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Physico-Chemical Characteristics and Total Quality of Date Palm Varieties Grown in the Southern of Tunisia

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Abstract: The date palm, *Phoenix dactylifera*, is a palm extensively cultivated for its edible fruit. The chemical composition and the water content of ten Tunisian date varieties were determined. For all analysis, the Deglet Nour variety was taken as reference. Compositional analysis showed that the littoral varieties were very rich in reducing sugars (26 to 51%) than Deglet Nour which was rich in sucrose (54%). The relative results of the moisture content showed that the littoral varieties were classified as soft dates. The vitamin C analysis showed that the littoral varieties were very rich in this compound (24 to 46 mg/100 g) than Deglet Nour (1.12 mg/100 g). The mineral analysis showed that the littoral dates were relatively rich in potassium (283 to 733 mg/100 g) and presented a weak content in sodium (0.06 to 0.09 mg/100 g).

Key words: *Phoenix dactylifera* L., chemical composition, sugars, vitamin C, minerals, Tunisia

INTRODUCTION

For centuries, the date (*Phoenix dactylifera* L.) has been an important crop in the desert regions of Arabian countries and has formed the basis of survival for many ancient nomads, this continues to be true today (Mohammed *et al*., 1983). It is extremely useful in controlling desertification by creating a microclimate which prevents long-term degradation of ecologically weak environments (Rhouma, 1995). At present, 2000 or more different cultivars of date palm are known to exist all over the world, but only a few important ones have been evaluated for their agronomic performance and fruit quality (Al-Hooti *et al*., 1997). Rygg (1975) gave a detailed description of the date-growing regions of the world, varieties and general cultural practices. On the other hand fruits exploitation of date palm trees represents an important economical support for indigenous populations (Reynes *et al*., 1994).

Actually, the mean yield of date production is important as it varies between 18 and 50 kg of dates per tree. Tunisia is considered to be one of the date-producing countries; the number of date trees is estimated to be over 4 million and around 100,000 tons of dates are produced annually. The fruit of the date palm is composed of a fleshy pericarp and seed. Considering the food importance of the flesh date fruit, numerous studies have been reported on the characterization of it chemical composition particularly, polysaccharides, minerals, carbohydrates and Vitamins identification (Al-Shahib and Marshal, 2002; Al-Hooti *et al*., 1995; Fayadah and Al-Showiman, 1990; Sawaya *et al*., 1983; Vandercook *et al*., 1980; Youssef *et al*., 1982). The date is a one-seeded fruit, usually oblong. It has been the staple food and chief source of wealth in the irrigable desert from ancient times. 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 *et al*., 2005; Myhara *et al*., 1999). According to Sawaya *et al*. (1983), the moisture, total nitrogen, fat, fiber, ash, tannins, vitamin C, β-carotene and ten nutritionally important minerals were highest in the early stages of development and decreased during maturation. Date fruit, being exceptionally rich in potassium and extremely low in sodium, is a desirable food for hypertensive persons who are advised to consume low sodium diets. Increase in date fruit production will, therefore, play an extremely significant role in worldwide improvement of the nutritional status of people, with special reference to calories and important minerals (Ahmed *et al*., 1995).

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Although the date is a popular human food, very little is known about the chemical composition (minerals, carbohydrates) and the moisture of fruit date in Tunisia. Therefore, the objective of this study was to analyze various physicochemical characteristics of ten extensively grown littoral cultivars obtained from Gabes oases during the 2003-2004 crop year that would be used for subsequent processing. The chemical composition of date fruits from these cultivars was compared to the one of Deglet Nour, grown in the continental Oases and the most exploited and commercial culivar in Tunisia.

MATERIALS AND METHODS

Plant material: Ten Tunisian date varieties were used in the setting of this work. Samples were collected at maturity stage Tamar at the end of 2003-2004 cropping year. Ten feet of each cultivar were used for all analysis. The Deglet Nour variety, the most exploited in Tunisia, was taken as reference for all analysis.

Water content: The water content was determined by desiccation of 2 g of pulp. The sample, weighed is spread out in a tared stainless capsule and then dried at a temperature of 70°C for 48 h. These conditions permit to avoid the sugars caramelization.

