



## Physical and Nutritional Properties of Iraqi Dayri Dates

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ARTICLE INFO	ABSTRACT
<p><b>Article History:</b></p> <p>Received 2022/ 10/ 30 Accepted 2022/ 12/ 07</p> <hr/> <p><b>Keywords:</b></p> <p>Dayri dates, Physical properties, Nutritional properties.</p> <hr/> <p><b>DOI:</b> 10.22034/FSCT.19.129.67 <b>DOR:</b> 20.1001.1.20088787.1401.19.129.5.2</p> <hr/> <p>*Corresponding Author E-Mail: haiderjk77@gmail.com</p>	<p>Physical properties of Dayri dates fruits are important for reducing losses during the harvesting, storage and designing machines, processing, transportation machines, handling, packaging, and assessment of fruits quality. Also, the nutritional composition of this variety of date is important to know the nutritional values of it, the importance of its consumption, the qualities available in it, and comparing it with other varieties of dates and the same variety, but from another country. In this study the average of mass, length, width, thickness, sphericity, true and apparent volume, surface area, Bulk and True density, geometric and arithmetic mean diameter, porosity, and aspect ratio were 5.01g, 33.26mm, 18.89mm, 15.07mm, 63.3%, 3.72 cm<sup>3</sup>, 4 cm<sup>3</sup>, 13.91 cm<sup>2</sup>(McCabe), 11.65 cm<sup>2</sup>(Jean&amp; Ball), 0.52 g. cm<sup>-3</sup>, 0.99 g. cm<sup>-3</sup>, 21.28mm, 21.90mm, 54.06%, 55%, respectively. Dayri dates are rich in nutritional properties, such as fiber (59.26g/100g), Total solids (96.03g/100g), Energy (143.278 Kcal), Carbohydrate (29.457g/100g), Protein (3.55g/100g), Fat(1.52g/100g), Magnesium (3.81g/100gm), Ash(2.52g/100g), Vitamin B1 (4.44ppm), B2 (2.77ppm), and limited amount or not of Zinc, Magnesium, Copper, Vitamin (A, E, B6, C). Sucrose was (3.679 ppm) and this amount is high compared to other varieties of dates, on the other hand, the amount of fructose and glucose were lower compared to other varieties.</p>

## 1- INTRODUCTION

Date palm (*Phoenix dactylifera L.*) belongs to palm tree family (*Arecaceae*) and cultivation is widespread in Iraq, Middle East and North Africa [1]. A palm tree in the religious culture of Muslims is considered a sacred tree, as it was mentioned in the Qur'an and ancient texts which indicate that the Sumerians in Iraq were the first to plant this tree 4,000 years ago BC [2]. In terms of its nutritional value, it is the most important for humans, as it is an important source of energy because they have high content of carbohydrate (70–80%). In addition, other nutritional facts that date comprise: protein (2.30– 5.60%), fiber (6.40–11.50%), fat (0.20– 0.50%), vitamins for example (B1, B2, B3, C and A), salts and minerals (15 %), and with very little or no starch [3, 4]. In addition to eating it as a fruit, it is used in many other food industries such as pastries, date syrup and many products of date processing such as organic acids, exopolysaccharides and others. Iraq produces about 646,163 tons of dates and had 15139076 trees in the year 2018. Dayri date trees produce about 26215 tons per year about 4.1% of all Iraqi date types. In 2018 Iraq had 1119980 Dayri trees; an average palm produces about 56.3 kg/tree. Diyala province ranks first for the number of Dayri palms while Basrah province comes second [5]. Dates go through multiple stages of growth, such as hababouk, kimri, bisir or khalal, rutab and tamr, and are usually not consumed, except for the period during khalal stage such as barhi and all of them are consumed in the Rutab and Tamr stages. Dates are divided according to their texture into soft, dry and half-dry dates [6]. The most Dayri dates in Iraq are eaten after the Rutab and tamr stages when it becomes dry, because even Rutab stage has alight sweetness and undesirable for eating in this stage so it is left to dry and then harvested in mid- September. Therefore, it is only sold in the market at the stage when the date has a dry texture with a similar strength of chewing gum; the humidity decreases a lot, deep brown color and distinctive flavor.

Because of its low water content, it is stored for long periods of time; it is subject to many physical changes such as loss of weight, size and dryness to a level that makes them hard to chew.

