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Fruit Evaluation of Minor Nubian Date Palm Cultivars

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Abstract: Domestication of date palm in the Nuba-land of Mahas and Sakkot tribes since ancient times had been well documented in archeological records. The commercially valuable Sudanese date palm cultivars originated there and were distributed country-wise. Besides, there are many minor cultivars in that habitat, rarely recognized in other dates producing areas in Sudan. In this study, the physical, chemical and sensory attributes of 10 of these cultivars were studied in comparison to Barakawi, the major date cultivar in Sudan. Kulmat Al Borgaig scored top rank for fruit weight, width and pulp thickness, sharing weight position with Kajnosa, while Barakawi fruit was the longest. The highest total and non-reducing sugars were recorded in Zagloul and Kulumtoad fruits. The moisture content of all cultivars was extremely low, except for Kulmat AlBorgaig which was characterized by relatively higher moisture. The overall acceptance in the panel of sensory evaluation was in favour of Kulmat Al Borgaig and Kajnosa, with relatively higher grades for taste and palatability for Kulmat Al Borgaig.

Key words: Date palm (*Phoenix dactylifera* L.); Nubian cultivars; Physico-chemical; Sensory

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is a member of the monocotyledonous family Arecaceae. It is native to tropical Asia and Africa (Wrigley 1995), and had been cultured in northern Sudan since antiquity representing the predominant fruit tree in the Northern State. The date palm is a tree of life

and symbol of wealth and social status in that state. Date palm is valued for its nutritional fruit with sugars being the principal constituent (Samarawira 1983; Ahmed *et al.*1995) and by-products such as timber and leaves. Soft date types are sold immediately whereas dry date types are packed in sacks for transport for distant markets or for longer storage. Date palms tolerate drought, very high temperatures, and low atmospheric relative humidity. Compared to other fruit trees, it can also tolerate marginal lands and minimum human attention. In Sudan, date cultivation is a major economical activity in the Northern State (Dirar 2003). The prevalence of this palm in the Nile valley is prehistoric and is well documented in ancient Egyptian and Nubian civilizations through archeological records. Although Aswan Dam created a physical barrier between the Nubas of north Sudan and southern Egypt, still they share the history, blood and ethnic features, traditions, values, professional activities, and the dry types of date palm. Sudan dates originated in the Nuba-land neighboring Egypt and from there the commercial cultivars were distributed southwards. Cultivation of date palm in Sudan, however, involves a narrow range of indigenous cultivars making date culture vulnerable to genetic erosion. The commercial cultivars are few, and this may be attributed primarily to the preference of cultivars that can store well for long periods without considerable loss in quality traits under ambient hot and extremely dry conditions prevailing in that area. In addition to the commercial varieties, date plantations include seedling trees, called "Jaw" which originated from hybrid seeds and display very high phenotypic diversity. Each seedling date tree may be considered a potential cultivar due to the high degree of heterozygosis in date palm. Most of the commercially known date palm cultivars currently used worldwide developed from seedlings by growers (Nixon 1971). Nevertheless, there are some minor cultivars restricted to the Mahas and Sakkot Nubian tribes which are unknown in other date producing areas. These cultivars represent an important genetic resource offering a base for starting national research programmes for improving and widening the genetic base of date palm varieties in Sudan. There are meager research efforts on date palm in Sudan, especially on crop improvement (Nixon 1967; Idris *et al.* 2006). However, in recent years, Sudan date palms suffered numerous attacks of insect pests and diseases and the impacts of climate change may necessitate the search for cultivars with tolerance to various biotic and abiotic stresses. Correct identification of date palm

varieties is not possible until fruits are produced. Therefore, assessment studies of the prevailing gene pool might provide a base for an expanded acquaintanceship with potential selection candidates upon need if the survival of the major commercial cultivars is endangered by a latent threat.

The objective of this study was to evaluate the physico-chemical properties and sensory attributes of minor Nubian date cultivars in comparison with "Barakawi", the major dry date cultivar in Sudan.

