J. Food and Dairy Sci., Mansoura Univ., Vol. 8 (1):9 -16, 2017

Utilization of Different Seedss for Production Multigrain Pan Bread

Youssif, M. R.[1] and Gehan A. Ghoneim[2]

[1]Bread and Pasta Research Department, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

[2]Food Industries Department, Faculty of Agriculture, Mansoura University, 35516, Mansoura, Egypt

ABSTRACT

Effect of replacement of wheat flour with different levels of multigrain mix (MGM) 5, 10, 15 and 20% containing black, sesame, flaxseeds and chia seeds on rheological and bread-making attributes of wheat flour was evaluated. The obtained results revealed that, both of black, sesame, flax seeds and Chia seed contained high amounts of crude protein, lipids, ash and crude fibers in addition to high levels of minerals as calcium, potassium, iron and zinc, comparing with wheat and barley flour. Moreover, the above mentioned seeds having high levels of amino acids, especially lysine compared to the wheat and barley flour. Also, high amount of phenolic compounds was detected. Moreover, high content of unsaturated fatty acids, especially linoleic acid (C18:2) and oleic acid (C18:1) was also detected. Increasing the MGM levels from 0 to 20% increased farinograph water absorption. Meanwhile, dough stability, resistance to extension, proportional number and energy were decreased. Supplementation levels of (5, 10, 15 and 20%) MGM gradually increased weight loaf values. While, bread loaf volume and specific volume were gradually decreased by increasing the level of substitution compared to the control sample. The sensory evaluation data demonstrated that, the MGM successfully replaced wheat flour to produce pan bread up to 15% without any unfavorable change.

Keywords: Bread - Hull-less Barley flour - Black seeds - Sesame seeds - flaxseeds - Chia seeds - Multigrain - Nutritional value - Rheological properties - Sensory evaluation.

INTRODUCTION

Bread is considered as a major processed food. The bread is poor in content of nutrients, due to the use of refined wheat flour in baking. For that reason, supplementation of wheat flour with cheap food sources such as various cereal, mixture of legumes, seeds and grains are modern methods to produce a high quality bakery products (Sharma *et al.,* 1999).

Multigrain bread is bread process with multiple grains, legumes and seeds. These breads are more nutritious, richer in flavor and tastier than regular bread (Indrani *et al., 2010).*

Barley is a good source of soluble dietary fibers, specially β-glucan and could be considered a prebiotic food (Seidel *et al.,* 2007).

Inclusion of barley flour in formula of wheat flour to preaper bread enhances the β-glucan content of bread. β-glucan soluble fibers (3 g/day) from oat bran and rolled oats or whole grain barley and dry milled barley products, may have a beneficial effect on human health (Food and Drug Administration, 2003 and Skrbic *et al*., 2009)..

Black seeds, are a spicy plant, which cultivated in various parts of the world. The seeds, are usually used in bakery products and other dishes. The seeds of black seeds or its oil were used for medicinal purposes as a natural therapy for a number of illnesses (Burits and Bucar, 2000; Ali and Blunden, 2003).

Sesame (*Sesamum indicum* L.) seeds is a very old crop. It's consumes raw or toasted and used in many foods such as candy and pastry products to improves taste of the products. Sesame seeds a rich source of protein, also it contain a high amount of calcium. Sesame seeds also considered to be a useful food to health (Randhawa, 2008 and Pal, 2010).

Flaxseeds (*Linum usitatissimum)* are one of the oldest crop , having been cultivated since the beginning of civilisation (Goyal, 2014). Also flaxseeds are a premium source of dietary fiber and a rich source of polyunsaturated fatty acids containing a high ratio of omega-3 to omega-6.

Near two third of the total fiber in flax seeds are insoluble which increase the volume in the digestive system, prevent constipation and defense against cancers. Whereas, the remaining fiber amount of the flax seeds is soluble, having the ability to decrease cholesterol levels in the blood and optimize the blood sugar concentrations (Singh *et al.,* 2011 and Alhassane and Xu 2010).

Chia seeds (*Salvia hispanica* L.) are one of the fundamental foods of Central American civilisation. *Salvia hispanica* seeds contain a high amount of antioxidants, minerals, vitamins and very rich in polyunsaturated fatty acids, especially the omega-3 (50-57 g/100 g) and omega-6 (17-26 g/100 g) fatty acids (Ixtaina *et al.*, 2008 and Reyes-Caudillo *et al.,* 2008).

Coelho and Salas-Mellado (2015) reported that duto of the nutritional properties of chia, its consuming can be decreased blood cholesterol and glucose levels in blood.

The objective of the current study was to investigate the effect of of replacing of wheat flour with a mix be formed of barley flour, black seeds, sesame seeds, flaxseeds and chia seeds powder on the dough properties and the quality attribute of produced bread.

MATERIALS AND METHODS

Materials

Wheat flour 72% extraction rate was obtained from Five Stars Flour Mills Company, Suez, Egypt. Hull less barley grains (*Hordium vulgare L.*) were obtained from Barley Research Dept., Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.

Black seeds *(Nigella Sativa)*, Sesame seeds *(Sesamum indicum L.)*, Flaxseeds *(Linum usitatissimum)* and Chia seeds (*Salvia hispanica* L.) were obtained from Haraz Company for Agricultural seeds, Spices and Medicinal Plants, Cairo, Egypt.

Instant dry yeast (*Saccharomyces cerevisiae*) processed by AKMAYA Co., Turkey, was obtained from the local market.

