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Physiochemical Composition and Sensory Properties of Zahidi Date Seed Coffee and their Utilization as Antidiabetics

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Abstract: Dates (Arabic: Tamar, Latin: *Phoenix dactylifera*) are a native fruit from the Middle East, and it is a by-product of date's industry and date consumption. The present study is aimed to investigate the physiochemical composition like moisture content, crude protein, crude fat, crude fiber, carbohydrate, ash content, pH, total soluble solid and total titratable acidity and sensory evaluation-like taste, aroma, color, appearance, and overall acceptability of Zahidi date seed coffee powder which is commonly available types of date seed in the Iraqi market especially in Kurdistan market. On the other hand, to find out the efficacy of the date seed coffee drink in ameliorating serum glucose and insulin resistance. Thirty volunteers, ten of whom were classified as the negative control group (NCG), and twenty volunteers received their daily standard medical treatment (tablets or insulin). The date seed coffee supplementation is given to every patient in the experimental groups twice daily in cups. Each cup contains 10g of date seed coffee in 200 ml of distilled water. This process was continuous for about three consecutive months. The results revealed that Zahidi date seeds had higher protein, fat, fiber, and carbohydrate content on average 6.31, 8.87, 18.14, and 63.78%, respectively. For sensory evaluation, the results displayed a high value for aroma and overall acceptability. Additionally, for diabetics, the results indicated that fasting blood glucose was significantly reduced after the administration of date seed coffee powder, especially in diabetic patients treated with insulin, compared to the negative control group and diabetic patients treated with tablets.

Keywords: Zahidi date seeds, date coffee, physiochemical composition, sensory evaluation, diabetes type 2.

1 INTRODUCTION

Natural foods contain health-promoting active components that exert affirmative special effects on the physiological system of the human body. For Asian people, especially Iraqi people, the date palm tree is one of the essential plants in arid regions. Dates are considered one of the major agricultural products grown in the majority of Middle Eastern countries, and lots of people in this region use dates as a main food (El-Nemr et al., 2008).

Date palm (*Phoenix dactylifera*) is a flowering plant species in the palm family Arecaceae, also known as Palmaceae that consisting about 200 genera and more than 2500 species (Al-Alawi et al., 2017). Commonly known that the average weight of date seeds is about 10-15% of the whole date fruit (Chandrasekaran and Bahkali, 2013). Date palm plant is recognized as one of the mankind's ancient cultivated plants that has been used as a food for about 6000 years (Sahari et al., 2007). More than sixty countries, particularly in the Arabian Peninsula and played an important role in the people life (Abdillah and Andriani, 2012).

Date palm fruit is considered a very rich source of carbohydrates, and can provide a large amount of good-quality nutrients like dietary fiber, poly unsaturated fatty acids such as oleic and linoleic acids, and a wide range of micronutrients like riboflavin, niacin, tocopherols, potassium, and calcium (Barakat and Alfheeaid, 2023).

Date seed is residues of date fruit process usually discarded and sometimes used as animal feed. Chemically, date seed appeared excellent with significant levels of polysaccharides (75–80%), proteins (5–6%), and fat (10–12%) (Fikry et al., 2020). Moreover, in date seeds numerous types of bioactive phytochemicals such as dietary fibers, polyphenols, antioxidants, carotenoids and flavonoids were found in substantial levels, all of which may aid to defend against severe serious diseases including cardiovascular disorders and cancer, as well as lowering blood pressure and regulating blood sugar levels (Hussain et al., 2020; Chiara et al., 2007).

Exercise and regular physical activity are recognized as effective strategies for preventing and treating several metabolic disorders and chronic diseases, including cardiovascular disease, type 2 diabetes, cancer, metabolic syndrome, depression, and stress (Eime et al., 2013).

Diabetes mellitus (DM) has been known as one of the most universal endocrines, metabolic disorders that is characterized by the irregular metabolism of fat, protein, and carbohydrate due to decreased efficacy of insulin secretion or altered insulin activity (Kausar et al., 2019).

