PRODUCTION OF TAHINA SUBSTITUTE FROM FLAXSEED (*Linum Usitatissimum*)

Journal

Arafat, S. M., Amany, M. M. Basuny and Dalia, M. M. Mostafa

J. Biol. Chem. Environ. Sci., 2008, Vol. 3(1): 681-696
www.acepsag.org

Oils and Fats Research Department, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

ABSTRACT

Flax seed were cleaned, roasted and grinded in stone-mill to obtain flax butter (tahina). The obtained flax tahina was subjected to chemical analysis (chemical composition, physico-chemical properties, fatty acids composition, amino acids profile, mineral content) and organoleptic evaluation and compared with sesame tahina. Results indicated that there was reasonable similarity in proximate analysis of both flax and sesame tahina, except that flax tahina was characterized with high fiber content, while sesame tahina contained higher amount of oil. Fatty acids composition of both flax and sesame tahina was almost the same, while the percentage of lenolenic acid was higher in flax tahina than sesame tahina.

The protein of flax tahina was low in most essential amino acids. The content of these amino acids may be affected by the heat treatment (roasting). Analysis of minerals by Atomic absorption indicated that sesame tahina contained amounts of Ca, Na, Cu, Mn and Zn more than that found in flax tahina. The organoleptic evaluation of flax tahina indicated that the product characterized with acceptable taste, odor, color and texture and could be consumed directly as salad dressing. Generally the chemical and organoleptic evaluation of flax tahina indicated that the possibility of using this product directly as a salad or halawa tahinia production.

Key words: Flax seed, Linseed, Omega-3-fatty acids. Tahina, Stability, Storage, Organoleptic evaluation.

INTRODUCTION

Flax (*Linum usitissimum*), also known as linseed has a long history of food use in Europe and Asia. In the US, flax seed and flaxseed meal have found market acceptability as a component in some cereal, specialty breads, cookies, and in salad dressings (Wiesenfeld *et al.,* 2003, Young *et al.*, 2005 and Mohamed *et al.*, 2007). By virtue of the presence of physiologically active food components that may provide health benefits beyond basic nutrition, flaxseed is often grouped into one of several categories: "functional foods", "bioactive food" and an "endocrine active food" (Thompson, 1993, Thomas et al., 2003 and Wendland *et al.*, 2006). Among the reported potential health benefits associated with flaxseed are decreased risk of cardiovascular disease (Craig., 1999, and Harper *et al.*, 2006) and decreased risk of cancer (Thompson., 1998 Craig., 1999 and Harris., 2005), antiviral and bactericidal activity (Simpoulous., 2004), anti-inflammatory activity (Clark *et al.*, 2000 and Clark *et al.*, 2001), laxative effect (Ranich *et al.*, 2001), and prevention of menopausal symptoms and osteoporosis (Kurzer and Xu., 1997 and Sayed *et al.*, 2007).

The controversy about flaxseed nutritional benefit and safety is due in part to its complex nature. Flaxseed contains nutrient, non-nutrient and anti-nutrient components. Nutrients effects depending upon dose, timing and length of exposure. Among the bioactive nutrient in flax seed is the omega-3 fatty acid, α-linolenic acid, C18:3). In a previous study, 10 % ground flaxseed fed to rats was shown to alter both fatty acid composition and function of peritoneal exudates cell (Acikgoz and Kockar, 2007). In addition, omega-3 fatty acids, including C18:3 are reported to lower serum cholesterol and triglyceride levels (Craig., 1999 and Hasler *et al* 2000).

Other health concerns are related to non-nutrient components in flaxseed. Secoisolariciresinol diglycoside is a precursor of the lignans, enterodiol and entrolactone (Orcheson., *et al* 1998 and Wiesenborn *et al.,* 2005). Once formed, these lignans exert weak estrogenic and anti-estrogenic effects. These estrogenic properties of flaxseed have been used as a part natural hormone replacement therapy (Brzezinski and Dabi., 1999 and Holub., 2002).

Among the anti-nutrient components in flaxseed that could have an adverse health effect is linatine, which is known to bind vitamin

B6. There fore eating diets rich in flaxseed could cause a B6 sufficiency (Thompson, 1993), leading to an increase homocyteine and renal insufficiency (Dave and Giuseppe, 1997 and Lindner *et al.*, 2002).