Methods

Preparation of barley flour

Hull less barley grains were moistened to 14% moisture content for 24 hours, then milled by perten laboratory mill to whole barley meal then, sieved through a 50-mesh screen. The resultant flour was packed in polyethylene bags and stored at (-18˚C) until used.

Preparation of Multigrain

Black seeds, sesame seeds, flaxseeds and chia seeds were selected and milled into grits using plate milling. The MGM was prepared by blending the grits of four different grains at equal ratio.

Preparation of composite flour blends

Different composite flour samples were prepared by partially substituting of wheat flour or wheat flour substituted with 10% barley flour by 5, 10, 15 and 20% multigrain mix, to prepare different flour samples which used in preparation of experimental samples of multigrain pan bread.

Analytical methods

Chemical analysis

Crude protein, ash, crude fibers and lipid contents of samples were determined according to the A.O.A.C (2000). The carbohydrate content was estimated as a nitrogen-free extract (NFE) by the difference from the sum of the protein, fat, ash and crude fibers content.

Mineral contents determined by wet acid-digested, using nitric and perchloric acids mixture ($HNO3$: $HClO4$, 5:1 w/v) according to the method described by Chapman and Pratt (1978). Then the total amounts of K, Na, Ca, Mg, Fe, Zn, Cu and Mn in the digested samples were determined by atomic absorption spectrophotometry.

Amino acids content were determined according to the method described by Pelltt and Young (1980), using a LKB 4151 Alpha plus Amino Acid Analyzer, Regional Center for Food and Feed, Agricultural Research Center, Giza, Egypt. Amino acid score (AAS) was calculated according to the FAO/WHO (1973) as follows:

$$\text{AAS (\%)} = \frac{\text{mg amino acid in 1gm test protein}}{\text{mg amino acid in 1gm reference protein}} \times 100$$

Fatty acids composition of the black seeds, sesame seeds, flaxseeds and chia seeds oils were analyzed by GC (HP 6890; Hewlett Packard Co., Wilmington, DE, USA) according to the method of ISO, (2011).

Total phenolic compounds for black seeds, sesame seeds, flaxseeds and chia seeds were determined , fractionated and identified at Bio-technology Lab., Plant Pathology Institute, Agricultural Research Center, Giza, Egypt according to the proposed method of Waskmundzka *et al.* (2007).

Rheological properties

Rheological properties of the various blends were determined by Barbender Farinograph and Extensograph according to the A.A.C.C (2000).

Bread making process

Pan bread was produced according to the method described in the A.A.C.C., (2000) with some modification by using multigrain blends. Multigrain pan bread making involved mixing 100 g flour, instant active dry yeast (0.5% w/w), sugar (4% w/w), fat (4% w/w), skim milk powder (2% w/w), salt (1.5% w/w), and water added according to the farinograph water absorption. Bread doughs were prepared by mixing all ingredients in a 300 g farinograph bowl until they reached maximum development. The resulted doughs were let to rest for 20 min at 28 - 30˚C (first proofing) then the doughs were separated into three 150 g pieces, hand-moulded and put into pans for final proofing at 32 - 35˚C and 80 - 85% relative humidity in fermentation cabinet for 60 min. Then baked in electrically heated oven with steam added during baking at 210 - 220˚C for 15 - 20 min. After baking, loaves were separated from the metal pan and allowed to cool at room temperature before organoleptic evaluation.

Evaluation of Multigrain Pan bread qualities

Physical properties

The bread loaves weight was determined after cooling for one hour. Bread loaf volume was measured by rape seed displacement method as described by the A.A.C.C. (2000).The specific volume of bread was calculated by dividing the volume of the loaves (cm^3) by their weights (g).

Organoleptic evaluation

Pan bread loaf samples were organoleptically evaluated according to Gelinas and Lachance (1995).

Statistical analysis

The results were analyzed by analysis of variance using the General Linear Model (GLM) method according to the method described by Snedecor and Cochran (1989). Means were separated using Duncan's test at a degree of significance ($P \leq 0.05$). Statistical analyses were made using the method of the SAS software system program (SAS, 1997).

RESULTS AND DISCUSSION

Chemical composition

The proximate compositions of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds are shown in Table (1). The obtained results reveal that, flaxseeds, chia seeds, sesame seeds and black seeds recorded the highest crude protein content being 24.61, 23.52, 23.19 and 21.60%, respectively, while hull-less barley flour had the lowest value (11.42%) compared with strong wheat flour (72% ext.) that having (12.58%)Table(1). These data are similar with those reported by Anderson *et al.* (1999) and Sheisa *et al.* (2013).

Sesame seeds recorded the highest value of lipid (58.62%), followed by flaxseeds (41.18%), black seeds (36.70%) and chia seeds (32.62) Table (1). Meanwhile, strong wheat flour (72% ext.) had the lowest lipid content (1.57%). The obtained data are in line with those reported by Nzikou *et al.* (2009) and Michele *et al.* (2014) who found that, lipid contents in sesame seeds and chia seeds were 54.00% and 32.40% ,respectively.

Chia seeds contained the highest ash content (5.53%) followed by black seeds (4.79%), sesame seeds (3.62%) and flaxseeds (3.21%). While, the strong wheat flour (72% ext.) had the lowest ash value (0.62%).

These results are in agreement with Anderson *et al.* (1999) and Al-Bahtiti (2015).

Flaxseeds contained the highest crude fibers content (8.14%) followed by chia seeds (6.99%), black seeds (6.43%) and sesame seeds (3.25%). Meanwhile, strong wheat flour (72% ext.) had the lowest crude fibers content being 0.91%. These results are in accordance with Nzikou *et al.* (2009).

