

Susceptibility of some dry date cultivars to infestation by

Oryzaephilus surinamensis L.

By

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Abstract

Susceptibility of eight date cultivars namely (Barhi, Barhi Al Madina, Deglet Noor, Rushodia, Sukari, Ajwa, Mabroom and Nabtat Ali) were estimated to attack by saw teethe beetle (*O. surinamensis*) under laboratory conditions. Some physical characters and chemical constituents' variations were recorded between the tested date cultivars in. The laboratory evaluation cleared that the most preferable cultivar to eggs deposition and attack of the saw teethe beetle adults was Sukari while the most resistance cultivars were Deglet Noor and Ajwa. The growth index of immature stages was increase in the most susceptible cultivars (Sukari) but decrease in the resistance one (Deglet Noor and Ajwa). On the other hand the measurements the susceptible index indicated that there are three cultivars like as Sukari, Barhi and Rushodia considered the susceptible cultivars comparable with the other tested one. There was a positive and significant correlation between moisture contents and susceptible index while Ash content elicited negative and highly significant correlation with susceptible index. During six months of storage, the highest rate of tested date cultivars weight loss which caused by infestation of saw teethe beetles were Barhi follow by Barhi Al Madina, Rushodia and Sukari.

Key word: Saw teethe beetle, Date cultivars, Susceptibility, epiphyllaxis factors, endophyllaxis factors, chemical constituents, physical characters.

Introduction

Few plant species have developed into an agricultural crop so closely connected with human life as has the date palm. The date palm (*Phoenix dactylifera* L.) was yielded a variety of products for use in agricultural production and for domestic utensils of human. The world date palm cultivation is concentrated mostly in the Near East and Africa, favored by the most suitable dry sub-tropical and high temperature climate prevailing in these regions.

The dates are the importance product of palm which used directly as fresh or dry at different countries especially, Arabic pepole. During storage, the dry dates attack by numerous pests which caused lost its' quality and quantity, as *O. surinamensis*, *Tribolium castaneum*, *Cadra* (= *Ephestia*) *cautella*, *Tribolium confusum*, *Plodia interpunctella*, *Carpophilus hemipterus* and *Lasioderma serricornis* (F). Recently, many researches were carried out to improve some of physical and chemical properties of palm tree try to overcome infestation of different pests this might lead to increasing its quality and quantity. Difference between cultivars dates classes are due to the presence of external or internal factors that distinguish cause it to be more resistance or sensitive to insect infestation. The fact that insects may be prevented from feeding by certain chemicals is the potential value in crop protection.

The aim of the present studies, to measure date cultivars susceptibility toward *O. surinamensis* infestation and the rate of its loss during storage.

Materials and Methods

I-Rearing *O. surinamensis*:

Infested dates were collected from storehouse at plastic containers and carefully investigated to isolate adult stage (female and male) of saw teethe beetle by using stereomicroscope according to description of ². After that five pairs of males and females beetles were put on plastic container (8x12 cm²) which contain 150 gm. of disinfested dates and then tight close it. The rearing containers were placed in incubators at 27±1°C and 65 ±5% Rh for three weeks. The infested dates were isolated in another plastic container and repeated that till obtain the pure and susceptible susceptible generation of saw teethe beetle to start laboratory experiment. The life cycle of saw teethe beetle was recorded as described Fig (1).

II- Determination of the physical characters and chemical constituent of tested cultivars: eight cultivars types of dates were selected namely (Barhi, Barhi Al Madina, Deglet Noor, Rushodia, Sukari, Ajwa, Mabroom and Nabtat Ali). The physical characters as texture, colour and shape were determined, in addition to analysis of its chemical constituents (total soluble solid, sugar, moisture, nitrogen, lipids, fatty acid and Ach percentages) which carried out at Research laboratory of plant production department, Agriculture and food Faculty, Saud University in Saudi Arabia Kingdom. The acidity, total sugar and moisture content percentages were calculated according to ⁴. The obtained dates were analysis through Master programs

III- Determination of the susceptibility of different date's cultivars to infestation by *O. surinamensis*: The experiments were carried out to determine its' susceptibility according to epiphyllaxis and endophyllaxis factors as follows:

III.1.Epiphyllaxis factors: it was evaluated through oviposition preference (non choice test) and the attractive cultivars to adult stage (choice test) of saw teethe beetle, the following experiments were conducted:

III.1.1. Non-choice test (oviposition preference): Five pairs of virgin males and females were released in Petri-dish (9 cm.) which contained one type of tested date cultivars. It was investigated daily to determine number of deposited eggs for fifteen days. Each experiment was replicated five times.

