Abu Dhabi Food Control Authority
Development Sector
Research & Development Division

Technical Report تقرير فني

Title العنوان	**Specification of Organic Dates Quality**				
Project Team فريق العمل	Mohamed Al-Farisi, Shamsa H. AlDhahry, Hassan Al Marzouqi & Samie M. Al Konaissi				
Duration فترة المشروع	**From:**	Jan. 2013	**To:**	Dec. 2013	

Background خلفية عن الموضوع

Dates represent a popular food for the population of the Middle Eastern countries, providing a staple food for millions of people in arid and semi-arid regions of the world. The world production of dates has increased from about 4.6 million tons in 1994 to 7.9 million tons in 2010 (FAO, 2012). Organic foods are foods that are produced using methods that do not involve modern synthetic inputs such as synthetic pesticides and chemical fertilizers, neither using irradiation, industrial solvents, or chemical food additives (Allen & Albala, 2007). There is a growing concern that the levels of some phenolics may be lower than optimal for human health in foods grown using conventional agricultural practices (Brandt et al, 2001; Woese et al, 1997). This concern is because conventional agricultural practices utilize levels of chemical pesticides and fertilizers that may result in a disruption of the natural production of phenolic metabolites in the plant (Macheix et al, 1990).
According to the latest FiBL-IFOAM survey on certified organic agriculture worldwide (2013), there are 37.2 million hectares of organic agricultural land which represent 0.9% from the total agriculture land. In spite of the slowdown in the global economy, international sales of organic products continued to rise. The organic food and drinks sales reached almost 63 billion US dollars in 2011 from 54 billion in 1999 (FiBL-IFOAM, 2013). Although organic farming is practiced in every continent, the production of organic foods in Asia, Latin America and Africa is mainly for export. In 2011, the largest organic markets were USA, Germany and France, whereas the highest per capita consumption was in Switzerland, Denmark and Luxemburg. According to the FiBL-IFOAM (2013), the number of countries with organic standards has increased from 74 countries in 2009 to 86 countries in 2011. In 2012 the EU and The USA reached to agreement makes possible for organic products certified in the EU or USA to be sold in the other country without any further inspection or certification. Tunisia, Saudi Arabia, UAE and Egypt are the largest organic date palm production areas in the Arab world. The organic date's production in Saudi Arabia reached 10,000 tons and 1,000 tons in UAE (SOFA, 2012; Al Foah, 2012). Several standards and regulation been issued on the activity of organic farming, all of these standards are general regulation on production, processing and trading of organic foods to meet the requirements of local markets and also external export markets (CAC GL 32:1999; EC No 889/2008; UAE.S / GSO / CAC GL 32: 2008; UAE regulation 84, 2012; KSA regulation 2010). This study was aims to determine the nutritional and functional properties of organic dates in order to establish a specific standard for organic dates.

Problems التحديات

Several standards and regulation been issued on the activity of organic farming, all of these standards are general regulation and there is no specific standards for organic dates, also there is no details about the nutritional and functional value of organic dates.

Objectives الأهداف

- Determine the nutritional and functional properties of organic dates.
- Identify and classify the quality parameters of organic dates.
- Establish detailed standards for organic dates.

Methods طريق العمل

1. Dates Material

The raw and packed organic dates of Khalas and Berhi used in this study were procured from Al Foah Company, Al Ain, UAE. Dates fruit and seeds were evaluated for physical characteristics, weight, length and diameter.

2. Proximate Analysis

Percentages of moisture by vacuum oven (method 934.06), protein by Kjeldahl nitrogen (method 920.152), and ash by direct analysis (method 940.26) were determined according to the Association of Official Analytical Chemists' methods (AOAC, 2000). The fat content determined by Ankom Extractor (XT15, Ankom Technology, NY, USA). Proximate analyses were expressed as grams per 100 g of fresh weight. Total carbohydrates were calculated by subtracting the total percent values of other measurements from 100. The energy value was calculated according to the method of the Ministry of Agriculture, Food, and Fisheries (1995), by multiplying available carbohydrate by 3.75, protein by 4, and fat by 9. Available carbohydrates, which were used for calculation of the energy value, were calculated by subtracting the total dietary fiber from total carbohydrates.

