

## Effect of two inhibitors of transpiration, copper, Chitosan, some plant extracts, and storage period on the storage traits of local orange fruits, *Citrus sinensis*.

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### Abstract

This experiment was conducted in a special refrigerated warehouse in the city of Baquba, Diyala Governorate, for the season 2021-2022. The study showed the effect of the treatments (plant extracts and anti-transpiration agents) and the storage period on the storage trait of the local orange fruits, *Citrus sinensis* L. The experiment was conducted in the period from 1/12/2021 to 1/3/2022 Where the fruits were harvested by the manual method using manual scissors and cutting the fruits from the fruit bearer at the level of the surface of the fruit from a private orchard in the city of Jdeidet Al-Shat, Diyala province, where a group of fruits were immersed in pomegranate peel powder extract in two concentrations (3 and 9 g.L<sup>-1</sup>) for 15 minutes. Another group dipped in thyme leaves extract in two concentrations (6 and 9 g.L<sup>-1</sup>) for 15 minutes. Another group was immersed in chitosan at a concentration of 2 g.L<sup>-1</sup> for two minutes, and a group was immersed in Disper Cu max at a concentration of 3 g.L<sup>-1</sup> for two minutes, and the comparison treatment was dipped in distilled water, and the fruits were packed in polyethylene bags of one kilo size and perforated with 16 holes. It was stored in the refrigerator at a temperature of (4±0.5) C and a relative humidity of 80-85% for a period of three months. The results were analyzed in the laboratory of the Department of Horticulture and Landscape Engineering of the College of Agriculture - University of Diyala. The experiment was conducted using a complete random design (CRD), and the averages were compared according to the Dunkin' multiple limit test. At a probability level of 0.05, the results were all the following: The results showed that the lowest percentage of weight loss was when the treatment with pomegranate peel powder extract with a concentration of 9 g.L<sup>-1</sup>, and also the treatment with pomegranate peel powder with a concentration of 9 g.L<sup>-1</sup> excelled in the highest weight of the peel. While the treatment with thyme leaf powder at a concentration of 6 g.L<sup>-1</sup> excelled in the highest rate of thickness of the peel and the percentage of carotene in the skin of the fruit, and the treatment with pomegranate peel powder extract at a concentration of 3 g.L<sup>-1</sup> excelled in the highest percentage of fruit juice, and The highest percentage of chlorophyll in the fruit peel

### Introduction

Citrus fruits belong to the Rutaceae family, including sweet oranges, tangerines, lemons, grapefruits, oranges, and bitter oranges. Citrus fruits are grown in tropical and subtropical regions and occupy a high economic position in the world economy. Where the world's production of citrus exceeds 98 million tons (1), oranges represent half of the production, Orange fruits are rich in a group of vitamins, including vitamin A, B, and vitamin C and a group of acids, including

citric acid, the fruits of oranges have many benefits, including stimulating blood circulation, increasing the body's immunity, and resisting colds. The fruits contain polyphenols, which protect the body from exposure to viral infections, as well as protect the digestive system from severe constipation. eyesight progressively) in addition to many other health benefits (2) Storing the fruits and delivering them to the consumer in a good way is one of the main goals that specialists