Diabetes has been classes into three major types: type I diabetes known as insulin dependent diabetes mellitus (IDDM) which results in deficiency of insulin, insulin resistance known as type II diabetes, it's also called non-insulin dependent diabetes (NIDDM) and gestational diabetes which is considered as type III diabetes which results in glucose intolerance during pregnancy (Hassan, 2018). Several studies are reported that the combination of extracted date seed with insulin can lower the toxic effects of diabetes (El-Fouhil et al., 2011; Abdelaziz and Ali, 2014).

2 MATERIALS AND METHODS

2.1 Materials

The experiment has been carried out in the Department of Food Technology, Agricultural Engineering Science, Salaheddin University-Erbil, Ministry of Trade and Industry, General Directorate of Industrial Development, Directorate of Quality Control and Layla Qasim Diabetes Center, Erbil. Date palm fruit (Phoenix dactylifera L.) was obtained from the markets of Baghdad city.

2.2 Methods

2.2.1 Preparation of Date Seed Coffee Powder

The date mesocarp was manually removed, ensuring recent harvest. Subsequently, the separated seeds were cleaned with distilled water then dried and roasted at 220°C for about 6 hours (Ghnimi et al., 2015). Finally, the roasted seeds were crushed by using an electric blender and powdered dates immediately analyzed in triplicates for the physiochemical properties and sensory assessment as well as for antidebate utilization.

2.2.2 Date Coffee Preparation as a Drink for Diabetics

Twice tea spoon of the prepared date powder about (10g) was added to a cup of water and prepared like Arabic and any coffee without addition any sugar, and stirred to obtain homogenized mixture then the mixed coffee was boiled until it becomes brownish in color then filtered by the sieve to be ready for drinking twice a day, one in the morning and once in the evening by a cup of tea for three consecutive months (Abdelaziz and Ali, 2014).

2.2.3 Physicochemical Analysis of Zahidi Date Seed coffee Powder

2.2.3.1 Determination of Moisture Content

According to the procedure of AOAC (2008), the moisture content of date seed was determined. Roughly 3g of date seed was taken, shifted to the empty dish, and weighed. Then the dish containing the sample within the conventional oven and the sample was dried by setting the temperature at 105 °C for about 3 hours to constant weight, after drying the sample was moved to the desiccator to cool off with a slightly closed lid.

$$\% \text{ Moisture} = \frac{W2-W1}{W1} * 100$$

Where:

W_1= Initial weight of sample; W_2= Weight of the dried sample.

2.2.3.2 Determination of Crude Protein

Crude protein (dry weight) content was measured by using the micro Kjeldahl method and calculated by multiplying the amount of nitrogen by a conversion factor of 6.25. Approximately 1g of powdered date seed was placed in a dry Kjeldahl flask, Kjeldahl digestion tablets 1:12 gm ($CuSO_4$ with K_2SO_4), and 20 ml of concentrated H_2SO_4 was added to the digestion tube. The mixture was digested under boiling until the mixture became clear, concentration of NaOH 50% was added, after the distillation process the titration was carried out with 0.1N HCl and phenyl naphthalene indicator. The nitrogen and crude protein content percentages were calculated for three replications according to the following equation (Kumar et al., 2022).

$$\mathbf{N}\ \% = \frac{14*N*V*100}{\text{Wt of sample (mg)}}$$

%**Crude protein** = % N × Protein Factor

Protein factor = 6.25

N = Normality of HCl

V = Volume of HCl (ml)

2.2.3.3 Determination of Crude Fat

The crude fat of date seed was determined by using the gravimetric solvent extraction technique that was described in AOAC (2008). The sample was covered in porous paper and 5g was put in a thimble (Whatman filter paper). Then 200 ml of petroleum ether and a Soxhlet reflux flask were used to hold the thimble after mounting it in them. The top of the reflux flask had a water condenser attached to it. After being heated, brought to a boil, and then given time to cool, petroleum ether was condensed into the reflux flask. The solvent was poured over the sample in the thimble and the oil extract was siphoned down to the boiling flask as soon as the reflux flask was filled. The defatted sample was removed, the solvent was recovered, and the oil extract was kept in the flask after this process was done four times. To remove any leftover solvent, the flask containing the oil extract was dried in the oven at 60°C for one minute. It was weighed after cooling in a desiccator. Thus, the weight of the oil (fat) extract was calculated as a percentage of the sample's overall weight.

