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Physicochemical Properties and Microbiological Quality of Dates Syrup Prepared from some Egyptian and Iraqi Dates Palm (Phoenix dactylifera L.) Fruits

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Abstract

Dates syrup is one of the most food products in Arab countries. It is very rich in nutrients, certain sugars and minerals elements. This research, dates syrup was manufactured using two types of Egyptian dates (meghal and siwy) and two types of Iraqi dates (zahidi and khestawi), where two methods were used in manufacturing (direct heat and steam heating). All samples evaluated for physical and chemical characteristics, microbiological and sensory quality. The results showed that the direct heating extraction method for moisture, total sugars, crude protein, fats, and ash for each dates syrup siwy and zahidi dates were (28.94 - 29.32%), (56.82 - 51.50%), (1.4 - 5.32%), (0.27 - 1.50%), (1.35 - 1.09%), respectively. The previous analyzes were performed on dates syrup obtained by the steam heating extraction method for both meghal and khestawi dates syrup were as follows (21.07-19.35%), (76.11-72.39%), (0.93-0.93) 2.70%), (0.005-0.41%), (0.6- 1.90%), respectively. The study also revealed the microbiological quality was under permissible limits of Egyptian Standardization Organization. The sensory evaluation of all treatments showed a high degree of susceptibility in dates syrup extracted by steam heat, more than in direct heat extraction. Therefore, the study recommends that the steam heat extraction method was better than direct heat extraction in all chemical, microbiological, and sensory characteristics.

Keywords: Dates Syrup, Nutrients, Extraction, Antioxidant, phenolic compounds, Sugar fractions

1. INTRODUCTION

The date fruits hold a special religious significance for Muslims all over the world, as it is mentioned numerous times in the Quran. Dates have always been the essential food to break the fastduring Ramadan [1]. Dates are one of nature's sweetest trees. Depending on the variety, fresh dates are fairly small in size and range in color from bright red to bright yellow. Medjool and Deglet Noor dates are the most consumed varieties. Dates are regarded as a nutritious meal. They can play a significant role in human nutrition and health because they own multiple functional and nutritional compounds essential to the human diet. Date's assuring preventive potential is hidden in its high nutritional value and its antioxidants, anti-inflammatory, antibacterial, and anticancer actions [2]. Dates honey is a concentrated dates juice containing colloidal components that has had most of its colors removed; it may be used in drinks and soft and hard candy products [3]. Sugar may be collected from the stem tissue of some dates palm varieties to produce a type of syrup. Dates syrup caramel colouring may be used in a variety of meals, including drinks, bread, confectionery, and meat items. Another dates palm product is "Tarooneh" arrack, which is formed from the cover of dates blooms and has some medicinal properties. Other items derived from dates palm stems include sago (white) and "Lagmi" (date palm sap). Dates palm sap is abundant in antioxidants and nutritional content, making it an excellent functional food [4].

Dates syrup is a concentrated extract of the dissolved solids in pitted date fruits [5]. It is also made by separating and heating juice on different scales [6]. Dates syrup contains more than 71% sugar [5,7]. with glucose and fructose serving as the primary sugars [8,9]. It also includes macro-elements including sodium, potassium, and calcium, as well as iron, which

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is the most prevalent high micro-element [5,7,10].

Results showed that a 25 percent sonication power at a ratio of 1/3 D/W could result in a higher recovery of soluble solids RSS (74 %) in a shorter time with a better physicochemical quality of syrup than a 0.1 percent enzyme mixture (67 %) and traditional extraction methods (59%) (6). This study set out to produce dates syrup by direct heat and steam heat method using two types of Egyptian dates (meghal and siwy) and types of Iraqi dates (zahidi and khestawi). Dates syrup prepared were evaluated for physical and chemical characteristics, microbiological, antioxidant activity, total phenolic, total flavonoids, and sensory quality.

2. MATERIALS AND METHODS:

2.1 Dates varieties and commercial dates syrup:

Iraqi dates varieties Zahidi and Khestawi were obtained from Ministry of Agriculture, Iraqi. Egyptian dates varieties Meghal and Siwy were obtained from Ministry of Agriculture, Egypt. All of dates samples collected during the 2020 season, at Tamr stage. The dates fruits were cleaned from impurities. The pits were removed and packed into polyethylene until used. Commercial dates syrup, commercial name (Elwaha), were purchased from local market at Cairo, Egypt.

