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Research Article

Comparative Analysis of the Nutritional Value of Bangladeshi and Saudi Arabian Date Palms Fruit Varieties

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Abstract

The date palm fruit (*Phoenix dactylifera*) is considered one of the primitive crops to be harvested in the Middle East. Nowadays, several varieties of dates are frequently available and being marketed at different price ranges, especially in the local markets of Bangladesh. However, there is no standardized data available to recognize the differences in the quality (nutritional quality) of Bangladeshi dates and Saudi Arabian dates. The current study aimed to conduct a comparative analysis of the nutrient contents of dates cultivated in Bangladesh and Saudi Arabia. Date samples were collected from the garden area of Bangladesh Open University, Gazipur, and then the samples were in the laboratory to find out the differences in the macro-nutrient level among the Bangladeshi and Saudi Arabian dates. To measure the protein, carbohydrates, fat, and fiber levels within these two varieties we performed Kjeldahl digestion, colorimeter test, Soxhlet extraction, and muffle furnace method respectively. The biochemical analysis of date varieties in our study revealed that protein content was 3.08%, carbohydrate 75%, fat 1.20%, and fiber 3.22% in Bangladeshi dates, while in Saudi Arabian varieties, the protein content was 2.15%, carbohydrate 67%, fat 2.30%, and fiber 7.14%. The results indicated that in Bangladeshi varieties protein and carbohydrate contents are higher than the Saudi Arabian varieties but fat and fiber contents are lower in Bangladeshi varieties. As we could not analyze the quality of macronutrients in Bangladeshi and Saudi Arabian date varieties, it is difficult to make any conclusion about the health benefits of these date varieties.

Introduction

The scientific name of the date palm is *Phoenix dactylifera* L. and it belongs to the Arecaceae family. In the Middle East, the date palm fruit (DPF) is considered one of the oldest crops [1]. Actually, it was recognized as one of the oldest cultivable crops frequently harvested in Northern Africa and the Middle East. This is a berry-type fruit that includes one seed and is surrounded by an endocarp which is relatively hard. This berry has other two layers after the endocarp named mesocarp and epicarp respectively [2]. Within the arid and semi-arid regions date is considered a significant subsistence crop, which plays a vital socioeconomic process for numerous nations [3]. According to previous research around the world, 2000 varieties of dates have been recorded, however, only a few of them could be used for their fruit quality and agricultural productivity [4]. Saudi Arabia has contained around 7 to 8 million palm trees and as a result, this nation has been considered as one of the major date exporters [1]. Around 400 numerous varieties of dates are harvested in Saudi Arabia, however, for scientific research only a small number of varieties have been used [5].

The physical properties of dates like color, shape, size, and texture have been utilized to justify the quality of dates on the other hand their chemical properties as well as their flavor contents are used to assess their nutritional quality, and sensory attributes respectively [6]. This fruit is recognized as an effective source of vital nutrients like simple and complex sugars, antioxidants, and minerals which contains large amounts of carbohydrates as a rapid energy source. These complex carbohydrates are mostly glucose and fructose which can be easily utilized by the body [7]. In regards to the protein

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content of DPF, it has been illustrated by many studies that around 23 types of amino acids have been found in DPF and some of them are very rare in popular fruits like oranges, apples, and bananas [8,9]. Depending on the soil and climate conditions as well as the agricultural practices date composition can vary from region to region [10].

In addition to that date plays a vital role in the diet of people as well as it has medicinal benefits as well. The fruit is famous for its endless health benefits including but not limited to the prevention and treatment of several diseases such as coronary heart-related disease, cancer, constipation, and so on [11]. Many previous experimental studies have demonstrated the health benefits of DPF, which justifies their ability to inhibit or suppress the occurrence of many diseases. From the medicinal point of view, several numbers of biological activities have been shown by DPF which include anti-inflammatory, antioxidant, and anti-carcinogenic activities. However, from a traditional viewpoint, DPF has been used to treat several health consequences like sore throat and fever [12-15]. According to a recent study, date fruits might be beneficial in controlling the lipid profile of diabetic patients [16].

