



Physico-chemical Composition of Two Varieties of Moroccan Palm Date Fruit

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For human nutrition, palm date fruit may be considered an ideal food, providing an essential nutriment and benefit health for the body. At this moment, few data are available on the composition of palm date fruit grown in Morocco. In this study date, fruit (*Phoenix dactylifera* L.) of two cultivars Aziza Bouzid and Assiane from Morocco were evaluated for the physical and chemical composition. Studied were also conducted on the physicochemical properties of dietary fibre. Weight ranged respectively for Aziza Bouzid and Assiane (5.85 to 6.22 g), volume (5.21 to 5.25 mL) induce that the two cultivars are classified as small fruits varieties, but both of them are good source of sugar (71 to 80 %) and dietary fibre (10.22 to 12.79 %) on a dry matter basis. When Aziza Bouzid contain a significant quantities of some essential amino acid (lysine: 184, isoleucine 122, threonine 98 mg/100 g dry matter), Assiane variety was richer in mineral macro-element (potassium: 863, calcium 87 mg/100 g dry matter). The hydration properties of dietary fibre for Aziza Bouzid and Assiane, respectively (14.90-15.30 g of water/g sample) and fat absorption capacity (8.6-9.15 g oil/g sample) make palm date fruit a valuable source to be include in the formulation in food.

Key Words: Chemical characterization, Dietary fibre, Holding capacity, *Phoenix dactylifera*, Sugar, Water.

INTRODUCTION

The most part of studies on the palm date '*Phoenix dactylifera* L.' in Morocco concentrates on the plant, its culture, its environmental role and the treatment methods for the parasites and diseases but were not much interested in the fruit and in its physicochemical characterization.

The date palm (*Phoenix dactylifera* L.) is a plant used in human and animal consumption, pharmacy, cosmetics, biscuits in carpentry and as firewood¹⁻⁴. The benefits of dates are obvious. This fruit is an important source of water, fibre, sugars and minerals essential to human body⁵⁻¹⁰.

The Moroccan palm groves are characterized by great genetic diversity with 223 varieties listed and over 2 million hybrids. The best commercial varieties (Jihl, Boufeggous and Mejhoul) represent 24, % while varieties consumed locally correspond only to 14 % and other varieties and hybrids as ca. 60 % for livestock¹¹.

Dates are unique in that they constitute a set of properties and characteristics, which distinguish them from all major fruits. Dates are consumed in at least three major stages of maturity: from fresh, crisp to succulent, to soft pliable. A fully tree ripened date is self-preserving for months and can be stored or transported as a concentrated food source. Dates have signi-

ficance as a staple food as well as a dessert fruit, whilst their use in date products and industrial applications has increased.

Research into dates has not been true reflection of the importance and potential of this crop. A fair amount of works has been directed at studying differences in chemical composition and physical characteristics but all of them were concentrated in noble variety or cultivars with the most part of production in the world.

The forces of local and international markets are a root cause of the disappearance of several varieties of date palm. Indeed, preferences markets will date of high commercial value (usually large, soft and sweet), which are from known varieties and affected transportation damage. To meet this demand, farmers are gradually replacing the existing varieties *in situ* by a small number of varieties offering better commercial appeal, thus limiting biodiversity in the oasis.

Knowledge of physico-chemical and biochemical characteristics is essential for each type of dates prior to treatment and or processing. Given their socio-economic importance, we will study the properties of two varieties of dates from Oasis Figuig, located in Eastern Morocco in the Moroccan-Algerian border; Assiane for its quantitative, qualitative and Aziza Bouzid for its commercial value.

The dates are known for their nutritional value. Although rich in certain minerals, vitamins, tannins, it is their high sugar content, which makes it a food of choice. According to FAO⁴, the pulp of dates is an average of 64-69 % of sugars, which predominantly fructose and glucose and 15-20 % water, cellulose, pectin, protein, vitamins and minerals making up the rest.

The date is considered as a nutritious fruits as research has indicated the clear contribution of dates to human health when consumed with other food constituents¹². Date contain sufficient quantities of minerals and vitamins that help to prevent deficiency. The usual sources of dietary fibre added to commercial foods (juices, dairy products, backed goods) are cereals. The demand for bio-products from fruits and vegetables as sources of dietary fibre has been increasing, because these sources present higher nutritional quality, higher amounts of total and soluble fibre, lower caloric content, stronger antioxidant capacity and higher levels of fermentability, water and oil retention, emulsifying and or gel formation. Indeed, date fruit can be incorporated in food products to modify textural properties, avoid synergetic and stabilize high fat food and emulsions^{13,14}.