2.2 Reagents and Microbiological media:

1,1-diphenyl-2 picrylhydrazyl radical (DPPH), standard phenolic compounds, Folin-Ciocalteu reagent, and 2,6-dichlorophenol-indophenol were obtained from Sigma Aldrich Germany). Ascorbic acid, other solvents, and microbiology medias were obtained from Gamhouria Trading Chemicals and Drugs Company (Cairo, Egypt).

2.3 Extraction of dates syrup:

Date syrup was extracted using two ways. The first approach (I) is shown in **Fig. (1)**, the method described by [12]**.** with a minor modification. Dates were soaked in a 100 L steam-heated double-walled tank (Stage 1) with water at 70 °C (1:4 solid to liquid ratio) for 6 hours with moderate agitation. The tank's agitation technique allowed for efficient homogenization and improved soluble molecule extraction. The second stage is to separate the liquid fractions, largely made up of dates soluble sugars, from the solid fractions, mostly made up of crude fibres and insoluble chemicals. A muslin layer was used in a second filtration stage to remove the foreign matters. Finally, the clarified juice was condensed using a vacuum evaporator. Stage 3 is to make a 70% dates syrup from dates syrup. This evaporation process by steam circulation at 55 °C minimized sugar caramelization via Maillard reactions and kept the nutritional quality of the final syrup, such as polyphenols and mineral content.

The second method (II) aimed to prepare dates syrup using the method described by [13]**.** with slight modifications **(Fig. 2)**. In brief, the water-to-dates pulp ratio (W/D) was utilised (3:1). Dates flesh was weighed and sliced into little pieces of around 1 cm x 1 cm/0.3 cm in size. The flesh was treated with hot water (70-75 °C) and left for three hours. The slurry was manually pressed twice through cheese cloth, and the residual pulp was blended with a little amount of hot water (70-75 °C) and filtered again. To achieve a water/dates (W/D) pulp ratio of (3/1), hot water was added twice. The slurry was blended by hand and filtered again using cheese cloth. The clear extract was concentrated using a rotary evaporator at (70 °C). Concentrated samples were sealed and stored in glass bottles. Some glasses were kept at room temperature. Dates syrup was tested and compared to a dates syrup sample from a local market.

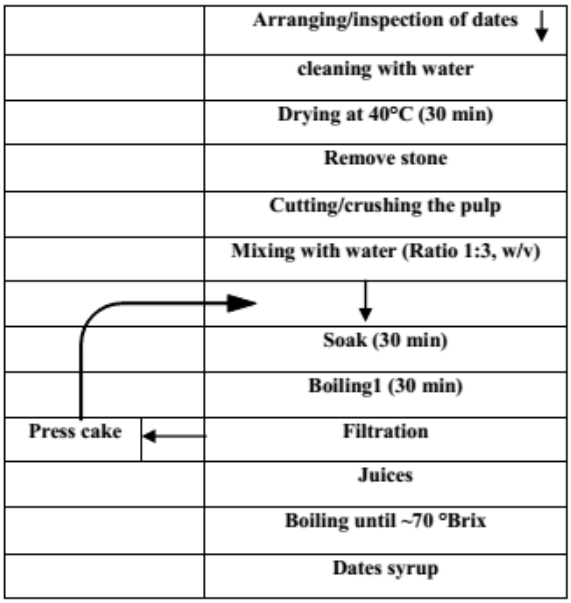

Fig. (1): Flowchart of the conventional process of date's syrup

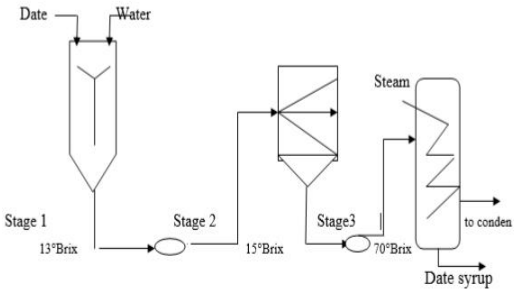

Fig. (2). Flowchart of the extraction process of dates syrup: (1) Maceration tank (1) separate liquid (3) Single-acting evaporator.

2.4. Chemical and physicochemical analysis of dates varieties and date syrup:

The moisture content, crude protein, crude fat, crude fiber, ash and ascorbic acid were determined according to the method described in [14]. Total acidity was estimated in all treatments by titration methods [14]. The pH was monitored using a digital pH meter (model 3505-JENWAY-UK) calibrated with buffers at pH 4.0 and 7.0. Total soluble solids (TSS) were determined in the filtered samples using an MA871 digital refractometer (Milwaukee 0 to 85% Brix – Romania) at 25°C [14].

