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Assessing fruit characteristics to standardize quality norms in date cultivars of Saudi Arabia

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Abstract

The date palm (*Phoenix dactylifera L*) is the most important crop of the Gulf region in the Middle-East. The Kingdom of Saudi Arabia with an estimated 25 million date palms produces nearly a million tones of dates annually with a good potential for exporting the surplus produce. In order to standardize quality norms of major date cultivars in the Kingdom, studies were taken up at the National Date Palm Research Centre, Al Hassa, Saudi Arabia to ascertain fruit characteristics of dates (*Tamar* stage) in the cultivars Khalas, Sheshi and Reziz with respect to fruit weight (g) , size of fruit (length and breath), number of fruits /500g, fruit moisture, colour and texture. Khalas recorded the maximum fruit length in all the three categories of large, medium and small sized fruits. With regard to the breath of fruits, the cultivar Sheshi registered the highest values. Further, Sheshi recorded the highest fruit weight values, which in turn influenced the number of fruits per unit weight, with Sheshi recording the least number of fruits per 500g. The cultivar Khalas had the least fruit moisture and the highest mean ΔE for colour indicating light colour (yellow) fruits. We also studied four texture parameters *viz,* hardness, springiness, cohesiveness and resilience of Khalas, Sheshi and Reziz date cultivars. Findings of this investigation will strengthen the data base of fruit quality norms in major Saudi Arabian date cultivars and boost export of dates from the Kingdom, besides protecting the identity of the cultivars studied.

Keywords: *Phoenix dactylifera L***.** cultivars, quality norms, Saudi Arabian dates.

Introduction

The date palm (*Phoenix dactylifera* L) is one of the oldest fruit trees of the world and is closely associated with the life of the people in the Middle East including the Kingdom of Saudi Arabia since ancient times. In the Middle-East date palm has been cultivated at least since 6000 BC (Al-Qarawi *et al*., 2003). The Arab countries of the Middle-East and North Africa account for 60 per cent of the world's production where 800 different kinds of date cultivars are reported to be grown (Al-Afifi & Al-Badawi, 1998; Mikki, 1998).The with an estimated 25 million date palms the Kingdom produces nearly a million tones of dates annually accounting for about 15% of the global date production (Anonymous, 2006). The date fruit is a good source of food, providing fibre, carbohydrates, minerals and vitamins besides having antimutagenic and anticarcenogenic properties (Mohamed, 2000; Vayalill, 2002; Al-Farsi, 2005; Ishurd & Kennedy 2005; Baloch *et al*., 2006).

Worldwide 2000 or more date cultivars are known to exist (Ali- Mohamed & Khamis, 2004). Saudi Arabia has a rich diversity of about 400 date cultivars of which 10 varieties including Khalas ,Sheshi and Reziz are popular and have a high consumer preference (Anonymous, 2006). With an estimated three million palms the Al Hassa oasis is the largest in the Kingdom where El-Baker (1952) listed 15 date palm varieties of commercial importance, while Asif *et al*. (1982) listed 25 cultivars from the Al-Hassa oasis. Further, Asif *et al*. (1986) grouped the Al-Hassa date palm cultivars based on the season of production and categorized the three cultivars under investigation in this study as mid-season cultivars. Khalas is widely cultivated in the Al Hassa oasis and considered by many as the best date of the world, with mostly medium to big sized fruits that make a delicacy as both fresh (*rutab)* and dry (*tamar)* dates which store well. Sheshi produces mostly medium to large fruits, plumpy and firm in texture. Skin separation of fruits is common in this cultivar which often lowers the quality and value of the produce. Reziz is widely cultivated in the Al- Hassa oasis and is distinguished by small dark coloured fruits that have a characteristic flavour (Asif *et al*., 1986).

In view of the increasing cultivation and surplus date production in the Kingdom there is an emphasis on exports where ascertaining the quality norms of specific date cultivars is crucial as emphasized by the National Committee on date palm in Saudi Arabia. Determining fruit characteristics of major Saudi Arabian date cultivars will also ensure that the cultivar is protected.