aspire to, including good economic returns, achieving economic security, and reducing waste of agricultural products during their production season. Specialists began to use some natural plant extracts as substitutes for chemicals to improve the storage properties of fruits, since many biotic and abiotic stress factors cause damage and deterioration of citrus fruits after harvest. The researchers pointed out that during the process of picking, handling, transportation, packaging and storage, the fruits get mechanical injuries that lead to infection with fruit-decomposing microorganisms that cause spoilage, reduce quality and cause high economic losses (3). The rate of citrus rot was 10-30% and could reach 50% in harsh conditions (4, 5 . (6) )indicated that the plant extracts have a clear effect on the storage characteristics of apricot fruits in reducing the respiration rate, as well as in the percentage of TSS and reducing acidity. The use of natural materials being safe, To replace harmful chemicals and limit their use to combat fungi that affect citrus fruits, the most important of which is *p. digitatum*, and *p. Italicum* and these alternative methods are usually from non-chemical sources that are less or no toxic to humans and are safe and environmentally friendly when compared to chemical fungicides. These alternatives include control using plant extracts, essential oils, and Chitosan, as well as bio- control that is used to treat diseases on plants (7,8 ). (7) found in a study conducted on orange fruits for some transpiration inhibitors, where the study showed that the treated fruits gave the least weight loss in the fruits, which amounted to 1.18%, while the untreated fruits had a weight loss average of 4.51%, The percentage of dissolved solids, the percentage of acidity, and the percentage of ascorbic acid for the treated fruits were the lowest rates (11.48%, 1.98%, and 46.12%), respectively, while the untreated fruits gave the highest rates (13.66%, 2.59%, and 49.56%) (8) .found that the incidence and severity of anthracnose disease on Washington oranges treated with 0.01 concentration of

Chitosan decreased by 4.5 times from those treated with 0.05 concentration of Chitosan . It was also found that treatment with Chitosan at a concentration of 1.5 ml increases the shelf life of cucumber and pepper compared to fruits treated with a concentration of 0.5 ml of Chitosan .Chitosan exhibits antimicrobial properties against many microorganisms, including fungi, bacteria, and yeasts, and specifically against post-harvest diseases such as *p. digitatum* and *p. italicum* that infects citrus fruits (9)

The study aims to:

- 1- Studying the effect of transpiration inhibitors and plant extracts on the storage characteristics of local orange fruits.
- 2- Studying the effect of storage period on storage characteristics of local orange fruits stored in refrigerated warehouses.

### Materials and Methods

The experiment was conducted in a special refrigerator in Baquba, Diyala province, during the period from December 1, 2021 to March 1, 2022, on local oranges harvested manually using manual scissors by cutting the fruit from the fruit stand at the surface level of the fruit from orange trees with an age of 15-20 years, shaded. With palm trees from a private orchard in the Jdeidet Al-Shatt area of Diyala province, and these trees are watered from the Tigris River using the irrigation method, the orange fruits were harvested when the percentage of discoloration in the fruits was 75% (10). When the fruits were harvested, they were placed in cardboard boxes so that they would not be affected during the transportation process, and after that they were sorted to exclude damaged fruits and small fruits, then washed with water to remove dust from them, and then divided into seven groups equally, and each group into three replicates weighing one kilogram per sample in the replicate. The samples are all of the following:

- 1- The control treatment was dipped in distilled water only and then left to air dry
- 2- A group of fruits were dipped in pomegranate peel powder extract at a concentration of 9 and 3 g. L<sup>-1</sup> for 15 minutes
- 3- A group of fruits were dipped in thyme leaf extract at a concentration of 9 and 6 g. L<sup>-1</sup> for 15 minutes.
- 4- A group of fruits were dipped in anti-transpiration copper disper at a concentration of 3g.L<sup>-1</sup> for two minutes.
- 5 - A group of fruits was dipped in the anti-transpiration agent, Chitosan , for two minutes, at a concentration of 2 g.L<sup>-1</sup>. Then the fruits were left to air-dry, after which they were packed in polyethylene bags perforated with 16 holes per kilogram and labeled and placed in the refrigerator at random after fixing the temperature of the refrigerator at a temperature of 4± 0.5 C and relative humidity 80-85, and the samples were stored in the refrigerator for three Months with detection every three days.

### 1.3: Academic factors and their levels

#### 3.1.1 : Pomegranate peel extract

The pomegranate peel extract was used with two concentrations of 3% and 9%, which was prepared by dissolving 30 g of pomegranate peel powder in a one-liter container and adding distilled water until the volume is one liter, leaving it at room temperature for 24 hours. Then it was filtered by a piece of gauze used for medical purposes, so the concentration became 3%, and in the same way the concentration of 9% was prepared, where the fruits were dipped in it for 15 minutes and the fruits were left to dry and then they were filled with polyethylene bags.

