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## Effect of Fermentation and Particle Size of Wheat Bran on the Antinutritional Factors and Bread Quality

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**Abstract:** Three local sudanese wheat cultivars, Debeira, El-Nielain and Sasaraib were obtained from Agricultural Research Corporation (harvest season 2002/03). Wheat bran was obtained from a local flour mill in Khartoum North. It was carefully sieved and classified as coarse, medium and fine bran size then fermented. Proximate composition, mineral content and anti-nutritional factors (tannin, phytic acid) were determined for all types of wheat bran. Results indicated that fermentation of wheat bran increased the percentage of crude fiber from 15.67 to 18.67%, 15.67 to 18.00%, 15.00 to 17.67%, protein content from 20.35 to 21.65%, 18.36 to 20.79%, 21.07 to 22.40% for coarse, medium and fine wheat brans, respectively. Carbohydrates percentage increased from 45.09 to 47.4% in fermented coarse wheat bran. Both anti-nutritional factors (tannins and phytic acid) were found to decrease significantly ( $P \leq 0.05$ ) in coarse, medium and fine wheat bran. The tannin content decreased from 0.03 to 0.01, 0.07 to 0.05 and from 0.07 to 0.06 mg catechin/100 gm, respectively. Phytic acid decreased from 626.1 to 572.8, 740.4 to 367.1 and from 795.2 to 301.6 mg/100 gm, respectively. There is no change on the values of Ca and Fe contents of coarse wheat bran after fermentation. Also there was an increase in Ca content of fine and medium wheat bran. Fe content of medium wheat bran decreased from 0.03 to 0.02% but Fe content of fine wheat bran increased from 0.023 to 0.033%. There is a slight decrease in P content of coarse wheat bran after fermentation. The phosphorous content as percentage decreased in fermented medium and fine wheat bran from 0.004 and 0.003% to 0.002 and .002%, respectively. Bread specific volume values of the three cultivars with 10, 15 and 20% fermented wheat bran decreased with increase in the amount of wheat bran. Bread with 10% fermented coarse wheat bran gave the best results for all characteristics tested in organolyptic evaluation.

**Key words:** Debeira, El-Nielain, Sasaraib, wheat, mineral content

### Introduction

Wheat bran, a by-product of flour milling is composed of the pericarp and the outermost tissues of the seed, including the aleurone layer. It constitutes almost 10% of the total weight of wheat milled for flour. On moisture-free basis, bran contains about 17% protein and 70% carbohydrates, about 80% of which is cellulose and hemicellulose. Most of the bran protein and other nutrients are contained in the aleurone cells (Saunders *et al.*, 1972). Ranum (2000) found that bran is mainly cellulose with very little gluten, so there is not much it can be used for other than being a source of fibre, but it does contain higher vitamin and mineral contents, so flour made with a higher extraction rate tends to be more nutritious. However, bran also contains higher levels of phytic acid, which makes the minerals less available to the body, particularly when used in a non-fermented food product. Stanyon and Costello (1990) used wheat bran to enhance the nutritional quality of baked products such as cakes, yeast bread and muffins. McRorie *et al.* (2000) reported that consumption of wheat bran in excess of levels in a typical western diet significantly increased stool output.

Malkki (2001) reported that the physiological effects of dietary fiber are usually compared with the intakes or contents of total dietary fiber. Many health-related effects such as cholesterol reduction attenuation of blood glucose and insulin and prolonged satiety, are due to the physical properties of a fiber. Dirar (1993) stated that fermentation is a method of preservation which may destroy undesirable factors in the raw product; the fermented food may have an enhanced nutritional value and digestibility. He further reported that fermented foods have a better flavour than the raw products. Wheat bran is more detrimental to loaf volume of bread and found to increase dough water absorption (Birch and Finney, 1980; Shogren *et al.*, 1981; Rogers and Hoseney, 1982; Moder *et al.*, 1984; Lai and Hoseney, 1989). Jeltema *et al.* (1983) reported that hemicellulose increases dough water absorption too. Mongeau and Brassard (1986) reported that addition of wheat and maize bran progressively reduced all bread quality characteristics.