Ripening of dates is characterized by four stages *viz*. Kimri, Khalal, Rutab and Tamar stage depending on the colour, softness moisture and sugar content (Farahnaky & Afshari-Jouybari, 2010). CODEX norms based on fruit weight are available for major North African date varieties *viz*. Deglet Nour and Majhoul. International standards for export of dates also demands homogeneity of color, size and texture (Anonymous, 1985). Jaradat and Zaid (2004) while studying quality traits of date palm fruits revealed that fruit colour, shape, size, ripening and their interactions predominantly reflect differences in consumer preferences, with fruit colour, softness and consumption

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stage explaining 65.5 per cent of the variability in the economic value of date palm cultivars.

Given the importance of the subject and lack of information on fruit characteristics of Saudi Arabian dates, studies were taken up at the National Date Palm Research Centre, Al Hassa, Saudi Arabia to ascertain fruit characteristics of dates (*Tamar* stage) in the cultivars Khalas, Sheshi and Reziz with respect to fruit weight (g) , size of fruit (length and breath) , number of fruits /500g, fruit moisture, colour and texture.

Materials and methods

Date samples of major Saudi Arabian date cultivars *viz.* Koalas, Sheshi and Reziz were collected at *Tamar* stage. Based on consumer preference as assessed from interviews with consumers (50) and key market stake holders (10) fruits in one kilogram of dates were sorted out as large, medium and small. The weight/ fruit (g) for the three cultivars as perceived by consumer preferences is given in (Table 1)

Table 1. The weight/ fruit (g) for the three cultivars as perceived by consumer preferences

Cultivar	Fruit weight (g)		
	Large	Medium	Small
Sheshi	> 11	8-10	<8
Khalas	>10	7-9	<7
Reziz	>7	5-7	<5

The average fruit weight (cultivar wise) for the above three categories was recorded. Further, the number of fruits per 500g as recommended by CODEX norms was also recorded for the above cultivars. Fruit size was determined by recording the fruit dimensions pertaining to length (mm) and breath (mm) of the above mentioned cultivars.

Fruit colour measurements ranging from dark to clear were recorded for 10 date samples using a spectrophotometer (Hunter ColorFlex^{TM}, USA) through digital imaging under controlled conditions. Analysis of pictures was performed using easy match QC software, which is a windows- based computer programme that performs numerical calculations on data measured by ColorFlex^{TM} , stores sample measurements and /or printed representation of data. The software also directly controls instrument standardization, measurement and diagnostics .Colour differences between samples were computed with the equation given below and represented by mean ΔE.

$$\sqrt{\Delta E = \Delta L^2 + \Delta a^2 + \Delta b^2}$$

Where L, a, and b are the colour values of the samples. The colour value 'L' measures relative white (100) to black (0). The value'a' measures relative green (-) to red (+) while the'b' colour values measures relative yellow (+) to blue (-). Further, fruit texture analysis (mm) with respect to hardness, springiness, cohesiveness, and resilience of dates, cultivar wise was carried out using a texture analyzer (TA.XT plus/TA.HD plus/MT.LQ plus^{TM}, England).

Hardness (mm) or firmness, also indicating extent of tissue softness was measured through a force test. Springiness (mm) is related to tissue elasticity and measured in the degree to which a product can be extended / stretched before breaking. Cohesiveness (mm) represents steadiness and measures tissue strength. Resilience (mm) of dates is the ability of the tissue to return to the original form after being compressed or stretched.

