



Effect of Processing and Packing Methods on Fruits Quality of Some Dates and Their Products

BY

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6. Summary

Date Palm (*Phoenix dactylifera* L.) has been one of the most important fruit crops in the arid regions of the Arabian, Middle East and North Africa (MENA). Date palm tree is among the most presented plants in our Holy Book, the Quran as well as Sunnah.

It is considered one of the leading most important fruits crop in Egypt, where is considers the highest country for date production over the world with 1.590.414 million ton, around 18% of the global date production. Its fruiting area reached 49.000.74 ha in 2018 (FAO, 2019). Dates are a very popular food worldwide because of their nutritional value and sweet taste. For further expansion of dates consumption and marketing, use of novel and innovative processing technologies is important.

There are many varieties of date palm (more than 3 thousand varieties) are cultivated in the world, including Barhi variety (soft variety), which is one of the sweet Iraqi varieties, which is consumed fresh at Khalal or early stage, sweet and juicy, yellow color, available seasonally during harvest months. Also, Saisy date is one of the most famous and important date cultivar; (semi dry variety) in Egypt.

The physical and chemical quality of the dates, along with the appropriate packaging and storage techniques, is an important component affecting the quality and shelf life of the dates. Dates are usually consumed fresh or dried or in different forms of processing.

It is known that dates are produced during a limited period of the year, some of which are consumed in the same period, and others are stored for longer periods, and therefore may be attacked by insects and other microorganisms. Currently, therefore, attention is being paid to developing and devising various methods for preserving and improving the quality of dates as well as prolonging their marketing period.

Accordingly, the aim of this study was to slow down the ripening rate of the fruits of Barhi date variety at Khalal stage by modified atmosphere packaging for as long as possible during storage. Also, maintaining the quality and the shelf-life of Saidy date fruits during storage time shelf life. On the other hand, a study of the possibility of producing date paste from Saidy date fruit the fruits, where the fruits can be converted (low quality) into an intermediate product of economic value that can be used as a substitute for sugar in some bakery products.

Physical, chemical, microbial and sensory characteristics of all date fruit samples were evaluated under study. The possibility of replacing sugar syrup with date paste in preparing some bakery products has also been studied and the extent of this effect on sensory characteristics of the final product during the storage period.

This study led to the following conclusions:

I. Barhi date fruits (Khalal stage):

a. Physical characteristics:

The mean weight of fresh fruits, pulp and stone were 20.35, 19.08 and 1.27 g, respectively. The percentage of fruit pulp and stone was 93.75 and 6.24, respectively. The mean value of fruit volume and texture was 18.94 Cm³ and 521.50 g/Cm². Meanwhile, the p^H of Barhi fruits was 6.15.

b. Chemical composition:

The chemical composition of Barhi date fruits; the moisture, acidity, TSS, sugars (total, reducing and non-reducing sugars), ash, crude fiber and crude protein values were 61.09, 0.09, 26.6% (74.24, 67.43 and 6.81%), 1.20, 7.35 and 1.99%, respectively.

c. Effect of packaging and treatments during storage periods on fresh Barhi fruits:

1. Physical properties:

1.1. Texture:

The interaction between packages and treatments during storage periods had a significantly affected on texture. The lowest decreased values were obtained by joint fruits stored in PP packages under modified atmosphere packaging (MAP) conditions with nitrogen (521.07, 508.50 and 495.57 g/cm³), while the highest decreased values were obtained by control detached fruits stored in PA/PE packages (512.27, 471.33 and 436.30 g/cm³) after 3, 6 and 9 weeks, respectively.

1.2. Weight loss%:

The interaction between packages and treatments during storage period under MAP had a significant affected on weight loss. The highest weight loss were recorded in the detached Barhi fruits (control B) stored in PA/PE packages while, the lowest losses were found in joint fruits stored in PP packages under MAP conditions with nitrogen (nitrogen A) during storage periods.

1.3. p^H value:

As the storage period increased, p^H decrease in the MAP samples stored at 5±1 °C. The interaction between packages, treatments and storage period had a significant effect on p^H values. The highest values were recorded by control detached fruits stored in PA/PE packages while, the lowest values were obtained by joint fruits stored in PP packages under MAP conditions with nitrogen during storage periods.