The major constituents of flax seed are oil (36%), protein (24%) and fiber (32%) (Thomas, *et al.,* 2003, Stuglin and Prasad, 2005 and Siemens and Daun, 2005). Tahina is the product resulting from the grinding of de-hulled roasted sesame seeds (Egyptian Standard Specifications, 2006). In Egypt, sesame seeds are considered the principal and traditional raw material used in tahina and halva tahina industry (El-Sherbeeny *et al.*, 1985 and Shaheen *et al.,* 1991) and tahina is consumed in salad dressing. Shahidi *et al.,* (1997) stated that the produced sesame tahina contains about (54%) oil and (28%) protein which contain high content of the essential amino acids. The soaking step (using warm water (50°C for 30hr) do not effect on rather the fatty acids composition or organoleptic test (Damir, 1984 and El-Adawy., 1999).

The main objective of this study was to produce flax seed tahina as sesame substitute in halawa tahinia manufacture. This investigation aimed to determine, the proximate analysis, fatty acids, amino acids and minerals composition of both sesame and flaxseeds.

MATERIALS AND METHODS

Source of seeds: Flax seed (*Linum usitatissimum*) variety Sakha-2 was obtained from Field Crop Research Institute, Agriculture Research Center, Giza, Egypt and de-hulled sesame seeds (*Sesamum indicum L.)* and sesame tahina (El-Rashidi) were came from El-Rashidi El-Mizan Factory for Sweets, Cairo, Egypt.

Technological processes: Flax and sesame tahina were prepared as follows: flax and sesame seeds were sorted, dehulled, roasted at 110-180°C for about 60- 120 min then cooled and sifted. Grinded through grinding stone- mill to produce flax and sesame butter (Tahina). The butter of either flax or sesame seeds were gradually mixed together at different ratios (Table 1) to produce tahina substitute samples were analyzed for their some organoleptic tests and for some physical and chemical properties at zero time and after 6 months from the storage.

Table (1): Ingredients of tahina substitute samples.

Ingredients	A	B	C	D	E
Sesame seed	98.80	0.00	73.8	48.8	25
Flaxseed	0.00	98.80	25	50	73.8
Antioxidants	0.2	0.2	0.2	0.2	0.2
Emulsifiers	1.00	1.00	1.00	1.00	1.00

Chemical analysis: Moisture, protein, fat, carbohydrates, ash and fiber were determined in both flax and sesame seeds and tahina according to the methods described by the A. O. A.C. (2000).

Fatty acids composition: Fatty acids composition of both flax and sesame seeds and tahina was determined by gas liquid chromatography according to the method of (Leth *et al.,* 1998).

Determination of some physico-chemical properties of tahina substitute samples: Refractive index at 25°C, acid value (%as oleic acid), peroxide value (meq. O_2 /kg oil) and spectrophotometric indices (k232 and k270) determined in tahina substitute samples according to the methods described in A. O.A.C., (2000).

Amino acids composition: Amino acids compositions of investigated tahina were determined using a Mikrotechna AAA 881 automatic amino acid analyzer according to the method described by (Moore and Stein., 1963). Meanwhile, tryptophan content was chemically determined by the method of (Miller, 1967). Available lysine content was determined according to the method described by (Capenter., 1960).

Minerals composition: The minerals composition (Ca, Mg, Na, Cu, Mn and Zn) were determined using atomic absorption apparatus, according to the methods described by A. O. A. C., (2000).

Organoleptic evaluation: The organoleptic evaluation of the produced tahina including taste, color, texture, odor and overall acceptability was carried out using the mean of ten person judgments according to the methods described by (Gafar., 1971 and Allam., 1981).

Statistical analysis: Results are expressed as the mean value ± standard deviations (SD) which were determined in duplicate. Data were statistically analyzed using analysis of variance and least significant difference using (SAS/STAT, 1994). Significant differences were determined at the $P < 0.05$ level.

RESULTS AND DISCUSSION

Chemical composition of flaxseed, sesame seed and tahina samples:

The chemical analysis in Table (2) indicated some variations concerning the chemical composition of flaxseed, sesame seed and tahina samples were investigated. Moisture content of flaxseed and sesame seed were significantly higher than tahina samples (flax, sesame and other blends). Meanwhile, the fat content of sesame tahina, blend C and blend D were found to be for some extent higher than that of flax tahina and blend E. Protein content it could be observed from the same table that protein content of flax tahina and blend E were lower when compared with sesame tahina and blend C. It could be also noticed that fiber of flaxseed and tahina were higher than sesame seed and tahina. Only slight differences could be observed in ash content was as 6.40 %, 6.20 %, 5.80 % and 5.70 %, respectively. However, the total carbohydrates of the seeds (flax and sesame) and tahina (flax and sesame) samples were as 16.50, 16.40 %, 16.35 % and 16.25% respectively. Generally from above mentioned data it could be observed that there is no significant variation between the chemical analysis of flax tahina and sesame tahina. Therefore the flax tahina can be replacing the sesame tahina as a source of fat, protein and carbohydrates in salad and halawa tahinia making.

