



Dates Quality Assessment of the Main Date Palm Cultivars Grown in Algeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author AS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed the literature searches. Authors DK and BA managed the analyses of the study. Authors TM and TB have managed the physical and biochemical analyzes of dates in the laboratory. All authors read and approved the final manuscript.

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ABSTRACT

The present study deals with the characterization and evaluation of the morphological and biochemical quality of 54 date palm cultivars grown in Algeria. This work was done at Station of Algerian National Institute of Agricultural Research Touggourt Ouargla Algeria, between October 2007 and November 2010. We chose ten homogeneous palms tree for each cultivar. For each palm tree, 60 fruits without calyx are collected at rate of 6 to 7 fruits per bunch and on each bunch at various heights and orientations. Date fruits were harvested at a maturation stage. So, the obtained results show that the dates produced by Abdelazzaz, Bayd-El-kadhi, Baydh-Ghoul, Bent-Khbala, Deglet-Djdir, Dguel-Mghass, H'mira, Horra, Laadjina, Mezith, Sebaa-Bedraa, Takerboucht, Tantboucht, Tamsrit, Tanslit, Thaoudant, Timjoughert and Tindokan cultivars present the best morphological characteristics of the dates compared to the other cultivars. Sugars were the predominant components in all date palm fruits cultivars, ranging between 59.18 ± 1.68 to 92.04 ± 2.19 g/100g dry weight, followed by moisture i.e., 9.00 ± 1.16 - 44.00 ± 1.29 % and fiber, i.e., 2.00 ± 0.77 - 20.45 ± 1.48 g/100 g dry weight. However, they contain small amounts of protein i.e., 1.84 ± 0.38 - 2.75 ± 0.62 g/100g dry weight. The study of the date quality

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shows that the most of these cultivars present a combination of good and bad characters of fruit. At this effect, Cheikh-M'hamed and Deglet-Ziane cultivars present high sugars content and an acceptable moisture content but low dates weight and size. For these cultivars, the application of certain technical cultural practices could ameliorate the characteristics of their fruits. In conclusion, we could say that on the 54 cultivars studied, solely six ten such as, Aghares, Baydh-Elkadhi, Bouarous, Bouldjib, Dguel-M'ghas, Figuigue, Horra, Mezith, Ouarglia, Sebaa-Bedraa, Tacherouint, Tafazouine, Tamsrit, Tawragha, Timjoughert and Tindokan present a good physical and biochemical dates quality to knowledge, an elevated length, diameter and weight of the dates, an acceptable pH, an acceptable water content and a high sugars content.

Keywords: Date; cultivars; morphological characteristics; moisture; sugars; quality.

1. INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the oldest fruit trees in the world. It is known as "tree of life" because of its resilience, its need for limited water inputs, its long term productivity and its multiple purpose qualities. Date fruits are an important commercial crop in Algeria. The date palm is one of mankind's oldest cultivated plants. It could be used for generations to come due to its remarkable nutritional, health and economic value in addition to its aesthetic and environmental benefits. Every part of the date palm is useful. Dates offer useful prospects for fighting hunger and diseases. In Algeria, the date production is estimated between 520.000 to 540.000 tons [1]. Algeria have a rich diversity of about 1900 date cultivars, but only some are evaluated for their yield and their fruit quality [2]. However, different names are sometimes given to the palm trees of the same cultivar. In addition, only four cultivars, Deglet-Nour, Ghars, Degla-Beida and Mech-Degla have a real economic significance [2]. These cultivars have a highly appreciated sensory quality leading to a high marketing value. The date has always been considered an important food for both humans and animals in oases. Thus, it can be eaten as fruit at "Bser" stage (Barhi and Zaghoul cultivars) and as a staple food at "Tamar" stage for other cultivars [3]. However, with changing food habits in oases and rationalization of farming and the search for an optimal balance of rations, a significant decrease in local consumption of dates was noted [4]. Furthermore, consumption is oriented at progressively to high dates quality such as Deglet-Nour.

Morphological and biochemical composition of date palm fruit has been reported by various researchers [5,6,7,8,9,10,11,12,13,14,15,16,17,18], but only a few reports are available on the dates cultivars growing in Algeria [2,4,19,20]. Date fruits are considered as a good source of sugars. It provides natural sugar in the form of glucose and fructose [4]. On the other hand, dates were also a good source of mineral salts and fiber [5,11,13,21]. The aim of the present study is to evaluate the physical and biochemical dates quality of 54 main date palm fruits cultivars cultivated in Algeria.

2. MATERIALS AND METHODS

2.1 Plant Material

The plant material used consists of 54 date palm cultivars grown in Algeria.