Table 1. Proximate chemical composition of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds (% on dry weight basis)

Constituents(%) Samples	*Crude protein	Lipids	Ash	Crude fibers	Nitrogen free extract (NFE)
Wheat flour (72% extraction)	12.58	1.57	0.62	0.91	84.32
Hull-less barley flour	11.42	2.12	1.91	2.69	81.86
Black seeds powder	21.60	36.70	4.79	6.43	30.48
Sesame seeds powder	23.19	58.62	3.62	3.25	11.32
Flaxseeds powder	24.61	41.18	3.21	8.14	22.86
Chia seeds powder	23.52	32.62	5.53	6.99	31.34

*** Wheat and barley flour (N×5.70) while, black seeds, sesame seeds, flaxseeds and chia seeds (N×6.25).**
NFE: Calculated by difference.

Strong wheat flour (72% ext.) recorded the highest value of nitrogen free extract (NFE) followed by hull-less barley flour, chia seeds, black seeds and flaxseeds having 84.32, 81.86, 31.34, 30.48 and 22.86%, respectively. While, sesame seeds had the lowest NFE being 11.32%. These results are in agreement with the data reported by Cevdet and Semih (1993) who found that, carbohydrates content in black seeds was 36.91%.

Minerals content

From the data tabulated in Table (2), it could be summarized that, both of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds had adequate amounts of essential minerals. Potassium content ranged from 153.7 to 897.8 mg/100g for strong wheat flour and black seeds. (Malik, 1982). Sesame seeds recorded the highest value of calcium (696.8 mg/100g) followed by chia seeds (680.4 mg/100g) and flaxseeds (633.5mg/100g). While, black seeds recorded the highest values of phosphorus, magnesium and sodium (433.5, 309.8 and 93.6 mg/100g, respectively). Magnesium is an essential mineral for enzyme activities, as calcium. Moreover phosphorus is needed for preserving the body's acid-alkaline balance also it plays an important role in bone growth (Fallon, 2001). On the other hand, black seeds recorded the highest iron and cupper content (56.80 and 8.08 mg/kg, respectively). However, chia seeds recorded the highest concentration of Manganese (23.16 mg/kg) and Zinc (14.53 mg/kg).

Table 2. Minerals content of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds

Samples	Macro elements (mg/100g)					Micro elements (mg/Kg)			
	Na	K	Ca	Mg	P	Zn	Cu	Fe	Mn
Wheat flour (72% extraction)	42.2	153.7	11.2	35.2	98.4	0.45	0.82	0.95	1.12
Hull-less barley flour	93.5	390.9	36.7	99.8	231.2	1.68	0.41	2.09	2.39
Black seeds powder	93.6	897.8	516.7	309.8	433.5	12.35	8.08	56.80	21.12
Sesame seeds powder	40.2	413.5	696.8	242.6	250.9	9.04	2.63	11.98	7.58
Flaxseeds powder	29.3	470.3	633.5	215.3	237.8	11.50	4.80	13.72	9.79
Chia seeds powder	81.6	702.7	680.4	257.9	302.3	14.53	5.31	41.26	23.16

Amino acid composition

Data presented in Table (3) shows the essential and non-essential amino acids content of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds. It was noticed that, both of wheat flour and barley flour are the least content of all amino acids, compared with black seeds, sesame seeds, flaxseeds and chia seeds. Also, it is noted that, both of wheat flour and barley flour showed to be relatively low in their contents of lysine (0.25 and 0.27 g/100g, respectively). While, black seeds, sesame seeds, flaxseeds and chia seeds had high levels of lysine.

Also, it was clearly noticed that the highest contribution compared to other amino acids detected in all samples. Sesame seeds contain 7.20 g/100 g of glutamic acid followed by black seeds, chia seeds and flax seeds (5.54, 5.33 and 5.23 g/100 g, respectively). Among all essential amino acids, leusine was found to be of the highest content, while hisitidine was the two lowest essential amino acids in black seeds, sesame seeds, flaxseeds and chia seeds. The amounts of another 6 essential amino acids were found to vary in black seeds, sesame seeds, flaxseeds and chia seeds. Similarly, the amount of other non-essential amino acids analyzed were found to vary in the black seeds, sesame seeds, flaxseeds and chia seeds with the lowest amount shown by cysteine in barley flour.

Table 3. Amino acids composition of wheat flour, barley flour, black seeds, sesame seeds, flaxseeds and chia seeds

Samples Amino acids (g/100g protein)	Wheat flour	Barley flour	Black seeds	Sesam e seeds	Flax seeds	Chia seeds
Aspartic	0.50	0.63	2.34	3.01	2.45	2.61
Therionine	0.31	0.42	0.98	1.30	0.98	1.11
Serine	0.49	0.75	1.09	1.52	1.16	1.53
Glutamic	3.47	3.31	5.54	7.20	5.23	5.33
Glycine	0.43	1.03	1.56	1.96	1.64	1.42
Alanine	0.37	0.62	1.33	2.07	1.35	1.76
Valine	0.49	0.37	1.36	2.20	1.54	1.64
Isoleucine	0.41	0.47	1.10	2.90	1.34	1.14
Leucine	0.82	0.56	1.56	2.89	1.61	1.96
Tyrosine	0.54	0.30	1.15	2.19	0.80	1.28
Phenylalanine	0.64	0.37	1.03	2.11	1.36	1.66
Hisitidine	0.30	0.26	0.73	1.05	0.60	0.93
Lysine	0.25	0.27	1.09	1.08	0.91	1.49
Argnine	0.46	0.41	2.30	4.84	2.58	3.17
Proline	1.26	1.25	1.18	1.27	1.07	1.15
Cystine	0.25	0.13	0.26	0.73	0.32	0.35
Methionine	0.19	0.18	0.68	1.81	0.63	1.06

Fatty acids composition

Fatty acid composition of black, sesame, flaxseeds and chia seeds are shown in Table (4). From the obtained results, it could be observed that, the major saturated fatty acids in black seeds oil were palmitic (11.33%) and stearic (2.92%) while, arachidic acid found in a small amount (0.26%). The major unsaturated fatty acids are linoleic (53.40%) and oleic (22.30%) acids. These results are in agreement with those of those reported by Gharby *et al.* (2015).