Therefore it is important to study the physical properties of Dayri dates due to the economic importance and for the purpose of reducing losses during the harvesting, storage and designing machines, processing, transportation machines, handling, packaging, and assessment of fruit quality and also it is important to study the nutritional value of these dates and compare them to other varieties of dates or the same variety but from another environments.

Unfortunately, there is no study on the nutritional and physical properties of the Iraqi Dayri dates yet. The study of nutritional properties include: vitamins, minerals, protein, fat, sugar, ash, and fibers, on other hands the physical properties in this study include: mass, length, width, thickness, sphericity, volume, surface area, Bulk and True density, geometric and arithmetic mean diameter, aspect ratio, porosity. More studies have been done on the physical properties of fruit, seeds, and grains, such as kiwifruit [7], lentil seeds [8], Bambara groundnuts [9] and Cotton seed [10].

The aim of studying the physical and nutritional properties of Dayri dates is to create a database for Iraqi Dayri dates that enables us to benefit from it if we want to design the machines for separating, transporting and processing these dates, as well as packing, marketing and storage operations. Also, knowing the distinctive nutritional value of these dates and comparing them with other varieties, which make it possible to recommend eating them and introducing their nutritional value.

## 2- Materials and method

### 2-1-Samples

Dayri dates were harvested in September from the palm orchards of Maysan city in the south of Iraq and transferred to the laboratory of Market Research and Consumer Protection/ University of Baghdad. 100 fruits are gathered randomly for testing at room temperature.

## Nomenclature

L	length of fruit ,mm	M	unit mass of seed, g
R	aspect ratio, %	W	width of fruit, mm
S	surface area, mm <sup>2</sup>	T	thickness of fruit, mm
V <sub>a</sub>	apparent volume, cm <sup>3</sup>	D <sub>g</sub>	geometric mean diameter ,mm
V <sub>t</sub>	true volume, cm <sup>3</sup>	D <sub>a</sub>	arithmetic mean diameter, mm
R <sub>a</sub>	aspect ratio, %	φ	sphericity, %
ρ <sub>t</sub>	true density, g/m <sup>3</sup>	P	porosity, %
ρ <sub>b</sub>	bulk density, g/m <sup>3</sup>		



Fig 1 Sample of Iraqi Dari dates

## 2-2- Physical properties

The calculation of mass of fruit is conducted by an electronic balance which indicates a sensitivity of 0.01g (ML3002.E, Mettler Toledo, Switzerland). Thickness (T), Width (W), and Length (L) are calculated by a micrometer (Tuff 0.01mm). As for sphericity, geometric means diameter ( $D_g$ ), and arithmetic means diameter ( $D_a$ ), these are figured as in the equation below [11].

$$\phi = \frac{(LWT)^{0.333}}{L}$$

(1)

$$D_g = (LWT)^{1/3}$$

(2)

$$D_a = \frac{(L+W+T)}{3}$$

(3)

The surface area (S) of fruit is expressed by the equation of McCabe *et al.* (1978) & Jean & Ball, (1997) [11]:

$$S = \pi D_g^2$$

(4)

$$S = \frac{\pi B L^2}{2L-B}$$

(5)

$$\text{Where } B = (WT)^{0.5}$$

True volume ( $V_t$ ) is calculated by the liquid displacement method [12] :

The apparent volume ( $V_a$ ) is calculated theoretically by calculation Jain & Bal (1997) [11] :

$$V_a = \frac{\pi B^2 L^2}{6(2L-B)}$$

(6)

The following equation has showed the error between apparent volumes to true volume:

$$\%e_v = \frac{v_a - v_t}{v_t} \times 100$$

(7)

Aspect ratio (Ra) is determined by Maduako & Faborode (1990) [13]:

$$\%R_a = \frac{W}{L} \times 100$$

(8)

True density ( $\rho_t$ ) is measured by the following equation [14] :

$$\rho_t = \frac{M_a}{V_t}$$

(9)

The bulk density (g/ cm<sup>3</sup>) is obtained by a container filled with Barhi fruits known mass and measured the volume. The bulk density is determined by the ratio between the fruits mass in the container to its volume [15].

$$\text{Bulk density} = \frac{\text{Sample Weight}}{\text{Volume}}$$

(10)

The porosity of the bulk is determined by mohsenin (1978) [11]:

$$\% \epsilon = \left(1 - \frac{\rho_b}{\rho_t}\right) \times 100$$

(11)

## 2-3- Chemical Analysis

### 2-3-1- Moisture Content

The moisture content is determined by drying a suitable quantity of dates in an air oven at 90-100 °C for 2-3 hours to constant weight.