3. Sugars Analysis

Sugar levels were measured according to high-performance liquid chromatography (HPLC) method of ADFCA Lab. Division, LAD-DPM-CHNA-17 (2013). Sugars were extracted from dates (2 g) with 50 mL of water for 15 min. The sample then clarified by adding 2 ml of zinc ferro cyanide and filtered by Whatman no. 541 filter paper. The extraction was repeated three times and all combined supernatants were collected and made up to a final volume of 100 mL with the extraction solvent. The HPLC column, pump, refractive index detector, and auto sampler used were the same as those described in ADFCA Lab. Division (2013). Column temperature and injection volume were set at 30 °C and 20 μL, respectively. The mobile phase was a mixture of acetonitrile and HPLC-grade water at a ratio of 75:25 (v/v) at 1 mL/min. Identified sugars were quantified on the basis of peak areas and comparison with a calibration curve obtained with the corresponding standards ranging from 1 to 10 mg/100 mL. Sugars were expressed as grams per 100 g of fresh weight.

4. Mineral Analysis

Minerals in dates were determined according to ADFCA Lab division method LAD-DPM-CHI-16 (2010), using ICP-MS method. The wet digestion approach was done using microwave closed vessels technique, half gram of the sample was placed in a 250 ml digestion tube and 10 ml of concentrated nitric acid was added. The samples were heated in the microwave for 2 hrs until a clear solution was obtained. Thereafter, the solution was filtered using Whatman No. 42 filter paper and the filtrate was then transferred to a 25 mL volumetric flask and volume was made up using distilled water. The mineral contents were determined by Inductively Coupled Plasma ICP-MS (Perkin Elemer, model Elan 6000 DRC-e). The method (extraction and

quantification) was validated using certified reference material. The reference material used was brown bread (BCR-191) European Commission, Belgium.

5. Dietary Fiber

Dietary fiber content was determined by Neutral Detergent Fiber method using ANKOM Fiber Analyzer A200. All samples were dried in a forced-air oven (55°C for 24 h) and ground to pass through a 1mm screen of a cutter mill before analysis. Extraction of neutral detergent fiber using filter bags was based on an in-house procedure using a fiber analyzer (Ankom220, Ankom Technology Corp. NY, USA). Briefly, 2 L of neutral detergent, 20 g of sodium sulfite and 4 ml of alpha-amylase were poured into the extraction chamber. Filter bags (F57, 25 µm, Ankom Technology Corp. NY, USA) containing 0.5 g of the test sample were placed in plastic trays. After inserting the plastic trays, the chamber lid was sealed, and the solution was heated to 100°C within 15 min. After 60 min of extraction (75 min total times) the detergent was expelled. Filter bags were washed three times within the chamber with 2 L of water at 80–90°C and 4 ml alpha-amylase. All washes were performed for 5 min each time with the chamber lid sealed and heat and stirrer turned on. After the last water wash, extracted filter bags were removed from the chamber and placed between two absorbent pads, and gently pressed to remove water. Filter bags were placed in a 500mL beaker, and approximately 250mL of acetone was added and soaked for 5 min. Filter bags removed from acetone and allowed to evaporate (air-drying) and bags were then dried in forced-air oven at 102°C for at least 4 h before being weighed.

6. Phenolic Content

The total phenolic content of samples was determined according to the Folin-Ciocalteu method (Yoo, Lee, Park, Lee, & Hwang, 2004) with some modifications. Briefly, phenolics were extracted from sample using 50% acetone. 1 ml of sample extract was mixed with 1 ml of Folin-Ciocalteu's phenol reagent and allowed to react for 5 min. Then, 10 ml of 7% sodium carbonate solution (w/v) were added, and the final volume was made up to 25 ml with deionised water. After 1 h of reaction at room temperature, the absorbance at 750 nm was read using a Spectrophotometer (Electron Corporation, Cambridge, England). Measurements were calibrated to a standard curve of prepared ferulic acid solution, and the total phenolic concentration was expressed as milligrams of ferulic acid equivalents per 100 g of sample on a wet weight basis.