2.5 Total sugars:

Standard techniques were used to calculate total sugars, reducing and non-reducing sugars [14]. Reducing sugars detected using the [15]. method: Reducing sugars extracted with ethanol at 80% and detected using arsinomolybdates and the Somogyi Cupper reagent as reported by [15,16].

2.6 Total phenolic content (TPC) assay:

Total phenolic content (TPC) was assessed using the Folin–Ciocalteu colorimetric technique [17,18]**.**and the results were expressed as mg gallic acid.

2.7 Total flavonoids content (TFC) assay:

Total Flavonoid Content (TFC) was assessed by using the **(19).** Total flavonoid content expressed as quercetine equivalents (mg RE)/g dry extracts in HP and MP extracts.

2.8 Antioxidants assay:

The antioxidants activity of the extract was measured in triplicate at Al-Azhar University's Regional Center for Mycology and Biotechnology (RCMB) using the DPPH free radical scavenging test, and average values were used. A freshly formed (0.004 percent w/v) methanol solution of the radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) was made and kept in the dark at 10 °C. The test chemical was dissolved in methanol. To 3ml of DPPH solution, a 40 µL aliquot of methanol solution was added [20].

2.9 Sugars composition of dates syrup:

Sugars (Glucose, Fructose, and Sucrose) were measured by Agilent Technologies 1100 series liquid chromatography equipped with an autosampler and a refractive index detector. The analytical column was SCR-101N. The mobile phase was water, and the flow rate was 0.7 ml/ minute. The temperature of the oven was optimized to 40 ^{o}C.

2.10 Microbiological examination:

Ten grams of each treatment was included to a culture medium/diluent (1:10 and homogenized for 2 min in a Stomacher), in treaty with standard methods for total microbial count [21]**,** mould and yeast [22]**.** and coliform group [23]**.**

2.11 Sensory evaluation:

Sensory evaluation of date syrup treatments was evaluated by 12 member panels from the Food Technology Department, Faculty of Agriculture, Benha University. The panel scoring system applied was color, taste, odor, texture, appearance, and overall acceptability, this approach was applied for some date products by [13, 24].

2.12 Statistical analysis:

The results are given as means ±standard deviation of at least 3 independent determinations. One-way analysis of variance (ANOVA) was used to compare the means and then the means were separated by Duncan's multiple range tests. All statistical analysis was performed at $P< 0.05$ using the SPSS 17.0, according to [25].

3. RESULTS AND DISCUTIONS

3.1 Nutritional and physiochemical properties of Egyptian and Iraqi dates varieties:

Dates have a high nutritional value; it has been suggested that dates can constitute a complete meal since they contain enough amounts of macro- and microelements required for human health. **Table (1)** displays the chemical composition of dates. Dates samples were found to have a high concentration of sugars and a low concentration of protein and ash. Iraqi Khestawi dates type recorded a higher percentage of sugars (81.47%), moisture (14.59%), crud protein (4.83%), crud fat (0.43%), ash (2%), and folic acid (97mg/100g). On the other hand, Egyptian Meghal dates variety recorded percentage of sugars (77.23%), moisture (11.53%) crude protein (1.22%), crude fat (0.29%), ash (2.71%) and folic acid (33.0 mg/100g). However, the acquired data showed that the moisture content of dates was lower than the observed average of semi-dry kinds. This might be attributed to a greater loss of moisture content after harvesting, during storage, and marketing [6]. In general, the chemical composition results are within the range of values given before in the literature for the identical dates fruits kinds [8,26,27]. Variances in nutritional composition of dates fruits types cultivated in the same nation or various locations are most likely due to differences in harvest time, postharvest treatments, and environmental conditions.

It can be observed that different dates had fibre contents ranging from 2.25 to 6.75 %, with the Zahidi date having the greatest percentage (6.75%) and the Meghal date having a substantially lower proportion (2.25 %). **Table 1** lists the dietary fibre content of each date's fruits type. Since enzymes progressively convert these molecules into more soluble chemicals during the ripening process, the variations in dates fruits types might be connected to their level of maturity [28]. The primary ingredient in dates is sugar, which is present in high concentrations. This carbohydrate is mostly composed of non-reducing sugars (primarily sucrose) and reducing sugars, such as glucose, fructose, mannose, and

maltose, with minor quantities of polysaccharides like cellulose and starch [29]. The total sugar content in the analysis varied from 74.57 % (Zahidi) to 81.47 % (Khestawi).

