenolphthalein pigment as an indicator. Then, the total acidity was calculated in terms of Malic acid.

7- Fruit Juice Percentage (%): it was determined after washing the fruits and juice extracting, with the use of a lab-scal fruit juice extractor Juicer/blender, Panasonic, Mj, Japan **(Karadeniz and Aksi, 2002).**

The data were truckled to analysis of variance (ANOVA) in RCBD with factorial experiment (2*3*3) to determine differences between the treatment means **(Al-Rawi and Khalafallah, 2000).** The results were analyzed using Statistical Analysis System (SAS) version 9.1. Comparisons of the treatment means was done by the Duncan Multiple Range test at 5% significance level **(Duncan, 1955).**

The Results

Total Soluble Solid (TSS %)

Results in Table (1) clears that none perforated polyethylene bags were surpassed in maintain TSS% as compared with perforated polyethylene bags but without reached to significant level. Same table shows that waxing in 10% was the best level in maintain TSS% but without reached to significant level. On the other hand, fruit dipping in mint extract 5% was surpassed on other levels but without reached to significant level.

The interaction between (Polyethylene bags and Waxing) was not significantly effected on fruit TSS. Whereas the interaction between (Polyethylene bags and Mint) was significantly effected on fruit TSS %, the interaction between (none perforated polyethylene bags and 30% mint extract) appeared to be the most operative interaction treatment as it gave the highest fruit TSS%. Also the interaction between (waxing and mint extract) was significantly effected on fruit TSS%, the interaction between (no waxing and 30% mint extract) appeared to be the most operative interaction as it gave the highest fruit TSS%.

As for the interactions between Polyethylene bags, Waxing and mint extract) had a significant impact on fruit TSS (%), Perforated polyethylene, 5% wax and 0% mint extract recorded significantly the maximum fruit TSS (%) compared to some other tri interactions (Table 1).

Table (1): Effect of polyethylene bags, Waxing and Mint extract on fruit TSS (%) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	**0**	12.567 abc	14.667 ab	11 c	12.744 a	13.137 a
	5	12.333 abc	14 abc	12 abc	12.778 a	
	10	13.4 abc	13.675 abc	14.6 ab	13.889 a	
Perforated	**0**	11.267 bc	14.1 abc	13.333 abc	12.9 a	12.711 a
	5	15.067 a	10.733 c	13.5 abc	13.1 a	
	10	12.7 abc	11.6 abc	12.1 abc	12.133 a	
P. bags * Mint	**None perforated**	12.767 ab	14.111 a	12.533 ab	**Effect of Waxing**	
	Perforated	13.011 ab	12.144 b	12.978 ab		
Waxing * Mint	**0**	11.917 b	14.383 a	12.167 ab	12.822 a	
	5	13.7 ab	12.367 ab	12.75 ab	12.939 a	
	10	13.05 ab	12.633 ab	13.35 ab	13.011 a	
Effect of Mint Extract		12.889 a	13.128 a	12.756 a		

+Means of each factor and their interactions followed by the same or shared letters are not significantly different from each other according to Duncan's multiple ranges test at 5% level.

Total Sugars (%)

The obtained results indicated that the none perforated and perforated polyethylene bags were no significant effect on fruit total sugars after storage period. Also fruits dipped in each of wax solutions and mint extract was not significant effect on fruit total sugars after storage period (Table 2).

The interaction between bags and fruit dip in wax solutions has no significant effect on fruit total sugars (Table 2).

There were significant differences among the means of fruit total sugars as a result of interaction between bags and fruit dip in mint extract. The highest mean of total sugar was obtained at the interaction treatment of none perforated bags x 30% mint (Table 2).

Data in the same Table, significant differences were recorded as a result of interaction between bags and fruit dip in wax solutions. The maximum value of total sugar was obtained at the interaction between fruit dip in wax (0%) and fruit dip in mint extract (30%).

Regarding the effect of interaction among bags, wax and mint, there was a significant effect on fruit total sugar. The maximum percentage of sugar was showed when peach fruits were treated with perforated bags + 5% wax and 0 % mint extract (Table 2).