Fruit moisture was also measured for three cultivars using the protocol given below by Marzouk and Kassem (2010). Fruits were washed with tap water, then rinsed twice with distilled water and cut into small pieces with a knife. Then an amount of fresh weight sample was weighed (fresh weight) and dried to a constant weight (g) in an air drying oven at 70^{o} C, then weighed (dry weight). Fruit moisture and dry matter contents were calculated as:

Fruit moisture content (%) = Average fresh fruit weight - Average dry fruit / Average fresh weight X 100

For each of the three cultivars, all observations (except number of fruits/ 500g) were recorded on a 10 replicate basis with each replicate being the mean of three observations. Data was subjected to ANOVA using the randomized block design. In case of number of fruits /500g observations were recorded on a three replicate basis and data was subjected to ANOVA using the completely randomized design. With regard to the physical parameters *viz.* weight / fruit (g), number of fruits /500g and size of fruit (length and breath) observations were recorded for each of the three fruit categories viz. large, medium and small. All data were analyzed through the Web Based Agricultural Statistics Software Package (WASP 1.0 - http://www.icargoa.res.in)

Results and discussion

The physical characteristics (fruit weight, size, number of fruits/500g) and other quality parameters *viz.* fruit moisture, fruit colour and texture are presented and discussed below:

Fruit size

Results presented in Table 2 reveal that the cultivar Khalas recorded the maximum fruit length (39.60-31.45mm) in all the three categories of large, medium and

Table 2. Fruit size of major Saudi Arabian date cultivars

	Fruit Size					
Cultivar	Fruit Length(mm)			Fruit Breath(mm)		
	Large	Medium	Small	Large	Medium	Small
Khalas	39.60a	38.50a	31.45a	23.60b	24.50b	20.16b
Sheshi	35.30b	26.00b	29.50b	25.70a	25.50a	21.80a
Reziz	26.57c	25.26b	24.68c	18.60c	17.69c	17.08c
CD(p=0.05)	0.66	1.19	1.11	0.89	0.77	0.67

Values followed by different letters within the same column are significantly different at 5% significance level.
CD : Critical Difference

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Table 3. Weight per fruit and number of fruits per 500g of major Saudi Arabian date cultivars

Cultivar	Weight per fruit (g)			Number of fruits per 500g		
	Large	Medium	Small	Large	Medium	Small
Khalas	10.70b	8.65b	6.05b	44.00b	60.67b	83.67b
Sheshi	11.60a	10.30a	7.05a	39.00c	52.33c	72.67c
Reziz	7.55c	6.08c	4.71c	65.67a	78.33a	109.67a
CD (p=0.05)	0.15	0.41	0.27	4.66	2.00	2.31

Values followed by different letters within the same column are significantly different at 5% significance level.
CD : Critical Difference

small sized fruits and was statistically superior to Sheshi and Reziz . With regard to the breath of fruits, the cultivar Sheshi registered the highest values (25.70 - 21.80 mm) and was significantly different from Khalas and Reziz which second and third ,respectively. Sakr *et al*. (2010) reported fruit length to significantly differed among the fruits of eight date palm cultivars studied with the cultivar Kuboshy and Zaghloul registering the maximum fruit length of 6.65 and 6.10 cm, respectively, while the cultivar Samany registered the maximum breath of 3.31 cm. Asif *et al*. (1986) categorized fruits of both Khalas and Sheshi as medium to big and that of Reziz to be small. In the Western region of Saudi Arabia, large fruit size characteristic of the cultivar Anbarah from Al Medina is reported to be a unique variant found with relatively low frequency and high polymorphic index (Jaradat & Zaid, 2004).

Fruit weight related characters

With regard to weight of individual fruits, the cultivar Sheshi recorded the highest and significantly superior values (11.60 - 7.05 g) in all the three categories of large, medium and small fruits tested. Consequently, fruit weight influenced the number of fruits per unit weight, with Sheshi recording the least number of fruits per 500g (39.00 - 72.67) and was significantly different from Khalas and Reziz in the three categories of large, medium and small fruits (Table 3). Sakr *et al*. 2010 recorded maximum and minimum fruit weight of 28.71g and 8.50g in the cultivar Samany and Amhat, respectively.

Fruit size in dates of the Egyptian cultivar Zaghloul were enhanced with the application of organic manures or its supplementation with mineral NPK compared to mineral fertilization alone (Marzouk & Kassem, 2010).