#### 3.1.2: Thyme leaves extract

I used extract of thyme leaves with two concentrations of 6% and 9%, which was prepared by adding 60 gm of thyme leaves in a

container of one liter volume and adding distilled water until the volume is complete to one liter and left at room temperature for 24 hours, then filtered with a piece of gauze The concentration became 6%. In the same way, the concentration was prepared at 9%. The fruits were immersed in it for 15 minutes, then left to dry and filled with polyethylene bags.

#### 3.1.3: The copper disper

The copper disper of French origin was used at a concentration of 3 g.L<sup>-1</sup> by dissolving the copper disper in one liter of warm distilled water and leaving it for 10-15 minutes until it completely dissolved, then the fruits were dipped in it for two minutes.

#### 3.1.4: Anti-transpiration Chitosan

The Chitosan of German origin was used at a concentration of 2 g.L<sup>-1</sup>. The fruits were immersed in it for two minutes. A Chitosan solution was prepared by dissolving it in acidified water (adding 0.1 N of hydrolic acid to 100 ml of distilled water) due to the fact that the substance is insoluble in distilled water according to the method (11).

#### 3-2- Experimental Design:

A factorial experiment was conducted with two factors according to a completely randomized design (C.R.D) with three replications and a weight of one kilogram for each experimental unit and one, 42 experimental units (2 x 7 x 3). The results were analyzed using the SAS program and the averages were compared with the Dunkin's multiple test at the level of 0.05 (12).

#### 3-3- The studied traits:

All chemical, physical and physiological traits were studied at the beginning of storage, after 45 days and at the end of the storage period, except for the percentage of each of physiological damage, biological damage, total spoilage, taste test, appearance and

attractiveness of the fruits. Only the end of the storage stage was calculated after 90 days.

1- alnisbat almiawiat lifuqdan alwazni: - husibat alnisbat almiawiat lifuqdan alwazn hasab almueadalat alatiati: - alnisbat almiawiat lifuqdan alwazn = (alqias eind althimar wazn - alkhazn bidayatan fi althimar wazn) / (bidayatualkhazan fi althimar wazn) \* 100

Percentage of peel weight:

The percentage of the peel weight of the fruit was calculated on the basis of the weight of the fruit peel to the weight of the fruit in the treatment according to the following equation:

The percentage of the weight of the peel = (the weight of the peel) / (the weight of the fruit) x 100

3- The thickness of peel:

It was calculated by Vernier Caliper.

4- Percentage of fruit juice:

The percentage of fruit juice was calculated by taking the fruit juice to the weight of the fruit according to the following equation:

The percentage of juice = (juice weight) / (fruit weight) x 100

5- Stars tar border Determination of Chlorophyll and Carotene Content in Fruit Peel:-

The percentage of chlorophyll and carotene was calculated by taking 0.5g from the skin of the then and placed in a dark colored peel and added to it 20 ml of acetone 80% and left for 72 minutes with Rejoin from time to time until the green color disappeared, then a certain percentage of the suspension was placed in a spectrophotometer and the reading was The device is at wavelengths of 663, 645, and 450, and then records the readings according to the following equations:

Chlorophyll A = (9.78 x 663 A) - (0.99 x 645 A)

chlorophyll b = (21.4 x 645 A) - (4.65 x 663 A)