Table (2): Effect of polyethylene bags, Waxing and Mint extract on fruit total sugar (%) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	**0**	10.637 abc	12.59 ab	9.18 c	10.802 a	11.167 a
	5	10.42 abc	11.97 abc	10.11 abc	10.833 a	
	10	11.412 abc	11.66 abc	12.528 ab	11.867 a	
Perforated	**0**	9.428 bc	12.063 abc	11.35 abc	10.947 a	10.771 a
	5	12.962 a	8.932 c	11.505 abc	11.133 a	
	10	10.761 abc	9.738 abc	10.203 abc	10.234 a	
P. bags * Mint	**None perforated**	10.823 ab	12.073 a	10.606 ab	**Effect of Waxing**	
	Perforated	11.050 ab	10.244 b	11.019 ab		
Waxing * Mint	**0**	10.033 b	12.327 a	10.265 ab	10.875 a	
	5	11.691 ab	10.451 ab	10.808 ab	10.983 a	
	10	11.087 ab	10.699 ab	11.366 ab	11.050 a	
Effect of Mint Extract		10.937 a	11.159 a	10.813 a		

+

Fruit Decay (%)

The data in Table (3) displays that the fruit stored in perforated and none perforated bags had no a significant influence on fruit decay percentage. Also fruit dip in mint extract had no a significant effect on fruit decay percentage after storage period. Whereas in the same Table, significant differences was observed when fruits dipped in wax solutions, the highest fruit decay percentages were obtained when fruits were dipped in 0 and 5% wax after storage period.

Concerning the interaction between bags and fruit dip in wax has a significant influence on fruit decay percentage, the highest value of decay percentage was obtained at the interaction between fruit stored in perforated bags and 0% of wax (Table 3). Results from the same Table revealed that fruit stored in polyethylene bags and mint extract had no significant effect on fruit decay percentage.

The combination between fruit dipped in wax and mint extract displayed that there was a significant effect on fruit decay percentage, the highest value was noticed at 0% wax and 60% mint extract.

Results of bags, wax and mint interaction indicated that the interaction among perforated bags + 0% wax +60% mint extract was the most significant effective treatment as it gave the highest value of fruit decay percentage (Table 3).

Table (3): Effect of polyethylene bags, Waxing and Mint extract on fruit decay (%) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	0	33.337 def	28.573 def	38.097 def	33.336 cd	46.561 a
	5	47.62 b-f	52.38 b-e	66.667 a-d	55.556 b	
	10	61.903 a-d	42.857c-f	47.62 b-f	50.793 bc	
Perforated	0	85.713 ab	80.953 abc	90.473 a	85.713 a	46.561 a
	5	19.047 ef	52.38 b-e	47.62 b-f	39.682 bc	
	10	9.527 f	19.05 ef	14.287 ef	14.288 d	
P. bags * Mint	None perforated	47.62 a	41.27 a	50.794 a	Effect of Waxing	
	Perforated	38.096 a	50.794 a	50.793 a		
Waxing * Mint	0	59.53 ab	54.763 abc	64.29 a	59.524 a	
	5	33.333 bc	52.38 abc	57.143 abc	47.619 a	
	10	35.72 bc	30.953 c	30.953 c	32.541 b	
Effect of Mint Extract		42.858 a	46.032 a	50.794 a		

+

Fruit Flesh Firmness (lb/cm^2)

Table (4) noticed that fruit flesh firmness was significant differ between the none perforated and perforated polyethylene bags after storage period. None perforated polyethylene bags significantly give the maximum fruit flesh firmness compared perforated polyethylene bags.

Table (4) shows that there was a steadily increment in fruit flesh firmness with increasing wax concentrations. Thereupon, fruit dip in 5% and 10% wax significantly increased fruit flesh firmness as compared with control.

In the same table, with respect to specific effect of fruits dipped in mint extract concentrations, it is so clear to be noticed that response of fruit firmness to the different investigated mint dipping treatments was significantly statistically absent.

Table (4) shows that differences between various combinations (Polyethylene bags × wax concentrations) were in most cases it significantly differ on fruit firmness after storage period as compared with those of other interaction treatments. The highest mean of fruit firmness was obtained at the interaction treatment of none perforated bags x 10% wax. Also the interaction between polyethylene bags and mint extract on fruit firmness was significant and best interaction between them was none perforated bags with 60% mint which give the highest fruit firmness.

