UTILIZATION OF FLAXSEEDS IN IMPROVING BREAD QUALITY

KHORSHID, AHMED M., NADIA H.A. ASSEM, NADIA M. ABD-EL-MOTALEB AND JERMINE S. FAHIM

Bread and Pastry Res. Dept., Food Tech. Res. Institute, ARC, Giza

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Abstract

Three levels of whole flaxseed (5, 10 and 15%) were used to substitute wheat flour (72% and 82%) in order to produce pan and balady bread. The obtained results showed that as the level of substitution increased, all compounds increased except total carbohydrate. The nutritive value of the produced bread enhanced due to the content of unsaturated fatty acids in the whole flaxseed. Sensory evaluation of the produced pan and balady bread, and the freshness values after 12, 24 and 48 hs were evaluated.

INTRODUCTION

From 2500 years ago, Hippocrates mentioned that "Let food be the medicine and medicine be the food". Today scientists are being charged with the responsibility of clarifying the role that food play in maintaining and promoting health (Milner, 1998).

Fats and oils are important components of the human foods. Their function as an efficient energy supply and store, important building component of all cell membranes, precursors of hormone, source of essential fatty acids and fat soluble vitamins (A, D, E and K) and their absorption in addition to their effect in improving the diet palatability (MC-Laughlim *et al.,* 2005).

Fats consisted of different kinds of fatty acids. These acids may be saturated, monounsaturated and polyunsaturated. They have a chain-like structure and differ from each other in chain length, number and location of the double bonds. Polyunsaturated fatty acids can be divided into two families according to the position of the first double bond on their chain, omega-3 and omega-6 fatty acids. The primary fatty acid in the n-6 family is linoleic (LA). The corresponding fatty acids in the n-3 family are alpha-linolenic (ALA). Both of them are essential (Holman, 1998).

In Egypt the major vegetable edible oils sources are palm, soybean, cottonseed, sunflower and corn while the minor ones are olive oil, flaxseed oil and canola oil (FAO, 2005).

Flaxseed has been consumed throughout the world used in bread and cherished by health foods and enthusiasts. Today, flaxseed is recognized as good source of soluble fiber, which helps lower blood cholesterol, insoluble fiber, which

promotes laxation, α-linolenic acid, an essential omega-3 fatty acid important for cardiovascular health and phytoesterogens which are plant compounds with estrogen-like activity

This study was carried out to investigate the possibility of using substitutions of whole flaxseed flour (5, 10 and 15%) with wheat flour (72% and 82%) to produce pan and balady bread. Also, chemical composition, rheological properties, sensory evaluation and freshness of the pan and balady bread were determined.

MATERIALS AND METHODS

2.1 Materials

2.1.1 Wheat flour (72% extraction) was obtained from Universal Company for Processing Grain products (Flour Land) 6th October City, Egypt.

2.1.2 Wheat flour (82% extraction) was purchased from South Cairo Mills Company, Egypt.

2.1.3 Flaxseeds were obtained from Agricultural Research Center Oil Department, Giza, Egypt.

2.1.4 Other materials were obtained from supermarket such as salt, dry yeast and sugar.

2.2 Methods

2.2.1 Chemical analysis

Moisture, protein, ash, crude fiber and ether extract were determined according to the method described in A.O.A.C. (2000). Total carbohydrate was calculated by differences.

2.2.2 Fatty acid composition

The methyl esters of crude oil were prepared according to Chalvardjian (1964) by using 1% of H_2SO_4 in absolute methyl alcohol. A perkin-Elmer gas chromatography (Model F22) with a flam ionization detector was used in the presence of nitrogen as a carrier gas. A glass column (2mx2.5mm) packed with chrom Q 80/100 mesh at a temperature of 270 °C was used. Standard fatty acid methyl esters were used for identification. The area under each peak was measured and the percentage expressed in regard to the total area.

2.2.3 Technological methods

2.2.3.1 Preparation of flaxseed whole meal

Seeds were dry cleaned to remove dust and undesirable materials, and then they were conditioned before use by soaking seeds in water overnight using a 2:1 ratio of water to flaxseed and placing the flaxseed in 18°C water for 30 min. as

recommended by **(Payne, 2000)**. After that seeds were ground and mixed with flour to produce pan and balady bread at soon.