7. Antioxidants

The total antioxidant activity was measured by Antioxidants Assay Kit (Sigma-Aldrich, CS0790, USA). Briefly, samples were extracted three times by phosphate buffer (pH 7.4). In 96 well plate, 10 µl of standard or sample extract and 20 µl of myoglobin were added followed by 150 µl of ABTS. After incubating the plate for five minutes at room temperature, 100 µl of stop solution was added to each well and absorbance measured at 405 nm. Measurements were calibrated to a standard curve of trolox acid ranged between 0.045-0.42 mM. Total antioxidant activity was expressed as mM of trolox equivalents per 100 g of sample on a wet weight basis.

Results النتائج

1. Physical Characteristics

Table 1 presents the physical characteristics of organic Khalas and Berhi dates. The average weight of Khalas fruits was 9.12g and 7.73g for Berhi. Also, Khalas fruits were longer (3.76 cm) as compared to Berhi (3.15 cm), whereas the diameter for both varieties was similar. Seeds physical characteristics are presented in table 1 which shows similar trend to fruit characteristics, as Khalas seed was heavier and larger than Berhi seed. In comparison with dates produced by conventional production, Al-Kharusi et al (2007) and El Mardi et al (2007) reported Khalas weight which ranged between 13.46-14.28 g, fruit length ranged between 3.82-

3.83 cm and fruit diameter ranged between 2.40-2.45 cm. Their results were higher than our results for organic Khalas. Bacha and Abo-Hassan (1982) found that addition of chemical fertilizer increased weight, diameter and length of Khudari date as compared to the addition of organic manure only. This is also supported by Jeong-Hwa Kang et al (2012), they found organic strawberry 15% lower fruit weight compared to those of conventional one. Also Rousses et al (2009) found conventional apple is higher in weight compared to organic apple.

Table 1: Physical characteristics of organic Khalas and Berhi dates

Cultivars	Fruit			Seed		
	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)
Khalas	9.12 ±1.75	3.76 ±0.26	2.25 ±0.08	0.78 ±0.08	2.17 ±0.11	0.74 ±0.03
Berhi	7.73 ±1.32	3.15 ±0.12	2.29 ±0.02	0.58 ±0.07	1.69 ±0.08	0.72 ±0.04

Data are expressed as mean ± SD (*n* =300).

2. Proximate Analysis

The moisture content, protein, fat, ash, carbohydrates and energy of organic raw and packed Khalas and Berhi are presented in table 2. The average moisture content of raw Khalas was 12.36% increased to 15.23% for packed Khalas while Berhi moisture increased from 13.78% in raw to 16.21% in packed Berhi. This increase in moisture content was due to washing process of dates during processing. Protein content of organic Khalas was1.27% and 1.68% for Berhi. Al-Farsi et al (2005) and Ahmed et al (1995) reported higher protein content for conventional Khalas (1.7%) and Berhi (2.3%). This is supported by other studies which found that organic crops tend to have less protein than conventional crops (Riahi et al, 2009; Roussos et al, 2009). Because organic management present less nitrogen to the plants compared to chemically fertilized soil (conventional), it would be expected that organic fruits would have less nitrates and less protein. The fat content of organic dates was higher in Khalas (0.73-0.74%) than Berhi (0.63-0.65%). These values were higher than fat content of similar varieties grown by conventional plantation, which is 0.5% for Khalas and 0.1% for Berhi (Al-Farsi et al, 2005 and Ahmed et al, 1995). Protein and fat occur in small amounts in dates, these values differing between varieties would be expected due to differences in cultivation, drying condition and determination methods.

Total carbohydrates content was calculated by subtracting the sum of the content of moisture, protein, lipid and ash from 100. As shown in table 2, the average carbohydrate of organic raw and packed Khalas were 84.45 and 81.58%, respectively, and for raw and packed Berhi were 82.33 and 79.5%, respectively. The carbohydrate content would be expected to be high and consists of mainly sugars and fiber. In comparison with conventional varieties, Khals was 83.4% and Berhi was 66.1% (Al-Farsi et al, 2005 and Ahmed et al, 1995).

