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Abstract:

The present study was carried out to supplement some products with sunflower seeds powder and determine the chemical composition, minerals content. The results indicated that the studied sunflower seeds powder considered an important source of protein and crude oil. All sunflower seeds treated (raw, soaked and roasted) contained considerable amount of Mg, Zn, Ca, K and P. The results showed that the supplementation with 10%, 20% and 30% sunflower seeds powder had a different effect on all studied sensory attributes among halwa spread, coffee, syrup and koufta. Moreover, halwa spread, coffee, syrup and koufta with 10% sunflower seeds powder were recorded the best scores of all studied sensory evaluation. So, the sunflower seeds could be useful application in different food formulation.

Key words: Chemical compositions, minerals, halwa spread, coffee, syrup, koufta, sensory evaluation, sunflower seeds powder.

Introduction:

Sunflower (*Helianthus annuus*, L.) is an important economic crop worldwide and it ranks third in production next to ground nut and soybean (**Byrareddy, 2008**). The importance of sunflower as source of edible oil and high quality protein is continuously increasing.

The chemical composition of sunflower shows that the seed is an important source of oil, protein, calcium, carbohydrate and ash. Fat is a major nutrient. Fats are made up of fatty acids which include saturated fatty acids and polyunsaturated fatty acids (**Nagraj, 1995; Ingale and Shrivastava, 2011)**.

Sunflower is an important oil seed crop having a wide range of adaptability. It contains a high percentage of oil (40-50%) and low quantity of saturated fatty acids palmitic (4.32-9.16%) and stearic (0.20-

6.64%) acids. It is a rich source of unsaturated fatty acids such as oleic acid (10.34-17.41%), linoleic acid (20.18-81.10%) and linolenic acid (0.09-20.96%) with crude protein content of 27% (**Andrich *et al*., 1985 and Rosa *et al*., 2009)**.

Sunflower with high oil content is one of the more prominent oilseed crops for biodiesel production. Sunflower (*Helianthus annuus* L.), belonging to the family Compositae, is a major oilseed, used for the production of edible oil, with an annual production of 25.1 million tons. The composition of linoleic, oleic and linolenic acids in oil has been an affect the oxidative stability. Sunflower oil has approximately 70% linoleic acid and is highly susceptible to lipid oxidation (**Gbogouri *et al*., 2013; Saydut *et al*., 2010** and **Marvey, 2008**).

Sunflower seed oil is light in taste and appearance and supplies more vitamin E than any other vegetable oil. Sunflower oil is susceptible to oxidation during frying and roasting (**Yoshida *et al*., 2002** and **Yoshida *et al*., 2001**).

Vegetable oils constituted a major component of human diet because their essential fatty acid content, solubility of vitamins and high energy value. Cooking oils activities are used worldwide. Fried foods are pleasant because their flavor, crispy texture and color which make fried foods very popular to consumers (**Boskou *et al*., 2006**). Frying has become a very common cooking practice, with fried food contributing significantly to the daily total energy intake (**Sanchez-Muniz** and **Bastida, 2006**).

Oils are not stable products. Heating oil is the presence of air causes several chemical reactions, such as hydrolysis, dehydration, thermoxidation, hydro peroxidation and polymerication, leading to volatile chain-scission products non-volatile cyclic monomeric and poly merised compounds (**Friedman, 2000**; **Gertz, 2000** and **Srivastava *et al*., 2010**).

Soaking could be one of the processes to remove soluble antinutritional factors, which could be eliminated with the discarded soaking solution, but some metabolic reactions could take place during soaking affecting the content of some compounds (**El-Morsi, 1996**).

Roasting and expelling are key steps for making condiment oils because the color, flavor, composition and quality of the oil all are in

flounced by processing conditions (**Lee *et al*., 2004**). Changes in chemical composition and levels of minor constituents affect the functional and nutritional characteristics of oils (**Yoshida *et al*., 1995**).

Halawa is a traditional confection and has gained popularity as a versatile, quality dessert in the Mediterranean and Middle East. It consists of tahena, sugar, citric acid and Saponaria officinalis (soapwort; family Caryophyllaceae) root extract (**Ayaz *et al*., 1986**). Halawa is composed of 500 gkg^{-1} tahena, 250–350 gkg^{-1} sugar, 120–250 gkg^{-1} glucose and 10 gkg^{-1} additives such as flour and whipping agents. In some varieties of halawa cocoa power or nuts such as pistachios and walnuts are mixed in with the halawa for a richer, more flavorful taste (**Herda, 1980**).