In the same trend, the interaction between wax solution and mint extract was significant to improve fruit firmness after storage period, the maximum value of fruit firmness was obtained at interaction treatment of 10% wax with 60% mint (Table 4).

Regarding the tri interaction among polyethylene bags, wax solutions and mint extracts were significantly affected on fruit firmness after storage period. The highest value of fruit firmness was obtained from tri interaction of none perforated bags + 10% wax + 60% mint.

Table (4): Effect of polyethylene bags, Waxing and Mint extract on fruit firmness (lb/cm^2) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	**0**	13.97 a-f	14.323 a-f	11.77 c-g	13.354 b	14.937 a
	5	12.86 b-g	15.27 a-e	16.71 ab	14. 947 ab	
	10	15.793 a-d	16.013 abc	17.723 a	16.51 a	
perforated	**0**	6.257 hi	4.44 i	6.633 hi	5.777 d	8.439 b
	5	12.447 b-g	8.71 ghi	5.307 i	8.821 c	
	10	10.19 fgh	10.707 e-h	11.257 d-g	10.718 c	
P. bags * Mint	**perforated**	14.208 a	15.202 a	15.401 a	**Effect of Waxing**	
	perforated	9.631 b	7.952 b	7.732 b		
Waxing * Mint	**0**	10.113 cd	9.382 d	9.202 d	9.566 c	
	5	12.653 abc	11.99 abcd	11.008 bcd	11.884 b	
	10	12.992 abc	13.36 ab	14.49 a	13.614 a	
Effect of Mint Extract		11.919 a	11.577 a	11.567 a		

+

Ascorbic Acid (mg. 100ml^{-1} juice)

It is clear from Table 5, fruit putted in polyethylene bags during storage period cause increase ascorbic acid in fruit juice, but without accessing to a significant level. Significant variation in the ascorbic acid content of peach fruits was recorded due to the effect of wax dipping after storage period. Peach fruits showed significant difference in ascorbic acid due to the effect of mint dipping after storage period (Table 5).

Significant difference in the ascorbic acid of peach fruits was observed due to the interaction effect of polyethylene bags and wax dipping Table 5. The highest rate of ascorbic acid in peach fruit was observed in none perforated bags with 10% wax after storage period.

The interaction effect of polyethylene bags and mint dipping had a significant influence on the ascorbic acid content of peach fruits Table 5. The highest ascorbic acid value was recorded in the interaction of none perforated polyethylene bags with fruit dipping in 60% mint.

The amount of ascorbic acid peach fruits was significantly influenced due to the interaction effect of wax dipping and mint extract dipping (Table 5). Treatment combinations of 10% wax + 60% mint maintained ascorbic acid in highest value in peach fruits. Stored peach fruits showed a significant difference in ascorbic acid due to the tri interaction effect of polyethylene bags, wax dipping and mint extract dipping Table 6. The highest ascorbic acid value was recorded in perforated bags + 10% wax + 60% mint (Table 5).

Table (5): Effect of polyethylene bags, Waxing and Mint extract on ascorbic acid content (mg. 100ml^{-1} juice) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	**0**	0.923b	1.017 b	0.946b	0.962b	1.075 a
	5	0.960 b	1.13b	1.159 b	1.083 ab	
	10	1.149b	0.979 b	1.411a	1.180a	
Perforated	**0**	1.074 b	1.149a	0.992 b	1.072ab	1.086 a
	5	0.979b	1.055 b	1.017 b	1.017 b	
	10	0.989 b	1.055b	1.468 a	1.171 a	
P. bags * Mint	**None perforated**	1.011b	1.042ab	1.172 a	**Effect of**	

	Perforated	1.014 b	1.086 ab	1.159a	Waxing
Waxing * Mint	0	0.998b	1.083 b	0.969 b	1.017 b
	5	0.970 b	1.092 b	1.088b	1.05b
	10	1.069b	1.017b	1.440 a	1.175a
Effect of Mint Extract		1.0123b	1.064 b	1.166 a	

+

Fruit Total Acidity (%)

Table 6 shows that there was no significant difference between fruit acidity which stored in none perforated and perforated polyethylene bags after storage period. From the same Table, It was observed that there were significant differences between fruit dipped in wax concentrations for fruit total acidity after storage period. There was no statistically significant difference amongst fruit dipped in mint extract concentrations for total acidity after storage period.