2.2 Methods

2.2.1 Sampling methods

The sampling method adopted is that reported by [4]. So, we chose ten homogeneous palms tree for each cultivar. For each palm tree, 60 fruits without calyx are collected at rate of 6 to 7 fruits per bunch and on each bunch at various heights and orientations. Date fruits were harvested at edible maturation stage. Three samples of dates harvested in three farms for each cultivar were established.

2.3 Analytical Methods

2.3.1 Physical analysis

The color was assessed by color chart, against, consistency was determined by touch. On the other hand, we taken 40 to 60 date fruits per cultivar and we determine the dates and seeds weights in grams, the percentage of Seed weight/Date weight, the diameter of dates in centimeters, and length and diameter of dates and seeds in centimeters [19].

2.3.2 Biochemical analysis

Date fruits were cut, deseeded and the pulp was homogenized in blender for analysis. The moisture content was determined by drying 10 g of dates pulp to a constant weight in air drying oven at 105°C [22]. The pH was determined at 20°C by using a pH meter [22]. Reducing sugars, sucrose and total sugars were determined by the method of Bertrand, reported by [23]. Ash content was determined by heating samples of date in furnace at 600°C for 4 h [22]. Protein is determined by the Kjeldahl method which consists of a transformation of organic nitrogen to ammonium (NH₄⁺) with sulfuric and then measuring the amount of ammonium [22]. For pectin, the method assayed was reported by [24] with slight modifications and the pectin was determined as g/100g sample. The pulp date was soaked in water for 24 h, 30.0 ml of 95 % ethanol were added to each 10.0 g of pulp dates, the mixture was centrifuged, and filtered through buchner funnel. Acidified ethanol was added to the filtrate (7.5 ml of ethanol, 20.0 ml of distilled water and 5.0 ml of HCl), left for one hour and then filtered and then he was washed with 20.0 ml acetone and filtered again. The filtrate obtained was dried at 40°C for 18 h and the product was ground into fine powder and sieved through a 40 mesh sieve and weighted. Cellulose, hemi cellulose and lignin are assayed by the method of Van-Soest [25] which consists of a fragmentation of the membrane, based on the nutritional principle. The whole of pectin, cellulose, hemi cellulose and lignin were considered as total fiber.

2.3.3 Assessment of dates quality

Criteria for assessment of date fruits quality were reported by [14,26,27] on Iraqi, Egyptian and Algerian date palm fruits cultivars.

1/ Date weight	- Low	: Less than 6 g	: Bad character
	- Medium	: 6 - 8 g	: Acceptable
	- High	: Greater than 8 g	: Good character
2/ Flesh weight	- Low	: Less than 5 g	: Bad character
	- Medium	: 5 - 7 g	: Acceptable

	- High	: Greater than 7 g	: Good character
	- Low	: Less than 10 %	: Good character
3/ Seed weight/Date weight	- Medium	: 10 - 18 %	: Acceptable
	- High	: Greater than 18 %	: Bad character
4/ Date length	- Reduced	: Less than 3.5 cm	: Bad character
	- Medium	: 3.5 - 4 cm	: Acceptable
	- Long	: Greater than 4 cm	: Good character
5/ Date diameter	- Low	: Less than 1.5 cm	: Bad character
	- Medium	: 1.5 - 1.8 cm	: Acceptable
	- High	: Greater than 1.8 cm	: Good character
	- Medium	: 10 - 24 %	: Good character
6/ Moisture	- High	: 24 - 28 %	: Acceptable
	- Very high	: Greater than 28 %	: Bad character
7/ pH	- Less than or equal to 5.5 : dates acids (Bad character)		
	- Low	: 50 - 60 %	: Bad character
8/ Total sugars	- Medium	: 60 - 70 %	: Acceptable
	- High	: Greater than 70 %	: Good character

2.4 Statistical Analysis

The statistical analysis carried is the calculation of the standard deviation and the analysis of variance. The analysis of variance (ANOVA) was conducted to test least significance differences (LSD). Significance was accepted at 0.05 level of probability ($p < 0.05$).

3. RESULTS AND DISCUSSION

3.1 Morphological Characterization of Dates

Fruit color ranging from dark (Abdelazzaz, Ali-Oua-Rached, Amari, El-Kaid, Tamsrit, Tanslit, Takerboucht, Tantboucht and Tinissine) to clear (Kenta) were recorded in Table 1. Fruit consistency constitutes an important quality parameter in dates. The classification of dates into soft, semi-dry and dry types, mainly based on the consistency of the ripe fruit, is thought to be associated with the content of particular sugars and water [27,28]. Dry types of dates are exceptionally important for the date palm culture in production areas where storage under in room temperature required. Dry types are considerably easier to store than soft types that are consumed fresh during the production season [28]. The obtained results show that the dates cultivars were clustered on the basis of fruit consistency as soft fruit (Abdelazzaz, Adham-Dali, Aghares, Ali-Oua-Rached, Amari, Baydh-Ghoul, etc.), semi-dry fruit (Aabad, Cheikh-M'hamed and Tindokan) and dry fruit cultivars (Bouhlass, Garn-El-Ghazel, Halwa, Hamraia, Horra, Kenta, Tinaceur and Tinakor). On the other hand, the date weight, the flesh weight, the date length, the seed weight, the percentage of seed weight/date weight, date length, seed length and date diameter vary significantly from one cultivar to another.