Chemical analysis

Sugar contents: Sugars were extracted from 3 g of broyat by a 100 mL ethanol solution (ethanol 80 mL and water 20 mL). Surnagent was analyzed by HPLC, using a chromatograph of the type Knauer model Wellchrom. The separation was carried out on a Eurospher column 100°C 18, 17 μm, 250×4.6 mm. Sugar quantifications were made, by comparison to the standards sugars (external standard method). These standards (fructose, gluctose and saccharose) were mixed to obtain a synthetic solution of 10 g L^{-1}. The peak surfaces were determined by the software Eurochrome 2000.

Vitamin C analysis: Vitamin C was extracted starting from 5 g of broyat by a metaphosphoric acid solution (80%). Extracts were homogenized during 1 min at a maximum speed. After centrifugation at 1740 t/15 min at 20°C, the extracts were filtered through a 0.45 μm filter micropore and were diluted with 25 mL of metaphosphoric acid. Twenty microlitres of filtrate were injected into the injector. The quantification was made by comparison to vitamin C standards. All manipulations were quickly carried out to avoid vitamin C degradation.

Mineral analysis: Plant material was dried at 70°C. One gram of sample (date pulp), placed in a porcelain capsule, was calcined then by the muffle furnace at 550°C/4 h. After cooling, ashes were attacked by 5 mL of deionized water and 1 mL of hydrochloric acid and were subjected in boiling. The capsule content was filtered. The filtrate was adjusted by deionized water to 100 mL. This solution will be used for mineral analysis such as potassium, sodium, calcium, magnesium and phosphorus.

Statistical analysis: Data were subjected to statistical analysis. Results were expressed in dendrogram form using the order TREE. This technique was founded on the Euclidean distance. The classification of the varieties is based on their affinities for the studied variables. All analysis was carried out by software SPSS 12.5 version.

RESULTS AND DISCUSSION

Dates moisture: Moisture is one of the essential components of the fruit which imports basically on its quality and acts on its conservation. The moisture content of the fruit vary from 60% at the mature to about 25% at the dried stage (Barreveld, 1993), safe moisture content for storage of date is between 24 and 25%. Results showed that this parameter vary from 14 to 47% (Fig. 1). The highest rate was observed at the Mattata variety (47%). The low one was recorded at the Garn Ghazel variety (14%). Toutain (1976) considered dates as soft if they present a water content more than 30%, dry if this rate is less than 10% and half-soft if the rate is between 10 and 30%. This nomenclature permits us to classify the littoral dates as soft dates.

Sugar contents: Results showed that the majority of the littoral varieties were rich in reducing sugars (glucose + fructose) (Fig. 2 and 3). Whereas, they presented a weak rate of saccharose; only the two varieties Garn Ghazel and Korkobbi presented the highest content. The values were respectively about 24.05 g/100 g MF and 17.75 g/100 g MF for the two previous varieties.

Results corroborate those obtained by Bouabidi *et al.* (1996) and Cance and Widdowson (1993) which suggested that the soft dates are rich in reducing sugar and poor in saccharose. These results are also in agreement with Ben Salah and Hellali (2003) for littoral dates. Similar rates of reducing sugar were shown by Youssef *et al.* (1982) and Sawaya *et al.* (1983) for Iraqi and Saoudi varieties, respectively.

Comparison of the littoral varieties according to their sugar content: Results of date sugar varieties analysis separated four groups (Fig. 4).

