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**Faculty of Agriculture**  
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## **PHYSIOLOGICAL AND MICROBIOLOGICAL STUDIES ON STORAGE OF DATE PALM FRUITS**

By

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## 5. SUMMARY AND CONCLUSION

### *Title of thesis: Physiological and microbiological studies on storage of date palm fruits*

This investigation was carried out during two successive seasons in 2014 and 2015 on Hayany date palm (as soft cultivar). Date Palm trees played significant roles in agriculture and represents a significant part of the reclamation program. Besides the nutritional values and health benefits of the fruits, the Date Palm by-products are daily used by the local population in many countries in which they are cultivated. Hayany is one of early season date palm cultivars being extensively cultivated in the Damietta region. At the mature (*Bisir*) stage, the fruit is astringent as a result of high contents of soluble tannins, and removal of tannins is necessary for the fruit to be edible. Fruits were harvested at the second week of October during each studying seasons at three degrees of red color (100 % fully red – 90 % red – 80 % red). Then, fruits transported to the laboratory of Agriculture Development System (ADS) project, faculty of Agric., Cairo Univ., without signs of mechanical damage and deterioration were selected and standardized showing homogeneous size, color and form.

The objective of this study is:

- 1- The possibility of using natural alternatives as postharvest treatments such as sodium carbonate and chitosan as a safe way to improve the fruit quality and fruits storability during cold storage periods as well as marketing period of the Hayany date palm
- 2- Induce the ripening process of Bisir Hayany date palm during cold storage by safe postharvest treatments in order to increase the percentage of edible Rutab fruit.
- 3- Decreasing the number of harvest times and thus decreasing the costs.

The selected fruits were washed with tap water; air dried and was immersed for 2 minutes in one of the following:



- 1- Dipping the control fruits for each of 80, 90 and 100 % red color in tap water only.
- 2- Dipping the control fruits for each of 80, 90 and 100 % red color in the solution of chitosan at 0.75 and 1.5 % .
- 3- Dipping the control fruits for each of 80, 90 and 100 % red color in the solution of sodium carbonate at 0.75 and 1.5 % .

Fruits stored at  $2 \pm 0.5^{\circ}$  C with relative humidity (RH) 90-95% for 45 days. The characters were determined at harvest and during storage, such as fruit physical properties; fruit firmness (lb/inch<sup>2</sup>), decay %, weight loss %, and moisture %. Fruit chemical properties; titratable acidity ( % ), total sugar , reducing sugar and non reducing sugar contents (%), soluble solids content ( SSC % ), crude fiber ( %), pectin content (%) , Anthocyanin (mg /100 g), tannins (mg /100 g) and the total phenols (mg /100 g) and microbial load.

The results obtained were statically analyzed and could be summarized: During the storage period all the physical and chemical characteristics will be determined in fruits sample every 15 days until the end of storage period up to 45 days.

## **1. Physical Characteristics**

### **1.a. Weight Loss Percentage (%)**

It was increased significantly as storage period advanced. The present data reveal that dipping the date palm fruits in 1.5% sodium carbonate recorded the lowest significant percentage of fruit weight loss in both seasons as compared with other treatments.

### **1.b. Decay Percentage (%)**

It was increased significantly as storage period advanced. Control treatment recorded the highest fruit decay at the end of storage period in the 1st and 2nd season respectively. While, chitosan 1.5% and 0.75 % treatment recorded the lowest fruit discarded percentage in both seasons compared with the other treatments.

### **1.c. Firmness (Ib/inch<sup>2</sup>)**

Firmness was significantly decreased with prolonged cold storage period. Fruit firmness significantly the highest flesh firmness was attained by chitosan 1.5 % treatment during cold storage. On the other hand the control treatment gave the lowest significant values in both studied seasons.

### **1.d. Rutability (%)**

It was increased significantly as storage period advanced. It was also found that the higher chitosan concentration used, the more frequent fruits were transformed from the bisir to the rutab stage.

### **1.e. Moisture (%)**

It was significantly decreased with prolonged cold storage period. The minimum moisture loss occurred in fruits treated with chitosan 1.5% followed by the fruit treated with chitosan 0.75% as compared with untreated fruit. The untreated fruits showed significantly higher moisture content than treated ones.

## **2. Chemical characters**

### **2.a. Total Soluble Solids in (°Brix)**

It was significantly increased with extending of storage period during two seasons. chitosan treated fruits at either 1.5 or 0.75% gave the highest value of total Soluble Solids in (°Brix) at either khalal or rutab fruits . Meanwhile, control treatment either khalal or rutab fruits gave the lowest value of total Soluble Solids in (°Brix) in both seasons.

### **2. b. Total acidity (TA %)**

It was significantly decreased with prolonged cold storage period. All tested treatments increased to some extent fruit total acidity over control during both seasons. However, the increase over control was significant with comparison to treated fruits. Moreover, control treatment gave the lowest value of acidity in both seasons at khalal stage. Meanwhile, total acidity of rutab fruits was increased with prolonged cold storage period.