The antioxidants activity of the extract was measured in triplicate at Al-Azhar University's Regional Center for Mycology and Biotechnology (RCMB) using the DPPH free radical scavenging test, and average values were used. A freshly formed (0.004 percent w/v) methanol solution of the radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) was made and kept in the dark at 10 °C. The test chemical was dissolved in methanol. To 3ml of DPPH solution, a 40 µL aliquot of methanol solution was added [20].

There were slight differences in sugar concentration between cultivars, with a few exceptions. The Zahidi cultivar has roughly three times as much sucrose as other cultivars, while Sayer has almost four times ascorbic acid. Similar tendencies are visible in other components. Dates are often a great source of vitamins, [30]. These findings conflict with those of [13]. who found that the moisture contents of Siwy and Zahdy dates fruits were 18.00 and 17.30 %, respectively. However, these results concur with [13]. who found that Siwy and Zahdy dates had high levels of total sugars, with 75.25 and 76.20%, respectively. Siwy and Zahdy date fruits contained 3.85 and 2.20% of crude protein, respectively, while Ether extract contained 0.60 and 0.40% fat. According to the data in the same table, the Siwy and Zahdy dates fruits had an ash level of 2.30 and 3.90 %, respectively.

3.2 Phenolic and flavonoid contents of Egyptian and Iraqi dates types:

Fig. (3) shows the total phenolic and total flavonoids of Egyptian and Iraqi dates types and the average contents of phenolics ranged from 58.04 mg/ gm for Siwy dates to 143.92 mg/gm for Khestawi date. On the other hand, total flavonoids ranged from 22.31mg/ gm for Zahidi dates to 29.74 mg/gm for Meghal dates. Total phenolic may be found in dates in reasonable quantities. Apigenin, luteolin, quercetin, isoquercetin, and rutin were identified in research on 11 different types of Saudi dates fruits [31]. Dates fruits from the Amari and Hallawi varieties were found to have derivatives of the naturally occurring flavonol kaempferol, with Amari having five flavonols in substantial amounts and Hallawi having one [32].

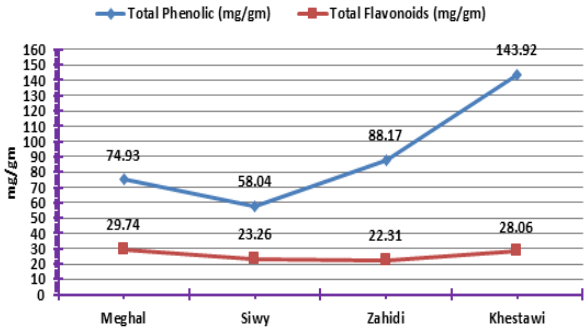

Fig. (3): Phenolic and flavonoid contents of Egyptian and Iraqi dates varieties.

Table (1): Nutritional and physiochemical properties of Egyptian and Iraqi dates varieties (wet/weight basis):

Components (%)	Meghal	Siwy	Zahidi	Khestawi
Moisture	11.53±0.07^{c}	12.22±0.02^{b}	10.23±0.10^{d}	14.59±0.56^{a}
Total solids	88.47±1.05^{b}	87.78±0.09^{b}	89.77±0.14^{a}	85.41±0.89^{c}
Ash	2.71±0.01^{a}	2.01±0.03^{b}	1.19±0.02^{c}	2.00±0.02^{b}
Crude fat	0.29±0.01^{c}	0.31±0.01^{c}	1.53±0.07^{a}	0.43±0.07^{b}
Crude protein	1.22±0.02^{d}	1.79±0.01^{c}	5.43±0.11^{a}	4.83±0.20^{b}
Fiber	2.25±0.04^{d}	5.29±0.01^{b}	6.75±0.05^{a}	2.44±0.13^{c}
pH value	6.27±0.02^{b}	5.62±0.02^{c}	6.20±0.10^{b}	6.63±0.03^{a}
Total sugars	77.23	77.38	74.57	81.47
Reducing sugars	73.78	70.80	57.30	76.71
Sucrose	3.45	6.58	17.27	4.69
Fructose	34.91	31.11	26.35	38.04
Glucose	38.87	39.69	30.95	38.65
Ascorbic acid (mg/100g)	3.95	9.15	0.09	0.03
Folic acid	33.0	21.64	68	97

Results are mean of three values ± Standard error (SE). Values with the different superscript letters in a row are significantly different at $p \leq 0.05$ Duncan's multiple range test.