The energy of organic dates is shown in table 2. This method of calculation of energy assumes that all carbohydrates present are energy providing. However, a proportion of the carbohydrates in date would be expected to be dietary fiber which would not contribute to the energy when they are consumed by humans. The average energy of organic raw and packed Khalas was 302 and 292 kcal/100g, respectively. For raw and packed Berhi it was 302 and 291 kcal/100g, respectively. Dates are good source of energy mainly due to their high sugar content.

Table 2: Proximate analysis of organic Khalas and Berhi dates

Cultivars	Moisture %	Protein %	Fat %	Ash %	Carbohydrates %	Energy Kcal/100g
Raw Khalas	12.36 ±0.17	1.27 ±0.08	0.74 ±0.00	1.18 ±0.14	84.45	302
Packed Khalas	15.23 ±0.43	1.38 ±0.09	0.73 ±0.00	1.08 ±0.18	81.58	292
Raw Berhi	13.78 ±0.33	1.68 ±0.05	0.63 ±0.00	1.58 ±0.08	82.33	302
Packed Berhi	16.21 ±0.31	1.73 ±0.07	0.65 ±0.00	1.91 ±0.63	79.5	291

Data are expressed as mean ± SD (n =3) on a wet weight basis.

3. Sugars Content

Glucose, fructose and sucrose were determined in organic Khalas and Berhi dates, only glucose and fructose were detected. Table 3 presents the sugars composition of organic raw and packed Khalas and Berhi dates. The average content of glucose and fructose in raw Khalas were 36.31 and 37.50 %, respectively, with an average of total sugar of 73.81 %. Glucose and fructose of raw Berhi were 35.37 and 36.29, % respectively, with total sugars of 71.66 %. Glucose and fructose for both varieties were found almost in equal amounts. In comparison with conventional dates, the total sugar content of Khalas and Berhi was 62.2 and 57.3 %, respectively (Al-Farsi et al, 2005; Ahmed et al, 1995). This is in agreement with many studies stated that organic crops tend to have more sugars compare to conventionally grown produce (Lester et al, 2011; Bertazza et al, 2010; Raigon et al, 2010 and Marzouk et al, 2011). Also Jeong-Hwa Kang et al (2012) found that organic strawberry was 1.2 times sweeter than the conventional one. When a plant is supplied with a lot of nitrogen, such as in conventional practice, it increases protein production and reduces carbohydrates production. (Worthington, 2001). Sugars in dates are the most important constituents as they provide a rich source of energy to humans. Reducing sugars such as glucose are readily absorbed during digestion and lead to rapid elevation of blood sugars (Liu et al, 2000). Also sugars in dates induce a feeling of satiety and may reduce the total calorie intake compared to fat-rich foods (ACBCI-EU, 2007).

Table 3: Sugars composition of organic Khalas and Berhi dates.

Cultivars	Glucose %	Fructose %	Sucrose %	Total %
Raw Khalas	36.31 ±0.23	37.50 ±0.35	nd	73.81 ±1.55
Packed Khalas	35.49 ±0.18	37.81 ±0.06	nd	73.3 ±0.95
Raw Berhi	35.37 ±0.18	36.29 ±0.46	nd	71.66 ±1.35
Packed Berhi	35.71 ±0.14	35.39 ±0.27	nd	71.1 ±0.85

Data are expressed as mean ± SD (n =3) on a wet weight basis.

4. Mineral Content

Table 4 shows the mineral content of organic raw and packed Khalas and Berhi dates. Dates were found to be rich sources of magnesium, potassium, iron and copper. Magnesium content in raw Khalas and Berhi was 775.55 and 609.46 ppm, respectively, whereas potassium content was 7200 ppm in Khalas and 7516 ppm in Berhi. Iron content in raw Khalas was 0.835 ppm and 0.504 ppm in raw Berhi. The copper content was 0.093 ppm in Khalas and 0.117 ppm in Berhi. The value of minerals for similar dates varieties grown by conventional practice reported by Al-Farsi et al, 2005 and Ahmed et al, 1995. Their values don't show a particular pattern with our results, as its increase in some mineral and decrease in other.