According to a recent study on the potassium content of date palm fruit, it has been demonstrated that after removal of seeds from dates around 648 to 790 milligrams of potassium has been found per 100 grams of seedless dates. The study also recognized some health benefits of potassium like nerve improvement, muscle functioning, and waste reduction from the human body [17]. Dates also contain some amount of copper which is not so significant for our health but if we consume nuts, seeds, and whole grains along with date palm fruits then we can meet the recommended amount of copper which is around 0.9 mg per day for an adult [18]. In terms of the sodium content of dates, it has been recognized that the sodium content of dates varies from 3 to 10 mg per day for 100 g of dates [19].

Whole parts of DPF as well as their byproducts, produced during the processing of dates could be utilized for different purposes which include but are not limited to the production of sweets, snacks, confectionary, baking products, institutional feeding, and healthy foods. It could be used as a perfect natural alternative to added sugar as it contains different sugars like glucose, fructose, and sucrose, and could be used to invent numerous healthy recipes [20].

Actually, in Bangladesh, the nutritional values, as well as the biochemical properties of dates, have still not been properly discovered yet as there is a lack of detailed reports about the biochemical and nutritional values of date fruits in Bangladesh. This study used a number of well-established biochemical techniques to compare the nutritional qualities of date palm fruits from Saudi Arabia and Bangladesh. Protein content was determined using the Kjeldahl method, which entails digestion, ammonia distillation, and titration. For fat analysis, n-hexane was used to remove fats, and the residual weight was calculated using Soxhlet extraction. Furthermore, fiber content was evaluated by consecutive acid and base treatments followed by incineration, and carbohydrate content was determined by hydrolysis and subsequent colorimetric analysis. This study advances the field of food science by bringing to light the variations in the macronutrient compositions of dates, which have not received much attention in the context of Bangladeshi agriculture. It does this by directly comparing date varieties from two geographically different regions. These results highlight the superiority of Bangladeshi dates in terms of protein and carbohydrates over Saudi Arabian dates, which have a greater fat and fiber content. They also offer useful information on the nutritional makeup of locally grown dates. This advances our knowledge of how local growth environments might affect the nutritional makeup of dates, which may help inform both consumer preferences and farming methods. As a result of that through this study, we have tried to investigate the nutritional properties of date fruits cultivated in Bangladesh and Saudi Arabia, and have tried to make a comparative analysis of their nutritional values.

Materials and methods

Sample collection and preparation

The fruit varieties of the date, Bangladeshi, and Saudi Arabian types were collected from the garden area of Bangladesh Open University, Gazipur, during the peak harvesting season in July, when the average temperature was around 30 °C with 80% humidity. These conditions reflect the typical subtropical monsoon climate of the region. The Saudi Arabian date samples were sourced during the spring season, under dry, arid climate conditions with an average temperature of 35 °C and low humidity (~20%). These climatic differences may influence the nutritional profile of the date varieties. The samples were washed with tap water, air-dried, deseeded, chopped, and homogenized before analysis. For each test, three replicates were performed to ensure the accuracy and reliability of the results.

Protein content analysis

The protein content of the samples was analyzed by the Kjeldahl method. Prior to analysis, the homogenized sample was first oven-dried at 105 °C and then ground to a fine powder. A 2.0 g portion of the dried sample was digested with a catalyst mixture (K_2SO_4:$CuSO_4$ = 5:1) and concentrated K_2SO_4 at 420°C for 75 min. The digested solution was cooled and diluted with distilled water, followed by distillation in a way that the evolved ammonia was collected in the HCl solution. The separation containing ammonia was used for titration with standardized NaOH. The content was estimated as per cent of nitrogen and the crude protein content was calculated using a conversion factor of 4.4.

