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CHARACTERISTICS OF SEEDS AND SEED OILS OF SOME EGYPTIAN PUMPKIN CULTIVARS

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ABSTRACT

In recent years, there has been a growing interest in pumpkin and its nutritional importance. This study was designed to shed light on the seed oils of four Egyptian pumpkin (Cucurbitamaschata) cultivars (Qina, Edwa, Kafr-Saad and Kafr-El-Battikh)as new sources for the production of oil.The study included the determination of gross chemical composition of pumpkin seeds and some physicochemical properties of pumpkin seed oils such as the refractive index, acid value, peroxide, saponification number and the iodine value. Total lipids of pumpkin seed oils were fractionatedbythin layer chromatography technique (TLC).Tocopherol contents and total phenolic compounds were determined by HPLC technique. The results indicated that pumpkin seeds consider a rich source of protein and oil which ranged from 30 to 31% and 33 to 36% (on wet weight basis), respectively. They also contained relatively high levels of minerals.The major lipid component was the triglycerides which constituted from 69.09 to 80.31% of the total lipids, while polar lipids constituted the minor proportion (0.89 to 1.41% of total lipids).The total unsaturated fatty acids in pumpkin seed oils ranged from 70 to 73% and consisted mainly of oleic and linoleic acids, while the total saturated fatty acids ranged from 26.66 to 27.96% and consisted mainly of palmitic acid (16.02 to 17.17%) followed stearic acid (8.97 to 10.50% of total fatty acids).Tocopherol contents of the studied pumpkin seed oils were 98, 67, 158 and 111 mg/100g oil, while the total phenolic compounds were 6.86, 35.20, 55.34 and 0.27mg/kg oil for Qina, Edwa, Kafr-Saad and Kafr-El-Batikh, respectively.

Keywords: Pumpkin seeds, Pumpkin seed oils, Tocopherol, Phenolic compounds, Vitamin E

INTRODUCTION

In Egypt, pumpkin seeds are the alternative to the western popcorn as they are commonly eaten for leisure as a part of the Egyptian lifestyle (Abdel-Rahman, 2006).Egypt is one of five major pumpkin producing countries in the world. Pumpkin seeds are consumed directly for human consumption as a snack food in many cultures throughout the world, and the seeds are especially popular in Arab countries after salting and roasting (Al-Khalifa, 1996). In Austria pumpkin are grown primarily for the production of pumpkin seeds that can be used for the production of salad oil (Murkovic and Pfannhauser, 2000).Cucurbit seeds are used widely in many countries for oil or protein production (Tsaknis *et al*. 1997).Pumpkin (*Cucurbita maxima*) seeds contain many valuable functional components and have been traditionally used for herbal, therapeutic as well as clinical applications.

Pumpkin seeds have been used as safe deworming and diuretic agents and the seed oil as a nerve tonic (Younis *et al.* 2000).

Pumpkin seeds contained higher amounts of oil compared to some other oil seeds, such as soybeans and cotton seeds, which have average oil contents of only 20% and 14%, respectively (Schinas *et al*., 2009).Pumpkin seed oil has strong antioxidant properties (Stevenson *et al.* 2007) and has been recognized for several health benefits such as prevention of the growth and reduction of the size of prostate, retardation of the progression of hypertension, mitigation of hypercholesterolemia and arthritis, reduction of bladder and urethral pressure and improving bladder compliance, alleviation of diabetes by promoting hypoglycemic activity, and lowering levels of gastric, breast, lung, and colorectal cancer (Caili *et al.* 2006 andStevenson *et al*. 2007).

There has been an increasing interest in studying phenolic compounds from oil seeds, their skins, hulls and oil cake meals because they possess potentially health promotingcharacteristics and have industrial applications (Shadidi *et al*., 2006).This is dueto their antioxidant, antimicrobial, antiproliferative and preservative properties (Balasundram et al., 2006).Natural phenolic compound play an important role in cancer prevention and treatment (Huang and Cai, 2010).

Abd-El-Aziz and Abd El-Kalek (2011) found that the moisture, protein, lipid, ash, fiber and Carbohydrates of pumpkin seeds were 7.73, 39.25, 44.45, 4.41, 3.60 and 8.52%, respectively.

Zhong *et al.* (2007) reported that the main phenolic compounds in pumpkin seed oil are tyrosol, vanillic acid, caffeicacid and O-coumaric acid. The total phenolic content measured in pumpkin seed oil samples ranged from 24.71 to 50.93mg GAE/kg of oil.

However, there is a lack of information on phenolic compound in both pumpkin and pumpkin seed oil (Andjelkovic *et al*. 2010). Different researches agree in indicating that more scientific studies are needed to achieve greater and better utilization of the important pumpkin crop. In additionthe available information about the Egyptian pumpkin cultivars is very scarce.

