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The Effect of Substituted Flaxseed Flour on the Rheological, Chemical and Sensorial Properties of Toast Bread

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ABSTRACT

This paper pointed to study the impact of flaxseed flour partial replacement with wheat flour in toast bread preparation. The chemical composition, bioactive compounds and antioxidant activity (DPPH) of wheat and flaxseeds flour were evaluated. Four toast bread samples were prepared using 10, 20, 30, and 100% flaxseed flour replaced with the wheat flour and the sensory evaluation of prepared toast bread samples was studied to choose the most acceptable bread sample to customers. The chemical analysis results showed that, compared to wheat flour (72% extract), flaxseed flour had a low carbohydrate content, no gluten, in addition to its high protein and fiber content, which recorded 19.87 and 13.61%, respectively. It is known that flaxseed flour is one of the best plant sources of antioxidant chemicals. Therefore, the results recorded the highest value of total phenolic content, which amounted to 0.364 mg/g, total flavonoids 6.667 mg/g, and antioxidant activity (DPPH) 86.131% compared to wheat flour. The control toast bread sample had no significant difference with other sample contained 10% flaxseeds flour in crust color, crumb color, odor, taste and overall acceptability values. Also, the results of testing the dough's rheological characteristics showed that they were affected by the addition of flaxseed flour. Moreover, replacing 10% of wheat flour with flaxseed flour led to an increase in water absorption and dough development time, while stability and dough energy values decreased with the addition of flaxseed flour.

Keywords: flaxseed flour, chemical, bioactive, rheological, physical properties, toast bread

INTRODUCTION

All across the world, people rely on bakery goods as a vital part of their daily diet. Carbohydrate in these foods provides a lot of energy, and the fiber and other ingredients that may be thrown into a bread recipe to make it a nutrient (Guiné, 2022). Flaxseed is one of food component that may improve the nutritional quality of bread products, a high source of omega-3 fatty acids (Bekhit *et al.*, 2018; Eyres, 2015).

Consuming flaxseeds only for our diets is a somewhat monotonous activity, and some people find flaxseed's weak sensory appeal offensive. Thus, whole or milled flaxseed has been incorporated into a variety of common foods, such as breads, crackers, muffins, energy bars, snacks, cookies, cake and soups (Karakurt *et al*., 2022; Sanmartin *et al.,* 2020; Lohan *et al*., 2020; Mostafa *et al*., 2019). Flaxseed may have several positive effects on health, including reducing blood fat, anti-inflammation, preventing cancer, and aiding weight loss, because it contains bioactive including protein, dietary fiber, and lignan (Bechlin *et al.*, 2019; de Oliveira Giarola *et al.*, 2019; Lan *et al.*, 2020), for healthy foods needs from customers, researchers and food producers are working to develop products based on flaxseeds. Whole seeds, crushed or milled flaxseed (flour), flaxseeds oil and blended oils, dehulled flaxseed, hull (flaxseed gum), cyclic peptides, protein concentrations, lignan extracts, and flaxseeds are just a few of the many flaxseed products available (Kajla *et al.*, 2015; Sangiorgio *et al*., 2023). Rich potential health advantages associated with flaxseed's physiologically active components such alpha-linolenic acid, lignans, and dietary fiber have led to its increased attention as a functional food ingredient in recent years, antioxidant, anti-diabetic, anti-cancer, and other health effects have been ascribed to flaxseed. Flaxseed and its oil have been used in a wide variety of meat products, baked goods, muffins, milk, juices, dry pasta products, macaroni as a functional food ingredient (Raghuwanshi *et al.*, 2019).

All of these uses have demonstrated that flaxseed can be added to food products as a nutrient supplement. Maintaining the stability of the bioactive components in flaxseed is one of the main goals for the creation of products containing this ingredient. The physicochemical qualities of food may be considerably impacted by adding flaxseed (Mercier *et al.*, 2016). The combination of wheat flour and flaxseed flour is used to make a variety of goods that contain flaxseed. Flaxseed flour is added to food products, the gluten network in pasta may be destroyed, resulting in foods with poor structural integrity (Mercier *et al.*, 2014). Maintaining the structural integrity of the goods and preserving the benefits of the bio actives during the production and storage phases is another goal for the development of flaxseed-based products (Mercier *et al.*, 2014).