MATERIALS AND METHODS

A survey was conducted in the Mahas and Sakkot tribal area, extending between "Al Borgaig" and "Abri" towns, in the eastern bank of the Nile in the Northern State during October 2010, with the objective of selecting superior seedling date palm clones of the dry type, based on growers' subjective observations. The growers proposed around 80 selections. The selections were anonymous without specific naming except some that were recognized as minor local cultivars with limited distribution among the famous date producers in the area but are well known to most inhabitants. These 10 selections were locally named as "Garjcola", "Nawwa", "Sherwa", "Shadda", "Kulmat Borgaig", "Gargoda", "Kajnosa", "Sultani", "Zagloul", and "Kulumtoad". Fruit samples from these cultivars were collected at harvest and tagged according to their local names, location of collection and owner's address. The fruits were photographed. Their physical, chemical and sensory attributes were compared against "Barakawi", the major commercial date cultivar whose origin was the selection area. Twenty fruits were randomly taken from each cultivar to determine the average weight of whole fruit and seed using a digital top loading balance. The average fruit length, width, seed (pit) length and pulp thickness were determined by a Vernier caliper. The moisture content of 50 g fruit flesh, replicated thrice for each cultivar, was determined using an oven adjusted at constant 70°C. The total sugars and reducing and non-reducing sugars were determined, according to the standard methods of A.O.A.C. (1995). The fruits of the different cultivars were evaluated by 12 panelists in terms of fruit color, shape, taste, palatability and over-all acceptance on a numerical scale of 1 to 5, with 1 indicating poor, 2 fair, 3 good, 4 very good and 5 excellent. The data were

subjected to analysis of variance for the completely randomized design using the MSTAT4 statistical package (Nissen 1987), followed by Duncan's multiple range test to compare differences among individual means at 95% confidence limits.

RESULTS

The evaluation of the physical characteristics of the minor Nubian cultivars in comparison to "Barakawi" is presented in Table 1. Five of these cultivars exceeded "Barakawi" in fruit weight, with heaviest weights recorded for "Kajnosa" and "Kulmat Borgaig". "Zagloul" and "Kulumtoad" ranked second while "Barakawi" ranked third. The length of "Barakawi" fruit exceeded their length significantly except for "Zagloul". Five of these cultivars recorded significantly higher fruit width than "Barakawi", with best width recorded for "Kulmat Borgaig". "Sultani", "Zagloul" and "Kulumtoad". "Kulmat Borgaig" scored the top rank for pulp thickness with significant difference from all. Four cultivars shared "Barakawi" the top rank for seed weight, while no significant difference was obtained among the other five cultivars for this character. The "Barakawi" seed length significantly, exceeded the seed length of the other cultivars, followed by "Sherwa" and "Gargoda" that shared the second position, while the shortest seeds were recorded in "Sultani", "Nawwa" and "Garjicola".

The analysis of fruit sugar content of the cultivars is presented in Table 2. Seven cultivars contained significantly higher reducing sugars than "Barakawi" which resembled the other 3 cultivars for this character. The non-reducing sugars were significantly higher in "Zagloul" and "Kulumtoad" compared to other cultivars. "Barakawi" shared a second position with "Nawwa" and "Garjicola" and its content of non-reducing sugars was significantly higher than the rest except "Shadda". "Zagloul" and "Kulumtoad" shared the top rank for the content of total sugars with significant increase compared to the other cultivars, while "Garjicola" and "Nawwa" shared a second rank with "Barakawi" for this character.