2.2.3.2 Blends

Whole flaxseed was added at different ratios (5, 10 and 15%) to wheat flour (72% and 82% extraction) to produce pan and balady bread as illustrated in table (1).

Table 1. Blends of whole flaxseed with wheat flour (72% and 82%).

Treatment	Blends
Control	100% wheat flour (72%extraction)
5%	5% whole flaxseed + 95% wheat flour (72%extraction)
10%	10% whole flaxseed + 90% wheat flour (72%extraction)
15%	15%whole flaxseed + 85% wheat flour (72%extraction)
Control	100% wheat flour (82%extraction)
5%	5% whole flaxseed + 95% wheat flour (82%extraction)
10%	10% whole flaxseed + 90% wheat flour (82%extraction)
15%	15%whole flaxseed + 85% wheat flour (82%extraction)

2.2.3.3 Baking techniques

Pan bread was prepared according to the method described by A.A.C.C. (1990). While, balady bread was produced according to the method described by Atia (1986).

2.2.3.4 Sensory evaluation

All samples were evaluated by ten panelists from the Bread and Pastry Res. Dept. staff in Food Tech. Res., Institute Agric. Res. Center. Quality score for pan bread included: taste (20), flavor (15), crumb distribution (15), color of crumb (15), color of crust (15) and general appearance (20). The procedure technique was carried out as mentioned by Kralmer and Twigg (1962).

While evaluating of balady bread included: taste (20), flavor (15), crumb distribution (15), color of crumb (15), color of crust (15) and general appearance (20) as described by Atia (1986).

The average of total score was converted to a descriptive category as follows:

90-100: very good 80-90: good

70-79: satisfactory less than 70: questionable

2.2.3.5 Determination of staling rate

After baking, bread freshness was determined at zero time and after 12, 24 and 48 hours of storage by Alkaline water retention capacity (AWRC) according to the method of Kitterman and Rubentholar (1971).

2.2.4 Statistical analysis

Data were statistically analyzed according to Snedecor and Cocheran (1980).

RESULTS AND DISCUSSION

3.1 Chemical composition of raw materials

Results presented in Table (2) showed the chemical composition of flaxseed and wheat flour (72% and 82%) on dry weight basis. From these data it could be noticed that flaxseed had the highest values in crude protein (23.62%), ether extract (36.89%), fiber (8.90%) and ash content (3.61%).

Also, it was found that wheat flour 82% extraction had higher contents of fiber (1.20%), ash (1.15%) and protein (11.85%) than that of wheat flour (72% extraction) which contained 0.62% of fiber, 0.55% of ash and 10.92% of protein. These data are confirmed with those obtained by Arafat *et al.* (2008).

Table 2. Chemical composition of raw materials (on dry weight basis).

Chemical composition	Raw materials		
	Wheat flour 72%	Wheat flour 82%	Flaxseed flour
Protein	10.92	11.85	23.62
Ether extract	1.03	1.27	36.89
Fiber	0.62	1.20	8.90
Ash	0.55	1.15	3.61
Total carbohydrates	86.88	84.53	26.98

3.2 Fatty acid composition

As shown in table (3) flaxseed had a high content of unsaturated fatty acids. Also, it could be observed that the major fatty acid in flaxseed were linolenic acid $C_{18:3}$ (44.0%), oleic acid $C_{18:1}$ (26.20%) and linoleic acid $C_{18:2}$ (18.36%). The flaxseeds content of fatty acid indicated that they are rich in essential fatty acid such as (omega-3). These data are confirmed with those obtained by Mostafa (2007).

Table 3. Fatty acid composition of flaxseed oils (%).