Katina *et al.* (2001) reported that in baking, however, addition of wheat bran results in bread with inferior quality, low volume poor crumb structure, poor shelf-life

and a bitter flavour. They added that pre-fermentation of wheat bran with yeast or yeast and lactic acid bacteria improved the loaf volume, crumb structure and shelf-life of bread supplemented with bran. The positive effect of fermentation of bran on bread quality was evident in the changes of protein network structure of the breads. Pre-fermentation of the bran with yeast and lactic acid bacteria had the greatest effect on the structure of starch. Furthermore, Katina *et al.* (2001) revealed that the bread also had added flavour and good homogeneous crumb structure and elasticity of the crumb was excellent. Mustafa *et al.* (2002) reported that fermentation darkens the bran color, which is observed in the bread produced. Further fermentation is noticed to increase the flavour and acidity. The objective of this study was to evaluate the effect of fermentation as a mean of reducing anti-nutritional factors on the different fractions of wheat bran and on bread quality.

### Materials and Methods

Cleaning of the three local wheat grains (Debeira, El-Nielain and Sasaraib) was done by aspiration sieving and manual separation of impurities by hand. For obtaining uniform seeds, 2.8 micron sieve was used for removing small grains. A sample of each cultivar was tempered to 13.5% moisture for 24 hours, then milled in Barbender Quadrumat Junior mill (Regulation No. 1) to white flour, the flour was adjusted to 72% extraction rate by adding the right amount of ground and sieved bran of the same wheat (if needed). Each sample was well mixed and placed in air tight plastic container, then stored under appropriate conditions (deep freezer) until used.

Wheat bran was sieved and separated to pass through a special plan sifter (sieve 355, 500 and 710 micron). The throughs were classified as fine bran over 355 micron sieve, over 500 micron sieve were classified as medium bran and the overs of the sieve No. 710 micron were classified as coarse bran. Each bran fraction was well mixed and stored in air-tight plastic container in a deep freezer until used.

Each wheat bran fraction (coarse, medium and fine wheat bran) was mixed with 2% dry yeast and 30 ppm ascorbic acid, then covered with water, well mixed and placed in an incubator at 30°C for 4 hours (incubator RO-8 memmerr made in Western Germany). The bran was spread on a wide tray then placed in an oven (oven Heraeus Type T5050 Fabrik-Nr 8204271) set at 70°C until dry. Each of the samples was packed in polyethylene bags and stored in a deep freezer until used.

The wheat bran fraction (fermented and non-fermented coarse, medium and fine) were mixed with wheat flours (Debeira, El-Nielain and Sasaraib wheat flour) in the percentages 10, 15 and 20%.

**Chemical analysis of the wheat bran:** The moisture content was determined according to the method of AACC (1983) using Buhler Rapid moisture tester (type MLI-1000). The ash content was measured according to the AOAC method (1990) using muffle furnace (model Tipoforno ZA No. 18203 Gef Ran 1001). AOAC (1984) methods were used for determining protein, fat and crude fiber content. The total carbohydrates were calculated by difference according to Pearson (1976). Determination of minerals (Ca and Fe) was carried according to Pearson (1970) by the Atomic Absorption Spectrum (A.A.S) model G.B.C 932, while phosphorus was determined by the Spectrophotometer (Model CECILCE 1021 1000) series according to Pearson (1970). Tannins were determined by Price *et al.* (1978) techniques using Vanillin-HCl in methanol and 1% vanillin/methanol, while phytic acid by the method of Wheeler and Ferrell (1971).