As shown in Table 6, levels of total acidity of peach fruits were significantly affected by interaction of stored in polyethylene bags and waxing. The interaction between none perforated bags and treatment 10% wax was the best interaction which having higher levels of total acidity than other interactions after cold storage period. Fruit total acidity no significantly associated with interaction between perforated polyethylene bags and mint extract. Fruit total acidity content in both 0% mint and 10% wax interaction treatment significantly increased during the whole storage period (Table 6).

Concerning of the tri combination among polyethylene bags, wax solutions and mint extracts were significantly affected on fruit total acidity after storage period. The highest value of fruit total acidity was obtained from tri combination of none perforated bags + 10% wax + 0% mint (Table 6).

Table (6): Effect of polyethylene bags, Waxing and Mint extract on fruit total acidity (%) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	0	1.677 c	1.750 c	1.743 c	1.723 d	2.253 a
	5	2.547 ab	2.057 bc	1.757 c	2.120 c	
	10	2.949 a	2.947 a	2.857 a	2.917 a	
Perforated	0	2.147 bc	2.450 ab	2.043 bc	2.213 bc	2.140 a
	5	1.877 c	1.630 c	1.813 c	1.773 d	
	10	2.477 ab	2.407 ab	2.417 ab	2.433 b	
P. bags * Mint	None perforated	2.390 a	2.251 a	2.119 a	Effect of Waxing	
	Perforated	2.167 a	2.162 a	2.091 a		
Waxing * Mint	0	1.912 bc	2.100 bc	1.893 bc	1.968 b	
	5	2.212 b	1.843 bc	1.785 c	1.947 b	
	10	2.712 a	2.677 a	2.637 a	2.675 a	
Effect of Mint Extract		2.278 a	2.207 a	2.105 a		

+

Fruit Juice Percentage (%)

Data presented in Table 7 revealed that fruit juice percentage in peach fruit showed no significant differences for polyethylene bags treatment after storage period. Whereas, there were positive significant effect of fruit dip in wax on fruit juice percentage after storage period. Also the effect of mint extract on fruit juice percentage after storage period was no significant effect.

Regarding the combination between polyethylene bags and fruit dip in wax concentrations had a significant influence on fruit juice percentage, the maximum value of juice percentage was obtained at the interaction between fruit stored in none perforated bags and 10% of wax (Table 7). Results from the same Table revealed that fruit stored in none perforated polyethylene bags and 30% mint extract had a high significant effect on fruit juice percentage.

The interaction between fruit dipped in wax concentrations and mint extract displayed that there was a significant effect on fruit juice percentage, the maximum value was noticed at 10% wax and 30% mint extract.

Results of bags, wax and mint combination indicated that the interaction among perforated bags + 10% wax +60% mint extract was the most significant effective treatment as it gave the highest value of fruit juice percentage (Table 7).

Table (7): Effect of polyethylene bags, Waxing and Mint extract on fruit juice percentage (%) after storage period of peach fruits

Polyethylene bags	Waxing (%)	Mint extract (%)			P. bags * Waxing	Effect of P. bags
		0	30	60		
None perforated	**0**	56.415 cde	59.268 a-d	57.460 b-e	57.714 bc	58.536 a
	5	57.027 cde	56.497 cde	58.132 a-e	57.218 c	
	10	60.062 abc	61.932 ab	60.034 abc	60.676 a	
Perforated	**0**	54.976 de	58.550 a-e	54.895 de	56.140 c	57.228 a
	5	56.556 cde	56.994 cde	53.968 e	55.839 c	
	10	57.588 b-e	59.068 a-d	62.456 a	59.704 ab	
P. bags * Mint	**None perforated**	57.835 ab	59.232 a	58.542 ab	**Effect of Waxing**	
	Perforated	56.373 b	58.204 ab	57.106 ab		
Waxing * Mint	**0**	55.696 c	58.909 ab	56.178 bc	56.927 b	
	5	56.791 bc	56.746 bc	56.050 bc	56.529 b	
	10	58.825 abc	60.500 a	61.245 a	60.190 a	
Effect of Mint Extract		57.104 a	58.718 a	57.824 a		

+

DISCUSSION

Firmness of peach fruits irrespective of polyethylene treatment decreased after storage period. Among these treatments, the highest firmness was recorded in polyethylene bags with none perforated (14.937 lb $cm^{2\ -1}$) followed by perforated (8.439 lb $cm^{2\ -1}$) respectively on 30th day of storage. The cause of decline in fruit firmness after storage period of peach fruits might be due to break-down of enzymes, wastage of water and degenerating of pectines present in the cell wall of fruits. **Galvis Sanchez *et al*. (2003)** and **Drake *et al*. (2004)** they reported similar results in pear fruits during storage period.

