

Fruit chemical composition and it's correlations of some date palm cultivars during fruit development stages

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Abstract. Chemical composition of the fruits of Sillaj, Sakhi, Khudari and Sifri date palm cultivars were studied during the stages of fruit development (Kimri, Khalal, Tamre) in 2004 and 2005 seasons at Hada Al-Sham Experimental Station, King Abdul Aziz University. The studied traits varied greatly from one stage to another with some variations between cultivars. Moisture, ash, and protein contents significantly decreased sharply especially in the Tamre stage. Total soluble solids and reduced and nonreduced sugars increased progressively from Kimri, Khalal and Tamre stages. Pigments content (chlorophyll a+b and carotene) being high in the Kimri stage, were greatly significantly reduced in the other two stages. Significant positive correlations were found between protein content (%) and ash %, chlorophyll % and carotene %, but negative and significant correlations were detected with reducing % and nonreducing sugar % (0.676^{**}). Reducing sugars negatively and significant correlated with ash % (-0.883^{**}), chlorophyll % (-0.698^{**}) and carotene % (-0.758^{**}). Chlorophyll % negatively significantly correlated with carotene % (-0.964^{**}).

Introduction

Date palm (*Phoenix dactylifera* L.) is one of the oldest known and cultivated fruit trees in Saudi Arabia. It has both economic and cultural impacts on the lives of native inhabitants. With more than 22 million date palm trees (Ministry of Agriculture, 2006) Saudi Arabia is considered as one of the most important dates producing countries. The chemical composition of the fruits of various date palm cultivars has been investigated by several workers (Salem and Hegazi, 1971, El-Assouni, *et al.*, 1975; Minessy, *et al.* 1975). In Saudi Arabia, some investigations are available regarding the composition of the different Saudi Arabian date palm cultivars, and rarely for the correlation studies between the chemical composition traits. Hussein *et al.*, (1974), Hussein and El-Zeid (1975), Hussein *et al.*, (1976), Abdul Hafiz *et al.*, (1980), Sawaya *et al.*, (1982a,b,c, 1984), Shaheen, *et al.*, (1999) and El-Sese, *et al.*, (2000, 2001) studied the chemical quality traits of the date palm in Saudi Arabia.

Therefore, the present investigation is carried out to evaluate chemical changes in stages of fruit development of four date palm cultivars, besides of determine the correlation coefficients between the main chemical traits of date palm fruit.

Materials and Methods

The study was carried out using four date palm cultivars (Sillaj, Sakhi, Khudari and Sifri) during 2004 and 2005 seasons at Hada Al-Sham Experimental Station, King Abdul Aziz University. Management practices were the same. Pollination was carried out during March. Ten fruit random samples were taken from each of 10 (random trees for each cultivar to study the chemical composition of the fruits in each of three stages of fruit development. The samples consisted of 100 fruits each, were collected in the Kimri stage (8-9 weeks after pollination), Khalal (fruit attained full color, red for Khudari cv. and yellow for other cultivars) and Tamre stage (fruit fully ripened). The experimental design used in this study was factorial experiment in completely randomized design.

The determined chemical composition traits percentages were moisture, acidity, ash, protein, TSS, reducing sugars, non reducing sugars, chlorophyll (a+b), and carotene contents. Moisture, acidity, ash, protein ($N \times 6.25$) and T.S.S. were determined according to the A.O.A.C. methods (1980). Sugars extraction was done with 80% ethyl alcohol. Reducing and non reducing sugars were determined using Somogy's method (1952). Chlorophyll and caroten pigments of the fruit skin were determined according to the procedure suggested by Wenstein (1957). Analysis of variance, comparisons between the treatments means and correlation coefficients were statistically analyzed according to Steel and Torrie (1981).

Results and Discussion

Moisture content:

Analysis of variance of the studied traits showed significant interaction between the date palm cultivar and the fruit stage. Accordingly the means of the cultivars x fruit stages would be compared and illustrated.

Data illustrated in (Table 1) showed that moisture content of the fruits was significantly high in the Kimri stage, then decreased rapidly in the Khalal and Tamre stages. This result holds true in the different cultivars. The decrease in the latter stage (Tamre) was greater than in the

former one. The differences among the interactions of cultivars x fruit stages were significant. At Kamri stage Sifri fruits had the highest moisture content (82.70 %) and in Khalal stage Sifri also was the highest moisture content (68.62%), while in the Tamre stage Sifri fruits also had the highest moisture content (18.5%). These results were similar in trend with Mougheith *et al.* (1976), Sawaya *et al.* (1982a), Saad *et al.* (1986), Shaheen *et al.*, (1999), El-Sese *et al.*, (2000) and El-Sese *et al.*, (2001).

