J. Food and Dairy Sci., Mansoura Univ., Vol. 10 (5): 159- 163, 2019

Influence of Incorporating Chia Seeds on the Quality Characteristics of Pan Bread

Abou raya, M. A.[1]; Faten Y. Ibrahim[1]; Amal M. H. Abdel-Haleem[2] and Khloud I. Abosalem[2]
[1]Food industries Dept., Fac., of Agric., Mansoura Univ., Egypt
[2]Food Technol. Res. Inst., Agric.Res. Center, Giza, Egypt

ABSTRACT

The influence of incorporating chia seeds at 2, 4, 6, and 8% levels on the quality characteristics of pan bread was studied. Chemical, nutritional and sensory evaluations for raw materials and pan bread were performed. Results of chemical analysis showed chia seeds had significant amounts of crude protein (21.06%), ether extract (26.3%), crude fiber (31.03%) and ash (3.43%), compared to wheat flour. Chia seeds were rich in calcium (600 mg/100 g), phosphorus (860 mg/100 g), and potassium (666 mg/100 g), than wheat flour. Chia seeds was deficient in cysteine (0.41%), histidine (0.53%), tyrosine (0.58 %), methionine (0.59%) and had predominant contents of. isoleucine (0.8%), lysine (0.93%), valine (0.95%) and aspartic (1.69%). The results of sensory acceptability of pan bread with chia seeds indicated no significant differences in appearance, taste, aroma, tint, weaving and overall acceptability up to 6%, comparing with wheat pan bread. Chemical composition results indicated that pan bread with chia seeds had significant amounts of crude protein, oil, crude fiber and ash. It could be substituting flour with chia seeds to 6% to deliver functional pan bread to consumers, with a good acceptability and high quality nutrients.

Keywords: Chia seeds - pan bread- chemical analysis, nutritional value, sensory acceptability.

INTRODUCTION

Chia (*Salvia hispanica L.*) is summer anniversary plant belong to Labiatae family (Vazquez-Ovando *et al.,* 2010). It had a little, oval and flat shape and measured from two to 2.5 mm tallness 1.2 to 1.5 mm broadness and 0.8 to 1 mm of density. Its color differs from dark brown to black, occasionally grey or white, 2.5 and 2.6; white seeds maximal in tonnage, broadness and density than dark seeds (Ixtaina *et al.,* 2008).

The seed has 25-38% oil, which is macro plant source, make it source of fatty acids (Capitani *et al.,* 2012).

USDA, (2011) recommend a daily intake of Omega-3 1200 mg for a good healthy. Addition to that, chia contain high amount of natural antioxidant, which prevent rancidity of unsaturated fatty acids in food what contain these seeds.

In addition, chia seeds are an excellent source of balanced protein. Chia seeds have 20% protein with completely essential amino acids, an inexpensive vegetable source of protein with high nutritional value. Moreover, one of the most importance of these seeds its higher content of fiber; its use had elementary benefits like regulation of intestinal transit, reduction of glycemic index and corresponding insulin restraint. (Ullah *et al.,* 2016). Content of fiber in chia seed include polysaccharide gum with altitude molecular mass and mucilage. As consequence of opinion by European Food Safety Authority about safety of chia as food ingredient (Hruskova and Svec 2015), from 2009 chia seeds and powder of chia seeds might laid on market in European Community as novel food ingredient to use in products of bread, with high content of 5% chia seeds (Zettel *et al.,* 2014).

Bread significantly fraction of daily diet in many territories all over world, where in it calculation for about 20% of calories wasted by folks (Saccotelli *et al.,* 2017). It had varies toppings, fillings, shapes, and textures. Pan bread mention to as loaf bread or sliced bread, in what dough was baked in loaf pan to confer its characteristic shape (Ishida and Steel 2014). It seem that pan bread is excellent vehicle to deliver chia seeds; especially nowadays client advantage in health is return by sales characters for latest years, that decline increase in sales of white bread with adding fiber, and of bread with adding whole grains. (Costantini and Molinari 2014). Taking into calculation that chia seed supply plurality of all these complexes with nutritional and functional characteristics in expression of fiber, antioxidants, polyunsaturated fatty acids, minerals, vitamins and hydrocolloids, and being a vegetable source, it would be very good constituent in bakery products. (Sandoval-Oliveros and Paredes-Lopez 2013).