1.4. The percentage of Rutab fruits:

In all treatments, as storage period increased, higher proportions of fruits changed to Rutab. It was noted that the ripening rate was low in joint

fruits stored in PP packages under MAP conditions with nitrogen, the ratio is maturity reached 90.75% after 9 weeks of storage, followed by joint fruits stored in PE packages under MAP conditions with nitrogen it was reached 95.00% after 8 weeks, and finally joint fruits stored in PA/PE packages under MAP conditions with nitrogen, it was reached 98.30% after 7 weeks store in the refrigerator, respectively.

2. Chemical properties:

2.1. Moisture content:

The interaction between packages, treatments and storage period had significantly affected on moisture content of the studied samples. The moisture was decrease during storage period. At the harvest the moisture content of fruits was 61.09%. The highest moisture contents were obtained by control detached fruits stored in PA/PE packages (55.40, 52.30 and 49.50%) while, the lowest values were obtained by joint fruits stored in PP packages under MAP conditions with nitrogen 59.20, 56.20 and 54.23% at 3, 6 and 9 weeks, respectively.

2.2. Total soluble solids (TSS):

The interaction between packages and treatments during storage period on TSS of fruits had a significantly affected. In all treatments TSS increased by increment the storage period. The lowest increment values were obtained by joint fruits stored in PP packages under MAP conditions with nitrogen were 26.81, 27.79 and 27.78%, while the highest increment values were obtained by the detached fruits (control B) stored in PA/PE packages were 28.52, 29.35 and 30.54% after 3, 6 and 9 weeks, respectively

2.3. Acidity:

The interaction between packages, treatments and storage periods had significantly effect on fruit samples acidity. At harvest, the level of

acidity was 0.09 % and acidity was increased significantly throughout the evaluation period for all samples. The highest acidity (0.28%) was scored by control detached fruits stored in PA/PE packages while, the lowest value (0.23%), were scored by joint fruits stored in PP packages under MAP conditions with nitrogen after 9 weeks store in the refrigerator.

2.4. Total sugars:

At the beginning of the experiment, total sugars content of Barhi fruits was 74.24% and increased at different rates during storage. The obtained data demonstrated that the interaction between packages, treatments and storage period had a significantly effect on fruit total sugars. The highest change were occurred in control detached fruits stored in PA/PE packages were 78.77, 86.24 and 87.30% while, the lowest change were occurred in joint fruits stored in PP packages under MAP conditions with nitrogen were 76.49, 77.35 and 78.74% at 3, 6 and 9 weeks, respectively.

2.5. Reducing sugars:

The interaction between packages, treatments and storage periods had significantly effect on fruit samples reducing sugars. At harvest, the level of reducing sugars was 67.43% and it was increased significantly during storage for all samples. The lowest content of reducing sugars in control detached fruits stored in PA/PE packages. On contrary, the lowest content of reducing sugars was in fruits stored in PP packages under MAP conditions with nitrogen during the storage periods.

2.6. Non-reducing sugars:

At the beginning of the storage period, non-reducing sugars content in Barhi fruits at Khalal stage (6.81% on dry weight basis), followed by a slight decrease for all treatments during storage. It was observed that the lowest rate of decrease in the non-reducing sugars content in joint fruits

stored in PP packages under MAP conditions with nitrogen, compared to control detached fruits stored in PA/PE during the storage period.

3. Effect of packaging and treatments on microbial counts of Barhi date fruits during storage:

3.1. Total bacterial count:

The total bacterial count of all Barhi date fruits increased during storage periods. Control samples recorded the highest values at the beginning of the experiment. Control detached fruits stored in PA/PE packages contained the most bacterial count, while joint fruits stored in PP packages under MAP conditions with nitrogen recorded the lowest bacterial count during the storage period.

3.2. Total count of fungal and yeasts:

The results showed a gradual decrease in the total fungal and yeasts count of all Barhi date fruits samples during storage stages. Control detached fruits stored in PA/PE packages had higher total count fungal and yeasts, while joint fruits stored in PP packages under MAP conditions with nitrogen had lower total count fungal and yeasts during the storage period.