Differences between organic and conventional foods with respect to minerals are not apparent, as studies show differing levels of some minerals depend upon the particular fruit, leafy vegetable or root crop (Lester et al, 2011). Worthington (2001) found more iron, magnesium and phosphorus in organic crop compare to conventional crops. When potassium fertilizer is added to soil (conventional practice), the amount of magnesium absorbed by plants decreases. Because phosphorus absorption depends on magnesium, less phosphorus is absorbed as well.

Table 4: Mineral content of organic Khalas and Berhi dates

Mineral	Unit	Raw Khalas	Packed Khalas	Raw Berhi	Packed Berhi
Zinc	ppm	0.115	0.147	0.158	0.126
Tin	ppm	1.466	1.926	2.324	1.475
Lead	ppb	0.482	0.859	0.816	0.317
Sodium	ppm	48.91	45.10	23.77	23.68
Manganese	ppm	0.134	0.262	0.186	0.236
Magnesium	ppm	775.55	523.50	609.46	461.44
Iron	ppm	0.835	0.670	0.504	0.484
cobalt	ppb	0.941	1.021	1.331	0.465
Calcium	ppm	581.11	457.91	284.03	178.72
Arsenic	ppb	1.027	0.997	0.617	0.858
Copper	ppm	0.093	0.120	0.117	0.153
Cadmium	ppb	0.394	0.258	0.266	0.286
Chromium	ppb	23.62	30.59	22.49	28.11
Nickle	ppb	19.94	28.67	25.72	26.76
Selenium	ppb	13.98	15.92	7.17	18.91
Potassium	ppm	7200	6377	7516	6194
Phosphours	ppm	420.95	427.43	657.89	499.05

Data are expressed as mean ± SD (n= 3) on a wet weight basis.

5. Functional Components

Table 5 presents dietary fiber, phenolics and antioxidants of raw and packed Khalas and Berhi dates. The average dietary fiber of raw Khalas and Berhi was 7.02 and 5.22%, respectively. Dietary fiber constitutes of cellulose, hemicelluloses, pectin and lignin. Al-Farsi et al (2005) reported similar value (7.1%) of total dietary fiber in conventional Khalas. Whereas other study reported 22% higher amount of dietary fiber in organic strawberry than those of conventional one (Jeong-Hwa Kang et al, 2012). From the content of dietary fiber in dates and the recommended daily intake of dietary fiber (25 g/day), dates could be a good source of dietary fiber in the diet, as 100 g of dates provide 28% of the recommended daily intake of dietary fiber.

Table 5 shows higher content of phenolics in raw Berhi (194.31 mg/100g) compared to raw Khalas (146.04 mg/100g). Antioxidant also has the same trend as phenolics, where raw Berhi has the highest antioxidants level (2314 mM/100g) compared to raw Khalas (1592 mM/100g). Several studies have reported that organically grown foods are richer in phenolic compounds than those produced by conventional agriculture

practices (Asami et al, 2003). Leccese et al (2010) reported that organic apricots had greater antioxidants than apricots produced by conventional practices. Also Bertazza et al (2010) found significantly higher content of total phenolics in organic apricots and pears.

Organic crops tend to have more vitamin C and phenolics than conventionally grown produce. Organic kiwifruits were 15% higher in total phenolics than convectional fruits (Amodio et al, 2007). When the plant is supplied with a lot of nitrogen such as in conventional practice, it increases protein production and reduces carbohydrate production. Because vitamin C is classified as carbohydrates, the synthesis of vitamin C is reduced also.

Table 5: Dietary fiber, phenolics and antioxidants of organic Khalas and Berhi dates

Cultivars	Dietary fiber %	Phenolics mg/100g	Antioxidants mM/100g
Raw Khalas	7.02 ±0.19	146.04 ±2.16	1592 ±107
Packed Khalas	6.96 ±0.03	158.03 ±5.39	1959 ±112
Raw Berhi	5.22 ±0.15	194.31 ±5.17	2314 ±101
Packed Berhi	5.21 ±0.24	185.86 ±1.48	2818 ±108

Data are expressed as mean ± SD (n= 3) on a wet weight basis. Phenolics expressed as milligrams of ferulic acid equivalents per 100 g of wet weight. Antioxidant expressed as micromoles of Trolox equivalents per 100g of wet weight.