Accordingly, present work aimed to study chemical, nutritional and sensory quality characteristics of pan bread as influenced by incorporating chia seed at 2, 4, 6, and 8% levels.

MATERIALS AND METHODS

Materials

Seeds of chia purchased from local market at Kafr El-Sheikh city, Egypt.

Wheat flour 72% extraction purchased from Delta Middle and West Milling Company, at Tanta City, Egypt.

Other ingredients yeast, sugar, corn oil and salt purchased from local market Kafr El-Sheikh City, Egypt.

Chemicals used purchased from Company of El-Gomhoria for Chemicals and Drugs at Tanta City, Egypt.

Methods

Preparation samples:

Seeds cleaned manually and strong matters, like stones, uncleanness and cracked seeds were extracted. Thereafter, put in hermetic plastic vessels and stocked at 5±1°C till used. The seeds were ground to obtain powder.

Pan bread preparation:

Pan bread had been prepared according Lazaridou *et al.,* (2007) as follows: yeast (2%) melted in 174 ml warm water (35°C) then add to dried ingredients (2% table salt, 2% sugar can and 300 g wheat flour 72 % extraction). Corn oil (2%) added and mixture has been kneaded for 4 min at a slow speed then for 2 min at a high speed. Dough fermented at 30°C for 30 min and 80-85% relative humidity in a fermentation cabinet. Dough splitted into 150g pieces, placed in pan and put to the proof under same conditions for 45 min. Bread dough baked at 240 °C for 20–25 min following steaming for 10sec. Baked pan bread cooled down at room temperature for 60 min.

Table A. Pan Bread preparation with chia seeds:

Samples Ingredients	Control	2% Dried Chia seeds	4% Dried Chia seeds	6% Dried Chia seeds	8% Dried Chia seeds
Wheat flour(72%)	300 g	294 g	288 g	282 g	276 g
Corn oil	2%	2%	2%	2%	2%
Sugar	2%	2%	2%	2%	2%
Salt	2%	2%	2%	2%	2%
Yeast	2%	2%	2%	2%	2%

Analytical methods:

Gross chemical composition:

Moisture content, ether extract, protein, ash and fibers established according to A.O.A.C. (2005). Total carbohydrates content evaluated by difference according to James (1995) as follows:

$$\textbf{Total carbohydrates}\% = 100 - (\textbf{protein}\% + \textbf{ether extract}\% + \textbf{ash}\%)$$

On dry weight basis.

Determination of mineral contents:

Five grams the sample was digested using concentrated HNO_3 for two hourse. (until the solution become colorless) and diluted to 100 ml with distilled water. Calcium, manganese, iron, zinc and copper had been established, using PYE Unicom SP19000 Atomic Absorption Spectroscopy which recounted in A.O.A.C. (2005). Sodium and potassium had been determined by flam photometer according to Pearson (1976). Phosphorus was estimated calorimetrically according method described by Murphy and Riley (1962).

Determination of fatty Acids Composition:

Fatty acids composition of chia seeds oil had established, in Faculty of Agriculture, Alexandria University, by gas chromatography (GC Modle,Shimadzu-8A, equipped with FID Chromo Q, Detector temperature 270 °C,H2 flow rate 75ml/min, Sensitivity 16x10, Column temperature 150-180 °C at rate 2 c/min,N2 flow rate 20ml/min, Air flow rate 0.5ml/min and Start speed 2.5 mm/min according to Radwan (1978).

Determination of amino acids:

Wheat flour and chia seeds flour had been subjected to acid hydrolysis using 6N HCl according A. O. A. C. (2005). Amino acids data had analyzed by amino acid analyzer. (LC 3000 amino acid analyzer, High performance system, a product of LC biochrom Eppdrop, Germany). Flow rate 0.2 ml/min, Pressure of buffer form 0 to 2 bars, Pressure of reagent to 0-150 bar and reaction temperature 123 °C.

Sensory Evaluation of Pan Bread:

A group of 25 panelists from organization of Food Technology Research Institute (Agricultural Research Center, Kafr El-Sheikh Research Station, Kafr El-Sheikh Governorate, and Egypt) evaluates sensory properties of pan bread according Renzo (1975). Panelists gave scores for appearance, taste, smell, color, texture and over all acceptability on hedonic scale from one (very disliked) to nine (very liked).