Waxing incloses the amount of moisture loss through transpiration by decreasing the number and sizes of the lenticels on fruit surface, this will be leading to water saturated of internal environment and also organized gaseous exchange on surface of fruit leading to a high CO_2 and low O_2 levels of fruit inside **(Hagenmaier and Baker, 1994)**. Waxing cause in created of low oxygen conditions which affect on some physiological processes such as respiration and enzyme mediated processes like the ethylene biosynthesis pathway.

Activities of the enzymes involved in cell wall metabolism including polygalacturonase, endo-B-1,4-glucanase, pectin methylesterase, and pectatelyase activities is associated with firmness decreasing during storage (**Persis *et al.*, 2002)**. Fruit waxing cause delayed softening of fruit (Table 4) particularly for the cold storage might be due to decreased enzyme activity due to modified conditions of low O_2 and high CO_2 associated with fruit coating by waxes and low temperature, thus retaining membrane wholly longer. These results agree with another study which reported on the effect of coating of mango fruits **(Hagenmaier and Baker, 1994)**.

Changes in fruit total acidity (Table 6), none waxed fruits reduced total acidity compared to fruits paraffin wax treated. This might be due to the utilization of organic acids as respiratory substances during storage **(Kittur, *et al.*, 2010).**

Fruit coated with paraffin wax (10%) retain highest ascorbic acid (1.175 mg 100 mg^{-1} juice) after 30 days of storage which was significantly higher than control and 5% wax (Table 5). The high content of ascorbic acid may be due to metabolic changes and increasing of fruit acidity waxing conditions. Fruit waxing aided in reducing the rate of respiration and delay ripening which results in augment of ascorbic acid to dehydro ascorbic acid during storage. These results are in acceptation with **El-Monem *et al*. (2003)** in Mahlbe apple. The lowest ascorbic acid content (1.017 mg 100 ml^{-1} juice) of fruit was showed under control treatment was might be due to quick conversion of ascorbic-acid into dehydro-ascorbic-acid by presence of enzymes like ascorbinase in over stored fruit those were injured. The results corroborate with the finding of **Bisen and Pandey (2008)** and **Jadhao *et al*. (2008)** in lime fruits.

The highest juice (60.190%) content in fruits showed under liquid paraffin wax coating at concentration 10% after 30 days of storage (Table 7). It perhaps due to fewer moisture loss from skin of fruit were coating with paraffin wax. These results are similar with **Bullar (1988)** in lime which reported that highest juice percentage kept by fruit coated with wax emulsion. **Dashora and Shaffat (1988)** also had gotten similar data in sweet lime fruits. Whereas, the least value of juice content (56.529 and 56.927%) had showed under those fruits coated with paraffin wax at 5% and control respectively. This result could be due to continues perspiring from the skin of the fruit as a result of more dehydration **(Thomas *et al.* 2005).**

Decay percentage was reduced as result of peach fruit waxing before cold storage (Table 3) especially at concentration 10% as compared with 5% wax and control. **Bisen *et al*., (2012)** showed no occurrence of fungus on lime fruits coated with liquid paraffin up to 30 days. This might be due to the reason that liquid paraffin coating stamped the lenticels on the skin of the fruit there by preventing occurrence of moulds causes fruits decay.

