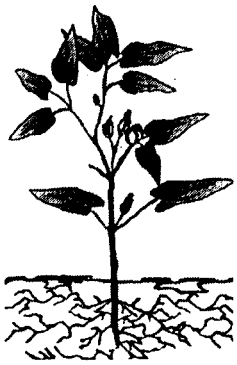

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CHEMICAL COMPOSITION AND CHARCTERIZATION OF OIL AND DEFATTED CAKE OF APRICOT KERNELS

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Azouz[1], A.; Alia, M. El-Gharably[2] and E. M. Rizk[1]

1- Food Technology Res. Institute, Agric. Res. Center, Giza, Egypt

2- Home Economics Dept., Fac. Specific Education, Ain Shams Univ., Abbasiya, Cairo, Egypt

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ABSTRACT

The chemical composition of apricot kernel oil and its defatted cake meal were chacterized for their physicochemical properties. Also the function properties of defatted apricot kernel cake (DAKC) were also studied. The proximate composition of whole kernel on dry bases were 5.50, 27.83, 50.30, 2.20, 11.32 and 3.16% for moisture content, crud protein, fat, ash, total sugars and crude fibers, respectively. The kernels contained 210, 400, 280, 2.80 mg/ 100g for elements of potassium, magnesium, phosphate and manganese, respectively. The characteristics of apricot kernel oil were 0.916g/ cm^3, 1.4699 and 2.00 for specific gravity, RI and colour (at 35 yellow), respectively. While the values of acid, peroxide, iodine number and smoke point (°C) were 0.14, 0.22, 108.00 and 240, respectively. The major fatty acid were oleic (66.25) and linoleic (25.57).The defatted apricot kernels cake were free from HCN and contained 16 amino acids, since the major amino acids were glutamic (20.75%), aspartic (14.11%) and glycine (11.86%). Results of functional properties of defatted apricot kernel meal (DAKC) indicated that, the protein solubility index (PSI) was increased versus the increasing of pH values towards alkaline media and the higher value of Emulsion capacity (EC) was observed at pH 9.0 while, the higher Emulsion Stability (ES) in comparing with percentage of aqueous phase separated after 48hr was at pH 8.0 and the Foam Stability (FS) was 590, 100 and 30 at values of pH 2.0, 3.0, and 4.0, respectively, also, each 1.0g of defatted apricot kernel flour was absorbed 3.24g water and 3.10g corn oil. On the other hand, the defatted apricot kernel cake (DAKC) was contained 625.37mg/ 100g total phenolics. Whereas, 500, 1000ppm phenolic compounds of apricot meal as antioxidant was more effective for loweringthe development of peroxide value for corn oil than using butylated hydroxyl toluene BHT. Therefore it can recommended with adding natural DAKC phenolic compounds with oil as antioxidant because it was more healthy useful and considered as alteration of synthetic antioxidants.

INTRODUCTION

As legal, environmental and economic issues are being reconsidered in the past two decades, it becomes more and more obvious that, disposal and landfill of those wastes present environmental and social drawbacks. In The same time advances in modern chemistry and biotechnology, academic awareness and industrial interest permitted the study of these "wastes. New technologies were proposed not only for their re- use in agriculture, but also for the production of common and novel products for other sectors. Today they can be used for compost, vermin compost , animal feed and supplements, food and nutritional supplements, (functional foods, nutraceuticals), alcoholic drinks, color and tanin extracts, inks and pigments, antibacterial agents, skin, hair and healthcare products, soaps and spa products, filtration and structural materials **(Hazell, 2000 and Bisson *et al* 2002).**

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Apricot kernels are the seeds found inside the stones or pits of fresh apricots. These kernels, which belong to a class of oil-bearing seeds/fruits are light brown in color, and resemble small almonds. They have a very high fat content which ranges between 50 – 60%. The kernels are used in the production of liqueurs, persipan (a marzipan substitute) and persic oil. When pressed, they yield an essential oils utilized by the confectionery industry, as a culinary flavoring, as well as a substitute for more expensive almond oil in soap and cosmetics. Also, raw apricot kernels contain vitamine B17 (Laetrile), in the form of cyanogenic glycosides which also referred as dietary cyanide. Although the kernels continue to be marketed in health food outlets or in capsule form, medical authorities generally regard the direct ingestion of unprocessed, raw apricot kernels as unsafe, with the potential for cyanide poisoning if eaten raw apricot kernel in sufficient quantities.**(Markle *et al* 1978; Femenia, *et al* (1995) and Gandhi *et al* 1997).**

The kernels of apricot wich considered as a waste in the canning and fruit industries, have been utilized in Germany and the USA for the manufacture of fixed oil. On the other hand, apricot kernel cake contains 41.5% crude protein **(Volotavskaya *et al* 1980) Abd-El-Aal *et al* 1986)** reported that, the apricot kernel contained 50.9% of oil. Apricot kernel oil is rich in unsaturated fatty acids especially oleic (31-80%) linoleic (6.3-51%) acids and is also a good source of tecopherol **(Lazos 1991)**. On the other hand, wild apricot, obtained from a variety of *Prunus armeniaca*, grows in the hilly regions of India. The seeds yield 27% of kernels, and these contains 47% of oil. The oil has 94% unsaturated fatty acids, rich in oleic and linoleic acids. Systemic effects and nutritional quality of wild apricot oil (WAO) were assessed in a 13-wk feeding study in weanling albino rats using a diet containing 10% WAO as the sole source of dietary fat. A similar diet containing groundnut oil (GNO) was used as the control. Wild apricot oil did not manifest any toxic potential. The food consumption, growth rate and food efficiency ratio of rats fed on WAO were similar to those fed on ground nut oil GNO. The digestibility of this oil was found to be comparable to that of GNO. Where, the results of this study indicated that, WAO could be used for edible purposes **(Gandhi *et al* 1997).**

