Effect of Blending Flax Seeds (*Linum usitatissimum* L.) on Tahena Quality

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Abstract:

The quality of tahena from sesame seeds and its blended with 10 % flax seeds were evaluated for chemical composition, physical properties, anti nutrional factors and sensory evaluation. The results showed that the moisture, protein, fat, fiber, ash, carbohydrates and energy value contents of flax seeds as dry weight (DW) were 6.50, 24.40, 35.12, 3.15, 2.63, 28.20 % and 526 Kcal/100g, respectively. The moisture, protein, fat, ash, fiber, carbohydrates and energy value contents of sesame seeds as DW were 5.60, 22.60, 50.14, 4.60, 4.81, 12.25 % and 590.66 Kcal/100g, respectively. The highest significant ($p \leq 0.05$) content of tannins, phytates and oxalate were recorded for sesame seeds with significant differences while the lowest contents were recorded for the flax seeds.

At zero time of storage period, the highest moisture, fat and energy value content and lowest values for protein, ash, fiber and carbohydrates were recorded for the control tahena (i.e. sesame seeds). With progress of storage period up to 3 months, the highest moisture, protein, ash, fiber and carbohydrates content were recorded for tahena made with 10 mg/kg flax seeds. While, the lowest values recorded for control tahena. The highest acid value, free fatty acid, peroxide value and iodine number recorded for control tahena with no significant differences. The highest saponification value, refractive index and polyphenols recorded for tahena blended with 10 % sesame seeds with significant differences. At zero time of cold storage at 5°C all organoleptic properties (color, flavor, taste, texture, appearance , mouth feeling , and overall acceptability) recorded the highest organoleptic score (9), while, at the end of storage period (4weeks) a markedly reduction in all organoleptic properties were observed.

Key words: Tahena, flax seeds, sesame seeds, total phenolic content, fat constants, organoleptic properties.

Introduction:

The food industry is looking at the addition of flax seed in traditional food matrices to provide consumers the possibility to benefit from the aforementioned health effects. Cereal-based products, such as bread and pasta, represent prime candidates for flax seed enrichment as nontraditional ingredients can be added to their formulation without apparent loss of their quality **(Petitot *et al*., 2010).** However, challenges in the development of flax seed-enriched cereal based products include potential oxidation of the lipids, reduced contribution of the gluten network to the structure of the cereal product, and the need to preserve the health benefits of the flax seed constituents during processing **(Alasino *et al*., 2011 and Mercier *et al*., 2013)**.

The seeds have a crisp, chewy texture and a pleasant, nutty taste. Flax seed serves as the best and only source of *omega-3* fatty acid to the vegetarian diet. The use of natural sources to enhance the nutritional quality for human health is gaining momentum. Germination is a technological application widely used for its ability to reduce the levels of anti-nutritional factors in the seeds and improve the palatability and availability of nutrients **(Vidal-Valverde *et al*., 2002)**.

On the other side, flax is an important oilseed crop and its seeds are a valuable source of many bioactive compounds (**Toure and Xueming 2010).** Flax seed is one of the richest sources of α-linolenic acid, an important source of high-quality protein and soluble fiber **(Katare *etal*., 2012).** Moreover, the seed contains phenolic compounds **(Kasote ., 2013)** such as lignans, phenolic acids (*p*-coumaric, ferulic, *p*-hydroxybenzoic, caffeic, and sinapic acids) and their glucosides, as well as flavonoids (herbacetin and campherol diglucoside). Among the phenolic compounds, flax lignans are in focus because of their estrogenic/anti-estrogenic and anti-oxidant activity **(Sok *etal*., 2009).** Therefore, flax seeds and their products are used as a component of functional food. There are numerous examples of flax seed or oil application in production of bakery goods and some their utilization in meat products **(Oomah, 2001)**. Regarding the chemical composition, flax is rich in fat, protein and dietary fiber. An analysis of brown Canadian flax averaged 41% fat, 20% protein, 28% total dietary fiber, 7.7% moisture and 3.4% ash, which is the mineral-rich residue left after samples are burned **(Anonymous, 2001**).