III.1.2. Choice test: The experiment was carried out at arena apparatus which made of plastic plate (20 cm in diameter), divided to eight parts by plastic partitions and left its center open to facilitate motion of released beetle between tested varieties (Fig 2). Equal weight of tested cultivars dates were introduced in each partition of arena,

released 10 pairs of adult stages of saw tooth beetles and tight closed it. After seven days, each one was investigated to count number of beetle attacked 

II.2. Endophylaxis factors: In order to evaluate it the following experiments were carried out:

II.2.1. Susceptibility index : weigh 50 gm. from each tested dry date varieties was introduced separately in plastic container (500ml) and 5 pairs of virgin males and females of saw tooth beetles were released inside the container for ten days. After that the beetle were removed and the test was follow up till new generation is obtained⁵. Calculate the susceptible index according to ^{6 and 7} as follows:

$$(SI) = \frac{\log_{10} F1}{D} \times 100$$

Where; ^D

SI = Susceptibility Index

F1= total number of released weevil

D= duration needed to release 50% of new generation

Experiment was carried out at incubator (75±1°C and 65±5%) and each one replicated five times.

II.2.2. Growth index of immature stages (Larva and Pupae): Ten pairs of virgin males and females were released in Petri dish (9cm.) which contained 2gm flour and acted as eggs deposition substrate. Daily, the flour was investigated to obtained 1st instars larvae. The obtained larvae were released on 10 gm. of the tested date cultivar which put at plastic container (500ml). The tested container were tight closed and kept at incubator. Growth index of immature stages was calculated according to equation of ⁸ as follows:

$$\text{Growth index} = N/D$$

Where, D = the total development time

N = Larvae that become adult (%)

III. Effect of saw tooth beetle infestation on the weight loss of stored date cultivar: The test was carried out by using separately 100 gm. of tested date cultivar at sack clothes , placed inside plastic container (500ml.) and then released 10 pairs of virgin saw tooth beetles. After six month, the dates were weighted to calculate their weight loss according to ⁹ equations as follows: 

$$W = W_e - W_c$$

$$\text{Weight loss (\%)} = \frac{W_i - W}{W_i} \times 100$$

Where;

W = real weight loss due to infestation. We= weight of date lost after six month of infestation.

Wc = weight loss at the control (without infestation

WI= weight of dater before infestation.).

Results and discussions

1- **Estimation of the physical and chemical properties of tested date cultivars:** The results indicated to the variation in physical and chemical properties of tested date cultivar which might lead to variation in its susceptibility. It was recorded as following:-

a. **The physical characters:** The Fig (3) described that there were variations between tested dates in texture, colour, and shape. The texture of Barhi, Barhi Al Madina, Rushodia, Sukari, and Nabtat Ali were smooth, but Ajwa, Mabroom and Deglet Noor were curly, little and much wrinkle.

On the other hand, the colours were ranged between light brown to dark brown for Barhi, Deglet Noor, Rushodia, Barhi Al Madina, Sukari and Mabroom, but Ajwa and Nabtat Ali were Maroon and dark colour, respectively. Generally, the shapes were ranged between oval to elongate.

These observations agree with ¹⁰ who studied physical characters of six date cultivars and recorded the variations in size, colour, shape and weight among its. 

b- **The chemical composition:** The results indicated that there was significant ($p \leq 0.05$) variation in chemicals constituents of different date cultivars as recorded in Table (1).  Barhi cultivar was recorded the highest percentages significantly ($p \leq 0.05$ or 0.01) in total soluble solids (76.8%), and sugar content (68.98%) compare to Mabroom, Rushodia, Nabtat Ali and Sukari which were recorded the lowest one, ranged between 70 to 50 % respectively. While the acidity percentage of the most tested date cultivars were closely nearly to each other, except that Daglet nor and sukari were recorded significant ($p \geq 0.05$) low percentage (0.156%). In addition to the highest percentage of moisture content in date cultivar was recorded to Rushodia (15.67%) while the lowest one was Barhi Al Madina (11.38%). 

On the other hand Nitrogen, Lipids, Fiber and Ash percentages in tested date cultivars were recorded the high significantly variation ($p \leq 0.01$ or 0.05) in Ajwa, being 5.45,

0.38, 11.25 and 3.3% while Barhi was recorded the lowest percentage of nitrogen, lipids and fibers, being 1.42, 0.13 and 4.23% and Mabroom was recorded the lowest percentages of Ash content, reaching to 2.06%.