### 2-3-2- Protein Content

Protein was calculated by kjeldhal method; fat by soxhlet method, fiber by fibertec system analysis, ash by the sample kept in an oven at 500 °C for 24 hours then calculated by the difference between the weight before and after the burn.

### 2-3-3- Vitamin Content

Vitamins such as B1 (thiamine), B2 (riboflavin), B6 (pyridoxine), C (ascorbic acid) were carried by HPLC analysis (AOAC, 1990), equipped with a refractive index detector and the system is connected to the data processing unit. The sample was injected with 20 ml onto a Nova-Park Radial-Pak cartridge column (4 μm, 100 × 8 mm) (Waters Associates, Milford, MA, USA).

### 2-3-4- Invert Sugar

Mobile phase acetonitrile: water = 80% used at a flow rate of 1 ml/min to achieve optimum resolution peaks of fructose, glucose and sucrose in the presence of other components in fruits. The detector and column temperature was maintained at 30 °C.

### 2-3-5- Total Solids, Ash, Fat and Energy Content

Total solids were calculated after subtracting moisture from 100, carbohydrates based on the proximate composition of fat, total solids and ash, and energy was determined according to AOAC (2000) and person (1997) [16, 17].

#### 2.3.6. Mineral Content

Manganese (Mn), magnesium (Mg), copper (Cu), zinc (Zn), Iron (Fe), were determined by using atomic absorption spectrophotometry [18]. Sugars (sucrose, glucose and fructose) were conducted by El- Shaarnouby (2014) [19].

## 2-3- Statistical Analysis

The statistical analysis was carried out by using Microsoft excel software. Trends were

considered significant while means of compared sets differed at  $P < 0.05$  (Student's t-test).

## 3-Results and Discussion

### 3-1- Physical Properties

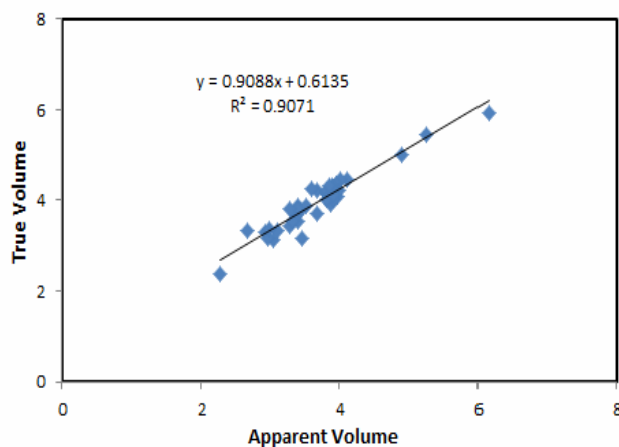
Physical properties of Dayri dates were given in Table1. About 80% of the lengths fruits were between 33 mm and 37 mm, 78% of the widths between 17 mm and 19 mm, 88% of thickness between 14 mm and 16 mm and the moisture contents were 3.39% for Dayri dates. This means that length was 33.26 mm, width was 18.89 mm and thickness was 15.07 mm and mass was 5.01 g for Dayri date. These results were lower than those reported by jahromi (2008) for Iranian Dayri dates, except thickness which was higher in this study [20]. Dimensions are important in separation of fruits; estimate the number of dates to be placed in boxes and how to design these boxes and determining aperture size of machines [21].

The main of aspect ratio and sphericity of Dayri dates were 55% and 63.13%, respectively. Sphericity expression to that of a sphere of the same volume whiles the aspect ratio indicating the tendency of fruits towards elongation [22].

These results indicate that the dimensions do not have an effect on the sphericity of the fruits individually, but rather have a combined effect, so the result values of sphericity obtained by jahromi (2008) were similar [20]. The sphericity of Dayri dates was lower than the results for kiwifruit (79.80%) by Razavi (2007), gumbo (77.80%) by akar and Aydin, and (2005) and higher than sweet cherry [7, 23, 24]. From the sphericity and aspect ratio, it possible to deduce how the fruits move on transport surfaces. Whenever their values are close to each other, this means that the fruit will undergo a mixture of rolling and sliding movement on the transport surfaces [7]. The true density, bulk density, true volume, apparent volume and porosity were 0.99 g cm<sup>3</sup> and 0.52 g cm<sup>3</sup>, 4 cm<sup>2</sup>, 3.72 cm<sup>2</sup>, 54.06%, Respectively (Table 1). The error between apparent volumes to true volume was -33.20% and this means that the true volume will be very suitable in the design of processing machines.