Statistical analysis:

Obtained results were statistically analyzed according to the SPSS-PC (statistical package software, version, 16.0). One-way analysis of variance (ANOVA) was used to test the differences between groups (SPSS, 1999).

RESULTS AND DISCUSSION

Chemical composition of dried chia seeds powder and wheat flour:

Chemical composition of raw material used are reported in Table (1). Content of moisture in chia seeds showed values (7.6%). As was expected, the seeds showed a high amount of ether extract (26.3%). According to study, chia seeds had ether extract content from 26 to 30% (Pizarro *et al.,* 2013).

Results listed in Table (1) reveal chia seeds had high percentages of protein and fibre which were (21.06 and 31.03%) respectively. results were in agreement with results of Pizarro *et al.,* (2013), (Valdivia-Lopez and Tecante 2015) and (Hruskova and Svec 2015).

On other hand, results of chia seeds were near from the results reported by Da Silva *et al.,* (2014), who indicated that content of protein in chia seeds was (15 – 25 %), ether extract (30 – 33 %) crude fiber (18 – 30 %) and ash (4 – 5 %) on dry weight basis, total carbohydrates (36 – 46%). High levels of protein, ether extract and crude fibre in chia seeds qualified to use like a novel source of vegetable oil and protein. Therefore, it is clear that addition of chia seeds to bakery products lead to increase nutritive synthesis, and total carbohydrates decrease.

Table 1. Chemical composition of dried chia seeds powder and wheat flour (g/100 g in dry matter):

Component %	Moisture	Ether extract	protein	Ash	fibers	Total carbohydrates
Dried Chia seeds powder	7.6	26.3	21.06	3.43	31.03	49.21
Wheat flour (72%)	14.71	0.88	10.15	0.62	0.56	88.35

Minerals content of chia seeds and wheat flour:

Data in Table (2) gives contents of some macro elements: calcium (Ca), potassium (K), Sodium (Na) and phosphorus (P) as well as some trace elements: iron (Fe) zinc (Zn), copper (Cu) and manganese (Mn) in chia seeds.

Macro elements:

Data recortd in Table (2) show chia seeds appear poor in sodium (Na) (16 mg/100 g), however, very rich in phosphorus (P) (860 mg/100 g), potassium (K) (666 mg/100 g) and calcium (Ca) (600 mg/100 g). The data are in agreement with (Marcinek and Krejpcio 2017) who indicated chia seeds had high quantities of K, Ca and P elements, which were necessary for proper human nutrition.

Trace elements:

Trace elements Content iron, zinc, copper and manganese, had been determined in chia seeds and wheat flour and data showed in Table (2). Data recorded that, chia seeds contain high quantities of iron, zinc, copper and

manganese (8, 5, 0.92 and 3.35 mg/100 g) compared with wheat flour (72%).

Trace elements described a series of food as long as in diet in little levels. Content of Trace elements diets is of high influx advantage to nutrition community because of mounting proof of marginal or not enough absorption among chunks of inhabitance (Weaver *et al.,* 1981).

For determined levels of macro or trance, elements and data in Table (2) might be demonstrated from nutritional mark of opinion on nutritional basis, necessarily of elements and their role in human body should be signalized. Nevertheless, chia seeds consider a good source for minerals.

Table 2. Minerals content of chia seeds and wheat flour (mg/100 g) on dry weight basis:

Samples	Macro elements mg/100g			
	Phosphorus (P)	Potassium (K)	Sodium (Na)	Calcium (Ca)
Chia seeds	860	666	16	600
Wheat flour (72%)	140	139	26.1	36.3
samples	Trace elements mg/100g			
	Iron (Fe)	Zinc (Zn)	Copper (Cu)	Manganese (Mn)
Chia seeds	8	5	0.92	3.35
Wheat flour (72%)	0.7	0.35	0.2	0.75

Fatty acids composition of chia seeds oil:

Results in Table (3) showed composition of fatty acids in chia seeds oil. It observed that Linoleic acid is predominant fatty acid in chia seeds oil. Oil of chia seeds contain a high amounts of palmitic acid (C16:0), 7.10, stearic acid (C18:0), 3.24 and oleic acid (C18:1), 12.01.

