

The role of some plant extracts and storage temperature in improving storage ability of Date palm fruits cv. Dayri (*Phoenix dactylifera* L. cv. Dayri)

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Abstract. This study was conducted on date palm fruits cv. Dayri obtained from a commercial orchards in Abou-Al-Khaseb region south of Basrah for the growth season of 2011 in order to improve the storage behavior of fruits after dipping them before storage on fenugreek seed extract (0.5 % w/v) or jujube leaf extract (6 % w / v) or garlic extract (5 % w/v) or dill extract (20 % w/v) in addition to control (distilled water only). The most important results showed the superiority of the plant extracts treatments in reducing fungal infection. Treating with garlic extract (5 % w/v) had no significant difference with the fenugreek seed extract treatment (0.5 % w/v) in reducing fungal infection and significantly reduce fungal infection after six months of storage as compared with other treatments. Treating with plant extract also reduced physiological disorders and *Oryzaephilus surinamensis* L. injury compared to untreated fruits. Treatment with fenugreek seeds extract proved to be the most effective in reducing the weight loss of fruits while the untreated fruits had significant increase in the percentage of total soluble solids, total and reducing sugars and the lowest percentage of sucrose. According to statistical analysis, there were no significant differences among treatments in their effect on the percentage of total titratable acidity. Changes in fruits stored at room temperature, were similar to the changes mentioned above, but the amount of those changes was greater in fruits stored at room temperature. Fruit treated with plant extracts retained a good appearance and taste after six months of storage in (5 ± 1 °C) compared with untreated fruits which had intermediate appearance and acceptable taste at the end of storage period. Fruits treated with plant extracts and stored at room temperature had intermediate appearance and acceptable taste while the untreated fruits had wretched appearance and slightly acceptable taste at the end of storage period.

Key Words: Dayri, plant extracts, storage ability, weight loss, total sugars.

Introduction. There is no doubt that the date palm *Phoenix dactylifera* L. is one of the most important fruit trees in Iraq because of their fruits of high nutritional value, making it an important food source and economically reliable supporter. In Iraq exists more than 600 varieties that varied in nutritional value and dating of fruit ripening and other characteristics for each variety (Al-Baker 1972; Shabana et al 2006).

As it is well-known that at the present time the use of chemicals to control the growth and spread of pathogens that are exposed fruit during handling and storage has its negative effects both on health and environment, prompting researchers to focus on the use of plant extracts that contain a lot of active compounds which can be a successful alternative to chemicals in improving the shelf life of fruits and vegetables (Saad et al 1988). Among those extracts aqueous extract of fenugreek seeds (*Trigonella foenum-graecum*) which is a member of the legume family, rich in protein, fat and carbohydrates in addition to fluid materials, nutrients and vitamins. Besides contain many active substances such as alkaloids and glycosides (Makai & Balatincz 1998). The aqueous extract of leaves of jujube trees that belong to the family Rhamnaceae which are evergreen fruit trees that grows in tropical, subtropical and warm temperate areas (Williams 2006) contains many soaps and flavonoids (Al-Korei 2000). The garlic (*Allium sativum* L.), which follows the family Amyralidaceae, contains active substances as essential oils with sulfur compounds, vitamins, hormones and antiseptic substances

concentrated in the garlic bulbs such as Allicin that underlie the therapeutic qualities and aroma of garlic plant (Krest & Keusgen 1999). The aqueous extract of dill (*Anethum graveolens* L.) which belongs to the family Umbelliferae contains oil, which was used as an insecticide (El-Lakwab et al 1993).

The Suriname beetle (*Oryzaephilus surinamensis* L.) spread in Egypt, Saudi Arabia, Iraq, Libya, and Algeria. This insect and their larvae infect stored grain and candied fruits, dates and more. The female lays from 150 - 200 eggs and placed them individually on the date fruits, the eggs hatch and the larvae feed on the dates during the larval stage of about 21 days, meantime the larva moult 2 - 4 times. Insects live 9 - 10 months and they are characterized by the ability to withstand high over a wide range of temperature and humidity and to have 4 - 5 generations per year. The larvae feed in the area bounded between the skin of the fruit and flesh, and noted the presence of larvae feces in this region, while the insects are found in all regions of the fruit and near the area surrounding the nucleus. In the case of severe infection remains only the powder containing insect feces in the interior content of the fruit (Abdul-Hussen 1985).