**Bread making procedure:** The various wheat flour/wheat bran blends and the control (0.0% wheat bran) were fermented and baked according to the procedure described by Badi *et al.* (1978) modified as follows:

Ingredients	1	2	3	4
Wheat flour	100%	90%	85%	80%
Wheat bran	0	10%	15%	20%
Water	F.W.A	F.W.A	F.W.A	F.W.A
	+3%	+6%	+6%	+6%
Sugar	2%	2%	2%	2%
Salt	1%	1%	1%	1%
Yeast	1%	1%	1%	1%
Shortening	2%	2%	2%	2%
Improver (Ascorbic Acid)	80 ppm	80 ppm	80 ppm	80 ppm

Where F.W.A = Farinograph water absorption.

The tap-water was used in this process. All ingredients were then weighed and mixed for 5 min. to form a dough in mono-universal laboratory dough mixer at medium speed. The dough was allowed to rest for 10 minutes at room temperature (30°C) and then scaled to three portions of 120 g each. The three dough portions were made into round balls and allowed to rest for another 15 minutes then molded and put into a pan and placed in the fermentation cabinet for final proof between 50 and 60 minutes. Baking was done in Simon Rotary Test Oven at 220°C with steam saturation. Baking time was 10-15 minutes. After one hour, the loaves were weighed in grams and the volumes were measured in ml using the millet seed displacement method (volumeter). Different types of breads were prepared using wheat flour blends with fermented wheat bran (different bran particle sizes and different percentages). Also, whole wheat flour bread was prepared as a second control sample. The loaves were sliced with an electric knife

Table 1: Proximate composition of wheat bran

Wheat bran		Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fibres (%)	CHO (%) (- fibre)
Non-fermented	Coarse	9.78 <sup>a</sup>	20.35 <sup>d</sup>	5.82 <sup>a</sup>	3.28 <sup>c</sup>	15.67 <sup>a</sup>	45.09 <sup>a</sup>
	Medium	9.70 <sup>a</sup>	18.36 <sup>e</sup>	5.46 <sup>c</sup>	3.26 <sup>c</sup>	15.67 <sup>a</sup>	47.55 <sup>c</sup>
	Fine	9.77 <sup>a</sup>	21.07 <sup>c</sup>	4.85 <sup>e</sup>	4.26 <sup>a</sup>	15.00 <sup>a</sup>	45.05 <sup>e</sup>
Fermented	Coarse	5.07 <sup>d</sup>	21.65 <sup>b</sup>	5.49 <sup>c</sup>	1.73 <sup>f</sup>	18.67 <sup>a</sup>	47.40 <sup>a</sup>
	Medium	6.80 <sup>c</sup>	20.79 <sup>e</sup>	5.68 <sup>b</sup>	2.78 <sup>d</sup>	18.00 <sup>a</sup>	45.96 <sup>ab</sup>
	Fine	7.70 <sup>b</sup>	22.40 <sup>a</sup>	4.98 <sup>d</sup>	3.77 <sup>b</sup>	17.67 <sup>a</sup>	43.48 <sup>ad</sup>

\*Any mean values in the same column having different superscript letters differ significantly ( $P \leq 0.05$ ).

Table 2: Effects of fermentation on the antinutritional factors (tannins and phytic acid)

Wheat bran	Tannin (mg catechin/100 gm material)	Phytic acid (mg/100 g)
Non-fermented		
Coarse	0.03 <sup>d</sup>	626.12 <sup>c</sup>
Medium	0.06 <sup>b</sup>	740.36 <sup>b</sup>
Fine	0.07 <sup>a</sup>	795.20 <sup>a</sup>
Fermented		
Coarse	0.01 <sup>e</sup>	572.79 <sup>d</sup>
Medium	0.05 <sup>c</sup>	367.13 <sup>e</sup>
Fine	0.06 <sup>b</sup>	301.63 <sup>f</sup>

\*Any mean values in the same column having different superscript letters differ significantly ( $P \leq 0.05$ ).

and the slices were kept closed in polyethylene bags at room temperature for sensory evaluation in the same day.

