Study of anti-nutrients and antioxidant in date palm fruits (*Phoenix Dactylifera* L.) from Saudi Arabia and Egypt

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Abstract: Saudi (Sukkari) and Egyptian (Sewi) palm dates samples were collected from local markets in both countries and were analyzed for nutritional and anti-nutritional composition using standard analytical methods. The results showed significant differences at ($p \leq 0.05$) in phytate, tannins, oxalate, Ca, Fe, Zn, phenolics, flavonoids, antioxidant activity and carotenoids. The levels of phytate and tannins were low in both samples, Egyptian (1.79%) and (1.92%) respectively. There was no oxalate in both samples. The percentages of mineral elements to phytate indicated the abundance of mineral elements. Ca was the most abundant in Egyptian and Saudi samples (3.981%) and (3.7665%) respectively. Fe and Zn were least abundant in Egyptian dates (0.175%) and (0.0286), followed by Saudi Sample (0.167%) and (0.026%) respectively. Also, this study indicated both samples were rich of phenolic compound and flavonoids with greater antioxidant activity, where the Egyptian dates sample had the high levels (532.96%), (54.06%) and (62.79%) respectively. The Saudi sample had the high level of carotenoids (3.48 mg/g). The results illustrate that Saudi and Egyptian dates are good for consumption and processing due to their low levels of anti-nutritional factors and the abundance of phenolic compounds, flavonoids and antioxidant activity and carotenoids. The differences in results of Saudi (Sukkari) and Egyptian (Sewi) palm dates samples could be referred to the samples sources, growth conditions and fruit age.
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1- Introduction

Palm dates tree is a palm in the genus of *Phoenix* and *P. dactylifera* L species. It is a long-life plant that produces edible fruit and cultivated in farms and house gardens, and has important role in the economic, environmental, social, cultural and health aspects of many people around world (Augstburger et al., 2002 and Ismail et al., 2008). Saudi Arabia and Egypt are world leading dates producers. Egypt has the first rank with 1373570 M ton, followed by Saudi Arabia with 112822 M ton (FAOSTAT, 2011).

Dates constitute an important part of a balance diet as they are natural sources of nutrients needed by human and animals. These nutrients include protein, carbohydrates, minerals and dietary fiber **(Sadiq et al., 2013)**. Also, dates are rich source of antioxidants, mainly Carotenoids and Phenolics **(Rock et al., 2009 and Al-Farsi and Lee, 2008)**. The antioxidant activity of dates differs according to their contents of phenolic compounds, vitamin C, vitamin E, carotenoids and flavonoids (Al-Turki et al., 2010). Although the most antioxidants types in date fruit are water-soluble, it has shown potent ability to act as antioxidant activity in lipids membrane system. This is could be partially due to the property of flavanols which can react in both side of water and lipid layers of cell membranes **(Vayalil, 2002, Verstraeten et al, 2003 and Saleh et al., 2011)**. The average content of phenolics ranged from 193.7 mg/100g for fresh dates to 239.4 mg/100g for dried dates **(Biglari et al., 2008)**.

Phytic acid acts as phyto-nutrient and has antioxidant properties. It plays a role in preventing colon cancer and other types of cancer by reducing oxidative stress **(Eaton et al., 1987 and Vucenik and Shamsuddin, 2003)**. The consumption of food containing phytate and tannins may reduce the risk of chronic diseases, because these compounds have natural antioxidant effect on membrane system **(Ames, 1995 and Moong-Ngarm et al., 2004)**. However, high phytate diets result in mineral deficiencies. In populations where cereal grains provide a major source of calories, rickets and asteoporosis are common, since the human body will bind Ca to phytic acid and form insoluble phytate complexes. The result is the body loses Ca and doesn't absorb P. Further, 20% Zn and 60% Mg are absorbed when phytate is absent **(Navert and Sandstrom, 1985 and Lestinne et al., 2005)**.

Long term diet either with low levels of minerals or with phytate reduced the metabolism process and raised minerals deficiency in human body. Phytic acid not only chelates important minerals, but also inhibits enzymes that human body need to digest food, including pepsin needed for the breakdown of proteins in the stomach, amylase needed for the breakdown of starch into sugar and trypsin needed for protein digestion in the small intestine **(Rehman and Shah, 2001, Caramori et al., 2004 and Johnson et al., 2012)**. Phytate level varies in food according to growing conditions, food age, processing and testing methods **(Nagel, 2012)**.

The goal of conducting this study is determination of anti-nutrients of palm date fruits (phytate, tannins &oxalate) and antioxidant activity, phenolic compounds, flavonoids, and carotenoids to evaluate its suitability for consumption.

2- Materials and Methods

Semi dry Sukkari and Swei date samples were collected from the local dates markets in Saudi Arabia and Egypt. All analysis results are the mean values of 3 readings.