The main saturated fatty acids in sesame seed oil were palmitic (9.45%) and stearic (6.10%) acids with a low level of arachidic acid (0.63%). The major unsaturated fatty acids are linoleic (41.08%) and oleic (41.76%) acids as present in Table (4). Sesame seed oil is mostly made up of oleic and linoleic acids (41.76% and 41.08%) respectively. The obtained results are in good accordance with those reported by Nzikou, *et al.* (2009).

Concerning to Flaxseeds (*Linum usitatissimum*), the main saturated fatty acids were palmitic (5.84%), stearic (3.98%) acids with a small amount of arachidic acid (0.12%). The major unsaturated fatty acids are linoleic (15.94%), gamma linoleic (54.04%) and oleic (19.36%) acids. On the other hand, the main saturated fatty acids in chia seedss (*Salvia hispanica* L.) seeds oil were palmitic (7.00%), stearic (3.29%) acids with a small amount of arachidic acid (0.31%). The major unsaturated fatty acids are linoleic (18.44%), gamma linoleic (63.75%) and oleic (6.56%) acids. These results are in accordance with Bernacchia *et al.*, (2014) and Coelho and Salas-Mellado (2015).

Table 4. Fatty acids composition of black seeds, sesame seeds, flaxseeds and chia seeds

Samples Fatty acids (g/100g oil)		Black seeds	Sesame seeds	Flax seeds	Chia seeds
Myristic acid	C14:0	0.16	0.03	0.04	0.04
Tetradecenoic acid	C14:1	0.09	ND	ND	ND
Pentadecanoic acid	C15:0	0.11	ND	ND	ND
Palmitic acid	C16:0	11.33	9.45	5.84	7.00
Palmitoleic	C16:1	0.26	0.20	0.09	0.07
Margaric Acid	C17:0	0.08	0.05	0.06	0.05
Heptadecenoic acid	C17:1	0.04	0.03	0.04	0.01
Stearic acid	C18:0	2.92	6.10	3.98	3.29
Oleic acid	C18:1	22.30	41.76	19.36	6.56
Linoleic acid	C18:2	53.40	41.08	15.94	18.44
γ-linolenic acid	C18:3n6	ND	ND	0.20	0.25
α-linolenic acid	C18:3n3	1.38	0.31	54.04	63.75
Arachidic acid	C20:0	0.26	0.63	0.12	0.31
Eicosenoic acid	C20:1	1.27	0.20	0.14	0.13
Eicosadienoic acid	C20:2	2.43	0.01	ND	ND
Behenic acid	C22:0	0.10	0.12	0.13	0.07
Erucic acid	C22:1	3.84	ND	ND	ND

ND: Not detedted.

Phenolic compounds

The data of phenolic compounds are listed in Table (5) and show that , Pyrogallol, benzoic and catechein, were the major free phenolic compounds existed in black seeds (129.34, 69.91and 44.02 ppm respectively). E-vanillic acids was the main phenolic compound in sesame seeds (102.94 ppm). Pyrogallol acids (26.75 ppm), Ellagic (24.61 ppm), and Sallicylic (18.29 ppm)were found in moderate amounts. On the other hand, the major phenolic compounds content in chia seeds were Benzoic (35.48 ppm), Pyrogallol (26.58 ppm), P-Coumaric (22.86 ppm) and e-vanillic (22.82 ppm). Flaxseeds had the highest values of phenolic compounds. Epicatachin was the major phenolic compound (392.58 ppm), folled by Protocatchuic (242.09 ppm), Vanillic (201.48 ppm), Benzoic (171.47 ppm) and e-vanillic (163.16 ppm).Moderate amounts of Sallicylic (86.18 ppm) , Pyrogallol (79.20 ppm) , Ellagic (79.15ppm) , Iso-ferulic (64.61 ppm) and Catechol (57.49 ppm).

Table 5. Phenolic compounds content in black seeds, sesame seeds, flaxseeds and chia seeds

Samples Phenolic compounds Concentration (ppm)	Black seeds	Sesame seeds	Flax seeds	Chia seeds
Gallic	5.99	0.42	8.34	0.33
Pyrogallol	129.34	26.75	79.20	26.58
4-Amino-benzoic	0.64	0.25	2.94	0.73
Protocatchuic	28.53	2.35	242.09	1.66
Catechein	44.02	0.81	26.37	5.66
Chlorogenic	18.42	8.44	27.66	8.13
Catechol	6.48	1.85	57.49	1.75
Epicatachin	9.53	1.00	392.58	1.24
Caffeine	5.40	0.77	3.30	1.19
P.OH. Benzoic	22.37	0.97	18.92	5.15
Caffeic	4.68	0.56	13.75	1.05
Vanillic	13.21	0.70	201.48	6.67
P- Coumaric	2.54	0.41	42.97	22.86
Ferulic	1.43	0.22	43.32	16.29
Iso-ferulic	3.55	1.92	64.61	4.00
Reversetrol	0.58	1.30	5.40	10.16
Ellagic	13.29	24.61	79.15	3.54
e-vanillic	20.78	102.94	163.16	22.82
Alpha- Coumaric	5.61	9.45	12.49	1.85
Benzoic	69.91	13.01	171.47	35.48
3,4,5-methoxy-cinnamic	1.72	0.93	11.90	0.73
coumarin	1.83	2.59	6.82	0.45
Sallicylic	3.94	18.29	86.18	5.99
Cinnamic	1.09	0.43	6.02	2.15