Since there are no formal recommendations for the daily intake of flaxseed, the amounts were determined in accordance with earlier studies that found the highest bread quality attributes could be attained up to an added level of 10-15% flaxseed flour. So, present study focuses on the replacement of wheat flour (72%) with flaxseed flour at ratio of 10, 20, 30 and 100% as a functional ingredient in toast bread and chemical, physical properties of the dough and bioactive compounds were evaluated.

Therefore, the current study focuses on replacing wheat flour (72%) with flaxseed flour in proportions in proportions of 10, 20, 30 and 100% as a functional ingredient

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in toasted bread. The chemical and physical properties of the dough and its bioactive compounds were evaluated.

MATERIALS AND METHODS

Materials:

Raw materials: Wheat flour *Triticum aestivum*, (72% extraction), and flaxseeds *(Linum usitatissimum* L) were obtained from a local market (Fath Allah Market), El-Mansoura City, El-Dakalia Governorate.

Other Ingredients: Salt, corn oil, sugar, skim milk powder, and commercial instant active dry yeast were purchased from the local market in El-Mansoura, El-Dakahlia Governorate, Egypt.

Chemicals: The analytic grade chemicals utilized were procured from El Gomhouria Pharmaceutical Company, El-Mansoura city, El-Dakahlia Governorate, Egypt

Methods:

Flaxseeds preparation:

The seeds were manually cleared of foreign objects, dirt, rocks, and broken seeds. Using a BRAWN grinder machine, the cleaned seeds were ground into a powder and then passed through a 120 mesh sieve, then stored in hermetic plastic containers in a refrigerator (3:5°C) until they were employed as indicated by (A.A.C.C., 2010).

Finally, in a high-speed grinder type, whole flaxseeds were ground into a fine powder (Braun spice grinder) in order to use in toast bread preparation.

Preparing of toast bread:

Toast bread was prepared according to the method described by (A.A.C.C., 2010) as follows: All of the dry ingredients listed in Table (A) were added in the mixer (Ka 5ss, Kitchen Aid, St. Joseph, MT) for 4 minutes at a slow speed (30 rpm) and water added in twice, followed by adding the oil for 6 minutes at a fast speed (60 rpm). After forming, the dough fermented in room temperature for 60 minutes at 36°C before resting for 20 (min) at 28–30°C (first proofing). The loaves were baked in an electrical oven (Zanussi produced Italy) at 210–220°C for 15 - 20(min) for toast bread, subsequently removed from the metal pan, allowed to cool at room temperature for different analysis carried out.

Table A. Formulae used in toast bread preparation

Bread formula	Wheat flour (g)	Flaxseed flour (g)	Active Dry yeast (g)	Sugar (g)	Skin milk powder (g)	Commercial corn oil	Salt
Control	100	-	2	4	2	4	1.5
Blend 1 (10%)	90	10	2	4	2	4	1.5
Blend 2 (20%)	80	20	2	4	2	4	1.5
Blend 3 (30%)	70	30	2	4	2	4	1.5
Blend 4 (100%)	-	100	2	4	2	4	1.5

Analytical Methods:

Proximate Chemical analysis of raw materials and toast bread samples:

The content of moisture, ash, crude fat, protein, and crude fiber were measured at the Agricultural Seeds Laboratory, Mansoura University, El-Dakahlia, using the method outlined by (A.O.A.C, 2019). As for the content of total carbohydrates was measured by difference from the following equation:

Carbohydrates content =

%100- [%moisture+% protein + % ash + % fat].

Rheological properties for dough flour properties were done at Food Tech. Res. Institute, Agric. Res. Center, El-Giza. Egypt as follow:-

- **Farinograph test:** flour dough samples were subjected determine Farinograph properties by instrument for farinographs (manufactured in West Germany by Brabender Duis Bur G., type 810105001, number 941026) was employed to ascertain how well dough made with amounts of wheat and flaxseed flour absorbed water and mixed using the (A.A.C.C., 2012) method.
- **Extensograph test:** Extensograph properties of flour dough samples were performed using Extensograph test (Brabender Duis Bur G. type 86001 No. 9416003 produced in West Germany) in accordance with the procedure outlined in the (A.A.C.C., 2012).

Gluten Content in flaxseed flour: were performed at Food Technology Research Institute, Agriculture Research Center, El-Giza, Egypt, gluten content method No. 10-11 (AACC, 1984) was used to estimate the amount of gluten in wheat and flaxseed flours.