Fruit moisture and colour

Fruit moisture in dates is an important quality parameter that contributes to the quality of dates. Results presented in fig.1 indicate that the cultivar Khalas had the least fruit moisture of 13.96 per cent and was significantly different from Sheshi (15.24 %) and Reziz (15.52%) which were statistically at par.

Hussein *et al*. 1979 classified dates on the basis of moisture content as dry date with less than 20 per cent moisture that require high temperature and sun intensity for maturity with about the same level of sucrose and reducing sugars. Semi-dry dates were found to have moisture levels ranging from 20-30 per cent with low sucrose content and soft dates with more than 30 per cent moisture with low sucrose content and must be eaten fresh. According to this classification the dates studied in this investigation would therefore be classified as dry dates as moisture levels were less than 20 per cent ranging from 13.96 to 15.24 percent (Fig.1)

With regard to fruit colour (Fig 2.) Khalas recorded the highest mean ΔE of 25.34 indicating light colour (yellow) and was statistically at par with Sheshi (23.44), both of which were significantly different from Reziz (14.83) where the darkness increased (Fig 3.) Fruit colour constituted the most important trait in the Gulf Cooperation Council countries of the Middle-East when quality traits were scored on fruits of 203 date palm cultivars. Further, predictors of fruit economic value for date palm cultivars revealed that yellow colour had 70 per cent economic value in Saudi Arabia like in the United Arab Emirates as against 64 per cent in Qatar. In Bahrain, Kuwait and Oman different shades of red colour predominated (Jaradat & Zaid, 2004).

Studies conducted in Iran on Mazafati dates showed that red colour in Khalal stage turns to black during the

Fig.1. Fruit moisture in Saudi Arabian data cultivars [CD:0.89; p=0.05]

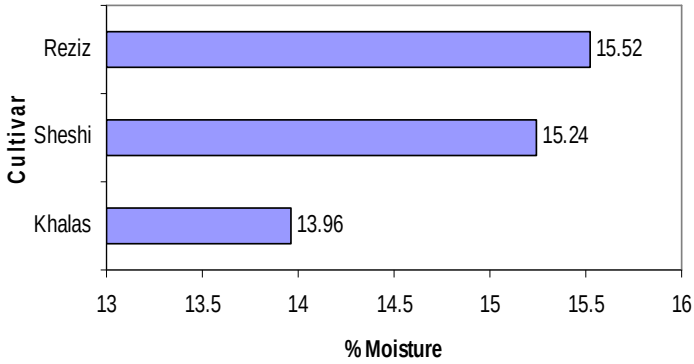
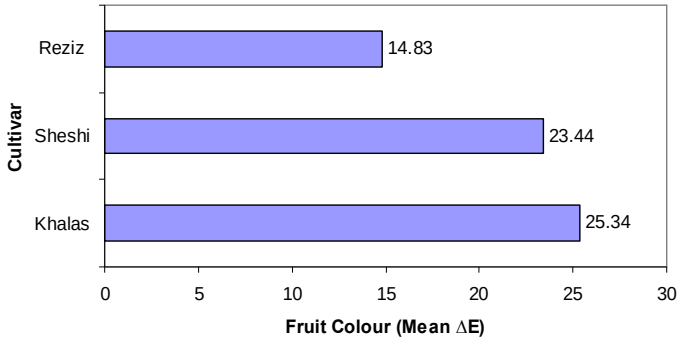


Fig. 2. Fruit Colour of Saudi Arabian data cultivars [CD:2.10; p=0.05]



Rutab stage and that colour change may not be a suitable indicator for ripening of Mazafati dates (Farahnaky &