The objective of this work is to achieve a comprehensive characterization with emphasis on health relevant components for different Egyptian pumpkin cultivars.

MATERIALS AND METHODS

Materials:

Four Egyptian pumpkin (*Cucurbitamoschata)*cultivars namely: Qina, Edwa, Kafr-Saad and Kafr-El-Battikh were obtained from the Faculty of Agriculture Farm, Assiut University, at season of 2009. The seeds were separated from the fruits. The obtained seeds were washed, sun dried for two days, milled and kept in closed bottles until further analysis at -20 °C.

Lipids extraction*:*Total lipids of the ground pumpkin seeds were extracted using a chloroform and methanol mixture (2:1v/v). The extracted lipids were filtrated over anhydrous sodium sulphate and stored in dark brown glass bottles at -20 °C until further analysis.

Analytical Methods:

Gross chemical composition

Moisture content, crude protein (% N x 6.25), crude fat, crude fiber and ash were determined in pumpkin seeds according to AOAC (1997) methods. Carbohydrates content was determined by difference. Energy values (kcal) were calculated applying the factors; 4, 9 and 4 for each gram of protein, fat and carbohydrates, respectively (Osborne and Voogt, 1978).

Determination of minerals:

Minerals content of pumpkin seeds were determined by a Flame Photometer 410 for sodium and potassium, Spekol 11 spectrophotometer for phosphorus and a Perkin-Elmer Atomic Absorption and Spectrophotometer 2380 for calcium, magnesium, manganese,copper, iron, zinc and cadmium were used (AOAC 1997).

Physicochemical properties of pumpkin seed oils:

The saponification value, acid value, iodine value and peroxide value were determined for pumpkin seed oils by the method described in AOCS (2004). The refractive index of the oils was evaluated using an Abbe refractometer at 25ºC.

Lipids fractionation by Thin Layer Chromatography:

The total lipids of pumpkin seeds were fractionated by Thin Layer Chromatography technique. The total lipids were separated on silica gel G-coated thin layer plates using a solvent system of petroleum ether: diethyl ether: acetic acid (80:20:1 v/v/v) as previously described (Mangold and Malins,1960). The lipid fractions were visualized by exposure to iodine vapor. All lipid fractions were identified on thin layer plates by comparing their R_f values with those of known lipid standards (Blank *et al*. 1964). For quantitative analysis the separated chromatograms were scanned using the charring densitometry technique. The area under each peak was measured by computer software (TL See 2v.) from LabHut.com, and the percentage of each fraction was computed with regard to the total area.

Fatty acids composition of pumpkin seed oils:

Preparation of methyl ester of fatty acids:

The methyl esters of fatty acids were prepared from aliquots total lipids using 5 ml 3% H_2SO_4 in absolute methanol and 2 ml benzene(Rossell *et al*.,1983). The contents were heated for methanolysis at 90°C for 90 minute. After cooling, phase separation was performed by addition of 2 droplets of distilled water and the methyl esters were extracted with 3 aliquots of 2 ml hexane each. The organic phase was removed and filtered through anhydrous sodium sulfate.

Determination of fatty acids by Gas Liquid Chromatography:

The methyl esters of fatty acids were separated using HP 6890 GC capillary column Gas Liquid Chromatography with a dual flame ionization detector, and were carried out on (60 m x 0.32 mm x 0.25 µm) DB-23 capillary column, stationary phase (50% cyanopropyl phenyl + 50% dimethyl polysiloxane). Column temperature:initial temperature was 150 ºC and increased from 150-170 ºC at the rate of 10°C/minute, then increased from

170-192°C at the rate of 5 ºC/minute, holding at 192 ºC for five minutes and then increased from 192-220°C during 10 minutes, holding three minutes .The injector and detector temperatures were 230 °C and 250 °C, respectively. Carrier gas: Hydrogen flow rate 40 ml/minute, nitrogen at the rate 3 ml/minute and air flow rate was 450 ml/minute. Peak identifications were established by comparing the retention times obtained with standard methyl esters. The areas under the chromatographic peak were measured with an electronic integrator

Determination of theTocopherols inpumpkin seed oils:

Tocopherollevels in pumpkin seed oils were determined by HPLC according to the method of Pyka and Sliwiok (2001). Normal-phase HPLC conditions were used as follows: HPLC system Knauer (Berlin, Germany); column: Hypersil Silica 5 µm (250 mm × 4.6 mm) (Termo-Quest, Egelsbach, Germany); mobile phase: hexane–amyl alcohol (99.5:0.5, v/v); eluent flow: 2 µl /min; Knauer pomp (Berlin, Germany), detection: UV at 290 nm (Knauer); injection volume: 20 ml of standard tocopherols in ethanol, Temperature, 293 Kelvin.