Physical properties of toast bread samples:

Samples of toast were allowed to cool at room temperature for an hour, a total weight was calculated. Flax seeds displacement was used to measure volumes, as reported by (A.A.C.C., 2012), specific volumes = volume (cm^3)/ weights (g).

Determination of bio-active compounds and antioxidant activity of raw materials and toast bread samples: at the Seeds and Tissues Pathology Laboratory in the Faculty of Agriculture, all bio-active compound and antioxidant activity were measured at Mansoura University, Egypt.

- **Total phenolic compounds content:** as mentioned by (Singleton and Rossi, 1965) method for measuring total phenolic compounds in raw materials and studied toast samples was modified slightly and measured using a Spectrometer (model T80, UK)
- **Total flavonoid compounds content:** the total flavonoid compound content of the raw materials and samples of the studied toast was determined by the methanolic extract accordance with (Zhuang, 1992) method.
- **Determination of DPPH%:** raw materials and studied toast samples according to (Siger *et al.*, 2008) instructions for measuring free radical capacity. Spectrometer (model T80) was used to measure the 1,1-diphenyl -2-picrylhydrazyl (DPPH) content of.

Sensory Evaluation of toast bread samples:

After baking, the samples of toast bread were let to cool at room temperature (25±2◦C) for one hour, according to (A.A.C.C, 2005). The bread samples were tested by panel testers after being cut using a sharp knife by twenty member from Food Industries Dept. Fac. Agric. El-Mansoura University. The toast breads evaluated used the following parameters crust color (10), crumb color (10), odor (15), taste (15) and overall acceptability (50)**.**

Statistical analysis: by using ANOVA, data were analyzed by the Statistical Package of Social Sciences (SPSS) software version 17 (2008). According to Gomez and Gomez (1984), Significant differences among treatment means were identified using Duncan's Multiple Comparisons at $P \leq 0.05$.

RESULTS AND DISCUSSION

Chemical properties, bioactive compounds and antioxidant activity of wheat and flaxseed flours:

Changes in the chemical composition between wheat flour and flaxseed flour are presented in Table 1. The wheat and flaxseed flours chemical composition were determined in dry basis. From data in Table (1), wheat flour recorded the highest moisture content 12.64% in comparing with flaxseed flour which recorded 6.99%. In addition, flaxseed flour recorded highest amount crude fiber content 13.61%, wheat flour 0.59%. Fat content was low in wheat flour 3.60%, while in flaxseed recorded 32.64%. The protein content being 10.69 % and 19.87% for wheat and flaxseed flour, respectively. Ash content was low in wheat flour 0.47 % and increased in flaxseed flour 6.08%. But, the gluten content in wheat flour was about 27.50%, while the flaxseed flour was free from wet gluten. These obtained results are nearly accordance with (Abd El-Ghany, 2020) and (El-Refai *et al.*, 2021) resulted that wheat flour 72% extraction contain in (%), 13.82 (moisture), 11.21 (protein), 0.72 (Ash), 0.61 (crude fibers) and 86.28% carbohydrates as well as wet gluten (25.67%).

Table 1. Proximate chemical composition, wet gluten and bioactive compounds of wheat and flaxseed flours on dry basis.

Raw materials Chemical composition (%)	Wheat flour (72% ext.)	Flaxseed flour
Moisture	12.64	6.99
Ash	0.47	6.08
Crude fat	3.60	32.64
Protein	10.69	19.87
Total carbohydrates	72.60	34.42
Crude fiber	0.59	13.61
Wet gluten	27.50	-
Bioactives compounds and antioxidant activity (DPPH):-		
Total phenolics content (mg/g dry weight)	0.215	0.364
Total flavonoids content (mg/g dry weight)	0.667	6.667
Antioxidant scavenging activity- DPPH (%)	18.007	86.131

***Carbohydrates were calculated by the difference**
- = Free of gluten

Furthermore, the high level of dietary fiber in flaxseeds may prevent or lower the risk of a number of diseases. Results of previous studies achieved by (Khouryieh and Aramouni, 2012; Marpalle *et al*., 2014), also (Codină *et al.*, 2019) showed that the range of flaxseeds chemical compositions were 5.6-6.2% moisture, 41.12-42.25% lipid, 19.74-20.85 % total protein, free of dry gluten, 3.41- 3.50% ash, and 28.31-29.02 % carbohydrates.