Bitter apricot (*Prunus armeniaca*) seeds (kernels) are a by-products of the apricot processing industry. They contain approximately 50–150 µMol/g (dry weight basis) of potentially toxic cyanogenic glycosides, mainly amygdalin and prunasin. A hot water blanching treatment of 20 min at 100 °C was adequate to inactivate endogenous β-glucosidase activity in raw bitter apricot seeds **(Tunçel, *et al* 1998).**

The chemical composition of bitter and sweet varieties of apricot (Prunus armeniaca L.) kernels was investigated. Sweet apricot kernels were found to contain more oil (63 g/100 g) and less soluble sugars (7 g/100 g) than bitter kernels (43 and 14 g/100 g, respectively). No significant differences in the protein content were found in either bitter or sweet variety. Oleic acid and linoleic acid are approximately 92 g/100 g of total fatty acids. Pectic polysaccharides, cellulose, and hemicelluloses (in decreasing amounts) were inferred to be their main component polysaccharides. Essential amino acids constitute 32-34 g/100 g of the total amino acids determined. Amygdalin content was very high (5.5 g/100 g) in bitter cultivars and was not detected in the sweet variety **(Femenia, *et al* 1995).** Meanwhile, **Dwivedi and Ram (2006)** found that, the bitter kernels revealed fat content in the bitter kernels to be as high as 54.24%. Protein content was found to vary from 17.75 to 22.56%, carbohydrate from 21.16 to 35.26%, crude fiber from 0.84 to 4.71%, and dietary fiber from 6.03 to 22.24%. Also, they founed that, the iodine number varied from 97.93 to 103.85 and saponification values from 189.57 to 191.71. Thereafter, the apricot oil is dominated by the presence of unsaturated fatty acids.

Phenolic compounds have great importance in the nutritional, organoleptic and commercial properties of plant-derived food and beverages. Furthermore, their consumption has been associated with positive health benefits such as antioxidant, antiviral, antiallergenic, cardioprotective, and anticarcinogenic effects. **(Halliwell *et al* 2005).**

The objective of the present study was to achieve the most efficient utilization of apricot kernels, more information about the chemical composition of kernels as well as the characteristics of oil and defatted cake and its functional properties. Used of phenolic compounds extracted from DAKC as antioxidant was also undertaken.

MATERIALS AND METHODS

Materials

Apricot kernels (*Prunus armeniaca*, L) were collected from Food Processing Factories of Food Technology Research Institute, Agriculture Re-

search Center, Giza Egypt, season 2007. and wheat flour (72% extraction) was purchased from Egyptian Millers Company, Giza, Egypt.

Methods

Preparation of apricot kernels cake

The apricot kernels were washed with water, then dehydrated with sun drying for 3 weeks. The dried kernels were crushed by manual cracking,. boiled for 30 min. in 0.1% sodium bicarbonate, then soaked for 48 min. in distilled water to remove bitterness (detoxification). After that, shelled brown skin dried at 50°C in a forced draught air oven. The apricot kernel were ground and sieving to pass through a 70 mesh sieve to get kernels cake.

Chemical analysis

Moisture, crude protein, crude fat, crude fiber, total ash, reducing sugar, total sugars and hydrocyanic acids (HCN) for apricot kernel, were determined according to the methods described in **A.O.A.C. (2000).**

Extraction of apricot kernel oil

The extraction of oil was done by diethyl ether in Soxhelt apparatus. The miscilla were collected and diethyl ether was evaporated by using rotary evaporator at 50°C under vacuum for 2 hours.

The crude oil were dried over anhydrous sodium sulfate and kept in brown bottles at 10°C till analysis. Acid, peroxide value, Iodine number and saponification number were determined according to the methods described by the **A.O.A.C. (1995).** The specific gravity, refractive index and color were determined using the methods described by **A.O.C.S. (1998).**

Extraction of phenolic compounds

Phenolic compounds were extracted from defatted apricot kernel cake by the **Azizah *et al* (1999)** method. A 25 g of defatted apricot kernel cake was mixed well with 250 ml ethanol in 500 ml conical flask and left overnight, stirred for one hour, then dried in air for 3hr, the residues from ethanol extracts were re-extracted with the same solvent. The extracts were combined after removing the ethanol with rotary evaporator and used as phenolic compounds.

Determination of total phenolics

Total phenolics were determined spectrophotometrically using the modified Folin-Ciocalteau colorimetric method **(Eberhardt *et al* 2000)**. A 125 µl of the extract was mixed with 0.5 ml of distilled water in a test tube; followed by addition of 125 µl of Folin-Ciocateau reagent and allowed to stand for 6 min. then, 1.25 ml of 7% sodium carbonate was added and the final volume was made up to 3 ml with distilled water. Each sample was allowed to stand for 90min at room temperature and the absorbance was measured at 760 nm using spectrophotometer. The total phenolic content was expressed as milligrams Gallic acid//100g GSP equivalents to Gallic acid standard calibration curve as reference.