4. Effect of packaging and treatments on sensory evaluation of date fruits during storage:

Statistical analysis of the results of sensory attributes (color, texture, smell, and overall acceptability) of joint fruits stored in PP packages under MAP conditions with nitrogen that have been stored at the refrigerator temperature for 9 weeks are significantly better in these characteristics among all other treatments. On the other hand, the results showed that previous sensory attributes of control detached fruits stored in PA/PE packages had the lowest values during the storage period.

II. Saidu date fruits:

a. Physical characteristics:

The mean date fruit weight of Saidu was 10.94 g. While flesh and pit weights were 9.39 and 1.44 g, respectively. Meanwhile, the percentage of flesh and pit was 85.56 and 14.44 %, respectively. The flesh/pits ratio was 5.92%. the p^H was 6.82 of Saidu date fruits (Tamar stage).

b. Chemical composition:

The moisture, acidity, TSS, sugars (total, reducing and non-reducing sugars), ash, crude fiber and crude protein values of Saidu date fruits were 11.81, 0.17, 84.25 (80.52, 75.20 and 5.32), 2.09, 2.67 and 2.47 %, respectively.

c. Effect of packaging and treatments during storage periods on Saidu date fruits:

1. Physical properties:

1.1. p^H value:

The interaction between MAP, temperatures and storage periods had a significant effect on p^H values. It was clear that during the storage period (9 months) the p^H value decreased. Consequently, it was concluded that the washing Saidu date fruits by tap water + OX fruits and heated for 20 mins, then stored under MAP by nitrogen in the refrigerator recorded lowest values on pH during the storage period.

2. Chemical properties:

2.1. Moisture content:

The obtained results indicated that there were a gradually decreases in the moisture contents of all Saidu date samples during storage. The highest decreased in moisture content was found in control samples. Meanwhile the lowest decreased in moisture content was found in the

Saidy date fruits washing by tap water + OX fruits and heated after nine months either at room and refrigerator temperatures.

2.2. TSS:

Data revealed that the interaction between MAP, treatments, temperatures and storage periods had a significant effect on TSS values. It was clear that TSS values increased during the storage period in all treatments.

Ultimately, it could be observed that Saidy date fruits treated by tap water + OX fruits and heated then packing under MAP with nitrogen and storage at refrigerator condition recorded the lowest increased in TSS values followed by that at room temperature.

2.3. Total sugars:

The obtained data illustrated that the interaction between MAP, treatments, temperatures and storage periods had a significant effect on total sugars content. The total sugars content of Saidy date fruits control and treated varied from 78.00 to 80.52%, at zero time and from 79.91 to 82.50% at room temperature. Meanwhile at refrigerator temperature it was a varied from 79.09 to 81.50% after storage for nine months.

Eventually, it was concluded that the washing Saidy date fruits by tap water + OX fruits and heated for 20 mints, then stored under MAP by nitrogen in the refrigerator had the lowest increment in the total sugars.

2.4. Reducing sugars:

The obtained data indicated that the interaction between MAP, treatments, temperatures and storage periods led to an increase in reducing sugars content. Where this increase in Saidy date samples stored at room temperature was higher compared to the same samples that were stored in the refrigerator.

From the obtained results, it could be observed that Saidu date fruits treated by tap water + OX fruits and heated then packing under MAP with nitrogen and storage at refrigerator condition recorded the lowest increased in reducing sugars compared to those stored at room temperature

2.5. Non- reducing sugars:

The results revealed that the non-reducing sugars content of the Saidu date fruit samples affected by MAP and washing treatments during storage at room and refrigerator temperatures. The non-reducing sugars content of Saidu date fruits (control and treatments) samples decreased during the storage periods (9 months). This decrease was higher in the fruits (control and treatment) stored at room temperature compared to those stored in the refrigerator.

3. Enzymatic activities:

3.1. Polyphenol oxidase (PPO) activity:

The results demonstrated that the interaction between MAP, treatments, temperatures and storage periods had a significant effect on PPO activity. From these results it was clear that during storage, there observed a decreasing trend in PPO activity either at ambient temperature or at $5\pm 1^{\circ}\text{C}$.

