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Original research

Flaxseed and Wheat Bran Flour Addition on Texture and Sensory Properties of Taftoon Bread

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ABSTRACT

This study aimed to improve the nutritional quality and shelf life of breads by adding supplements. One of these supplements is wheat bran, a low-cost and nutrient-fiber-rich source, and the other is flaxseed known as a functional food. In this study, flat Taftoon bread was baked with 5% bran flour, 5% flaxseed flour, a mixture of 5% flaxseed and 5% wheat bran flour, and finally 5% wheat bran flour and 10% flaxseed flour supplementations. The effects of supplements were examined for six days on the rheological properties of dough and bread texture, moisture content, pH, color, and sensory properties of bread compared to control. Water absorption was increased by increasing the percentage of wheat barn and flaxseed flour. The treatments had a darker color than the control sample. Also, during storage, bread containing 5% flaxseed flour had a significantly higher moisture content and sensory evaluation score than other samples (p<0.05). Based on the health benefits of wheat bran and flaxseed and the physicochemical findings of the flatbread that was done, 5-10% flaxseed and up to 5% wheat bran flour can be recommended.

Keywords: flatbread, flaxseed flour, sensory, texture, wheat bran

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1. Introduction

Bread is one of the most popular foods in the world, so preserving and improving its quality is important for human health. Effects of dietary fiber such as bran on gastrointestinal health, intestinal microbial flora regulation, cardiovascular disease control, and cancer and diabetes prevention have been proven (Stevenson *et al*., 2012; Packkia-Doss *et al*., 2019). Because bran increases water absorption, it can be used up to 10%, and higher amounts of bran hurt dough processing. The percentage of bran addition can be increased up to 14% if it is presoaked and if presoaking and optimal milling are associated, the percentage of bran can be increased up to 22% (Lai, *et al*., 1989). In the case of bran steaming, the amount of bran can be increased up to 25% (Banu *et al*., 2012) Also, extruded wheat bran increases the dough spreading time compared to non-extruded bran and minimizes the unsustainable drop (Gomez *et al*., 2012). Between bran compounds, fiber has the greatest interaction and effect on bread baking (Khalid *et al*., 2017). Yadav *et al.* (2009) suggested 5% fortification by wheat bran for making optimally acceptable chapatti (Yadav *et al*., 2009)

Flaxseed flour is rich in essential amino acids, unsaturated fatty acids, and phosphatides such as lecithin, phytase, and lipase enzymes, the amount of its protein and fiber depends on the processing conditions and its salt content depends on the cultivation area (Mujahid *et al*., 2000; Sanmartin *et al*., 2020). Among the results of the researchers on adding flaxseed flour to the bread formulation, we can mention the following: adding flaxseed flour at different levels significantly increased the moisture content, specific volume, water activity, porosity, peroxide value, nutritional value, and overall acceptance of bread production samples and reduction of hardness, resulting in a reduction in sample staling compared to the control sample (El-Shaarawy and Mesallam 1987; El-Minyawi and Zabik, 1981). Bread containing 10% complete flaxseed and 10% flaxseed powder can have acceptable quality, taste, and flavor. The quality of bread will be improved by adding 10% of flaxseed and strengthening the bread gluten network (Xu *et al*., 2014). Adding whole-fat flaxseed flour compared to the addition of 12% lean flaxseed flour can reduce the negative effects of flaxseed flour and can be recommended to people (*Hussain et al*., 2012). In other research, the effects of defatted flaxseed and full flaxseed on the

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quality of bread was examined and suggested that adding 15% flaxseed flour and 10% full flaxseed flour will improve the protein status of wheat flour in toasted bread (Mervat *et al.*, 2015). In this study, the effect of adding wheat bran flour and flaxseed flour on the quality and sensory characteristics of Taftoon bread during storage was investigated.

2. Material and Methods

2.1. Material

Wheat flour with 80% extraction rate and 9.12% protein content (ISO 20483: 2013) and wheat bran flour with 5.45% ash content (ISO 2171: 2007), particle size 4.25% (Mesh. 25) (AOAC 965.22: 1966) were used. Both of them were supplied from Alborz Flour Factory, Iran. Flaxseeds were purchased from Isfahan Pakan Bazr Company, Iran. The results of the chemical analysis of flaxseed flour are Moisture: 6.01% (ISO 712: 2009), Protein: 32.51% (ISO 20483: 2013), Ash: 2.82% (ISO 2171: 2007) and fat: 33.86% (ISO 20483: 2013). Active dry yeast was purchased from Fariman Factory in Mashhad, Iran. To prepare the dough, refined iodized salt (recrystallization) was used. Three-layer polyethylene nylons with a thickness of 45 µm were purchased from Pamchal Company. Iran. All chemicals used in the experiments were provided by Merck Co. Germany.