Coffee is one out of the most consumed beverages in the world mainly due to its stimulating effects, characteristic taste, and richness of coffee aroma which makes it a unique beverage (**Nebesny *et al*., 2006)**.

Coffee beans include between 0.8% and 2.8% caffeine, regarding the species and origin. It contributes 10-30% of the bitter taste of coffee brews (**Eggers** and **Pietsch, 2001)**.

Belitz *et al.* (2009) showed that Arabic coffee, caffeine can be found in values range between 0.8% and 1.4% (w/w) in raw, while for the Robusta is ranging between 1.7% and 4.0% (w/w). Chlorogenic acid in proportions which vary from 7% to 12%, about 3 to 5 times more than the caffeine

The aim of this investigation was to supplement some products with sunflower seeds powder as a source of oil and protein.

Materials and Methods:

Materials:

Sunflower seeds were obtained from El Minia Farm Faculty of Agriculture, Minia University, Minia, Egypt, during summer 2016.

Sesam seeds, corn oil, honey, cardamom powdered, orange flower water, coffee beans powder, sucrose, meat, seasoning were obtained from local market Assiut city, Assiut, Egypt.

Sample Preparation:

Sunflower seeds were cleaned manually by removing all the foreign matter dirt and broken seeds and treated as follows:

Raw sunflower seeds:

Soaked Roasted Sunflower Seeds (SRSFS):

Sunflower seeds soaked in water for about an hour then roasted at 200^{o}C for 15 min using an electrical drying oven (Model D-63450, Hanau, Germany).

Roasted Sunflower Seeds (RSFS):

Roasted sunflower seeds (RSFS) refers to sunflower seeds roasted at 200^{o}C for 15 min using an electrical drying oven (Model D-63450, Hanau, Germany).

Grinding:

After the roasted sunflower seeds are quite charred then were grinded into grinder machine (blender 2000 rpm) for 10 minutes.

Filtering:

To get the best powder, we need to filter the sunflower seeds powder using a sieve DPk.

Defatted Roasted Sunflower Seeds Flour (DRSFSF):

The prepared roasted sunflower seeds powder was defatted using n-hexane as described by **Barnes (1983**).

The formulations used for making halawa spread:

Sesame was blended very well then corn oil was added to be creamed together. Roasted sunflower seeds powder, honey, cardamom powder and orange flower water were added to the latest mix. The mix of halawa spread was ready to be packed in sterilized jars and kept in the refrigerator according to the method of **Hesham and Zohair (2006**).

Table (1): Formulas of sunflower seeds halawa spread.

Ingredients (%)	Sample 1	Sample 2	Sample 3
Roasted sunflower seeds powder	10	20	30
Sesame	30	20	10
Corn oil	40	40	40
Honey	18	18	18
Cardamom	1	1	1
Orage flower water	1	1	1

The formulations used for making coffee:

Defatted roasted sunflower seeds powder was added to coffee beans powder and sucrose to be ready milled with hot water. They were boiled together for a few minutes and filter to get fine coffee according to the method of **Ghnimi *et al*. (2015)**.

Table (2): Formulas of sunflower seeds coffee

Ingredients (%)	Sample 1	Sample 2	Sample 3
Defatted roasted sunflower seeds powder	10	20	30
Coffee beans powder	60	50	40
Sucrose	25	25	25
Cardamom powder	5	5	5

The formulations used for making syrup:

The weighed of 30 gm defatted roasted sunflower seeds powder samples and 25 gm sucrose were boiled in sufficient amount of water for 20 min. The syrup was filtered through a cloth with a hand press. The produced sunflower seeds powder syrup was packed in sealed glass bottles and kept in the refrigerator according to the method of **Hendrickson** and **Kesterson (1965)**.

Table (3): Formulas of sunflower seeds syrup

Ingredients (%)	Sample 1	Sample 2	Sample 3
Defatted roasted sunflower seeds powder	10	20	30
Sucrose	25	25	25
Water	65	55	45

The formulations used for making koufta:

The lean beef meat was cut into small cubes approximately 2 cm^3 minced in a commercial blender for 3 min. on the lowest settings. Then minced meat with roasted sunflower seeds powder and seasoned as described in Table (4) for 2 min. The doughs were shaped and stored under 18^oC then fried for 2-3 min. according to the method of **Saba (1997**).