Total Soluble Solids Contents:

The results illustrated in (Table 1) showed that TSS% increased progressively towards the Tamre stage and the increase was more intense in this stage (Tamre stage) in four date palm cultivars. The differences between the three stages cultivars interaction treatments were significant. Khudari cv. was the highest cultivar in T.S.S. % in the three fruit stages of development (Table 2). Similar results were obtained by Mougheith *et al.* (1976), Saad *et al.* (1986), Shaheen *et al.*, (1999), El-Sese *et al.*, (2000) and El-Sese *et al.* (2001).

Acidity:

It was shown that acidity of the fruits was slightly changed in the Kimri and Khalal stages. Sakhi cv. fruits had highest acidity in both Kimri and Khalal stages, while Sifri cv. fruits contained the highest acidity in the Tamre stage (0.61%) (Table 1). These results fall in line with Mougheith *et al.* (1976), Shaheen *et al.*, (1999), and El-Sese *et al.*, (2000, 2001).

Ash:

Ash fruit content was continually decreasing in the three stages of development in the four cultivars studied and the differences were significant. Its decrease in the Khalal stage was more profound than in the Tamre stage. Sillaj cv. fruits contained the highest values of ash % in Kimri (4.70%) and Khalal (3.2%) stages, while Sakhi cv. fruits contained the highest ash content in the Tamre stage (2.0%) as shown in (Table 1). These results were in agreement with those of Sawaya *et al.* (1982 a,c).

Protein Content:

Data in Table (1) showed that protein content of the fruits was high in the Kimri stage in the four cultivars, then it decreased greatly in the Khalal stage. Although in the Tamre stage, protein content decreased, but the decrease was relatively less in the Khalal stage in the four cultivars. Sakhi cv. fruits had the highest protein % in three stages with values of

5.54%, 3.27% and 3.51% in the Kimri, Kahalal and Tamer stages, respectively.

Sugar contents:

The results of the cultivar x fruit stages interaction (Table 2) indicated that reducing sugars increased progressively towards the Tamre stage, and this increase was more obvious in this stage in the four cultivars. This percentage increased from about 4.86% in the Kimri stage to 2.42% in the Tamre stage Sillaj cv. and from 5.43% in the Kimri stage to 45.04% in the Tamre stage in Sakki cv. While in Khudari it ranged from 5.31% to 54.78% in the first and third stages but in Sifri reducing sugar contents were 6.02% and 54.32% in Kimri and Tamre stages, respectively. These results confirm those reported by Minessy *et al.*, (1975), Sawaya *et al.*, (1982b) and Saad *et al.*, (1986) working on different date palm cultivars.

Pigments contents:

Pigments content including chlorophyll a+b % being dominant in the Kimri stage, was greatly reduced in the following stages of fruit development and almost diminished in the Tamre stage (Table 2). Carotene pigment showed the same trend as chlorophyll but its values were much less than chlorophyll (Table 2). Sillaj cv. had the highest chlorophyll value (24.12%) shown in the Kimri stage followed by Khudari cv. (23.41%) in the same stage. These results are in agreement with those reported by Dowson and Aten (1962) and El-Sabtout (1979) on different date palm cultivars.

As for the importance of date fruits to human health, Sillaj cv. especially at Kimri stage is the dominated cv. among the studied cultivars due to Sillaj cv. fruits at Kimri stage had the highest values from protein, carotene with lowest acidity and at Tamre stage the Sillaj fruits cv. had the highest saccharide values.