The total phenols content compounds in all selected seeds are shown in Figure (1). Total phenols contents ranged from 0.498 mg/g to 4.36 mg/g of the sample. The high total phenolic content of chia seeds (4036 mg/g) .However, it is found the lowest total content of phenols was determined in flax seeds where it reached 0.498 mg/g. In studied seeds, the decreasing order of total phenolic compounds concentration after chia seeds was black seeds > red sesame seeds > white sesame seeds > Flax seeds.

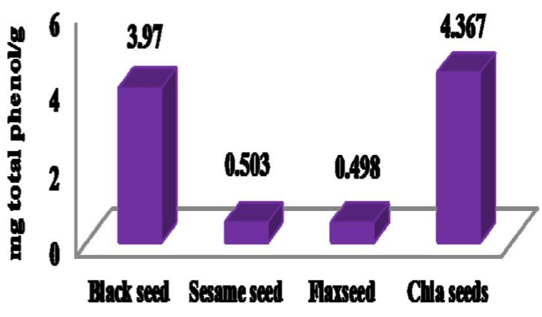

Figure 1. Total phenolic compounds content (mg/g) in studied seeds.

Rheological characteristics of bread dough

The farinogram and extensogram parameters of wheat flour and its blends with hull-less barley flour and multigrain mix are tabulated in Table (6). From the observed data, it could be cocluded that, raising the levels of MGM from 0 to 20% increased farinograph water absorption from 59.7 to 65.0%, dough development time from 1.0 to 3.0 min and decreased stability from 11.5 to 6.0 min. The increase in water absorption with the incorporation of MGM is due to the presence of protein and fibers in the MGM. The farinograph results showed that, raising the levels of MGM increased dough development time. This may be due to the delay in the hydration and development of gluten caused by the presence of multigrain. Addition of MGM decreased the stability values indicating an adverse effect on the strength of the dough. The obtained data shows that the addition of MGM allowing different mixing properties of the dough may be due to the presence of high protein, fibers, fat and mineral contents. The same trend was observed when mixing of barley flour (10%) and wheat flour (90%) with MGM. These final result are in good accordance with those reported by El-Adawy (1995); Izydorczyk *et al.,* (2008) and Švec and Hrušková (2015).

Concerning the extensogram parameters data, the results presented in the same table shows that, increasing levels of MGM from 0 to 20%, decreased all the extensograph parameters. The resistance to extension reduced from 960 to 640 BU, extensibility from 140 to 127 mm and area from 236 to 152 cm^2 Table (6). This weakness of the dough may be due to mix MGM that reduced the wheat gluten content (dilution effect) in the blends which make the dough more weak strength. The same trained was observed when using mix of barley flour (10%) and wheat flour (90%) with MGM. These results are in agreement with those reported by (Indrani *et al.,* 2010).

Table 6. Effect of MGM on the rheological characteristics of bread dough

Blends		Farinograph					Extensograph			
		Water absorption (%)	Arrival time (min)	Dough development (min)	Dough stability (min)	Degree of softening (B.U)	Resistance to extension R (B.U)	Extensibility E (m.m)	Proportional number (R/E)	Energy (cm2)
Control sample (100% wheat flour)		59.7	0.5	1.0	11.5	30	960	140	6.86	236
	95 : 5	61.4	1.0	1.5	10.5	50	900	146	6.16	215
Wheat flour	90 : 10	63.5	1.5	2.0	9.0	70	850	150	5.67	196
MGM	85 : 15	64.3	2.0	2.5	7.5	90	780	152	5.13	187
	80 : 20	65.0	2.5	3.0	6.0	100	640	127	5.04	152
Control sample (90% wheat flour + 10% barley flour)		62.5	1.0	1.5	9.5	60	870	155	5.61	204
90% wheat	95 : 5	63.7	1.5	2.0	8.0	90	800	175	4.57	185
flour + 10%	90 : 10	64.8	1.5	2.5	7.0	100	740	174	4.25	176
barley flour :	85 : 15	65.3	2.0	3.0	6.5	110	700	170	4.12	158
MGM	80 : 20	66.4	3.0	4.0	5.0	130	620	166	3.73	130

WF: Wheat flour (72% extraction rate). BF: Hull-less barley flour. B.U: Brabender Unit.

Physical properties of multigrain pan bread

Data presented in Table (7) show the effect of replacement of strong wheat flour (72% ext.) with different levels of MGM on the physical parameters of pan bread. From the aforementioned data, it could be sumarised that, the control sample which prepared from 100% wheat flour had a weight of 119.78 g and volume of 435.33 cm^3 with specific volume of 3.63cm^3/g. Increasing the substitution of wheat flour with 5, 10, 15 and 20% of MGM gradually increased the weight of bread loaves. The weight of bread samples containing 5, 10, 15 and 20% MGM were 120.51, 122.16, 123.45 and 125.98 g, respectively. The rasing in bread weight may be due to the increase in bread protein and fiber contents which characterized by higher water holding capacity as mentioned by Chen *et al.,* (1988).

