International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 18-11-2024, Accepted: 19-12-2024, Published: 03-01-2025
Volume 10, Issue 1, 2025, Page No. 84-87

Study on antioxidant and sensory properties of Phoenix *Dactylifera* seed brew

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Abstract
The Palm Dates aremain fruit in the Arabian Peninsula and are considered to be one of the most significant commercial crops and also have been documented in Holy Quran and modern scientific literatures. Various studies have shown that date seeds have been examined for extractable high value-added components for incorporation into functional foods. They had shown that date seeds contain large quantities of fiber, and caffeine-free, which may have potential health benefits. Hence this study is aimed to utilize the date seeds in the form of date seed brew and to study the antioxidant and the sensory properties present in it. The various parameters utilized to establish indicators for monitoring the quality of date seeds powder during roasting process and it could be used to optimize industrial processing conditions. Considering chemical composition and sensory evaluation of roasted date palm seeds, it could be valuable and excellent source of functional food components and low-priced coffee substitute beverage.

Keywords: Palm dates, phoenix dactylifera, roasting, date seed brew, antioxidants, dpph

Introduction
Palm dates (Phoenix dactylifera) are considered to be a nutritional component of the diet and a staple food source in most Middle Eastern and North African regions. Dates can be consumed either in a fresh form or as a derivative product, such as date-syrup, date-honey, date-jam, date-vinegar, and date-paste. Date seeds are generated during direct consumption or from the date processing industries. Presently, these byproducts are generally discarded leading to environmental problems, or instead, are utilized as animal fodder. The lack of uses for this by-product for human food constitutes a real economic loss since it is rich in dietary fiber, phenolic compounds and antioxidants, which can also be extracted and used as therapeutic components. Due to the above-mentioned benefits, several potential uses of date seeds have been identified and reported. These included date seed powder as an ingredient in food products such as bakery products, chocolate and non-caffeinated drinks. Thus, the present work is aimed to study the date seed (*Phoenix dactylifera*) brew under various roasting time to study the antioxidant properties of the dateseed (Phoenix dactylifera) powder and to evaluate the sensory properties of the developed brew.

Materials and methods
The present study was carried out at College of Food and Dairy Technology, a constituent college of Tamil Nadu Veterinary and Animal Sciences University, Koduveli, Chennai - 600 052. In accordance with the objectives of the study the materials used, and the experimental techniques adopted during the study were standard and specific methods described by AOAC (2000) [2] and FSSAI Manual.

Preparation of date seed powder
According to the procedure used by Fikry, *et al*., (2019) [6] the seeds were manually separated from the flesh and soaked in hot water at 100ºC for 1 h to remove any adhering residuals, then dried at 50ºC in solar dryer for 4 h to remove excess water from the surface of the seeds. Next, the date seeds were roasted by simulating the commercial roasting conditions of coffee using a baking oven) at a temperature of 200ºC. Before beginning of the roasting process, the oven was pre-heated for 10 minutes to ensure that the steady-state was reached. Then, around 100 ± 1.5 g of the date seed samples were placed on an aluminum tray and spread as a thin layer on an oven. In order to obtain date seeds with different roasting degrees, each sample was removed from the oven at roasting time intervals of 20, 30 and 40 min. The samples were removed from the oven in less than 10 seconds so that steady-state conditions were maintained during sampling. All roasted date seeds were allowed to cool at room temperature and were then ground into powder using a mixer grinder. Then the date seed powder was stored in an air-tight container in a cool and dry place.

Preparation of date seed brew
To obtain a good quality beverage, preliminary sensory testing was conducted by mixing the roasted date seeds powder and boiling water at a ratio of 1:10 (w/v) and the mixture was left to boil. Then palm sugar was added to the brew to make it more palatable. After that, the mixture was filtered using Whatman No.2 filter paper to remove insoluble solid leftovers from the brew. Thus, the prepared brew was used for the investigation of the quality properties.

Evaluation of sensory properties

Sensory evaluation was conducted with 20 assessors, consisting of people who are familiar with the taste of black coffee. Ethically, assessors were informed and agreed to evaluate the brew before conducting the test, and were informed of the type of brew being assessed and then requested to evaluate four sensory attributes of the date seed brew samples (color, aroma, taste, and overall preference). The sensory assessment was applied in an environmentally controlled room (25 ± 2 °C) under good lighting. According to Venkatachalam and Sengottian. (2016) [9] A 9-point hedonic scale (1 = disliked extremely and 9 = liked extremely) was used by the assessors to determine how much they liked or disliked the samples. Date seed brew samples were randomly evaluated in opaque, white and odorless cups, which were coded with random 3-digit numbers, and the samples were evaluated by all the assessors. Data were presented as means and standard deviations.