2.2. Methods

At first, the flaxseed flour was produced by hammer mill and taken to the place of dough preparation from the night to be at the ambient temperature. The amount of water absorption was determined by the Farinograph (Brabender, 81010, Germany). The amount of water was measured by the farinograph machine was added to a mixture of flour, 1% salt, and 2% yeast, and then dough was mixed for two minutes. Five samples were prepared according to Control (S0K0), Bran flour 5% plus flaxseed flour 0%(S5K0), Bran flour 0% plus flaxseed flour 5% (S0K5), Bran flour 5% plus flaxseed flour 5% (S5K5), and Bran flour 5% plus flaxseed flour 10% (S5K10).
After mixing, the dough was rested for 45 minutes at 28 °C and 50% relative humidity. Then, after a few seconds of kneading, it was divided. The weight of each bread loaf was considered about 300 grams. The flat loaves were transferred to a special cooking batch for Taftoon bread at a temperature of 230±10 °C for 10 to 12 seconds. After baking, sensory evaluation was done by 15 semi-professional panelists with two days intervals up to six days. Texture analyses were performed by the Instron machine (XT.TA model) for staling investigation. The pH (pH meter MP220 Mettler, Switzerland) and the protein content of the samples (Gerhardt, Germany) were determined during storage. The colorimetric test was carried out by the D25-9000 Hunterlab, United States. All experiments were carried out in a completely randomized design with three replications. The mean was compared with SPSS 21 based on Duncan's tests at a 5% level. The charts were plotted and evaluated in Excel.

3. Results and Discussion

3.1. Effect of adding wheat bran and flaxseed flour on dough characteristics

According to Fig 1 the percentage of water absorption was increased by increasing the percentage of wheat barn flour and flaxseed flour. Since the applied bran flour has improved water absorption without adversely affecting the properties of dough and bread (Lai, *et al.*, 1989), also flaxseed flour increases water absorption (El-Shaarawy and Mesallam 1987; El-Minyawi and Zabik, 1981). The highest percentage of water absorption was related to the treatments containing 5% wheat bran flour, which had a significant difference from the control sample ($p < 0.05$). The high quantity of hydroxyl group of the bran hydrocolloids allowed more water absorption through hydrogen bonding, besides that the bran size was more than 500 microns and can be affected by the high-water absorption (Majzoobi, *et al.*, 2013). An increase in flaxseed flour increases water absorption because of an increase in fiber content (Pourabedin, *et al.*, 2017). The valorimetric value of the dough is shown in Fig.2 the highest valorimetric value or the quality number is related to the treatment of 5% flaxseed flour and 0% wheat bran flour, 10% flaxseed flour, and 5% wheat bran flour. They have a significant difference with the control and the lowest quality number is related to the control treatment, which has a significant difference with all treatments (p <0.05). El-Shaarawy and Mesallam (1987) reported that 5 to 10% flaxseed flour addition increases the protein percentage and does not weaken the dough.

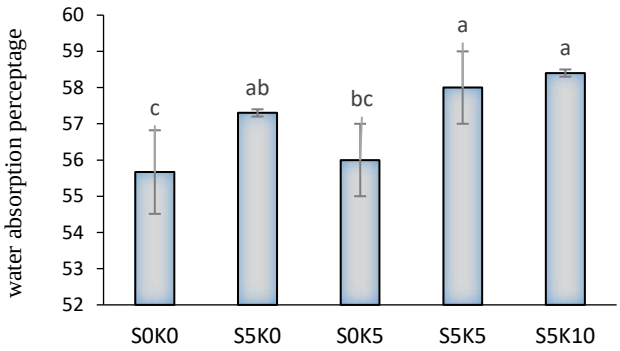

Fig.1 Effect of wheat bran flour and flaxseed flour addition on the percentage of dough water absorption. Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). (Different letters indicate statistically significant differences ($p \leq 0.05$)).