**Physical characteristics:** Different blends were tested for bread making quality. The loaf volume expressed in cubic centimeters was determined by the seed displacement method according to Pyler (1973). The loaf was placed in a container of known volume into which small seeds (millet seeds) were run until the container is full. The volume of seeds displaced by the loaf was considered as the loaf volume. The loaf weight of bread was measured in gm. Specific loaf volume was calculated as loaf volume (cc) divided by loaf weight in grams.

**Sensory analysis:** A panel of 15 members, composed of males and females, was used to judge the quality of the breads for color, taste, crumb texture, crumb grain and preference using a 10-points hedonic scale as follows:

10-9 as excellent, >9-7 as very good, >7-5 as good, >5-3 as fair and >3-1 as poor.

**Statistical analysis:** Analysis of variance was carried out according to the SAS (1997) system using 5% level of significance.

## Results and Discussion

The proximate composition of non-fermented and fermented wheat bran is presented in Table 1. The fermentation of wheat bran has affected the chemical components of wheat bran. The moisture content of the wheat bran, which was 9.78, 9.70 and 9.77% decreased

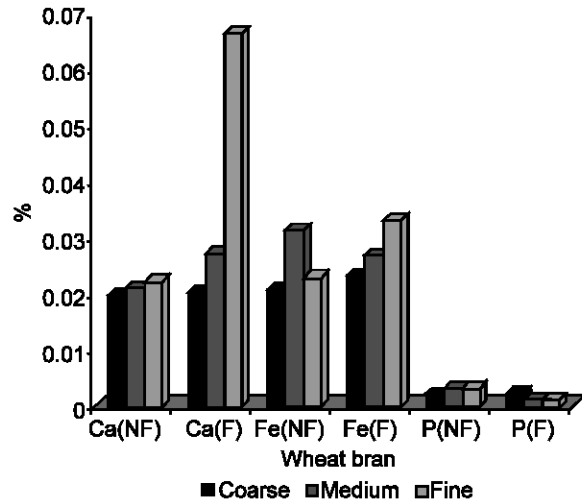


Fig. 1: Effects of fermentation of wheat bran on mineral content

to 5.07, 6.80 and 7.70% on the three fractions (coarse, medium and fine) of wheat bran after fermentation, respectively. This decline of moisture content could be attributed to the drying after fermentation of wheat bran. On the other hand, the fermentation of wheat bran increased the protein percentage from 20.35, 18.36 and 21.07% to 21.65, 20.79 and 22.40%. The fermentation of wheat bran also increased fiber percentage from 15.67, 15.67 and 15.00% to 18.67, 18.00 and 17.67%, respectively for all fractions of wheat bran. The increase in protein and fiber contents was mainly due to the yeast reproduction during fermentation.

The fat percentage of wheat bran decreased from 3.28, 3.26 and 4.26% to 1.73, 2.78 and 3.77%, respectively. The ash percentage of coarse wheat bran decreased from 5.82 to 5.49% and there is a slight increase in the fat percentage of medium and fine bran from 5.46, 4.85 to 5.68 and 4.98%, respectively. However, the fermentation of wheat bran increased the carbohydrates percentage from 45.09% in coarse wheat bran to 47.4%. The protein percentage of non-fermented wheat bran is almost similar to that reported by Ellis (1981). The result of moisture and fat percentages were in good agreement with the results reported by Sid Ahmed (2003).