Antioxidant activity testing

Extracted phenolic compounds from defatted apricot kernel cake extract was tested, as antioxidant, by the determination of peroxide value (POV) during incubation of corn oil at 60°C for 7 days as described by **Matthaus, (2002)**: A 25g of corn oil were mixed with100, 200, 500, 1000 ppm phenolic compounds of the defatted extract in a flask against Butylated hydroxyl toluene (BHT) as a control and the mixtures were placed in an oven at 60°C for 3 h daily, the experiment was continued for 7 days. The peroxide value was determined for each according to the method described in **A.O.A.C. (2000).**

Phesico-chemical properties and identification of fatty acids for apricot kernel oil

Phesico-chemical properties of apricot kernel oils were determined according to **A.O.C.S. (1998)** and fatty acids were identified by using Agilent HPLC 6890GC according to the method described by **A.O.A.C. (2000).**

Identification of amino acids for apricot kernel meal

Amino acids composition of defatted apricot kernel cake were analyzed using Amino Acid Analyzer, Beckman 7300, according to the method of *the* **Lopaz *et al* (1991).** EZ chrom (software was used for analysis of data collection).

Functional properties of defatted apricot kernel cake

Protein solubility index (PSI) was determined according to the method described by **Thompson *et al* (1982)**. The emulsifying capacity (EC) of oil was evaluated as mentioned by **(Marshall *et al* (1975)**. And the emulsion stability (ES) was recorded in term of the foam remained percentage after several times up to 48 hr **(Dipak and Kumar (1986)**. On the other hand, the Foam capacity (FC) and Foam stability (FS) were determined by the method of **(Dipak and Kumar (1986)**. Water and oil absorption were estimated according to **Beuchat (1977)**.

Statistical analysis

The obtained data in this research has been statistically analyzed by using the statistical analysis system **SAS (1996)**.

RESULTS AND DISCUSSION

Chemical composition and minerals of apricot kernel

Chemical constituents and minerals content of apricot kernel are presented in **Tables (1 and 2)**. It could be noticed that apricot kernel contained 5.5%, 27.83%, 50.30%, 2.20%, 4.65, 11.32 and 3.16 moisture content, protein, crude lipid, ash, reducing sugar, total sugars and crude fiber, respectively. While, potassium, magnesium, phosphate, calcium, sodium, iron, zinc, cupper and manganese were 210, 400, 280, 85, 46, 13.0, 6.2, 2.80 and 0.51 mg/100g on dry basis respectively. These results agree well with **Hallabo *et al* (1975)**. And also, **Galal (1992)** who evaluated the chemical composition of the three different apricot seed kernels and found also, all kernels had high in total fats (42.2- 50.91%),crude protein (23.74- 25.70%) and crude fibers (15.08- 18.02%).

Physico- chemical characteristics of apricot kernel oil

Physical and chemical characteristics (specific gravity, reflective index, acid value, peroxide value, iodine number, Saponification number, color and smoke point) of apricot kernel oil are given in **Table (3)**. The specific gravity, RI, Red color (at 35 yellow) and smoke point were 0.9160, 1.4699, 2.00 and 240, respectively. Whereas, the values of acid, peroxide, saponification and iodinenumber were 0.14, 0.22, 189.7 and 108.0 for apricot kernel oils, respectively. These results are in accordance with those obtained by **(Galal 1992 and Halabo *et al* 1975)**.

Table 1. Chemical composition of apricot kernel

Constituents	g/100g dry basis
Moisture	5.50
Crude lipid	50.30
Crud protein	27.83
Total ash	2.20
Total Carbohydrate	16.51
Crude fiber	3.16
Total sugar	11.32
Reducing sugar	4.65
Non reducing sugar	6.67

Table 2. Minerals content of apricot kernel

Element	mg/100g dry basis
Potassium	210.00
Magnesium	400.00
Phosphate	280.00
Calcium	65.00
Sodium	35.00
Iron	13.00
Zinc	6.20
Cupper	2.80
Manganese	0.51

Table 3. Physico-chemical characteristics of apricot kernel oil

Properties	*Apricot kernel oil*
Specific gravity at 25°C (g/cm^3)	0.9160
Reflective index (RI) at 25°C	1.4699
Acid value (mg KOH/g oil)	0.14
Peroxide value (meq/Kg oil)	0.22
Iodine number	108.00
Red color (at 35 yellow)	2.00
Smoke point (C°)	240
Saponification number	189.7

The lipids of apricot kernels were determined and its found to be 50.3%. The extracted apricot kernel lipid was analyzed for their fatty acids composition, and the results recorded in **Table (4)**, the major fatty acid of the triacylglycerols was oleic (66.25%) followed by linoleic (25.57%) and plamitic (4.25%). On the other hand, the minor amounts of fatty acids composition were found to be 4.25, 3.13, 0.70 and 0.14% for palmitic, myristic, palmitoleic and palmitolinic, respectively. Also, results indicated that, the extracted lipid has relatively high content of unsaturated fatty acid (92.62%). These results are similar with obtained by **Galal (1992) and Samah (2001)** which reported that, apricot kernel oil has a high content of oleic acid, high quality vegetable oil with superior nutritional properties, relatively low content of saturated and content of high monounsaturates fatty acids and high oxidative stability. Also, these results are very close with **Dwivedi and Ram (2006)** they reported that, the lipid profile of apricot kernels from Ladakh apricot variety shows that, oleic acid was the primary fatty acid, and its content varied from 70.52 to 75.99% in the different tested samples. In addition, linoleic acid (14.3-22.83%), arachidic acid (0.08- 0.39%), stearic acid (0.34-1.22%) has been observed as saturated fatty acids component, But it was contained palmitic acid (3.50- 5.04%) and palmitoleic acid (0.56- 0.91%).