So, out of 54 dates cultivars studied, Bayd-Ghoul indicated the highest date weight and flesh weight, i.e., 19.41 ± 0.79 g, and 17.80 ± 0.83 g followed by Deglet-Djdir, i.e., 15.68 ± 1.26 and 14.97 ± 1.21 g (Table 1).

Table 1. Morphological characteristics of dates and seeds

Cultivars	Color	Consistency	D.W (g)	F.W (g)	S.W (g)	SW/DW (%)	D.L (cm)	S.L (cm)	D.D (cm)
Aabad	Brown	Semi-dry	5.06	4.31	0.75	14.82	3.45	1.93	1.92
Abdelazzaz	Black	Soft	15.38	13.9	1.36	9.63	3.70	2.80	2.25
Adham-Dali	Brown	Soft	8.30	7.44	0.86	10.37	3.99	1.84	2.20
Aghares	Yellow	Soft	8.54	7.49	1.05	12.30	3.90	2.52	2.21
Ali-Oua-Rached	Black	Soft	7.87	6.84	1.03	13.09	3.17	2.00	1.94
Amari	Black	Soft	5.33	4.35	0.98	18.39	3.55	2.36	1.76
Arehti	Yellow	Soft	5.29	4.29	1.00	18.90	3.31	2.33	1.69
Azerza	Brown	Soft	7.98	7.04	0.94	11.78	3.62	2.15	2.05
Badjmill	Yellow	Soft	3.88	2.85	1.03	26.55	2.68	2.12	1.22
Bamekhlouf	Brown	Soft	8.87	7.33	1.54	17.37	4.22	2.82	1.85
Baydh-El-Kadhi	Brown	Soft	10.10	9.16	0.95	9.31	3.87	2.34	2.30
Baydh-Ghoul	Yellow	Soft	19.41	17.8	1.61	8.29	4.59	2.77	2.40
Baydh-Hmam	Brown	Soft	6.05	5.07	0.96	16.20	3.11	2.29	1.73
Bent-Khbala	Yellow	Soft	15.04	13.52	1.52	10.24	4.25	2.36	2.40
Bouarrous	Brown	Soft	9.14	8.20	0.93	10.29	4.19	2.60	1.91
Boufegous	Brown	Soft	9.01	8.13	0.88	9.77	3.77	2.40	1.93
Bouhlass	Brown	Dry	6.87	5.51	0.93	19.80	3.27	2.23	2.10
Bouldjib	Brown	Soft	8.85	7.69	1.16	13.11	4.52	2.66	1.93
Cheikh-	Brown	Semi-dry	6.10	5.40	0.80	13.11	3.35	2.16	1.85
M'hamed									
Degla-Sefra	Yellow	Soft	5.94	5.05	0.89	15.00	3.69	2.40	1.86
Deglet-Djdir	Yellow	Soft	15.68	14.97	0.71	4.53	4.26	2.43	2.25
Deglet-Ziane	Brown	Soft	7.08	5.93	1.17	16.25	3.57	2.55	1.82
Dguel-Mghass	Brown	Soft	10.00	9.23	1.01	7.70	4.15	2.11	2.29
Dhfer-El-Gatt	Brown	Soft	5.29	4.60	0.69	13.05	3.70	2.51	1.43
El-Kaid	Black	Soft	6.75	5.91	0.86	12.45	3.22	2.22	1.87
Figuigue	Brown	Soft	8.43	7.71	0.72	8.55	3.63	2.15	2.33
Garn-El-Ghazel	Yellow	Dry	6.50	5.81	0.69	10.62	4.10	2.62	1.46
Halwa	Brown	Dry	6.57	5.68	0.89	13.55	3.79	2.28	1.96
Hamraia	Red	Dry	7.64	6.71	0.92	13.31	3.50	2.24	1.92
H'mira	Yellow	Soft	11.04	9.83	1.22	11.00	4.00	2.76	2.00
Horra	Brown	Dry	11.94	10.83	1.08	9.30	4.26	2.27	1.95
Kenta	White	Dry	5.16	4.17	0.98	19.19	2.80	2.00	1.46
Laadjina	Brown	Soft	13.24	11.77	1.47	11.11	4.22	2.50	2.38
Litim	Yellow	Soft	9.33	8.20	1.11	12.12	3.49	2.09	2.08
Loulou	Yellow	Soft	8.27	7.22	1.05	12.70	3.11	2.08	2.03
Mezith	Yellow	Soft	14.00	13.00	1.00	7.14	4.37	2.31	1.85
Missouhi	Yellow	Soft	7.14	5.91	1.23	17.23	3.75	2.18	1.76
Ouarglia	Brown	Soft	8.71	7.72	0.98	11.37	4.18	2.45	1.82
Sebaa-Bedraa	Brown	Soft	10.46	9.56	0.90	8.61	4.85	3.02	2.02
Tacherouint	Brown	Soft	8.96	8.15	0.81	9.04	4.74	2.78	2.17
Tafazouine	Orange	Soft	8.54	7.26	1.18	13.82	3.89	2.55	1.82
Takerboucht	Dark	Soft	12.07	11.11	0.96	7.96	3.04	1.83	2.47

