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Research Article

PHYSICO-CHEMICAL EVALUATION OF SOME INTRODUCED DATE FRUITS CULTIVARS GROWN UNDER SUDANESE CONDITIONS

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Abstract

Fruit samples of five date cultivars, three cultivars of them were introduced from Emirates Tissue culture Laboratory-Alien Abu Dhabi and cultivated in Haj-Bashir orchard - Khartoum region were collected at the beginning of the Tamar stages. The present study was aimed to investigate the physical and chemical properties. The results showed that the physical characteristics like fruit weight, length, flesh thickness, seed weight differed significantly ($P < 0.05$) between the various cultivars. Chemical analysis indicated small amounts of crude fiber, crude protein, Fat and ash, while sugars predominated. In general the majority of date cultivars investigated was found to be of the soft date type characterized by the dominance of reducing sugars. The performance of introduced cultivars was well when compared with the indigenous cultivar of most physical, chemical characteristics and general evaluation.

Keywords: Date-palm; Fruit; quality.

Introduction

The fruit of the date palm (*Phoenix dactylifera* L), is a berry consisting of a single seed surrounded by a fibrous, parchment-like endocarp, a fleshy mesocarp and the fruit skin (pericarp) (Barreveld, 1993). The dates are very commonly consumed in many parts of the world and a vital component of the diet and a staple food in most of the Arabian countries. It is one of the most important fruit crops known by man as a high-energy food as well as a dessert fruit. Like most date palm growing countries, Sudan has its own indigenous cultivars. The long hot and dry summer with low relative humidity made Sudan an ideal location for dry and semi dry date palm production Dawoud (2006) According to Dawoud (2006), fruit growth and development passes through five stages, starting by *Hubabok* directly after pollination and takes 4-5 weeks. *Kimiri* is the second stage in which the fruit is green in color and it takes 9-14 weeks. *Khalal* stage is the stage during which the fruit reaches its maximum size and has yellow or red color depending on cultivar and it takes 3-5 weeks. *Rutab* stage covers the period from the time the fruit begins to be soft at the tip until it is fully soft and it takes 2-4 weeks. *Tamr* stage is the fully cured or dried fruit. Aleid (2012) reported that quality profile of dates in the marketplace involves evaluating four aspects: (a) color, shape, size, taste, texture, pit/flesh ratio, and uniformity in color and size of the fruit; (b) moisture, sugar, and fiber content; (c) defects of the fruits, which may include discoloration, broken skin,

sunburn, blemishes, shrivel deformity; and (d) insect infestation, foreign matter, pesticide residues, mold, and decay. Such evaluation forms the basis of "chemical," "physical," and "sensory" quality attributes. Date varieties can vary significantly in their chemical composition, especially the amounts of reducing, non-reducing sugars, and the composition of dietary fiber. The variations in composition have a significant effect on their structural, sensory and textural properties (Rahman and Al-Farsi 2005).

The objectives of the study were to determine the physical properties of introduced dates fruits cultivars and evaluation of the nutritional value its chemical composition and compared with indigenous cultivars.

Material and Methods

Plant Material

Five cultivars of date fruit, namely *Mishrig wad khateeb*, *Mishrig wad lagai*, *Sa'gai*, *Ambarah* and *Medjhoul*. *Mishrig wad khateeb* and *Mishrig wad lagai* cultivars were own Sudanese cultivar, and other cultivars were introduced from Emirates Tissue culture Laboratory-Alien Abu Dhabi and cultivated in Haj-Bashir orchard at Khartoum region-Sudan. The fruits where collected at Tamar stage (full ripeness) at the end of 2014 harvest season. Each sample was collected randomly to assure good representation, and each sample was cleaned by remove foreign matter and

taken in polyethylene bags with labels, and stored in a refrigerator till analyses.

Physical Methods

Characteristics which were studied included, fruit size, which is presented as fruit length, fruit width, fruit length/width ratio and flesh thickness. The fruit length, width and thickness were measured by Vernier caliber (Whiter-Gew Model) and expressed in centimeters (cm), and then the length/width ratio was calculated. The average fruits weight, pulp weight, seed weight and the pulp/seed ratio were measured and expressed in grams and then pit percentage was calculated. Surface area (S) was calculated by using the following equation:

$$S = \pi \cdot Dg^2$$

Where:

Dg = Geometric Mean diameter = L.W.T^{1/3}

L = length (L) cm

W = width (W) cm

T = thickness (T) cm²

π = 3.14 mathematical constant (Pi).