**Table1** Physical properties of Dayri dates

Attribute	Unit of measurement	Replication	Minimum value	Maximum value	Mean value	Standard deviation	Range
Length	mm	100	17	37	33.26	4.09	20
Width	mm	100	16	21	18.89	2.56	5
Thickness	mm	100	13	17	15.07	1.24	4
Mass	g	100	3.90	6.43	5.01	0.52	3.53
Geometric mean Diameter	mm	100	17.94	25.62	21.28	1.35	7.68
Arithmetic mean Diameter	mm	100	18.00	23.83	21.90	1.34	5.83
Sphericity	%	100	26.20	105.56	63.13	7.31	79.36
Surface area(McCabe)	cm <sup>2</sup>	100	10.86	19.75	13.91	1.64	8.89
Surface area(Jean& Ball)	cm <sup>2</sup>	100	9.12	17.08	11.65	1.34	7.96
Apparent volume	cm <sup>2</sup>	100	2.27	6.14	3.72	0.59	3.87
True volume	cm <sup>2</sup>	100	2.37	5.92	4.00	0.56	3.55
Aspect ratio %	%	100	44	71	55	11	0.73
Apparent density	g. cm <sup>-3</sup>	100	1.50	2.09	1.77	0.14	1.59
Bulk density	g. cm <sup>-3</sup>	5	0.50	0.56	0.52	0.02	0.06
True density	g. cm <sup>-3</sup>	100	0.89	1.16	0.99	0.08	0.27
Porosity	%	5	27.28	59.77	54.06	3.64	2.49

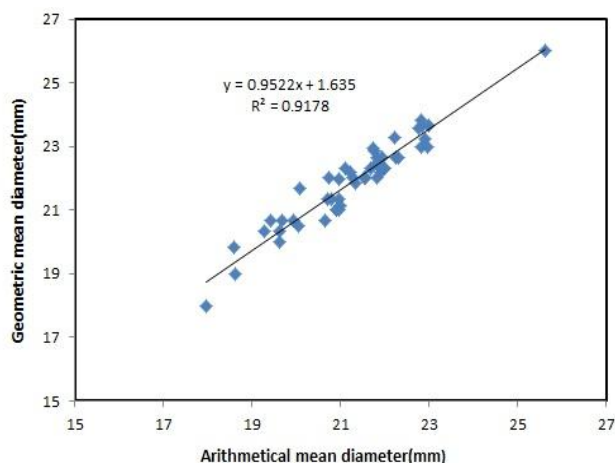
**Fig 2** Relationship between geometric and arithmetic mean diameters of Dayri dates

The true density and porosity were higher than those obtained by jahromi (2008) for Iranian dayri dates and this is because the weight of Iraqi Dayri dates to true volume were lower than Iranian dayri dates while the bulk density and porosity were lower [20].

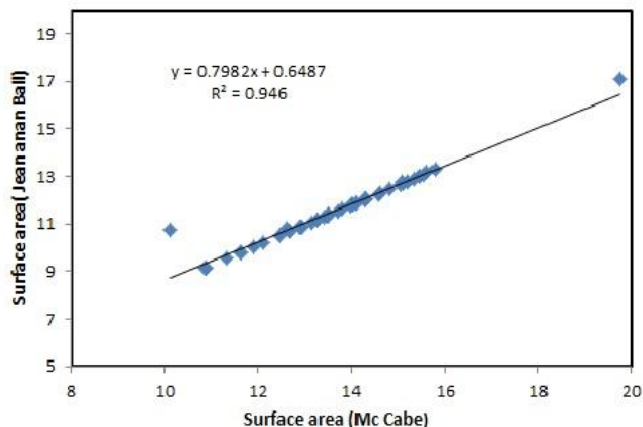
The geometric diameter was 21.01, arithmetic diameter was 22.33 and these results were almost the same (Fig1). So, both methods can be used to calculate the equivalent diameter of Dayri dates.

The values of surface area of Dayri dates calculated by two equations were (13.91 cm<sup>2</sup>) (McCabe) and (11.65 cm<sup>2</sup>) (Jean& Ball) (Table1).