Tannins content of wheat bran are shown in Table 2. Tannins content of wheat bran is almost similar to that

Table 3: Bread specific volume

Type of bread	Loaf weight	Loaf volume	Loaf specific volume
Sasarib flour+0% fermented bran	107.4 <sup>def</sup>	441.7 <sup>a</sup>	4.11 <sup>a</sup>
Sasarib flour+10% F.C.B	106.6 <sup>efgh</sup>	381.7 <sup>bc</sup>	3.58 <sup>c</sup>
Sasarib flour+15% F.C.B	100.7 <sup>m</sup>	346.7 <sup>de</sup>	3.44 <sup>d</sup>
Sasarib flour+20% F.C.B	101.6 <sup>m</sup>	313.3 <sup>gh</sup>	3.08 <sup>g</sup>
Sasarib flour+10% F.M.B	105.0 <sup>i</sup>	391.7 <sup>b</sup>	3.73 <sup>b</sup>
Sasarib flour+15% F.M.B	105.3 <sup>hi</sup>	333.3 <sup>ef</sup>	3.17 <sup>ef</sup>
Sasarib flour+20% F.M.B	103.0 <sup>k</sup>	305.0 <sup>ghik</sup>	2.96 <sup>ghi</sup>
Sasarib flour+10% F.F.B	109.1 <sup>abc</sup>	391.7 <sup>b</sup>	3.59 <sup>c</sup>
Sasarib flour+15% F.F.B	107.6 <sup>def</sup>	340.0 <sup>de</sup>	3.16 <sup>ef</sup>
Sasarib flour+20% F.F.B	109.6 <sup>a</sup>	310.0 <sup>ghl</sup>	2.83 <sup>i</sup>
El-Nielain flour+0% fermented bran	106.8 <sup>defg</sup>	353.3 <sup>d</sup>	3.31 <sup>de</sup>
El-Nielain flour+10% F.C.B	101.0 <sup>m</sup>	301.7 <sup>ijk</sup>	2.99 <sup>gh</sup>
El-Nielain flour+15% F.C.B	102.7 <sup>kl</sup>	288.3 <sup>k</sup>	2.81 <sup>i</sup>
El-Nielain flour+20% F.C.B	109.3 <sup>ab</sup>	253.3 <sup>j</sup>	2.32 <sup>l</sup>
El-Nielain flour+10% F.M.B	103.6 <sup>k</sup>	291.7 <sup>k</sup>	2.82 <sup>i</sup>
El-Nielain flour+15% F.M.B	105.7 <sup>ghi</sup>	265.0 <sup>j</sup>	2.51 <sup>k</sup>
El-Nielain flour+20% F.M.B	104.5 <sup>jl</sup>	220.0 <sup>m</sup>	2.11 <sup>m</sup>
El-Nielain flour+10% F.F.B	107.3 <sup>def</sup>	310.0 <sup>ghl</sup>	2.89 <sup>hi</sup>
El-Nielain flour+15% F.F.B	105.5 <sup>ghl</sup>	308.3 <sup>ghl</sup>	2.92 <sup>hi</sup>
El-Nielain flour+20% F.F.B	107.2 <sup>def</sup>	268.3 <sup>j</sup>	2.50 <sup>k</sup>
Debeira flour+0% fermented bran	107.9 <sup>de</sup>	438.3 <sup>a</sup>	4.06 <sup>a</sup>
Debeira flour+10% F.C.B	105.1 <sup>i</sup>	375.0 <sup>c</sup>	3.57 <sup>c</sup>
Debeira flour+15% F.C.B	103.4 <sup>k</sup>	341.7 <sup>de</sup>	3.30 <sup>de</sup>
Debeira flour+20% F.C.B	106.4 <sup>gh</sup>	293.3 <sup>k</sup>	2.75 <sup>j</sup>
Debeira flour+10% F.M.B	104.8 <sup>j</sup>	353.3 <sup>d</sup>	3.37 <sup>d</sup>
Debeira flour+15% F.M.B	108.1 <sup>bcd</sup>	341.7 <sup>de</sup>	3.16 <sup>ef</sup>
Debeira flour+20% F.M.B	107.7 <sup>def</sup>	265.0 <sup>j</sup>	2.46 <sup>kl</sup>
Debeira flour+10% F.F.B	109.6 <sup>a</sup>	350.0 <sup>de</sup>	3.19 <sup>ef</sup>
Debeira flour+15% F.F.B	107.7 <sup>def</sup>	321.7 <sup>g</sup>	2.99 <sup>gh</sup>
Debeira flour+20% F.F.B	107.2 <sup>def</sup>	301.7 <sup>ijk</sup>	2.82 <sup>i</sup>