The obtained results agree with ¹¹ who mentioned that there are significant variations in chemical composition of eight date cultivars. Also, Many searches confirmed that there are variations in physical characters and chemical constituents among various date cultivars. ^{11, 12 and 13}

II- Laboratory evaluation the susceptibility of different dates cultivars to infestation by *O. surinamensis*: From previous results, It is cleared that each date cultivar has physical and chemical characters which might effect on its' susceptibility toward the saw teethe beetles. The present work was carried out in order to evaluate such characters under laboratory conditions.

Epiphyllaxis factors (external protection agencies) were determined through ovipositional preferences and attractive of adult stages (choice test); while endophyllaxis factors (internal protection agencies) were determined through measurement the susceptible index and growth index. The effect of these factors was determined as follows:

1. **Ovipositional preferences:** Results presented in Table (2) show that the role of physical characters (external protection agencies) of different date cultivars in selection of the saw teethe beetles to the site oviposition. The data indicated that there was highly significant difference ($P \leq 0.01$) among the tested date cultivar. The highly susceptible date cultivar was sukari which was recorded the highest numbers of deposited eggs, being 61.67 ± 1.7 eggs/five females/two weeks compared to the most resistance one which were recorded the lowest numbers of deposited eggs, reaching 2.67 ± 0.9 eggs/five females/two weeks. The moderate susceptible one was Barhi, being 49.3 ± 3.2 eggs/five females/ two weeks while moderate resistance one was Mabroom cultivar, being 14 ± 0.01 eggs/five females/two weeks. On the other hand the most resistance one was Al Ajwa and Deglet Noor were recorded the least mean number of eggs deposition, reaching 2.67 ± 0.9 and 6.67 ± 1.2 eggs/five females/two weeks.

2. **Attractive of adult stage (choice test):** Results cleared in Table (3) indicated that there was an odd among tested date cultivars in the percentage of adult attack. The most preferable date cultivars were Rushodia and Sukari, reaching the

attraction percentage to 28.75 and 22.5% while Al Ajwa and Deglet Noor were the least desirable cultivars, reaching to 3.1%. 

From the obtained results it is clear that the physical characters like as colour, texture, size, etc. may play a role in orientation of adult stage to attack certain cultivars more than others as mentioned by ¹⁴. 

3- Measurement of Growth index of immature stages: Results in Table (4) indicated that there was highly significant ($P \leq 0.01$) variation in growth index of immature stages of Saw teeth beetle among the most of tested date cultivars. The growth index of immature stage was increase with increase the percentage of larval development within short time, vise verse. The most preferable date cultivar was recorded to Sukari followed by Barhi and Rushodia, reaching 4.16 ± 0.03 , 3.22 ± 3.7 and 3.22 ± 0.0  larva to adult /day respectively. While Deglet Noor and Ajwa stunted the growth of larvae, so it was recorded the lowest growth index, being 0.48 ± 0.02 and 0.94 ± 0.01 larvae to adult/day, respectively.

4-Measurement of Susceptibility  index: Table (5) cleared that there were three cultivars as Sukari, Barhi and Rushodia considered the most significantly ($P \leq 0.01$) susceptible cultivars comparable with others. It were recorded the SI ranged between 13.5 to 14.5%.

4- Relation between Susceptibility index and chemical constituent of date cultivars. The susceptibility of tested cultivars toward Saw teethe beetle affected by chemical constituents, as cleared in Table (6). The susceptible index of tested cultivar was insignificantly ($P > 0.05$) increased with decreased total sugar, acidity, lipids, fibers and nitrogen content (correlation value ranged between -0.25 and -0.62) while ash content was highly significantly affected on SI ($r = -0.833$).

On the other side, there are positive correlation between SI and water content of tested cultivars (r= + 0.71) and that mean increased susceptibility of date cultivar with increased its water content.

From the obtained results could be concluded that chemical composition of tested cultivars affected on its susceptibility toward Saw teethe beetle. These observations agree with ¹⁵ who recorded that the rate of eggs deposition, longevity of larvae and pupae of *O. surinamensis* affected by date cultivars.

¹⁶ recorded the variations in growth rate of *P. interpunctella* at different cereal cultivars and related that to the variation in the value of nutrition contents 

On the other hand there are many authors studied effects of others plant cultivars on growth index of larvae and deposited eggs of *O. surinamensis* as  different corn cultivars and ¹⁸ on five wheat cultivars.