Table 4. Fatty acids profile for apricot kernel oil

Fatty acid (F.A)		*Apricot kernel oil %*
Myristic	**C:14:0**	3.13
Palmitic	**C:16:0**	4.25
Palmitoleic	**C:16:1**	0.70
Palmitolenic	**C:16:2**	0.14
Oleic	**C:18:1**	66.21
Linoleic	**C:18:2**	25.57
Total saturated F.A		7.38
Total unsaturated F.A		92.62

Total phenolics content

Our results found that, the concentration of total extracted phenolics in defatted apricot kernel cake was 625.37 mg/100g DAKC.

Effect of antioxidant activity for phenolic compounds extracted from defatted apricot kernel cake on corn oil

Table (5) shows the effect of various concentrations of phenolic compounds extracted from defatted apricot kernels cake and BHT as antioxidant on the development of peroxide value of corn oil during 7 days of storage at 60°C. It is evident from these results that, as the concentration of antioxidant increased the inhibitory effect on peroxide value POV increased. However after 7 days of storage at 60°C, POV values were 10.32, 8.63 and 8.00 meq/Kg^{-1} for corn oil treated with 200, 500 and 1000 ppm of phenolic compounds extracted from defatted apricot kernel cake and used as natural antioxidant. Whereas, the corresponding values were 10.23, 9.10 and 8.92 meq/Kg^{-1} at the same concentration of BHT. On the other hand, concentration of 500, 1000 ppm phenolic compounds from defatted apricot kernel cake was more effective for retareding development of POV value than using BHT. Also, it could be observed that, using 1000ppm BHT was almost the same effect of 500ppm defatted apricot kernel phenolic compounds on decreasing the development of POV. Moreover, either using 500 or 1000ppm apricot kernel phenolic compounds caused to great decline for POV developing of corn oil after 7 days of storage at 60C on comparing with that 1000ppm BHT. Therefore, adding natural phenolic compounds extracted from defatted apricot kernels as antioxidant with corn oil was more effective for decreasing the development of corn oil oxidation than using synthetic BHT as antioxidant. Our results may be due to the antioxidant activity of phenolic compounds is mainly due to their redox properties, which can play an important role in adsorbing and neutralizing free radicals, quenching singlet and triplet oxygen, or decomposing peroxides **(Zheng and Wang 2001)**. Phenolics compounds act as antioxidants in different ways. Hydroxyl phenols are good metal ion chelators. The implication of this is that metal-catalyzed non-enzymatic free radical generation which is suppressed in the presence of suitable phenolics. Also, phenolic structures often have the potential to interact strongly with protein, mediated both by their hydrophobic benzenoid rings and the hydrogen bonding potential of the phenolic hydroxyl groups **(Aruoma *et al* 1996)**. Phenolic may also inhibit oxidation by chelating divalent metal ions and thus reducing the formation of free radicals **(Robards *et al* 1999)**.

Table 5. Effect of phenolic compoundS extracted from defatted apricot kernel cake (DAKC) and BHT as antioxidants on peroxide value (POV) of corn oil during storage at 60°C for 7 days

Storage time (days)	Developing of POV (meq/Kg^{-1}) for corn oil treated withvarious concentrations of						
	Corn oil without antioxidant (control)	BHT			Phenolic compounds from DAKC		
		200 ppm	500 ppm	1000 ppm	200 ppm	500 ppm	1000 ppm
0	1.20	1.20	1.20	120	1.20	1.20	1.20
1	3.65	2.80	2.50	2.36	3.13	2.32	2.21
2	5.62	3.67	3.21	3.11	4.34	3.10	2.90
3	7.52	4.28	4.42	4.20	5.86	4.18	3.98
4	8.83	5.92	5.92	5.32	6.92	5.11	4.86
5	12.36	7.23	7.23	6.46	8.38	6.28	5.93
6	15.90	9.16	8.12	7.52	9.47	7.20	7.00
7	19.32	10.23	9.10	8.92	10.32	8.63	8.00

Amino acids profile for defatted apricot kernel meal

Amino acid contents and types are very important parameters to evaluate the protein. The amino acids composition of defatted apricot kernel meal was quantitavely determined by amino acid analyzer and the results is calculated as g amino acid/100g protein. Also, the meal was free from HCN.

Amino acids composition of defatted apricot kernel meal are illustrated in **Table (6)** Results revealed that, the presence of 16 amino acids in apricot kernel protein Whereas, the major amino acids were glutamic (20.75), aspartic (12.82), glycine (11.86), alanine (7.52) and phenylalanine (6.95) g/100g protein. On the other hand, serine, valine, isoleucine, tyrosine, arginine, lysine, histidine, leucine and therionine were 5.38, 4.73, 4.50, 5.93, 4.73, 1.83, 2.53, 3.26 and 0.82 g/100g protein respectively. These results are in agreement with **EL-Samkary *et al* (1995)** they reported that, the presence of twelve amino acid in apricot kernel, where the glutamic acid was the highest (25.61%) followed by aspartic acid (14.11%), glycine (11.86%), tyrosine (5.15%) and theronin (0.2%),respectively. However, the amino acids profile may be vary according to the variety and the cultivation area. Where **Alpaslan and Hayta (2006)** reported that, essential amino acid in apricot kernel constituted 32- 34% of the total amino acid. The major essential amino acids (m mol/100g meal) were arginine (21.7- 30.5) and leucine (16.2-21.6) and predominant nonessential amino acid was glutamic acid (49.9- 68.0).