\*Any mean values in the same column having different superscript letters differ significantly ( $P \leq 0.05$ ). F.C.B = fermented coarse wheat bran. F.M.B = fermented medium wheat bran. F.F.B = fermented fine wheat bran.

reported by El Mubarak *et al.* (1988) and Babiker *et al.* (1993). Tannins content of the fine wheat bran was significantly ( $P \leq 0.05$ ) higher than that of both coarse and medium wheat bran. This difference is may be due to the fact that the fine bran is mostly seed coat. Phytic acid content of wheat bran is shown in Table 2. Phytic acid content of non-fermented fine wheat bran was significantly ( $P \leq 0.05$ ) higher than in non-fermented coarse and medium wheat brans. Phytic acid content of wheat bran is within the range reported by Mustafa *et al.* (2002); Elhag (1993) and Sid Ahmed (2003). But the phytic acid content of fermented wheat bran is higher than the values reported by Mustafa *et al.* (2002). This indicates that fermentation hydrolyzes the phytate by the enzyme phytase produced by the yeast, releasing the mineral elements. The hydrolyses of the phytate also improves the protein digestibility. Fig. 1 shows some minerals content in the wheat bran. Non-fermented wheat brans showed similar values of Ca and P contents. Non-fermented medium wheat bran has a higher value of Fe content compared with coarse and fine wheat bran. From the results shown in Fig. 1, it could be observed that fermentation reduced phosphorous content and increased Ca and Fe content.

Table 4: Sensory evaluation of the bread made with different ratios of fermented wheat bran