### **2.c. Reducing sugars, Non reducing sugar and total sugars (%)**

Total sugars increased gradually and significantly with extending of storage period during the two seasons of this study. Sodium carbonate 1.5% gave the highest value of total sugars. Meanwhile, control treatment which showed the lowest values of total sugars in both seasons at either khalal or rutab fruits. The reducing sugars increased gradually in fruit of all treatments as the storage period. The highest value of reducing sugars after 45 days obtained from treatments of sodium carbonate 1.5%. According to Non reducing sugar, there was an increasing-decreasing trend during the storage period.

### **2.d. Soluble tannins (%)**

It was significantly decreased with prolonged cold storage period. Sodium carbonate 0.75% delayed the decrease concentration of total soluble tannins. Moreover, control treatment gave the highest value of total soluble tannins content in both seasons.

### **2.e. Anthocyanin Content**

Anthocyanin decreased gradually and significantly with extending of storage period during the two seasons. chitosan played a positive role in controlling decrements and maintaining anthocyanins in dates. Meanwhile, control treatment which showed the highest of anthocyanin content in both seasons.

### **2.f. Total phenol compounds**

There was significantly increasing in total phenol compounds with all applications and control as the storage period advanced. 0.75% sodium carbonate treatment gave the highest value of total phenol. Moreover, control treatment gave the lowest value of total phenol both seasons.

### **2.g. Crude fiber (%)**

Crude fiber decreased gradually and significantly with extending of storage period during the two seasons. Sodium carbonate 0.75 % treatment gave the highest values of Crude fiber. Meanwhile, control treatment which showed the lowest of Crude fiber content in both seasons.

## 2.h. Pectin (%)

Pectin decreased gradually and significantly with extending of storage period during the two seasons. Sodium carbonate 0.75% treatment gave the lowest values of Pectin. Meanwhile, control treatment which showed the highest values of Pectin content in both seasons.

## 3. Microbiological analysis

The microbial load of Hayany date after 0, 15, 30 and 45 days of cold storage at  $2\pm 0.5^{\circ}\text{C}$  at three degrees (80 % red, 90 % red and 100 % red). Chitosan and Sodium carbonate were performed in two levels (0.75% and 1.5%) and (0.75% and 1.5%), respectively. Generally, the addition of chitosan and Sodium carbonate with concentration 0.75% and 1.5% reduce the bacterial count comparing with control at zero time. By the time the total bacterial count was decreased until reached to 00 CFU/g after 45 days. The treatment of chitosan and Sodium carbonate 1.5% took the same trend with 0.75%.

Generally, species of *Bacillus* (Gram positive and endospore former), *Micrococcus* (Gram positive and non spore former), *Streptomyces* (Gram positive and exospore former), and *Escherichia* (Gram negative and non spore former) were the most abundant bacterial genus on the date samples.

The trend of total fungal count took a reserve trend of bacterial count, where total fungal count was increased gradually by the time. The addition of chitosan with concentration 0.75% and 1.5% reduce the fungal count at zero. But, by the time, the total fungal count was increased until reached the maximum after 45 days. The concentration of chitosan (0.75%) took the same trend of concentration of chitosan (1.5%), but the concentration 1.5% was more effectiveness than 0.75% against fungi. Generally it was observed that, by increasing the date color the fungal load was increased specially in control. Also, sodium carbonate with concentrations 0.75% and 1.5% took the same trend of chitosan 0.75% and 1.5%.

The distribution of 70 fungal species of Hayany date samples were as following, *Aspergillus flavus* (which produce aflatoxin) achieved the highest distribution fungus of all samples being 17 isolate with a frequency rate 24.29%.

*Penicillium* sp. took the second position being 13 isolate with a frequency rate 18.57%. The third one was *Aspergillus niger* being 11 isolate with a frequency rate 15.71%. *Aspergillus glaucus* was the fourth fungus being 8 isolate with a frequency rate 11.94%. Then *Rhizopus nigricans*, *Mucor* sp., *Aspergillus ochraceus* (which produce ochratoxin), *Aspergillus oryzae* and Yeasts (*Saccharomyces* sp. and *Candida* sp.) with a frequency rates 8.57%, 7.14%, 4.71%, 4.29% and 4.29%, respectively.

## CONCLUSION

From this study, it can be recommended to collect the Hayany date fruits at a color degree at least 90% and not to collect the fruits at the 80% degree as a reason of increasing the percentage of loss and decay. dipping Hayany date palm fruits after harvest in chitosan at 1.5 % or sodium carbonate at 1.5 %. Both of which are natural, completely safe, and have the ability to reduce the proportion of decay fruits as well as the percentage of total loss of weight during cold storage. They also helped maintain quality qualities and increase rutability content.