On the other side, replacement of wheat flour with 5, 10, 15 and 20% MGM caused gradually decreased in bread volume by increasing levels of substitution compared with the control sample. The volume of the samples was being 413.67, 396.00, 372.50 and 342.00 cm^3, respectively. The decrease in loaves volume may be due to the dilution of wheat gluten as a result to addition of MGM which turn impairs gas retention rather than gas production (Elleuch *et al*., 2011) and increased fiber contents that presented in Table (1). As expected, the specific volume recorded approximately the similar trends (3.43, 3.24, 3.02 and 2.72 cm^3/g, respectively) for the above mentioned level of substitution. The same trend was observed when using a mix of barley flour (10%) and wheat flour (90%) with MGM.These results are in accordance with those reported by Indrani *et al.,* (2010); Hussain *et al.,* (2011) and Makinde and Akinoso (2014).

Table 7. Physical properties of multigrain pan bread

Blends		Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)
Control sample (100% wheat flour)		119.78	435.33	3.63
	95 : 5	120.51	413.67	3.43
Wheat flour :	90 : 10	122.16	396.00	3.24
MGM	85 : 15	123.45	372.50	3.02
	80 : 20	125.98	342.00	2.72
Control sample (90% wheat flour + 10% barley flour)		120.59	418.00	3.47
90% wheat flour +	95 : 5	121.37	382.16	3.15
10% barley flour :	90 : 10	122.82	345.66	2.81
MGM	85 : 15	124.58	317.33	2.55
	80 : 20	126.67	294.00	2.32

*** Means of triplicate.**

Sensory evaluation of fresh multigrain pan bread:

The organoleptic properties of pan bread produced using 100% strong wheat flour (72%) as control sample and pan bread samples which prepared by partial replacement of wheat flour by 5, 10, 15 and 20% of different selected seeds. Also, when using mix of barley flour (10%) and wheat flour (90%) with MGM were evaluated to select the best substitution level for produce high quality pan bread. The bread samples were evaluated by ten panelists for their external and internal properties as shown in Table (8). The results in this Table showed that, there were no significant differences ($p<0.05$) in crust color between the control sample and 5, 10 and 15% level of substitution. On the other hand, significant differences ($p<0.05$) were observed between the control sample and 25% substitution level. Makinde and Akinoso (2014) mentioned that, crust color is a very substantial parameter in bread making that reflect the appropriateness of raw material used for the production and provides information about the quality of the bakery product.

Crumb color was also significantly reduced by raising the level of substitution with MGM, it became darker than the control sample.

Concerning the data of texture and taste, no significant difference ($p<0.05$) was recorded between control sample and bread samples which substituted with 5 and 10% MGM, but there were significant differences ($p<0.05$) between control sample and bread samples contained 20% substitution level.

In addition, the obtained data showed that, there were no significant differences ($p<0.05$) between control bread sample and all other samples for flavor.

In general appearance, the tabulated data indicated that there were significant differences ($p<0.05$) between bread sample made from 100% wheat flour and bread sample which substituted with 20% MGM.

The overall acceptability (the mean total score values) of bread which prepared by using 100% strong wheat flour (72% extraction rate) was higher than those of other samples and decreased gradually with non-significant differences compared with control sample until 15% substitution level of MGM. These results are in agreement with those obtained by El-Adawy (1995); Hussain *et al.* (2011) and Makinde and Akinoso (2014) .

Table 8. Sensory evaluation of fresh multigrain pan bread

Properties Blends		Crust color (10)	Crumb color (10)	Texture (20)	Taste (20)	Flavor (20)	General appearance (20)	Over all acceptability (100)
Control sample (100% wheat flour)		9.60[a]	9.70[a]	19.50[a]	20.00[a]	19.20[a]	19.50[a]	97.50[a]
	95 : 5	9.40[a]	8.60[ab]	19.00[a]	19.70[a]	19.20[a]	19.00[a]	94.90[a]
Wheat flour :	90 : 10	9.00[a]	8.40[ab]	18.50[ab]	19.40[a]	19.20[a]	18.80[a]	93.30[ab]
MGM	85 : 15	8.60[ab]	7.60[b]	18.20[ab]	19.00[ab]	19.00[a]	18.20[ab]	90.60[ab]
	80 : 20	8.40[ab]	7.00[bc]	17.60[b]	18.30[ab]	18.80[a]	17.50[b]	87.60[b]
Control sample (90% wheat flour + 10% barley flour)		9.60[a]	8.60[ab]	19.20[a]	19.80[a]	19.20[a]	19.20[a]	95.60[a]
90% wheat	95 : 5	9.30[a]	8.30[ab]	18.80[ab]	19.60[a]	19.20[a]	18.60[ab]	93.80[ab]
flour + 10%	90 : 10	8.80[a]	7.60[b]	18.00[ab]	19.20[a]	19.00[a]	17.80[b]	90.40[ab]
barley flour :	85 : 15	8.00[ab]	7.00[bc]	17.60[b]	18.40[ab]	18.80[a]	17.00[bc]	86.80[b]
MGM	80 : 20	7.60[b]	6.40[c]	17.30[b]	17.80[b]	18.60[a]	16.40[c]	84.10[c]

*** Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).**

CONCLUSION

Finally, It can be concluded that multigrain mix can be used up to the level of 15% for the production of pan bread with acceptable taste and good nutrient balance.

REFERENCES

A.A.C.C. (2000). American Association of Cereal Chemists Approved methods (10th Ed) St. PAULMN: American Association of Cereal Chemists (Methods 08-01, 44-15A, 46-13, 54-20).

A.O.A.C. (2000). Official Method of Analysis. (16th Ed.) Association of Official Analytical Chemists Wahington DC, USA.