carotene C = (4.69 x 450 A - 0.268) (20.2 x 645A) + 8.02 x 663A

## Results and Discussion

### 4-1 - Weight loss percentage:

From studying the results of the effect of different treatments and the duration of storage and the interaction between them on the rate of loss percentage in the weight of the fruits shown in the results of Table. 1. The treatments showed a significant effect in reducing the percentage of weight loss in fruits. The fruits treated with pomegranate peel powder extract with a concentration of 9 g.L<sup>-1</sup> were distinguished. The percentage of weight loss in the fruits was 2.170%, while the highest rate of weight loss was in the control treatment, which amounted to 3.660. %. The same table also shows the effect of the storage period significantly on the percentage of loss by weight of the fruits, where the period 45 days excelled in reducing the average percentage of loss in the weight of the fruits amounted to 1.400%, while the percentage of weight loss increased after 90 days of storage to 3.800%. The interaction between the treatments and the storage period had a significant effect on the rate of loss in the weight of the fruits. While the highest percentage of weight loss was 5.100% when the interaction between the control treatment and the storage period was 90 days. The reason for the low percentage of weight loss for the stored fruits is due to the absence or lack of permeability of moisture and gases from the fruit, which leads to the accumulation of CO<sub>2</sub> gas and a decrease in the percentage of O<sub>2</sub> gas, which leads to a decrease in the vital processes inside the fruit and thus maintaining the weight of the fruits (13). As for the high

percentage of loss by weight of fruits in the control treatment , it results from the absence of materials that prevent the process of transpiration and respiration on the surface of

the fruit, and thus the vital interactions remain active, which leads to a high percentage of loss by weight of fruits.

**Table 1 shows the effect of the treatments and the duration of storage and the interaction between them on the percentage of loss by weight of local orange fruits stored in a refrigerated store (gm)**

| Treatments average | Storage period |         | Treatments             |
|--------------------|----------------|---------|------------------------|
|                    | 90day          | 45day   |                        |
| 3.660 A            | 5.100 a        | 2.230 e | Control                |
| 2.430 C            | 3.560 cd       | 1.300 f | pomegranate peel 3%    |
| 2.170 C            | 3.200 d        | 1.130 f | pomegranate peel 9%    |
| 2.400 C            | 3.600 cd       | 1.200 f | thyme leaves 6%        |
| 2.430 C            | 3.660 c        | 1.200 f | thyme leaves 9%        |
| 2.800 B            | 4.060 b        | 1.530 f | copper disper          |
| 2.300 C            | 3.330 cd       | 1.260 f | Chitosan               |
|                    | 3.800 A        | 1.400 B | average storage period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunckin's multiple range test at the probability level of 0.05.

#### 4-2 Percentage of fruit peel weight:

From a study of the results of the effect of different treatments and the duration of storage and the interaction between them on the average percentage of the peel weight of local orange fruits, which is fixed in Table 3, it was found that the treatments had a significant effect on the average percentage of the weight of the peel. It reached 44.66%, while the lowest rate for the weight of the shell was in the control treatment, which amounted to 39.66%. The results showed that the treatments had a significant effect on the weight of the peel, where the treatment with extract of pomegranate peels at a concentration of 9 g.L<sup>-1</sup> was characterized by the highest percentage in the weight of the peel, where the percentage of the weight of the peel reached 44.66%, thus

it is higher than all treatments and with a significant difference from the control treatment, which amounted to 39.83. As for the storage period, the period 45 days excelled, which reached the highest percentage of 42%, compared to the period 90 days, which reached 38.66%. The same table also shows the effect of the interaction between the treatments and the storage period, where the interaction between the treatment with pomegranate peel extract at a concentration of 9 g.L<sup>-1</sup> and the storage period of 45 days was characterized by the highest percentage in the mean weight of the peel amounted to 45.66%, while it decreased to the lowest rate in the weight of the peel when the interaction between the control treatment and Storage period of 90 days was 36.66%.