Table 6. Amino acids profile for defatted apricot kernel cake

AMINO ACID	g/100g protein
Aspartic	12.82
Therionine	0.82
Serine	5.38
Glutamic	20.75
Glycine	11.86
Alanine	7.52
Valine	4.73
Methionine	1.18
Cystine	1.27
Isoleucine	4.50
Leucine	3.26
tyrosine	5.93
Phenylalanine	6.95
Histidine	2.53
Lysine	1.83
Arginine	4.73

Functional properties of defatted apricot kernels cake

Functional properties of defatted apricot kernels cake can be used to define how these proteins can be added to exiting foods and how they can replace more expensive traditionally proteins uses with these which obtained from waste or unuseful materials. Therefore, protein solubility, emulsifying properties, foam properties, water and oil absorption are of great importance to evaluate the functional properties of defatted apricot meal.

Protein solubility index (PSI)

Protein solubility index (PSI) of defatted apricot kernel cake over a range of pH 2.0 to 9.0 was studied and the data are presented in **Table (7)**. It was exhibited a relatively board apparent isoelectric point near values lies between pH 4.0 to pH 4.5. as the pH value charged towards acidic or alkaline medium, the PSI was gradually increased. The PSI at pH 2.0 was 35.35 followed by gradual decreases reaching the lowest value at pH 4.0 to 4.5. thereafter, the PSI was increased versus increasing pH value towards alkaline media reaching the maximum values at pH 9.0 being 63.06. in this respect, **Kinsella *et al* (1985)** indicated that the degree of solubility of a protein in a given aqueous system is the net result of both electrostatic and hydrophobic interaction between the protein molecules. The conditions under which the electrostatic repulsion between the molecules is greater than the hydrophobic interactions between the non polar particles on the surface favor increased protein solubility. Conversely, conditions under which hydrophobic interactions are greater than the electrostatic repulsions will result in inter molecular aggregation and decrease protein solubility.

Table 7. Protein solubility index of defatted apricot kernel cake as a function of pH values

pH values	Solubility index %
2.0	35.35
3.0	28.67
4.0	20.76
4.5	10.52
5.0	26.83
6.0	46.36
7.0	57.79
8.0	59.86
9.0	63.06

Emulsion capacity (EC) and Emulsion stability (ES)

The emulsion capacity is measured as the amount of oil which can be emulsified by a given amount of protein before collapse of the emulsion system **(Yao *et al* 1990)**.

Effect of pH on the emulsion capacity (EC) of defatted apricot kernel cake are shown in **Table (8)**. The emulsion capacity are gradually decreasing at pH 2.0 to pH 4.0. the EC at pH 2.0, 3.0 and pH 4.0 were 82, 80 and 75 ml oil/g sample, respectively. On the other hand, the higher values of EC were observed at pH 9.0 followed by 8.0, 7.0, 6.0, 5.0 and pH 4.5 respectively. The higher values of EC for apricot flour probably due to the presence of carbohydrates such as starch which absorbs more both water and oil **(Abd El-Aal *et al* 1986b)**. Also, they added that, apricot flour protein has promising functional properties which may be used to advantage in bakery products. In addition, these results are in agreement with **Sosulski (1976) and Abbey and Ibeh (1987)** they demonstrated that, emulsion capacity depends on the solubilized nitrogen and pH. They also, added that, emulsification capacity of soluble protein depends on hydrophilic and lipophilic protein.

The emulsion stability (ES) In comparing with percentage of aqueous phase separated after 48 hours are shown in **Table (8)**. It could be noticed that, the percentage of separated aqueous phase increased with increasing time between 0-48 hr at every tested pH for defatted apricot kernel cake. Emulsion stability of DAKC had higher at pH 8.0 than those obtained at pH of dispersion. These findings are agreed with obtained by **Nakai (1983)**. He explained this observation by the fact that emulsifying properties are dependent not only on solubility but also on hydrophile-lipophile balance (HLB) of the particular protein. If the HLB of the protein is close to optimal HBL for the oil, the emulsion capacity and stability of the protein would be high.

Foam stability (FS) and Foam capacity (FC)

Foam stability (Fs) is important since the usefulness of whipping agents depends on their ability to maintain the whip as long as possible. Foam stability of defatted apricot kernel cake as a function of pH values during 120 min are illustrated in **Table (9)**.