Data in Table (3) are in same line with data showed by Ixtaina *et al*., (2011) who showed content of palmitic acid 7.2, stearic acid 3.8 and oleic acid 15.2, presence of high concentration of polyunsaturated fatty acids in chia oil had grown its publicity and agriculture several flection.

Table 3. Fatty acids composition of chia seeds oil (g/100g on dry weight basis):

Fatty acids	Symbol	Chia seeds oil
Lauric acid	$C_{12:0}$	0.3
Myristic acid	$C_{14:0}$	0.02
Palmitic acid	$C_{16:0}$	7.10
Margaric acid	$C_{17:0}$	0.06
Stearic acid	$C_{18:0}$	3.24
Arachidic acid	$C_{20:0}$	0.3
Saturated fatty acids		11.02
Palmitoleic acid	$C_{16:1}$	0.08
Oleic acid	$C_{18:1}$	12.01
Linoleic acid	$C_{18:2}$	60.78
Cis-Eicosenoico acid	$C_{20:1}$	0.09
Un saturated fatty acids		72.96
Ratio saturated FA / unsaturated FA		0.15

Amino acid composition:

Amino acids Composition of chia seeds were showed in Table (4) the results cleared that chia seeds protein was considered a poor source of cysteine 2.18%, histidine 2.81%, tyrosine 3.08%, methionine 3.13%, threonine 3.77% and phenylalanine 4.09% as essential amino acids.

On other hand, Isoleucine, Lysine, Valine and Aspartic were predomenant essential amino acids represented 4.3, 4.9, 5.05 and 8.98% respectively. Non-essential amino acids included Glutamic and Arginine are basic of amino acids that were 18.61 and 11.38% respectively, followed by proline, serine and alanine 6.38, 5.58, and 5.58 respectively.

These values of amino acids were in agreement with the result of (Ayerza and Coates 2011). The study revealed presence of 9 essential amino acids in chia in cognizable level. Foods wealthy in protein have senior transact of effect on weight loss because of loss of fats in body. Seed revealed exellant equation of essential and non-essential amino acids (Sandoval-Oliveros and Paredes-Lopez 2013).

Table 4. Amino acids composition of chia seeds and white wheat flour. (g amino acid per 100g protein):

Type	Amino acids	Chia seeds (%)	Wheat flour (%)
Essential amino acid	Lysine	4.9	5.59
	Isoleucine	4.3	3.89
	Leucine	5.05	7.78
	Phenylalanine	4.09	5.99
	Valine	5.05	5.63
	Threonine	3.77	5.18
	Methionine	3.13	4.72
Semi-essential amino acid	Tyrosine	3.08	2.53
	Histidine	2.81	3.11
	Cystine	2.18	1.59
Non-Essential amino acid	Aspartic	8.98	7.74
	Glutamic	18.61	11.67
	Serine	5.58	4.43
	Proline	6.38	9.40
	Glycine	5.05	7.32
	Alanine	5.58	5.34
	Arginine	11.38	6.92

Chemical composition of prepared pan bread:

Results cleared in Table (5) show chemical composition of prepared pan bread. Moisture Content in pan bread samples were from 42.33% to 45.07%. Protein, ash and fibre in pan bread increased mostly with increasing the level of chia seeds in bread. Addition chia seeds to pan bread characterized higher results of fiber, which increase twice comparing with control.

Every day consuming of fiber have to amount from 30 to 40 kg body weight. Its value in human diet lead to accelerate intestinal peristalsis reduces assimilation of cholesterol and triglycerides reduce levels of glucose in blood, and decrease feeling of hunger (Costantini *et al.,* 2014) and (Coelho and Salas-Mellado 2015) .

Ether extract of pan bread essentially increased with increasing of chia seeds level. Thus, extension of chia seeds to pan bread have appositive impact on nutritional value of final output.