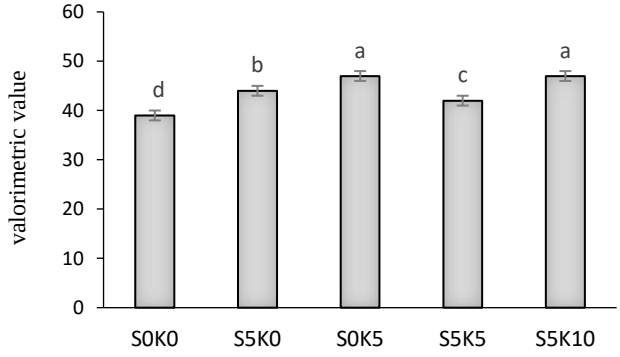

Fig.2 Effect of wheat bran and flaxseed flour addition on dough valorimetric value. Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). (Different letters indicate statistically significant differences ($p \leq 0.05$)).

3.2. *Chemical and physicochemical properties of Taftoon breads*

All experiments were performed in three replicates and by the standard methods. The lowest pH was related to a sample containing 5% bran and 10% flaxseed flour on the fourth day and the highest pH for the sample containing 5% wheat bran and 5% flaxseed flour on the sixth day. These two treatments had a statistically significant difference ($p < 0.05$), while the rest of the treatments did not differ statistically from each other ($p > 0.05$). On all days of the test, the control treatment has the highest pH among the treatments. In general, the pH of the treatments was reduced in all treatments over time. The pH decrease during bread storage is due to the oxidative corruption of fat found in the bread (Fellers and Bean, 1977). This fat comes from flour and flaxseed flour.

3.3. *Moisture content*

After baking, the highest moisture content was observed in the treatment containing 5% flaxseed and 0% wheat bran flour, and the moisture reduction during storage was much lower than in the other treatments (Table 1). This can be due to the reduced moisture migration from the bread crumb to the crust due to shortenings in the flaxseed flour. Therefore, maintaining moisture content during bread storage was well done in this treatment, so that on the 6th day, this treatment still had the highest moisture content compared to other treatments, which is consistent with the results of El-Minyawi and Zabik, 1981. After baking the moisture content of bread containing wheat bran was reported lower than the control sample, which can be due to the much water released because of the denatured proteins in the bran by the cooking heat, and the release of moisture makes its texture coherent, due to the presence of the compounds in the bran (proteins and hydrocolloids), the gelatinization temperature of the natural starch in the dough increases and so the water is removed during the baking process of the bread dough, and therefore the moisture content of the bread decreases (Majzoobi, *et al.*, 2013).

Table 1. Moisture content (%) changes of Taftoon bread samples with different percentages of flaxseed and wheat bran flour during storage

T	After baking	2 days	4 days	6 days
S0 K0	21.60 ± 0.10^{b}	18.87 ± 0.44^{b}	37.00 ± 0.06^{b}	12.29 ± 0.06^{b}
S5 K0	18.00 ± 0.12^{e}	15.89 ± 0.06^{d}	13.02 ± 0.00^{e}	10.73 ± 0.05^{d}
S0 K5	23.18 ± 0.05^{a}	20.56 ± 0.05^{a}	18.89 ± 0.04^{a}	14.44 ±0.03^{a}
S5 K5	19.30 ± 0.24^{c}	16.83 ± 0.04^{c}	14.62 ± 0.04^{c}	11.69 ± 0.03^{c}
S5 K_{10}	18.33 ± 0.00^{d}	15.66 ± 0.09^{e}	13.15 ± 0.00^{d}	10.59 ± 0.05^{e}

Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). Different letters indicate statistically significant differences ($p \leq 0.05$)

3.4. *Bread color*

These parameters include the luminance factor shown in the colorimetric with the letter L, the next factor is the degree of red color in the samples with the letter a, and, finally, the factor of the presence of yellow in the samples with the letter b. The effect on luminance parameters after baking was statistically different ($p<0.05$). The results of color assessments are given in Table 2.