6. Pesticide Residues

The table 6 list the pesticides analyzed by GC/MS of the organic dates. Organic Khalas and Berhi dates samples show no pesticide residue, as they were below detection level. This is one of the main advantages of organic products, as no pesticide used during the production.

Table 6: Pesticide residues in organic Khalas and Berhi dates

No.	Component	m/z	Qualifying Masses	No.	Component	m/z	Qualifying Masses
1	Dichlorovos	109	79 158 47	14	o,p-DDT	57	43 71 41
2	Cadusafos	159	158 41 88	15	p,p-DDD	235	237 165 236
3	Gamma HCH	180	182 11 218	16	Triazophos	161	162 77 172
4	Diazinon	137	179 152 153	17	Endosulfan sulfate	272	274 229 270
5	Chlorpyrifos Methyl	125	197 201 286	18	TTP (internal standard)	326	325 233 170
6	Pirimifos Methyl	290	276 305 233	19	Carbosulfan	118	135 160 380
7	Malathion	127	125 173 93	20	Bromoprpylate	155	183 185 343
8	Chlorpyrifos Ethyl	97	197 199 314	21	Fenpropathrin	97	55 181 125
9	Chlorfenvinphos	267	269 323 81	22	Phosalone	182	121 184 154
10	Methidathion	145	58 93 125	23	L-Cyhalothrin	181	208 209
11	Endosulfan 1	241	195 239 237	24	Benfuracarb	190	163 102 135
12	p,p-DDE	246	318 248 316	25	Pyridabin	147	148 117 132
13	Endosulfan 2	195	159 160 241	26	Alpha- Cypermethrin	163	167 181 206

Recommendations التوصيات

The physical, nutritional and functional properties of Khalas and Berhi dates been determined. Generally organic dates less in size and weight and has more sugars and antioxidants compare to conventional dates. This study has determined the organic dates specification for loose and pre-packaged organic to be as standards for organic dates products.

References المراجع

ADFCA Lab. Division (2010). Determination of elements by inductively coupled plasma with mass spectrometry (ICP-MS). LAD-DPM-CHI-16, Issue no. 1, 6-11.

ADFCA Lab. Division (2012). Multi-residue method for determination of pesticide residue in dates. LAD-DPM-CHPR-04, Issue no. 2, 6-16.

ADFCA Lab. Division (2013). Determination of mono and disaccharide and sorbitol by HPLC in food and beverage. LAD-DPM-CHNA-17, Issue no. 4, 1-10.

Ahmed, I.A., and Ahmed, W.K. 1995. Chemical composition of date varieties as influenced by the stage of ripening. *Food Chem*., 54:305–309.

Al Foah (2012). Al Foah Company. http://www.alfoah.ae/ accessed May 10, 2012.

Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M., and Shahidi, F. 2005. Comparison of antioxidant activity, anthocyanins, carotenoids, and phenolics of three native fresh and sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. *J. Agric. Food Chem*., 53:7592–7599.

Al-Kharusi Latifa; El Mardi Mahdi; Al Said Fahad; Al RAwahi Salem; Abdulbassit Khidir (2007). Effect of mineral fertilizer and organic peat on the physical charachterstics of Khalas and Khasab fruits. Acta Hort 736, ISHS.

Allen, Gary J. & Albala, Ken, ed. (2007). The business of food: encyclopedia of the food and drink industries. ABC-CLIO. p. 288. ISBN 978-0-313-33725-3.

Amodio, ML, Colelli, G, Hasey, JK, (2007). A comparative study of composition and postharvest performance of organically and conventionally grown kiwifruits. *J Sci Food Agric*. 87:1228–1236.

AOAC. (2002). Official methods of analysis. Arlington, VA: Association of Analytical Chemists.

Asami, D. K., Hong, Y-J., Barrett, D. M. & Mitchell, A. E. (2003). Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry and corn grown using conventional, organic and sustainable agricultural practices. *J. Agric. Food Chem.* 51(5):1237-1241.

Bertazza G., Cristoferi G., Bignami C. (2010). Fruit composition and quality of organically and conventionally grown Apple, Apricot and Pear in the Veneto region (Northern Italy). *ISHS Acta Horticulturae 873*, Organic Fruit Conference.