Calculation:

Crude protein content in the sample = % Nitrogen × 4.4 [N-conversion factor = 4.4]

Carbohydrate content assay

The carbohydrate content was determined by hydrolyzing 100 mg of the sample in 2.5 N HCL and boiling it for 3 hours in a

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water bath, followed by neutralizing it with sodium carbonate. Further dilutions were made up to 25 ml and centrifuged, along with a glucose standard solution. The absorbance of the standard and sample solutions was determined against water at 480 nm. The overall carbohydrate concentration was determined by evaluating the sample's absorbance in relation to the standard curve while also incorporating a dilution factor according to the following tables (Tables 1,2):

Calculation:

% of total carbohydrate = {(D.F. × Absorbance)/ 0.1} × 100

Crude fat content determination

Crude fat was extracted from the sample using a Soxhlet apparatus. A 10 g sample was placed in a thimble and extracted with *n*-hexane. The extract was then evaporated under reduced pressure using a rotary evaporator, and the remaining fat was dried in an oven at 110°C for 30 minutes to remove the residual solvent. The sample was weighed before and after extraction, and the weight difference was used as the reading for crude fat.

Calculation:

Let's

The Weight of the sample = W_0 g

The Weight of empty extraction flask with glass beads = W_1 g

The Weight of extraction flask with extract = W_2 g

The amount of fats in the sample = (W_2 – W_1) g

$$\% \text{ of crude fat in the sample} = \frac{W_2 - W_1}{W_0} \times 100$$

Table 1: Sample preparation.

		Add in stock and sample solution containing test tube.		
Conc. µg/ml	Add from stock in test tube	Distilled water	Phenol (5%)	Conc. H_2SO_4 (add slowly)
100	0.1 ml	0.9 ml	1 ml	5 ml
200	0.2 ml	0.8 ml	1 ml	5 ml
300	0.3 ml	0.7 ml	1 ml	5 ml
400	0.4 ml	0.6 ml	1ml	5 ml
500	0.5 ml	0.5 ml	1 ml	5 ml
600	0.6 ml	0.4 ml	1 ml	5 ml
700	0.7 ml	0.3 ml	1 ml	5 ml
800	0.8 ml	0.2 ml	1ml	5 ml
900	0.9 ml	0.1 ml	1 ml	5 ml
1000	1.0 ml	-	1 ml	5 ml
Blank	-	1 ml	1 ml	5 ml
Sample 1 (Bangladeshi Date)	1.0 ml (liquid)	-	1 ml	5 ml
Sample 2 (Saudi Arabian Date)	1.0 ml (liquid)		1 ml	5 ml

Table 2: Absorbance of the standards and samples.

SL	Conc. mg/ml	Absorbance
1	0.1	0.29
2	0.2	0.58
3	0.3	0.87
4	0.4	1.16
5	0.5	1.45
6	0.6	1.74
7	0.7	2.03
8	0.8	2.32
9	0.9	2.61
10	1.0	2.90
11	Blank	0.00
12	Sample 1 (Bangladeshi Date)	0.75
13	Sample 2 (Saudi Arabian date)	0.67

Cruding fiber content analysis

The content of crude fiber was obtained by successive boiling of the sample in solutions of acid and base. A 2 g sample was first boiled in 0.128 M K_2SO_4, then filtered and boiled in 0.313 M NaOH. The residue was then incinerated at 550 °C in the muffle furnace. By subtraction, the weight recovered on incineration was taken as the weight of the crude fiber.