Antioxidant activity of wheat and flaxseed flour were determined and showed in Table (1). It could be observed that total phenolic and flavonoids compounds in wheat flour were 0.215, 0.667 mg/g, respectively and 18.007% antioxidant activity (DPPH). While, one of the best plant sources of antioxidant chemicals is flaxseed. Have total phenolic contents being 0.364 mg/g, total flavonoids was 6.667 mg/g and antioxidant activity recorded 86.131%.

According to (Zaki *et al.*, 2013), antioxidant activity (as measured by DPPH percent) is a crucial indicator of a food product's ability to promote health. The DPPH-RSA values of the cereal milling products tested by (Smuda *et al.*, 2018) varied from 39.3 to 70.6%. Khalaf *et al*., (2019) showed that flaxseed flour contains values (643.04 mg GAE/100g for total phenolic contents and 112.46 mg CE/100g for total flavonoid contents, in addition flaxseed flours had an antioxidant activity-DPPH (%) in the range of 75.80 to 78.99 %. The preceding data suggests that flaxseed has an extremely potent endogenous antioxidant system. The search for natural antioxidants that are both effective and safe has gained a lot of attention. Natural phenolic acids, flavonoids, tannins, lignans, and tocopherols were all found in flaxseed (Oomah and Sitter, 2009). Because of their high levels of bioactive substances such phytochemicals, flaxseeds have been shown to be a promising choice for use in the creation of functional goods and dietary supplements (Wang *et al.*, 2017).

Sensory evaluation of toast bread samples:

Among the fundamental qualities associated with quality, such as crust color, crumb color, odor and taste, sensory evaluation plays a vital part in determining the quality of food since it assesses what customers actually perceive (Andrewes *et al.,* 2021). "The voice of consumers" is one of the most crucial stages in the development of new products (Crofton *et al*., 2013). Sensory attributes result of the prepared toast bread samples at different levels of flaxseed flour to produce high quality of these products are presented in Table (2).

The evaluation of the internal and external properties of the toast bread samples is displayed in Table (2). The results indicated a significant ($p < 0.05$) difference in the crust color, crumb color, odor, taste and overall acceptable between control toast bread and all samples replacement by flaxseed at different levels. Toast bread samples with 10% flaxseed flour have the highest values of color, odor, taste and overall acceptability in compare with control, also between toast bread with 20, 30% and 100% flaxseed flour.

Table 2. Sensory Evaluation of Toast Bread Samples with Different Levels of Flaxseed Flour

Sensory Attributes Bread samples	Crust color (10)	Crumb color (10)	Odor (15)	Taste (15)	Overall acceptability (50)	Total (100)
Control toast (wheat flour)	8.90a	8.60a	12.80a	12.50a	44.45a	87.25a
10% flaxseed flour	9.55a	9.50a	13.60a	13.70a	45.75a	92.10a
20% flaxseed flour	7.35b	7.05b	9.65b	8.90b	35.20b	68.15b
30% flaxseed flour	7.45b	7.35b	9.40b	8.80b	33.25b	66.25b
100% flaxseed flour	6.85b	7.20b	7.10c	6.40c	19.00c	46.55c
LSD $_{at\ 5\%}$	1.06	0.93	1.44	1.74	5.73	9.51

***The values followed by the same letter in the same column are not significantly different at $p \leq 0.05$.**

Generally, results revealed a significant differences ($p < 0.05$) among toast sample control, 10, 20, 30 and 100% flaxseed flour levels. Bread samples 100% flaxseed level have the lowest value of crust color, crumb color, odor, taste and overall acceptable scores among the other samples. Hence addition of 10% flaxseed level was most the acceptable sensory attributes values. For the physicochemical examination, a sample of toasted bread prepared from 10% flaxseed flour was used, replacing wheat flour.

Koca and Anil, (2007) discovered no appreciable differences between bread prepared with control ingredients and bread supplemented with 20% flaxseed in terms of crust color, crumb grain, texture, flavor, or overall acceptability. The findings showed that when flaxseed substitution was increased in comparison to control one, the taste score declined. Bakery items may be deeper in color because to the Millard interaction between flaxseed protein and lactose from milk (Khouryieh and Aramouni, 2012). Also, Pourabedin *et al.,* (2017) reported that there were no discernible changes between the control, 10%, and 20% samples in terms of how well received the Iranian toast.