Table 5. Chemical composition of prepared pan bread with chia seeds (%) on dry basis:

Values	Control	Drid Chia seeds 2%	Drid Chia seeds 4 %	Drid Chia seeds 6%	Drid Chia seeds 8%
Moisture (%)	45.07	43.23	43.01	42.49	42.33
protein (%)	10.27	12.44	12.19	12.26	13.52
Ash (%)	0.81	1.09	1.04	1.10	2.18
Crude fiber (%)	4.25	6.88	7.07	8.37	9.17
Ether extract (%)	1.03	1.46	1.85	2.22	2.44
Total carbohydrates (%)	87.89	85.01	84.92	84.42	81.86

Sensory evaluation of pan bread with chia seeds:

Data in Table (6) showed that no significantly variation ($p \leq 0.05$) in appearance of pan bread between control pan bread and pan bread with 2% chia seeds. There was significantly variation ($p \leq 0.05$) amidst control pan bread and pan bread with (4, 6 and 8%) chia seeds. However, 2% of chia seeds was the better addition and the nearest addition to control was 4% chia seeds .Pan bread with 2% chia seeds was no significantly variation ($p \leq 0.05$) comparing with control pan bread in taste, smell and color . Pan bread with 2%chia seeds was better than control in texture however; pan bread with 4%chia seeds was as good as control pan bread. There was significantly variation ($p \leq 0.05$) amidst control pan bread and pan bread with addition (4, 6 and 8%) chia seeds in taste, smell and color. No significantly, variation ($p \leq 0.05$) appear amidst control pan bread and pan bread with 2% and 4% chia seeds in texture and over all acceptability.

No significant difference in overall acceptability of pan bread with 2% and 4%chia seeds comparing with control however; there was significantly variation ($p \leq 0.05$) in overall acceptability amidst control pan bread and pan bread with 6% and 8% chia seeds. Results are on the same line of results recorded by (Romankiewicz *et al.,* 2017) who found the best addition of chia seeds to pan bread were 2% and 4%.

Table 6. Sensory evaluation of pan bread with chia seeds:

Samples Chrcteristics (9)	Control	Dried Chia seeds2%	Dried Chia seeds4%	Dried Chia seeds6%	Dried Chia seeds8%
Appearance (9)	8.4 ± 0.15^{a}	8.2 ± 0.26^{a}	7.4 ± 0.4^{b}	7.2 ± 0.25^{c}	6.4 ± 0.4^{d}
Taste (9)	8.4 ± 0.3^{a}	8.5 ± 0.3^{a}	7.3 ± 0.15^{c}	7.5 ± 0.2^{b}	7.00 ± 0.1^{c}
Smell (9)	8.4 ± 0.41^{a}	8.4 ± 0.45^{a}	7.8 ± 0.6^{ab}	7.4 ± 0.15^{b}	7.3 ± 0.41^{c}
Color (9)	8.1 ± 0.25^{a}	8.1 ± 0.2^{a}	7.6 ± 0.36^{b}	6.5 ± 0.2^{d}	6.5 ± 0.47^{d}
Texture (9)	8.1 ± 0.32^{a}	8.3 ± 0.5^{a}	8.4 ± 0.36^{a}	7.3 ± 0.32^{c}	7.1 ± 0.47^{c}
Overall acceptability(9)	8.4 ± 0.25^{a}	8.4 ± 0.4^{a}	8.2 ± 0.25^{a}	7.4 ± 0.36^{b}	7.3 ± 0.3^{c}

Means ± standard deviations with different superscript letters in the same row are significantly different at (P≤ 0.05).

CONCLUSION

The effect of substituting chia seeds at 2, 4, 6, and 8% levels on quality attributes of pan bread was considered, in terms of proximate composition, nutrition and sensory assessments. Chia seed had noteworthy contents of protein, oil, fiber and ash, as well as macro and micro minerals, in comparison to wheat flour. Not only chia seed is considered to be rich source of poly unsaturated fatty acids and unsaturated fatty acids, but as well it is a very excellent exporter of crude fiber., however, it had insufficient contents of sulfur amino acids namely cysteine and methionine. Substituting wheat flour with chia seeds above 6% could be a suitable tool to convey functional pan bread to consumer with high acceptability and condensed nutrients.

REFERENCES

A.O.A.C. (2005). Association of Official Analytical Chemists. Official Method of Analysis of the Association of Official Analytical Chemists. 18th Ed. Washington, DC, USA.

