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# WHEAT FIBER AS ADDITIVES IN REDUCED CALORIES WHEAT BREAD – PART ONE: DOUGH AND BREAD PROPERTIES

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## Abstract

*Reducing dietary calories is the primary dietary goal for many consumers. High-fiber ingredients are added to breads for several reasons. First, they are used to increase the total dietary fiber content of the bread. Second, they can be used to decrease the calories in the bread. Breads with increased levels of dietary fiber were produced by adding wheat fiber for 10, 15, 20, or 25% of the wheat flour. Effects of wheat fiber VITACEL® on the dough properties and on the final product (fiber enriched wheat bread) are described.*
***Keywords:*** *wheat fiber, dietary fiber, reduced calorie, wheat bread*

## Introduction

There is continuing interest in providing dietary options that deliver increased fiber for consumers who are mindful of the linkages between diet and health (Dreher, 1987). Dietary fiber has interested nutritionists for over 20 years due to its beneficial physiological effects (Kuntz, 1994, Sosulski, 1988; Stauffer, 1991).

Breads are sources of carbohydrates and can also be sources of dietary fiber (Cho, 1999). High-fiber ingredients are added to breads for several reasons (Czuchajowska, 1992; Sievert, 1990). First, they are used to increase the total dietary fiber content of the bread. Second, they can be used to decrease the calories in the bread (Sosulski, 1988; Pechanek, 1990). Common high-fiber ingredients used for high-fiber and low-calorie breads and related products include whole grains and whole-grain flours, cereal fibers and bran (Kulp, 1988; Lang, 1990, Sievert, 1990). These sources contain higher amounts of insoluble fibers than soluble fibers (Stauffer, 1991).

VITACEL® wheat fiber is extracted from the structure-forming parts of wheat using special thermo-mechanical processing and

refining. VITACEL® wheat fiber is up to 98% dietary fiber and is, from a nutritional physiological point of view, very significant. It is approved as a food and does not require an ''E" number. The declaration is ''wheat fiber" or ''wheat plant fiber".

The formulation of high-fiber or reduced-calorie bread involves the substitution of the high-fiber ingredient for a portion of the flour (Chen, 1988; Stauffer, 1991; Pechanek, 1990; Lang, 1990; Czuchajowska, 1992).

## Experimental

Data of the wheat flour, wheat fiber and yeast are given in Table 1.

**Table 1**. Data on raw material used

| Raw material | Characteristics |
|---|---|
| **Wheat flour** | - commercial wheat flour (Cibin Mill) |
| | - wet gluten: 28.9% |
| | - the deformation index: 6 mm |
| | - humidity: 13.7% |
| | - falling number: 265 |
| | - ash: 0.645% |
| | - Farinograph absorption: 60.5% |
| | - dough development time: 2 min |
| | - mixing tolerance index: 80 BU |
| | - stability: 12 min |
| | - degree of softening: 80 BU |
| **Wheat fiber** | - type WF 600 |
| | - white color |
| | - neutral in taste |
| | - 98 % dietary fiber content |
| | - free from gluten and phytic acid |
| | - fiber length 80 μm |
| | - fiber thickness 20 μm |
| **Compressed yeast** | - commercial |

The baking formulas are given in Table 2. Loaves of bread were backed by a straight dough baking procedure with a 450 grams weighing. Dough was mixed in a Marché Siemens mixer. Kneading the dough was performed till a soft consistency was reached for all samples. The temperature of the dough removed from the mixer was 30°C. Then the dough was scaled, rounded and placed in the

cylindrical baking pans for fermentation. The fermentation time was variable according to dough features. The fermentation and the final fermentation temperature was 30°C. The loaves of bread were baked at 220°C without steam for 35 minutes.

The volume of the cooled loaves was determinate by a millet seed displacement using a loaf volume meter (Fornet).

**Table 2**. The baking formulas

| Raw material | Control sample | 10 % wheat fiber | 15 % wheat fiber | 20 % wheat fiber | 25 % wheat fiber |
|---|---|---|---|---|---|
| Wheat flour (g) | 100 | 100 | 100 | 100 | 100 |
| Wheat fiber (g) | - | 10 | 15 | 20 | 25 |
| Compressed yeast (g) | 3 | 3 | 3 | 3 | 3 |
| Salt (g) | 1 | 1 | 1 | 1 | 1 |
| Ascorbic acid (mg) | 10 | 10 | 10 | 10 | 10 |
| Water (ml) added up to the same consistency of the bread dough | 66 | 78 | 86 | 99 | 109 |

## Results and Discussion

Digital images of wheat bread (control samples) and wheat bread with wheat fiber added are given in Figure 1. The water absorption increased with the increase of the wheat fiber in the blends. The effects of adding wheat fiber on the loaf volume are shown in Figure 1. Adding up to 25% of the wheat flour with wheat fiber had the higher reduced of the loaf volume. Reduction in the loaf volume was probably related to the overall decrease in gluten content.

The dough features has changed with increased quantities of wheat fiber which was added. The elasticity of the sample with 10% wheat fiber added was sensorial determinate. It was considered very alike even a little bit better than that of the control sample one. Increasing wheat fiber addition was followed by decreasing elasticity of the samples. The sample with 25% wheat fiber added had the lowest elasticity from all the tested samples. Adding up to 20-25% of the wheat flour with wheat fiber had decreased dramatically the cohesiveness of the dough.