The aim of this work is to characterize these two varieties mentioned above and to prove that despite their low commercial value they can have a crucial importance for food industry and human nutrition.

EXPERIMENTAL

Physical analysis: Three trees were taken randomly as replicate for each variety selected in the oasis, sample of 100 fruits were chosen randomly for each cultivars. Fruits were picked in Tamar stage, the latest stage of repining.

For the 100 fruits the following physicals, characters were determined: fruit weigh, length, diameter, seeds weight. The volume of the fruit was determined by the water displacement method and the fruit density was calculated as weight over volume. The measurements were determined using Vernier calliper and electronic balance with sensitivity of 0.01 g.

Chemical analysis: About 2 Kg of random sample of date fruits was collected from each cultivar, stones removed. The flesh was cut into small pieces using blender, mixed well and sampled for moisture content. The remaining rinds were immediately heated in boiling water in a stainless steel reactor flask under magnetic stirring for 3 min, to inactivate the cell wall endogenous enzymes. The fruits were immediately packaged in strong poly-bags and placed into frozen storage at -15 °C for chemical analysis.

Moisture, ash, fat, crude protein, sugars content were determined according to the method of the Association of Official analytical Chemists¹⁵.

Mineral elements were extracted and analyzed by atomic absorption spectrophotometry according to the methods described by Cucu¹⁶, Ozer *et al.*¹⁷. 1 g of fresh fruit were weighed and dried at 105 °C for 24 h, before placing the dry matter in porcelain cup and charring it in a muffle oven at 550 °C for 4 h after cooling, 5 mL hydrochloric acid solution at 20 % (v/v) was added. Then it was boiled and the content was filtered into a 100 mL flask with ionized water. Mineral elements were

determinate by atomic absorption spectrometry (Shimadzu AA 6800, Italy).

Amino acid have been analyzed by methods based on the technology developed by Stein en Moore, 0.5 g of flesh date was hydrolyzed using 10 mL of HCl 6 N (with 0.1 % phenol) at 100 °C/24 h, a 50 µM/mL of norleucine was added as internal standard and the mixture was neutralized with ammonia to pH 2.2, filtered an injected. Free amino acids are separated by cation-exchange chromatography and treated with ninhydrin in postcolumn dervatization step and the derivatives are detected in the visible region.

Dietary fibre characterization: Dietary fibre content was determined by gravimetric enzymatic method AOAC¹⁵. Triplicate samples of date were gelatinized with tetramyl (heat stable α -amylase), then enzymatically digested with protease and amyloglucosidase to remove the protein and starch present. The precipitation of the fibre were realized with ethanol 96 % and the filtration with "FIBERTEC TECATOR". Total dietary fibre (TDF) was calculated as the sum of soluble dietary fibre (SDF) and insoluble dietary fibre (IDF) after correcting for ash and undigested protein.

Determination of uronic acid (UA) content of the dietary fibre was done by high-performance anion-exchange chromatography hyphenated to a pulsed amperometric detector (HPAEC-PAD)¹⁸. Individual neutral sugars were released by acid hydrolysis with 1 M H₂SO₄ at 100 °C for 3 h and converted to alditol acetate¹⁹. Alditol acetate derivatives were separated and quantified by gas chromatography (Hewlett-Packard Co., Palo Alto, CA) using a high performance capillary column, HP1-methylsiloxane (30 m × 0.32 mm, 0.25 µm film thickness, Scientific Glass Engineering, Melbourne, Australia). 2-Desoxy-D-glucose (purity > 99.5 %, Sigma Chemical Co., St Louis, MO) was used as internal standard.

Determination of hydration properties: The hydration properties of the sample from both cultivars were determined as per the following procedure reported by Robertson *et al.*²⁰. The water holding capacity is defined by the quantity of water that is bound to the fibre without the application of any external force, except for gravity and atmospheric pressure. It is calculated and the ratio of quantity of water held up to the initial dry weight of the residue.

Samples (250 mg × 3) were suspended in 15 mL of water. After 24 h of stirring at room temperature, the suspension was centrifuged at 14000 g for 1 h. Supernatant were carefully discarded and the hydrated fibres were weighed. WLC was expressed as mL /g fibrous residue.