Proximate analysis of date seed (*Phoenix dactylifera*) powder

The proximate parameters such as Moisture content (%), Fat (%), Fibre (%), Protein (%), Ash (%), Total sugar (%), Energy (Kcal) of the date seed powder were analyzed. The moisture content was determined using a Hot Air Oven by measuring the mass of the food sample before and after moisture removal through evaporation. The ash content was analyzed using a Muffle Furnace, where the organic matter was incinerated, leaving behind the mineral residue. The protein content was assessed using the Kjeldahl Apparatus, which quantifies nitrogen content to estimate protein levels. The fiber content was measured using a Fiber Analyzer, while the fat content was determined through solvent extraction with a Soxhlet Apparatus. Carbohydrate content was calculated by difference method recommended by AOAC (2000) [2] methods using the following formula: Total Carbohydrate (%) = 100 - (Crude Protein + Crude Fat + Ash + Crude Fibre + Moisture)

Determination of DPPH radical scavenging activity

The method recommended by Fikry *et al*. (2019) [6] was used to measure the DPPH free radical scavenging activity. To determine the DPPH radical scavenging activity of the date seeds brews, 0.2 mL of the brew and 0.4 mL of 0.4 mmol/L DPPH radical were mixed with ethanol. The mixture was powerfully agitated and then left for 10 min. To measure the absorbance of the mixture (Abs), a UV-VIS spectrophotometer at 520 nm was used. By using ethanol as the sample's replacement, the absorbance of the control was attained. DPPH radical scavenging activity of the sample was calculated as follows:

$$\text{DPPH radical scavenging activity (\%)} = \left[1 - \left(\frac{\text{Abs sample}}{Abs\ control}\right) \times 100\right]$$

Determination of extraction yield

According to the procedure used by Ghnimi *et al*. (2015) [7], a sample of the date seeds extract (10 mL), was moved into a Petri dish and then dried at 105°C in a convection oven until the constant weight of the sample was achieved. The extraction yield was expressed as a ratio of the weight of the extracted solids and the initial weight of the sample.

Results and discussion

1. **Effect of different Roasting time on physical and quality properties of date seed (*Phoenix dactylifera*) powder at 200°C**

Table 1: Effect of Different Roasting Time on Physical and Quality Properties of Date Seed Powder at 200ºC

Roasting Conditions		Moisture Content (% D.B)	Bulk Density (kg/m^3)	DPPH Radical Scavenging Activity (%)	pH	Extraction Yield (g/g)	Browning Index (Abs at 420 nm)
T (ºC)	t (min)						
200	20	1.71	363.25	79.84	4.67	0.0134	0.189
	30	1.59	332.89	81.27	4.61	0.0141	0.199
	40	1.44	315.36	82.52	4.56	0.0151	0.206

The physical and quality properties of date seed powder *viz*., Moisture content, Bulk density, pH, Extraction Yield and Browning Index values were given in the Table 1. Moisture content of the roasted seeds inclined from 1.71 to 1.44% on dry basis. According to Bouhlali., *et al* (2017) [4] the moisture content of the roasted seeds powder was decreased as the roasting time increased. This result could be attributed to the dehydration of the date seeds during the roasting process.

From the given Table No.1, it is found that the bulk density of the Date seed powder decreased as the roasting time of the seeds increased (Table 1). The decrease of density could also be attributed to the rise of the volume. This could be due to the increase of porosity of the seeds structure, as determined by the rise in pressure of the internal gases (released CO_2, water, and volatile substances) resulting from pyrolysis reactions. El Sheikh et.al., (2014) [4].

The DPPH radical scavenging activity can be used for determining the antioxidative activity. It is shown from the Table 1 that the DPPH radical scavenging activity increased from around 79 to 82% with increase of roasting time. These values are comparable with those reported for the roasted date seed extracts.

According to Amany (2012) [3], the antioxidant activity of the different food materials was found to be increased as the roasting degree increases owing to development of the Maillard reaction products, called melanoidins during the roasting process. It was reported that development of the Maillard reaction products led to the formation of enediolstructure reductones, which can significantly reduce the oxidation rate of fats leading to increase of DPPH radical scavenging activity. It was further reported that the positive relationship was found between the DPPH and the BI values of the brew (Al-Farsi etal., (2005) [1].

Extraction yield was identified as the mass of soluble solids in the date seed brew. Table 1 showed that the maximum extraction yield of the brew was found with a roasting temperature of 200°C for 40 min. As it can be seen, the increase in the roasting time caused an increase in the extraction yield of the brew. Hossain., *et al* (2014) [8], reported that these results may be associated with the softening of seeds texture for the material flux and the

decomposition of insoluble polymers by the roasting temperatures.

Table 1 listed the pH values of the brew as affected by the roasting time. It can be seen that the pH of the brew decreased with the increase of the roasting time. The pH values of the brew changed from 4.67 to around 4.56 during roasting period (Table 1). Amany., *et al* (2012) [3] reported that the decrease in the pH value could be explained by the development of acidic caramelization byproducts, such as pyruvic acid, and the formation of Maillard reaction products during the roasting process.