It is clear from Table (5) that the dipping treatments in 60% mint extract affected the ascorbic acid of peach fruits during cold storage. The ascorbic acid values, in general, increased with mint 60% treatment and reached the maximum value after 30 days of storage at 1±1 C°. The results were consistent with **(Nasrin *et al.*, 2020) and (EL-Eryan and Tarabih, 2020).** The retention of ascorbic acid in the coated fruits with wild mint might be due to the reduction of oxidation of ascorbic acid content through reducing of respiration process according to **(Abdel-Salam 2016 and Atrash *el al.*, 2018).** Whereas, the lowest ascorbic acid content values were recorded with "Control and mint extract at 30%". The reducing fruit content of ascorbic acid in these treatments could be due to the increased respiration rate and rapid transformation of L- ascorbic acid into dehydroascorbic acid in the presence of L-ascorbic acid oxidize **(Abdel-Salam 2016, and Atrash *el al.*, 2018).**

CONCLUSIONS

Overall results, we can conclude that none perforated polyethylene bags well led to improve only fruit firmness after cold storage period (30 days). Fruit dipping in wax before storage especially in 10% wax was more effective in maintains most fruit quality parameters after storage period (fruit decay, fruit firmness, ascorbic acid, total acidity and fruit juice percentage). Whereas fruit dipping in mint extract before storage period was less effective in maintains fruit quality parameters after cold storage periods (30 days) because it was improved only ascorbic acid.

Concerning the interactions between all factors were significant effective in maintains most fruit quality parameters after storage period.

REFERENCES

Abd-Elghany, N.A.; S.I. Nasr and H.M. Korkar, (2012). Effects of polyolefin film wrapping and calcium chloride treatments on postharvest quality of "wonderful" pomegranate fruits. J. Hort. Sci. and or. Plants. 4 (1): 07-17.

Abdel-Salam, M.M. (2016). Improving grapefruit quality during storage life by using some coating materials on different temperature. Middle East J, 5(1), 29-36.

Al-Rawi, K. M. and A. Khalafalla (2000). Analysis of Experimental Agriculture Disgen. Dar Al-Kutub for Printing and Publishing. Mosul Univ. (In Arabic).

Al-Shammary, G.N.H. (2005). Effect of some plant extracts on the storability of Orange fruits local cultivar. Ph. D. Thesis. University of Baghdad.

Atrash, S., Ramezanian, A., Rahemi, M., Ghalamfarsa, R.M., and Yahia, E. (2018). Antifungal effects of savory essential oil, gum Arabic, and hot water in Mexican lime fruits. HortScience, 53(4), 524-530.

Bani, Sh. H. S.(2012). Effect of iron, sulfur, ascorbic acid and their interactions on the vegetative growth, yield and fruit quality of peach trees (Prunus persica L.) cv. Dixired. Ph.D. Dissertation. Duhok Univ. Iraq.

Bisen A, and Pandey SK. (2008). Effect of post harvest treatments on biochemical and organoleptic constitutes of Kagzi lime fruits during storage. *J Hortic Sci.*;3:53–56.

Bisen, A., Pandey, S.K. and Patel, N. (2012). Effect of skin coatings on prolonging shelf life of kagzi lime fruits (Citrus aurantifolia Swingle). J. Food Sci. Tech. 49 (6): 753–759.

Bullar JS. (1988). Storage behaviour of kagzi lime fruits. *Haryana J Hortic Sci.*;12:52–55.

Dashora LK, and Shaffat M.(1988). Effect of 2, 4-D, wax emulsion and their combination on the shelf life of sweet orange (*Citrus sinensis* Osbek) cv. Mosambi. *South Indian Flora.*; 36:172–176.

Drake SR, Mielke EA, and Elfving DC. (2004). Maturity and storage quality of 'Concorde' pears. Hortic Technol. ;14:250–256.

Duncan, D. B. (1955). Multiple Range and multiple F. tests. Biometrics, 11: 1-42.

El-Eryan, E.E., and Tarabih, M.E. (2020). Extending Storability of Egyptian Banzahir Lime Fruits by Aqueous Ozone Technology with Edible Coating. Science and Technology, 13(1), 9-21.

El-Monem E.A.A.A., Mostafa A., and El-Maged M.A.A. (2003). Effect of harvest treatments on storage behaviour of guava fruits cv. Sardar. *J Maharashtra Agric Univ.*;26:297–300.

Emond, J.P., F. Castaigne, C.J. Toupin and D. Desilets (1991). Mathematical modeling of gas exchange in modified atmosphere packaging. Trans ASAE 34(1):239–245.

Fishman, S., V. Rodov and S. BenYahoshua (1996). Mathematical model for perforation effect on oxygen and water vapour dynamics in modi- fied atmosphere packages. J. Food Sci., 61(5): 956–961.