2.2.3.4 Determination of Crude Fiber

The crude fiber of date seed powder was determined by using acid/alkali digestion (AOAC, 2008). 5 g of dry roasted powder was placed into a beaker, 150 ml of 1.25% sulfuric acid solution was added and heated to boil under reflux for 30 minutes. Then quickly the hot solution was filtered, and the insoluble matter was

washed several times in hot water. Insoluble matter was quantitatively transferred into a beaker, 150 ml of 1.25% sodium hydroxide solution was added and also boiled under reflux for 30 minutes then filtered and washed with boiling water. Samples were dried to constant weight in an oven at 105°C and weighed (W_1). The weighed sample (W_1) was then burned in a muffle furnace at 550°C for 3 hours, cooled, and reweighed (W_2). The percentage of crude fiber is calculated using the following equation.

Where:

W_1 = Sample weight before placing in furnace.

W_2 = Sample weight after placing in furnace.

$$\textbf{Crude fiber } \% = \frac{W1 - W2}{\text{Weight of original sample}} * 100$$

2.2.3.5 Determination of Ash Content

In brief, 5g of the date seed powder was weighed into a porcelain crucible and measured there. The sample was burnt until it was reduced to ashes in a muffle furnace that was heated to 550°C for about 3 hours. After chilling in a desiccator, it was weighed and analyzed (AOAC, 2008).

2.2.3.6 Determination of Carbohydrate

Carbohydrate was determined by the following formula as per AOAC, 2008.

Total carbohydrate = 100- (%protein+ %fat+ %fiber+ %ash).

2.2.3.7 Determination of pH

The pH value of date seed powder coffee was taken using a Mettler-Toledo Automatic Titrator (Greifensee, Switzerland), before use, calibration was performed using known buffers with pH values of 4, 7, and 10. Approximately 5g of date seed coffee powder was mixed with 50 mL of distilled water and then filtered using Whatman No. 2 filter paper. Finally, a pH meter was then used to determine the pH value of the roasted kernel aqueous filtrate. The device was flooded in the suspended solution, and the readings were recorded in triple time (Souda et al., 2020).

2.2.3.8 Determination of Total Soluble Solids (TSS)

The Total Soluble Solids (TSS) content of the date seed powder coffee was measured using a portable digital refractometer (model DBX-55, Atago, Tokyo, Japan). About 5g of roasted date seed powder coffee dissolved in 50 mL of distilled water. Total soluble solids at 22°C were directly recorded and the results were expressed as percent soluble solids (°Brix) (Rosdiana et al., 2024).

2.2.3.9 Determination of Total Titratable Acidity (TTA)

The total titratable acidity measurement was performed in terms of anhydrous citric acid by titrating against the basic solution of 0.1N NaOH using phenolphthalein indicator as described in (AOAC, 2008). Whenever 5g of date seed coffee powder was added to a 100 mL volumetric flask and the volume was made up to 100 mL by adding distilled water. Future 10 mL diluted filtrate was titrated against 0.1N NaOH using phenolphthalein as indicator. The appearance of pink color indicated the endpoint of the titration.

$$\text{TTA } \% = \frac{\text{ml NaOH} * \text{Normality} * 64}{\text{Volume of sample (ml)} * 1000} * 100$$

Milliequivalent of malic acid = 0.064

2.2.4 Sensory Evaluation

For the consumer, the most important attributes of a food are its sensory properties such as taste, aroma, color, appearance, and overall acceptability. Consequently, sensory evaluation method was conducted according to the approach that described by (Mirghani et al., 2012). The date seed coffee was served hot to 10 experienced coffee students from the college of Agricultural Engineering Science and department of food Technology at the Salahaddin University. A 10-point hedonic scale was employed for each attribute assessment, where one represented from "dislike extremely" to ten indicates "liked extremely".