Sesame (*Sesamum indicum* L.) is one of the worlds important and oldest oilseed crop known to man that plays an important role in human nutrition. Sesame seed is high priced seed compared to other known oil seeds such as soybean, rapeseed, canola, sunflower seed and cotton seed. It has very good nutritional value and very easily digested and also stable to oxidative stress. Sesame not only contains ‘‘good’’ fat (mono-unsaturated and poly-unsaturated fat) but also high in a variety of helpful anti-oxidants that protects the human being from the damaging effects of free radicals. Sesame seeds are good source of proteins, complex carbohydrates and some minerals. Additionally isoflovones and sesame in also play a role in the reduction of the development of chronic diseases such as cancer, diabetes, and coronary heart diseases. It is source of nutritional and helpful biologically active components, such as phytochemicals **(Kanu *et al*., 2007).**

Sesame is used in the production of tahena which is the product of the milled seeds, which were dehulled and roasted without adding or removing any of its constituents. Tahena is also called tahin, tahinah or tahina and its used in food formulations such as halaweh (sweetened tehineh), breakfast cereal based porridge mixed with sesame, java beans and salads, chick peas (hommus tehineh) and in desserts such as honey and palm-date molasses. Whole sesame is used in the production of a locally produced weaning food in Sierra Leone **(Abou-Gharbia *et al*., 2000; Abu-Jdayil *et al*., 2002 and Kanu *et al*., 2007).**

Tahena is a food product that is usually produced by milling hulled, roasted sesame seeds into a paste. The resulting product can be used as a condiment, dressing, spread, sauce and mixture with different fruits syrups. Several tahini varieties and combinations of tahini with various types of food have been described, such as a tahini-pine honey blend **(Akbulut *et al*., 2012)**. Tahena is also the major ingredient in halva (a confection that includes nougat), hummus (mashed chickpeas, flavored with lemon juice and garlic) and baba ghanoush (a purée of eggplant, lemon juice, garlic and oil) **(El-Adawy and Mansour, 2000)**.

This work was conducted to evaluate the quality of tahena from sesame seeds and that blended with 10% flax seeds for chemical composition, physical properties, anti-nutrional factors and sensory evaluation.

Materials and Methods:

Materials:

Flax seeds were obtained from Agricultural Research Center, Oil Crops Department, Giza, Egypt. Wheat flour (72% extraction), corn oil, salt, and sesame seeds were obtained from the local markets of Shibin El-Kom, Menoufia Governorate, Egypt.

Methods:

Preparation of flaxseeds:

1-The seeds were dry cleaned to remove dust and undesirable materials.

2-After cleaning, the seeds were heated at (roasted) 150°C for 15 min in an electric oven.

3-Then the seeds were grounded and kept stored at 4°C until used.

Preparation of sesame seeds:

1-Sesame seeds were cleaned to remove dust and undesirable materials.

2-The sesame seeds were washed with tap water and roasted in an electric oven for 3 hours in 150°C.

3-Finally, the roasted sesame was grind in an electric grinding mill until tahena produced.

Preparation of tahena:

Tahena is the result from pressing sesame seeds to produce sesame oil. There are two types of tahena, red and white according to colour and kind of used sesame **(Saba, 1991**). Toasted sesame seeds and toasted flax seeds were mixed at the ratio (10%), and then ground in an electric mill until tahena formed.

Analytical Methods:

Moisture, protein (N x 6.25 Keldahl method), fat (hexane solvent, Soxhielt apparatus), fiber and ash were determined according to the method recommended by **A. O. A. C. (2010)**.

Carbohydrates and energy value:

Carbohydrate calculated by differences as follows:

Carbohydrates (%) = 100 - (% moisture + % protein + % fat + % ash + % fiber). Energy value was estimated by the sum of multiplying protein and carbohydrates by 4.0 and fat by 9.0 according to **FAO (1982)**.

Determination of anti-nutritional:

The tannin content was determined using the vanillin-HCl reagent method of **Burns, (1971)**. The oxalate content of the samples were determined by using the potassium permanganate titration method of **Dye, (1956),** while the phytic acid content was determined using the method of **Mc Cance and Widdowson, (1935)**.

Determination of refractive index:

Refractive index and specific gravity were determined according to the method described by **AOCS (1982).**

Determination of fat constants:

Peroxide value (PV), free fatty acids (FFA), saponification value (SV) and iodine number (IN) were determined according to **AOAC, (2005); PORIM (2005); AOAC, (2005) and Singh *et al*., (1981)**.

Determination of total phenolics:

Total phenolics content expressed as cafeic acid (µgg^{-1}oil) was performed at 725 nm usingthe folin ciocalteau spectrophotometric method described by **Singleton *et al*.,(1999)**.

