RHEOLOGICAL EFFECTS OF SOME NATURAL FIBERS USED IN BREADMAKING

— research paper —

Mihai OGNEAN[1], Claudia-Felicia OGNEAN, Neli DARIE

"Lucian Blaga" University from Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania,

Abstract: The use of fibers in bread recipe will modify the doughs rheology. Fibers from wheat, oat, potato, apple (Vitacel product) and pea (Cosucra) are used. The fibers addition will increase the hydration capacity and dough development time. Pea and apple fibers use lead to doughs similar to control doughs while wheat, oar and potato fibers severally affect dough rheology, Increase stability and decrease the softening of doughs.

KEYWORDS: wheat flour, dough, rheology, supplementation pea, apple, wheat, potato, oat, fibers

INTRODUCTION

Cereal based products represent the main food consumed. From these, bread are the most important products and wheat based bread is present on people table on different form. Bread and cereal products should represent the most important quantitative part (about 30%) from total daily food consumed (W.H.O., 2005). When the level of living increased during the former century, and food become available in large quantity and at accessible prices the preferences of people to refined products increases and also the preferences for bread made from white flour. Wheat breads which are actually consumed are prepared from low extraction flours with low dietary fiber content and nutritive values lower than high extraction flours. All the food consumed are depleted in nutritive factors. From these reasons we should work to improve the nutritionally properties of food and bread too. In past traditional bread made from low grade flour or whole flour were good

[1] Corresponding author. Mailing address: University "Lucian Blaga" of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Str. I. Raţiu 7-9, 550012 Sibiu, Romania. Phone: 0040/269/211338. Fax: 0040269212558. E-mail address: *mihai.ognean@ulbsibiu.ro*

source of fibers, insoluble and soluble, so nowadays the bread could be used to improve the people nutrition with fibers. Bread is a good vector for many other nutritive factors as minerals (Fe, Ca, Mg, I), vitamins (folic acid) because are largely consumed. The fibers could be added to bread recipes to improve the nutritive value of breads because these fibers didn't suffer modification during breadmaking, are relative stable during baking. We can add diverse products in wheat bread to obtain healthier breadstuff. Technological problems occur when fibers are added because they dilute the gluten from dough and also interfere with gluten formation. The addition of fiber (or any other product) modifies the technological properties of dough and properties of breads, positively or negatively (Ang et al., 2005) (Cauvain et al., 2001) (Shradanant et al., 2003).

Fibers, soluble or insoluble, aren't absorbed in human gut and act as bulk in food. They cand be used to reduce the caloric content of foods as bulking agent and also because they can bind large quantity of water. Fibers bind large quantities of water which will dilute the final products (Asghar, 2005). The products will be much moist, with reduced levels of dry maters and reduced caloric values (Ognean et al., 2006). Addition of fibers to bread could be a valuable method to obtain breads with low caloric content. The quantity of fibers which could be added is still limited because the dilution gluten from dough. The dough rheology is very important, a high alteration of dough properties lead to product with poor characteristics and acceptance from consumers. In bakery recipe up to 10% of flour could be replace with flour from other sources or other ingredients without an appreciable impact on bread characteristics.

The aim of this study is to investigate haw the addition of fibers in large quantity influence the rheology of dough. The fibers are added in 10 and 15% proportion, based on flour basis.

MATERIALS AND METHODS

As fiber sources were used commercial products; theirs characteristics are given in Table 1.

The water retention of fibers were determined according to Method AACC 56-20 (Hydration capacity of Cereal Products) with some modification. Basically 2 g of fibers was suspended in 4o ml of water for 10 minutes and then centrifuged 15 min. at 1000 g. After centrifugation the wet fibers are deposited and drained on filter paper on Buchner funnel under vacuum. The weight of prewetted filter paper was subtracted.

Table 1. The characteristics of fibers

Comercial name	Biological source	Producer	Fiber content, %	Moisture, %
Exafine 250	pea	Cosucra	85	6,7
Apple AF12	apple	J. Rettenmaier Sohne	55	6,8
Oat HF200	oat	J. Rettenmaier Sohne	96	6,9
Potato KF200	potato	J. Rettenmaier Sohne	74	7,3
Wheat WF400	wheat	J. Rettenmaier Sohne	97	7

The rheological characteristics of dough with and without fibers were determined by AACC Method 54-21. Because the development time of dough with fibers is greater than 10 or 20 minutes the softening of dough at 12 minutes after peak time are measured, according to ICC method. The rheological characteristics of dough were measured with the equipment Flourograph E6 produced by Haubelt Laborgeräte GmbH. The mixing bowl capacity was for 100 g of flours.
The flour used in experiments was commercial white flour kindly provided by Cibin Mill from Sibiu. the main characteristics of flour was 13.4% moisture content, 0.65% ash, 29.6 wet gluten content and FN 263 s.