Determination of phenolic compounds in pumpkin seed oils:

Phenolic compounds were determined by HPLC according to the method of Goupy *et al.* (1999). 5g of sample were mixed with methanol and centrifuged at 10000 rpm for 10 min.The supernatant was filtered through a 0.2 µm Millipore membrane filter and 1-3 ml was collected in a vial for injection into HPLC Hewlett Packared (series 1050) equipped with autosamplling injector, solvent degasser, ultraviolet (UV) detector set at 280 nm and quarter HP pump (series 1050). The column temperature was kept at 35ºC. Gradient separation was carried out with methanol and acetonitrile as a mobile phase at flow rate of 1 ml/min. A phenolic acid standard from sigma Co. was dissolved in the mobile phase and injected into the HPLC. Retention time and peak areas were used to calculate of phenolic compounds concentration by HP software.

Statistical analysis:

The analysis of variance (ANOVA) wasused to assess for the differences between pumpkin cultivars **(SAS version 6.12, 1997).**Tukey-HSD was used for multiple comparisons and the level of significance was set at 0.05**.**

RESULTS AND DISCUSSION

Gross chemical composition of seeds:

Figures (1) and (2) show the four studied Egyptian pumpkin cultivars fruits and their seeds. The gross chemical compositions of the seeds of the studied pumpkin cultivars are presented in Table (1). The moisture content ranges from 6.43 to 7.20%. This is in agreement with the values reported by Esuoso *et al*. (1998) and Nyam *et al*. (2009),(6.3 and 7.9%) respectively . However, also other values were reported (3.21%) by Al-

Khalifa(1996), (5.6%) by Fedha *et al*. (2010)and (10.93%) by Agatemor (2007).

Fig.(1) Egyptian pumpki cultivarsFig. (2)Seeds of studied pumpkin cultivars

Table (1): Gross chemical composition of the studied pumpkin cultivar seeds (wet weight basis).

Estimates	Pumpkin cultivars			
	Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
Moisture %	06.43^{b}	07.20^{a}	06.76^{b}	07.12^{a}
Crude protein %	30.50^{a}	31.10^{a}	30.77^{a}	30.27^{a}
Crude fat %	33.68^{b}	35.18^{a}	36.43^{a}	36.06^{a}
Crude fibers %	19.71^{a}	15.42^{b}	19.55^{a}	19.16^{a}
Ash %	04.53^{a}	04.53^{a}	04.48^{a}	04.56^{a}
Carbohydrates* %	05.15^{a}	06.57^{a}	02.01^{b}	02.83^{b}
Caloric value Kcal/100g	445.72^{a}	467.30^{c}	458.99^{b}	456.94^{b}

Values are expressed as mean of three samples. Values with different superscripts on the same row are significantly different at ($p<0.05$)*Calculated by differences

Data presented in Table (1) also revealed that pumpkin seeds are considered a rich source of protein content (30.27 to 31.10%, on wet weight basis). Similar values of protein in pumpkin seeds were reported by Abd El-Ghany *et al.* (2010) and Sew*et al*. (2010). In addition, no significant differences between the studied pumpkin seeds in their protein content were observed.The results also show that crude oil content of pumpkin seeds ranged from 33.68 to 36.43%. The obtained results of crude oil contents are in a good agreement with those reported by Nyam *et al*. (2009).

The high percentage of oil makes pumpkin seeds suitable for the industrial oil production. The advantage of pumpkin oil over sunflowers oil, soybean oil and rapeseed oil would lie in the economic cost (Schinas *et al.,* 2009).An additional advantage of pumpkin oil is the fact that it enjoys in several geographies, such as the Austria, Hungary, the Balcans and Southern regions of the former USSR , a very positive image (Tsaknis *et al*. 1997). As shown in Table (1) there are no significant differences between the studied cultivars seeds in their crude oils content except Qina cultivars which was significantly less oil content.

The crude fiber content determined ranged from 15.42 to 19.55 %. The high content of crude fibers in pumpkin seeds might be due to the presence of seed hulls. Hamed *et al. (*2008) and Sew *et al. (*2010)studies indicated that crude fiber contents were lesser than that found in this study.On the other hand, high crude fiber content (24.2%) in pumpkin seeds was reported by Nyam *et al*. (2009). Moreover, no significant differences between Qina, Kafr-Saad and Kafr-El-Batikh seeds cultivars in their contents of crude fibers were observed.