**Table 2 Effect of treatments and storage period and their interactions on the percentage of peel weight of orange fruits stored in a refrigerated store**

| treatments<br>average | Storage period |           | Treatments                |
|-----------------------|----------------|-----------|---------------------------|
|                       | 90day          | 45day     |                           |
| 39.89 B               | 36.66 e        | 43.00abc  | Control                   |
| 39.67B                | 39.00cde       | 40.33b—e  | pomegranate peel<br>3%    |
| 44.66 A               | 43.66 ab       | 45.66 a   | pomegranate peel<br>9%    |
| 38.66 B               | 37.33 ed       | 40.00 b—e | thyme leaves 6%           |
| 40.67 B               | 38.00 ed       | 43.33 a—d | thyme leaves 9%           |
| 39.50 B               | 37.33 ed       | 41.66 a—d | copper disper             |
| 39.20 B               | 38.33 ed       | 40.00 b—e | Chitosan                  |
|                       | 38.62 B        | 42.00 A   | average storage<br>period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunckin's multiple range test at the probability level of 0.05.

### 3-4- Percentage of the average thickness of peel.

From the study of the results of the effect of the treatments and the duration of storage and the interaction between them, Table No. 3 shows that the treatments had a significant impact on the results, as the treatment with thyme leaf extract at a concentration of 6 g L<sup>-1</sup> was characterized by the highest thickness of the peel amounted to 4.130 mm, and the lowest thickness of the peel in the fruits of the control treatment was 3.720 mm. While the period 45 days excelled, where it recorded the highest value of 4,300 mm, and the lowest value in the period of 90 days, 3,620 mm. As for the interaction between the treatments and the storage period, the highest value was recorded when the

interaction between the treatment with thyme leaf extract at a concentration of 9 g.L<sup>-1</sup> and the storage period was 45 days amounted to 4.530 ml. which amounted to 3,500 mm. The treatment with plant extracts led to maintaining the average thickness of the crust, and this is due to the fact that the plant extracts contain secondary chemical compounds that cover the skin of the fruit with an insulating layer that works to reduce the moisture loss of the fruits and then maintain the thickness of the crust compared to untreated fruits in which the thickness of the crust is reduced (14) As for the 90-day storage period, the average thickness of peel decreased due to the increase in the respiration process over time and the increase in the activity of the vital reactions inside the fruit, and thus affects the average thickness of peel (15).

**Table (3) shows the effect of the treatments and storage period and the interaction between them on the average peel thickness (mm) of local oranges stored in a refrigerated store.**

| Treatments average | Storage period |         | Treatments             |
|--------------------|----------------|---------|------------------------|
|                    | 90day          | 45day   |                        |
| 3.720 D            | 3.550 e        | 3.900 c | Control                |
| 4.000 C            | 3.730 d        | 4.260 b | pomegranate peel 3%    |
| 4.050 BC           | 3.730 d        | 4.330 b | pomegranate peel 9%    |
| 4.130 A            | 3.760 d        | 4.500 a | thyme leaves 6%        |
| 4.090 B            | 3.660 d        | 4.530 a | thyme leaves 9%        |
| 3.930 C            | 3.560 e        | 4.300 b | copper disper          |
| 3.900 C            | 3.500 e        | 4.300 b | Chitosan               |
|                    | 3.620 B        | 4.300 A | average storage period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunkin's multiple range test at the probability level of 0.05.

#### Percentage of juice in the fruit:

From the study of the results of the effect of the treatments and the duration of storage and the interaction between them between Table 4, there are significant differences between the effect of the treatments on the percentage of juice in the fruit, where the treatment with pomegranate peel powder extract at a concentration of 3 g L<sup>-1</sup> was excelled on all treatments with a juice percentage of 46.26%, the lowest percentage of juice when the treatment Chitosan

40.83%.The same table shows the effect of the storage period on the percentage of juice in the fruit, where the storage period was 45 days, with the highest percentage of juice amounting to 4.824%, while the period of 90 days recorded the lowest value, amounting to 42.03%.As for the interaction between the treatments and the storage period, the interaction between the treatment with pomegranate peel powder extract at a concentration of 3 g L<sup>-1</sup> and the storage period of 45 days was superior to all interactions with a value of 46.93%.