RESULTS AND DISCUSSIONS

In Table 2 the hydration capacity of fibers used in experiment are shown. In the first step of experiments a selection of fibers has been made, the main criteria been the hydration capacity. From similar products the products with higher water retention was selected. The results are the average of four replicas.

Table 2. Hydration capacity (HC) of fibers

Comercial products	HC, %	STD
Vitacel Apple AF12	150,2	6,2
Vitacel Apple AF401	133,4	6,7
Exafine Pea	128,8	1,5
Vitacel Oat HF200	138,7	3,6
Vitacel Oat HF401	71,7	2,3
Vitacel Oat HF600	113,4	4,2
Vitacel Potato KF200	230,5	4,3
Vitacel Wheat WF200	89,9	1,6
Vitacel Wheat WF400	117,4	4,5
Vitacel Wheat WF600	97,1	3,5
Vitacel Wheat WF600-30	84,9	3,7

In figure 1 the values of capacity of hydration of dough prepare with 10 and 15% fibers added are shown, compared with control – no fibers added. Differences were observed between the capacities of hydration of dough prepared with the same proportion of fibers added. To see if it is any correlations between quantity of fibers added and quantity of water bound the trendlines were obtained, the results are shown in figure 2.

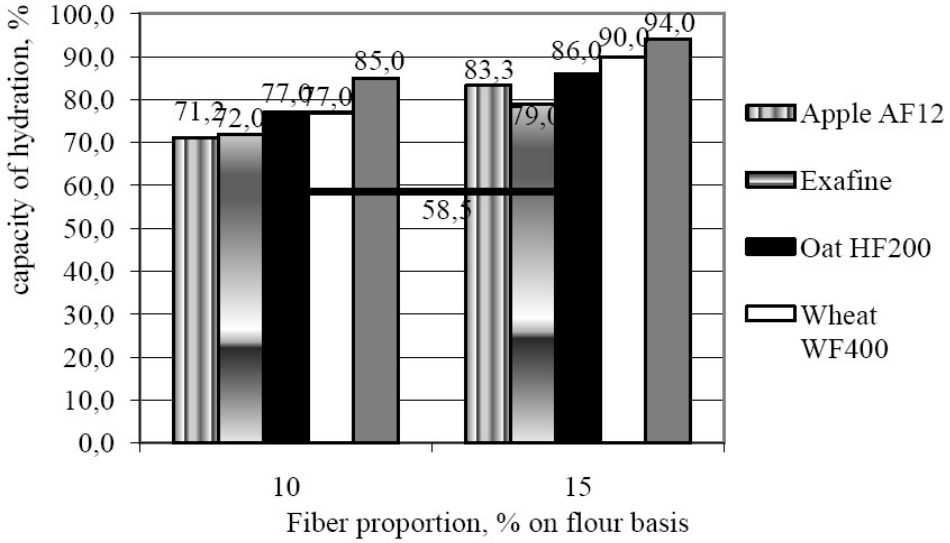

Figure 1. Hydration capacity of dough prepared with 10 and15% fibers

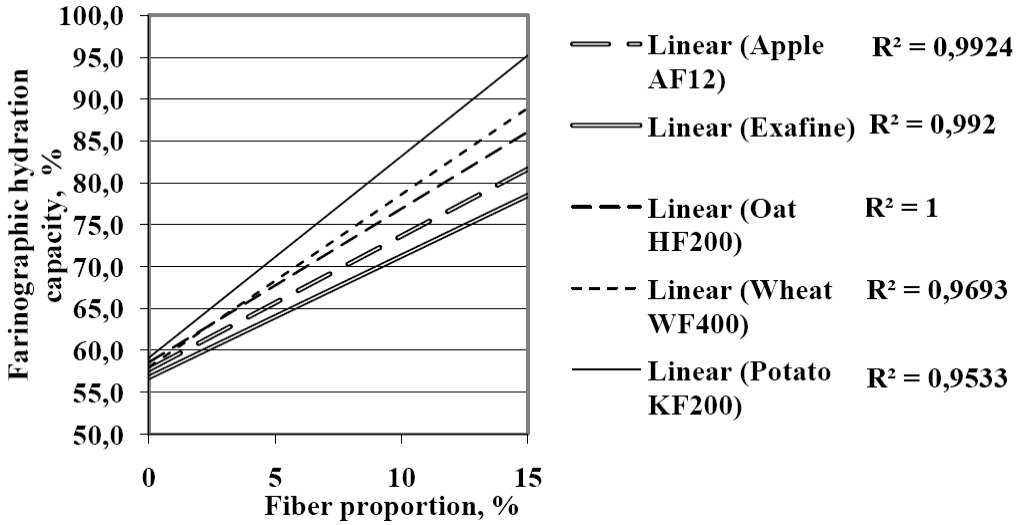

Figure 2. Correlations between the fiber proportion and capacity of hydration

For each type of fibers added a strong correlation was established between the quantity of fibers added and quantity of water bound in dough. For these proportions the interferences with dough formation were linear. We tried to establish a correlation between the dough hydration capacity and fibers capacity to retain water, for each proportion of fibers added, but the correlations were poor. This indicates the fact that each fibers interfere with dough formation in different way. The particular way of interference with dough formation could be observed too from the flourograms of dough formation which are shown in figure 3.