Table (4): Formulas of sunflower seeds koufta

Ingredients (gm)	Sample 1	Sample 2	Sample 3
Roasted sunflower seeds powder	10	20	30
Lean beef meat	490	480	470
Onion powder	10	10	10
Sodium chloride	2.5	2.5	2.5
Garlic powder	5	5	5
Cinnamon	5	5	5
Black pepper	2.5	2.5	2.5

Sensory evaluation of sunflower seeds products:

Sensory evaluation were carried out according to **Moor (1970)** which expressed as (10) excellent, (9) very good, (8) good, (7) medium, (6) fair, (5) poor, (4) very poor, (3) extremely poor.

Methods:

Gross Chemical Composition and Energy Value:

Moisture, crude protein, crude oil, crude fiber and ash were determined as described in **AOAC (2000)** methods. The total carbohydrates were calculated by difference according to the equation of **Chatfield** and **Admas** (**1940**). The energy value determined according to **Wilson *et al.*,** (**1974**) and **Seleet** (**1990**) as follow:

Energy (Kcal/100g) = (protein content × 4) + (fat content × 9) +

(carbohydrate content × 4)

Minerals Content:

Calcium, Iron, Manganese, Magnesium, Zinc, Selenium and Copper contents in the samples were determined by iCAP6200 (ICP-OES) Inductively Coupled Plasma Emission Spectrometry (**Issac** and **Johnson, 1985**). Sodium and Potassium contents were determined by a Flame Photometer corning 400; however, Phosphorus content was determined by spectrophotometer **Jakson** (**1967**) after wet ashing by method described in **AOAC** (**2000**).

Statistical Analysis:

The data collected were analyzed with analysis of variance (ANOVA) procedures using the Duncan test, differences between means were compared at 5% level of significant (**Gomez and Gomez, 1984**).

Results and Discussion:

Table (5): Gross chemical composition of treated sunflower seeds on dry weight basis

Constituents	Treated sunflower seeds		
	Raw	Roasted	Soaked Roasted
Moisture (%)	5.62±0.21^{a}	2.58±0.14^{c}	4.69±0.23^{b}
Protein (%)	24.54±0.12^{b}	30.73±1.60^{a}	31.80±1.87^{a}
Crude oil (%)	39.79±1.23^{b}	43.11±1.61^{a}	42.10±2.74^{a}
Ash (%)	4.9±0.11^{a}	5.0±0.23^{a}	4.8±0.02^{b}
Crude fiber (%)	3.57±0.21^{a}	3.33±0.13^{b}	3.30±0.24^{b}

Constituents	Treated sunflower seeds		
Carbohydrates (%)	27.2±1.23[a]	17.83±1.31[b]	18.00±0.36[b]
Energy value (Kcal/100g)	565.07±6.15[c]	582.23±16.25[a]	578.1±9.63[b]

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

Gross chemical composition of treated sunflower seeds:

The gross chemical composition of treated sunflower seeds are shown in Table (5). The data revealed that variation (2.58±0.14-5.62±0.21%) in moisture content of raw, roasted and soaked roasted sunflower seeds. The results indicated that treated sunflower seeds ranged from (24.54±0.12 – 31.80±1.87%), (39.79±1.23 – 43.11±1.61%), (4.8±0.02 – 5.0±0.23%), (3.30 ± 0.24 – 3.57±0.21%) and (17.83±1.31 – 27.2±1.23%) of protein, crude oil, ash, crude fiber and carbohydrates; respectively. The energy values were (565.07±6.15, 582.23±16.25 and 578.1±9.63 kcal/100g) of raw, roasted and soaked roasted sunflower seeds. These results are disagreement with **Akindahunsi (2004)** who observed that the high protein content (41.7%) of raw sample was significantly reduced by the various treatments. Salt treatment (10.5%), soaking and cooking (9.9%) and fermenting (8.0%), could be due to leached into the processing water especially during soaking and cooking of protein.