Calculation:

W_s = Weight of the sample

W_1 = Weight of the crucible with fiber

W_2 Weight of the crucible with ash

$$\% \text{ Crude Fiber} = \frac{W_2 - W_1}{W_s} \times 100$$

Results and discussion

The present study was conducted to compare the nutritional values of Bangladeshi and Saudi Arabian date palms that are available frequently within the local markets of these two countries. The carbohydrate, protein, fat, and fiber content were considered as the parameter of nutritional values, which varies considerably among the date palms of these two countries. Dates contain various vital nutrients and it is considered one of the major sources of potassium required in our diet. The comparative analysis of protein content in dates available in the garden area of Bangladesh Open University has been shown in Figure 1 and the protein content is significantly higher in Bangladeshi dates (3.08%) in comparison with the Saudi Arabian dates (2.15%). From the studies of various researchers on date palms, it was described that the flesh dates showed numerous ingredients of nutritional value. Among several varieties around 2.3% - 5.6% protein content was displayed by the fruits of *Phoenix dactylifera* which is very much in line with the study result of our protein content [8,21].

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Basically, among all the fruits dates are considered highly nutritious because of their high carbohydrate (70%) content which is why it is considered a highly energetic fruit [22]. An investigation showed that *P. dactylifera* (dates) contained around 44% - 88% carbohydrates [8]. In addition, date fruits are a good source of instant energy as they contain around 70% - 80% sugar as carbohydrates [23]. The present result has indicated that the Bangladeshi varieties of dates contain around 75% carbohydrate on the other hand the Saudi Arabian varieties of dates contain only 67% carbohydrate which is around 8% lower than the Bangladeshi varieties (Figure 2). According to Food and Agricultural Organization (FAO) report dates should contain around 70% carbohydrate which is now considered as the standard amount of carbohydrate content for date fruits [22]. So, from the FAO report, we can demonstrate that only the Bangladeshi varieties of dates in our study contained the standard amount of carbohydrates, however, in Saudi Arabian dates our study could not find that standard level of carbohydrate. In a previous study on date fruit, around 44% - 88% carbohydrates were identified in Saudi Arabian varieties while 70-80% carbohydrate contents were observed in the date varieties harvested in Bangladesh, which is very much in accordance with the present study results [8,24].

According to previous studies conducted in different parts around the world on dates, flesh reported less than 2% fat content in date flesh whilst date palms contain only around 0.2-0.5% fat content [8,22]. The results of the present study revealed that Saudi Arabian dates contain around 2.30% fat whereas Bangladeshi dates contain only 1.20% fat, which means date varieties of Saudi Arabian has higher fat content than the Bangladeshi date varieties (Figure 3). However, the fat percentage in Saudi Arabian dates is not satisfactory according to FAO because it has been stated by FAO that the standard level of fat percentage in date fruits should be lower than 2%, and if we consider this statement as standard then we can say that the fat percentage of Bangladeshi dates in our study has shown the standard level while the Saudi Arabian dates could not meet the standard level of fat contents.

The region's hot climate and soil conditions may have an impact on the synthesis and storage of sugars in the fruit, which could explain why Saudi Arabian dates have a reduced carbohydrate content. Date palms may put fat storage ahead of carbohydrate accumulation in areas like Saudi Arabia that have greater temperatures and less water supply in order to withstand the severe circumstances. This adaptation is probably a reaction to environmental stress; the fruit's increased fat content may act as an energy store, and the decrease in carbohydrates may be a result of the water availability required for the production of carbohydrates.

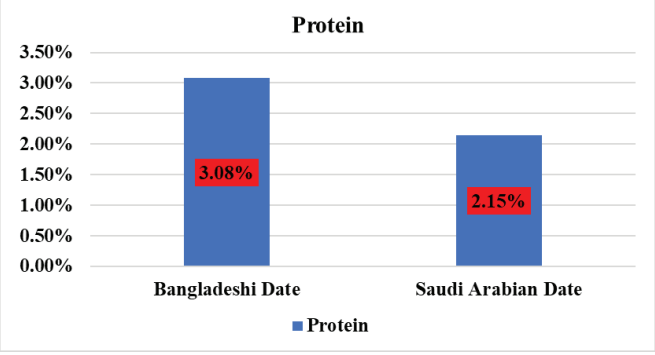

Figure 1: Comparison of protein content between Bangladeshi dates and Saudi Arabian Dates.