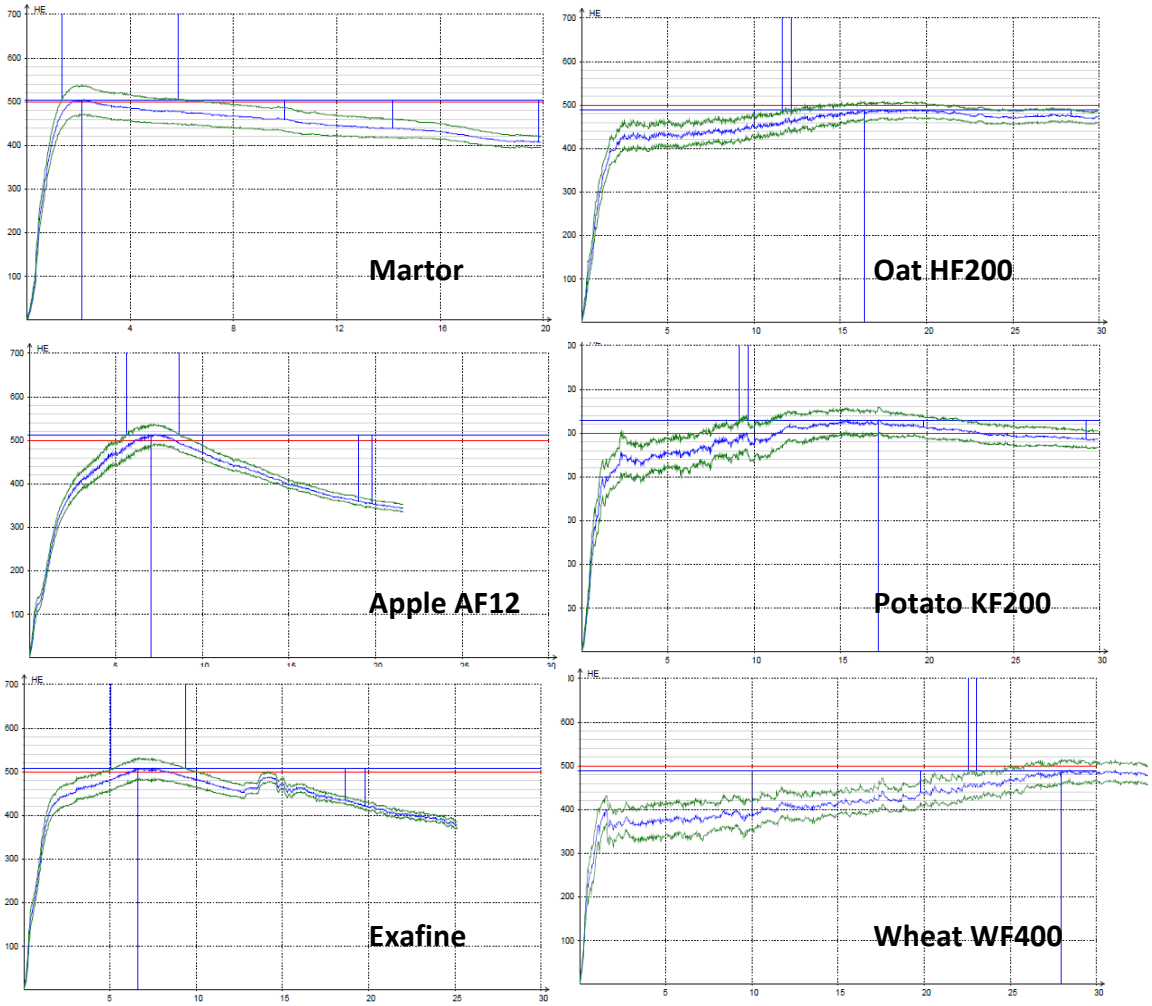

Figure 3. Flourograms of control dough and dough prepared with 15% fibers added

Development of dough is retarded by fiber addition, and also other characteristics of dough are modified. In general the stability of dough is increased, according to these flourograms, but we must consider that the increased stability is due to slow development of dough or the high viscosity and stickiness of dough. A great competition for water appears between the gluten and fibers and the gluten proteins. The fibers from wheat, oat and potato had a similar behavior. These fibers have a similar appearance, are white, inodorous and fibrous and seem to be processed and refined. The fibers from pea and apple are much less processed, the biological sources could be identified easily. The poor refinement could explain why the stability of dough is smaller than for dough prepared with fibers from wheat, oat or potato.

In table 3 are presented the development time, dough stability, and softening and also the quality number (FQN).

Table 3. Rheological characteristics of dough prepared with and without fiber

	Development time [min]		**Stability [min]**		**Degree of softening [HU*]**		**FQN**	
Level of fiber adition	10%	15%	10%	15%	10%	15%	10%	15%
Control	**2,2**		**4,4**		**65**		**44**	
Apple AF12	6.7	7.0	3.8	3.0	158	152	86	60
Exafine	6.4	6.6	6.0	4.2	62	74	89	93
Oat HF200	11.1	16.4	8.9	11.4	44	nd	21	nd
Potato KF200	11.9	17.2	5.9	11.1	67	43	95	176
Wheat WF400	20.5	28.0	15.4	14.0	nd	nd	128	374

*HU – Haubelt Units, **nd - undetermined

The rheology of dough with apple fiber are weakest than all other dough prepared with fibers and even than control dough. Dough with pea fiber are weak to but similar to control. When the level of fiber addition is high the rheology of dough is weak. Better rheological effect resume when fibers from wheat, oat and potato are added, the best are for wheat fiber. Still the rheology of these doughs is abnormal due to extremely long time of dough fermentation. Because of long term of fermentation some flourographic characteristics were unable to measure. Also the dough with fibers from wheat, oat and potato are very sticky and plastic. Much more “normal” doughs are obtained with apple and pea fibers.