Statistical analysis:

Analysis of variance was conducted for the data in accordance with procedures described by **Steel and Torrie (1980)**. L.S.D. at 5 % level of significance was used to compare between means.

Results and Discussion:

Chemical composition of flax seeds:

Data given in Table (1) show the chemical composition of flax seeds. The obtained results indicated that the moisture, protein, fat, fiber, ash, carbohydrates and energy value contents of flax seeds as dry weight

(DW). These data are in agreement with **Blaschek *et al.*, (2011**), which reported that the seeds contain nearly 25% of bulk materials (3 - 6% of mucilage, 4 - 7% of alimentary fibers), 30 - 45% fatty oil, 20 - 27% proteins, 3 - 5% minerals, 0.1 - 1.5% cyanogenic glycosides, vitamins, lignan precursors, linustatin, neolinustatin and linamarin, enzymes**.**

Table (1): Chemical composition of flax seeds

Constitutes of flax seed	**(%, DW)**
Moisture	6.50 ± 0.89
Protein	24.40 ± 3.12
Fat	35.12 ± 4.11
Ash	2.63 ± 0.56
Fiber	3.15 ± 0.65
Carbohydrates	28.20 ± 5.01
Energy value (Kcal/100g)	526 ± 14.32

DW= Dry weight

Chemical composition of sesame seeds:

The data in Table (2) show the chemical composition of sesame seeds. The results indicated that the moisture, protein, fat, ash, fiber, carbohydrates and energy value content of flax seeds as wet weight (W/W). These data are in agreement with **Nzikou *et al.*,(2009)**, they reported that the seeds contained 5.7% moisture, 48.5% crude oil, 20% crude proteins, 7.78% carbohydrate (by difference), 9.4% crude fiber and 4.2% ash. The high percentage of oil makes this seed a distinct potential for the oil industry.

Table (2): Chemical composition of sesame seeds

Constitutes of sesame seeds	**(%, DW)**
Moisture	5.60 ± 1.22
Protein	22.60 ±2.11
Fat	50.14 ±8.23
Ash	4.60 ± 0.99
Fiber	4.81 ± 1.21
Carbohydrates	12. 25 ± 2.10
Energy value (Kcal/100g)	590.66 ± 12.0

Anti-nutritional materials content of flax and sesame seeds:

Data presented in Table (3) show the anti-nutritional materials content of flax and sesame seeds. It is obvious that the highest tannins, phytates and oxalate recorded for sesame seeds with significant differences. The mean values were 230.50, 268.15 and 75.20 mg/100g, respectively. While, the lowest contents recorded for flax seeds which were 118.24, 225.16 and 16.20 mg/100g, respectively. These results are in agreement with **Embaby (2010)**, who reported that the average value of tannin obtained in this study was within the range reported for brown and white sesame seeds (180–270 mg/100 g).

Table (3): Anti-nutritional compounds (Mean±SD) of flax seeds and sesame seeds

Anti-nutritional	**Flax seeds**	**Sesame seeds**
Tannins (mg/100g)	118.24±0.12[b]	230.50±0.11[a]
Phytates (mg/100g)	225.16±0.13[b]	268.15±0.10[a]
Oxalates	16.20±0.10[b]	75.20±0.20[a]
LSD	4.50	5.86

Means with the same different superscript letters in the same raw are different significantly at $p \leq 0.05$

Chemical composition of tahena as influenced by addition of flax seeds during storage for 3 months at room temperature:

Data presented in Table (4) showed that, the chemical composition of tahena as influenced by addition of flax seeds during storage for 3 months at room temperature (on wet /weight basis). It is obvious at zero time of storage period, the highest moisture, fat and energy value content recorded for control Tahena. The values were 1.90%, 50.55% and 618.30 kcal/100g while the lowest values recorded for protein, ash, fiber and carbohydrates. The values were 23.63%, 2.91%, 3.69 and 17.32 Kcal/100g, respectively. On the other hand, with progress of storage period up to 3 months, the highest moisture, protein, ash, fiber and carbohydrates content were recorded for tahena made with 10 mg/kg flax seeds, the values were 1.60, 23.75, 3.88 and 18.25 %, respectively. While, the lowest values recorded for control tahena being 53.46 and

635.94 kcal/100g for fat and energy value, respectively. Finally, the obtained data indicated that with progress of storage period, the moisture, protein, ash, and carbohydrates decreased. While the fat, ash, fiber, carbohydrates and energy value increased. These results are in agreement with those reported by **Mueller *et al*. (2010)**