Tamsrit	Black	Soft	10.59	9.27	1.32	12.47	4.40	2.76	2.10
Tanslit	Black	Soft	10.52	9.39	1.20	10.75	4.23	2.79	2.02
Tantboucht	Black	Soft	11.11	10.11	1.00	9.00	2.69	1.93	2.39
Tati	Yellow	Soft	9.25	8.05	1.20	13.00	3.48	2.26	2.07
Tawragha	Orange	Soft	8.31	7.18	1.13	13.60	4.00	2.37	2.04
Thaoudant	Yellow	Soft	11.68	10.48	1.12	10.28	4.00	2.49	2.35
Timedwel	Yellow	Soft	7.72	6.74	0.98	12.70	3.82	2.08	1.84
Timjouhert	Red	Soft	10.10	8.86	1.24	12.28	4.12	2.46	2.03
Tinaceur	Yellow	Dry	6.90	6.06	0.85	12.18	3.87	2.29	1.81
Tinakor	Yellow	Dry	4.81	4.36	0.45	9.36	2.61	1.43	1.50
Tindokan	Black	Semi-dry	11.60	10.52	1.08	9.32	3.77	1.87	2.65
Tinissine	Black	Soft	6.63	5.72	0.97	13.73	3.55	2.34	1.69
Signification			***	***	**	**	***	NS	**

3.1.1 Explanation of symbols

D.W: Date weight F.W: Flesh weight S.W: Seed weight
D.L : Date length S.L: Seed length D.D: Date diameter

*** significant at $P < 0.005$; ** significant at $P < 0.01$; * significant at $P < 0.05$;
NS: Not significant.

The date palm fruits of Laadjina, Mezit, Bent-Khbala and Abdel-Azzaz cultivars were also, a high date weight and flesh weight, i.e., 13.24 ± 1.11 , 14.00 ± 1.00 , 15.04 ± 1.08 , 15.38 ± 0.93 g and 11.77 ± 1.05 , 13.00 ± 0.75 , 13.52 ± 0.95 , 13.90 ± 0.99 g, respectively, whereas the smallest date weight and flesh weight were observed in Badjmill, Tinakor, Aabad, Kenta, Dhfer-El-Gatt, Arehti and Amari i.e, 3.88 ± 0.27 - 5.33 ± 0.23 g and 2.85 ± 0.22 - 4.35 ± 0.19 g, respectively (Table 1). Mean values for date weight and flesh weight of other cultivars ranged from 5.94 ± 0.33 g to 12.07 ± 1.18 g and 5.05 ± 0.29 g to 11.11 ± 1.14 g (Table 1). Other authors recorded minimum and maximum dates weight of 3.04 - 8.50 and 11.60 - 28.71 g in Sheshi, Desi, Samany, Reziz, Dhakki and Amhat cultivars [16,29,30,]. With regard to date length and diameter, the maximum mean values for length were recorded in Sebaa Bedraa, i.e., 4.85 ± 0.38 cm and for diameter in Baydh-Ghoul and Bent-Khbala, i.e., 2.40 ± 0.28 cm. The minimum mean value for length and diameter were recorded in Badjmill, Kenta and Tinakor, i.e., 2.61 ± 0.32 - 2.80 ± 0.33 cm and 1.22 ± 0.25 - 1.50 ± 0.26 cm, respectively (Table 1). [16] reported that the maximum mean value for date diameter was recorded in Aseel-Sindh (2.40cm) and for length in Dhakki (4.56cm), while minimum mean value for diameter and length were recorded in Desi, i.e., 1.30 cm and 2.08 cm, respectively. Results regarding mean values of seed weight, seed length and the percentage of Seed weight/Date weight are reported in Table 1. So the seed weights and lengths were in the range of 0.45 ± 0.45 g to 1.54 ± 0.06 g and 1.43 ± 0.08 cm to 2.82 ± 0.12 cm, respectively. The highest seed weight and length were found in Bamekhlouf and Baydh-Ghoul, i.e., 1.54 ± 0.06 g and 2.80 ± 0.11 - 2.82 ± 0.12 cm, respectively. However, the lowest mean values of seed weights and lengths were observed in Tinakor, i.e., 0.45 ± 0.03 g and 1.43 ± 0.08 cm, respectively. The highest mean value of Seed weight/Date weight percentage was found in Badjmill, i.e., 26.55 ± 1.86 % and the lowest in Baydha-Ghoul, Deglet-Djdir, Dguell-Mghass, Figuigue, Mezith, Sebaa-Bedraa Takerboucht cultivars, less than 9.0 ± 1.28 %. This last is comparable to those obtained with Deglet-Nour. According to [2,19,20,27], mean value of Seed weight/Date weight percentage obtained with Deglet-Nour varied between 8.5 to 10.0 %.