Fig3. Showed the relationship between the values of surface area of Dayri dates by the (McCabe) equation and (Jean& Ball) equation and the results showed that both equations were suitable for the prediction of surface area as indicated by the coefficient of determination (R<sup>2</sup>), contrary to the results obtained by Razavi (2004) regarding the Kiwi fruit, where it was found that the equation of (Jean& Bal) was not suitable for measuring the surface area [7]. The surface area of Iraqi Dayri dates were lower than Iranian Dayri dates where studies by jahromi (2008) and the reason for this is that the weight of the Iranian fruits is higher, as Razavi (2004) indicated that there is a direct relationship between the surface area clearance of Kiwi fruit and its weight [7, 20].



**Fig 3** Relationship between geometric and arithmetic mean diameters of Dayri dates



**Fig 4** Relationship between two equations of surface area.

### 3-2- Nutritional Properties

The nutritional properties of Dayri dates are shown in Table 2. These properties are important to know the nutritional characteristics of this variety and compare it with other varieties of dates. The results show that the protein in Dayri dates was 3.55% and these values are higher than the Egyptian siwi date (1.72%), Oman date such as Fard (1.47%), khasab(1.61%), khalas(1.68%) which reported by Khaled (2012), Alfarisi (2005) [25, 26]. In another study, it was found that the protein content of three date fruit varieties from Libya (Bekraray, Deglet-Nour and Khathori) ranged between 1.86 to 2.78% [27].

From these results, Fat, Ash, Fiber and Carbohydrate were (1.25%), (2.52%), (59.26%), (29.45%), respectively. These results were higher than siwi date. Carbohydrate in Dayri date was lower than three Oman dates (Fad, Khasab, Khalas), this difference can be explained by the difference in the maturity stage in each variety is consumed. For example Barhi dates are consumed in the khalal stage, while most of Dairy dates are consumed at the stage when the date becomes dry. Dayri dates were characterized by a high percentage of fiber when compared to the results obtained by Al- shahib and marshall (2005); the study included fourteen dates and found that their fiber content was between (7.2-14%). As a result, one of the advantages of Dayri dates can be considered is its high fiber content. This can be explained by the low water content of these dates [7].

The minerals were (Fe 1.6), (cu 0.26), (mg 3.81), (mn0.11), (Zn 0.1), these results indicate a good iron content when compared to iron content of other fruits, for example, oranges contain (0.70- 1.77mg/l) [28], and it is also higher than dates varieties studied by the Alfarisi (2005) [26].

Two monosaccharaides were, glucose (3.416 ppm) and fructose (3.007 ppm) (Table 1), while the content of the sucrose was (3.67ppm) in Dayri dates. Glucose and fructose were lower than 12 different varieties of dates in the United Arab Emirates, while the sucrose was higher [29]. The high percentage of sucrose because of low inverts enzyme activity at Dayri date at all stages, for example, the activity of this enzyme in date shahani was 28 fold that was found in the Dayri date and this low activity is due to the low water content of these dates as the water content is an important factor in the enzyme inverts activity [30]. Therefore Dayri dates are characterized by their moderate sweetness compared to other date varieties.

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**Table 2** Nutritional properties of Dayri dates

Attribute	Unit of measurement	Values
Moisture	g/100g	3.3963± 1.13
Protein	g/100g	3.55± 0.51
Fat	g/100g	1.25±0.31
Fiber	g/100g	59.26±3.25
Ash	g/100g	2.52±0.22
C.H.	g/100g	29.457±2.40
T.S	g/100g	96.037±2.57
Energy	(Kcal)	143.278±2.92
Fe	(ppm)	1.6982±3.54
Cu	(ppm)	0.2642±0.02
Mg	(ppm)	3.8150±0.11
Zn	(ppm)	0.1074±0.33
Mn	(ppm)	0.1121±0.06
Fructose	(ppm)	3.007±0.19
Glucose	(ppm)	3.416±0.18
Sucrose	(ppm)	3.679±0.14
Vitamin B1	(ppm/10g)	2.77±0.36
Vitamin B2	(ppm/10g)	4.44±0.38
Vitamin B6	(ppm/10g)	0.2005±0.19
Vitamin C	(ppm/10g)	0.00023±0.001

Through this study, the vitamins were (B1 2.77 ppm), (B2 4.44 ppm), (B6 0.2005 ppm) and (C 0.00023 ppm), respectively. These results indicate that Dayri dates are a very poor source of vitamin C, B6, while being a good source of vitamin B2, B1 and no significant of vitamin F, A.