Chemical analysis:

Phytate content in dates was determined by following the procedure described by **Haug and Lantzsch, (1983)** using Spectrophotometer (Irmeco U-2020) at 519nm while tannin contents were estimated by Folin-Danis method using Spectrophotometer (Irmeco U-2020) at 700nm **(Schanderi, 1970)** but Oxalate was determined by one gram date powder in conical flask and 75 ml of 15N H2SO4 added to it by (**Day and Underwood, 1986**).

The mineral elements (Fe, Zn& Ca,) were analyzed using walinga et al., (1989) method. Flavonoid compounds and phenolic compounds were determined by High Performance Liquid Chromatography (HPLC) Agilent-1200 at 254nm (Mattila et al., 2000 and Goupy et al., 1999). Antioxidant activity was determined with 2,2-Diphenyl-l-picrylydrazyl (DPPH) Radical scavenging method (Politeo et al., 2006) while carotenoid compounds were determined by Liquid Chromatography (LC) and Spectrophotometer (**Bushway and Wilson, 1982)**.

Statistical Analysis

All study results were subject to statistical analysis of Variance (ANOVA) of SAS (SAS, 1998) to study the significant differences at ($p \leq 0.05$) among dates samples.

3. Results and discussion

Table (1) shows the anti-nutrient contents of Saudi and Egyptian date samples. Tannins' high level was Saudi sample (2.50%), then Egyptian (1.92%). Tannins are important for secondary metabolic process (**Bodake et al, 2002 and Huang et al, 2005**). Tannins work as anti-diarrhea agent with a suppression role of internal parasite worms, especially the taenia (**Osman, 2008**). Tannins are polyphenolic compounds. The consumption of tannin in large doses may cause bowel irritation, liver damage, stomach and kidney irritation and gastrointestinal pain, chelates minerals and makes them unavailable to the body. Also, polyphenols reduce the bioavailability of Fe and causes anemia **(Morton, 1987, McGee 2004 and Karamac, 2009)**.

High level of phytate was appeared in Saudi Sukkari date (2.17%), followed by Egyptian (1.79%). **Hambidge et al., (2005) and Ekop, 2007** mentioned that phytate chelates strongly with minerals needed by the body, which cause minerals deficiency. Both samples don't contain Oxalates. Oxalates are harmful to human body as they can complex with most essential trace metals therefore prevent them of enzymatic activities and metabolic process. The obtained results of both samples (low level of Phytate and Tannins with no content of Oxalates) were agreed with **Birgitta and Caroline, (2000)** who recorded that these low levels in date varieties are below the recommended toxic levels cause by anti-nutrients. Phytate and tannins levels in palm dates grown in Pakistan were below the recommended toxic levels **(Nadeem et al., 2011)**. Also, Tannins were low in five varieties of palm date during Khalal stage (Al-Hooti et al., 1997 **and Awad**, 2007). Our result in regards of oxalates disagreed with **Jamil et al., (2010)** that indicated palm date varieties had low levels of oxalates.

Table (1): Comparison of anti-nutrient contents of Saudi and Egyptian date samples.

Sample / Anti-nutrient	Saudi Sukkari Sample (%)	Egyptian Swei Sample (%)
Tannins	2.50	1.92
Phytate	2.17	1.79
Oxalate	-	-

Table (2) illustrates the mole ratio of some minerals in Saudi and Egyptian dates. The nutrients' ratio to the anti-nutrients was calculated to predict the bioavailability of divalent metals (Ca, Fe, Zn). Mole ratio of Ca was high in Egyptian sample (3.981%), Saudi (3. 7665%), followed by Fe and Zn in Egyptian dates sample (0.175%), (0.0286%), then Saudi dates (0.167%) and (0.026%) respectively. These results agreed to (Domingues et al., 2002, Egli et al., 2004 and Engle-stone, 2005) that Phytate and its salts strongly bind to rare metals, especially divalent ones, thus prevent those divalent minerals' bioavailability that depends on the mole ratio of Phytate/Ca, Fe and Zn (Umeta et al.,2005).

Table (2) Mole ratio of some minerals in Saudi and Egyptian dates

Sample / minerals	Saudi Sukkari Dates (mg/100g)	Mole ratio of Saudi Sukkari Sample	Egyptian Swei Dates (mg/100g)	Mole ratio of Egyptian Swei Sample
Ca	75.33	3.7665	79.62*	3.981
Fe	4.35	0.167	4.56	0.175
Zn	0.80	0.026	0.86	0.0286

** Molecular weight: Ca:20/ Zn:30/ Fe:26

Table (3) shows the percentages of antioxidant activity, phenolics, flavonoids and carotenoids in Saudi & Egyptian date samples. The high level of antioxidant activity was in the Egyptian Swei date (62.79%) then the Saudi sample (53.30%). Also, the Egyptian sample was the higher in phenolics and flavonoids (532.96 and 54.06 mg/100g), followed by Saudi sample (266.54 and (17.69 mg/100g) respectively. Our phenolics results are lower than obtained by **Sawaya et al., 1983**, but agreed to studies indicated the correlation between date content of antioxidant activity and polyphenols, in particular flavonoids (**Eid et al., 2011).** Palm dates are rich in phenolic compounds possessing antioxidant activity, because of their high capacity in scavenging free radicals related to various diseases **(Tanaka et al., 1993 and Silva et al., 2007)**. Saudi sample has the high level of carotenoids (3.48 mg/g) but the Egyptian was 2.80 mg/g.