**Table 4 shows the effect of the treatments, storage period, and the interaction between them on the percentage of juice of local oranges stored in a refrigerated store.**

| treatments average | Storage period |          | Treatments             |
|--------------------|----------------|----------|------------------------|
|                    | 90day          | 45day    |                        |
| 42.70AB            | 41.96abc       | 43.43a-c | Control                |
| 46.26A             | 45.60ab        | 46.93 a  | pomegranate peel 3%    |
| 2.96 AB            | 39.90c         | 46.03 ab | pomegranate peel 9%    |
| 45.83A             | 45.13abc       | 46.53a   | thyme leaves 6%        |
| 43.00AB            | 43.74 ac       | 46.20 ab | thyme leaves 9%        |
| 43.15AB            | 42.60abc       | 43.70abc | copper disper          |
| 40.38B             | 39.86d         | 40.90bc  | Chitosan               |
|                    | 42.03B         | 44.82 A  | average storage period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunckin's multiple range test at the probability level of 0.05.

#### 4-5 Chlorophyll content in the fruit peel (mg/100g):

Table 5 shows the results of the effect of the treatments, the storage period and the interaction between them on the chlorophyll content in the fruit peel, where the highest chlorophyll content in the treatment with pomegranate peel powder extract at a concentration

of 3 g L-1 was 0.920 mg / 100 g, while the lowest chlorophyll content when treated with Jitosan was 0.740 mg / 100 gloom

The same table showed that the storage period had a significant effect on the chlorophyll content in the stored fruit peel, where the highest chlorophyll content during the 45-day period amounted to 1.250 mg / 100 g, and the lowest chlorophyll content in the peel at the

90-day storage period amounted to 0.470 mg / 100 g.

Through the argument, it was found that there was a significant effect of the interaction of the treatments and the storage period on the chlorophyll content in the fruit peel, where the interaction between the treatment with pomegranate peel extract at a concentration of 3 g

L-1 and the storage period of 45 days was distinguished by the highest content of chlorophyll

in the fruit peel reaching 1.320 mg / 100 g, while the lowest The content of chlorophyll in the

peel when the overlap between the treatment with gitosan and the storage period for 90 days amounted to 00.26 mg / 100 g.

grandfather



**Table No. 5 shows the effect of each of the anti-transpiration agents and the storage period and the interaction between them on the chlorophyll content in the fruit peel.**

| treatments average | Storage period |          | Treatments            |
|--------------------|----------------|----------|-----------------------|
|                    | 90day          | 45day    |                       |
| 0.850 B            | 0.470 ef       | 1.240 b  | Control               |
| 0.920 A            | 0.530 de       | 1.320 a  | pomegranatepeel 9%    |
| 0.910 A            | 0.560 d        | 1.260 ab | pomegranatepeel 9%    |
| 0.910 A            | 0.530 de       | 1.290 ab | thyme leaves 6%       |
| 0.890 AB           | 0.500 de       | 1.290 ab | thyme leaves 9%       |
| 0.790 C            | 0.420 f        | 1.160 c  | copper disper         |
| 0.740 C            | 0.260 g        | 1.220 bc | Chitosan              |
|                    | 0.470 B        | 1.250 A  | Averagestorage period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunkin's multiple range test at the probability level of 0.05.

4-6: Carotene content in the fruit peel mg / 100 gm:

Table 6 shows a study of the effect of the treatments and the duration of storage and the interaction between them on the carotene content of local orange fruits stored in a

refrigerated store, where the treatment with thyme leaf extract at a concentration of 6 g L<sup>-1</sup>

was characterized by the highest content of carotene in the fruit peel of 199.7 mg / 100 g, and the lowest The content of carotene in the cortex was 156.6 mg/100 when treated with gitosan.

The same table showed that the effect of the storage period on the content of carotene in the

fruit peel, where the storage period of 90 days was characterized by the highest content of

carotene in the fruit peel amounted to 177.4 mg / 100 g, while the lowest content of carotene

in the fruit peel at the storage period of 45 days amounted to 159.3 mg / 100 g.