Brandt K, Molgaard JP. Organic agriculture: does it enhance or reduce the nutritional value of plant foods. J Sci Food Agric 2001; 81: 924-931.

CAC GL 32 (1999). Guidelines for the production, processing, labeling and Marketing of Organically Produced Foods, FAO.

EC No 889/2008 organic production and labelling of organic productsOfficial Journal of the European Union.

El Mardi Mahdi; Al Said Fahad; Bakheit Charles; Al Kharusi Latifa; Al Rahbi Ibrahim; Al Mahrazi Khalid (2007).Effect of pollination method fertilizer and mulch treatments on the physical and chemical charactrestics of date palm (*Phoenix dactylifera*) Acta Hort 736, ISHS.

FAO. 2012. Statistical Databases; http://faostat.fao.org, accessed May 24, 2012.

FiBL-IFOAM (2013) Organic Agriculture Worldwide, Helga Willer, Research Institute of Organic Agriculture (FiBL), Frick,Switzerland.

Jeong-Hwa Kang; Seung-Hee Nam; Min-Soo Park; Kyung-Ju Jung; Bong-Yun Oh (2012). Physiochemical and functional properties of organic or conventional strawberry. ASHS Annual Conference, July 31-Auqust 3, 2012, Miami, Florida, USA.

KSA Organic farming regulation (2010), Ministry of Agriculture, KSA.

Leccese A; Bartolini S., Viti R., Pirazzini P. (2010). Fruit quality preferormance of organic Apricots at harvest and after storage from different environmental conditions. *ISHS Acta Horticulturae 873*, Organic Fruit Conference.

Lester, G.E., & Saftner, R.A. (2011). Organically versus conventionally grown produce: common production inputs, nutritional quality, and nitrogen delivery between the two systems. *Journal of Agricultural and Food Chemistry*, 59 (19), 10401-10406.

Liu, S.; Willett, W. C.; Stampfer, M. J.; Hu, F. B.; Franz, M.; Sampson, L.; Hennekens, C. H.; Manson, J. A. (2000). A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. *Am. J. Clin. Nutr.*, *71*, 1455-1461.

Macheix, J. J., Fleuriet, A., & Billot, J. (1990). Fruit phenolics (pp. 1– 126). Boca Raton, FL: CRC Press.

MAFF. *Manual of Nutrition*, 10th ed.; Reference Book 342; HMSO: London, U.K., 1995.

Marzouk, H. A. (2011). Improving fruit quality, nutritional value and yield of Zaghloul dates by the application of organic and/or mineral fertilizers. Sci. Hort. 127:249-254.

Raigón, M. D., A. Rodríguez-Burruezo and J. Prohens (2010). Effects of organic and conventional cultivation methods on composition of eggplant fruits. J. Agric. Food Chem. 58:6833-6840.

Roussos P.A., Denaxa N-K., Damvakaris T., 2009. Strawberry fruit quality attributes after application of plant growth stimulating compounds. Sci. Hort. 119, 138–146.

SOFA (2012). Saudi Organic Farming Association. http://www.sofa.org.sa/ accessed May 24, 2012.

UAE organic farming regulation 84 (2012), Ministry of Enviroment & Water, UAE.

Woese K et al. A comparison of organically and conventionally grown foods results of a review of the relevant literature. J Science Food and Agric 1997; 74(3): 281-293.

Worthington V. Nutritional quality of organic versus conventional fruits, vegetables, and grains. *J Alt Comp Med* 2001; 7(2): 161-173.

Worthington Virginia (2001). Nutritional quality of organic versus conventional fruits, vegetables and grains. *The Journal of Alternative and Complementry Medicine*. 7, 2, 161-173.

Yoo, K. M., Lee, K. W., Park, J. B., Lee, H. J., & Hwang, I. K. (2004). Variation in major antioxidants and total antioxidant activity of Yuzu (Citrus junos Sieb ex Tanaka) during maturation and between cultivars. Journal of Agricultural and Food Chemistry, 52, 5907–5913.

R&D Director: ……..…….…….. **Date:** ……..