Table 8. Emulsion sapacity (EC) and emulsion stability (ES) of defatted apricot kernel cake as a functional of pH values

pH values	ml oil per g sample.(EC)	ml aqueous phase separated after time (min)							
		Zero	15	30	60	120	180	24h	48h
2.0	82	-	24	44.5	56.5	68.0	70.5	74.0	74.0
3.0	80		30	50.0	62.0	65.5	70	71.5	71.5
4.0	75		33.5	53.0	60.5	66.5	71.5	76.5	76.5
4.5	77		50.0	60.5	70.0	75.5	80.5	83.5	85.5
5.0	80		55.5	65.0	75.5	80.5	83.0	88.5	90.0
6.0	82		60.0	70.0	80.5	86.5	90.0	92.0	92.0
7.0	86		10.5	22.5	50.5	65.5	75.0	85.0	90.0
8.0	88		65.0	72.5	80.5	90.0	95.0	99	99.0
9.0	94		26.0	36.5	47.5	52.5	60.5	65.5	70.0

Table 9. Foam capacity and foam stability of defatted apricot kernel cake as a functional of pH values

pH values	Volume of foam (vol) after time (min)							
	Zero	5	10	20	40	60	90	120
2.0	650	620	590	550	450	300	100	60
3.0	400	200	100	30	0	0	0	0
4.0	320	120	30	0	0	0	0	0
4.5	200	150	120	60	50	50	50	50
5.0	220	200	150	100	60	60	0	0
6.0	250	225	225	200	100	80	50	0
7.0	260	230	200	150	125	100	60	0
8.0	280	250	225	200	150	100	40	0
9.0	300	275	225	200	175	100	60	50

The foam stability of defatted apricot kernel flour at pH 2.0 after 120 min was higher than other tested pH values while, FS of defatted apricot kernel meal were 590, 100, 30, 120, 150, 225, 200, 225 and 225 ml after 10 min at values of pH 2.0, 3.0, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0 and 9.0, respectively. On the other hand, no foam was observed at pH 3.0, 4.0, 5.0, 6.0, 7.0 and pH 8.0 after 40, 20, 90, 120, 120 and 120 min respectively. **Kinsella (1981)** observed that some of the properties desired for the facile of foam formation by proteins such as molecular flexibility, don't ensure stability while molecular characteristics interaction and cohesiveness are not compatible with facile foam formation. Foam stability is related to the rate of decrease of surface tension of the air/water interface caused by adsorption of protein molecules **(Shanmugasundaram and Venkataraman 1989)**.

Foam capacity of defatted apricot kernel flour at values of pH 2.0 to pH 9.0 are shown in Table (9). The foam capacity was higher at acidic pH values (pH 2.0 to pH 4.0) than alkaline pH values (pH 5.0-pH 9.0). the foam capacity in defatted apricot kernel cake were 650, 400, 320 and 200 ml at pH 2.0, 3.0, 4.0 and pH 5.0 respectively. On the other hand, the FC were 220, 250, 260,280 and 300 ml at pH 5.0, 6.0, 70, 80 and pH 9.0 respectively. While the corresponding values were 100, 200, 150, 200 and 200 after 20 min, respectively.

Water and oil absorption

Water binding is useful indication if whether flours or protein isolates be incorporated into aqueous or food formulation especially those involving dough handling. Our results indicated that, each 1.0g of defatted apricot kernel flour absorbed 3.24 g water and 3.10g corn oil. These results are very close with reported by **EL- Samkary *et al* (1995)** where, the oil defatted flours of apricot kernel were 3.32 and 3.47. **Abd El-Aal *et al* (1986a)** reported that, the high values of water and oil absorption capacities for apricot kernel flour may be due to the presence of starch, which absorbs more water and oil.

REFERANCE

A.O.A.C. (1995). Official Methods of Analysis. 16th Ed. Association of Official Analytical Chemists. Published by the Association of Official Analytical Chemists, Inc, Washington D.C. USA.

A.O.A.C. (2000). Official Methods of Analysis. 17th Ed. Association of Official Agriculture Chemists, Washington, D.C..

A.O.C.S. (1998). Official Method and Recommendation Practices of the American Oil Chemists Society 4th Ed., American Oil Chemists Society Press, Champaign, USA.

Abbey, B.W. and G.O. Ibeh (1987). Functional properties of raw and heat processed Brown Bean flour. **J. Food Scl., 52: 406-412.**

Abd El-Aal, M.; K.M. Khalil and E.H. Rahma (1986a). Apricot kernel oil: Characterization chemical composition and utilization in some baked products. **J. Food Chem. 19(44): 287-293.**

Abd El-Aal, M.H.; M. Hamza and E.H. Rahma (1986b). In vitro digestibility, physicochemical and functional properties of apricot kernel proteins. **J. Food Chem. 19(44): 197-203.**

Alpaslan, M. and M. Hayta (2006). Apricot kernel: Physical and chemical properties. **J. American Oil Chemists Society. 83 (5): 469-471.**

Aruoma, O.I.; J.P. Spencer; R. Rossi; R. Aeschbach; A. Khan; N. Mahmood; A.M. Munoz; A. Murcia; J. Butler and B. Halliwell (1996). An evaluation of the antioxidant and antiviral action of extracts rosemary and Provencal herbs. **Food Chem. Toxicol., 34: 449-456.**

Azizah, A.H.; N.M.N. Nik-Ruslawati and T. Swee-Tee (1999). Extraction and characterization of antioxidant from coca by-products. **Food Chem., 64: 199-202.**

Beuchat, L.R. (1977). Functional and electrophoretic characteristics of succinylated peanut flour protein. **J. Agric. Food Chem. 25: 235-261.**

Bisson, L.F.; A.L. Waterhouse; S.E. Ebeler; M.A. Walker and J.T. Lapsley (2002). the present and future of the international wine industry. **Nature, 418: 696-699.**

Dipak, K. and K.D. Kumar (1986). Functional properties of rapeseed products with varying phytic acid contents. **J. Agric. Food Chem. 34:775-783.**

Dwivedl, D.H.; and R.B. Ram (2006). Chemical Composition of Bitter Apricot Kernels from Ladakh India. International Society for Horticultural Science. http://www.actahort.org/

Eberhardt, M.V.; C.Y. Lee and R.H. Liu (2000). Nutrition-antioxidant activity of fresh apples. **Nature, 405: 903-904.**

El-Samkary, M.A.; M.G. El-Shemy and I.M. Galal (1995). Functional properties of apricot and peach kernels. **Proceedings of the XXV Annual Meeting (Working Group 5: Environmental Aspects Energy Use. pp. 30-44.** Piacenza-Italia.