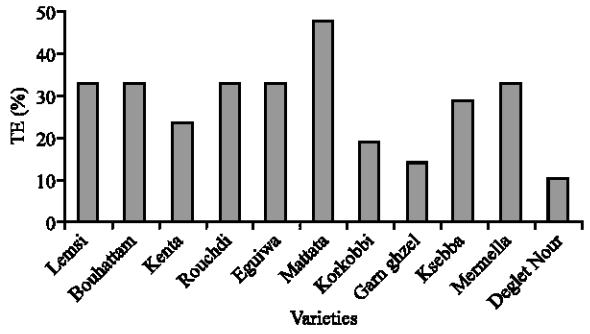

Fig. 1: Water content (TE) of the different date cultivars

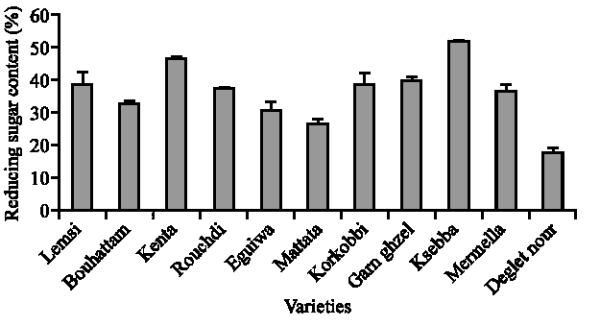

Fig. 2: Reducing sugar content (%) of the different date cultivars

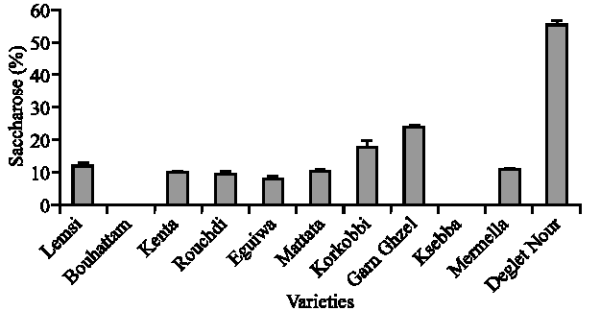

Fig. 3: Saccharose content (%) of the different date cultivars

Group 1: It contains six varieties (Lemsi, Kenta, Rochdi, Korkobbi, Garn Gazel, Mermella) this group is characterized by:

- A high content of total sugar (> 50%);
- A mean content of reducing sugar (39 to 46%);
- A mean content of saccharose (10 to 24%).

Group 2: This group consists of three varieties (Bouhattam, Eguwa, Mattata) which is characterized by:

- A weak content of reducing sugar (< 30%);
- A mean content of total sugar (> 30%);

Group 3: Contain one variety (Ksseba) which is characterized by:

- Absence of saccharose;
- A high content of reducing sugar (> 50%).

Group 4: Contain the Deglet Nour variety which is characterized by:

- A high content of saccharose (> 60%);
- A weak content of reducing sugar (< 20%).

Several reports were interested in the sugar date compositions. Myhara *et al.* (1999) considered the percentage of reducing sugar as criteria for date qualities. In the aim of the quality improvement of the Deglet Nour variety, these authors proposed to add the invertase in order to convert saccharose into reducing sugar.

By comparing the sugar content of the Deglet Nour variety with the one of littoral varieties, results showed a fundamental difference in the composition of the glucidic fraction (absence of saccharose in the littoral varieties). This saccharose underwent a complete hydrolysis into reducing sugar at stage tamar.

Although the littoral varieties were composed of high percentage of reducing sugar (glucose and fructose), which are the most important as energy calories (Al-Farsi *et al.*, 2005; Myhara *et al.*, 1996), easily digestible and hydrolysables. The farmer and consumer attentions were already directed towards the Deglet Nour variety with saccharose. Indeed, the principal reason of the Deglet Nour popularity is the high content in saccharose (34% more sweetened than glucose) which confers consequently a more pleasant taste (Reynes, 1994). It is important however to note that the high energy capacity of date and their easy assimilability thanks to their high content in reducing sugars permit to advise them with a large variety of public. It is thus the case of littoral varieties.

Vitamin C contents of: Results showed that vitamin C content vary according to varieties (Fig. 5). This content reached 45 mg/100 g MF for Ksebba variety, was only 23 mg/100 g MF for Korkobbi. In previous report, Youssef *et al.* (1982) showed in Iraqi dates a weak rate in vitamin C varying from 2.41 to 17.51 mg/100 g MF. Rates of 2 mg/100 g MF were recorded by Cance and Widdowson (1993).

Vitamins are essential micro-nutrient for organisms. It intervenes in multiple biochemical reactions such as:

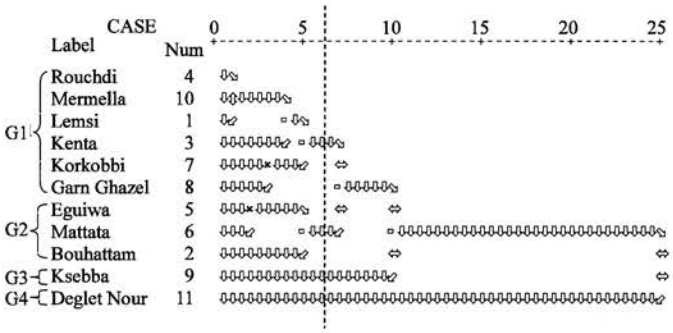

Fig. 4: Dendrogram obtained in the basis of sugar content of the different date cultivars