Ash content of pumpkin seeds ranged from 4.48 to 4.56%. Similar results of ash content of pumpkin seeds were reported by Onimawo *et al*. (2003) and Nyam *et al*. (2009).Qina and Edwa pumpkin seeds had significantly higher content of carbohydrates than those of Kafr-Saad and Kafr-El-Batikh cultivars. The carbohydrates content in pumpkin seeds ranged from 2.01 to 6.57%. The results are inagreement with those obtained byAbd-El-Aziz and Abd-El-Khalek(2011) while high carbohydrates content (23 and 15.63%) were reported by Al-Khalifa (1996) and Hamed *et al*. (2008), respectively.

The caloric value of pumpkin seeds ranged from 445.72 to 467.30 Kcal/100g. The high caloric value of pumpkin seeds reflects their high contents of protein and oil. In addition, pumpkin seeds are high–energy source and are consumed globally (Caill *et al.* 2006).

Minerals content of pumpkin seeds:

The results of mineral contents of pumpkin seeds are presented in Table (2). Pumpkin seeds contained high contents of phosphorus, magnesium and calcium. However, the sodium content of pumpkin seeds is low (40-70 mg/100g dry weight). Similar results were reported by Akwaowo *et al*. (2000). Cadmium, a toxic element, was absent in Qina and Kafr-El-Batikh cultivar seeds while very low amounts were detected in seeds of Edwa and Kafr-Saad cultivars.

Table (2): Mean values of minerals content ofpumpkin cultivar seeds (mg/100g dry weight basis)

Minerals	Pumpkin cultivars seeds			
	Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
K	80	90	80	90
P	240	330	360	350
Mg	260	290	300	300
Ca	240	230	210	220
Na	40	50	70	40
Fe	16.61	10.20	18.93	10.13
Zn	7.63	7.34	9.14	8.24
Cu	1.38	1.20	1.50	1.28
Mn	2.29	2.47	2.68	2.27
Cd	00	0.01	0.01	00

Physicochemical properties of pumpkin seed oils:

Physical and chemical properties of pumpkin seed oils are shown in Table (3). The refractive index of the studied seed oils ranged from 1.4672 to 1.4676, while it was 1.4710, 1.4695, 1.4715 and 1.4737 as found by Younis *et al*. (2000), El-Adawy and Taha(2001) and Poiana *et al. (*2009), respectively. The acid value of pumpkin seed oilsranged from 0.59 to 0.99 (mg KOH/g oil). Similar result was found by Vujasinovic *et al*. (2010). However, the maximum acid index of edible oils is 15 mg KOH/g of oil (Krishnamurthy, 1982).

Table (3): Physicochemical properties of pumpkin seed oils

Characteristics	Pumpkin seed cultivars			
	Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
Refractive index (25°C)	1.4676	1.4675	1.4672	1.4674
Acid value (mg KOH/g)	0.94	0.59	0.99	0.78
Saponification number (mg KOH/g)	183.60	182.20	186.30	183.40
Iodine value (g I_2/100g oi)l	81.80	81.26	80.40	81.20
Peroxide value (meq/kg)	2.99	3.03	3.09	2.99

The peroxide value of pumpkin seed oils was very low and ranged from 2.99 to 3.09 (meq peroxide/kg oil) which was indicative of a high oxidative stability for pumpkin seed oils. Moreover, the Codex Alimentarius Commission (1982) stipulated permitted maximum peroxide levels of 10 meq peroxide/kg oil for soybean, cottonseed, rapeseed and coconut oils. The iodine value of the studied pumpkin seed oils ranged from 80.40 to 81.80 (g I_2 /100g oil). The iodine value of pumpkin seed oils of this study was close to the value of 80.1 which reported by Esuoso *et al*. (1998) and similar to the values of 83.81 and 86.70 which found by Achu *et al. (*2006) and Nyam *et al*. (2009), respectively. On the other hand, high iodine value (131g I_2/100g oil) was found by El-Adawy and Taha(2001) and (130 g I_2/100g oil) was reported bySabudak(2007). In addition, Achu *et al*. (2009) reported that the iodine value of pumpkin seed oilsranged from 66.62 to 103.55 g I_2/100g oil. However, the high iodine value indicating a high degree of unsaturation of pumpkin seed oil, and this makes it a good cooking oil and suitable for margarine production (Agatemor, 2006).

Saponification number of pumpkin seed oilsl ranged from 182.20 to 186.30 (mg KOH/g oil) as shown in Table (3). The obtained value of saponification number is in agreement with those reported by Poiana *et al*. (2009) and Nyam *et al*. (2009).

Saponification number (182.20 to 186.30mg KOH/g oil) observed for pumpkin seed oils was within range 175-250 (mg KOH/g oil) normally found in other seed oils such as raspberry seeds, safflower, sunflower and corn (Yong and Salimon, 2006). Moreover, the saponification value of pumpkin seed oils indicated that the oils have high molecular weight fatty acids and therefore provides a good feedstock for lubricants, candles and soap production (Agatemor,2006).