2.3 Statistical analysis

The statistical analyses were performed using the SPSS (Statistical Package for the Social Sciences, version 22.0) program. The analysis of variance which consisted of univariate analysis was performed followed by Duncan test. One-way analysis of variance (ANOVA) was used to compare means at the significant level $p<0.05$. All analyses were performed with replicates.

3 RESULTS AND DISCUSSION

3.1 Physicochemical Analysis of Zahidi date seed coffee powder

Physiochemical composition which includes moisture, crude protein, crude fat, crude fiber, ash, pH, total soluble solid (TSS) and total titratable acidity of date seed coffee powder are displayed in Table 1. The determination of the physiochemical compositions was done in triplicates.

Table 1. Physicochemical analysis test results of Zahidi date seed coffee powder.

Parameters	Moisture	Crude Protein	Crude fat	Crude fiber	Ash content	CHO	pH	TSS(°Brix)	(TTA)
Mean ± SD (g/100g)	4.5%	6.31%	8.87%	18.14%	2.9%	%63.78	4.21	2.1	0.96%

The date seed coffee powder results showed low moisture content 4.5%. The moisture content obtained was similar to the finding of Al-Farsi and Lee, (2008) stating the Um-sellah (Sun-dried, Oman) variety from about 4.4%. Further, Joardder et al., (2012) reported that the range of moisture content in Rajshahi (Bangladesh) varied from 5.0 to10%.

The crude protein content reported in the analyzed date seed coffee powder 6.31%. The minimum level was stated by (Al-Farsi et al., 2007) who reported the protein content in the Shahal (Sun-dried, Oman) variety with 2.29%. Similarly, Fikry et al., (2019) revealed the maximum level of protein content in the type of date seed in (Oman) with 7.08%.

The crude fat content in date seed coffee powder was to be 8.87%. The result was lower than the fat content in the Kabkab and Shahani varieties in (Iran) reported by Azodi et al., (2014). However, the fat content found 8.33% was similar to the result of Saafi et al., (2008) who reported the fat content in the Khalti (Tunisia) variety.

As for crude fiber content, the date seed coffee powder contains 18.14%. The obtained result is in agreement with the work reported by Al-Askari et al. (2024), who compared the fiber content in three types of date seed,

which ranged from 16 to 16.33%. Furthermore, the lower fiber content was stated by Rathi (2022), who experimented with three varieties of date seed coffee, which varied from 30 to 55.43%.

The date seed coffee powder exhibited the highest carbohydrate content (63.78%). This result aligns with those reported by Khierallah et al. (2015), who found that date seeds contained carbohydrates ranging from 55 to 66%, while Hossain et al. (2014) described those lower values in samples from Omani date seeds (70.9-86.9%).

The ash content of date seed coffee was high compared to the study of El Sheikh et al. (2014), which examined roasted date pits and found a value slightly above what is obtained in this research. The concentration of ash found in four different date seed varieties varied from 0.900 of Yemeni date seed coffee % to 2.160% of Iraqi date coffee (Al-Askari et al., 2024).

The pH value was recorded 4.21 in the Zahidi date seed coffee powder. The higher pH values may be due to the loss of acidity. The pH value of date seed coffee of four varieties was ranged from 4.43 to 4.56 by (Rathi, 2022).

The Total Soluble Solids (TSS) content of the date seed powder coffee was high, 2.1°Brix. The achieved result is slightly in agreement with the work informed by Rathi, (2022) who compared the three variety of date coffee powder which are Ajwa date seed powder, Maryaam date seed powder and Mixed date seed powder and the results are 1.96, 1.96 and 2.00 respectively.