Physical-chemical characteristics of tahena as influenced by addition of flax seeds:

Data given in Table (5) show the physical-chemical properties of tahena as influenced by addition of flax seeds. It is clear to mention that, the highest acid value, free fatty acid, peroxide value and iodine number recorded for control tahena with no significant differences and the mean value were 1.2 mg KOH/ g^{-1} oil, 0.53 oleic acid, 0.19 meq O_2/ kg^{-1} oil and 91.46 g of I_2/100g^{-1}, respectively. On the other hand, the highest saponification value, refractive index and polyphenols recorded for tahena blended with 10 % sesame seeds with significant ($p \leq 0.05$) differences and the mean values were 188.15 mg KOH/g^{-1} oil, 1.475 and 18.20 mg caffeic acid/kg^{-1} oil, respectively .

Organoleptic properties of tahena as influenced by addition flax seeds during cold storage at 5^{0}C for 1 month:

Data present in Table (6) show the organoleptic properties of tahena as influenced by addition flax seeds during cold storage at 5^{0}C for 2 weeks. It is clear to notice that at zero time of cold storage at 5$^{\mathbf{0}}$C all organoleptic properties (color, flavor, taste, texture, appearance , mouth feeling , and overall acceptability) recorded the highest organoleptic score (9). Advancement of storage period for 2 weeks all tested organoleptic properties were slightly decreased. The scores ranged from 8.8 - 8.4 for color, 8.6 - 8.3 for flavor, 8.6 - 8.4 for taste, 8.5 - 8.3 for texture, 9.0 - 8.8 for appearance, 9.0-8.7 for mouth feeling and 9.0-8.7 for overall acceptability. At the end of storage period (4 weeks) a markedly reduction in all organoleptic properties was observed. The scores ranged from 8.1 - 7.8 for color, 8.0 -7.7 for flavor, 8.2 - 8.0 for taste, 8.1- 7.7 for texture, 8.4 -8.1 appearance, 8.4 - 8.0for mouth feeling and 8.5- 8.0 for overall acceptability these result are an agreement with **Mente 2008.** It was observed that the colour of the products is retained well, and scores for the characteristic flavour decreased significantly during the storage period.

Table (4): Chemical composition of tahena as influenced by addition of flax seeds during storage for 3 months at room temperature

Storage period (months)	Samples	Moisture %	Protein %	Fat %	Ash %	Fiber %	Carbohydrates %	Energy value (Kcal /100g
Zero time	Control Tah.	1.90	23.63	50.55	2.91	3.69	17.32	618.30
	Tah+10%Fla	1.75	25.76	46.27	3.10	3.77	19.35	596.87
1	Control Tah.	1.72	23.10	51.46	2.98	3.71	17.03	623.66
	Tah+10%Fla	1.70	25.34	46.85	3.28	3.82	19.01	599.05
2	Control Tah.	1.54	22.73	51.90	3.20	3.93	16.70	624.82
	Tah+10%Fla	1.64	24.82	47.32	3.60	3.97	18.65	599.80
3	Control Tah.	1.39	22.24	53.46	2.38	3.98	16.46	635.94
	Tah+10%Fla	1.60	23.75	48.29	3.88	4.23	18.25	602.61

Tah.= Tahena Fla. = Flax seeds

Table (5): Physico-chemical characteristics (Mean±SD) of tahena as influenced by addition of flax seeds

Properties	Control tahena	Tahena with 10 % flax seeds
Acid value (mg KOH g-1 oil)	1.20 ± 0.12^a	0.95 ± 0.01^a
Free fatty acids (as Oleic acid %)	0.53 ± 0.01^a	0.48 ± 0.03^a
Peroxide value (meq O_2 kg -1 oil)	0.19 ± 0.20^a	0.16 ± 0.01^a
Iodine number (g of I_2 100 g-1 of oil)	91.46 ± 0.13^a	90.05 ± 0.24^a
Saponification value (mg KOH g-1 oil)	185.50 ± 0.20^b	188.15 ± 0.13^a
Refractive index (at 20 °C)	1.471 ± 0.001^a	1.475 ± 0.001^a
Polyphenols (as mg caffeic acid kg-1 oil)	16.75 ± 0.30^b	18.20 ± 0.10^a
LSD	1.45	0.87