Total lipids composition of pumpkin seed oils:

The qualitative and quantitative analyses of the studied pumpkin seed oilsare shown in Figure (3) and Table (4). Using Thin Layer Chromatography (TLC) technique the total lipids of pumpkin seed oils were fractionated to eight fractions namely; polar lipids, monoglycerides, 1,2 & 2,3 diglycerides, 1,3 diglycerides, sterols, free fatty acids, triglycerides and sterol ester & hydrocarbons as well as two unknown fractions as shown in Figure (1).

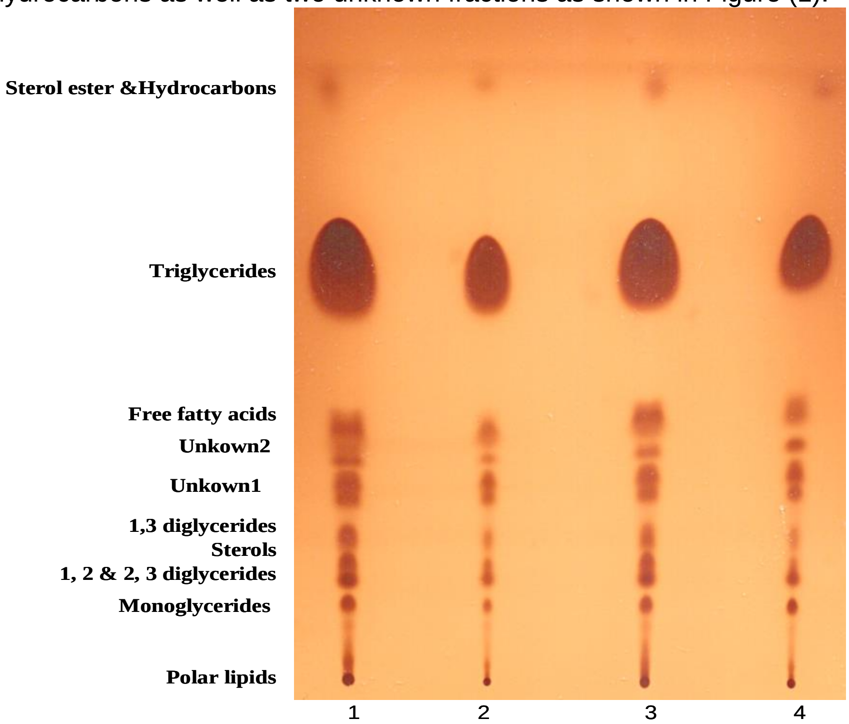

Fig.(3): Thin layer chromatograms of total lipids fractions of pumpkinseed oils cultivars (Qina(1), Edwa(2), Kafr-Saad(3) and Kafr-El-Batikh(4)).

Data in Table (4) show the percentages of each fraction of total lipids of the studied pumpkin seed oils. The results indicated that major lipid component was triglycerides which constituted from 69.09 to 80.31% of total lipids, while polar lipids constituted the minor proportion (0.89 to 1.41% of total lipids). Yoshida *et al*. (2004) fractionated pumpkin kernel seed oils by TLC into six fractions and mentioned that triglycerides represented > 90% of total lipids and phospholipids represented from 1.0 to 1.5% of total lipids of pumpkin seed kernel oils. The presence of free fatty acids (4.22 to 4.69%) in oil samples may be due to enzymatic hydrolysis of triglycerides during storage of the seeds which resulted also in high proportion of monoglycerides and diglycerides as indicated in Table (4).In addition, the percentages of monoglycerides, sterols and polar lipids in this study are in agreement with the results of Imbs and Pham (1995) for pumpkin (*Cucurbitapepo*) seed oil, but they found that no free fatty acids fraction was detected when they fractionated the total lipids by TLC to eight fractions.

Table (4): Total lipids composition of pumpkin seed oils (as % of total lipids).