The high oil content of African oil bean makes it a good source of vegetable oil for nutritional and industrial purposes. While, **Anjum *et al.* (2006**) who reported that the moisture contents of the unroasted sunflower oil seeds variety of protein, fiber and ash of KL-39 were 24.94; 7.01 and 5.00. While 21.00, 9.50 and 5.50 of FH-330; respectively.

Table (6): Minerals Content of raw and treated sunflower seeds.

Constituents	Treated sunflower seeds		
	Raw	Roasted	Soaked Roasted
Mn (mg/kg)	94.61±3.14^{c}	103.35±5.12^{a}	99.92±1.34^{b}
Mg (mg/kg)	4349±25.34^{b}	4723±31.25^{a}	4283±25.17^{c}
Zn (mg/kg)	148.44±2.51^{c}	169.94±3.17^{a}	163.96±4.03^{b}
Fe (mg/kg)	85.71±1.34^{b}	92.74±3.75^{a}	85.64±2.18^{b}
Cu (mg/kg)	37.88±2.12^{b}	44.80±2.10^{a}	32.96±1.06^{c}
Se (mg/kg)	0.11±0.01^{b}	0.24±0.01^{a}	0.24±0.01^{a}
Ca (mg/kg)	3712±8.31^{b}	3997±9.31^{a}	3448±12.14^{c}
Na (mg/kg)	172.03±3.61^{b}	100.35±4.25^{c}	190.05±2.15^{a}
K (mg/kg)	9743±9.15^{b}	11417±30.41^{a}	11159±13.17^{b}
P (mg/kg)	9780±14.36^{b}	8917±18.61^{c}	10106±21.12^{a}

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

Minerals content:

The present data in the Table (6) revealed that there were significant varietal effect on Zn, Ca, Fe, Na, K and P contents. The abundant minerals in the studied samples were K and P with values ranging from (9743±9.15 to 11417 ± 30.41 mg/kg) and (8917 ± 18.61 to 10106 ± 21.12 mg/kg); respectively. Followed by Ca and Mg (3448 ± 12.14 – 3997 ± 9.31 mg/kg) and (4283 ± 25.17 – 4723 ± 31.25 mg/kg).

Soaked seeds showed a wide variation in their mineral elements content compared with unsoaked sunflower seeds. The high level of Na in soaked sunflower seeds might be due to leaching out of Na from the seed coats in the soaking medium, which was thereby re-absorbed by the imbibed cotyledons (**Youssef *et al.*, 1987**). On the other hand **Abdel-Gawad (1991**) reported that the increase in mineral contents by roasted was mainly due to the decrease in dry weight of sunflower seeds during this process.

Table (7): Sensory evaluation of halwa spread.

Sample	Consistency (10)	Homogeneity in color (10)	Intensity of odor (10)	Intensity of taste (10)	Free of sugar granules (10)	Overall acceptability (50)
10%	9.1^{a}	9.3^{a}	9.0^{a}	8.9^{a}	8.7^{a}	45^{a}
20%	9.0^{a}	9.0^{b}	8.8^{b}	8.8^{a}	8.5^{b}	44.1^{a}
30%	8.7^{b}	8.7^{c}	8.5^{c}	8.5^{b}	8.3^{c}	42.7^{b}

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

10% = halwa spread supplemented with 10% sunflower seeds powder.

20% = halwa spread supplemented with 20% sunflower seeds powder.

30% = halwa spread supplemented with 30% sunflower seeds powder.

Table (8): Sensory evaluation of coffee

Sample	Consistency (10)	Homogeneity in color (10)	Intensity of odor (10)	Intensity of taste (10)	Free of sugar granules (10)	Overall acceptability (50)
10%	9.0^{a}	9.5^{a}	9.1^{a}	9.3^{a}	8.5^{a}	45.4^{a}
20%	8.7^{b}	9.0^{b}	8.7^{b}	8.6^{b}	8.3^{b}	43.3^{b}
30%	8.0^{c}	8.5^{c}	8.6^{b}	8.0^{c}	8.0^{c}	41.1^{c}

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

10% = coffee supplemented with 10% sunflower seeds powder.

20% = coffee supplemented with 20% sunflower seeds powder.

30% = coffee supplemented with 30% sunflower seeds powder.