Means with the same different superscript letters in the same raw are different significantly at $p \leq 0.05$

Table (6): Sensory evaluation of tahena as influenced by addition of flax seeds during cold storage at 5°C for 1 month

Storage period (weeks)	Color	Flavor	Taste	Texture	Appearance	Mouth feeling	Overall acceptability
Zero	9.0 ^{a}	9.0 ^{a}	9.0 ^{a}	9.0 ^{a}	9.1 ^{a}	9.2 ^{a}	9.2 ^{a}
1	8.8 ^{a}	8.6 ^{a}	8.6 ^{a}	8.5 ^{a}	9.0 ^{a}	9.0 ^{a}	9.0 ^{a}
2	8.4 ^{ab}	8.3 ^{ab}	8.4	8.3 ^{ab}	8.8 ^{a}	8.7 ^{a}	8.7 ^{a}
3	8.1 ^{ab}	8.0 ^{ab}	8.2 ^{ab}	8.1 ^{ab}	8.4 ^{ab}	8.4 ^{ab}	8.5 ^{ab}
4	7.8 ^{bc}	7.7 ^{bc}	8.0 ^{ab}	7.7 ^{c}	8.1 ^{ab}	8.0 ^{ab}	8.0 ^{ab}

Means with the same different superscript letters in the same raw are different significantly at $p \leq 0.05$

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تأثيـر إضــافة بذور الكتــان على جــودة الطحينــــة

عصام عبد الحافظ بودى ، وفاء أحمد رفعت ، ربيعة رجب رمضان

قسم التغذية وعلوم الأطعمة ـ كلية الأقتصاد المنزلى . جامعة المنوفية – شبين الكوم– مصر

الملخص:

تم تقييم جودة الطحينة التى تم تصنيعها من بذور السمسم وكذلك المخلوطة مع ١٠٪ من بذور الكتان وتأثير ذلك على التركيب الكيميائي، والخواص الطبيعية، والعوامل المضادة للتغذية والتقييم الحسي. ولقد أظهرت النتائج أن قيم الرطوبة والبروتين والدهون والألياف والرماد والكربوهيدرات والطاقة لبذور الكتان كانت ٦,٥٠ ، ٢٤,٤٠ ،٣٥,١٢، ٣,١٥ ، ٢,٦٣ ، ٢٨,٢٠٪ ، ٥٢٦,٤٨ كيلو كالوري / ١٠٠ جم (وزن جاف) على التوالي، بينما سجلت نفس المكونات في بذور السمسم ٥,٦٠ ، ٢٢,٦٠ ، ٥٠,١٤ ،٤,٦٠، ٤.٨١، ١٢,٢٥٪ ، ٥٩٠.٦٦ كيلو كالورى/١٠٠ جم (وزن جاف) على التوالي. كما سجلت أعلى قيم من التانينات والفيتات والأكسالات مع بذور السمسم مع وجود فرق معنوى ($p \leq 0.05$) عند المقارنة مع بذور الكتان. في بداية فترة التخزين كان أعلى محتوى من الرطوبة والدهون والطاقة وأقل القيم للبروتين والرماد والألياف والكربوهيدرات قد سجلت مع عينات الطحينة الكنترول (المصنعة من بذور السمسم). ومع طول فترة التخزين (٣ أشهر)، سجلت أعلى قيم من الرطوبة والبروتين والرماد والألياف والكربوهيدرات مع عينات الطحينة المخلوطة مع ١٠% من بذور الكتان، بينما سجلت أقل قيم من تلك المكونات مع عينات الطحينة الكنترول. أما ما يتعلق بنسب الأحماض الدهنية الحرة، رقم البيروكسيد والرقم اليودى فقد سجلت أعلى القيم مع عينات الطحينة الكنترول مع عدم وجود فرق معنوى، فى حين سجلت أعلى قيمة لمعامل التصبن ومعامل الانكسار والفينولات الكلية مع عينات الطحينة المخلوطة مع بذور الكتان بنسبة ١٠٪ مع وجود فرق معنوى ($p \leq 0.05$). وفي بداية فترة التخزين البارد على درجة خمسة مئوية لوحظ أن جميع الصفات الحسية (اللون والنكهة والطعم والملمس والمظهر والشعور فى الفم، والقبول العام) سجلت أعلى درجة الجودة، في حين في نهاية فترة التخزين (٤أسابيع) لوحظ انخفاض ملحوظ في جميع الصفات الحسية السابقة.