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Compositional and functional characteristics of dates, syrups, and their by-products

Mohamed Al-Farsi [a,*], Cesarettin Alasalvar [b], Mohammed Al-Abid [a], Khalid Al-Shoaily [a], Mansorah Al-Amry [a], Fawziah Al-Rawahy [a]

[a] Plant Research Centre, Ministry of Agriculture and Fisheries, P.O. Box 292, P.C. 132, Al-Khoud, Muscat, Oman
[b] TÜBİTAK Marmara Research Centre, Food Institute, P.O. Box 21, 41470 Gebze/Kocaeli, Turkey

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Abstract

Three native sun-dried date varieties from Oman (namely Mabseeli, Um-sellah, and Shahal), as well as their syrups and by-products (press cake and seed) were examined for their proximate composition, dietary fibre, total phenolics, and total antioxidant activity. Carbohydrate was the predominant component in all date varieties, syrups, and their by-products, followed by moisture, along with small amounts of protein, fat, and ash. Press cakes had the highest protein content, ranging in concentration from 3.62 g/100 g in Shahal to 5.23 g/100 g in Mabseeli, whereas fat was the highest in seeds and ranged from 5.02 g/100 g in Mabseeli to 5.90 g/100 g in Um-sellah. Seeds and press cakes were found to be good sources of dietary fibre, varied between 77.75 and 80.15 g/100 g fresh weight and between 25.39 and 33.81 g/100 g fresh weight, respectively. Among dates, syrups, and their by-products, seeds had the highest contents of total phenolics (3102–4430 mg of gallic acid equivalents/100 g fresh weight) and antioxidant activity (580–929 μmol of Trolox equivalents/g fresh weight). The results obtained suggest that date by-products (particularly seeds) serve as a good source of natural antioxidants and could potentially be considered as a functional food or functional food ingredient.

Keywords: Date; Syrup; Press cake; Seed; Dietary fibre; Total phenolics; Total antioxidant activity

1. Introduction

Oman produced 240 000 metric tons of dates in 2005, contributing around 3.5% to the total global production (MAF, 2006). According to the Omani Ministry of Agriculture and Fisheries (MAF, 2005), date palm cultivation accounted for 49% of the total cultivated land and date production, representing 81% of the total fruit production. In 2004, surplus from dates were 52 000 metric tons, 32% of which were from low quality dates such as Mabseeli, Um-sellah, and Shahal (MAF, 2005). Therefore, utilisation of such surplus is very important to maintain dates cultivation and to increase the income of that sector. Dates are rich in certain nutrients and provide a good source of rapid energy due to their high carbohydrate content (~70–80%). Most of the carbohydrates in dates are in the form of fructose and glucose, which are easily absorbed by the human body (Al-Farsi, Alasalvar, Morris, Baron, & Shahidi, 2005a; Myhara, Karkalas, & Taylor, 1999).

Epidemiological studies have consistently shown that high fruit and vegetable consumption is associated with a reduced risk of several chronic diseases such as coronary heart disease (CHD), cardiovascular disease (CVD), cancers, aging, atherosclerosis, neurodegenerative diseases (such as Parkinson and Ahlzeimer), and inflammation, among others (Dillard & German, 2000; Fuhrman, Lavy, & Aviram, 1995; Joseph et al., 1999; Prior & Cao, 2000; Wargovich, 2000). This is attributed to the fact that these foods may provide an optimal mixture of phytochemicals

* Corresponding author. Tel.: +968 26893917; fax: +968 26893097.
E-mail address: malfarsi61@hotmail.com (M. Al-Farsi).

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such as dietary fibre, phenolics, natural antioxidants, and other bioactive compounds.

To best of our knowledge, limited data is available regarding the compositional and functional characteristics of date by-products grown in Oman. Detailed information on nutritional composition and health-promoting components of dates and their by-products will enhance our knowledge and appreciation for the use of dates, syrups, and their products in a variety of food and specialty products, including their use as functional foods and ingredients in nutraceuticals, pharmaceuticals, and medicine. The objectives of this research were to compare the existing differences in compositional and functional characteristics of three low quality of date varieties, as well as their syrups and by-products (press cakes and seeds) grown in Oman.