III- Study The weight loss of stored date cultivar due to *O. surinamensis* infestation: The dates in table (7) cleared that there were gradual loss of date weight due to attack the saw teethe beetles. The highest percentages of weight loss were recorded to Barhi follow by Barhi Al Madina, Rushodia and Sukari, ranged between 62.7 to 43.7% after six months. While the least weight loss was recorded to Deglet Noor and Ajwa, reaching to 11.6 and 21.5% after six months.

It is clear that infestation by *O. surinamensis* caused loss in quality and quantity of Barhi Barhi Al Madina, Rushodia and Sukari during storage. The results confirmed on other date cultivars by other authors as  who found that the Al Mahlawi cultivar was lost weight when exposed to *O. surinamensis* after 90 days of storage. Generally, the heavy infestation by insects in storage leads to increase the temperature degree which leads to increase loss of water content of stored materials and that lead to increase moisture and agglomeration of stored materials.

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UNDER PEER REVIEW

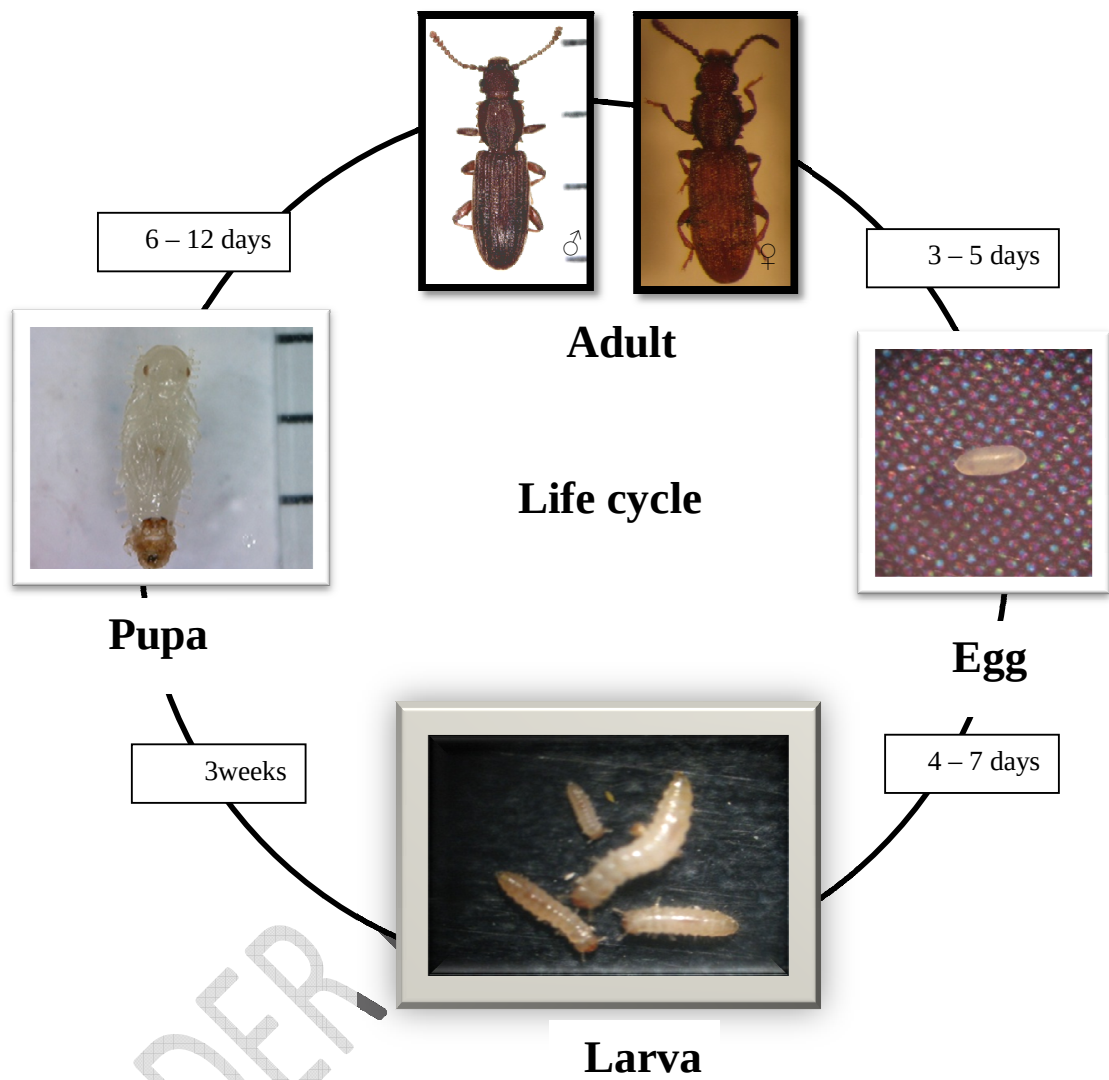


Fig. (1): Life cycle of *O. surinamensis*

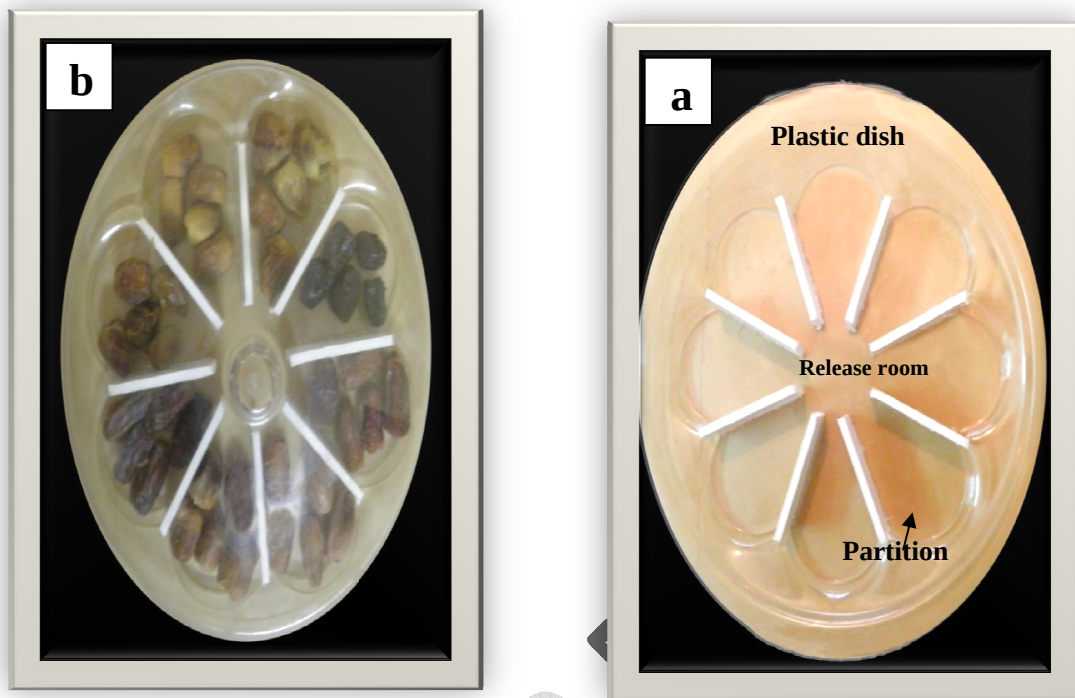