Table 1. Physical characteristics of minor Nubian dry date cultivars

Cultivar	Fruit weight (g)	Fruit length (cm)	Fruit width (mm)	Pulp thickness (mm)	Seed weight (g)	Seed length (cm)
Garjicola	4.92e	3.10f	17.56de	3.48d	0.98bc	2.26fg
Nawwa	7.92c	3.40	20.56c	5.20b	0.80c	2.10g
Sherwa	7.32cd	4.50cd	17.02e	3.96d	1.20ab	3.12b
Shadda	8.36c	4.46cd	18.14de	5.38b	1.04bc	2.76cd
Kulmat Borgaig	12.60a	4.52cd	26.46a	7.74a	1.02bc	2.66cd
Kajnosa	12.68a	4.70bc	22.88b	5.14b	0.98bc	2.80c
Gargoda	6.46d	3.94e	18.10de	4.26cd	1.22a	2.92bc
Sultani	11.14b	4.16de	23.52b	5.28b	1.08ab	2.10g
Zagloul	10.38b	5.00ab	23.60b	4.30cd	0.82c	2.38ef
Kulumtoad	10.50b	4.62bcd	23.00b	3.82d	1.40a	2.52de
Barakawi (control)	8.62c	5.30a	19.26cd	4.90bc	1.14ab	3.38a

Means with the same letter(s) in the same column are not significantly different at P=0.05, according to Duncan's multiple range tests.

Table 2. Sugar content of minor Nubian dry date cultivars

Cultivar	Reducing sugars	Non-reducing sugars	Total sugars
Garjicola	44.53b	16.47b	61.00b
Nawwa	43.80c	17.20b	61.00b
Sherwa	44.90ab	11.10d	56.00cd
Shadda	44.77ab	12.23cd	57.00cd
Kulmat Borgaig	43.20d	09.48d	52.67e
Kajnosa	43.80c	09.20d	53.00de
Gargoda	45.00a	10.00d	55.00de
Sultani	44.73ab	11.27d	56.00cd
Zagloul	44.77ab	23.90a	68.67a
Kulumtoad	44.77ab	23.23a	68.00a
Barakawi (control)	43.40cd	14.73bc	58.33bc

Means with the same letter(s) in the same column are not significantly different at P=0.05.

The highest moisture content was recorded for “Kulmat Borgaig” with significant increase over the others. “Barakawi” ranked second, and the least moisture was detected in “Kulumtoad” (Table 3).

The results of the sensory evaluation of the cultivars are presented in Table 4. Collectively and except for colour, “Kulmat Borgaig” ranked top for all other parameters.

“Barakawi” and “Gargoda” shared the top rank for colour with no significant difference from “Shadda”. “Sherwa” and “Kajnosa” ranked second without significant difference from “Garjicola” and “Nawwa”. The panelists gave the highest shape values for “Barakawi”, “Kulmat Borgaig” and “Kajnosa”. The other cultivars were not significantly different from them except for “Garjicola” and “Nawwa” which received

the least scores, and "Shadda" ranked second. Concerning taste, "Kulmat Borgaig" was a celebrity as it ranked top for this parameter although its difference from "Kajnosa", "Gargoda", and "Barakawi" was insignificant. The least marks were given to "Garjicola". "Kulmat Borgaig" was also preferred for palatability with exceptionally high marks although it was not statistically different from "Kajnosa" and "Gargoda", but compared to "Barakawi" its supremacy was clear. The overall acceptance was also in favour of "Kulmat Borgaig" and "Kajnosa" that ranked top. However, they did not differ significantly from "Gargoda", "Zagloul" and "Barakawi". It is to be noted that "Garjicola" received the least overall preference without significant difference from "Nawwa", "Shadda", and "Kulumtoad".

Table 3. Moisture content of minor Nubian dry date cultivars

Cultivar	Moisture content (%)
Garjicola	11.37efg
Nawwa	13.01bcd
Sherwa	12.21def
Shadda	11.15fg
Kulmat Borgaig	18.86a
Kajnosa	12.75cd
Gargoda	13.48bc
Sultani	12.32de
Zagloul	10.91g
Kulumtoad	09.31h
Barakawi (control)	13.95b

Means with the same letter(s) in the same column are not significantly different at P=0.05.