Femenia, A.; C. Rossello; A. Mulet and J. Canellas (1995). Chemical composition of bitter and sweet apricot kernels. **J. Agric. Food Chem., 43(2): 356-361.**

Galal, I.M.I. (1992). Chemical Valuation and Utilization of Some Wastes from Caning Industry. pp. 36-40 & 46-48. MSc. Thesis, Fac. of Agric. Ain Shams Univ., Cairo Egypt.

Gandhi, V.M.; M.J. Mulky; B. Mukerji; V.J. Iyer and K.M. Cherian (1997). Safety evaluation of wild apricot oil. **Food and Chemical Toxicology, 35(6): 583-587.**

Hallabo, SA.A.S.; F.A. El-Wakeil and M.K.S. Morisi (1975). Chemical and physical properties of apricot kernel, apricot kernel oil and almond kernel oil. **Egypt, J. Food Sci., 3: 1-6.**

Halliwell, B.; Rafter J. and Jenner A. (2005). Health promotion by flavonoids, tocopherols, tocotrienols, and other phenols: direct or indirect effects? Antioxidant or not? 1–4. **Am J Clin Nutr 81: 268S–276S.**

Hazell, P. (2000). Winery Environmental Management Regulation: A State Comparison. pp. 516- 524. 1st National Wine Industry Environmental Conference. Royal Adelaide Showground's, Australia.

Kinsella, J.E.; S. Damodaran and B. German (1985). Physicochemical and functional properties of oil seed protein with emphasis on soy proteins. **New Protein Foods 5: 108-179.**

Kinsella, J.E. (1981). Functional properties of proteins possible relationship between structure and function in foam. **J. Food Chem. 7: 273-278.**

Lazos, E.S. (1991). Composition and oil characteristics of apricot, peach and cherry kernel. **Grasas y Aceites. 42: 127-131.**

Lopaz, P.O.; A.C. Falomir and O.O. Pezguaz (1991). Chickpea protein isolate, phsio-chemical functional and nutritional characterization. **J. Food Sci. 56: 726-729.**

Markle, G.; E. James C. Petersen and M.O. Wagenfeld (1978). Notes from the cancer underground: Participation in the Laetrile movement. **Social Science & Medicine. Part A: Medical Psychology & Medical Sociology, 12: 31-37.**

Matthaus, B. (2002). Antioxidant activity of extracts obtained from residues of different oil seeds. **J. Agric. Food Chem., 47: 2350-2354.**

Marshall, W.H.; T.R. Duston; Z.L. Carpenter and C. Smith (1975). A simple method of emulsion end-point determination. **J. Food Sci., 40: 896-903.**

Nakai, S. (1983). Structure-function relationship of food protein hydrophobicity. **J. Agric. Food Chem. 31: 672-675.**

Robards, K.; P.D. Pernzler; G. Tucker; P. Swatsitang and W. Glover (1999). Phenolic compounds and their role in oxidative process in fruits. **Food Chem., 66: 401-436.**

Samah, S.M. Allam (2001). Utilization of some untraditional sources of high oleic acid oils for improving vegetable oil stability. **Sostanze Grasse 78(66): 337- 341.**

SAS (1996). Statistical Analysis System. SAS User's Guid: Release 6.12 Edition SAS Inst. Inc Cary, NC, USA.

Shanmugasundaram, T. and L.V. Venkataraman (1989). Functional properties of defatted and detoxifie medhuco (*Medhuca butyraceae*) seed flour. **J. Food Sci., 54: 352-359.**

Sosulski, F.W. (1976). Functional properties of rapeseed flour concentrates and isolates. **J. Food Sci., 41: 1349-1352.**

Thompson, L.U.; E. Reyes and J.D. Jones (1982). Modification of the Na hexametaphosphate extraction precipitation technique of rape see protein concentrate preparation. **J. Food Sci., 47: 982-988.**

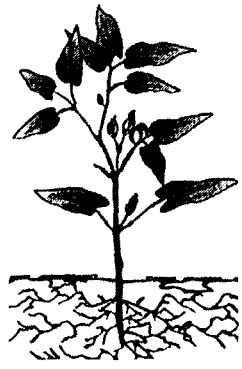
Tunçel, G.; M.J.R. Nout and L. Brimer (1998). Degradation of cyanogenic glycosides of bitter apricot seeds (Prunus armeniaca) by endogenous and added enzymes as affected by heat treatments and particle size. **J. Food Chemistry, 63(1): 65-69.**

Volotavskaya, S.N.; L.M. Zalevskaya and V.A. Melnikova (1980). Refinin oil from Peach kernels. **Moslozhirovaya Promyshlennost. 12: 21-22.**