Rheological properties of selected toast bread samples:-

Farinograph results:

It has been demonstrated that rheological models are useful for describing the viscoelastic behavior of dough throughout the baking process (Sun *et al.,* 2023). Table (3)and Figure (1) present the Farinograph sample data. The Farinograph readings significantly changed when flaxseed flour was substituted to wheat flour at various quantities. Variations in water absorption values were observed when 10% flaxseed flour was substituted to wheat flour 72% extracted for bread-making. It is evident that the water absorption values increased when flaxseed flour was substituted (Figure 1). With 10 incorporation flaxseed flour, the lowest decrease in water absorption was observed with wheat flour extraction 72% was 60%, which subsequently increased as the level of flaxseed flour increased and recorded 66.7 and 73%, respectively. According to (Kundu *et al.*, 2014), the dilution of gluten, which needs less water, is mostly to blame for the difference in water absorption. As a result, less water is needed in the dough system for the wheat-flaxseed composite flours to achieve the desired consistency. These results are agreement with those reported by (Codină *et al.*, 2019) and (Istrate *et al.*, 2020) they found that water absorption values was increased with addition of flaxseed at different concentrations.

From the perspective of dough development time, samples incorporation flaxseed flour and wheat flour showed greater values for this parameter when compared to the control sample. The fact that dough needs more time to mix because it absorbs more water may be attributed to this rise in water absorption value. However, it is possible to see a reduction in the development time value for the sample with 10% flaxseed flour. This is most likely caused by the fact that the dough loses strength as the amount of gluten in its system is reduced. From the perspective of stability, it is possible to see that the substituted of flaxseed flour has a strengthening impact on wheat flour dough, with greater stability values for the samples compared to the control. addition of flaxseed flour has a strengthening impact on wheat flour dough, with greater stability values for the fortified samples compared to the control. This conduct aligns with that observed by (Istrate *et al.*, 2020; Meral and Dogan, 2013; Roozegar *et al.,* 2015) and it may be explained by the gum from the flaxseed, which makes the dough more uniformly dense. But with high addition quantities of flaxseed flour, the dough tends to become weaker, likely as a result of the dough system's diluted gluten.

The dough weakening (B.U.) was increased comparing to the control. The dough weakening increased from 110 (B.U) for wheat (extracted72%) dough to 120 (B.U) with 10% flaxseed flour. Also , when 10% flaxseed flour was substituted to wheat dough, the mixing tolerance index drops to 40 (B.U.) from 50 (B.U.). Codină *et al.*, (2017) and Codină *et al.*, (2019) showed that the incorporation of flaxseed into white wheat flour led to a reduction in the dough extensibility, weakening, and dough consistency.

Table 3. Farinograph parameters of flour samples used in toast bread preparation:

Farinograph parameters Flour sample	Water Absorption (%)	Degree of Weakening (B.U.)	Dough Development Time (min)	Stability time (min)	Tolerance index (B.U)
100%W. F	60	110	2	1	50
W.F +10% flaxseeds flour	66.7	120	9	6	40

W.F: wheat flour

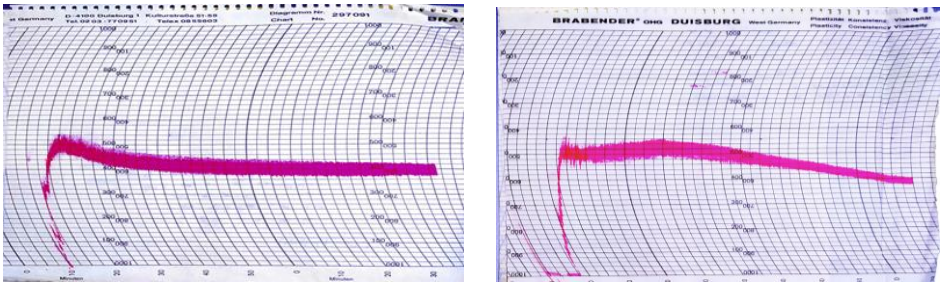

Fig. 1a. 100%W. F (72% ext.) **Fig. 1b. W.F +10% flaxseeds flour**

Fig. 1 a-b. Farinograph parameters of flour samples used in toast bread preparation

Extensograph characteristics:

Extensograph analysis provides information on a dough's viscoelastic properties, resistance to extension, and dough extensibility. Combination between good extensibility and resistance produced a desirable properties of dough (Kohajdová *et al.*, 2012). To extensograph of samples (Table 4 and Figure 2), the elasticity was increased while, the extensibility of the samples decreases as flaxseed flour substitution increasing. This data was similar with those reported by (Codină *et al.*, 2017; Pourabedin *et al.*,

2017) and (Istrate *et al.*, 2020) demonstrated that the extensibility decreased with increasing in flaxseed concentrations.