3.2 Biochemical Composition

Moisture is one of the essential constituents of the date fruit. It had a fundamental importance in dates quality and acts on its conservation. Moisture contents of date pulp samples of the main cultivars grown in Algeria at the "Tamar" stage were ranged between 9.00 ± 1.16 to 44.00 ± 1.29 %. The analysis of variance shows a highly significant difference in moisture content between different cultivars (Table 2).

Table 2. Biochemical composition of dates in g/100 g (dry weight)

Cultivars	Moisture	pH	Ash	Reducing sugars	Sucrose	Total sugars	Fiber	Protein
Aabad	22.20	6.07	3.44	34.89	48.86	86.32	2.22	2.56
Abdelazzaz	30.75	5.80	1.70	86.00	0.45	86.50	3.36	1.59
Adham-Dali	39.70	6.89	3.82	69.89	0.00	69.89	13.25	3.56
Aghares	28.70	6.39	3.53	68.33	20.0	89.34	2.55	1.25
Ali-Oua-Rached	33.70	6.70	1.68	83.01	0.00	83.01	4.48	1.57
Amari	28.75	6.60	2.57	75.77	4.32	80.32	5.20	2.88
Arehti	28.50	6.50	1.54	63.15	1.69	64.93	11.47	2.85
Azerza	29.00	7.13	1.26	70.36	1.61	72.06	6.58	3.55
Badjmill	28.00	6.20	2.28	77.00	1.90	79.00	3.16	2.25
Bamekhlouf	39.00	6.48	3.69	90.95	0.00	90.95	2.22	0.85
Baydh-El-Kadhi	27.00	6.90	1.28	71.10	4.65	76.00	5.47	1.87
Baydh-Ghoul	39.50	6.40	2.26	51.77	24.83	77.90	4.32	2.95
Baydh-Hmam	28.00	6.75	2.40	72.00	6.13	78.45	3.45	2.25
Bent-Khbala	38.50	7.00	1.62	75.00	0.25	75.26	5.22	3.46
Bouarrous	28.00	6.86	1.86	75.16	2.15	77.43	4.22	1.84
Boufegous	28.35	7.15	1.47	68.32	1.42	69.83	11.51	2.26
Bouhlass	18.50	5.80	2.00	46.34	28.18	76.00	4.65	2.33
Bouldjib	27.00	6.80	1.60	78.12	4.49	82.85	3.25	2.46
Cheikh-M'hamed	21.30	6.31	1.75	69.76	17.89	88.60	3.24	2.12
Degla-Sefra	26.50	6.90	1.93	61.85	8.43	70.73	11.89	2.77
Deglet-Djdir	31.20	6.00	1.11	68.50	5.78	74.61	6.45	2.66
Deglet-Ziane	27.00	5.90	1.66	81.45	2.45	84.00	4.25	2.54
Dguel-Mghass	26.75	5.80	1.95	76.50	2.94	79.60	3.35	3.44
Dhfer-El-Gatt	27.25	6.80	1.88	58.29	0.85	59.18	19.45	2.54
El-Kaid	28.13	6.05	1.89	81.10	6.63	88.10	2.62	1.89
Figuigue	27.80	6.57	3.18	71.87	8.17	80.47	5.82	2.41
Garn-El-Ghazel	12.00	5.70	1.96	35.61	41.31	79.10	4.73	2.88
Halwa	15.80	5.84	3.32	31.29	41.42	73.85	7.55	2.65
Hamraia	18.75	5.50	2.50	31.15	43.90	77.30	6.32	2.58
H'mira	38.75	6.90	0.81	68.91	0.00	68.91	6.22	2.78
Horra	15.00	5.80	1.30	29.86	50.00	82.46	3.63	2.41
Kenta	14.75	6.10	1.60	36.80	40.55	79.47	7.44	2.52
Laadjina	33.90	6.93	2.41	58.08	7.63	66.11	15.71	2.14
Litim	30.10	6.71	1.85	77.92	3.40	81.50	3.18	2.40