Table (3) Comparison of antioxidant activity, phenolics, flavonoids and carotenoids contents in Saudi & Egyptian date samples

Sample / Compounds	Saudi Sukkari Sample	Egyptian Swei Sample
Antioxidant Activity (%)	53.30	62.79
Phenolics (mg/100g)	266.54	532.96
Flavonoids (ppm)	17.69	54.06
Carotenoids (mg/g)	3.156	2.953

Table (4) shows phenolic compounds in Saudi and Egyptian dates samples. The highest phenolic compound was ellagic in Egyptian dates (28.293 mg/100g), but there was no Ellagic content in Saudi sample. The values of caffeic, catechein, chlorogenic, protocatechuic and gallic were high in Egyptian dates (21.723, 18.044, 17.051, 13.591 and 11.885 mg/100g) comparing to Saudi sample (8.288, 12.556, 11.443, 2.494 and 9.251 mg/100g) respectively. Catechol, caffien and coumarin were high in Saudi Sukkari sample (10.049, 4.165 and 3.441 mg/100g) than Egyptian sample (8.989, 4.124 and 1.449 mg/100g), respectively. The Egyptian sample had the high level of Ferulic (2.021 mg/100g), then Saudi dates (0.823 mg/100g). The lowest phenolic compound in Saudi & Egyptian samples was Vanillic (0.994 mg/100g and 0.933 mg/100g, respectively).

These results were agreed with **El-Sabrout, (1979) and Bacha et al., (1987)** who recorded that carotenoids were high in Nebutat Seif cultivar than Khudari, and were different in various growth stages.

Table (5) illustrates the comparison of flavonoid compounds in Saudi & Egyptian date samples. Hisperdin, hypersoide, luteolin and apignin were the highest flavonoid compounds in Egyptian dates (228.98, 2.27, 2.08 and 1.75 ppm), followed by Saudi sample (24.39, 0.44, 0.21and 0.00ppm, respectively). Egyptian date sample had the high level of Kampferol, Quercitrin, Rutin, Querctin, Hespertin and Rosmarinic (0.31, 1.17, 1.15, 1.00, 0.94 and 0.52 ppm) comparing to Saudi sample (0.31, 0.37, 0.32, 0.31, 0.30, and 0.23 ppm,respectively). The lowest phenolic compound was narenginin, (0.51 ppm) in the Egyptian sample followed by Saudi one (0.19 ppm).

The obtained results illustrate the differences among phenolic compounds, flavonoids and carotenoids, which could be due to samples sources, climate conditions and soil. Also, these levels vary according to date palm cultivars **(Amiot, 1997 and El-Rayes, 2009). (Abed et al., 2006)** mentioned that there were significant differences among dates contents of phenolic compounds, where Sair cultivar was (2.15%) and Reem was (1.03 %).

Table (4) Comparison of phenolic compounds contents in Saudi & Egyptian date samples

Sample / Phenolic Compounds	Saudi Sukkari Sample (mg/100g)	Egyptian Swei Sample (mg/100g)
Gallic	9.251	11.885
Protocatechuic	2.494	13.591
Catechein	12.556	18.044
Catechol	10.049	8.989
Chlorogenic	11.443	17.051
Caffeic	8.288	21.723
Vanillic	0.994	0.933
Caffiene	4.165	4.124
Ferulic	0.823	2.021
Ellagic	---	28.293
Coumarin	3.441	1.449

Table (5) Comparison of flavonoid compounds contents in Saudi & Egyptian date samples

Sample / Flavonoid Compounds	Saudi Sukkari Sample (ppm)	Egyptian Swei Sample (ppm)
Rosmarinic	0.23	0.52
Hisperdin	24.39	228.98
Rutin	0.32	1.15
Hypersoide	0.44	2.27
Quercitrin	0.37	1.17
Narenginin	0.19	0.51
Querctin	0.31	1.00
Hespertin	0.30	0.94
Luteolin	0.21	2.08
Kampferol	0.31	1.61
Apignin	----	1.75

Conclusion

The results of our study illustrate that anti-nutrients were in low levels in Saudi & Egyptian dates and phenolic compounds were in high levels. Flavonoids, antioxidant activity and carotenoids support their safety and usefulness for consumption. The significant differences among palm date contents refer to sources, cultivars and date fruit age.

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