Al-Bahtiti, N.H. (2015). Chemical Investigation and Preservative Effect of Jordanian *Nigella Sativa* L. Seeds Oil on Date Paste. International Journal of Research Studies in Biosciences, 3 (4): 120-124.

Alhassane, T. and Xu, X.M. (2010). Flaxseeds lignans: source, biosynthesis, metabolism, antioxidant activity, bio-active components and health benefits. Food Sci., 9:261-269.

Ali, B.H. and Blunden, G. (2003). Pharmacological and toxicological properties of *Nigella sativa*. Phytotherapy Research, 17: 299-305.

Andersson, A.A.M.; Andersson, R.; Autio, K. and Aman, P. (1999). Chemical composition and microstructure of two naked barleys. J. Cereal Sci., 30: 183-191.

Bernacchia, R.; Preti, R. and Vinci, G. (2014). Chemical Composition and Health Benefits of Flaxseeds. Austin. J. Nutri Food Sci. 2 (8): 1045-1055.

Burits, M. and Bucar, F. (2000). Antioxidant activity of *Nigella sativa* essential oil. Phytotherapy Research, 14: 323-328.

Cevdet, N. and Semih, O. (1993). Chemical composition of *Nigella sativa* L. seedss. J. of Food Chemistry 48: 259-261.

Chapman, H.D. and Pratt, P.F. (1978) Methods of Analysis for Soils, Plant and Water. University of California Division of Agriculture Science, California.

Chen, H.; Rubenthaler, G.L. and Schamus, E.C. (1988). Effect of apple fibers and cellulose on the physical properties of wheat flour. J. Food Sci., 53 (91): 304-306.

Coelho, M.S. and Salas-Mellado, M.M. (2015). Effects of substituting chia (*Salvia hispanica* L.) flour or seedss for wheat flour on the quality of the bread. LWT -Food Sci.and Tech., 60: 729-736.

El-Adawy, T.A. (1995). Effect of sesame seeds proteins supplementation on the nutritional, physical, chemical and sensory properties of wheat flour bread. Plant Foods for Human Nutrition, 48: 311-326.

Elleuch, M.; Bedigian, D.; Roiseux, O.; Besbes, S.; Blecker, C. and Attia, H. (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications. Food Chemistry 124: 411-421.

Fallon, S. and Enig, M.G. (2001). Nourishing Traditions. The Cookbook that Challenges Policitally Correct Nutrition and the Diet Dictocrats. Revised 2nd Ed., pp: 40-45.

FAO/WHO (1973). "Energy and protein requirements" F.A.O Nutrition Meetings Report, Series No.

Food and Drug Administration (FDA) (2003). Food labeling; Health claims; Soluble dietary fibers from certain foods and coronary heart disease. Final rule. Federal Register, 68 (144): 44207-44209.

Gelinas, P. and Lachance, O. (1995). Development of fermented dairy ingredients as flavor enhancers for bread. Cereal Chem., 72(1): 17-21.

Gharby, S.; Harhar, H.; Guillaume, D.; Roudani, A.; Boulbaroud, S.; Ibrahimi, M.; Ahmad, M.; Sultana, S.; Ben Hadda, T. and Charrouf, Z. (2015). Chemical investigation of Nigella sativa L. seeds oil produced in Morocco. Journal of the Saudi Society of Agricultural Sciences, 14: 172-177.

Goyal, A.; Sharma, V.; Upadhyay, N.; Gill, S. and Sihag, M. (2014). Flax and flaxseeds oil: an ancient medicine & modern functional food. J Food Sci. Tech., 51(9):1633-1653.

Hussain, S.; Anjum, F.M. and Alamri, M.S. (2011). Fortification of pan bread with healthy flaxseeds. Australian Journal of Basic and Applied Sciences, 5(11): 978-983.

Indrani, D.; Soumya, C.; Rajiv, J. and Rao, G.V. (2010). Multigrain bread- its dough rheology, microstructure, quality and nutritional characteristics. Journal of Texture Studies, 41: 302-319.

ISO (2011). Animal and vegetable fats and oils - Gas chromatography of fatty acid methyl esters, International Organization for Standardization No. 12966-2:2011 (E).

Ixtaina, V. Y.; Nolasco, S. M. and Tomas, M. C. (2008). Physical properties of chia (Salvia hispanica L.) seedss. Industrial Crops and Products, 28 (3): 286-293.

Izydorczyk, M.S.; Chornick, T.L.; paulley, F.G.; Edwards, N.M. and Dexter, J.E. (2008). Physicochemical properties of hull-less barley fibre-rich fractions varying in particle size and their potential as functional ingredients in two-layer flat bread. Food Chem., 108: 561-570.

Makinde, F. M. and Akinoso, R. (2014). Physical, nutritional and sensory qualities of bread samples made with wheat and black sesame (*Sesamum indicum* Linn) flours. International Food Research Journal, 21(4): 1635-1640.

Malik, C.P. and Srivastava, A.K. (1982). Text Book of Plant Physiology. Ludhiana, New Delhi.

Michele, S.C.; Myriam, D.I. and Mercedes, S.M. (2014). Chemical characterization of chia (*Salvia hispanica* L.) for use in food products. Journal of Food and Nutrition Research, 2 (5): 263-269.

Nzikou J.M.; Matos, L.; Bouanga-Kalou, G.; Ndangui, C.B.; Pambou-Tobi, P.N.G.; Kimbonguila, T.S.; Linder, M. and Desobry, S. (2009). Chemical composition on the seedss and oil of sesame (*Sesamum indicum* L.) grown in Congo-Brazzaville. Advance Journal of Food Sci. and Tech., 1(1): 6 -11.