The formation of non-enzymatic reactions such as the Maillard reaction and sugar caramelization is considered one of browning causes in roasted foods. Browning index (BI) can be used as an indicator of the contents of pigment compounds resulted from the non-enzymatic browning reactions. As it can be observed in Table 1, the highest BI value of the brew was detected for a roasting temperature of 200°C for 40 min. The increase in the roasting time caused a significant increase in BI (Table 1).

2. Proximate composition of date seed (*Phoenix dactylifera*) powder

The proximate characteristics of the date seed powder such as Moisture content (%), Fat (%), Fibre (%), Protein (%), Ash (%), Carbohydrate (%) and Energy (Kcal) were analyzed for the date seed powder and the results were shown in Table 2.

Table 2: Proximate composition of date seed (Phoenix dactylifera) powder on 100g

S. No	Proximate Composition (g/100g)	Values
1.	Moisture Content	4.27
2.	Carbohydrates	61.11
3.	Protein	6.48
4.	Fat	9.06
5.	Fibre	17.80
6.	Ash	1.28
7.	Energy (kcal)	351.36

3. Effect of roasting conditions on the sensory properties of the date seed (*Phoenix dactylifera*) brew

The sensory attributes of the brew made from the date seed powder under different roasting times at 200ºC, namely, color, aroma, taste, and overall acceptability were evaluated. A possible acceptability limit can be selected based on a score equal to 6.0 in a nine-point hedonic scale.

From Table 3, it is revealed that the highest color score of the brew was 7.55 for a roasting temperature of 200°C and a roasting time of 40 minutes. Obviously, Table 3 showed that the color score increased as the roasting time increases. It is interesting to observe that the changes in accepting the color of the brew could be due to the increase of BI which was resulted from Maillard reactions.

Table 3: Effect of roasting conditions on the Sensory Properties of Date Seed (*Phoenix dactylifera*) Brew (M±SE)

Treatments	Colour	Taste	Aroma	Overall Acceptability
T_1	7.40 ± 0.51	7.25 ± 0.48	7.35 ± 0.68	7.45 ± 0.44
T_2	7.55 ± 0.54	7.35 ± 0.71	7.40 ± 0.50	7.75 ± 0.51
T_3	7.45 ± 0.51	6.90 ± 0.64	7.35 ± 0.60	7.60 ± 0.50
T_4	7.50 ± 0.81	7.25 ± 0.78	7.45 ± 0.58	7.65 ± 0.51

Where,

T_1 – Date Seed Powder (200ºC for 30 minutes)

T_2 - Date Seed Powder (200ºC for 40 minutes)

T_3 - Date Seed Powder (200ºC for 30 minutes) with chicory powder (4: 1)

T_4 - Date Seed Powder (200ºC for 40 minutes) with chicory powder (4: 1)

The largest aroma score of the brew was 7.45 for a roasting temperature of 200 °C and a roasting time of 40 min with chicory powder in a ratio 4:1 (Table 3). Noticeably, the aroma scores increased with increasing roasting time (Table 3). It was suggested that the changes in accepting the aroma could be due to the drop in the pH of the brew.

In terms of the taste attribute, it can be observed from Table 3 that the highest score of the date seed brew was 7.35 obtained at roasting temperature 200°C and roasting time 40 minutes. Clearly, taste scores increased as the roasting time increases. The changes in accepting the taste could be due to the decline in the pH of the brew that effects on the acid flavor.

Table 3 indicates that the highest overall preference score of the date seed brew was 7.75 obtained at roasting temperature 200 °C and roasting time 40 minutes, respectively. The overall preference scores of the date seed brew increased with the increase of roasting time.

Conclusion

Date seeds can be a good source of the antioxidants that can be used as curative ingredients. The results showed that the roasting temperature and time significantly affected the moisture content of the roasted date seeds powder, DPPH radical scavenging activity, extraction yield, pH, browning index and the sensory properties of the brew prepared from the date seeds. In addition, brew made from dark date seeds powder was preferred and scored the highest by the panelists in the sensory evaluation. The present results could be utilized to establish indicators for monitoring the quality of date seeds powder during roasting process and to optimize industrial processing conditions. Considering chemical composition and sensory evaluation of roasted date palm seeds it could be concluded that the waste date seeds could be valuable and excellent source of functional food components and low-priced coffee substitute beverage. Also, date seeds could be regarded as an excellent source of

dietary fibre. More detailed investigations are needed to expound the chemical changes which are responsible for the changes in antioxidants during roasting process.

Acknowledgement
Part of the project work was submitted to College of food and Dairy Technology, Koduveli, Tamil Nadu Veterinary and Animal Sciences University, Chennai - 52 by the project student in partial fulfilment for the award of B. Tech degree.

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