Type of bread	Colour	Odour	Taste	Crumb texture	Crumb grain	Preference
Sasarib bread	9.3 <sup>a</sup>	7.5 <sup>c</sup>	7.5 <sup>c</sup>	9.1 <sup>a</sup>	9.3 <sup>a</sup>	8.7 <sup>b</sup>
El-Nielain bread	9.3 <sup>a</sup>	8.8 <sup>a</sup>	9.0 <sup>a</sup>	8.5 <sup>c</sup>	7.5 <sup>c</sup>	8.8 <sup>b</sup>
Debeira bread	9.3 <sup>a</sup>	8.9 <sup>a</sup>	9.0 <sup>a</sup>	8.9 <sup>b</sup>	8.3 <sup>b</sup>	9.1 <sup>a</sup>
SWF+10% F.C.B	8.2 <sup>c</sup>	6.8 <sup>d</sup>	7.0 <sup>c</sup>	6.6 <sup>e</sup>	6.7 <sup>a</sup>	8.0 <sup>c</sup>
EWf+10% F.C.B	8.8 <sup>b</sup>	7.3 <sup>c</sup>	7.8 <sup>b</sup>	6.5 <sup>e</sup>	7.3 <sup>d</sup>	7.8 <sup>d</sup>
DWF+10% F.C.B	9.3 <sup>a</sup>	8.0 <sup>b</sup>	7.4 <sup>c</sup>	7.3 <sup>d</sup>	6.8 <sup>a</sup>	8.3 <sup>c</sup>
SWF+10% F.M.B	7.1 <sup>d</sup>	6.7 <sup>d</sup>	6.5 <sup>e</sup>	6.5 <sup>e</sup>	6.3 <sup>e</sup>	7.0 <sup>e</sup>
EWf+10% F.M.B	6.0 <sup>f</sup>	6.5 <sup>d</sup>	5.3 <sup>f</sup>	4.7 <sup>f</sup>	5.2 <sup>e</sup>	6.5 <sup>f</sup>
DWF+10% F.M.B	6.9 <sup>d</sup>	6.7 <sup>d</sup>	6.4 <sup>e</sup>	5.9 <sup>e</sup>	5.8 <sup>b</sup>	6.9 <sup>e</sup>
SWF+10% F.F.B	7.0 <sup>d</sup>	5.4 <sup>e</sup>	5.5 <sup>f</sup>	5.7 <sup>f</sup>	5.7 <sup>f</sup>	5.3 <sup>f</sup>
EWf+10% F.F.B	6.5 <sup>e</sup>	5.7 <sup>e</sup>	6.2 <sup>e</sup>	6.7 <sup>e</sup>	5.7 <sup>f</sup>	6.3 <sup>f</sup>
DWF+10% F.F.B	5.9 <sup>f</sup>	6.1 <sup>e</sup>	6.1 <sup>e</sup>	6.4 <sup>e</sup>	6.5 <sup>f</sup>	6.6 <sup>f</sup>
SWF+15% F.C.B	5.1 <sup>e</sup>	5.9 <sup>f</sup>	5.2 <sup>f</sup>	4.7 <sup>f</sup>	5.1 <sup>f</sup>	5.9 <sup>b</sup>
EWf+15% F.C.B	7.1 <sup>d</sup>	6.4 <sup>e</sup>	7.3 <sup>d</sup>	5.7 <sup>f</sup>	6.1 <sup>e</sup>	7.5 <sup>d</sup>
DWF+15% F.C.B	6.9 <sup>d</sup>	6.0 <sup>f</sup>	6.0 <sup>f</sup>	5.6 <sup>f</sup>	5.7 <sup>f</sup>	6.3 <sup>f</sup>
SWF+15% F.M.B	4.0 <sup>f</sup>	4.9 <sup>e</sup>	4.6 <sup>f</sup>	4.4 <sup>f</sup>	4.4 <sup>f</sup>	4.4 <sup>f</sup>
EWf+15% F.M.B	3.7 <sup>f</sup>	4.7 <sup>f</sup>	4.1 <sup>f</sup>	5.5 <sup>f</sup>	4.6 <sup>f</sup>	4.3 <sup>f</sup>
DWF+15% F.M.B	3.5 <sup>f</sup>	4.3 <sup>f</sup>	4.7 <sup>f</sup>	4.8 <sup>f</sup>	4.7 <sup>f</sup>	4.2 <sup>f</sup>
SWF+15% F.F.B	4.2 <sup>f</sup>	4.8 <sup>e</sup>	5.1 <sup>f</sup>	5.2 <sup>f</sup>	4.5 <sup>f</sup>	3.9 <sup>f</sup>
EWf+15% F.F.B	4.4 <sup>f</sup>	5.3 <sup>b</sup>	4.4 <sup>f</sup>	5.3 <sup>f</sup>	4.6 <sup>f</sup>	3.8 <sup>f</sup>
DWF+15% F.F.B	4.4 <sup>b</sup>	4.7 <sup>f</sup>	4.9 <sup>f</sup>	5.5 <sup>f</sup>	5.1 <sup>f</sup>	4.7 <sup>f</sup>
SWF+20% F.C.B	4.7 <sup>b</sup>	5.3 <sup>b</sup>	5.9 <sup>b</sup>	4.2 <sup>m</sup>	4.9 <sup>f</sup>	5.1 <sup>f</sup>
EWf+20% F.C.B	4.3 <sup>f</sup>	4.5 <sup>f</sup>	4.7 <sup>f</sup>	4.7 <sup>f</sup>	4.7 <sup>f</sup>	4.3 <sup>f</sup>
DWF+20% F.C.B	4.3 <sup>f</sup>	4.6 <sup>f</sup>	4.5 <sup>m</sup>	4.5 <sup>f</sup>	4.2 <sup>f</sup>	4.2 <sup>f</sup>
SWF+20% F.M.B	2.1 <sup>e</sup>	3.3 <sup>e</sup>	3.3 <sup>e</sup>	3.2 <sup>e</sup>	3.6 <sup>m</sup>	3.0 <sup>m</sup>
EWf+20% F.M.B	2.4 <sup>e</sup>	2.5 <sup>i</sup>	3.1 <sup>e</sup>	3.2 <sup>e</sup>	5.0 <sup>f</sup>	2.5 <sup>e</sup>
DWF+20% F.M.B	2.0 <sup>e</sup>	2.9 <sup>f</sup>	3.0 <sup>e</sup>	2.6 <sup>i</sup>	3.1 <sup>e</sup>	2.6 <sup>e</sup>
SWF+20% F.F.B	2.6 <sup>m</sup>	3.3 <sup>b</sup>	2.7 <sup>b</sup>	3.5 <sup>f</sup>	3.5 <sup>m</sup>	2.8 <sup>f</sup>
EWf+20% F.F.B	1.4 <sup>e</sup>	3.1 <sup>e</sup>	2.5 <sup>i</sup>	3.7 <sup>n</sup>	4.1 <sup>f</sup>	2.5 <sup>e</sup>
DWF+20% F.F.B	2.7 <sup>m</sup>	3.6 <sup>m</sup>	4.4 <sup>m</sup>	5.4 <sup>i</sup>	4.7 <sup>f</sup>	3.6 <sup>f</sup>