Physico-chemical properties of tahina samples:

The results in Table (3) illustrated that the physico-chemical properties of tahina samples (flax and sesame) compared with tahina El-Rashidi. It could be observed that the refractive index of flax tahina was higher than sesame. The acid value (% as oleic acid) of flax tahina was higher than sesame tahina, 0.7% and 0.50% respectively. The peroxide value (meq/ kg oil) and spectrophotometric indices (k232nm and k270nm) of flax tahina were higher than sesame tahina may be due to the higher percentage of linolenic acid in flax seed than sesame seed.

Table (2): Chemical composition of flaxseed, sesame seed and tahina substitute samples.

Components (%)	Seeds		Tahina						LSD value at P ≥ 0.05
	Sesame	Flax	El-Rashidi	A	B	C	D	E	
Moisture	7.21	6.90	1.65	1.89	1.85	1.86	1.88	1.87	0.40
Oils	50.85	41.69	55.12	56.00	51.65	52.31	53.71	54.67	1.20
Protein	27.70	28.42	27.20	28.00	29.20	28.45	28.50	28.59	0.55
Carbohydrates	6.40	7.90	8.42	6.00	7.70	7.43	6.96	6.21	0.60
Ash	3.35	3.41	3.30	3.41	3.40	3.42	3.38	3.39	0.15
Fiber	4.49	11.68	4.31	4.70	6.20	6.53	5.57	5.27	1.53

Values in each column followed by the same letter are not significantly different at P ≥ 0.05.

Table (3): Pysico-chemical properties of tahina substitute samples.

Parameters	Tahina						LSD value at P ≥ 0.05
	El-Rashidi	A	B	C	D	E	
Refractive Index at25°C	1.4711	1.4701	1.4781	1.4720	1.4740	1.4761	0.005
Free fatty acid (% as oleic acid)	0.33	0.20	0.360	0.22	0.26	0.28	0.10
Peroxide value meq.o_2/kg oil	1.21	0.50	0.70	0.56	0.63	0.69	0.340
K232nm	0.015	0.001	0.002	0.012	0.012	0.011	0.010
K270nm	0.009	0.006	0.000	0.000	0.000	0.000	0.000

Values in each column followed by the same letter are not significantly different at P ≥ 0.05.

Fatty acids composition of flaxseed, sesame seed oils and tahina sample:

The fatty acids composition of both flax and sesame was investigated by means of gas liquid chromatography technique. The results obtained are tabulated in Table (4). It could be observed that flax seed oil was found to have high content of unsaturated fatty acids as compared with that of sesame seed oil. However, the unsaturated fatty acids found in flaxseed oil were only linoleic and linolenic acids, while there were oleic and linoleic acids in sesame seed oil. The fatty acid composition of flaxseed oil indicated that flaxseed oil rich in essential fatty acids and omega- 3- fatty acids and could be replace sesame oil in tahina making. From table (4) it could be also noticed that the fatty acids composition of tahina samples (flax and sesame). Linolenic acid C18:3 in flax tahina were the predominant fatty acids while sesame tahina linoleic acid C18:2 were the major unsaturated fatty acids.

During soaking, of the seeds may be partially occurred little changes in the composition of the fatty acids present. Meanwhile the high temperature used during roasting as well as heat regenerated during may also affect the fatty acids composition. From Table (4) it could be seen that no great differences between the fatty acids composition of both flax and sesame tahina samples were found. Therefore flax tahina can be partially or completely participate or substitute sesame tahina.

Table (4): Fatty acid composition of flaxseed, sesame seed and tahina substitute samples.