Table (9): Sensory evaluation of syrup

Sample	Consistency (10)	Homogeneity in color (10)	Intensity of odor (10)	Intensity of taste (10)	Free of sugar granules (10)	Overall acceptability (50)
10%	7.9^{a}	7.7^{a}	7.7^{a}	7.8^{a}	8.0^{a}	39.1^{a}
20%	7.7^{b}	7.5^{b}	7.5^{b}	7.5^{b}	7.8^{b}	38^{b}
30%	7.0^{c}	6.9^{c}	7.0^{c}	7.0^{c}	7.5^{c}	35.4^{c}

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

10% = syrup supplemented with 10% sunflower seeds powder.

20% = syrup supplemented with 20% sunflower seeds powder.

30% = syrup supplemented with 30% sunflower seeds powder.

Table (10): Sensory evaluation of koufta

Sample	Color (10)	Odor (10)	Taste (10)	Hardness (10)	Juiciness (10)	Overall acceptability (50)
10%	8.5^{a}	8.1^{a}	8.8^{a}	8.5^{a}	8.6^{a}	42.5^{a}
20%	8.3^{b}	8.0^{a}	8.4^{b}	8.3^{b}	8.4^{b}	41.4^{b}
30%	8.0^{c}	7.8^{b}	7.9^{c}	8.0^{c}	7.8^{c}	39.5^{c}

Mean values ± SD

Mean values in each column having different superscript (a, b and c) are significant.

10% = koufta supplemented with 10% sunflower seeds powder.

20% = koufta supplemented with 20% sunflower seeds powder.

30% = koufta supplemented with 30% sunflower seeds powder.

Sensory evaluation of halwa spread, coffee, syrup and koufta:

Sensory evaluation is considered to be a valuable tool in solving problems involving food acceptability. It is useful in products improvement, quality maintenance and more important in an new products development (**Kramer and Twigg, 1974**).

The results of analysis of variance in consistency, homogeneity in color, intensity of odor, intensity of taste, free of sugar granules and over all acceptability of halwa spread, coffee and syrup made from sunflower seeds powder are shown in Table (7), (8) and (9). The results indicated significant difference in all sensory attributes among halwa spread, coffee and syrup samples. The differences depended on the amount of roasted sunflower seeds powder used in processing halwa spread, coffee and syrup. The halwa spread, coffee and syrup made with 10% sunflower seeds powder recorded the highest scores of sensory attributes.

Sensory evaluation of supplemented koufta samples are shown in Table (10). It was observed that there were significant differences in color, odor, taste, hardness and juiciness. The total score (50) for supplemented koufta samples varied from 39.5 to 42.5. koufta made with 10% sunflower seeds powder recorded the highest score 42.5 of sensory attributes followed by koufta made with 20% and 30% sunflower seeds powder.

Conclusion:

In conclusion the results of this study indicated that roasting sunflower seeds can be increase the concentrations of protein and crude oil so the sunflower seeds powder can be easily incorporated in to a normal diet at a level that might benefit health as a natural antioxidant.

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بعض المنتجات المدعمة بمسحوق بذور عباد الشمس كمصدر للزيت والبروتين

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تهدف هذه الدراسة إلى تدعيم بعض المنتجات بمسحوق بذور عباد الشمس وتقدير التركيب الكيميائي والعناصر المعدنية وأظهرت النتائج أن مسحوق بذور عباد الشمس تعتبر مصدر مهم للبروتين والزيت.

فكل العينات (الخام والمنقوعة والمحمصة) إحتوت على كميات كبيرة من الماغنسيوم والزنك والكالسيوم والبوتاسيوم والفسفور.

كما أظهرت نتائج التدعيم بنسب ١٠ و ٢٠ و ٣٠% من مسحوق بذورعباد الشمس إختلافات في جميع المقاييس الحسية بين الحلاوة الفرد والقهوة والشراب السكري والكفتة. علاوة على أن الحلاوة الفرد والقهوة والشراب السكري والكفتة المدعمة بـ ١٠% سجلت أفضل نتائج للتقييم الحسي. لذلك يمكن الانتفاع ببذور عباد الشمس واستخدامها في مختلف الوصفات الغذائية.

الكلمات المفتاحية: التركيب الكيميائي . العناصر المعدنية . الحلاوة الفرد . القهوة . الشراب السكري . الكفتة . التقييم الحسي . مسحوق بذور عباد الشمس.