During storage control sample had the highest brightness among treatments. Due to the presence of phenolic compounds and proteins in the flaxseed, the Millard reactions increased, so that by adding the flaxseed, the bread's brightness decreased and became darkened, the color measurements revealed that as more flaxseed flour was added, the brightness of the samples lowered and the bread seemed greener (Alpaslan and Hayat, 2006; Koka and Anil, 2007; Lilpilina and Ganji, 2009; Calderelli, *et al.* 2010). After baking, the highest red and yellow color were found in a sample containing 10% flaxseed and 5% wheat bran flour, adding flaxseed flour would increase the red color of the bread than the control sample. The yellowness of the treatments increases with the addition of bran (Matz, 1991; Alpaslan and Hayat, 2006).

Table 2. Color variations of Taftoon bread samples with different percentages of flaxseed and wheat bran flour during storage

T	After baking	2 days	4 days	6 days
L*				
S0-K0	76.07 ± 0.09^{b}	75.12 ± 0.72 ^{b}	81.14 ± 0.03 ^{a}	81.22 ± 0.02^{a}
S5-K0	76.69 ± 0.08^{a}	75.12 ± 0.72 ^{b}	75.03 ± 0.02^{b}	75.03 ± 0.01^{c}
S0-K5	73.26±0.12^{c}	78.62 ± 0.20^{a}	71.87 ± 0.02^{c}	71.84 ± 0.00^{c}
S5-K5	69.45±0.14^{d}	69.91 ± 0.36^{d}	75.39 ± 0.06^{b}	75.84 ± 0.00^{b}
S5-K10	63.74± 0.10e	72.16 ± 0.55^{c}	71.16 ± 0.04^{d}	71.20 ± 0.05 ^{d}
a*				
S0-K0	3.41 ± 0.02^{d}	3.41±0.085^{c}	2.85 ± 0.05^{e}	2.74 ± 0.01^{d}
S5-K0	2.45 ± 0.01^{e}	2.32 ±0.17 ^{e}	5.71 ±0.01^{b}	5.77 ± 0.02^{a}
S0-K5	5.02 ± 0.01^{c}	2.35 ± 0.02^{d}	5.03 ± 0.01^{c}	5,04±0,00^{b}
S5-K5	5.23 ± 0.00^{b}	5.83 ± 0.01^{a}	4.06 ± 0.01^{d}	4.02 ± 0.00^{c}
S5-K10	8.62 ± 0.06^{a}	5.16 ± 0.08^{b}	6.04 ± 0.09^{a}	5.58 ± 0.20^{a}
b*				
S0-K0	19.70 ± 0.03^{d}	19.45 ± 0.05 ^{c}	20.05 ± 0.06^{c}	20.05 ± 0.09^{c}
S5-K0	18.67 ± 0.01^{e}	18.16 ± 0.07 ^{d}	23.31 ± 0.01^{a}	23.30 ± 0.01^{a}
S0-K5	21.39 ± 0.00^{c}	17.29 ± 0.11^{e}	19.66 ± 0.01^{d}	19.71 ± 0.01^{d}
S5-K5	21.96 ± 0.01^{b}	22.29 ± 0.01^{b}	20.25 ± 0.03^{b}	20.32 ± 0.03^{b}
S5-K10	26.12 ± 0.04^{a}	23.00 ± 0.09^{a}	23.32 ± 0.08^{a}	23.29 ± 0.01^{a}

Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). Different letters indicate statistically significant differences ($p \leq 0.05$)

3.5. *Hardness*

The increase in wheat bran increases the hardness and the presence of flaxseed and an increase in its amount reduces hardness (table 3). After baking, the least hardness is in bread containing 5% wheat bran and 0% flaxseed flour. This can be due to bread containing bran has a loose texture because bran in flour causes the gas bubbles to flow out of the bread dough texture and causes bloating and loosening of the bread texture (Hemdane *et al.*, 2016; Saeed *et al.*, 2009). During

storage, hardness in treatments containing bran is increased the gluten networks are weakened and elasticity is reduced. Ishida and Steel (2014) reported that adding flaxseed flour would reduce the hardness and thus reduce the sample staling compared to the control sample, the presence of fat in flaxseed flour will result in this effect. The result is consistent with Roozegar *et al.* (2015).