CONCLUSIONS

As we expected, the addition of fibers at so high levels affect drastically the rheology of doughs. By fiber addition the quantity of water bound in dough is increased, proportionally with quantity of fibers added but each fiber in part had act specific. Some similarities still occurs. Pea and apple fiber addition lead to less stable doughs while addition of fibers from wheat, oat and potato need abnormally long time to development and have a greater stability due their high viscosity. The use of such great proportion of fibers in recipe will create many problems in practice especially if levels equal to 15% are used.

ACKNOWLEGMENTS

We want to thank to **Haubelt** Laborgeräte GmbH who kindly allow us to use the Flourograph E6.

This paper was presented at the Jubilee International Conference "Agricultural and Food Sciences, Processes and Technologies" 9 – 12 December, 2010, Sibiu, Romania

REFRENCES

1. Ang, J.F., and Crosby, G.A., Formulating Reduced – Calorie Foods with Powdered Cellulose, Food Technology, 2005, 59, p.35-38
2. Asghar, A., Effect of Carboxyl Methyl Cellulose and Gum Arabic on the Stability of Frozen Dough for Bakery Products, 2005, 29,p. 237-241
3. Cauvain, S., Young, L., *Baking problems solved,* Woodhead Publishing Limited and CRC Press LLC, 2001
4. Ognean, C.F., Darie, N., Ognean, M., Nutritional and technological studies about using carboxymethylcellulose in low calories bakery products, Act. Univ. Cibin., F series, 2006, v 9(1)
5. Ognean, C.F., Darie, N., Ognean, M., *Hypocaloric and Hypoglucidic Food – Technological Trends,* Alma Mater Publishing House, Sibiu, 2006;
6. Sharadanant, R., and Khan, K., Effect of Hydrophylic Gums on Frozen Dough: I Dough Quality*,* Cereal Chemistry, 2003, 80, p. 764-772;
7. Sharadanant, R., and Khan, K., Effect of Hydrophylic Gums on the Quality of Frozen Dough: II. Bread Characteristics, Cereal Chemistry, 2003, 80, p. 773-780;
8. WHO, Obesity: Preventing and Managing the Global Epidemic, Report on a WHO Consultation Technical Report Series, 2005, No 894

10. ***, *AACC Approved Methods*, 9th edition, American Association of Cereal Chemists , St. Paul, Minnesota, 1995