The PPO activity of Saidu date fruits control and treated samples varied from 4300 to 4370 U/min, at zero time and from 4190 to 4295 U/min at room temperature, Meanwhile it was varied from to 4130 to 4280 unit/ min at refrigerator temperature after storage for nine months.

Consequently, it was concluded that the washing Saidu date fruits by tap water + OX fruits and heated for 20 mints, then stored under MAP by nitrogen in the refrigerator was the best among all the different samples, and therefore it can be recommended to preserve the quality of the fruits and extend their marketing period.

3.2. Peroxidase (POD) activity:

From the results it was observed that the thermal treatment at 65 °C/20 minutes had a clear effect on the activity of the POD enzyme. The activity of the POD enzyme in the dates of control and samples treated ranged between 0.280 and 0.300 U/min at the beginning of storage while it was between 0.270 and 0.297 U/ min at room temperature, while the refrigerator is between 0.250 to 0.290 U/ min after storage for nine months.

4. Effect of packaging and treatments on microbial counts of Saidu date fruits during storage:

4.1. Total bacterial count:

The results showed that the total bacterial count of all Saidu date fruit samples decreased during storage time. Date fruit control samples had the highest counts; 3.00 and 2.37 log cfu/g after nine months at room and refrigeration temperature, respectively. Also, all used treatments of Saidu date fruit reduced the total bacterial count during storage periods in comparison with the control sample. Moreover, the Saidu date fruits treated by tap water + OX fruits and heated then packing under MAP with ozone recorded the lowest value either at room and the refrigerator temperatures (0.95 and 0.52 log cfu/g, respectively) after nine months of storage.

4.2. Total count of fungal and yeasts:

Data showed that total fungal and yeast counts were decreased gradually with storage time increasing of Saidu date fruits. The highest of fungal and yeasts counts were found in both control samples (1.60 and 1.37 log cfu/ g) at the end of storage (9 months) at room and refrigerator temperatures. Saidu date fruits treated by tap water + OX fruits and heated then packing under MAP with ozone was the most effective and best in reducing the total fungal and yeasts counts among all treatments

5. Effect of packaging and treatments on infestation % of

Saidy date fruits during storage:

From the results it could be noted that all washing treatments and MAP reduced the infestation ratio, of storage at refrigerator and room temperatures for Saidy date sample. No insect infestation was found on Saidy date fruits packed under MAP, after three months of storage.

Generally, Saidy date fruits by tap water + OX fruits and heated for 20 mints, then stored under MAP by ozone was the best treatment, as the rate of insect infection reduced to 2.90 and 1.86% at the end of storage (9 months) on room and refrigerator temperature, respectively.

MAP coefficients are most effective in controlling insect infestation of stored dates. Therefore it can be recommended to use MAP by ozone in an integrated pest management program in date warehouses stored as a promising alternative to the negative effect of methyl bromide.

6. Effect of packaging and treatments sensory evaluation of

Saidy date fruits during storage:

The results of the sensory attributes (color, appearance, taste and overall acceptability) of the Saidy date fruits showed a gradual decrease during storage. The samples stored in the refrigerator recorded higher values in all sensory attributes compared to the ones at room temperature until the end of storage (9 months). Saidy date fruits by tap water + OX fruits and heated for 20 mints, then stored under MAP by ozone in the refrigerator was the most acceptable in the sensory test values among all other treatments.

III. Saidy date paste:

a. Chemical composition of Saidy date paste:

The; the moisture, acidity, sugars (total, reducing and non-reducing sugars), ash, crude fiber, crude protein and crude fat content of Saidy date

paste were 18.91, 035, (79.17, 75.50 and 3.67), 2.11, 2.03, 2,38 and 1.40 %, respectively.

b. The effect of replacing sugar (concentrated solution) by date paste on sensory evaluation of the Baklava Date:

Results of the sensory attributes (taste, texture, flavor, aroma and general acceptance) of the prepared Baklava date during the storage period (21 days) at room temperature showed significant differences between the replacement of sugar syrup by date paste formulas and the control. Baklava date paste with cinnamon 2% at the highest values of sensory attributes values, followed by that contained date paste with 4% roasted sesame.

Generally, it can be observed that replacement of sugar syrup by different date paste formulas not only maintained the sensory quality of Baklava date but also improved its nutritional value with more storability.