In some other varieties of dates, it was found that vitamin C was a great proportion, such as the study conducted by parvin (2015) on Tunisian dates, were the proportion of vitamin C was 0.7- 0.9 mg% [31]. By comparing of vitamins in Dayri dates, which are dry dates, and comparing that with wet dates, we conclude that dry dates contain fewer vitamins, and the reason is the depletion of vitamins during the process of drying these dates. In general, the concentration

of vitamins decreases at the maturity stages of dates, where the concentration is less in the rutab and tamer stages [32, 33].

#### 4-CONCLUSION

Dayri dates are one of the important types of dates, which are characterized by the fact that its consumption is mostly dry. After harvest, these fruits require the processes of separation, purification, cleaning, packaging and transportation, so the first step in completing the mentioned processes is to design machines suitable for these processes, and this requires studying the physical properties of these fruits. According to the results of chemical analysis, Dayri dates were rich in fiber, carbohydrate, energy, protein, iron, ash, Mg, and vitamin B1



and B2. There was also a high content of sucrose compared to other varieties, while the fructose and glucose were low. Daryi dates contain low levels of fat, Zn, Cu, Mn, Vitamin B6 and C.

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## خواص فیزیکی و غذایی خرمای دیری عراقی

حیدر جمعه الکعبی

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اطلاعات مقاله	چکیده
<p>تاریخ های مقاله :</p> <p>تاریخ دریافت: ۱۴۰۱/۰۸/۰۸</p> <p>تاریخ پذیرش: ۱۴۰۱/۰۹/۱۶</p>	<p>خواص فیزیکی میوه خرمای دیری برای کاهش تلفات در هنگام برداشت، نگهداری و طراحی ماشین آلات، فرآوری، ماشین آلات حمل و نقل، جابجایی، بسته بندی و ارزیابی کیفیت میوه، بسیار بااهمیت است. علاوه بر این، ترکیب غذایی این رقم خرما برای دانستن ارزش غذایی آن، اهمیت مصرف آن، کیفیت آن و مقایسه آن با دیگر انواع خرما و نیز همان رقم، اما از کشوری دیگر، حائز اهمیت است. در این مطالعه میانگین جرم، طول، عرض، ضخامت، کرویت، حجم واقعی و ظاهری، مساحت سطح، چگالی توده و واقعی، میانگین هندسی و حسابی قطر، تخلخل و نسبت ابعاد به ترتیب ۵،۰۱ گرم، ۳۳،۲۶ میلی متر، ۱۸،۸۹ میلی متر، ۱۵،۰۷ میلی متر، ۶۳،۳ درصد، ۳،۷۲ سانتی متر مکعب، ۴ سانتی متر مکعب، ۱۳،۹۱ سانتی متر مربع، ۱۱،۶۵ سانتی متر مربع، ۰،۵۲ گرم بر سانتی متر مکعب، ۰،۹۹ گرم بر سانتی متر مکعب ۲۱،۲۸ mm، 21.90mm، 54.06%، 55% بود. خرمای دیری حاوی فیبر (۵۹،۲۶ گرم در ۱۰۰ گرم)، مواد جامد کل (۹۶،۰۳ گرم در ۱۰۰ گرم)، انرژی (۱۴۳،۲۷۸ کیلو کالری)، کربوهیدرات (۲۹،۴۵۷ گرم در ۱۰۰ گرم)، پروتئین (۳،۵۵ گرم در ۱۰۰ گرم)، چربی (۱،۵۲ گرم در ۱۰۰ گرم)، منیزیم (۳،۸۱ گرم در ۱۰۰ گرم)، خاکستر (۲،۵۲ گرم در ۱۰۰ گرم)، ویتامین (B2 (2.77ppm, B1 (4.44ppm) و مقدار محدودی از روی، منیزیم، مس، ویتامین (A, E, B6, C)، ساکارز (3.679 ppm) بود که این مقدار در مقایسه با سایر ارقام خرما بالا است. از طرفی میزان فروکتوز و گلوکز آن در مقایسه با سایر ارقام کمتر بود.</p>
<p>کلمات کلیدی:</p> <p>خرما دیری، خواص فیزیکی، خواص غذایی.</p> <p>DOI: 10.22034/FSCT.19.129.67 DOR: 20.1001.1.20088787.1401.19.129.5.2</p> <p>* مسئول مکاتبات: haiderjk77@gmail.com</p>	