Table 4. Sensory evaluation of minor Nubian dry date cultivars

Cultivar	Colour	Shape	Taste	Palatability	Overall preference
Garjicola	3.00bc	1.10c	2.50e	3.00bcd	2.20d
Nawwa	2.90bc	1.40c	3.20cde	2.90cd	2.60cd
Sherwa	3.20b	3.00ab	3.30cde	3.70bc	3.20bc
Shadda	3.80ab	2.50b	2.90cde	1.10bcd	2.30cd
Kulmat Borgaig	2.50cd	4.00a	4.70a	4.90a	4.60a
Kajnosa	3.36b	4.00a	4.50ab	4.10ab	4.40a
Gargoda	4.30a	3.50ab	3.80abc	4.00abc	3.80ab
Sultani	2.80c	3.30ab	3.50bcde	3.30bcd	3.20bc
Zagloul	2.90c	3.50ab	3.70bcd	3.80bc	3.80ab
Kulumtoad	2.80c	3.50ab	2.60de	2.20d	2.60cd
Barakawi (control)	4.20a	4.00a	3.80abc	3.60bc	3.70ab

Means with the same letter(s) in the same column are not significantly different at P=0.05, according to Duncan's multiple range test.

DISCUSSION

The study revealed the prevalence of minor date cultivars, rarely recognized outside the study area. Variations were detected in the physical and chemical properties of their fruits, and some of them equaled or excelled "Barakawi", the leading date cultivar in Sudan, in structure, composition or consumer preference. The existence of such cultivars is expected as date cultivation in the area had been practiced there since very ancient times (Zaid 2005). Similar results were obtained and similar conclusions were reached by Mohamed *et al.* (1983) for Iraqi cultivars. Elshibli and Korpelainen (2008), however, reported high genetic diversity in Sudan date palm germplasm. Again, Elshibli and Korpelainen (2009) reported chemical, morphological and DNA variations in selected Sudanese date cultivars. In a comparative evaluation study, Idris *et al.* (2012), also reported morphological and yield differences in date palm types in the Northern State, Sudan.

Acquiring knowledge on the diversity among individuals and populations is an essential step for selection, conservation and utilization of the genetic resources of a species. Regarding this fact, it is noteworthy to mention the threats of insect pests and diseases facing Sudan date palms in the last two decades which necessitate research efforts on culture, protection and selection for tolerance or resistance coupled with fruit quality traits (Ahmed 2007; Idris *et al*. 2011; Eldoash *et al*. 2011). However, these cultivars under study are expected to be indigenous to the study area or limited introductions from south Egypt, as "Zagloul" which is a major commercial cultivar there. Introduction from neighboring Libya or other North African countries is another probability.

"Gargoda"and "Kajnosa" followed by "Nawwa" are of higher prevalence compared to the other cultivars. "Kulmat Borgaig" might be a mutant from the well known "Kulma" cultivar. The reason behind the limited distribution of most of these minor cultivars might be a natural difficulty in rooting their offshoots, or poor performance after lengthy post harvest storage.

The major commercial cultivars have excellent keeping quality under ambient hot and dry conditions, coupled with tolerance to rough transport and handling. As claimed by Eltayeb *et al.* (1999), the low moisture content in all of these minor cultivars coupled with their high non-reducing sugar content classifies them as members of the dry date type.

As conditions have changed in the last few years in Sudan due to improvements in trans-country roads, electrical supply, and refrigerated storage, the basis for sticking to the old commercial cultivars may shake or change leading to conceptual changes in quality determining factors (Idris *et al.* 2012). Besides, climate change has created flowering and yield disturbances in the commercial cultivars in the last three years with the onset of cases of group deaths in few date pockets without identification of the real causes behind such phenomena. Nevertheless, the expanded genetic resources of the crop in this area might be a valuable tool serving breeding objectives. In conclusion further assessment of adaptive traits, propagation, yield, yield components and post harvest performance of these cultivars is needed for a comprehensive solid view of their potential.

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