Acidity plays a vital role in the flavor of the products. The Total Titratable Acidity of date seed coffee powder was low compared to the report of Rathi, (2022) among three date seed coffee varieties, which ranged from 1.11% of mixed date seed coffee to 1.21% of Maryaam date seed coffee.

3.2 Sensory Evaluation of Zahidi date seed coffee powder

The sensory evaluation had been performed by fourteen semi-trained panelists. The panelists comprised of female and male members who had previous a few experiences on food products evaluation. Mean score for sensory evaluation of Zahidi date seed coffee powder is displayed in Table 2. The study test had relatively score for aroma were scored 7.78. In the of appearance and color concentrate the sample scored 6.50 and 6.57 respectively. The mean score of taste deserved maximum score 6.64 for the tested sample. Additionally, the mean regarding overall acceptability of Zahidi date seed coffee powder concentrate revealed that overall acceptability of sample was highest acceptability were scored 7.0. The results of sensory evaluation suggest that the Zahidi date coffee powder can be successfully used as unique natural alternative to coffee.

Table 2. Sensory Evaluation of Zahidi date seed coffee powder

Sensory attributes	Appearance	Color	Aroma	Taste	Overall acceptability
Score	6.50 ± 0.52a	6.57 ± 0.48a	7.78 0.52b	6.64 ±0.43a	7.0 ± 0.53b

3.3 Glycemic profiles in diabetic patients

Table 3. display the glycemic profiles in diabetic type 2 patients which are treated with tablets and insulin before and after administration of Zahidi date seed coffee powder (ZDSCP). It could be studied from table 3 that serum glycemic profiles had significantly treatable after treatment. Patients after oral administration of ZDSCP in two time daily presented significantly decreasing in serum fasting blood glucose in two groups to almost normal levels, the percentage of reduce compared to diabetic control group were varied from -4 to -15% in diabetic group one and -6 to -61% in diabetic group two while in negative control group the percentage range was increased from 2 to 16%.

Table 3. Glycemic profiles in diabetic patients before and after oral administration of Zahidi date seed coffee powder

		NCG	Diabetic patients treated with tablets	Diabetic patients treated with insulin
			DG1	DG2
FBG (mg/dl)	Before	178	126	324
	After	189	111	301
% of change		11	- 15	- 23
FBG (mg/dl)	Before	203	263	380
	After	207	252	319
% of change		4	- 11	- 61
FBG (mg/dl)	Before	311	283	418
	After	225	276	397
% of change		14	- 7	- 21
FBG (mg/dl)	Before	300	185	482
	After	303	178	473
% of change		3	- 7	- 9
FBG (mg/dl)	Before	429	174	390
	After	431	170	337
% of change		2	- 4	- 53
FBG (mg/dl)	Before	415	379	384
	After	419	358	373
% of change		4	- 21	- 11
FBG (mg/dl)	Before	251	151	391
	After	258	139	380
% of change		7	- 12	- 11
FBG (mg/dl)	Before	273	182	327
	After	289	174	321
% of change		16	- 8	- 6
FBG (mg/dl)	Before	281	422	450
	After	289	416	407
% of change		8	- 6	- 43
FBG (mg/dl)	Before	297	488	378
	After	303	479	343
% of change		6	- 9	- 35

FBG: Fasting blood glucose; **NCG:** Negative Control group; **DG1:** Diabetic group1; **DG2:** Diabetic group2. Reference values obtained from: Fischbach and Dunning, (2009).

CONCLUSION

Currently, the food sector produces many by-products that are frequently not recognized, including date seeds from varieties with limited commercial potential. Date seed is a rich source of nutritive substances like proteins, fats, fibers, carbohydrates, and bioactive compounds. To conclude, this research paper provides ideal information for people to consume healthy drinks from popular fruits and herbs. Finally, we believe

that date seed coffee could be used to replace coffee for coffee drinks as a caffeine-free coffee and an ideal choice for healthy treatment in regulating diabetic type 2 diabetes.

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