3.3. Antioxidant activity using DPPH scavenging of Egyptian and Iraqi dates varieties:

In this work, the DPPH free radical scavenging test was used to assess the dates palms' capacity to scavenge free radicals; the findings are shown in **Fig (4)**. Zahidi was **reported** to be the most effective DPPH free radical scavenger among the four dates cultivars. As previously indicated, extract concentration depended on range examined, however ascorbic acid was marginally more effective than dates palm extract. The percentage (%) inhibition values of Zahidi dates palm fruits found to be 0.68, 1.79, 2.86, 5.27, 8.19, 14.23, 20.86, 26.91, 47.37 and 79.64 for concentrations 2.5, 5, 10, 20, 40, 80, 160, 320, 640 and 1280 µg/ml, respectively. The order of activity stands as Meghal > Siwy > Zahidi > Khestawi (IC50 weak, weak, 147.02 and 1034.32 µg/mL, respectively) and Iraqi dates types of extracts showing good scavenging activity (IC50 < 1 mg/mL) when compared to the positive control, i.e., ascorbic acid (IC50 10.62 µg/mL). The findings suggest that the extracts have strong proton donating potential and qualify as main antioxidants. The results corroborated the findings of [33]. who claimed that dates may be regarded as a rich source of hydrophilic antioxidants and that this reducing capability is often linked to the presence of polyphenols. Also**,** it was reported that all the dates extracts offered good DPPH radical scavenging (IC50 103–177 µg/mL). [34]. Egyptian dates fruits were shown to have a significant concentration of phenolic compounds and antioxidant potential, which encourages food makers to employ them as functional foods, according to the current study.

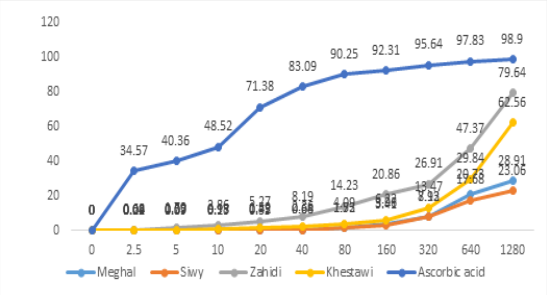

Fig. (4): Antioxidant Activity using DPPH scavenging of Egyptian and Iraqi dates varieties compared to ascorbic acid.

3.4 Nutritional and physiochemical properties of Egyptian and Iraqi dates syrup:

Dates syrup is a popular product yielded by some date processing factories in Egyptian and Iraqi. Moreover, many dates syrups are made at home from local dates varieties. Dates syrups are formed from great amounts of reducing sugars. Fructose and glucose are the main sugar fractions in dates syrup. **Table (2)** shows the chemical composition of dates syrups produced by different methods. Dates syrup moisture level has a significant role in determining how long it will stay fresh and resist bacterial fermentation deterioration **(35).** The moisture content in the studied date syrup treatments varied significantly ($p < 0.05$) and ranged from 19.35 % for Iraqi Khestawi dates syrup to 29.32% for Iraqi Zahidi dates syrup (**Table 2**). Our values were higher than those for Omani and Egyptian dates fruits syrups published by [8,36]. respectively. Different varietals, boiling times, temperatures, extraction times, processing times, and moisture content loss after harvesting and during storage might all contribute to the variances seen in the analysed syrups. Dates syrup include sugars, which can interact with water molecules and reduce the water availability for microbes as shown by the water activity, despite their high-water content [37].

One of the most crucial indicators of food quality that might affect how long food products can be stored is pH [38]. As shown in Table 2, the pH values of the examined syrups diverse between 4.10 for Egypt Siwy and 6.15 for Iraqi Khestawi dates syrup. These outcomes are in agreements with those stated by [39,40] for Tunisian syrups which revealed pH values in the range of 4.02–4.10 and 3.07–4.87, respectively. On the other hand, all of the dates syrup had acidic pH values that may be primarily attributed to titrable acids and secondly to either the removal of dispersed or insoluble components of an amphoteric type or structural alterations of a few of the syrup's acidic molecules during processing [41]. The amount of protein in the examined dates syrup is modest. The lowest quantity was discovered in Egypt Meghal dates syrup (0.93 %), as indicated in **Table (2)**, while the largest amount was seen in Iraqi Zahidi dates syrup (5.32 %). In comparison to the figures reported by [8]. (1.09 - 1.66 % DW),(40). (0.97-1.50 % DW), and (39). (0.84-1.39 % DW), these numbers are quite high. The large amount of date fruit required to manufacture the syrup may account for the higher protein content found in dates fruit syrup compared to the dates fruit reported by [42]. The variations and degree of protein transformation throughout the heat process through Maillard reactions may be the causes of the discrepancies between the studied syrups [43].