Dairi cultivar grown in Basrah region, south of Iraq, which is considered a half dry cultivar. Fruits of this cultivar have oblong shape with a good flavor and get purplish red color in the khalal stage (Mater 1991; Shabana et al 2006).

The studies on the use of plant extracts to improve the storage ability of date palm fruits are very rare. According to the available literatures, it was not found any study regarding the use of aqueous extracts of fenugreek seeds, leaves of jujube, garlic cloves and dill extract (which are used in the present study) to improve the storage ability of the fruits of date palm. Therefore, this study was conducted in order to improve the storage ability of Dairi fruits after treating them before storage with plant extracts.

Material and Method

Plant extracts. Dairi fruits were collected from a private orchard in Abu-Alkhaseb region, south of Basrah, during the growing season of 2011. Chosen fruits were as possible as similar in volume and outward appearance. Fruits were treated with the following plant extracts by soaking them for 5 minutes:

1. Fenugreek extract. Pure fenugreek seeds were milled and took 5 grams of seeds to soak in a liter of distilled water at a temperature of 50 °C for 24 hours, then the extract was filtrated, thus obtaining a concentration of 0.5 % (Moses et al 1999).

2. Jujube leaves extract. 60 grams of jujube leaves cv. Zautoni were blended and add a liter of distilled water for 5 minutes, and then the extract was filtrated, obtaining a concentration of 6 % (Al-Korei 2000).

3. Extract of garlic bulbs. Extract was prepared by adding 50 grams of powdered garlic bulbs to one liter of distilled water and it was getting on the concentration of 5 % (Al-Shimari 2005).

4. Dill extract. Extract was prepared by adding 200 grams of dill plant (vegetative shoots) to distilled water in a blender for 3 minutes, completed the volume to one liter with distilled water and so has been obtained on the concentration of 20 % (Al-Shimari 2005).

5. Control (distilled water only).

Fruits were packed in cardboard boxes with a capacity of 2 kg divided into two groups, the first batch was stored at 5 ± 1 °C and relative humidity of 90 - 85 % and the second batch was stored at room temperature, which ranged between 25 - 30 °C.

Evaluation. Tests on fruits were conducted at the end of the storage period (six months) which included the followings:

1. Fungal infections (%) were estimated as a percentage, the fruit was considered damaged at the onset of any infection by fungi which were calculated as follow:

$$\text{Fungal infections (\%)} = \frac{\text{Weight of fruits attacked by fungi in the package}}{\text{Total weight of fruits in the package}} \times 100$$

The fungal infections were estimated according to Dementeva & Vegonski (1988), and in doubt a microscope has been used to identify fungi accurately.

2. Physiological disorders (%) were calculated as a percentage as follows:

$$\text{Physiological disorders (\%)} = \frac{\text{Weight of damaged fruits in the package}}{\text{Total weight of fruits in the package}} \times 100$$

3. The Suriname beetle injury (%) estimated as a percentage by anatomizing fruit lengthwise and through the presence of the insect or larva or both, and as follows (Abdul-Hussein 1985):

$$\text{The Suriname beetle injury (\%)} = \frac{\text{Weight of fruits attacked by the beetle in the package}}{\text{Total weight of fruits in the package}} \times 100$$

4. Weight loss (%) calculated as a percentage, as follows:

$$\text{Weight loss (\%)} = \frac{\text{Weight of the fruits before storage} - \text{Weight of the fruits at the end of storage}}{\text{The weight of fruits before storage}} \times 100$$

5. Total soluble solids (T.S.S.) of fruit pulps were measured by hand refractometer (°Brix) and the results were corrected to 20 °C.

6. Total and reducing sugars (%) of fruits were determined according to Lane & Eynon method outlined in A.O.A.C. (1990).

7. Total titratable acidity (%) and ascorbic acid (mg/100 g fresh weight) were determined according to the method outlined in A.O.A.C. (1990).

8. Sensory evaluation of fruits quality. Fruits were evaluated through the outward appearance and taste by giving the following grades (Polegaev 1988) via the performance of several experienced evaluators (Table 1).

Table 1

Evaluation scales for taste and appearance

<i>Scale of taste</i>	<i>Scale of outward appearance</i>
1: Excellent	1: Excellent
2: Good	2: Good
3: Acceptable	3: Intermediate
4: Lightly acceptable	4: Bad
5: Unacceptable	5: Very bad

Complete Randomized Design (CRD) was used with four replicates. The results were analyzed by the analysis of variance and mean values were compared using the Revised Least Significant Difference Test at 0.05 probability level (Al-Rawi & Khalf Allah 1980).