Fatty Acid Composition	Seeds		Tahina						LSD value at $P \geq 0.05$
	Sesame	Flax	El-Rashidi	A	B	C	D	E	
C14:0	0.50	0.03	0.55	0.50	0.03	0.41	0.32	0.23	0.20
C16:0	8.10	5.10	7.98	8.60	5.10	7.22	7.00	6.69	0.15
C16:1	4.50	0.00	4.60	4.50	0.00	3.80	3.40	1.70	0.16
C18:0	0.50	3.53	0.40	1.30	3.53	0.60	2.20	2.70	0.20
C18:1	44.00	19.50	44.50	44.00	21.50	37.11	30.14	24.90	0.90
C18:2	40.00	12.30	40.27	40.00	12.30	33.50	24.73	21.60	0.55
C18:3	0.80	59.50	0.60	0.00	56.50	16.20	31.50	41.47	0.60
C20:0	1.00	0.01	0.80	0.50	0.01	0.75	0.47	0.40	0.33
C20:1	0.50	0.03	0.30	0.50	0.03	0.40	0.23	0.21	0.20
Total saturated	10.20	8.67	9.73	10.20	8.67	8.99	10.00	10.12	0.20
Monounsaturated	49.00	19.53	49.4	49.00	21.53	41.31	33.77	26.81	0.50
Polyunsaturated	40.80	71.80	40.87	40.80	69.80	49.70	56.23	63.07	0.90
Total unsaturated	89.80	91.33	90.27	89.80	91.33	91.01	90.00	89.98	0.66

Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

Amino acids composition of flaxseed, sesame and tahina samples:

From the nutritive point of view, it is necessary to evaluate the protein of both flaxseed and sesame seed. Thus, the protein of both flax and sesame seeds were analyzed for its amino acids composition. Table (5) shows the amino acids of the protein of flax and sesame seeds and tahina samples. From Table (5) it could be noticed that flaxseed protein was found to be richer in all essential and non-essential amino acids when compared with sesame protein. It could be concluded that the protein of both flax and sesame seeds were found to have isoleucine, leucine, lysine, cystine, methionine, tyrosine, phenylalanine, theronine, tyrptophan, valine, aspartic, glutamic, serine, praline, histidine, arginine glycine and alanine but in varied concentrations.

Table (5): Amino acid composition of flaxseed, sesame seed and tahina substitute samples.

Amino acids	Seeds		Tahina						LSD value at $P \geq 0.05$
	Sesame	Flax	El-Rashidi	A	B	C	D	E	
Isolucine	4.00	3.51	3.92	3.89	3.81	3.97	4.10	4.30	0.20
Leucine	3.93	3.88	3.96	3.94	4.11	4.23	4.31	4.61	0.11
Lysine	3.86	3.21	3.76	3.81	2.52	2.44	2.49	2.51	0.25
Cystine	3.24	1.40	3.28	3.69	1.91	2.10	2.16	2.21	0.20
Methionine	4.15	1.73	3.13	3.29	2.00	2.01	2.07	2.10	0.15
Phenyalanine	6.15	5.45	6.12	5.13	5.29	5.41	5.87	6.13	0.60
Throinine	4.85	3.95	4.80	4.82	3.91	3.92	3.92	3.94	0.41
Tryptophan	2.62	4.39	1.67	2.50	3.51	2.88	3.10	3.22	0.20
Tyrosione	4.31	2.48	4.33	4.30	2.39	2.40	2.41	2.42	0.23
Valine	4.00	5.52	4.88	4.00	4.56	4.80	5.00	5.18	0.90
Total essutial amino acid	40.11	34.52	39.85	39.37	34.01	34.16	35.43	36.62	0.85
Alanine	3.74	4.62	3.80	3.78	4.00	4.11	4.22	4.41	0.10
Arginine	10.87	8.48	10.89	8.93	6.96	9.68	9.23	8.64	0.15
Proline	3.40	4.15	3.36	3.61	3.70	3.84	3.97	4.07	0.15
Serine	3.83	5.06	3.85	4.05	4.23	4.47	4.59	4.83	0.10
Aspartic acid	8.13	9.75	8.00	8.31	8.49	8.67	8.98	9.21	0.25
Glutamic	21.62	20.42	21.82	21.60	20.42	21.35	21.45	21.50	0.10
Glycine	4.39	5.79	4.44	4.38	5.77	5.61	5.21	4.67	0.10
Histidine	2.95	3.20	2.99	2.91	3.20	3.10	3.00	2.96	0.13
Total nonessntial amino acid	59.89	65.48	60.15	60.63	65.99	65.84	64.57	63.38	0.45

Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

Comparing the amino acids composition of both flax and sesame protein with FAO pattern it could be seen that sesame protein was greatly deficient in lysine, theronine, valine, isoleucine, leucine and phenylalanine, meanwhile flax seed protein contained the same essential amino acids in amounts comparable for that of FAO patterns. The high content of essential and non- essential amino acids of flax seed protein confirmed the superiority for using flaxseed in tahina making.