In all the syrups made from date fruit that were examined, sugar was the main ingredient. As seen in **Table (2)** , the principal sugars in these syrups were fructose and glucose. Total sugars were found between Egypt Meghal dates syrup 76.11% and Iraqi Zahidi dates syrup 51.5 %. Reducing sugars were found in Egypt Meghal dates syrup 72.66% and Iraqi Zahidi dates syrup 34.84%. The fructose content was found between 13.99 and 34.13 % while the glucose level ranged from 20.85 to 38.53%. The total and reducing sugar reported in this study are slightly lower than those reported by [36, 40].

Table (2): Physiochemical properties of Egyptian and Iraqi dates syrup (on wet weight basis):

Components (%)	Local market Datesyrup (control)	Steam heated		Direct heat	
		EgyptMeghal date syrup	Iraqi Khestawi date syrup	Egypt Siwy date syrup	Iraqi Zahidi date syrup
Moisture	25.40±2.01	21.07±2.07	19.35±2.02	28.94±2.06	29.32±2.01
Total solids	74.60±4.85	78.92±7.02	80.65±7.03	71.06±5.07	70.68±6.03
Crude protein	1.10±0.023	0.93±0.10	2.70±0.07	1.40±0.04	5.32±1.13
Crude fat	0.31±0.01	0.005±0.00	0.41±0.01	0.27±0.01	1.50±0.19
Ash	0.80±0.04	0.6±0.01	1.90±0.080	1.35±0.70	1.09±0.24
Carbohydrates	72.39±6.05	77.395±7.05	75.64±7.06	68.04±6.03	62.77±5.06
Fiber	0.11±0.01	0.85±0.50	1.80±0.85	5.28±1.08	6.63±1.20
pH value	4.10±1.25	4.26±1.09	6.15±1.06	4.10±0.06	4.90±1.01
Total sugars	72.06	76.11	72.39	56.82	51.50
Reducing sugars	45.17	72.66	69.33	50.47	34.84
Sucrose	26.89	3.45	3.06	6.35	16.66
Fructose	20.97	34.13	32.72	21.97	13.99
Glucose	24.20	38.53	36.61	28.51	20.85

Results are mean of three values ± Standard error (SD).

3.5 Chromatograms of sugar analysis of Egyptian and Iraqi dates syrup:

Glucose, fructose, sucrose, and total sugar content in the 5 date syrup cultivars were analysed under the same HPLC operating conditions **Table (3).** As illustrated in **Fig (5**), clear and distinct peaks were achieved. The local market syrup (control) had 26.89% of sucrose, followed by 16.66% of Iraqi Zahidi date syrup, indicating that date cultivars have a high sucrose content. Most of the cultivars of date syrup that were evaluated had greater fructose and glucose contents. The concentrations of glucose and fructose in Siwy date syrup from Egypt were 38.53% and 34.13%, respectively, and Khestawi date syrup from Iraq was 36.61% and 32.72%. According to **(44).** fructose level varied between 23.3 and 32.5% and 21.8 to 29.8% for glucose. Tamaajount's syrup had the lowest total sugar content, whereas Iklan's syrup had the highest total sugar content. Iklan's syrup had a sucrose content of 3.28%, whereas Bousthammi's syrup had 18.7%. Since fructose has a lower postprandial rise in plasma glucose than other common carbohydrates do, it is possible that these date syrups might be utilised as natural sweeteners in the diabetic diet. This is because all samples had significant quantities of fructose relative to glucose and sucrose **(45).**

3.6 Microbial count of Egyptian and Iraqi:

Dates syr Iraqi Khestawi date syrup and Egypt Meghal dates syrup, Iraqi Zahidi dates syrup and Egypt Siwy dates syrup and Local market syrup as affected by different extracted were presented in **Table (4).** The total bacterial count was ranged between 11x10 and 28x10 CFU/g for Egypt Siwy dates syrup and Egypt Meghal dates syrup, respectively. On other hand, Yeasts and molds count were not detected in all dates syrup. However, coliform group was not detected in all dates syrup, this is due to extracted steam heated and direct heat methods and higher sugar ratio. And followed hygiene and sanitation during the dates syrup processing stage. However, all produced dates syrup was under the **(46).** and the product must be treated with sufficient heat to kill pathogenic and spoilage microorganisms.