Results and Discussion

The percentage of fungal infections, physiological disorders, Suriname beetle injuries and weight loss. Table 2 showed the effect of plant extracts in the fungal infection of Dairi fruits stored at 5 ± 1 °C, there were found the superiority of treatment with plant extracts to control (by reducing) the fungal infections. Treating with extract of

garlic bulbs reduced fungal infections after six months of storage 1.55 % and the difference was not significant with Fenugreek extract and significant with the rest of the treatments. The reason for the decline in the fungal infections in fruits treated with plant extracts compared with untreated fruits may be due to the composition of these extracts, many effective chemical compounds, working to inhabit the development of fungi such as tannins, alkaloids, aromatic and volatile oils (Moses et al 1999). It was found that the main reason for decay of fruits was fungal infections with *Penicillium italicum*, *Penicillium digitatum* and *Alternaria alternata*. It is also known that the fungus *Penicillium* is unable to attack the health fruits, so it remains inactive on the surface of the fruit waiting for an opportunity of weakness or damage of the fruit by mechanical injuries or insects infestation that make openings to facilitate the entry of pathogens and leading to fungal infections (Al-Ani 1985). Treatment with plant extracts reduced the physiological disorders and *O. surinamensis* injuries in fruits after six months of storage compared with untreated fruits. According to statistical analysis, there were not any significant differences among plant extracts in their impact on the studied character.

Treatment with aqueous fenugreek seeds was superior to the rest treatments reducing the weight loss of fruits with 1.11 % followed by the treatment of aqueous jujube leaves. Loosing weight includes the loss of moisture and loss of substances used in respiration. The used plant extracts leads to the reduction of respiration rate, in addition to reduce the loss of moisture because they contain many compounds with similar effect of wax or vegetable oils and composed insulating layer covering the skin of fruits worked as anti-transpiration (Rizk et al 1985; Al-Ameri 2001; Al-Asadi 2004) in addition to the reduced the rate of physiological disorders and weight loss in fruits.

Table 2

Effect of plant extracts on fungal infections, physiological disorders, Suriname beetle injury and weight loss of date palm fruits cv. Dayri stored at 5 ± 1 °C

<i>Treatments</i>	<i>Fungal infection (%)</i>	<i>Physiological disorder (%)</i>	<i>Suriname beetle injury (%)</i>	<i>Weight loss (%)</i>
Fenugreek extract (0.5 %)	1.65	2.89	0.66	1.11
Jujube leaves extract (0.5 %)	3.23	3.01	1.06	1.45
Extract of garlic bulbs (5 %)	1.55	2.44	0.51	2.41
Dill extract extract (20 %)	3.11	2.95	0.75	2.32
Control (distilled water only)	1.65	4.22	2.33	2.92
RLSD 0.05	1.14	1.19	1.22	0.31

Table 3 show the effect of treatment with plant extracts on studied characteristics of Dairi fruits stored at room temperature. Data referred that the changes in those characteristics are similar to the changes listed in the table 1, but the amount of those changes was greater in fruits stored at room temperature.

Table 3

Effect of plant extracts on fungal infection, physiological disorder, Suriname beetle injury and weight loss of date palm fruits cv. Dayri stored at room temperature

<i>Treatments</i>	<i>Fungal infection (%)</i>	<i>Physiological disorder (%)</i>	<i>Suriname beetle injury (%)</i>	<i>Weight loss (%)</i>
Fenugreek extract (0.5 %)	4.01	5.51	2.42	33.12
Jujube leaves extract (0.5 %)	5.18	5.44	2.96	34.03
Extract of garlic bulbs (5 %)	3.57	5.38	2.51	35.52
Dill extract extract (20 %)	5.62	5.44	3.04	35.49
Control (distilled water only)	7.45	6.88	5.63	39.61
RLSD 0.05	1.16	1.38	2.51	0.37

The highest percentage of fungal infection, physiological disorders, Suriname beetle injuries and the loss weight of fruit has been recorded in untreated fruits compared with fruits treated with plant extracts. Results are consistent with Al-Essawi (2004), which found that the percentage of weight loss and the percentage of decay in fruits of Zahdi date palm cultivar treated with liquorice extract decreased when stored at -3 ± 1 °C compared with fruits stored at 0 °C.