Chemical Analysis

The chemical composition included moisture content, protein, ash, fat and crude fibre, carbohydrates and minerals which include calcium, magnesium, phosphorus, sodium and potassium. Total and reducing sugar. The protein and moisture content were analyzed according to A. O. A. C (2000) methods. Ash, fat and crude fiber according to A.O.S.C (1985) methods. The carbohydrates content were calculated by difference. Minerals were measured by EEL flame photometer. Total and reducing sugars, Filtrate can be used directly for titration was according to Lane and Anon, described by A. O. A. C (2000), using the following equation for calculation:

Reducing sugars %

$$= \frac{Mg / 100g \times dilution factor \times 100}{1000 \times Wt taken}$$

(Factor obtained from the table of glucose. Pearson, (1976).

Sucrose content was calculated by subtraction of reducing sugars from total sugars. Moisture content, ash, total sugars, reducing sugars, sucrose, carbohydrate, total protein, total fats, Minerals and dietary fibres were expressed as percentages.

Statistical Analysis

Analysis of variance (ANOVA), followed by Fisher's protected LSD test with a significance level of $P \leq 0.05$ were performed on the data Gomez and Gomez (1984).

Results and Discussion

Physical Analysis

Table 1 shows the dimensions of date fruits of five cultivars at Tamr stage. Statistical analysis revealed significant differences among the evaluated date varieties in all characters. *Ambrah* showed the maximum fruit length (5.6cm), fruits width (2.6cm), length/width ratio (2.13) and surface area (19.06 cm²) which was significantly higher than all other cultivars (Table 1) while *Mishrig wad Khateeb* had the least fruit length (2.67 cm) followed by *Mishrig wad lagai* (2.83cm). *Medjhouh* recorded high significant value of flesh thickness (1.93cm) followed by *Ambra* (1.05cm), while *Mishrig wad Khateeb* and *Mishrig wad lagai* they had the least flesh thickness (0.50cm), significantly lower than of the other cultivars. The average of date length, fruits width and length/width ratio were in the range of the findings in previous studies of saeed and Yousof. (2014), Shattir *et al.* (2002), Sulieman *et al.* (2007) and Sulieman *et al.* (2012). while flesh thickness and surface area, both values were slightly higher than that reported by Sulieman *et al.* (2012) and saeed and Yousof. (2014).

Table 1: Dimensions of date fruits of five cultivars at Tamr stage.

Variety	Fruit length(cm)	Fruit width (cm)	length/width	Flesh thickness (cm)	Surface area(cm ²)
Ambrah	5.6 a \pm 0.20	2.6 a \pm 0.264	2.13 a \pm 0.152	1.05 b \pm 0.250	19.06 a \pm 4.39
Medjhouh	3.67 b \pm 0.115	1.9 b \pm 0.010	0.57 c \pm 0.057	1.93 a \pm 0.115	7.74 b \pm 0.472
Sa'gai	3.63 b \pm 0.152	1.9 b \pm 0.300	1.93 a \pm 0.251	0.50 c \pm 0.264	6.81 b \pm 1.70
Mishrig wad lagai	2.83 c \pm 0.208	1.77 b \pm 0.208	1.60 b \pm 0.100	0.37 c \pm 0.057	4.62 b \pm 1.14
Mishrig wad Khateeb	2.67 c \pm 0.152	1.93 b \pm 0.057	1.38 b \pm 0.058	0.37 c \pm 0.028	4.77 b \pm 0.340
LSD 0.05	0.308	0.378	0.261	0.315	3.97
SE \pm	0.169	0.208	0.143	0.173	2.186

Any two mean values bearing different superscripts within a row are significantly different ($P \leq 0.05$) according to DMRT. Values are mean \pm SD.

Table 2: Physical characteristics of five date cultivars at Tamr stage.

Variety	Fruit weight(g)	Pulp weight(g)	Pit weight(g)	Pulp/Pit ratio	Pit%
Ambrah	22.81 a \pm 3.83	21.47 a \pm 3.76	1.28 a b \pm 0.07	16.70 a \pm 0.21	5.68 b \pm 0.691
Medjhoul	13.18b \pm 0.77	11.84 b \pm 0.53	1.32 a \pm 0.29	9.23 b \pm 1.78	8.95ab \pm 2.67
Sa'gai	8.28c \pm 2.25	7.33 c \pm 2.23	0.99 a b \pm 0.13	7.43b \pm 2.27	12.53a \pm 3.73
Mishrig wad lagai	7.01c \pm 0.50	6.09 c \pm 0.50	0.92 b \pm 0.24	7.03 b \pm 2.16	13.03 a \pm 3.57
Mishrig wad Khateeb	6.62c \pm 0.72	5.77 c \pm 0.54	0.87 b \pm 0.19	6.78 b \pm 0.92	12.97 a \pm 1.58
LSD 0.05	3.74	3.63	0.37	3.49	4.93
SE \pm	2.05	1.99	0.20	1.92	2.71

Any two mean values bearing different superscripts within a row are significantly different ($P \leq 0.05$) according to DMRT. Values are mean \pm SD.