Fig (2): Arena design which used in preference test

(a) = Structure of arena, (b) = Arena during experiment



Fig (3): Photo shows the physical properties (texture, colour, shape and size) of the different varieties of date.

Table (1): Analysis of chemical constituents of tested date cultivars.

Means with the same letters have no significant difference

Date cultivars	Total soluble solids (%)	Acidity (%)	Total sugars (%)	Moisture content (%)	Nitrogen (%)	Lipids (%)	Fiber (%)	Ash (%)
Barhi	76.80 _a	0.192 _a	68.98 _a	14.54 _b	1.42 _f	0.130 _f	4.23 _f	2.14 _b
Barni Al Madina	74.00 _b	0.205 _a	67.02 _a	11.38 _e	3.91 _d	0.141 _f	7.06 _d	2.30 _b
Deglet Noor	74.00 _b	0.156 _b	65.40 _a	13.10 _d	5.12 _b	0.321 _b	9.33 _b	2.31 _b
Rushodia	68.40 _d	0.217 _a	58.78 _c	15.67 _a	2.74 _e	0.143 _f	5.79 _e	1.72 _d
Sukari	71.60 _c	0.156 _b	57.98 _d	14.70 _b	4.67 _c	0.285 _c	8.74 _b	1.73 _d
Ajwa	74.40 _b	0.217 _a	61.98 _b	14.02 _b	5.45 _a	0.380 _a	11.25 _a	3.30 _a
Mabroom	69.60 _c	0.205 _a	57.84 _d	13.87 _c	4.11 _d	0.187 _e	8.19 _c	2.06 _c
Nabtat Ali	71.20 _c	0.192 _a	59.68 _c	14.61 _b	4.99 _b	0.215 _d	8.52 _b	2.23 _b
LSD _{0.05}	2.09	0.027	3.95	0.70	0.299	0.015	0.89	0.24

Table (2): Effect of tested date cultivars on female fecundity of *O.surinamensis*.