The dough energy (E), and maximum resistance to extension decreased when wheat flour replaced by 10% flaxseed flour as it indicated from the Figures 2. Pourabedin *et al.*, (2017) and Istrate *et al.*, (2020) claim that the interaction between gluten in wheat flour and flaxseed flour is what causes the increase in resistance to extension when large quantities of flaxseed flour are added to wheat flour. They linked this behavior to the insoluble fiber addition's adverse effect on the formation of the gluten network due to the dilution of gluten.

Table 4. Extensograph parameters of flour samples used in toast bread preparation

Extensograph parameters Flour samples	Elasticity (B.U.)	Extensibility (min)	Maximum Elasticity (B.U.)	Proportional Number	Energy (Cm^2)
100%W. F	210	220	390	1	92.5
W.F +10% flaxseeds flour	290	160	300	1.8	72.5

W.F: wheat flour

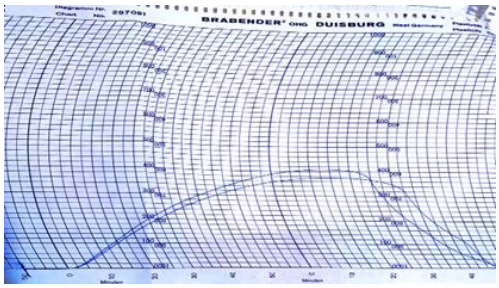

Fig. 2a. 100%W. F (72% ext.)

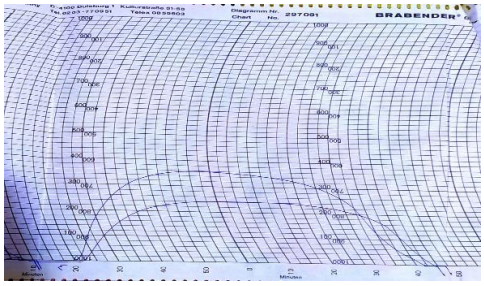

Fig. 2b. W.F +10% flaxseeds flour

Fig. 2 a-b. Extensograph parameters of flour samples used in toast bread preparation

Chemical composition, bioactive compounds and antioxidants activity of selected toast bread samples.

Chemical analysis and bioactive compounds of toast bread prepared from flaxseed flour in compared with toast bread prepared from 100% wheat flour have been represented in Table 5. Control toast bread sample had the lowest amount of moisture (7.81%), ash (0.97%), protein (10.18%), fiber (0.76) content, crude fat (10.47%), and total carbohydrates (70.57%) whereas the flaxseed toast sample, Increased values of protein and fiber content could be the result of raw flaxseed flour's naturally greater protein and fiber content. When flaxseed flour was substituted for wheat flour, the energy value increased significantly, in line with the results of an earlier investigation by (Hussain *et al.*, 2008). Table (5) shows that substituting of 10% flaxseed flour to wheat flour can increase the nutritional content of baked goods. The reduction in moisture content in flaxseed toast bread sample were represented in previous research by (Khouryieh and Aramouni, 2012) who showed that increasing the amount of flaxseed flour from 0 to 12% considerably decreased the moisture content (6.48-4.77%), which is how the moisture content in the flaxseed toast sample was reduced.

Table (5) also displays the bioactive components and the DPPH% as antioxidant activity of the toast bread samples. The results showed that substituting 10% flaxseed flour to the toast increased the amount of total phenols, total flavonoids, and DPPH%, which recorded highest values with and scored 1.634, 5.733 and 35.749 for total phenolic, total flavonoids and DPPH, respectively when compared to control (100% wheat flour toast) which recorded 0.077, 3.067 and 8.841, respectively for total phenols, total flavonoids and DPPH.

These findings are consistent with a prior study on Chinese steamed bread with husk extracts of and barley-flaxseed, barley, and flaxseed, which found that total phenolic content and antioxidant activity were higher than in those of control sample (Hao and Beta, 2012).

Table 5. Proximate chemical composition, bioactive compounds and antioxidant activity of different toast bread samples.