Lipids fractions	Pumpkin seed cultivars			
	Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
Polar lipids	1.41	1.27	0.93	0.89
Monoglycerides	3.59	2.25	2.19	1.34
1,2&2,3 diglycerides	4.02	5.82	2.98	2.90
1,3 diglycerides	2.81	3.41	2.24	2.10
Unkown 1	5.06	3.67	4.43	0.28
Unkown 2	3.11	4.69	4.39	2.85
Sterols	2.97	2.21	4.80	2.44
Free fatty acids	4.22	4.69	4.33	4.32
Triglycerides	70.34	70.27	69.09	80.31
Sterol ester & hydrocarbons	2.40	1.72	2.14	1.35

Fatty acids composition of pumpkinseed oils:

The fatty acid composition data for the studied pumpkin seed oils are presented in Table (5). The obtained data revealed that fatty acids of pumpkin seed oil consisted mainly of four fatty acids namely; oleic, linoleic, palmitic and stearic. The same observation was reported by Younis *et al*. (2000) and Mitra *et al*. (2009). However, oleic acid was the predominant fatty acid in seed oils of Edwa, Kafr-Saad and Kafr-El-Batikh cultivars and ranged from 38.00 to 46.04% of the total fatty acids. The result indicated that linoleic acid was the major fatty acid in Qina seed oil (35.17%) as show in Table (5). Predominancy of oleic fatty acid in pumpkin seed oils of this study is in agreement with the results of Sabudak (2007) and Nyam *et al*. (2009). On the other hand, several studies indicated that linoleic acid was the major fatty acid of the pumpkin seed oilsfollowed by oleic (Stevenson *et al*., 2007; and Szterk *et al.*, 2010). The differences in the fatty acid composition may be due to variety, growing area, climate and state of ripeness (Wentzel, 1987and Parry *et al*., 2006).As shown in Table (5), linoleic acid constituted from 26.21 to 35.17% of the total fatty acids of pumpkin seed oils. This essential fatty acid is not easily synthesized in the human system and must be supplied externally through the diet (Mitra *et al*., 2009). Therefore, pumpkin seed oils can be a good nutritional supplement as a source of linoleic acid. In addition, the oil with high content of oleic acid has been associated with lowering the risk of cardiovascular disease as mentioned byHargrove *et al*. (2001).

Table (5): Fatty acid composition of pumpkin seed oils (% of total fatty acids)

Fatty acids		Pumpkin seeds cultivars			
		Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
Palmitic	C16:0	17.17	16.13	16.02	16.57
Palmitoleic	C16:1	0.25	0.18	0.20	0.17
Stearic	C18:0	8.97	9.10	9.62	10.50
Oleic	C18:1	34.27	46.04	45.43	38.00
Linoleic	C18:2	35.17	26.21	27.24	33.31
Linolenic	C18:3	0.58	0.49	0.15	0.33
Arachidic	C20:0	0.89	1.43	1.11	0.89
Gadoleic	C20:1	0.42	0.38	0.20	0.20
Unknown		2.25	0.00	0.00	0.00
Total Saturated		27.03	26.66	26.75	27.96
Total unsaturated		70.69	73.30	73.22	72.01

Data in Table(5) indicated that pumpkin seed oils are very poor in linolenic fatty acid (0.15 - 0.58% of total fatty acids) and this result is agreement with the values of (0.12%) byAl-Khalifa (1996); (0.2%) by Tsaknis *et al*. (1997); (0.1 – 0.22%) by Achu *et al.* (2006) and (<1%) by Stevenson *et al.*(2007). Although, linolenic acid is an omega-3 fatty acid with positive health effects, it easily oxidizes and it is undesirable in edible oils because of the off-flavors and potentially harmful oxidation products formed (Achu *et al.* 2006). Warner and Gupta (2003) showed the decrease in linolenic acid from 2 to 0.8% in oils, improved flavor quality and oxidative stability of fried food. This shows that for oil to be very good for frying, its linolenic acid level should be less than 1%, as in pumpkin seed oils and therefore, pumpkin seed oils can be used as frying oils.According to Choe and Min (2006) the rate of linoleic acid oxidation in 10 – 40 times higher than that of oleic and the rate of linolenic oxidation is 2-4 times faster than that of linoleic. Thus, pumpkin seed oils with very low linolenic acid content provide high oxidative stability, making it suitable for industrial application and long shelf life (Stevenson*et al*., 2007).

The results indicated that the total unsaturated fatty acids in pumpkin seed oils ranged from 70.69 to 73.30% and consisted mainly of oleic and linoleic acids. On the other hand the total saturated fatty acids ranged from 26.66 to 27.96% and consisted mainly of palmitic acid (16.02 to 17.17%) and stearic acid (8.97 to 10.50%). The obtained result in this study is similar with the result ofAchu *et al. (*2009) and Stevenson *et al*.(2007).

Tocopherol content of pumpkin seed oils:

Tocopherol content of pumpkin seed oils is shown in Figure (4). Tocopherol values were ranged from 67 to 158 mg/100g of oil. The highest values of tocopherols were recorded for Kafr-Saad pumpkin cultivar oil, while

Edwa cultivar oil recorded the lowest value. Qina and Kafr-El-Batikh seed oils recorded intermediate values (98 and 111 mg /100g oil, respectively).