3.7 Organoleptic evaluation of Egyptian and Iraqi dates syrup:

The dates syrup prepared from Egyptian and Iraqi dates by two extracted steam-heated and direct heat methods were palatability tested in terms of color, taste, odor, texture, appearance, and overall acceptability were presented in **Table (5)**. Compared with local market syrup (control), the results are listed in Table 5. It was evident from these data that were significant differences between all studied dates syrups in their color, taste, odor, texture, appearance, and overall acceptability Iraqi Khestawi dates syrup extracted by steam heated recorded the highest average scores for color, taste, and overall acceptability 18.25, 17.33 and 84.08 respectively followed by Egypt Meghal dates syrup extracted by steam-heated, Iraqi Zahidi dates syrup extracted by direct heat, Local market syrup (control) and finally, Egypt Siwy dates syrup extracted by direct heat for overall acceptability 83.75, 82.91, 79.25 and 67.83 . The results stated that, prepared date syrups are highly desirable and more acceptable. The results obtained are in accordance with those obtained by **(47,13,48).**

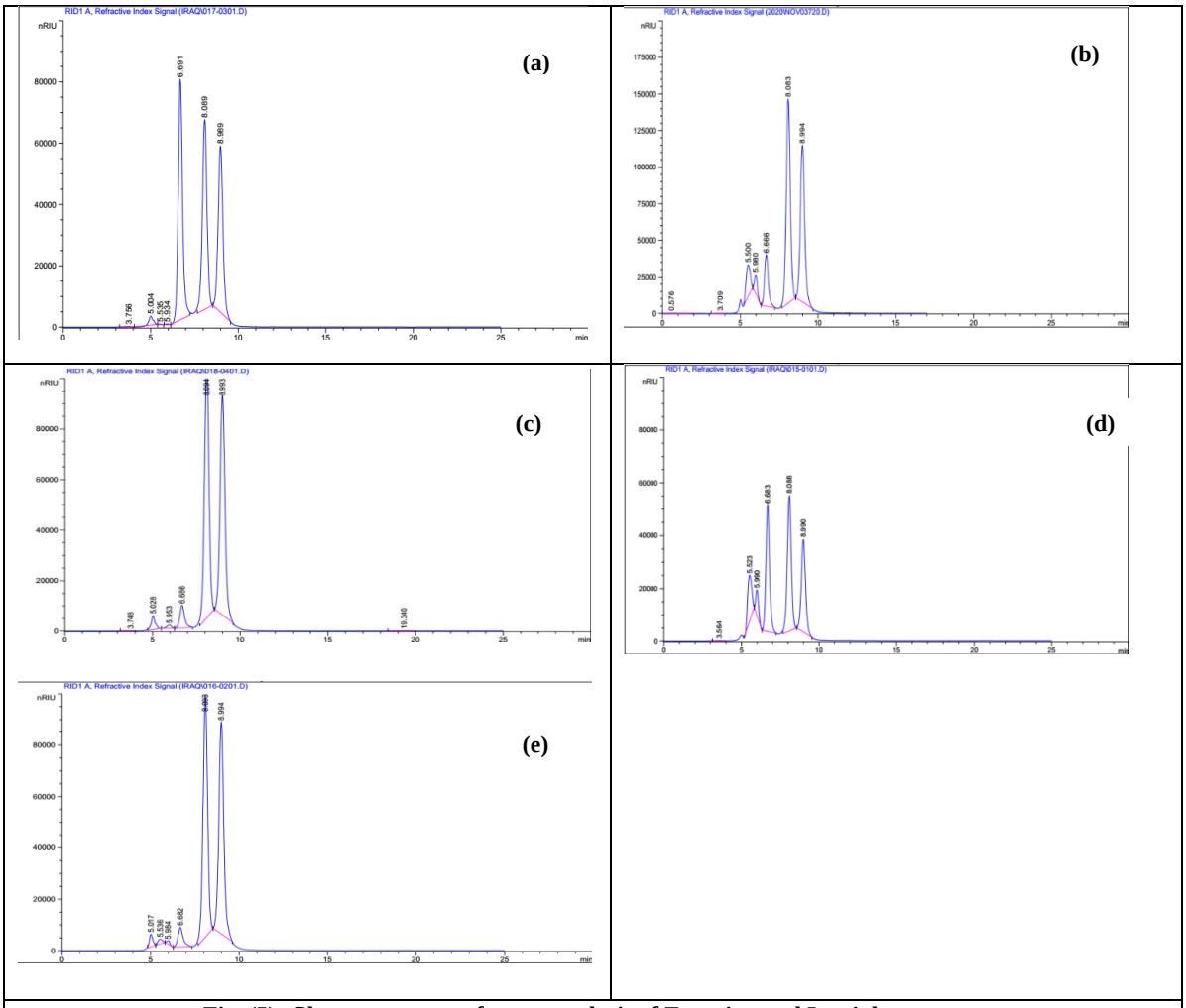

Fig. (5): Chromatograms of sugar analysis of Egyptian and Iraqi dates syrup

Table (3): Chromatograms of sugar analysis of Egyptian and Iraqi dates syrup:

Samples	Sucrose %	Glucose %	Fructose %
Local market syrup (control)	**26.89**	**24.20**	**20.97**
Egypt Meghal date syrup (SH)*	**3.45**	**38.53**	**34.13**
Iraqi Khestawi date syrup (SH)*	**3.06**	**36.61**	**32.72**
Egypt Siwy date syrup (DH)**	**6.359**	**28.511**	**21.971**
Iraqi Zahidi date syrup (DH)**	**16.66**	**20.85**	**13.99**

*(SH): Steam heated, ** (DH): Direct heat

Table (4): Microbial count of Egyptian and Iraqi dates syrup:

Samples	Total bacterial count	Molds and Yeast count	Coliform group
Local market syrup (control)	**25×10**	**ND**	**ND**
Egypt Meghal dates syrup (SH)*	**28×10**	**ND**	**ND**