For five date palm cultivars grown in Khartoum area which showed that, the *Ambrah* had the maximum fruit weight (22.81g) pulp weight (21.47g) and pulp/pit ratio (16.7), which was significantly higher than all other cultivars (Table 2) According to Hussein, *et al.* (1976) on their study on eighteen date cultivars in Saudi Arabia, the fruits exceed 15 g were classified as fruits of heaviest weight. While *Mishrig wad Khateeb*, *Mishrig wad lagai* and *Sa'gai* had the least fruit weight (6.62 g), (7.01g) and (8.28g) and pulp weight (5.77g), (6.09g) and (7.33g) respectively, significantly lower than of the other cultivars. The average of date weight (11.54 g) and pulp weight (10.48g) were higher than that reported by saeed and Yousof. (2014), Shattir *et al.* (2002), Sulieman *et al.* (2007) and Sulieman *et al.* (2012). *Mishrig wad lagai* had the highest value of pit percentage (13.03%), followed by *Mishrig wad Khateeb* (12.97%) and the lowest was *Ambrah* (5.68%). This result was slightly lower than that reported by Sulieman *et al.* (2012) and saeed and Yousof. (2014). Table 2. Characters like fruit weight and length, flesh thickness, seed weight, are of importance in differentiation between the cultivars. Other studies also proved significant differences of the fruit characters in the study of cultivars (Nour *et al.*, 1986) and (Selim *et al.*, 1970). Fig. 1 shows the various date fruits used in the study.



Fig. 1: Various date fruits used in the study. A. Ambrah; B. Medjhoul; C. Sa'gai; D. Mishrig wad lagai

Table 3: chemical composition of five cultivars at Tamr stage.

Variety	Moisture content %	Protein	Fat	Fiber	Ash	Carbohydrates	Total sugar	Reducing sugar	Non reducing sugar
Ambrah	24.37a ±2.3007	1.57b 0.0173	0.18a b ±0.08888	3.15 a ±0.142	1.67 a±0.028	69.06 d ±2.192	81.83a ±3.764	76.80 a ±2.788	5.02 a ±1.288
Medjhoul	18.17b ±0.642	1.57 b ±0.010	0.007 b ±0.00577	1.88 c ±0.247	1.50 b±0.015	76.87 c ±0.437	76.26 b ±0.423	74.3 a ±0.407	1.96 c ±0.336
Sa'gai	9.03 d ±0.3785	1.29 c ±0.005	0.06 b ±0.0200	2.33 b ± 0.180	1.14 d±0.005	86.13 a ±0.506	72.31b c ±3.393	68.66 b ±3.68	3.64 b ±1.114
Mishrig wad lagai	11.4 c ±1.0816	2.62± a 0.030	0.31 a ±0.0200	1.74 c ± 0.020	1.18d ±0.030	82.74 b ±1.158	67.32 c ±4.020	63.5 c ±2.00	3.82 a b ±0.030
Mishrig wad Khateeb	11.9 c ±0.6350	2.6a ±0.300	0.19 a b ±0.0200	2.13 b c ± 0.040	1.42 c ±0.050	81.58 b ±0.197	70.16 c ±2.00	68.2 b ±2.10	1.96 c ±0.020
LSD 0.05	2.2165	0.2458	0.14933	0.277	0.0545	2.0959	5.519	4.453	1.4133
SE±	1.2184	0.1351	0.07775	0.1524	0.03	1.1521	3.033	2.447	0.776

Any two mean values bearing different superscripts within a row are significantly different ($P \leq 0.05$) according to DMRT. Values are mean ±SD.

Chemical Analysis

Table 3 shows the chemical composition of five date cultivars. The mean crude protein content of the five cultivars was 1.93%. *Mishrig wad lagai* and *Mishrig wad Khateeb* they showed the highest level (2.6%) which was slightly higher than those reported by (Ali and Sidahmed, 1988), while, *Sa'gai* had the lowest level (1.29%) (Table 3). All values of protein reported in this study were within the range (1.29% to 2.62%) reported by Sulieman et al. (2007) and Ali (1985) and lower than those reported by (Ali and Aldosari, 2007). There were significant differences ($p < 0.05$) among the five cultivars tested. The moisture contents of *Ambrab*, *Medjhoul*, *Sa'gai*, *Mishrig wad Lagai* and *Mishriqi Wad Khateeb* date cultivars were 24.37%, 18.17%, 9.03%, 11.4% and 11.9%, respectively. The average of moisture contents of date cultivars were higher than those reported by Sulieman *et al.* (2007) and (El-Sohaimy and Hafez, 2010). Fat content (Table 3) ranged from 0.31% in *Mishriqi wad lagai* to 0.007% in *Medjhoul*. The statistical analysis showed that there were significant differences ($p < 0.05$) between the five cultivars tested. These results were lower than those reported by Sulieman *et al.* (2012), saeed and Yousof. (2014), Sulieman *et al.* (2007) and Al-Hooti *et al.* (1997). Fats are mainly concentrated in the skin (2.5% - 7.75%) and have a more physiological importance in protecting the fruit than contributing to the nutritional value of the date flesh (Barreveld, 1993). The low level of the fat content in date fruit (very low level of fatty acids and cholesterol) compared with its higher content of sugars, means that, consumption of date fruit is safe for people suffering from heart and blood diseases. The crude fiber contents of *Ambrab*, *Medjhoul*, *Sa'gai*, *Mishrig wad Lagai* and *Mishrig Wad Khateeb* date cultivars were 3.15%, 1.88%, 2.33%, 1.74 and 2.13 respectively. The mean values of crude fiber content in five date cultivars was fall within the range (3.15% to 1.74%) which was higher when compared with that reported by Sulieman *et al.* (2007) which was (1.53-