The obtained results for tocopherols in pumpkin seed oils (except of Kafr-Saad cultivar) fell in the range of 589.4 to 1234.2 µg/g seed oil which reported by Stevenson *et al*. (2007) when studied the tocopherol content of 12 cultivars pumpkin seed oils. However, the obtained data also, are agreement with Szterk *et al.* (2010) and Ardabili *et al*. (2011) who pointed out that total tocopherol content in pumpkin seed oil were 882.65 mg/kg oil and about 148 mg/100g oil, respectively. On the other hand, lesser tocopherol contents were reported bymany works as (126 mg/kg) by Tsaknis *et al*.(1997); (13.60-17.89 g/kg) by Vanhanen *et al*. (2003) and (15.7 mg/100g) by Ryan*et al*. (2007). Such differences in tocopherol contents may be caused by variations in cultivar or origin (Tsaknis *et al.,* 1997). In addition, the obtained data shows that the studied Egyptian pumpkin seed oils consider a good source of tocopherols especially Kafr-Saad cultivar seed oil.

Tocopherols, the major vitamers of vitamin E, are fat soluble and important biological antioxidants that function as scavengers of lipid peroxylradical and prevent oxidation of body lipids including polyunsaturated fatty acid and lipid components of cells and organelle membranes (Ryan *et al.*, 2007 and Nyam *et al.*, 2009). Kushi *et al.* (1996) demonstrated that tocopherol content in food is inversely associated with mortality from cardiovascular disease. In addition tocopherol, due to their capacity to quench free radical damage, plays a putative role in prevention of Alzheimer's disease and cancer (Tucker and Townsend, 2005).

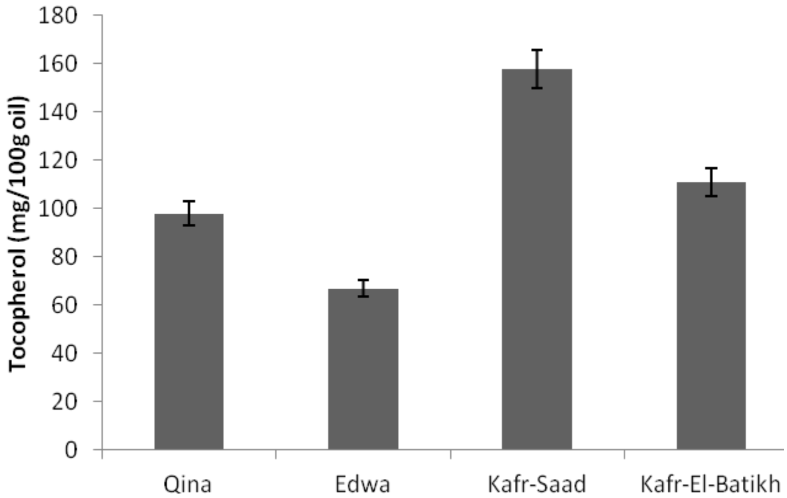

Fig. (4): Tocopherol (vitamin E) content in pumpkin seed oils (mg/100g)

Phenolic compounds of pumpkin seed oils:

Phenolic compounds in pumpkin seed oils as determined by HPLC are presented in Table (6). The total phenolic content of the studied pumpkin seed oilsranged from 0.27 to 55.34 mg/kg oil. The highest value of total phenolic compounds (55.34 mg/kg oil) was recorded for Kafr-Saad seed oil cultivar, while the lowest value (0.27 mg/kg oil) was recorded for the oil of Kafr-El-Batikh cultivar. Qina and Edwa seed oils recorded intermediate levels (6.86 and 35.2 mg/kg oil), respectively. The values of Kafr-Saad and Edwa are close to data reported earlier (Andjelkovic *et al*. 2010 and Hoed, 2010)which ranged from 24.71 to 50.93 mg GAE/kg oil however the values for the two other cultivars a significantly lower. . The obtained data in Table (6) shows that there was wide variation in phenolic compound of the four studied oils.

Table (6): Phenolic compound content of pumpkin seed oils (ppm).