Determination of fat absorption capacity: Fat absorption capacity is the measure of retention of fat in the food that is normally affected during cooking²¹. A mass of 0.5 g of dry sample received 10 mL of refined oil in a centrifuge tube and allowed to equilibrate over night. It was then centrifuged at 10,000 rpm for 0.5 h, the supernatant was decanted and the weight of the residue was recorded. Fat absorption capacity is calculated as the ratio of quantity of fat held up to the initial dry weight of the residue.

RESULTS AND DISCUSSION

Physical properties: The Moroccan climate conditions may influence the composition and the physicochemical

properties of palm date. The fertilization is one of the important practices, which increase date production and improve fruits quality and characteristics.

The physical measurements results are presented in Table-1. At the 'Tamar' stage, the latest stage of repining, each cultivar are developed a distinctive colour, Aziza variety a more attractive colour (golden brown) that give it pleasant and distinctive apparent, then a market value higher than Assiane (Brownish).

TABLE-1
FRUIT PHYSICAL PROPERTIES OF TWO VARIETY OF
PALM DATE FROM MOROCCO AT TAMAR

Cultivars	Aziza Bouzid	Assiane
Colour	Golden brown	Brownish
Length (mm)	31.23 ± 1.20	35.87 ± 1.25
Diameter (mm)	17.52 ± 0.85	17.85 ± 0.90
Weight (g)	5.85 ± 0.10	6.22 ± 0.12
Pulp:Seed ratio	80:20	78:22
Fruit volume (mL)	5.21 ± 0.25	5.25 ± 0.20
Fruit density (g/mL)	1.12	1.18

All the given value is means of ten-determination ± standard deviation.

The physical properties of many dates cultivars were developed in numerous studies²²⁻²⁴. They are within the range in the present studies.

According to variety and growth conditions, date fruits vary in shape, size and weight. Usually they are oblong though certain varieties may reach a near round shape. Length and width may vary from respectively 18 and 8 mm to 60 and 32 mm but averages at 40 and 20 mm. Average weights per fruit is about 7 to 10 g FAO⁴.

Although the first variety shows a dimension relatively small and more cylindrical in shape compared to the second, both cultivars have almost the same density and the same report pulpe: seed. They are classified as small fruits varieties.

Chemical analysis: The results of proximate composition analysis of the two cultivars are presented in Table-2, the moisture is respectively 19 and 30 % for Aziza Bouzid and Assiane then, they are classified as semi dry and soft date. These results were in agreement with those found by Booiij *et al.*²⁵ who mentioned the amount of 25 % for Deglet nour. In contrast, this content of water could reach highest values in others fruits, this concentration was 53.72 % in strawberry²⁶, 84.57 % in pomegranate²⁷ and 86.89 % in apple²⁸. Indeed, this weak content in moisture of studied varieties permits a better conservation and inhibits the development of bacteria.

The chemical properties of date are considered important in grading, preservation, storage and processing of dates. The high moisture content will facilitate spoilage of dates and low moisture content will lead to dry dates not acceptable to consumers. However, many researchers^{24,29}, observe a decrease in moisture content during ripening of date fruits.

The total sugars content in Aziza Bouzid was 80 %, it's sweetest than Assiane 71 %, but both of them are in same range with other report^{25,30}. Previously reported results also indicated that the most abundant sugars in dates are fructose and glucose, with sucrose being present in small quantities that varied according to variety²⁴.

TABLE-2
CHEMICAL CHARACTERISTICS OF
AZIZA BOUZID AND ASSIANE FRUITS

Cultivars	Aziza Bouzid	Assiane
Moisture (g/100 g flesh)	19 ± 0.55	30 ± 0.35
Total sugars (g/100 g DM)	80 ± 1.06	71 ± 1.15
Protein (g/100 g DM)	3.87 ± 0.13	2.89 ± 0.10
Fat (g/100 g DM)	0.26 ± 0.02	0.19 ± 0.01
Ash (g/100 g DM)	1.59 ± 0.04	1.79 ± 0.02
Mineral macro-element (mg/100 g DM)		
Potassium	648 ± 0.78	863 ± 0.89
Calcium	59 ± 0.22	87 ± 0.35
Sodium	16 ± 0.18	10 ± 0.21
Magnesium	37 ± 0.25	41 ± 0.31

All the given value is means of 3-determination ± standard deviation.