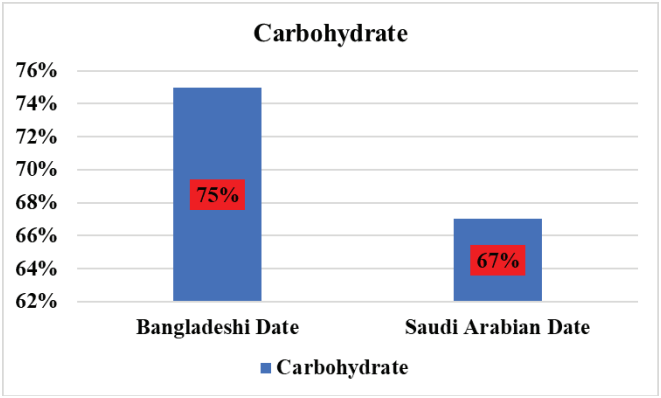

Figure 2: Comparison of carbohydrate content between Bangladeshi dates and Saudi Arabian Dates.

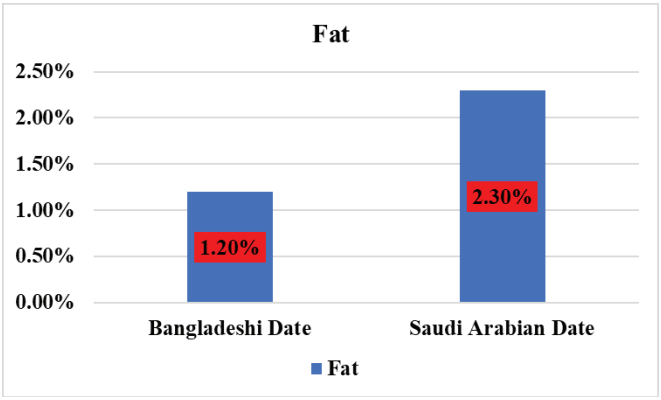

Figure 3: Comparison of fat content between Bangladeshi dates and Saudi Arabian Dates.

On the other hand, Bangladesh's subtropical monsoon climate, which features increased humidity and consistent rainfall, would offer the perfect environment for improved carbohydrate synthesis, which would explain the higher quantities found in this investigation. A greater carbohydrate profile could result from the buildup of simple and complex sugars, which could be encouraged by the moisture in the soil and air.

In regards to the standard level of fiber contents in date fruits, FAO has stated that the standard level of fiber content should be 2.5% in flesh dates however depending on the degree of ripeness and varieties of date fruits the fiber contents in it should be between 6.4% to 11.5% which was established by previous studies on 14 varieties of dates [8,22]. In the present study, the fiber content in both the Bangladeshi dates and Saudi Arabian dates is 3.22% and 7.14% respectively, and from our study, we have observed that the dates harvested in Saudi Arabia contained higher fiber contents in comparison with the date varieties of Bangladesh (Figure 4). The results of our study showed that the fiber contents in both Bangladeshi and Saudi

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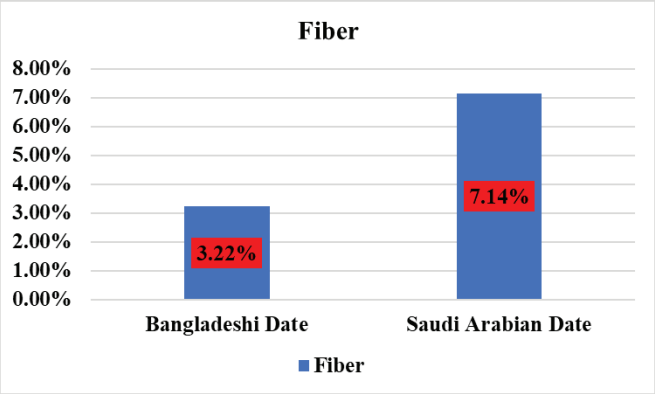

Figure 4: Comparison of fiber content among Bangladeshi dates and Saudi Arabian Dates.