Ayerza, R. and Coates, W. (2011). Protein content, oil content and fatty acid profiles as potential criteria to determine the origin of commercially grown chia *(Salvia hispanica)*. Ind Crop Prod; 34:1366-1371.

Capitani, M. I.; Spotorno, V.; Nolasco, S. M.; and Tom´as, M. C. (2012).). "Physicochemical and functional characterization of by-products from chia (*Salvia hispanica L.)* seeds of Argentina," LWT- Food Science and Technology, vol. 45, no. 1, pp. 94-102.

Coelho M. S. and Salas-Mellado, M. D. L. M. (2015). "Effects of substituting chia *(Salvia hispanica L.)* flour or seeds for wheat flour on the quality of the bread," LWT- Food Science and Technology, vol. 60, no. 2, pp. 729-736.

Costantini, L.; Luksic, L.; Molinari, R.; Kreft, I.; Bonafaccia, G.; Manzi, L.; and Merendino, N. (2014). "Development of gluten-free bread using tartary buckwheat and chia flour rich in flavonoids and omega-3 fatty acids as ingredients," Food Chemistry, vol. 165, pp. 232-240.

Da Silva, M. R.; Moraes, E.A.; Lenquiste,S.A.; Godoy,A.T.; Eberlin, M.N. and MarósticaM.R. (2014) Chemical characterization and antioxidant potential of Chilean chia seeds and oil (*Salvia hispanica L.)* Food Science and Technology 59 - 1304-1310

Hruskova, M. and I. Svec, (2015). "Chemical, rheological and bread characteristics of wheat flour influenced by different forms of chia *(Salvia hispanica L.),*" Emirates Journal of Food and Agriculture, vol.27, no.12, pp.872-877.

Ishida, P. M. G. and Steel, C. J. (2014). Physicochemical and sensory characteristics of pan bread samples available in the Brazilian market. Food Science and Technology,34(4),746-754.

Ixtaina, V.Y.; Martmez, M.L.; Spotorno, V.; Mateo, C.M.; Maestri, D. M. and Diehl, B. W. K. (2011). Characterization of chia seed oils obtained by pressing and solvent extraction. J Food Comp Anal;24(2):166-174.

Ixtaina, V.Y.; Nolasco, S.M. and Tomas M.C. (2008). Physical properties of chia (*Salvia hispanica L.*) seeds. Ind Crop Prod 28:286-293

James, C.S. (1995). .Analytical Chemistry of Foods. Chap .6, General Food Studies , Firsted ., The Alden press , Oxford, UK

Lazaridou, A.; Duta, D.; Papageorgiou, M.; Belc, N. and Biliaderis, C. G.(2007) Effects of hydrocolloids on dough rheology and bread quality parameters in gluten-free formulations. Journal of Food Engineering,79,1033–1047.

Marcinek, K. and Krejpcio, Z. (2017). Chia seeds *(Salvia hispanica L.)* :Health promoting and therapeutic applications –areview 68(2):123-129 http://wydawnictwa.pzh.gov.pl/roczniki_pzh

Murphy, J. and Riley, J. (1962). Amodified single solution method for determination of phosphate in natural water . Anal .Chem . Acta.27:31-36 .

Pearson, D. (1976). The chemical Analusis od Foods. 7th edn. Edinburgh, London: Churchill Livingstone.

Pizarro, P. L. E. L.; Almeida, N.; Sammaan, C. and Chang, Y. K. (2013). "Evaluation of whole chia (*Salvia hispanica L.)* flour and hydrogenated vegetable fat in pound cake," LWT- Food Science and Technology, vol. 54, no. 1, pp. 73-79.

Radwan, S. S. (1978). Coupling of two dimension thin layer chromatography with gas chromatography for the quantitative analysis of lipids classes and their constituent fatty acids. J. Chrom.Sci., 16:538-542.

Renzo, D. (1975). Bakery products yeast leavened. Noyes Data Corporation. London, England.

Romankiewicz, D.; Hassoon,W. H.; Cacak-Pietrzak, G.; Sobczyk, M.; Wirkowska-Wojdy Ba, M.; CegliNska, A. and Dziki,D. (2017). The Effect of Chia Seeds *(Salvia hispanica L.)* Addition on Quality and Nutritional Value of Wheat Bread. Journal of Food Quality, Article ID 7352631, 7 pages

Saccotelli, M.A.; Conte, A.; Burrafato, K.R.; Calligaris, S.; Manzocco, L. and Del Nobile, M.A. (2017). Optimization of durum wheat bread enriched with bran. Food Sci Nutr 5: 689–695.