Pal, A. (2010). Nutritional, medicinal and industrial uses of sesame (*Sesamum indicum* L.) seedss - An Overview.Agriculture Conspectus Scientifics. 75(4): 159-168.

Pellett, P.L. and young, V.R. (1980). Nutritional. evalution of protein foods. Published by the United Nations University.

Randhawa, M. (2008). Black seeds, *Nigella Sativa*, Deserves more attention. J. Ayub Med. Coll. Abbottabad, 20(2):1-2.

Reyes-Caudillo, E.; Tecante, A. and Valdivia-Lopez, M. A. (2008). Dietary fibre content and antioxidant activity of phenolic compounds present in Mexican chia (*Salvia hispanica* L.) seedss. Food Chem., 107: 656-663.

SAS Institute, Inc.,(1997). SAS Macro Language: Reference, First Edition, Cary, NC, SAS Institute, Inc.

Seidel, C.; Bochm, V.; Vogelsang, H.; Wagner, A.; Persin, C.; Glei, M.; Pool-Zebel, B.L. and Jahreis, G. (2007). Influence of prebiotic and antioxidants in bread on the immune system, antioxidative ststus and antioxidative capacity in male smokers and non-smokers. Br. J. of Nutr., 97: 349-356.

Sharma, S.; Sekhon, K.S. and Nagi, H.P.S. (1999). Suitability of durum wheat for flat bread production. J. Food Sci. Tech., 36: 61-62.

Sheisa, C.S.; Beatriz, C.S.; Hevelyse, M.C.; Paula, F.M.; Joana, S.B.; Oscar, O.S.; Nilson, E.S. and Jesui, V.V. (2013). Antioxidant capacity and chemical composition in seedss rich in omega-3: chia, flax, and perilla. Food Sci. and Tech., 33(3): 541-548.

Singh, K.K.; Mridula, D.; Rehal, J. and Barnwal, P. (2011). Flaxseeds- a potential source of food, feed and fibers. Crit. Rev. Food Sci. Nutr. 51:210-222.

Skrbic, B.; Milovac, S.; Dodig, D. and Filipeev, B. (2009). Effects of hull-less barley flour and flakes on bread nutritional composition and sensory properties. Food Chem., 115: 982-988.

Snedecor, G.W. and Cochran, W.G. (1989) Statistical Methods. 8th edition. Ames, Iowa: IowaState University Press. 503 pp.

Švec, I. and Hrušková, M. (2015). Hydrated chia seeds effect on wheat flour and bread technological quality. Agric Eng Int: CIGR Journal, Special issue 2015: 18th World Congress of CIGR: 259-263.

Waskmundzka, M. ; Wianowska, D. Szewczyk, K. and Oniszczuk, A. (2007). Effect of sample-preparation methods on the HPLC quantitation of some phenolic acids in plant materials. Acta Chromatographica, 19: 227-237.

استخدام بذور مختلفة لإنتاج خبز قوالب متعدد الحبوب

محمد رشاد جودة يوسف[1] و جيهان علي غنيم[2]

[1]قسم بحوث الخبز والعجائن، معهد بحوث تكنولوجيا الأغذية، مركز البحوث الزراعية، الجيزة، مصر.

[2]قسم الصناعات الغذائية – كلية الزراعة – جامعة المنصورة – المنصورة – جمهورية مصر العربية

تم دراسة تأثير استبدال دقيق القمح بمستويات مختلفة من خليط بذور 5 ، 10 ، 15 و 20٪ مكون من بذور حبه البركة، بذور السمسم، بذور الكتان وبذور الشيا على الخصائص الريولوجية و الخبيز لدقيق القمح. وقد أوضحت النتائج المتحصل عليها أن كلا من بذور حبه البركة، بذور السمسم، بذور الكتان و بذور الشيا تحتوي علي كميات مرتفعة من البروتين الخام، الدهون، الرماد، الألياف الخام بالإضافة إلى نسبة عالية من العناصر المعدنية، خصوصا الكالسيوم، البوتاسيوم، الحديد والزنك، مقارنة مع دقيق القمح ودقيق الشعير. بالأضافة إلي احتوائها علي نسب مرتفعة من الأحماض الأمينية خاصة الليسين مقارنة مع دقيق القمح ودقيق الشعير. وايضا احتوت على نسب مرتفعة من المركبات الفينولية. بالإضافة الى احتوائها على نسبة مرتفعة من الأحماض الدهنية غير المشبعة، وخاصة حمض اللينوليك (C18: 2) وحمض الأوليك .(C18: 1) و قد ادت زيادة نسبة استبدال الدقيق بمخلوط البذور السابقة إلي زيادة نسبة امتصاص الماء بينما انخفض كلا من ثبات العجينة، المقاومة للشد (المرونة)، الرقم النسبي والمساحة اسفل المنحني (الطاقة). كذلك تؤدي زيادة نسبة الاستبدال إلي زيادة تدريجية في وزن رغيف الخبز في حين يحدث انخفاض تدريجي ايضا بالنسبة لكلا من الحجم والحجم النوعي مقارنة بالعينة الكنترول. أظهرت نتائج التقيم الحسي امكانية استبدال الدقيق المستخدم في صناعة الخبز باستخدام خليط البذور حتي مستوي 15٪ دون حدوث تغيرغير مرغوبة في المنتج النهائي.

الكلمات الدالة: خبز القوالب - دقيق الشعير - بذور حبه البركة - بذور السمسم - بذور الكتان - بذور الشيا - الحبوب المتعددة - القيمة الغذائية - الخصائص الريولوجية - الخصائص الحسية.