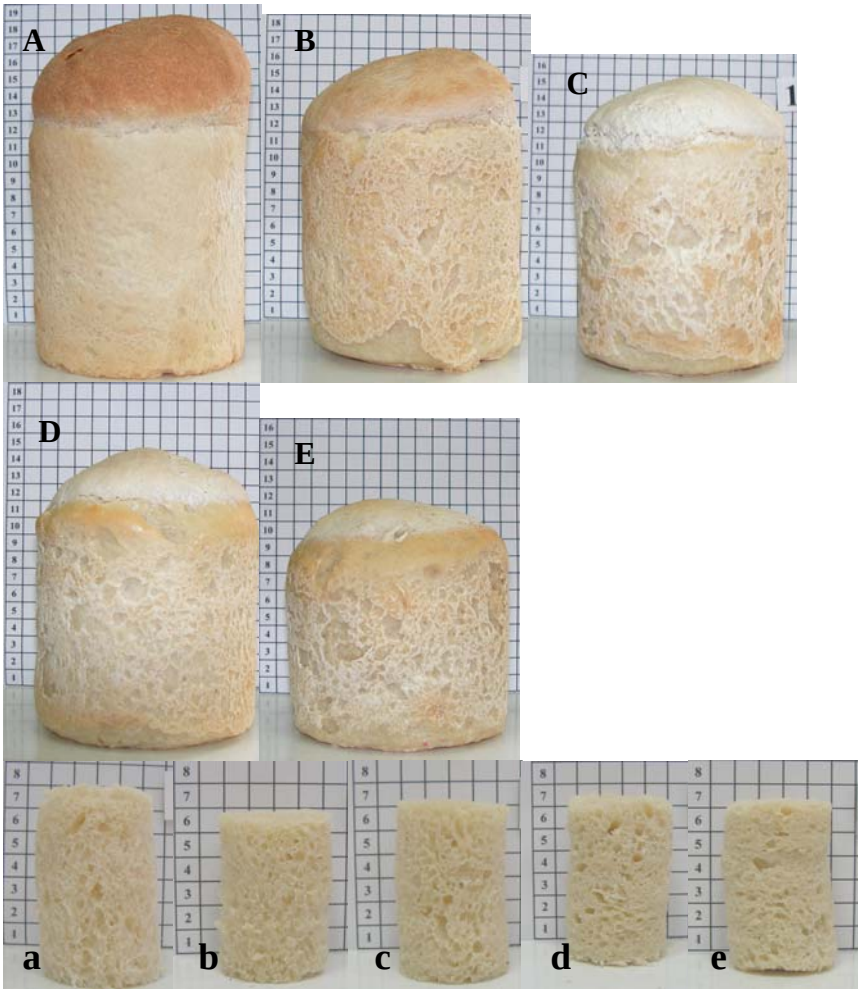


**Fig. 1**. Images of loaf (A - control samples, B - 10% fiber, C - 15% fiber, D - 20% fiber, E - 25% fiber) and crumb (a - control samples, b - 10% fiber, c - 15% fiber, d - 20% fiber, e - 25% fiber control samples)

The wheat fiber addition gives softness like velvet in samples with added wheat fiber. Starting with 15% wheat fiber added, the dough became look alike dry. Sticky dough was obtained by increasing the wheat fiber addition.

The rounded of the dough was easy for samples with 10% and 15% wheat fiber added. Tiny quantities of wheat flour were requested for the rounded of those samples. Increasing the wheat fiber addition the

manipulation and the rounded of the dough become difficult. The stickiness of the dough was higher and the quantity of the wheat flour which was necessary for the rounded phase was greater. Also at the rounded phase of the 20% and 25% wheat fiber added appeared broken on the dough.

In final fermentation stage the sample with 10% added fiber increased easy. In samples with higher wheat fiber level the dough increasing carry on breaking of the surface. Adding wheat fiber makes the gases retention lower. The sample with 25% wheat fiber added had the lowest capacity to retain the formed gases. At baking stage the samples with wheat fiber added had colorless crust. The crust is whitish and dull.

The physico-chemical characteristics of the bread are presented in the Table 3

**Table 3**. The physico-chemical characteristics of the bread

| | Loaf humidity % | Specific volume $cm^3/100g$ | Crumb elasticity % | Crumb acidity $^oT$ | Crumb porosity % |
|---|---|---|---|---|---|
| Control sample | 46.5 | 301 | 95 | 1.8 | 80 |
| 10 % wheat fiber | 49.8 | 286 | 91.6 | 1.2 | 73 |
| 15 % wheat fiber | 51.2 | 244 | 91.6 | 1.2 | 65 |
| 20 % wheat fiber | 52.5 | 227 | 93.3 | 1.2 | 64 |
| 25 % wheat fiber | 53.1 | 204 | 90 | 1.0 | 58 |

## Conclusions

Wheat fiber ingredients affect the formulation and processing of bread to some extent. Wheat fiber adding increased the water-absorption properties of the dough. The extent of this effect depends on the amount of fiber used. Additional water is necessary in the formulation to adequately hydrate the gluten as well as the added fiber.

The addition of wheat fiber requires an increase in the mixing time of the dough. The increase is necessary to ensure complete hydration of the dough as well as the formation of gluten. Formation of the gluten matrix is hindered because the fiber molecules obstruct the flour proteins from coming together and combining to form gluten.

One of the most noticeable effects of the addition of high-fiber ingredients to breads is the reduction in the final volume of the

product. The proportion of gluten is lower if the fiber source is added as a straight replacement of the flour. This is called dilution of the gluten. The decrease of loaf volume is thought to result from a reduction in the dough's gas retention ability caused by the presence of the wheat fiber ingredients and the dilution of gluten.

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