Arabian dates have showed a significantly higher level of fiber contents if we compare it with the standard of FAO. Another study showed 4.34% of crude fiber in date fruits, which might be due to the use of different date varieties in comparison with the used varieties in our study [25].

Various studies have been done till now to analyze the fruit characteristics, nutritional values, and biochemical constituents of numerous varieties of date palm and it was observed by these studies that the maternal tissues of date fruits such as shape, size, weight, percentage of pericarp and ripening time were highly influenced by the pollen samples of date palm [26]. Another study on the proximate composition of eight date palm varieties has reported a high concentration of carbohydrate, protein, fat, and fiber, however, a low concentration of moisture and ash levels has also been reported [27]. Our study results are significantly in line with these results as we found almost the same percentage of various macronutrients in Bangladeshi and Saudi Arabian date palm varieties. Previous studies also illustrated more or less the same values of nutrients in different varieties of date palms as we have observed in Bangladeshi and Saudi Arabian date palm fruits. In a nutshell, from our study, we can state that the date palm fruits that are cultivated in Saudi Arabia could be a rich source of dietary fats and fibers in comparison with Bangladeshi dates, while it has also observed from this study that Bangladeshi dates contain more protein and carbs than the Saudi Arabian dates. Though we have conducted this study to find out the main differences in the nutritional values of the date palm which are cultivated within the above-mentioned countries, we could not justify the quality of nutrients during our study due to our limited resources. However, through this comparative study, we have achieved the major objective of our research which was to produce an effective nutritional comparison of Bangladeshi dates and Saudi Arabian dates, so that the audience could make an effective dietary decision to choose the right varieties of date palm on the basis of their nutritional needs.

Environmental factors can potentially be linked to the observed variations in fiber content. The fiber content of Saudi Arabian dates was higher (7.14%) than that of Bangladeshi dates (3.22%). Saudi Arabia's arid climate might encourage the formation of stronger cell walls and more fiber as a preventative measure against water loss. The greater fiber content of Saudi Arabian dates is a result of these structural variations.

Limitations of the study

The study has a number of limitations even though it offers insightful information about the macronutrient content of dates from Saudi Arabia and Bangladesh. First, this study only examined a small number of macronutrients, including proteins, fiber, lipids, and carbs, without examining the type or quality of these nutrients (e.g., saturated versus unsaturated fats, and monosaccharides against polysaccharides). Second, a more thorough understanding of the nutritional disparities may have been obtained if the study had taken into consideration possible seasonal fluctuations in nutrient content. Furthermore, only dates grown in one area of each nation were included in the study, and the sample size and variety selection were constrained.

Recommendations for future research

Future research could build on this comparative analysis by looking at the bioactive substances (like antioxidants) and micronutrient profiles (like vitamins and minerals) in various date varietals. Additional information might be obtained by looking into how post-harvest storage conditions, irrigation methods, and soil composition affect the nutritional content of date fruits. Future research could also examine the useful qualities of dates, such as how they might be used to create food items that cater to particular dietary requirements. Last but not least, carrying out customer preference research and sensory analysis could supplement the nutritional information and offer a comprehensive assessment of date types.

Conclusion

The present study was a comparative study of Bangladeshi and Saudi Arabian date palm varieties for their nutritional values. It can be concluded that all the Bangladeshi and Saudi Arabian date palm varieties contained high levels of protein, carbohydrate, fat, and fiber. However, this study did not provide the quality characteristics of nutrients present in the date varieties of these two countries. Our findings could help the policymakers and heathcare providers to have a comparable insight into date varieties of Bangladesh and Saudi Arabia. Future studies should not only focus on the quality analysis of date varieties but also on the phytochemicals as well as anti-oxidant properties of dates.

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Data availability statement

Data will be available on request.

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