Sandoval-Oliveros, M. R. and Paredes-Lopez, O. (2013). "Isolation and characterization of proteins from chia seeds *(Salvia hispanica L.*)," Journal of Agricultural and Food Chemistry, vol. 61, no. 1, pp. 193-201.

SPSS, (1999). SPSS-PC for the IBM PC/XT computer. Version 16. SPSS Inc., II. U.S.A.

Ullah, R.; Nadeem, M.and Khalique , A. (2016). "Nutritional and therapeutic perspectives of Chia *(Salvia hispanica L.)*: a review, J Food Sci Technol 53(4): 1750-1758.

USDA. (2011). National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory Home Page, U.S. Department of Agriculture, Agricultural Research Service.

Valdivia-Lopez, A. M. and Tecante, (2015). "Chia(*Salvia hispanica*): a review of native mexican seed and its nutritional and functional properties," Advances in Food andNutrition Research, vol. 75, pp. 53-75,.

Vazquez-Ovando, A.; Rosado-Rubio, G.; Chel-Guerrero, L. and Betancur-Ancona, D. (2010) Physicochemical properties of a fibrous fraction from chia (*Salvia hispanica L.).* Food Sci Technol-Leb 42:168-173

Weaver, C.M.; Chen, P.H. and Rynearson, S.L., (1981). Effect of milling on trace elements and protein content of oats and barley. Cereal Chem., 58(2): 120-124

Zettel, V.; Kramer, A.; Hecker, F.and Hitzmann, B. (2014). "Influence of gel from ground chia (*Salvia hispanica L.)* for wheat bread production," European Food Research and Technology, vol. 240, no. 3, pp. 655-662.

تأثير إضافة بذور الشيا على خواص وجودة خبز القوالب.

مسعد عبد العزيز أبو رية [1]، فاتن يوسف إبراهيم [1]، امل محمود عبد الحليم [2] وخلود إبراهيم أبو سالم [2]

[1]قسم الصناعات الغذائية – كلية الزراعة – جامعة المنصورة – مصر.

[2]معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – مصر.

تمت دراسة تأثير إضافة بذور الشيا بنسب اضافة 2 و4 و6 و8 ٪ على خصائص ونوعية خبز القوالب. وتم إجراء تحليلات كيميائية وحسية للمواد الخام وخبز القوالب. وقد أظهرت نتائج التحليل الكيميائي لبذور الشيا احتوائها على كميات كبيرة من البروتين الخام (21.06 ٪) والمستخلص الايثيري (26.3 ٪) والألياف الخام (31.03 ٪) والرماد (3.43 ٪)، مقارنة بدقيق القمح وكانت بذور الشيا غنية في الكالسيوم (600 ملجم / 100 جرام) والفوسفور (860 ملجم / 100جرام) والبوتاسيوم (666ملجم / 100 جرام) مقارنة بدقيق القمح. كانت بذور الشيا فقيرة في السيستين (0.41 ٪)، الهستيدين (0.53 ٪)، التيروزين (0.58 ٪، الميثيونين (0.59 ٪) وكانت ذات محتويات عالية من الإيزوليوسين (0.8 ٪)، الليسين (0.93 ٪)، الفالين (0.95 ٪) والأسبارتيك (1.69 ٪). لم توضح نتائج التقييم الحسي لخبز القوالب مع اضافة بذور الشيا وجود فروق معنوية في المظهر، والطعم، والرائحة، واللون، والملمس، والقبول العام بنسبة استبدال تصل إلى 6٪ من بذور الشيا، مقارنة بخبز القمح. ووجد ان التركيب الكيمائي للخبز مع بذور الشيا به كمية كبيرة من البروتين والمستخلص الايثيري والألياف والرماد. من ذلك يتضح انه يمكن اضافه بذور الشيا بنسبة تصل إلى 6٪ الي دقيق القمح لتقديم خبز للمستهلكين، ذو خواص حسية مقبولة ومغذيات عالية الجودة.