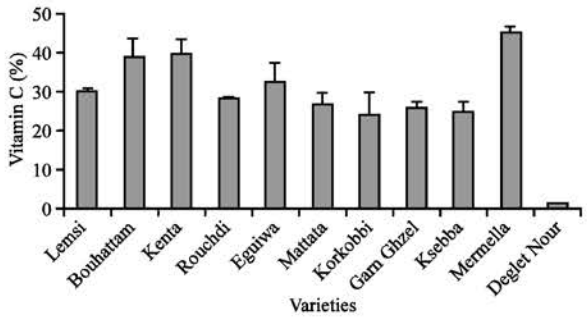

Fig. 5: Vitamin C content (%) of the different date cultivars

- Hormonal, adrenal and sexual functions;
- Metabolisms of iron (activates its absorption by the intestinal membrane), of glucids, lipids and proteins (the collagen formation which intervenes in the skin tonicity);
- Muscular and cerebral metabolisms (activates certain neuro-transmitters);
- Defence immunizing mechanisms;
- Anti-oxidant activity: plays with vitamin E, carotenes, vitamin A and other substances an important antioxidant role.

Comparison of the littoral varieties according to their vitamin C content: Results of vitamin C analysis permit to separated two groups (Fig. 6).

Group 1: Contains the majority of varieties (Bouhattam, Kenta, Mattata, Korkobbi, Eguiwa, Mermella) which is characterized by a high content of vitamin C (23 to 35 mg).

Group 2: Contain the Deglet Nour variety which is characterized by a very low content of vitamin C (< 5 mg).

Mineral analysis: Results showed that dates are particularly rich in mineral (Table 1). Some minerals are well represented in dates and are used for their characterization such as potassium (K). Others are present only in traces. The potassium, phosphorus and iron percentages in dates are higher than in other fruits; three to five times higher than in the grapes, apples and oranges Al-Showiman (1998).

Booij *et al*. (1992) classified dates on three groups thanks to their composition in potassium (K), calcium (Ca), magnesium (Mg) and phosphorus (P) with percentages of 0.6, 0.05, 0.04 and 0.045%, respectively. This classification seems to be validate for littoral varieties (Table 1). For instance, the Lemsi and Mattata varieties presented however according to the previous values a high content of K reached the 0.73%. They exceed the one of Deglet Nour. The Eguiwa variety was characterized by low mineral contents.

Comparison of the studied varieties according to their mineral contents: Results of date mineral composition permit to discuss three groups (Fig. 7).

Group 1: Contains the majority of the varieties (Bouhattam, Kenta, Rochdi, Korkobbi and Ksebba) which is characterized by:

- A mean content of potassium (0.41 to 0.48%);
- A high content of calcium (0.07 to 0.10%);
- A high content of phosphorus (0.6 to 0.8%);
- A mean content of magnesium (0.4 to 0.6%).

Group 2: this group contains only one variety (Eguiwa) which is characterized by a low content for all minerals.

Group 3: contain four varieties (Lemsi, Mattata, Mermella and Deglet Nour) which is characterized by:

- A high content of potassium (> 0.7%);
- A high content of phosphorus (< 0.6%);
- A low content of sodium.

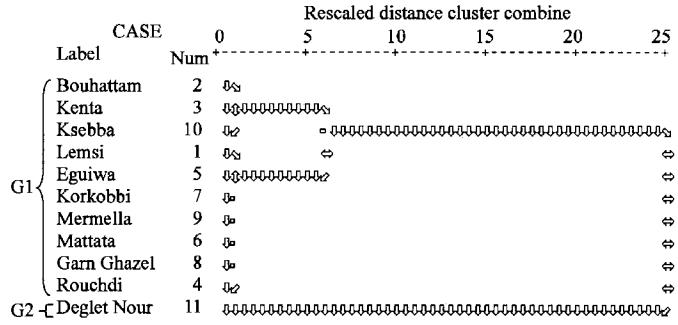

Fig. 6: Dendrogram obtained in the basis of vitamin C content of the different date varieties