Sugars contribute the most prevalent single component and in the ancient date production countries, the date has been used more as a sugar source than as a fruit. In Tibesti water is boiled with dates to make tea, the nomads boil milk with dates, or they are simply chewed to obtain daily calorie intake⁵. With the relatively high sugar content of the fruit³¹ suggest that the date palm may have an important agro-industrial future as a potential source of refined sugar comparably with cane sugar and beet sugar production.

Hulme³² mentioned that 61 % of the fresh weight of the date consists of sugar. He added that sugar content of fruits of a particular species might vary considerably with variety, soil and climatic conditions during their life on the plant. Fadel *et al.*³³ conclude that, due to the significant correlation factors between sugar content and red and green colours, both colours' intensities should be used to estimate sugar content in date fruits under specific conditions of illumination.

It is important to note that the ratio of moisture content is related to sugar content, since dates with low moisture content will contain high sugar and *vice versa*²⁹.

Dates contain a higher percentage of protein than other type of fruits. They contain 2.3-5.6 % protein, whereas apples, oranges, bananas and grapes contain 0.3, 0.7, 1.0 and 1.0 %, respectively¹⁰. Proteins occur in date fruits though their amino acid pattern is favourable to human needs, the amount are too small. Data given in Table-2 shown significant difference concerning of content proteins, Aziza Bouzid with 3.87 % on dry matter basis have the highest content of protein than Assiane 2.89 %. The analyses of date flesh content established the presence of 17 amino acid. Many of these are not present in the most popular fruits such as oranges, apples and bananas. For example, aspartic acid, threonine, serine, glutamic acid, proline, glycine and alanine are found almost exclusively in dates, isoleucine is present in dates at over 800 times the quantity in apples. The lysine content of dates is nearly 5000 times that in oranges and over 2000 times that in bananas¹⁰. Both varieties were found to be richer in most essential amino acid like lysine, threonine, valine, isoleucine, tryptophane was not detected (Table-3).

Lipids in the date flesh had more attention than those in the seeds. This is because of the nutritional as well as the commercial values of the fruits³⁴, Al-Hooti reported²⁴ that the date fruit at all stages of development, were very low in crude

TABLE-3
AMINO ACID CONTENT OF DATE FLESH (mg/100 g DM)

Cultivars	Aziza Bouzid	Assiane
Alanine	167 ± 0.88	123 ± 0.74
Arginine	34 ± 0.54	28 ± 0.14
Aspartic acid	25 ± 0.29	11 ± 0.12
Cysteine	12 ± 0.33	4 ± 0.08
Glutamic acid	230 ± 0.95	192 ± 0.45
Glycine	123 ± 0.45	14 ± 0.17
Histidine	7 ± 0.10	0.6 ± 0.02
Proline	98 ± 0.21	63 ± 0.19
Serine	181 ± 0.36	119 ± 0.45
Tyrosine	26 ± 0.24	10 ± 0.12
Essential amino acid		
Lysine	184 ± 0.30	162 ± 0.25
Threonine	98 ± 0.21	90 ± 0.13
Valine	88 ± 0.15	56 ± 0.23
Isoleucine	122 ± 0.28	105 ± 0.25
Phenylalanine	1 ± 0.04	0.8 ± 0.02
Leucine	0.8 ± 0.01	–
Methionine	0.5 ± 0.01	–
Tryptophan	–	–

All the given value is means of 3-determination ± standard deviation.

fat content (0.05 to 0.6 %). The crude fat content consistently decreased or remained constant as the fruit passed through the different stages of maturity. In present study it is found respectively 0.26 and 0.19 % of fat in Aziza Bouzid and Assiane which constitutes a weak rate in relation to the other components.

The ash present a low percentage in two studied varieties until now. Dates are very good source of many minerals with concentration near to the average nutrient intake of minerals. Potassium can be found³⁵ in many types of dates with concentrations as high as 0.9 %. The percentages of potassium, phosphorus and iron in dates are much higher than in other types of fruit. The amount of these three minerals in dates is three to five times the amount in grapes, apples, oranges and bananas¹⁰.

The most important mineral for both cultivars was potassium, followed by calcium, magnesium and sodium. These results agree those reported by Reynes *et al.*³⁰.