Phenolic compound	Pumpkin seed cultivars			
	Qina	Edwa	Kafr-Saad	Kafr-El-Batikh
Protocatechuic	1.830	3.780	21.490	---
P.OH benzoic	0.073	0.240	---	0.023
Catechein	0.773	1.950	3.035	0.182
Synergic	---	28.198	28.198	-----
Chlorogenic	0.195	---	---	---
P. Comaric	---	0.100	---	---
Comaric	0.120	---	1.690	---
Narenginin	---	---	---	0.013
Vanillic	1.560	---	0.930	0.055
Salycilic	2.310	0.940	---	---
Total phenolic content	6.86	35.20	55.34	0.27

Data in Table (6) also shows that Qina seed cultivar oil contained seven different phenolic compounds, however, only four compounds presented in Kafr-El-Batikh seed oil. On the other hand, six and five phenolic compounds were detected in Edwa and Kafr-Saadseed oils, respectively. Moreover, catechein compound was detected in all studied oils, while P-comaric acid was only detected in Edwa seed oils, chlorogenic acid was only detected in Qina cultivar oil and narenginin found only in Kafr-El-Batikhseed oils. However, both chlorogenic acid and caffeic acid are antioxidants and inhibit the formation of mutagenic and carcinogenic N-nitroso compounds in vitro as reported by Han *et al*. (2007). Hoed (2010)mentioned that protocatechuic acid is typical for pumpkin seed oil.This phenolic acid was detected in three cultivars with amounts of 1.83, 3.78 and 21.49 mg/kg oil in Qina, Edwa and Kafr-Saad oils,respectively, while it was absent in Kafr-El-Batikh cultivar.

From the data in Table (6) it can be noted that synergic acid compound recorded the highest value (28.20 mg/kg oil) in Edwa and Kafr-Saad cultivars seed oils among all the detected phenolic compounds. Also, protocatechuic acid recorded 21.49 mg/kg oil in Kafr-Saad seed oils cultivar, while the other detected phenolic compounds were ranged between 0.01 to 3.04 mg/kg.

Conclusion

The findings of this paper overcome the unclarity of inconsistent data from various sources a characterization of pumpkin seed oils. Comprehensive data set of reliable data. the data covering different cultivars also illustrates the levels of variations one has to expect between different pumpkin seed oils. The determined physicochemical properties of the oil demonstrated that, the pumpkin seed oil is a good candidate for use as edible oil or supplementand can be a good nutritional supplement as a source of the essential linoleic acid. In addition, Egyptian pumpkin seed oils is a good source of tocopherol especially Kfr-Saad cultivar and there was wide variation in phenolic compounds of the studied pumpkin seed oils.

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مواصفات بذور وزيت بذور بعض اصناف القرع العسلي المصري

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يزداد الأهتمام في السنوات الأخيرة بالأهمية الغذائية للقرع العسلي . وقد أجريت هذه الدراسة لإلقاء الضوء على بذور أربعة أصناف مصرية من القرع العسلي هي على وجه التحديد أصناف قنا ، العدوة ، كفر سعد ، كفر بطيخ كمصدر للزيت . و اشتملت الدراسة على تقدير التركيب الكيميائي العام للبذور إلى جانب تقدير بعض الصفات الفيزو كيميائية لزيت البذور مثل معامل الإنكسار ورقم الحامض ورقم البيروكسيد ورقم التصبن والرقم اليودي . كما تم تفريد تجزؤات الليبيدات الكلية للزيت بإستخدام طريقة كروماتوجرافيا الطبقة الرقيقة (TLC) وقدرت كميا بينما تم تقدير محتوى الزيت من التوكوفيرول والمواد الفينولية الكلية بإستخدام ال HPLC . و أوضحت النتائج أن بذور القرع العسلي تعتبر مصدرا غنيا للبروتين والزيت والتي تراوحت نسبتهما من ٣٠% - ٣١% ،و ٣٣% - ٣٦% (على أساس الوزن الرطب) على التوالي . كما تحتوي البذور على مستويات مرتفعة نسبيا من بعض العناصر المعدنية . ومثلت الجليسريدات الثلاثية من ٦٩.٠٩% إلى 31. ٨٠% من جملة الليبيدات الكلية بينما شكلت الليبيدات القطبية من ٠.٨٩% إلى ١.٤١% منها . وتراوحت نسبة الأحماض الدهنية غير المشبعة في زيت بذور القرع العسلي من ٧٠ إلى ٧٣% من جملة الاحماض الدهنية و تكونت بصفة أساسية من حامض الأوليك و الليفوليك بينما تراوحت نسبة الأحماض الدهنية المشبعة من ٢٦.٦٦ إلى ٢٧.٩٦% وتكونت أساسا من حامض البالمتيك (١٦.٠٢ إلى ١٧.١٧%) متبوعا بحامض الإستياريك (٨.٩٧ إلى ١٠.٥ %) من جملة الاحماض الدهنية . وكان محتوى الزيت من التوكوفيرول هو ٩٨- ٦٧- ١٥٨- ١١١ ملجم / ١٠٠ جم زيت للاصناف المدروسة على الترتيب بينما كان محتواها من المواد الفينولية الكلية هو ٦.٨٦ – ٣٥.٢٠ – ٥٥.٣٤ – ٠.٢٧ملجم / كجم زيت على التوالي .

قام بتحكيم البحث

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