Garner, D. Crisosto C. H., Wiley P. and Crisosto G. M. (2008). Measurement of pH and titratable acidity. In: Crisosto, C. H. (ed.) vol. 2: Central Valley Postharvest Newsletter.

Galvis Sanchez AC, Fonseca SC, Morais AMMB, and Malcata FX. (2003). Physicochemical and sensory evaluation of 'Rocha' pear following controlled atmosphere storage. J Food Sci. 2003; 68:318–327. doi: 10.1111/j.1365-2621..tb14159.

Hagenmaier R. D. and Baker, R. A. (1994). "Wax micro emulsions and emulsions as citrus coatings," *Journal of Agricultural and Food Chemistry*, vol. 42, no. 4, pp. 899–902.

Hassan ZH, Lesmayati S, Qomariah R, Hasbianto A (2014). Effects of wax coating applications and storage temperatures on the quality of tangerine citrus (Citrus reticulata) var. Siam Banjar. International Food Research Journal 21(2):641-648.

Jadhao SD, Borkar PA, Borkar SL, Bakane PH, and Murumkar RP.(2008). Effect of different treatments and packaging materials on biochemical changes during storage of kagzi lime. *Asian J Biol Sci.* ;3:247–250.

Joslyn, M.A., (1970). Methods in Food Analysis (2). Acad. Press, N. Y. London.

Karadeniz, F. and A. Aksi (2002). Sugar composition of apple juices. Eur. Food. Res. Technol. 215: 145-148.

Kittur, F., Saroja, N., Habibunnisa, and aranathan, R. (2010). "Polysaccharide-based composite coating formulations for shelf-extension of fresh banana and mango," European Food Research and Technology, vol. 213, no. 4, pp. 306–311.

Martinez, G.; Sozzi, P. Raquel G. O.; Manuel S. R. and Thomas M.G. (2003). New approaches to prunus tree crop breeding. Agriculture and Enviroment, 1(1): 52-63.

Mir, A.A. , Sood M. and Bandral J.D. (2018). Effect of active packaging on quality and shelf life of peach fruits. The Pharma Innovation Journal. 7(4): 1076-1082.

Nasrin, T.A.A., Rahman, M.A., Arfin, M.S., Islam, M.N., and Ullah, M.A. (2020). Effect of novel coconut oil and beeswax edible coating on postharvest quality of lemon at ambient storage. Journal of Agriculture and Food Research, 2, 100-119.

Pearson, D. (1976). The Chemical Analysis of Food. Chemical Publishing Company INC. New York.

Persis, E., Eckerman, M., Ben-Arie, R.(2002). “Ethylene involvement in chilling injury symptoms of avocado during cold storage,” *Postharvest Biology and Technology*, vol. 24, pp. 171–181.

Pal, R.K., (1998). Ripening and rheological properties of mango as influenced by ethrel and calcium carbide. J. Food Sci. Technol. Mysore, 35: 358-360.

Rathore, H.A. , Masud, T. , Sammi, S. and Majeed, S. (2009). Effect of Polyethylene Packaging and Coating Having Fungicide, Ethylene Absorbent and Antiripening Agent on the Overall Physico-Chemical Composition of Chaunsa White Variety of Mango at Ambient Temperature During Storage. Pakistan Journal of Nutrition. 8 (9): 1356-1362.

SAS Institute, Inc (2002). Statistical Analysis System Ver. 9.0. SAS institute Inc., Cary, NC. USA.

Scetar, M., M. Kurek and K. Galic (2010). Trends in fruit and vegetable packaging–a review. Croatian J. Food Technol Biotechnol. Nutri., 5(3–4): 69– 86.

Seleshi, G. , Woldetsadik, K. and Azene M. (2019). Effect of Calcium Chloride Dipping and Beeswax Coating on the Shelf Life and Quality of Nectarine (Prunus persica (L.) Batsch var. nucipersica) Fruits. Agriculture and Food Sciences Research. 6 (1): 71-78.

Thomas SA, Bosques EM, Stelik S, and Sanchez F.(2005). Effect of skin coatings on prolonging shelf life of kagzi lime fruits (Citrus aurantifolia Swingle) J Phys IVFrance. 2005;125:889–892.doi: 10.1051/jp4:125206.

Yuniarti and Suhardi, (1992). Ripening retardation of Arumanis mango. ASEAN Food J., 7: 207-208.