Dietary fibre analysis: Table-4 shows the content of total dietary fibre (TDF), insoluble fibre (IF), soluble fibre (SF), the ratio between insoluble fibre and soluble fibre, the value of uronic acid (UA) and neutral sugars. For fully mature Aziza Bouzid and Assiane dates, the respective dry weights of total dietary fibre are 10.22 and 12.96 g/100 g dry matter. The present data agree with Aidoo *et al.*³⁶ who reported dietary fibre in the range 8.6-16.5 g/100 g dry weight for 11 samples of dates of diverse origins. The amount of the soluble fibre fraction was similar among cultivars *ca.* 2.5 g/100 g dry matter, but the insoluble fraction was quite different between both cultivars, it was higher in Assiane 10.58 g/100 g than Aziza Bouzid 7.88 g/100 g.

The insoluble fibre/soluble fibre ratio varied in two varieties from 3.36 to 4.40. The range to be obtained the physiological effects associated with both the soluble and insoluble fractions was 1.0-2.3³⁷.

Total reducing sugars are dominant in dietary fibre of the palm date flesh, in spite of their low quantities, the cultivars showed little differences in the contents of these monosaccharide. Based on the dry matter basis glucose was found to

TABLE-4
CHARACTERIZATION OF DIETARY
FIBRE OF TWO VARIETIES

Cultivars	Aziza Bouzid	Assiane
Total dietary fibre (g/100 g DM)	10.22	12.96
Insoluble dietary fibre (IF)	7.88	10.58
Soluble dietary fibre (SF)	2.34	2.38
Ratio IF/SF	3.36	4.40
WLC	17.90	15.30
OLC	8.60	9.15
Uronic acid	2.50	2.95
Neutral sugars	2.80	2.91
Rhamnose	0.03	0.04
Arabinose	0.11	0.12
Xylose	0.73	0.77
Mannose	0.06	0.06
Galactose	0.45	0.47
Glucose	1.42	1.45

All the given value is means of 3-determination ± standard deviation.

be the major component (1.42-1.45), respectively in Aziza Bouzid and Assiane followed by xylose (0.73-0.77), galactose (0.45-0.47), arabinose (0.11-0.12), mannose (0.06) and rhamnose (0.03-0.04).

These results are in concordance with those previously reported white Deglet noor and Allig varieties³⁸. The monosaccharide profile of total dietary fibre and uronic acid content suggest that this fraction of insoluble dietary fibre is mainly composed of cellulose, polygalacturonans and xyloglucans in fibre include highest proportions of hemicelluloses than pectin.

Functional properties: Water retention capacity was defined as the quantity of water that remains bound to the hydrated fibre following the application of an external force such as pressure or centrifugation. It is the ratio of the water retained to the initial dry weight of the residue. Swelling property is measure of the ratio of volume occupied when the sample is immersed in an excess of water and after equilibration to the actual weight.

The results obtained for WLC are presented in Table-4. WHC is an important property of dietary fibre from both physiological and technological points of view. Dietary fibre in date palm flesh had a WHC (14.90-15.30 mL of water/g dry matter) similar to previous results³⁸, this result are in the range of most described fibre, 12.6 mL water/g for peach pulp fibre³⁹ and more than 11 mL water/g for lemon fibre⁴⁰. WLC showed significant differences, depending on the severity of processing/fibre obtained with thermal treatment had higher WLC, heating might modify the structural characteristics of the fibre, hence facilitating its water uptake⁴¹.

Results for oil holding capacities (OHC) for both cultivars was inferior than WLC, ranged between 8.6 and 9.15 mL oil/g of DM, but values found in the literature were much lower than those for date flesh, 0.6-1.8 oil/g for apple pomace and citrus peel⁴¹ and around 2 mL oil/g for unripe banana flour⁴².

Dietary fibre had even higher value, so the use of this fibre may be appropriate in products where emulsifying properties are required.

Conclusion

The dates of the variety Aziza Bouzid is richer in sugars, in proteins and amino acids; have a flavour and interesting appearance and because of the little percentage of humidity

elevated agree for a longer conservation and a distinctly more elevated commercial value. In spite of an appearance and a least content in sugar, the dates of the variety Assiane contain more fibre and minerals, its rate of humidity is not supposed a handicaps for has conservation.

Dietary fibre is a complex mixture of polysaccharides with many different functions and activities as passes through the gastrointestinal tract. Many of these functions and activities depend on its physical chemistry, the dietary fibre from the date palm present a high WLC, OLC and more other rheological properties in other data, which may have important health benefits and modify a texture and viscosity of formulated product.

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