Date cultivars	Number of deposited eggs/5femal/2weeks (Mean $\pm$ S.E)
Barhi	49.33 $\pm$ 3.2b
Barni Al Madina	16.67 $\pm$ 0.9e
Deglet Noor	6.67 $\pm$ 1.2f
Rushodia	25.00 $\pm$ 1.1d
Sukari	61.67 $\pm$ 1.7a
Ajwa	2.67 $\pm$ 0.9f
Mabroom	14.00 $\pm$ 0.01e
Nabtat Ali	32.33 $\pm$ 0.9c
L.S.D at 0.05	4.68
L.S.D at 0.01	5.69

Means with the same letters have no significant difference

Table (3): Attraction percentage of *O. surinamensis* adults toward eight dry date cultivars (Choice test).

Date varieties	Percentages of adults attract
Barhi	13.8
Barni Al Madina	11.3
Deglet Noor	3.1
Rushodia	28.8
Sukari	22.5
Ajwa	3.1
Mabroom	4.4
Nabtat Ali	13

Table (4): Measurement of growth index of immature stages of *O. surinamensis* rearing on different dates varieties

Date varieties	Growth Index (Mean $\pm$ S.E)
Barhi	3.7 $\pm$ 0.08
Barni Al Madina	2.7 $\pm$ 0.33
Deglet Noor	0.48 $\pm$ 0.02
Rushodia	3.22 $\pm$ 0.06
Sukari	4.16 $\pm$ 0.03
Ajwa	0.94 $\pm$ 0.01
Mabroom	2.29 $\pm$ 0.32
Nabtat Ali	2.15 $\pm$ 0.1
L.S.D at 0.05	0.504
L.S.D at 0.01	0.898

Table (5): Susceptible index measurement of tested date cultivars towards Saw teethe beetle.

Date varieties	Total No. of First progeny	period for emergences of 50% First progeny	S.I(%)
Barhi	47±2.08b	28	14.3±0.4a
Barni Al Madina	34±4.5d	35	10±0.4c
Deglet Noor	27.7±3.7d	35	9.4±0.4d
Rushodia	43±2.5b	28	13.4±0.2a
Sukkari	57±1.5a	28	14.5±0.1a
Ajwa	13.67±3.9d	35	7.1±0.03d
Mabroom	24.33± 2.6d	28	11.4±0.4c
Nabtat Ali	39±6.6c	30	12.4±0.3c
L.S.D at 0.05	10.12		1.42
L.S.D at 0.01	13.45		1.95

Means with the same letters have no significant difference

Table (6): Correlation between chemical compositions of tested date cultivars and susceptibility index.

Components (%)	Correlation (r)	significant
Total soluble solids	-0.252	No sig.
Acidity	-0.364	No sig.
Total sugars	-0.238	No sig.
Moisture content	0.714	0.05
Nitrogen	-0.619	No sig.
Lipids	-0.476	No sig.
Fiber	-0.548	No sig.
Ash	-0.833	0.01

Table (7): The percentages of the real weight of the different varieties of dates during storage for six months

Tested Date cultivars \ Months of store	(% of weight loss)						Mean of monthly loss (%)
	1	2	3	4	5	6	
Barhi	2.7	5.5	18	40.4	55.4	62.7	30.8
Barni Al Madina	2.9	4.6	13.7	34.7	48.3	55.2	26.6
Deglet Noor	5.2	7	7.5	10.5	11.3	11.6	8.9
Rushodia	4.9	7	16.9	38.3	49.19	53.5	23.3
Sukkari	5.9	8.8	18.9	36	41.6	43.7	25.8
Ajwa	3.4	3.7	7.1	10.5	16.7	21.5	10.5
Mabroom	1.7	2.2	4.9	18.1	31.3	40	16.4
Nabtat Ali	5.6	8.2	18.7	33	36.7	38.6	23.5