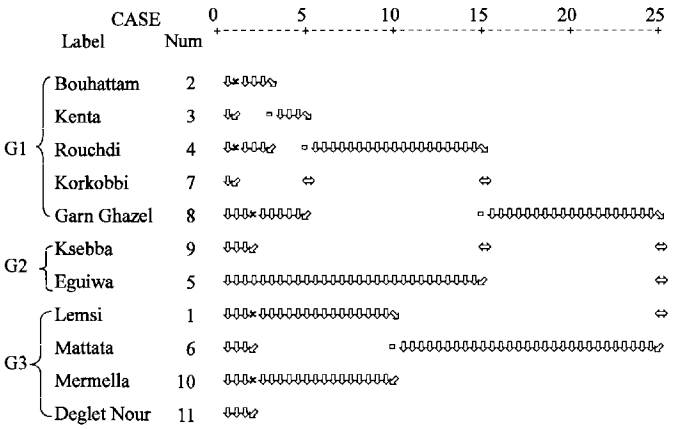

Fig. 7: Dendrogram obtained in the basis of mineral content of the different date cultivars

Table 1: Mineral content of the different date cultivars (g/100 g DW)

Varieties	K	Ca	Mg	Na	P
Lemsi	0.733	0.074	0.089	0.011	0.0808
Bouhattam	0.486	0.101	0.068	0.011	0.0662
Kenta	0.461	0.091	0.064	0.009	0.0643
Rouchdi	0.435	0.060	0.048	0.008	0.0639
Eguiwa	0.283	0.049	0.043	0.007	0.0574
Mattata	0.725	0.109	0.091	0.012	0.0916
Korkobbi	0.449	0.074	0.063	0.016	0.0827
Garn Ghazel	0.410	0.085	0.072	0.009	0.0647
Ksebba	0.389	0.059	0.048	0.013	0.0622
Mermella	0.636	0.088	0.079	0.013	0.0668
Deglet Nour	0.606	0.073	0.052	0.013	0.0675

According to Booij *et al.* (1992), the mineral composition of the different dates varieties vary accordingly with their geographical origin. Indeed, the dates of the littoral varieties present as similar mineral contents as the ones of the continental varieties. The current results seems to confirm those mentioned by Youssef *et al.* (1982) which showed that the mineral variations in fruits can in general show considerable variations not only between the species and the varieties but also within the same varieties cultivated under different agroclimatic conditions. However, the abundance of the minerals in dates, like that of all the fruits, leaves an alkaline surplus. This alkalinity reached 10 meq/100 g for dates, was only 4 to 8 meq/100 g for other fruits (Levine *et al.*, 2003). It is thanks to their high contribution in minerals that dates take part in the good food balance (rich in potassium) in particular for sportsmen and old people.

It is interest to note through this study that the Deglet Nour variety, considered as reference for the studied dates, did not have a high content of minerals. It was however the Lemsi, Mattata and Mermella varieties which presented the important contents.

CONCLUSIONS

The little or not exploited common dates varieties can be considered as an important nutritional and energy values. A laboratory experiment was carried out to characterize the food and the energy values of certain common date varieties in the littoral oases of Tunisia. For all analysis, the variety Deglet Nour was taken as reference.

Results showed that, generally, the common dates were very rich in reducing sugar (Fructose and glucose; 26 to 51%) by comparison to the Deglet Nour variety (high content of saccharose; 60%). This result confers consequently to the common varieties good food and medical values (easily assimilable and high energy capacity).

Concerning the vitamins C, present study affirms, contrary to previous reports neglecting these compounds that the common varieties are especially very rich in vitamin C (24 to 46 mg/100 g) which is absent in Deglet Nour (traces).

The mineral composition results showed that the littoral dates are characterized by their similar mineral contents as the ones of the continental varieties. The Deglet Nour variety, considered as reference, did not have a high minerals content. It was however the Lemsi, Mattata and Mermella varieties which presented the important contents.

It arises from the present report that the littoral dates could present a particular interest and are able to compete the most marketed varieties (Deglet Nour). The few source data, results of this study, may permit to the industrialists to take certain measurements for the date treatments in the chain of conditioning (humidification, drying) and on the storage spot.

REFERENCES

Ahmed, I.A., A.W.K. Ahmed and R.K. Robinson, 1995. Chemical composition of date varieties as influenced by the stage of ripening. Food Chem., 54: 305-309.