Fatty acid	(%)
Saturated:	
$C_{12:0}$	0.22
$C_{14:0}$ (palmitolic acid)	0.53
$C_{16:0}$ (palmitic acid)	4.08
$C_{18:0}$ (stearic acid)	4.62
Unsaturated:	
$C_{16:1}$	1.05
$C_{18:1}$ (oleic acid)	26.20
$C_{18:2}$ (linoleic acid)	18.36
$C_{18:3}$ (linolenic acid)	44.00
Saturated : Unsaturated fatty acids ratio	
1 : 9.65	

3.3 Chemical composition of produced pan and balady bread

From the obtained results in tables (4 and 5), it could be observed that the chemical composition of pan and balady bread which were produced from 100% wheat flour (72% and 82% extraction) were, protein (9.59 and 10.25%), ether extract (3.88 and 1.08%), ash (0.96 and 1.78%), crude fiber (1.25 and 2.03%) and total carbohydrates (84.32 and 84.86%), respectively.

Regarding the chemical composition of produced pan and balady bread with 5, 10 and 15% substitution of flaxseed flour, it could be noticed that as the level of flaxseed flour increase, all chemical composition except the total carbohydrate were increased. These findings are in line with those obtained by Pohjanheimo *et al. (*2006).

Table 4. Chemical composition of pan bread produced from 72% wheat flour and different levels of flaxseed.

Samples	**Components**				
	protein	**Ether extract**	**Ash**	**Crude fiber**	**Total carbohydrates**
Control	9.59	3.88	0.96	1.25	84.32
5 %	9.79	5.63	1.64	2.45	80.49
10 %	10.90	7.42	2.03	2.86	76.79
15 %	16.35	9.30	3.05	4.29	67.01

Table 5. Chemical composition of balady bread produced from 82% wheat flour and different levels of flaxseed.

Samples	Components				
	protein	Ether extract	Ash	Crude fiber	Total carbohydrates
Control	10.25	1.08	1.78	2.03	84.86
5 %	10.39	1.95	2.72	3.10	81.84
10 %	11.35	3.86	3.35	3.98	77.46
15 %	17.02	5.70	5.02	5.97	66.29

3.4 Sensory evaluation of pan and balady bread produced from wheat flour and different levels of flaxseed

The results concerning sensory evaluation of pan bread produced from different levels of added flaxseed were illustrated in table (6). It could be observed that samples of pan bread which made from 100% wheat flour (72%) were high in acceptability for all parameters and they had a very good grade (except 10% addition, it had a good grade).

Table (7) showed the sensory properties of balady bread which were prepared from 82% flour and different levels of flaxseed were high except the addition of 10% had a good grade. Results reported harein are in agreement with those of Pohjanheimo *et al. (*2006) and Afaik and Munir (2007) who clarified that an acceptable bread could be produced by adding flaxseed up to 20% replacement.

Table 6. Sensory evaluation of pan bread produced from wheat flour (72%) and different levels of flaxseed.

samples	General Appearance (20)	Color of crust (15)	Color of crumb (15)	Crumb distribution (15)	Flavor (15)	Taste (20)	Overall scores (100)	Grade
Control	19.6 ^{a}	14.5 ^{a}	14.6 ^{a}	14.4 ^{a}	14.3 ^{a}	19.6 ^{a}	97.0 ^{a}	V.G.
5 %	19.3 ^{a}	14.0 ^{a}	14.0 ^{b}	14.3 ^{a}	13.0 ^{b}	19.0 ^{a}	93.6 ^{b}	V.G.
10%	19.0 ^{a}	13.5 ^{b}	13.5 ^{c}	14.0 ^{b}	12.5 ^{c}	18.5 ^{b}	91.0 ^{c}	V.G.
15%	17.5 ^{b}	13.0 ^{c}	13.0 ^{d}	14.0 ^{b}	12.0 ^{c}	18.0 ^{b}	87.5 ^{d}	G.
L.S.D.	0.6221	0.798	0.6970	0.6640	0.5980	0.706	0.5330	

Table 7. Sensory evaluation of balady bread produced from wheat flour (82%) and different levels of flaxseed.

samples	General Appearance (20)	Color of crust (15)	Color of crumb (15)	Crumb distribution (15)	Flavor (15)	Taste (20)	Overall scores (100)	Grade
Control	19.5 [a]	15.0 [a]	15.0 [a]	14.5[a]	15.0 [a]	20.0 [a]	99.0 [a]	V.G.
5 %	19.0 [a]	14.5 [b]	14.0 [a]	14.5 [a]	15.0 [a]	18.0 [b]	95.0 [b]	V.G.
10 %	18.0 [b]	13.5 [c]	13.0 [b]	14.0 [a]	14.0 [b]	17.5 [c]	90.0 [c]	V.G.
15 %	17.0 [d]	12.0 [c]	12.6 [b]	12.0 [d]	13.2 [c]	17.2 [c]	84.0 [d]	G.
L.S.D.	0.6321	0.7431	0.7520	0.6624	0.5340	0.5410	0.5325	