From Table (5) it could be seen that the amino acids pattern of flax and sesame tahina are not similar to that obtained for seed protein. A pronounced loss in most amino acids of tahina samples (flax and sesame) could observed when compared with that found in seeds. However, the loss in the amino acids was found to range 10 to 50 %. The greatest loss could be observed in most of amino acids present, while the lowest loss was occurred only in lysine and arginine. It could be concluded that the decrease occurred in the amino acids present can be attributed to the influence of both heat treatment (roasting process) and may also to the generated heat produced from the pressure during grinding.

Mineral content:

The mineral content of flax and sesame seeds and tahina samples (calculated as mg / 100g sample) is shows in Table (6). The mineral content mainly calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, and manganese were determined using atomic absorption technique. From Table (6) it could be mentioned that regarding Mg, Mn, and Na, no great differences were found in both flax and sesame seeds. Ca and Cu content in sesame seed was higher than its content in flaxseed. Meanwhile, flaxseed contained Zn in amounts higher than that in sesame seeds. In addition data in table (6) revealed no great differences between the mineral content of tahina samples.

Sensory evaluation of flax and sesame tahina:

The results concerning sensory evaluation of tahina produced from different seeds (flax and sesame) used are shown in Table (7). It could be noticed from Table (7) that tahina substitute sample B made from 100 % flax seed was characterized with low acceptable were from taste, odor, and overall acceptable with total score 30. 20.

Table (6): Mineral content of flaxseed, sesame seed and tahina substitute samples.

Minerals Content	Seeds		Tahina						LSD value at $P \geq 0.05$
	Sesame	Flax	El-Rashidi	A	B	C	D	E	
Calcium	165	184	172	166	185	176	172	169	1.00
Iron	585	497	578	585	497	511	541	567	4.50
Magnesium	347	985	349	347	986	850	720	511	15.20
Phosphorus	435	315	441	434	317	335	371	400	20.10
Potassium	639	531	640	640	531	553	581	601	5.50
Sodium	31	30	31	30	31	31	31	31	6.50
Zinc	351	290	352	351	290	300	320	344	10.11
Copper	124	760	128	123	762	670	457	286	12.40
Manganese	313	435	314	315	435	400	380	357	15.30

LSD value at $P \geq 0.05 = 0.010$

Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

Table (7): Organoleptic evaluation of tahina substitute samples produced from

Parameters	Tahina					
	El-Rashidi	A	B	C	D	E
Taste	10.00	9.00	6.50	9.30	8.70	8.10
Color	10.00	9.00	3.20	8.90	8.20	7.90
Texture	10.00	9.00	7.20	9.20	8.30	8.00
Odor	10.00	9.00	6.50	9.00	8.50	8.11
Overall	10.00	9.00	6.80	9.10	8.60	8.30
Total score	50.00	45.00	30.20	44.50	42.30	40.41

Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

However, from the same Table (7) flaxseed used instead of sesame seed up to 50 % gave some what similar scores compared to the control sample (A). It is great importance to conclude from the obtained results that flaxseed can be used instead of sesame seeds up to 50 % in the making of tahina substitute samples. Therefore, from the above result it can be concluded that tahina substitute sample no. C, D and E which made from flaxseed up to 50 % instead of sesame seeds are suitable for using, while sample no. B are not suitable for using that they gave the lowest score specialist in over all acceptability.

Effect of the store at room temperature for 6 months on the physico-chemical properties of tahina substitute:

The changes of the physico-chemical properties (acid value, peroxide value and spectrophotometric indices k232nm and k270nm) in tahina substitute samples during store for 6 months at room temperature were studied and the results are shown in Table (8, 9, and 10). From the Tables, it could be observed that physico-chemical properties of tahina substitute samples were slightly increased during the storage period. All the values of physico- chemical properties for all samples were under limiting of the Egyptian standard Specifications (2007).

Table (8): Changes in acid value (% as oleic acid) for tahina substitute samples during storage period at room temperature.