Loulou	31.13	5.68	2.22	70.59	1.99	72.68	8.12	4.44
Mezith	27.50	6.20	2.06	76.25	0.54	76.82	5.58	4.13
Missouhi	27.00	6.75	1.77	87.6	3.57	91.36	2.04	0.85
Quarglia	28.80	5.80	2.25	81.55	0.00	81.55	6.52	3.45
Sebaa- Bedraa	27.80	6.60	1.93	64.00	9.31	73.80	9.15	2.22
Tacherouint	26.50	6.76	2.81	78.21	2.21	80.54	5.32	2.69
Tafazouine	27.77	6.50	1.66	79.23	4.66	84.13	4.57	2.39
Takerboucht	31.00	7.29	0.87	74.98	0.00	74.98	7.63	4.41
Tamsrit	26.90	6.57	1.85	73.54	3.90	77.65	6.25	3.42
Tanslit	36.72	7.10	1.92	63.18	8.06	71.67	9.52	3.36
Tantboucht	32.42	6.43	1.37	77.49	0.47	77.99	8.78	2.35
Tati	44.00	6.05	1.94	91.39	0.63	92.04	2.02	0.85
Tawragha	30.20	6.19	2.55	72.52	0.00	72.52	9.45	2.13
Thaoudant	34.00	6.70	1.30	75.00	6.36	81.70	6.65	2.51
Timedwel	34.00	6.43	1.75	74.25	2.61	77.00	7.94	3.35
Timjoughert	27.25	6.60	1.92	77.86	3.43	81.47	5.45	2.33
Tinaceur	19.30	5.46	1.60	32.65	42.87	77.77	8.14	2.25
Tinakor	9.00	5.42	2.67	18.54	34.9	55.27	20.45	3.24
Tindokan	21.80	6.58	1.11	63.80	12.82	77.30	8.42	2.25
Tinissine	30.58	6.15	2.37	78.76	1.05	79.87	8.31	4.35
Signification	***	**	*	***	***	***	***	***

Similar results were obtained by [4,6,12,14,15,17,19,26,29,31]. On the other hand, the obtained results show that Tinakor and Garn-El-Ghazel cultivars have the low moisture content, i.e., 9.0 ± 1.16 - 12.0 ± 1.22 % and H'mira, Adham-Dali, Baydh-Ghoul and Tati have the highest, i.e., 38.70 ± 1.33 - 44.0 ± 1.29 %. The dates produced by Garn-El-Ghazel cultivar have the highest dry matter content whereas Tati cultivar have the lowest, i.e., 46.0 %. The analysis of variance shows a highly significant difference in pH value, reducing sugar, sucrose, total sugars, fiber and protein contents between different cultivars. The pH value of fruits is one of the important attributes which affected their processing and storage. The pH values of the date samples ranged from 5.40 ± 0.40 for Tinakor to 7.29 ± 0.52 for Takerboucht (Table 2). Similar results were reported by the several reports [4,6,15,20]. Dates are considered as fruits with high sugar content. These come in two forms: sucrose and reducing sugars. The main reducing sugars are fructose and glucose, but the dates contain other sugars such as arabinose, galactose and others [4,19,32]. The average contents of reducing sugars and sucrose ranged from 18.54 ± 1.28 to 91.39 ± 2.17 % dry weight and 0 to 48.86 ± 1.65 % dry weight. In addition, Aabad, Abdelazzaz, Aghares, Bamekhlouf, Chikh-M'hammed, El-Kaid, Missouhi and Tati cultivars, contain high sugars content with this value exceeds 85.0 % dry weight. In the contrast, Tinakor and Dhfer-Elgatt cultivars have low sugars content $\leq 60.0 \pm 1.71$ % dry weight. In general, the total sugar content of dates produced by these cultivars is high ranging between 59.18 ± 1.68 to 92.00 ± 2.19 % dry weight. These results were in agreement with those obtained by [4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,21,28,31,33], on different date palm cultivars cultivated in the world. As for the ash content, this latter depends on the fertility status of soils and amendments. However, Adham-Dhali and Bamekhlouf cultivars exhibit high levels ranging between 3.69 ± 0.77 to 3.82 ± 0.82 % dry weight. Protein content ranged from 0.85 ± 0.19 to 4.44 ± 0.72 % dry weight. The date produced by Loulou cultivar presented the highest protein content, i.e., 4.44 ± 0.72 % dry weight followed by Takerboucht, i.e., 4.41 ± 0.65 % dry weight and Tinissine, i.e., 4.35 ± 0.54 % dry weight.