1.90)%, and comply with El-Sohaimy and Hafez,(2010) and (Ali and Sidahmed, 1988). There are significant differences between the five cultivars tested of date fruits in carbohydrates content, The carbohydrates contents of *Ambra*, *Mejhoul*, *Sa'gai*, *Mishrig wad Lagai* and *Mishriqi Wad Khateeb* date cultivars were 69.06%, 76.87%, 86.13%, 82.74% and 81.58% respectively. The values were similar to that reported by Sulieman *et al.* (2007) and Ali and Aldosari (2007).and higher than those reported by El-Sohaimy and Hafez, 2010) which were ranged from (84.26%-89.28%). *Ambrab* recorded high significant value of total sugar content 81.3%, reducing sugars 76.8% and sucrose content $5.02 \pm$ % compared to other cultivars, flowed by *Medjhoul* which had (76.26%) of total sugar and (74.3%) of reducing sugars, while *Mishrig wad Lagai* and *Mishrig wad Khateeb* they had the least total sugar content (67.32%), (70.16%) and reducing sugars (65.5%), (68.2%) respectively, lowered than that reported by (Ali and Sidahmed, 1988), significantly lower than of the other cultivars. Table 3. The average percentage of ash content as shown in Table 3, ranged from 1.67% in *Ambrab* to 1.14% in *Sa'gai*. There were significant differences ($p > 0.05$) among the five varieties tested. The element analysis of date palm extract showed that, the fruit of date palm contains many of valuable and useful elements like Potassium, Phosphorous, Iron, Calcium and Magnesium. All the five date cultivars were different significantly in their mineral levels (Table 4). *Medjhoul* had highest Potassium and Iron (8.2%), (5.11%) respectively. whereas, *Mishrig wad Khateeb* and *Mishrig wad Lagai* (0.92%), (0.73%) they had the lowest level, The insignificant differences were recorded between fruits of five cultivars regarding Phosphorous. *Ambrab* and *Sa'gai* showed the highest Calcium and Magnesium (0.6%) and (0.2%) respectively while *Mishrig wad Khateeb* have the lowest (0.24%), (0.12%) reported by saeed and Yousof. (2014), El-Sohaimy and Hafez. (2010).

Table 4: Minerals content of five cultivars at Tamr stage.

Variety	K%	P%	Fe%	Ca%	Mg%
Ambrab	8.20 c \pm 0.070	0.05 a \pm 0.015	2.8 b \pm 0.065	0.60 a \pm 0.020	0.17 a \pm 0.010
Mdejhoul	15.06 a \pm 0.060	0.06 a \pm 0.010	5.11 a \pm 0.115	0.51 a \pm 0.015	0.13b \pm 0.011
Sa'gai	8.65b \pm 0.1	0.24a \pm 0.311	2.3 c \pm 0.100	0.63a \pm 0.152	0.27 a \pm 0.011
Mishrig wad lagai	1.10 d \pm 0.095	0.12 a0.015	0.67 e \pm 0.015	0.26 b \pm 0.010	0.17 a \pm 0.020
Mishrig wad Khateeb	0.92 e \pm 0.020	0.16a \pm 0.015	0.73 d \pm 0.026	0.24 b \pm 0.025	0.12 b \pm 0.051
LSD 0.05	0.1362	0.254	0.137	0.127	0.030
SE\pm	0.0748	0.1400	0.075	0.070	0.016

Conclusion

From these results it could be concluded that the dimensions and Physical characteristics of the date fruits differ from one cultivar to another but the Ambra has wide dimensions, heaviest weight, highest surface area smaller seed or pit and thicker flesh which were preferred. Although most of the cultivars contain almost differences in chemical components, however, there are some few similar in these components. Finally Ambra, *Mejhoul* and *Sa'gai* they get better compared to other indigenous cultivars studied, of most physical and chemical parameters.

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