Storage time (month)	Tahina					
	El-Rashidi	A	B	C	D	E
Zero	0.33	0.02	0.30	0.10	0.15	0.20
1	0.35	0.03	0.35	0.12	0.18	0.25
2	0.42	0.07	0.40	0.15	0.21	0.28
3	0.49	0.10	0.47	0.19	0.26	0.31
4	0.56	0.14	0.50	0.22	0.29	0.35
5	0.61	0.19	0.56	0.27	0.33	0.39
6	0.68	0.23	0.59	0.32	0.38	0.42

LSD value at $P \geq 0.05$ =0. 10

Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

Table (9): Changes in peroxide value (meq / kg oil) for tahina substitute samples during storage period at room temperature.

Storage time (month)	Tahina					
	El-Rashidi	A	B	C	D	E
Zero	1.21	.50	0.9	.70	0.80	0.85
1	1.60	1.00	1.40	1.10	1.22	1.30
2	2.11	1.55	1.71	1.76	1.99	2.12
3	2.43	1.90	2.30	2.11	2.41	3.15
4	2.87	2.24	2.96	2.89	3.22	4.01
5	3.91	3.71	5.50	3.70	4.75	5.11
6	6.66	6.12	9.01	6.70	6.95	8.82

LSD value at $P \geq 0.05 = 0.20$
Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

Table (10): Changes in k232 and k270nm for tahina substitute samples during storage period at room temperature.

Storage time (month)	Tahina											
	El-Rashidi		A		B		C		D		E	
	232	270	232	270	232	270	232	270	232	270	232	270
Zero	0.015	0.009	0.001	0.006	0.002	0.000	0.012	0.000	0.012	0.000	0.01	0.000
1	0.052	0.028	0.051	0.023	0.075	0.036	0.067	0.033	0.068	0.033	0.079	0.036
2	0.092	0.046	0.092	0.045	0.106	0.067	0.109	0.055	0.118	0.057	0.098	0.069
3	0.160	0.80	0.153	0.076	0.167	0.0105	0.168	0.105	0.159	0.098	0.157	0.087
4	0.200	0.100	0.194	0.093	0.218	0.147	0.200	0.140	0.209	0.136	0.195	0.126
5	0.230	0.120	0.225	0.114	0.295	0.180	0.235	0.188	0.229	0.217	0.298	0.281
6	0.289	0.196	0.272	0.197	0.366	0.219	0.299	0.205	0.308	0.268	0.339	0.238

LSD value at $P \geq 0.05 = 0.002$
Values in each column followed by the same letter are not significantly different at $P \geq 0.05$.

REFERENCES

Acikgoz, C. and Kockar,O. M. (2007): Flash pyrolysis of linseed (Linum ustatissimun L.) for production pf liquid fuels. J. Analytical & Applied Pyrolysis 78 (3) 406- 412.

Allam, M.(1981): Some microbial and chemical studies on wheat flour, Ph.D. Thesis, Fac. Of Agri., Al-Azhar Univ., Cairo, Egypt.

A. O. A. C. (2000): Official Methods of Analysis Association of Official Agricultural Chemists . 17th Ed., Washington, Dc, USA.

Brzezinski, A. and Debi, A. (1999): Phytoestrogens: The natural selective estrogen receptor modulators? European Obstetrics & Gynecological and Reproductive Biology, 85 (1)47- 57.

Capenter, K. J. (1960): The estimation of the available lysine in the animal protein food. Bioche. J. 77: 604- 610.

Clark, W. F., Kortas, C., Heidnhrim, A. P., Garland, J., Spanner, E. and Parbtain, A. (2001): Flaxseed in lupus nephritis: a two-year non placebo- controlled crossover study. Journal of the American College of Nutrition. 20(2) 143- 148.

Clark, W. F., Muir, A. D., Westcott, N. D. and Parbtain, A. (2000: Anoval treatment for lupus nephritis: lignan derived precursor from flax. Lupus, 9 (6) 429- 436.

Craig, W. J. (1999): Health-promoting properties of common herbs. American Journal of Clinical Nutrition . 70 (supp 1), 491, 54995.

Damir, A. A. (1984): Utilization of sunflower seed in tahina and halawa prpcessing. Food Chemistry, 14 (2) 83- 92.

Dave,O. B. and Giuseppe, M. (1997): Effect of de hulling on chemical composition of flaxseed. Lebensmittel- Wissenschaft und- Technologie, 30 (3) 135- 140.