Table 1. Chemical composition of the studied date palm cultivars fruit during fruit development stages as an average of 2004 and 2005 seasons

Cultivars	Fruit stage	Characters				
		Moisture %	T.S.S. %	Acidity %	Ash %	Protein %
Sillaj	Kimri	81.71	12.80	0.47	4.70	5.36
	Khalal	60.80	33.40	0.39	3.20	3.05
	Tamre	13.51	78.00	0.34	1.91	2.37
Sakhi	Kimri	80.92	16.72	0.51	4.56	5.54
	Khalal	60.44	37.13	0.48	2.74	3.27
	Tamre	14.43	80.20	0.42	2.04	3.51
Khudari	Kimri	80.43	19.04	0.44	4.42	4.76
	Khalal	57.32	37.75	0.44	2.72	2.38
	Tamre	15.94	80.95	0.52	2.95	2.20
Sifri	Kimri	82.70	17.74	0.44	4.12	5.36
	Khalal	68.62	34.84	0.40	3.00	3.01
	Tamre	18.15	79.46	0.61	1.94	3.19
L.S.D. (0.05)		1.49	1.72	0.03	0.16	0.38

Table 2. Sugars and pigments contents of the studied date palm cultivars fruit during fruit development stages as an average of 2004 and 2005 seasons

Cultivars	Fruit stage	Sugars		Pigments	
		Reducing sugars %	Non Reducing sugars %	Chlorophyll (a+b) %	Carotene %
Sillaj	Kimri	4.86	0.74	24.12	13.23
	Khalal	16.30	3.11	2.95	2.06
	Tamre	52.42	5.31	1.74	0.94
Sakhi	Kimri	5.43	0.17	20.61	8.45
	Khalal	14.31	2.32	3.74	2.34
	Tamre	45.02	3.74	2.02	0.34
Khudari	Kimri	5.31	0.37	23.41	9.64
	Khalal	16.39	3.92	2.54	2.61
	Tamre	54.78	5.19	2.00	0.54
Sifri	Kimri	6.02	0.41	16.82	7.49
	Khalal	15.99	4.30	2.37	3.52
	Tamre	54.32	1.94	1.47	1.31
L.S.D. (0.05)		2.27	1.27	1.74	0.66

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Correlation Study:

Correlation coefficients were calculated between the main chemical traits of the date palm fruit overall the studied cultivars and fruit development stages and presented in Table (3). The presented correlation coefficients values showed highly significant positive correlation between protein content and ash % (0.870), chlorophyll (%) (0.899) and carotene (0.853) and highly significant negative correlation between protein content and both reducing and non-reducing sugars.

Ash content negatively correlated at 0.01 level of probability with acidity, reducing and non-reducing sugars besides of carotene content, but positively correlated with chlorophyll with $r = 0.912^{**}$. Acidity significantly correlated only with chlorophyll (0.899^{**}). Reducing sugars correlated with a negative significant coefficient value (- 0.698^{**}) with chlorophyll and positive significant correlation coefficient (0.676^{**}) with non-reducing sugars.

Chlorophyll % positively and significantly correlated with non-reducing sugars % (0.845^{**}) but correlated with negative and significant value (- 0.964^{**}) with carotene %. Also, carotene negatively and significant correlated with non-reducing sugars (- 0.801^{**}) as shown in (Table 3). The previous data of the correlation study might be useful in the selection of fruits with some chemical traits using another correlated traits. Also, commercially we can predict with the trend of the chemical date palm fruits using some traits, not all.

Table (3) Correlation coefficients of the correlation between different chemical traits of the date palm fruit

Fruit Trait (%)	Protein	Ash	Acidity	Reducing Sugars	Non-reducing Sugars	Chlorophyll	Carotene
Protein	1.00 ^{**}	0.870 ^{**}	0.142 ^{NS}	- 0.696 ^{**}	- 0.904 ^{**}	0.899 ^{**}	0.853 ^{**}
Ash	-----	1.00 ^{**}	- 0.610 ^{**}	- 0.883 ^{**}	- 0.840 ^{**}	0.912 ^{**}	- 0.187 ^{NS}
Acidity	-----	-----	1.00 ^{**}	0.186 ^{NS}	- 0.361 [*]	0.899 ^{**}	0.018 ^{NS}
Reducing Sugars	-----	-----	-----	1.00 ^{**}	0.676 ^{**}	- 0.698 ^{**}	- 0.758 ^{**}
Non-reducing Sugars	-----	-----	-----	-----	1.00 ^{**}	0.845 ^{**}	- 0.801 ^{**}
Chlorophyll	-----	-----	-----	-----	-----	1.00 ^{**}	- 0.964 ^{**}
Carotene	-----	-----	-----	-----	-----	-----	1.00 ^{**}

NS: Not significant correlation at 0.05 level of probability.

*, **: Significant correlation at 0.05 and 0.01 levels of probability, respectively.

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