Al-Farsi, M., C. Alasalvar, A. Morris, M. Baron and F. Shahidi, 2005. Compositional and sensory characteristics of three native sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. J. Agric. Food Chem., 53: 7586-7591.

Al-Hooti, S., J.S. Sidhu and H. Qabazard, 1995. Studies on the physico-chemical characteristics of date fruits of five UAE cultivars at different stages of maturity. Arab Gulf J. Sci. Res., 13: 553-569.

Al-Hooti, S., J.S. Sidhu and H. Qabazard, 1997. Physicochemical characteristics of five date fruit cultivars grown in the United Arab Emirates. Plant Foods Hum. Nutr., 50: 101-113.

Al-Shahib, W. and R.J. Marshall, 2002. Dietary fibre content of dates from 13 varieties of 9 date palm *Phoenix dactylifera* L. Int. J. Food Sci. Technol., 37: 719-721.

Al-Showiman, S.S., 1998. Al Tamr, Ghetha wa Saha (Date, Food and Health). Saudi Arabia: Dar Al-Khareji Press.

Barreveld, W.H., 1993. Date palm products. FAO Agricultural Service Bulletin No. 101. Food and Agricultural Organisation of the United Nations, Rome.

Ben Salah, M. and R. Hellali, 2003. Phenopomologic description of 15 Tunisian cultivars of date palm (*Phoenix dactylifera* L.). Bulletin of the Phytogenetic Resources PGRI.

Booij, I., G. Piombo, A.M. Risterucci, Coupm, D. Thomas, and M. Ferry, 1992. Study of chemical composition of dates at various stages of maturity for the varietal characterization various cultivars of palm trees (*Phoenix dactylifera* L.). Fruits, 47: 667-678.

Bouabidi, H., M. Reynes and M.B. Rouissi, 1996. Criteria of characterization of the fruits of some cultivars of palm trees-date palms (*Phoenix will dactylifera* L.). Tunisian South. Annales de Institut National de la Recherche Agronomique, 69: 73-87.

Cance, S. and M.C. Widdowson, 1993. Chemical composition of foods. Food Res., 204: 144-152.

Fayadah, J.M. and S.S. Al Showiman, 1990. Chemical composition of some date (*Phoenix dactylifera* L.). J. Chem. Soc. Pak., 12: 84-103.

Levine, M., C.S. Rumsey, R. Daruwala, J.B. Park and Y. Wang, 2003. Criteria and recommendation for Vitamin C intake. J. Am. Med. Assoc., 281: 1415-1423.

Mohammed, S., H.R. Shabana and E.A. Mawlod, 1983. Evaluation and identification of Iraqi date cultivars: Fruit characteristics of 50 cultivars. Date Palm J., 2: 27-55.

Myhara, R., M. Taylor and I. Al-Bulushi, 1996. Moisture sorption isotherms and composition of Omani dates. J. Food Eng., 37: 471-479.

Myhara, R.M., J. Karkala and M.S. Taylor, 1999. The composition of maturing Omani dates. J. Sci. Food Agric., 79: 1345-1350.

Reynes, M., H. Bouabidi, G. Piombo and A.M. Risterucci, 1994. Characterization of the principal varieties of dates cultivated in the area of Djerid in Tunisia. Fruits, 49: 289-298.

Rhouma, 1995. Date palm in Tunisia. The genetic inheritance. 1, 14, INRA de Tunisie, Tunis.

Rygg, G.L., 1975. Date development, Handling and Packing in the United States. Agric. Handbook. 482, Agric. Res. Service. Washington, DC, US Department Agriculture.

Sawaya, W.N., H.A. Khatchadourian, J.K. Khalil, W.M. Sail and A. A1-Shalhat, 1983. Growth and compositional changes during the various development stages of some Saudi Arabian date cultivars. J. Food Sci., 47: 1489-1493.

Toutain, G., 1976. The date palm: Culture and production. Al Awamia, Rabat No. 25: 23-151.

Vandercook, C.E., 1980. Quality and nutritive value of dates as influenced by their chemical composition. Date Growers Inst. Rep., 54: 3-9.

Youssef, A.K., N.D. Benjamin, A. Kado, S.M. Alddin and S.M. Ali, 1982. Chemical composition of four Iraqi date cultivars. Date Palm J., 1: 285-294.