These results were in agreement with those reported by [6,7,8,9,10,11,12,13,14,15, 16,17,18,21,28,31,33], with other cultivars cultivated in the world. The dates are a better source of dietary fiber as raisins, dried apricots and prunes, but they are less rich in fiber as dried figs [5]. The obtained results show that dates produced by Laadjina, Dhfer-Elgatt and Tinakor have a high fiber content, i.e., 15.70 ± 1.35 and 20.45 ± 1.48 % dry weight, respectively compared to Missouhi and Tati, less than 2.50 ± 0.79 % dry weight. Similar results were reported by several authors [5,11,16].

3.3 Assessment of Dates Quality

The obtained results show that the most of the dates palm fruits cultivars have a combination of good and bad characters of the fruit (Table 3).

Table 3. Date quality assessment

Cultivars	Date weight	Flesh weight	S.W/ D.W	Date length	Date diameter	Moisture	pH	Total sugars
Aabad	L and B	L and B	A	L and B	H and G	Y and G	G	H and G
Abdelazzaz	H and G	H and G	G	Y and A	H and G	V and B	G	H and G
Adham-Dali	H and G	H and G	A	Y and A	H and G	H and G	G	Y et AB
Aghares	H and G	H and G	A	Y and A	H and G	H and G	G	H and G
Ali-Oua-Rached	Y and A	Y and A	A	L and B	H and G	H and G	G	H and G
Amari	L and B	L and B	B	Y and A	H and G	H and G	G	H and G
Arechti	L and B	L and B	B	L and B	Y and A	Y and G	G	Y and A
Azerza	Y and A	H and G	A	Y and A	H and G	H and G	G	H and G
Badjmill	L and B	L and B	B	L and B	L and B	Y et B	G	H and G
Bamekhlouf	H and G	H and G	A	H and G	H and G	V and B	G	H and G
Baydh-El-Kadhi	H and G	H and G	G	Y and A	H and G	H and A	G	H and G
Baydh-Ghoul	H and G	H and G	G	H and G	H and G	V and B	G	H and G
Baydh-Hmam	Y and A	Y and A	A	L and B	Y and A	H and A	G	H and G
Bent-Khbala	H and G	H and G	A	H and G	H and G	V and B	G	H and G
Bouarrous	H and G	H and G	A	H and G	H and G	H and A	G	H and G
Boufegous	H and G	H and G	G	Y and A	H and G	H and G	G	Y et AB
Bouhlass	Y and A	Y and A	B	L and B	H and G	H and G	G	H and G
Bouldjib	H and G	H and G	A	H and G	H and G	Y and G	G	H and G
Cheikh-M'hamed	Y and A	Y and A	A	L and B	H and G	Y and G	G	H and G
Degla-Sefra	L and B	L and B	A	Y and A	H and G	Y and G	G	H and G
Deglet-Djdir	H and G	H and G	G	H and G	H and G	V and B	G	H and G
Deglet-Ziane	Y and A	Y and A	A	H and G	H and G	Y and G	G	H and G
Dguel-Mghass	H and G	H and G	G	H and G	H and G	H and A	G	H and G
Dhfer-El-Gatt	L and B	L and B	A	Y and A	L and B	Y and G	G	L and B
El-Kaid	Y and A	Y and A	A	L and B	H and G	H and G	G	H and G
Figuigue	H and G	H and G	G	Y et AB	H and G	H and G	G	H and G
Garn-El-Ghazel	Y and A	Y and A	A	H and G	L and B	Y and G	G	H and G
Halwa	Y and A	Y and A	A	Y and A	H and G	Y and G	G	H and G
Hamraia	Y and A	Y and A	A	Y and A	H and G	Y and G	B	H and G