Egyptian Standard Specifications (2006): Egyptian Organization for Standardization and Quality, Tehina. ES: 941, ICS: 67. 200.20.

El-Adawy, T. A. (1999): Chemical, technological studies and characterization of apricot kernel proteins. Ph. D. Thesis, Fac. OF Agric., Menofiya Univ., Egypt. P. 57.

El- sherbeeny, M. R., Fahmi, S. M. and Bryan, F. L. (1985): Microbiological properties of foods in Egypt. Inter. J. Food Micro. 2 (6) 355- 364.

Gafar, M. (1971): Studies on pre-cooked dehydrated soup. M.Sc. Thesis, Fac. Of Agric., univ. of Alex., Egypt. P.

Harper, C. R., Edwards, M. J.,Defilpis, A. P. and Jcobson, T. A.(2006): Flaxseed oil increases the plasma concentrations of cardioprotective (m- 3) fatty acids in humans. J., Nutrition, 136: 83- 87.

Harris, W. S. (2005):zAlpha-linolenic acid. Circulation, 111: 2872-2874.

Hasler, C. M., Kundrat, S. and Wool, D. (2000): Functional foods and cardiovascular disease. Current Atherosclerosis Reports, 2 : 467-475.

Holub, B.J. (2002): Clinical nutrition: 4. Omega-3-fatty acids in cardiovascular care. Canadian Medical Association, 166 (5) 608-615.

Kurzer, M. S. and XU, X. (1997): Dietary phytoestrogens. Annual Reviews of Nutrition, 17; 353- 381.

Leth, T., Oversen, L. and Hansen, K. (1998): Fatty acid composition of meat raminants, with special emphasis on trans fatty acids. J. Am. Oil Chem. Soc. 73 (11) 275- 282.

Lindner, A., Bankson, D. D.,Stehman0-Breen, C., Mahuren, J. D. and Coburn, S. P. (2002): Vitamin B6 metabolism and homocysteine in end- stage renal disease and chronic rnal insufficiency. American Journal of Kidney Disease, 39 (1) 134- 145.

Miller, E. L. (1967): Determination of tryptophan content in feeding stuffs with particular reference to cereal. J.Sci. Food Agric., 18: 381- 386.

Mohamed, E., Souhail, B., Olivier, R., Christophe,B. and Hamadi, A. (2007): Quality characteristics of sesame and by- products. Food Chemistry, 103 (2) 641- 650.

Moore, S. and Stein, W. H. (1963): Chromatographic determination of amino acids by the use of automatic recording equipment. In Methods in Enzymology, Vol. 6 ed. Colowich, S. P. and Kaoplan, N. O. Academic Press. New York, P. 680.

Orcheson, L. J., Rickard, S. E., Seidl, M. M. and Thompson, L. U. (1998): Flaxseed and its mammalian lignan precursor cause a lengthing or cessation of estrous cycling in rats. Cancer Letters, 125: 69- 76.

Ranich, T, Bhathena, S. J. and Velasques, M. T. (2001): Protecctive effects of dietary phytoestrogens in chronic renal disease. Journal of Renal Nutrition, 11 (4) 183- 193.

SAS /STAT (1994): User's Guide, Fisher's protected LSD, Version 6, 4th ed. SAS Inst. Inc. Cary NC (chapter 24).

Sayed, M. A. R., Mohamad, B. H. N. and Zahra, A. (2007): The time independent rheological properties of low fat sesame paste / date syrup blends as a function of fat substitutes and temperature. Food Hydrocolliods, 21 (3) 198- 202.

Shaheen, A., Osman. M., Hashem, H. and Khalifa, A. (1991): Production of halva tahinia from sunflower (Helianthus annuus) seeds. 1. Chemical evaluation of sunflower and sesame seeds. Egypt. J. Food. Sci., (1- 2). 179- 187.

Shahidi, f., Aishima, T., Abou-Gharbia, H., Youssef, M. and Adel, Y. (1997): Effect of processing on flavor precursor amino acids and valatiles of sesame paste (tehina). J. am. Oil Chem. Soc. 74(6): 667- 678.

Siemens, B. J. and Daun, J. K. (2005): Determination of the fatty acids composition of canola, flax and solin by near-infrared spectroscopy. J. Am. Oil Chem. Soc. 82 (3) 153- 157.

Simpoulous, A. P. (2004): Omega- 6 / omega-3 essential fatty acids ratio and chronic diseases. Food Reviews International, 20 (1) 77- 90.