The table showed the effect of the interaction between the treatments and the storage period on the content of carotene in the fruit peel, where the interaction between the treatment with

thyme leaf extract at a concentration of 6 g L<sup>-1</sup> was distinguished with the highest content of carotene in the skin amounting to 205.4 mg / 100 g, while the lowest content of carotene was

in the skin of the fruits at the overlap Between the treatment with Jitosan and the storage period of 45 days, 137.9 mg / 100 g.

Table 6 shows the effect of each of the treatments and storage period, and the interaction between them, on the content of carotene in orange peel stored in a refrigerated store.

| treatments average | Storage period |           | Treatments             |
|--------------------|----------------|-----------|------------------------|
|                    | 90day          | 45day     |                        |
| 157.4 D            | 164.1ef        | 150.8 gh  | Control                |
| 162.3 CD           | 169.5 de       | 155.2 gh  | pomegranatepeel 3%     |
| 167.7 C            | 175.2 cd       | 160.2 efg | pomegranatepeel 9%     |
| 199.75 A           | 205.4 a        | 194.0 b   | thyme leaves 6%        |
| 177.20 B           | 184.1 c        | 170.2 de  | thyme leaves 9%        |
| 157.4 D            | 168.0 de       | 146.7 hi  | copper disper          |
| 156.6 D            | 175.5 cd       | 137.9 i   | Chitosan               |
|                    | 177.4 A        | 159.3 B   | Average storage period |

\* The means of each group followed by similar letters are not significantly different from each other according to Dunkin's multiple range test at the probability level of 0.05.

## Discussion

The results of tables 3, 4, 5 and 6 showed that there was a significant effect of anti-transpiration substances on (the average thickness of the crust, the percentage of juice in the fruit, the percentage), as the use of anti-transpiration materials was excelled in giving the highest percentage of the above-mentioned characteristics compared to the control treatment. The reason for this is that the anti-transpiration materials have an effect almost similar to wax, which may lead to the formation of an insulating waxy layer surrounding the fruits treated with these materials, covering the stomata and lenticels on the surface of the outer layer of the fruit, and then working to reduce water evaporation and moisture loss for the fruits, i.e. they retain moisture. for as long as possible (16).

As for the percentage of loss by weight, the speed of fruit respiration, and the total acidity, the results of the table showed that

there were significant differences in these studied characteristics, as it gave the lowest percentage for the above trait when treated with anti-transpiration materials compared to the control treatment. The reason for this is that the anti-transpiration substances act as a barrier between the tissues of the fruits and the surrounding environment, and thus they work to modify the internal atmosphere of the fruit by reducing the concentration of oxygen and increasing the concentration of carbon dioxide, and then the susceptibility to dissolving and accumulating carbon dioxide increases as a result of the fruit respiration process (Table 4) (17), And that the reason for the higher weight loss in the control treatment is the exposure of the surface of the fruits to the surrounding atmosphere, which leads to an increase in the rate of transpiration and respiration, and this in turn leads to an increase in weight loss (18), and these results are consistent with the results of (19). With regard to the effect of the storage period, the results of tables 1,5,6 show that there are

significant differences in the studied characteristics (percentage of loss by, the percentage of carotene in the skin of the fruit, The highest percentage of chlorophyll in the fruit peel weight (20) . The results of the above ratio showed a significant effect of the period of refrigerated storage on the characteristics (percentage of loss by weight, percentage in fruits, thickness of the peel, and yield of chlorophyll and carotene), as the results were at the period of refrigerated storage 45 days compared to the storage period of 90 days, and the reason for this is due to

The effect of the storage period on the moisture loss in this, the increase in the average thickness of the peel with the length of the storage period, as well as the percentage of factors in the fruit increased than it was before refrigerated storage, and the reason for this is the high percentage of moisture loss in the peel and juice bags, the percentage of total hair oil (21) and these results agree with the findings(22) and (23).

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