2. Materials and methods

2.1. Materials

Three native sun dried date varieties, namely Mabseeli, Um-sellah, and Shahal, were procured from Batinah region, Oman, at the beginning of the 2005 harvest season. Mature fruits of uniform size, free of physical damage and injury from insects and fungal infection, were selected and used for all experiments.

2.2. Chemicals

All chemicals and solvents were obtained from Sigma–Aldrich Co. Ltd. (Dorset, UK), unless otherwise specified.

2.3. Syrup production

Syrups from three date varieties were produced according to the method of Al-Farsi (2003). Briefly, dates were extracted twice with water (1:1) at 60 °C and then filtered through a Whatman no. 41 filter paper. Clear juice was concentrated to 72 °Brix using rotary evaporator at 70 °C. Finally, syrup, press cake (date flesh), and seeds were obtained.

2.4. Proximate analysis

Percentages of moisture by vacuum oven (method 934.06), protein by Kjeldahl nitrogen (method 920.152), and ash by direct analysis (method 940.26) were determined according to the Association of Official Analytical Chemists' methods (AOAC, 1995). The percentage of crude protein was estimated by multiplying the total nitrogen content by a factor of 6.25 (AOAC, 1995). The Bligh and Dyer method (Hanson & Olley, 1963) was used to determine the lipid content. Total carbohydrates were calculated by subtracting the total percent values of other measurements from 100. Proximate analyses were expressed as grams per 100 g of fresh weight.

2.5. Dietary fibre analysis

Determination of dietary fibbers was carried out using the AOAC enzymatic-gravimetric official method (991.43) (AOAC, 1995). The sample was de-sugared by three extractions, each with 85% ethanol (10 ml/g), and then dried overnight at 40 °C. Otherwise, the total dietary fibre content would have been overestimated. The flow diagram outlined by the AOAC procedure was followed. Contents of crude protein (percentage total nitrogen X 6.25) and ash determined by using the methods described above were used to correct the fibre content. Dietary fibre was expressed as grams per 100 g of fresh weight.

2.6. Measurement of total phenolics

Total phenolics were determined colorimetrically using Folin-Ciocalteau reagent as described by Al-Farsi, Alasalvar, Morris, Baron, and Shahidi (2005b), using a UV-1601 spectrophotometer (Shimadzu, Kyoto, Japan). The concentrations are expressed as milligrams of gallic acid equivalents (GA) per 100 g of fresh weight.

2.7. Measurement of total antioxidants

An improved oxygen radical absorbance capacity (ORAC) method of Ou, Hampsch-Woodill, and Prior (2001), using fluorescein (FL) as the fluorescent probe, was used with slight modifications. The $ORAC_{FL}$ assay measures the ability of antioxidative compounds in test materials to inhibit the decline in fluorescence induced by peroxyl radical 2,2′-azobis (2-amidinopropane) dihydrochloride (AAPH). The $ORAC_{FL}$ values were calculated according to the method of Wang, Cao, and Prior (1996) and Al-Farsi et al. (2005b) and $ORAC_{FL}$ values are expressed as micromoles of Trolox equivalents (TE) per gram of fresh weight.

2.8. Statistical analysis

Results were expressed as mean ± standard deviation (SD) ($n = 3$) on an extract. Statistical significance (t-test: two-sample equal variance, using two-tailed distribution) was determined using Microsoft Excel statistical software (Microsoft Corporation, Microsoft Office Excel 2003, Redmond, WA). Differences at $P < 0.05$ were considered to be significant.

3. Results and discussion

3.1. Weight and proximate analysis

Syrups had the highest weight (52–63.7 g/100 g), followed by press cakes (17.4–28.0 g/100 g), and seeds (7.8–14.8 g/100 g) (Table 1). Low temperature (60–70 °C) of extraction and concentration was used in order to minimise the effect of heat on syrup quality. No significant differ-