Iraqi Khestawi dates syrup (SH)*	**18×10**	**ND**	**ND**
Egypt Siwy dates syrup (DH)**	**11×10**	**ND**	**ND**
Iraqi Zahidi dates syrup (DH)**	**22×10**	**ND**	**ND**

ND: Not detected.*(SH): Steam heated** (DH): Direct heat

Samples	Color	Taste	Odor	Texture	Appearance	Overall acceptability
Local market syrup (control)	18.03±1.56^{c}	15.83±3.09^{c}	17.16±2.85^{a}	17.08±3.05^{b}	16.83±3.40^{c}	79.25±13.05^{d}
Egypt Meghal date syrup (SH)*	17.33±2.90^{d}	17.08±2.31^{b}	16.91±2.64^{c}	15.16±3.04^{d}	16.75±2.45^{d}	83.75±15.02^{b}
Iraqi Khestawi date syrup (SH)*	18.25±1.54^{a}	17.33±2.87^{a}	17.08±2.87^{b}	17.75±1.71^{a}	18.58±1.92^{a}	84.08±10.60^{a}
Egypt Siwy date syrup (DH)**	17.00±4.04^{e}	13.58±4.35^{e}	15.75±4.45^{e}	16.08±4.27^{c}	16.00±4.22^{e}	67.83±23.69^{e}
Iraqi Zahidi date syrup (DH)**	18.16±1.33^{b}	15.75±4.57^{d}	16.83±2.28^{d}	17.75±2.09^{a}	17.25±2.45^{b}	82.91±14.87^{c}

Table (5): Sensory evaluation of Egyptian and Iraqi dates syrup:

Results are mean of three values ± Standard error (SE). Values with the different superscript letters in a Column are significantly different at p ≤ 0.05 Duncan's multiple range test. ***(SH): Steam heated ** (DH): Direct heat**

4. Conclusion:

Dates have a high nutritive value due to their sugars and dietary fiber, but they also provide enough levels of antioxidants and phenolic compounds in our diet, so they may be utilized as a component in functional foods. Overall, four dates by products have the potential to produce value-added goods, particularly dates syrup. In fact, using steam heated treatments resulted in syrup with higher reducing sugars. This might help to reduce the occurrence of syrup crystallisation. When compared to local market syrup, the uses of steam heated treatments received the highest average ratings for organoleptic evaluation and were most enjoyed by customers among the various treatments used to manufacture dates syrup.

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