Where: 10-9 as excellent, >9-7 as very good, >7-5 as good, >5-3 as fair, >3-1 as poor. \*Any mean values in the same column having different superscript letters differ significantly ( $P \leq 0.05$ ). EWf = El-Nielain wheat flour; SWF = Sasarib wheat flour; DWF = Debeira wheat flour. F.C.B = fermented coarse wheat bran; F.M.B = fermented medium wheat bran; F.F.B = fermented fine wheat bran.

These results are in agreement with the results reported by Rendleman (1982) and Pomeranz and Gain (1983). Internet Report (2004) showed that wheat bran contains about 1013 mg/100 g phosphorous. Fermentation of wheat bran helps the alpha-amylase activity by releasing the Ca ion chelated with the phytic acid. The Ca ion is said to be important for the activity of alpha-amylase. Table 3 shows the bread specific volume of wheat bread from Debeira, El-Nielain and Sasarib flours supplemented with various levels of fermented wheat bran.

Loaf specific volume decreased with the increase in the level of replacement from 4.11, 3.31 and 4.06 in the control wheat bread to 2.83, 2.11 and 2.46 in bread supplemented with 20% fermented fine bran, 20% fermented medium bran and 20% fermented coarse bran, respectively (Table 3). This drastic reduction of the bread specific volume is mainly due to the dilution of the gluten content. This deleterious effect of the bran could be reduced by using more shortening and SSL (sodium stearoyl-2-lactylate) (Mustafa *et al.*, 2002).

The sensory evaluation results (Table 4) of the bread showed the high acceptability to the bread containing

10% fermented coarse wheat bran, while the high bran breads (15, 20%) showed low acceptability, but the odour of fermented coarse wheat bran bread was liked by the panelists due to its nice rye bread like flavor. The crumb color darkens with the increase of the bran ratio and the crumb texture becomes hard. These results are comparable with the data reported by Mustafa *et al.* (2002) and Sosulski and Wu (1988).

#### Conclusions:

1. The four hours fermentation process decreased tannins and phytic acid contents in wheat bran.
2. Fermentation of wheat bran increases the percentage of crude fibre, protein and total carbohydrates.
3. Fermentation increases Ca and Fe in the fine wheat bran.
4. Fermented coarse wheat bran can be used to produce highly acceptable bread supplemented with up to 10% fermented wheat bran.
5. The incorporation of fermented wheat bran in bread formulation reduced the bread specific volume slightly at 10% level but significantly at the higher levels (20%) so, the addition of fermented wheat bran affects the physical and sensory properties of the baked bread.

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