H'mira	H and G	H and G	A	H and G	H and G	V and B	G	Y and A
Horra	H and G	H and G	G	H and G	H and G	Y and G	G	H and G
Laadjina	H and G	H and G	A	H and G	H and G	V and B	G	H and G
Litim	H and G	H and G	A	L and B	H and G	V and B	G	H and G
Loulou	H and G	H and G	A	L and B	H and G	V and B	G	H and G
Mezith	H and G	H and G	G	H and G	Y et AB	H and G	G	H and G
Missouhi	Y and A	Y and A	A	H and G	Y and A	H and G	G	H and G
Ouarglia	H and G	H and G	A	H and G	H and G	Y and G	G	H and G
Sebaa- Bedraa	H and G	H and G	G	H and G	H and G	H and A	G	H and G
Tacherouint	H and G	H and G	G	H and G	H and G	Y and G	G	H and G
Tafazouine	H and G	H and G	A	Y and A	H and G	Y and A	G	H and G
Takerboucht	H and G	H and G	G	L and B	H and G	V and B	G	H and G
Tamsrit	H and G	H and G	A	H and G	H and G	H and G	G	H and G
Tanslit	H and G	H and G	A	H and G	H and G	H and G	G	H and G
Tantboucht	H and G	H and G	G	L and B	H and G	V and B	G	H and G
Tati	H and G	H and G	A	L and B	H and G	V and B	G	H and G
Tawragha	H and G	H and G	A	H and G	H and G	Y and G	G	H and G
Thaoudant	H and G	H and G	A	H and G	H and G	V and B	G	H and G
Timedwel	Y and A	Y and A	A	Y et AB	E et B	V and B	G	H and G
Timjouhert	H and G	H and G	A	H and G	H and G	H and A	G	H and G
Tinaceur	Y and A	Y and A	A	Y and A	H and G	Y and G	B	H and G
Tinakor	L and B	L and B	G	L and B	L and B	Y and G	B	L and B
Tindokan	H and G	H and G	G	Y and A	H and G	Y and G	G	H and G
Tinissine	Y and A	Y and A	A	Y and A	H and G	V and B	G	H and G

3.3.1 Explanation of symbols

L: Low Y: Average H: High or Long V: Very high
 B: Bad character A: Acceptable character G: Good character

Similar results were reported by [4,14,26]. On the other hand, Bayd-Ghoul, Bent-Khbala, Deglet-Djdir, Ladjina, Tanslit, Takerboucht and Tantboucht cultivars have a good morphological and biochemical dates quality.

However, they have a very high moisture content, which makes their conservations and hence their packaging and marketing difficult. By elsewhere, Deglet-Ziane, El-Kaid, Garn-Elghazel, Halwa, Missouhi and Tinaceur cultivars have a high sugars content and an acceptable water content but low to medium dates weight and size. For these cultivars, the application of certain technical cultural practices such as, sufficient irrigation, regular fertilization, limitation of the number of bunch and chiseling may improve the morphological characteristics of the dates. As for, Aabad, Amari, Arechti, Badjmill, Degla Sefra, Dhfer-El-Gatt, Kenta and Tinakori cultivars, these last have a bad characteristics of the dates, which makes their utilization and marketing difficult. The cultivar Bouhlass despite an a good to acceptable morphological and biochemical characteristics of the dates but it present the high percentage of Seed weight /Date weight, hence its bad dates quality and low commercial value. Also, Tinaceur, Tinakor and Hamraia cultivars have an acidic pH, i.e., 5.4 to 5.5 which makes a bad dates quality. According to [17], the dates with a low value of $\text{pH} \leq 5.5$ are considered as a low dates quality (dates acids).

On the other hand, Dhfer-El-Gatt and Tinakor cultivars have low sugars content less than

60 %. They are considered as cultivars with a low date quality. Finally, solely sixteen of date palm cultivars namely, Aghares, Baydh-El-Kadhi, Bouarous, Bouldjib, Dguel-M'ghas, Figuigue, Horra, Mezith, Ouarglia, Sebaa-Bedraa, Tacherouint, Tafazouine, Tamsrit, Tawragha , Timjoughert and Tindokan have a good physical and biochemical dates quality characterized by:

- * Date length is medium to high (3.63 - 4.85 cm).
- * Date and flesh weights are high ranging between 8.31 to 14.00 and 7.08 g to 13.00 g.
- * Date diameter is high (1.82 - 2.65 cm).
- * A good value percentage of Seed weight/Date weight, less than 13.82 %.
- * An acceptable moisture content ranging between 15.0 to 28.0 %.
- * A good value of pH ranging between 5.8 to 6.9.
- * A high sugars content, higher than 72.5 %.

4. CONCLUSION

Morphological and biochemical characterization of the main date palm fruits cultivars grown in Algeria revealed significant variations from cultivar to another and within the same cultivar, from region to another. Thus, these results indicate that most of these cultivars present good morphological characters like large date size, high date and flesh weight, and a low percentage of Seed weight/Date weight. On the other hand, the evaluation of the physical and biochemical dates quality show that the majority of these cultivars have a combination of good and bad characters of the fruit, which makes their utilization either for consumption or processing difficult. However, the dates produced by Asghares, Baydh-El-Kadhi, Bouarous, Bouldjib, Dguel-M'ghas, Figuigue, Horra, Mezith, Ouarglia, Sebaa-Bedraa, Tacherouint, Tafazouine, Tamsrit, Tawragha, Timjoughert and Tindokan cultivars have a good physical and biochemical dates quality comparable or better than those produced by Deglet-Nour, Ghars and Degla-Beida cultivars. It was concluded that these date cultivars would be suitable for table purpose. The others date cultivars are suitable for processing due to the higher sugar content.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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