Blends Components	Toast (control 100% wheat flour)	Toast (10% flaxseed flour)
A: Chemical composition (%)		
Moisture	7.81	27.92
Ash	0.97	0.60
Crude fat	10.47	25.88
Protein	10.18	14.49
Total carbohydrates	70.57	31.11
Crude fiber	0.76	8.75
B: Bioactives compounds		
Total phenolic content (mg/g dry weight)	0.077	1.634
Total flavonoid content (mg/g dry weight)	3.067	5.733
Antioxidant scavenging activity- DPPH (%)	8.841	35.749

***Carbohydrates were calculated by the difference**

Physical properties of selected toast bread samples:

The parameters used for measuring bread quality were toast loaf volume and specific volume. Table (6) suggests that substituting 10% flaxseed flour to the toast bread sample not much affected in the loaf's volume. However, addition of 10% flaxseed was a slight increase in toast loaf volume was observed. In addition, (Codina *et al.*, 2008) it was found a decrease in toast loaf volume and specific volume value in bread sample of flaxseed flour comparing to the control sample. The enhanced water holding capacity of fibers may account for the rise in bread weight when they were added. The use of gluten-free flaxseed flour in bread formulation, which decreased the ratio of wheat flour necessary for the formation of network structure, was expected to result in a drop in both loaf volume and specific volume (Codina *et al.*, 2008). According to (Marpalle *et al.*, 2014) adding 5 (g/100 g)

flaxseed to the bread had no impact on the loaf's volume. However, a substantial drop in bread loaf volume was observed.

Table 6. Physical properties of selected toast bread samples

Physical properties Bread samples	Loaf Weight (g)	Loaf Volume (Cm3)	Specific Volume (Cm3/g)
Toast (control 100% wheat flour)	173.2	525	3.03
Toast (10% flaxseed flour)	175.15	406	2.31

CONCLUSION

Strong antioxidant activity and high polyphenol content in flaxseed flour were drawn as conclusions. This toast recipe using flaxseed flour has been improved by partially replacing wheat flour, due to the increased fiber and protein content of the toast.

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تأثير دقيق بذور الكتان المستبدل على الصفات الريولوجية و الكيميائية و الحسية لخبز التوست

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الملخص

أشار هذا البحث إلى دراسة تأثير الاستبدال الجزئي لدقيق بذور الكتان بدقيق القمح في تحضير خبز التوست.، تم تقييم التركيب الكيميائي والمركبات النشطة بيولوجيا ونشاط مضادات الأكسدة (DPPH) لدقيق القمح وبذور الكتان. تم تحضير أربع عينات من خبز التوست باستخدام دقيق بذور الكتان 10، 20، 30 و 100% مع الإستبدال بدقيق القمح وتمت دراسة التقييم الحسي لعينات خبز التوست المحضر لاختيار عينة الخبز الأكثر قبولا للمستهلك. و أظهرت نتائج التحليل الكيميائي أنه بالمقارنة مع دقيق القمح (استخلاص 72%)، ان دقيق بذور الكتان تحتوى على نسبة منخفضة من الكربوهيدرات، ولا يحتوي على الجلوتين،بالأضافة لإرتفاع محتواها من البروتين والألياف التى سجلت نسبة 19.87 و 13.61% على التوالي. من المعلوم ان دقيق بذور الكتان أحد أفضل المصادر النباتية للمواد الكيميائية المضادة للأكسدة ولهذا سجلت النتائج اعلى قيم لة من المحتوى الفينولي الكلي الذى بلغت 0.364 ملجم/جم، والفلافونويدات الكلية 6.667 ملجم/جم و النشاط المضاد للأكسدة (DPPH)86.131% مقارنة بدقيق القمح. أظهرت نتائج إختبارات التقييم الحسي لعينات الخبز أنه لا توجد فروق معنويه واضحة بين عينة الكنترول لخبز التوست و عينة خبز التوست المدعم بدقيق الكتان بنسبة 10% من حيث لون القشره و الرائحة و الطعم و القبول العام ، كما أظهرت نتائج اختبار الخصائص الريولوجية للعجين تأثرها بإضافة دقيق بذور الكتان. علاوة على ذلك فإن إستبدال 10% من دقيق القمح بدقيق بذور الكتان أدى إلى زياده فى إمتصاص الماء ووقت تطور العجين بينما إنخفضت قيم درجة الثبات و طاقة العجين بإضافة دقيق بذور الكتان.