Stuglin, C. and Prasad, K(2005): Effect of flaxseed consumption on blood pressure, serum lipids, hemopoietic system and liver and kidney enzymes in healthy humans. J. Cardiovasc. Pharmacol. Ther. 10 (1) 23- 27.

Thomas, F. X. C., Sprando, R. L., Black, T. N., Olejnik, N., Wiesenfeld, R. W., Babu, U. S., Bryant, M., Flynn, T. . and Ruggles, D. I. (2003): Effect of flaxseed and defatted flaxseed meal on reproduction and development rats, Food and Chemical Toxicology, 41: 819- 834.

Thompson, L. U. (1993): Potential benefits and problems associated with antinutrients in foods. Food Research International, 26, 131- 149.

Thompson, L. U. (1998): Experimental studies on lignans and cancer. Baillieres Clinical Endocrinology and Metabolism, 12 (4), 691- 705.

Wendland, E., Farmer, A., Glasziou, P. and Neil, A. (2006): Effect of alpha linolenic acid on cardiovascular risk markers: a systematic review. Heart, 92: 166- 169.

Wiesenfeld, P. W., Babu, U. S., Collins, T. F. X., Sprando, C.R., Dannell. M. W. O., Flynn, T. J., Black, T. and Olejnik, N. (2003): Flaxseed increased α- linolenic and eicosapentaenoic acid and decreased arachidonic acid in serum and tissues of rat dams and offspring. Food & Chemical Toxicology, 41: 841- 855.

Wiesenborn, D., Kangas, N., Tostenson, K., Hall. C. and Chang, K. (2005): Sensory and oxidative quality of screw-pressed flaxseed oil. J. Am. Oil Chem. Soc. 82 (12) 887- 892.

Young, G. S., Conqer, J. A. and Thomas, R. (2005): Effect of randomized supplementation with high dose olive, flax or oil on serum phospholipids fatty acid level in adults with attention deficit hyperactivity disorder, Reprod NUTR. Dev. 45 (5) 549- 558.

إنتاج بديل الطحينة من بذور الكتان

شاكر محمد عرفات ، امانى محمد محمد بسيونى، دليا محمود محمد مصطفى
قسم بحوث الزيوت والدهون – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – جيزة – مصر.

تم في هذا البحث استخدام بذور الكتان في إنتاج بديل للطحينة. حيث تم تحميص البذور وطحنها وتم الحصول على الطحينة . وقد تم إجراء التحليل الكيماوي الكامل والذي تضمن تقدير النسبة المئوية للرطوبة والبروتين والألياف والرماد والكربوهيدرات والزيت والأحماض الامينية والأحماض الدهنية والعناصر مقارنة بالتحليل الكيماوي لطحينة السمسم المصنعة في المعمل أيضا تم إجراء تقييم حسي (اللون والطعم والقوام والرائحة والقابلية للاستهلاك) بالمقارنة بطحينة السمسم المصنعة في المعمل وطحينة الرشيدى الميزان كعينة تجارية.

أشارت النتائج المتحصل عليها إلى تقارب التحليل الكيماوي للطحينة المصنعة من بذور الكتان مع طحينة السمسم من حيث محتوى الرطوبة والرماد والكربوهيدرات والبروتين ولكن لوحظ ارتفاع محتوى الألياف في طحينة الكتان وزيادة نسبة الزيت في السمسم. أشار تركيب الأحماض الدهنية إلى احتواء طحينة الكتان على نسبة مرتفعة من حامض اللينولينك (اوميجا-3) بينما طحينة السمسم تحتوى على نسبة مرتفعة من حامض اللينوليك (اوميجا- 6). دل تركيب الأحماض الامينية على احتواء طحينة الكتان على الأحماض الامينية الضرورية بنسبة اقل قليلا من طحينة السمسم.

أشار تحليل المعادن إلى احتواء طحينة الكتان على عناصر الكالسيوم والصوديوم والزنك والنحاس والمنجنيز بنسب اقل من طحينة السمسم. كما دلت الاختبارات الحسية على جودة طعم وقوام والقابلية للاستهلاك لطحينة الكتان ومشابهتها لطحينة السمسم.

ولذلك فان النتائج تشير إلى تقارب الصفات الحسية والكيماوية لطحينة الكتان مع طحينة السمسم وعلى ذلك يمكن استخدام طحينة الكتان كبديل لطحينة السمسم.