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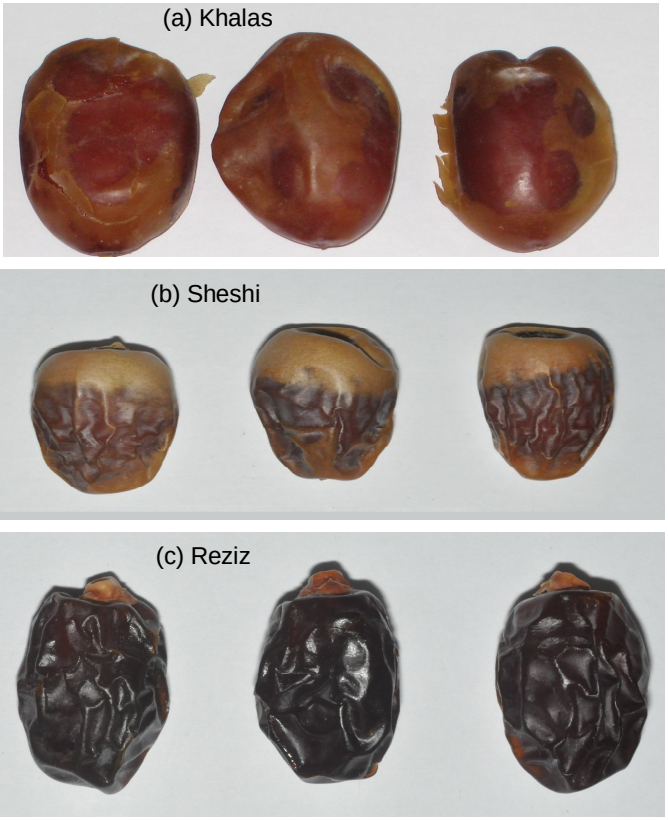
Fig.3. Colour differentiation in the date cultivars evaluated



Afshari-Jouybari, 2010). Marzouk and Kassem (2010) reported that fruit colour in dates is enhanced with the application of organic manures or its supplementation with mineral NPK compared to mineral fertilization alone. Mansour (2005) recorded five colours in date fruits ranging from bright yellow in the cultivar Aglany, yellow with red spots in Samany, orange in Amry , bright red in Zaghloul and scarlet-red in both Hayany and Bent-Aisha.

Texture of fruits

Fruit texture constitutes an important quality parameter in dates. We studied four texture parameters *viz,* hardness, springiness, cohesiveness and resilience

Table 4. Texture of major Saudi Arabian dates

Cultivar	Texture Parameters (g.sec)			
	Hardness	Springiness	Cohesiveness	Resilience
Khalas	3441.72b	0.56b	0.40a	0.10b
Sheshi	3817.34b	0.77a	0.46a	0.12a
Reziz	9166.81a	0.46c	0.27b	0.08c
CD (p=0.05)	2102.93	0.81	0.08	0.12

Values followed by different letters within the same column are significantly different at 5% significance level.
CD: Critical Difference

of Khalas, Sheshi and Reziz date cultivars that were measured as a force in g.sec (Table 4).

With regard to hardness, the cultivar Reziz registered significantly highest value (9166.81) indicating it is produces the hardest fruits compared to Khalas and Sheshi which were statistically at par. Jaradat and Zaid (2004) reported that with regard to fruit softness and semi-dry dates influenced 60 per cent of the predictors for fruit economic value in Saudi Arabia. Semi-dry and dry dates predominated in Oman and UAE, while in Bahrain, Kuwait and Qatar soft dates predominated. In Tunisia, date cultivars were clustered on the basis of fruit consistency as soft fruit, semi-dry fruit and dry fruit cultivars (Hammadi *et al*., 2009)

With regard to the preferred quality parameters of springiness and resilience the cultivar Sheshi recorded significantly superior values of 0.77and 0.12, respectively. However, with regard to fruit cohesiveness, Khalas was the best (0.40) but was statistically at par with Sheshi (0.46), both of which were significantly different from Reziz (0.27). Except for fruit hardness, there are no previous reports pertaining to the texture parameters of springiness, cohesiveness and resilience in dates. As compared to the cultivar Reziz, both Khalas and Sheshi have a high consumer preference in the Kingdom which can be attributed to the superior attributes of springiness, cohesiveness and resilience. This investigation will strengthen the data base for quality norms in dates of major Saudi Arabian cultivars and will support export of dates from the Kingdom, besides protecting the identity of the cultivars studied.

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