Yao, J.J.; K. Tanteeratarm and L. Wei (1990). Effect of maturation and storage on solubility. Emulsion stability and gelation properties of isolated soy proteins. **J. AOCS. 67: 974-980.**

Zheng, W. and S.Y. Wang (2001). Antioxidant activity and phenolic compounds in selected herbs. **J. Agric. Food Chem., 49: 5165-5170.**

حوليـــات العلـــوم الزراعية
جامعة عين شمس ، القاهرة
مجلد(٥٤)، عدد (٢)، ٣٧٣-٣٨٣، ٢٠٠٩



التركيب الكيماوي وخصائص زيت ودقيق نوى المشمش منزوع الدهن

[٢٩]

علاء عزوز[١]- علية محمد الغرابلي[٢]- عفت مهدي رزق[١]

١- معهـد بحـوث تكنولوجيـا الأغذيـــة - مركـز البحـوث الزراعيـة - الجيـزة - مصر

٢- قسم الاقتصاد المنزلي- كلية التربية النوعية- جامعة عين شمس- العباسية- القاهرة- مصر

الموجـــز

استهدفت هذه الدراسة التعرف علـي التركيـب الكيماوي لنوى المشمش ومعرفة خـصائص الزيـت والدقيق الخالي من الدهن المتحصل عليهما من نـوى المشمش وكذلك دراسة الخصائص الوظيفيـة لـدقيق نوى المشمش الخالي من الدهن.هذا ولقد أتضح مـن دراسة التركيب الكيماوي أن محتوى نوى المـشمش من الرطوبة،البروتين، الدهون، الرماد، والـسكريات الكلية كـان ٥,٥، ٢٧,٨٣، ٥٠,٣٠، ٢,٢، ١١,٣٢، ٣,١٦% علي التوالي. بينما احتوى نـوى المـشمش علي ٢١٠ ، ٤٠٠ ، ٢٨٠ ، ٢,٨/ ١٠٠جـم عينـة جافة من عناصر البوتاسيوم ،المغنسيوم، الفوسـفات، المنجنيز علي التوالي. ولقد أظهرت نتـائج خـواص زيت نوى المشمش أن هذا الزيـت كـان ذو كثافـة نوعية مقدارها ٠,٩١٦ جم/سم^{٣} ، ذو معامل انكـسار قيمته ١,٤٦٩٩ ولون مقداره(٢) كلون أحمـر عنـد (٣٥ أصفر) بينما كان رقم الحموضـة ٠,١٤، رقـم البيروكسيد ٠,٢٢، الرقم اليودي ١٠٨ ونقطة التدخين ١٨٠,٧°م. ولقد تم التعرف علي محتوي زيت نـوى المشمش من الأحماض الدهنية والتي تم فصلها بجهاز كروماتوجرافي الغاز أن الأحماض الدهنية الرئيـسية كانت الأوليك بنسبة ٦٦،٢٥%، واللينوليـك بنـسبة ٢٥،٥٧% بينما كان دقيق نـوى المـشمش منـزوع الدهن والذي تم الحصول عليه من نوى المشمش خاليا من حمض الهيدروسينيك وأحتوى علي ١٦ حمـض أمينـي وكانـت الأحمـاض الأمينيـة الجلوتاميـك (٢٠،٧٥%)، الأسـبارتيك (١٤,١١%)و الجليـسن (١١,٨٦%) هي الأحماض الامينية الأساسية له. ولقد اتضح من دراسة الخصائص الوظيفية لـدقيق نـوى المشمش منزوع الدهن أن معامل ذوبان البروتين كان متزايدا كما زاد رقم الأس الهيدروجيني بينما لـوحظ أن أعلي قيمة للكفاءة الاستحلابية كانت عند رقم أس هيـدروجيني مقـدارة ٩,٠بينمـا لـوحظ أن ثبـات المستحلب كان عند رقم أس هيدروجيني مقداره ٨ بعد ٤٨ ساعة ولقد سجلت ثبات الرغوة قيمـا مقـدارها ٥٩٠ ، ١٠٠، ٣٠ عند أرقام أس هيدروجيني (رقم حموضة) ٢، ٣، ٤ وأيضا فلقد لوحظ أن كل ١حـم من الدقيق منزوع الدهن له القدرة علـي امتـصاص ٣,٤٩ حم ماء، ٣,١ جم زيت ذره. ومن ناحية أخري فلقد وجد أن كل ١٠٠جم دقيق يحتوي علي ٦٣٥,٣٧ ملجم من المركبات الفينولية ومن دراسة تأثير هـذه الفينولات علي معدل أكسدة زيت الـذرة اتـضح أن استخدامه مع زيت الـذره بتركيـزات ٥٠٠، ١٠٠٠ جزء/ مليون كان أكثر فاعلية في تقليل معدل تطـور رقم البيروكسيد عن اسـتخدام بيوتليـد هيدروكـسي تلوين(جزء/ مليون) وعلي هذا فإنه يوصي بإضـافة الفينولات الطبيعية والمستخلصة مـن دقيـق نـوى المشمش خالي الدهن كمضادات أكسدة للزيوت لما لها من فوائـد صـحية وكبـدائل لمـضادات الأكـسدة الصناعية.

تحكيـم: أ.د مجدى جمعه الشيمى
أ.د صائب حافظ