Significant at 0.05 probability level. (Means with the same letter are not significant different).
90 – 100 (Very good), 80 -89 (Good), 70 -79 (satisfactory) and less than 70 questionable.

3.5 Freshness of pan and balady bread produced from wheat flour and different levels of flaxseed

Results in tables (8 and 9) showed that there were a gradual decrease in swelling power of pan and balady bread produced from wheat flour 72% and 82% extraction and all its blends with flaxseed flour after baking.

Pan bread showed a decrease in swelling power from 335.11% at zero time to 314.07%, 302.4 % and 294.6% after 12, 24 and 48 hours. While, balady bread showed a decrease in swelling power from 339.43 at zero time to 298.87 and 288.39 after 12 and 24 hours.

Data presented in these tables showed the positive effects of adding flaxseed flour on retarding staling of the baked pan and balady bread during 12, 24 and 48 h. of storage at room temperature.

Also, it was concluded that as the levels of added flaxseed flour increased, the swelling power was increased, while, the rate of decrease of all blends in pan and balady bread was decreased during storage at 12, 24 and 48h.

These results were in agreement with those obtained by Payne (2000) who stated that the water-binding properties of milled flaxseed helped to extend shelf life when used as a substitute for flour in baked goods.

Table 8. Effect of adding different levels of flaxseed to wheat flour (72%) on alkaline water retention capacity (AWRC%) of stored pan bread.

samples	Swelling power at zero time	After 12 hours	Rate of decrease %	After 24 hours	Rate of decrease %	After 48 hours	Rate of decrease %
Control	335.11	314.07	6.28	302.4	9.76	294.60	12.09
5 %	357.41	342.09	4.29	331.76	7.18	320.17	10.27
10 %	367.59	353.40	3.86	344.25	6.35	333.17	9.36
15 %	362.40	350.20	3.37	347.50	5.77	329.13	9.18

Table 9. Effect of adding different levels of flaxseed to wheat flour (82%) on alkaline water retention capacity (AWRC%) of stored balady bread.

samples	Swelling power at zero time	After 12 hours	Rate of decrease %	After 24 hours	Rate of decrease %
Control	339.43	298.87	11.95	288.39	15.04
5 %	352.70	325.12	7.82	318.67	9.65
10 %	361.54	334.24	7.55	331.64	8.27
15 %	360.73	336.73	6.65	334.12	7.38

From the mentioned results, it could be said that, flaxseed could be used to improve both pan and balady bread when it was used till 10% with wheat flour (72% and 82%). It could improve the nutritive value of the produced bread as well as the quality.

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الإستفادة من بذور الكتان فى تحسين جودة الخبز

أحمد خورشيد ، نادية حسنى عاصم ، نادية محمود عبد المطلب ، جيرمين صالح فهيم

قسم بحوث الخبز والعجائن- معهد بحوث تكنولوجيا الأغذية- مركز البحوث الزراعية

تم أستخدام ثلاث نسب من مطحون بذور الكـــتان (15,10,5%) للأستبدال مع دقيق القمح (72%، 82%) لانتاج كلا من الخبز التوست (خبز القوالب) والخبزالبلدى.

وقد أوضحت النتائج المتحصل عليها أنه كلما زادت نسبة الاضافة كلما زادت نسب المحتوى من عناصر التركيب الكيماوى فيهاعدا المحتوى من الكربوهيدرات الكلية. وقد تحسنت القيمة الغذائية للخبز المصنع وذلك بسبب المحتوى لمطحون بذور الكتان من الأحماض الدهنية الغير مشبعة. كذلك تم تقدير كلا من التقييم الحسى وتحديد درجة الطزاجة للخبز التوست (خبز القوالب) والبلدى.