Chemical characteristics. Table 4 show the effect of treatment with plant extracts on the chemical characteristics of the Dairi fruits stored at 5 ± 1 °C. The percentage of total soluble solids increased in control fruits at the end of storage period 74.4 % compared with the rest treatments. While the lowest percentage of total soluble solids was in fruits treated with the aqueous fenugreek seeds. Changes in total and reducing sugars got the same behavior above. Untreated fruit gave the highest percentage of total and reducing sugars and the lowest percentage of sucrose compared with the rest of the treatments. According to statistical analysis, there were no significant differences among treatments in their effect on the percentage of the total titratable acidity. Compared with fruits stored at room temperature, changes in the chemical studied characteristics were similar to those occurred in the fruits stored at 5 ± 1 °C, but the amount of those changes was greater in fruits stored at room temperature. The highest percentage of soluble solids and total sugars were in the untreated fruit with plant extracts which may be due to the increment of losses in water content of fruits that caused the loss of weight of untreated fruit (Table 2 & 3), as when talking about weight loss, treating with plant extracts led to reduce the loss of moisture content of fruits by making an insulating layer covering the surface of the fruit as anti-transpiration.

Table 4

Effect of plant extracts on chemical characteristics (%) of date palm fruits cv. Dayri stored at 5 ± 1 °C

<i>Treatments</i>	<i>Total soluble solids (T.S.S.)</i>	<i>Total sugars</i>	<i>Reducing sugars</i>	<i>Sucrose</i>	<i>Total titratable acidity</i>
Fenugreek extract (0.5 %)	71.4	58.36	46.22	12.14	0.63
Jujube leaves extract (0.5 %)	73.0	62.15	47.66	14.49	0.63
Extract of garlic bulbs (5 %)	72.6	59.11	46.82	12.29	0.67
Dill extract extract (20 %)	72.8	62.15	47.91	14.24	0.64
Control (distilled water only)	74.4	62.33	50.95	11.38	0.56
RLSD 0.05	1.17	0.16	2.94	0.74	N.S.

Table 5

Effect of plant extracts on chemical characteristics (%) of date palm fruits cv. Dayri stored at room temperature

<i>Treatments</i>	<i>Total soluble solids (T.S.S.)</i>	<i>Total sugars</i>	<i>Reducing sugars</i>	<i>Sucrose</i>	<i>Total titratable acidity</i>
Fenugreek extract (0.5 %)	73.22	61.22	50.85	10.37	0.66
Jujube leaves extract (0.5 %)	75.6	66.35	51.22	15.13	0.62
Extract of garlic bulbs (5 %)	74.7	63.11	51.66	11.45	0.69
Dill extract extract (20 %)	75.1	62.15	50.18	11.97	0.66
Control (distilled water only)	77.12	67.55	58.14	9.41	0.61
RLSD 0.05	1.41	0.89	6.38	0.91	N.S.

The results are consistent with Shabana & Moaad (1988) who studied the effect of the date of harvest and freezing on the quality of the date palm fruits cv. Zuhdi at rutab

stage under cold storage conditions. However, Al-Essawi (2004) found that the lowest percentage of total soluble solids were in the fruit stored at a temperature of 1 ± 3 °C compared with those stored at 0 °C. Results also in agreement with those obtained by Taain (2005) for Barhi date palm fruits.

Sensory evaluation of fruits quality. Sensory evaluation of fruits quality indicated that the fruits treated with plant extracts retained a good appearance and a good taste after six months of storage compared with control fruits that had intermediate appearance and acceptable taste at the end of storage at 5 ± 1 °C, while fruit treated with plant extracts and stored at room temperature had intermediate appearance and acceptable taste at the end of the storage periods, while the untreated fruits had bad appearance and lightly acceptable taste (Table 6).

Table 6

Sensory evaluation of the Dairi fruits at the end of the storage period at 5 ± 1 °C and at room temperature

Treatments	5 ± 1 °C		Room temperature	
	Scale of taste	Scale of outward appearance	Scale of taste	Scale of outward appearance
Fenugreek extract	2: Good	2: Good	3: Acceptable	3: Intermediate
Jujube leaves extract	2: Good	2: Good	3: Acceptable	3: Intermediate
Extract of garlic bulbs	2: Good	2: Good	3: Acceptable	3: Intermediate
Dill extract	2: Good	2: Good	3: Acceptable	3: Intermediate
Control (distilled water only)	3: Acceptable	3: Intermediate	4: Lightly acceptable	4: Intermediate

Conclusion. In conclusion, the results obtained in the present work clearly indicated to the role of postharvest application of plant extracts in improving storage ability of Dayri date palm fruits.

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