Table 3. The hardness changes of Taftoon bread samples with different percentages of flaxseed and wheat bran flour during storage

T	After baking	2 days	4 days	6 days
S0- K0	657.76± 0.001^{b}	781.07± 0.001^{b}	823.46 ±0.001^{a}	817.25± 0.001^{b}
S5- K0	504.69± 0.010^{e}	813.37± 0.001^{a}	639.1± 0.001^{c}	514.52± 0.001^{d}
S0- K5	835.02± 0.001^{a}	568.85±0.001^{e}	563.07 ±0.001^{d}	463.73± 0.001^{e}
S5-K5	630.65± 0.001^{d}	725.44±0.010^{d}	691.43± 0.001^{b}	1027.1± 0.109^{a}
S5-K10	655.19± 0.001^{c}	780.66±0.001^{c}	387.10 ±0.001^{e}	666.14± 0.001^{c}

Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). Different letters indicate statistically significant differences (p<0.05)

3.6. Sensory evaluation

After baking the best odor of bread belonged to the treatment containing 5% flaxseed and 0% wheat bran flour. The lowest score for this characteristic was in the control treatment. Regarding texture, appearance, taste, and oral sensation of bread, the lowest score was given to the control (fig 3). Roozegar *et al.* (2015) reported at 5% flaxseed replacing the best score was obtained and the score decreased by increasing the flaxseed replacing level. Although there are no significant differences, the presence of wheat bran flour and flaxseed flour together makes this similar to bread without supplementation in terms of acceptance. Aliani *et al.* (2011) evaluated sensory characteristics by trained panelists between different formulations, the orange cranberry, gingerbread raisin, and cappuccino chocolate chip snack bars showed no significant differences in aroma and flavor intensities of formulations with and without flaxseed. The promising flavoring option belonged to gingerbread raisin snack bar formulations because of the higher spice aroma in the flax sample.

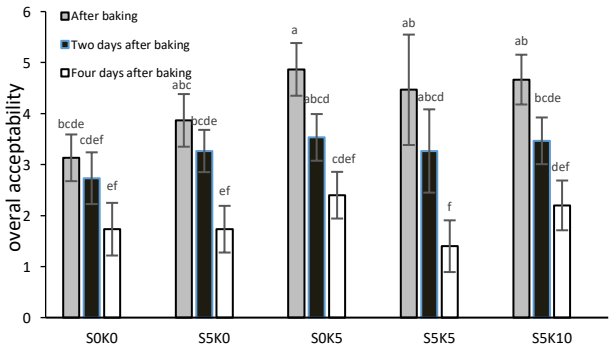

Fig.3 Effect of wheat bran and flaxseed flour addition on the sensory properties of Taftoon bread samples. Control (S0K0), Bran flour 5% flaxseed flour 0%(S5K0), Bran flour 0% flaxseed flour 5% (S0K5), Bran flour 5% flaxseed flour 5% (S5K5), and Bran flour 5% flaxseed flour 10% (S5K10). (Different letters indicate statistically significant differences (p≤0.05))

3. Conclusions

In the Farinograph test, the highest water absorption was related to the treatment containing 10% flaxseed plus 5% wheat bran flour and 5% flaxseed plus 5% wheat bran flour. The lowest amount of water absorption is related to control treatment which has a significant difference with all treatments (p<0.05). The best valorimetric value was given to the treatment containing 5% flaxseed and 0% wheat bran flour, and the control had the lowest valorimetric value and had a statistically significant difference with all treatments (p<0.05). The highest protein content is related to treatment containing 10% flaxseed and 5% wheat bran flour and the lowest amount for the control treatment. Sensory evaluation was completely consistent with the device evaluation. In both evaluations, treatment containing 5% flaxseed flour was selected as the best bread in terms of sensory and rheological features. On the other hand, the addition of flaxseed and wheat bran flour had a significant effect on the sensory and texture properties and shelf life of the bread produced. Also, the addition of wheat bran and flaxseed flour had a significant statistical effect on the luminance, yellowness, and redness of treatments. The treatments were also influenced by the addition of wheat bran and flaxseed flour in terms of rheological properties and were statistically significantly different from the control treatment (p< 0.05). Using wheat bran and flaxseed flour in the production of Taftoon bread improves the quality and shelf life of the product. Flaxseed and wheat bran flour can be used separately or in combination in bread, and in both cases, the bread staling was delayed. The best percentage obtained is 5% flaxseed flour, which can greatly enhance the quality and shelf-life and enhance the customer-friendly characteristics of Taftoon bread. With the use of fiber, the waste of bread is greatly eliminated. Wheat bran and flaxseed flour can be used to enrich other bakery products. In preparing Taftoon bread, 5% flaxseed flour alone or 10% flaxseed and 5% wheat bran flour can be used.

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