The Effect of Some Commercial Fibers on Dough Rheology

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Abstract. Bread is largely consumed and could be used as a carrier for different nutrients. Fibers play an important role in human nutrition but the bread are depleted in this nutrient. For fibers, supplementation could be used different sources. The fibers needed to be tested before their use in breadmaking. This work investigates how some commercial fibers (Exafine, Apple AF12, Potato KF 200, Oat HF 200 and Wheat WF400) influence the rheology of dough at 10 and 15 % addition. All fibers increased the water absorption and development time because of competition for water between fibers and flour component. Product Apple AF12 deteriorates the dough rheology by dough stability reduction and increases the degree of softening. The cereal fibers increase the development time and stability of dough and decrease the degree of softening, the higher effects being observed for wheat WF200.

Keywords: Flourgraph E6, breadmaking, wheat flour, bread supplementation.

INTRODUCTION

Bread products are largely consumed by population and could act as a carrier for many nutritional supplements. The modern bread are depleted of many nutrients, fibers are some of these, through flour extraction during milling. The current vision is to supplement the bread with fibers. The first step was to introduce bran in bread but, lately, many other sources of fibers are available, fibers with different properties.

Physiological properties of dietary fibers are associated with prevention of certain diseases. Dietary fibers are associated with weight control and act as natural barrier to excess energy intake. Fibers could prevent constipation by restoring normal bowel function. It helps to increase stool weight, produce softer and more bulky stool, and reduce gastrointestinal time (Schrijver et al., 1992). Gastrointestinal disorders (gallstone and appendicitis), biventricular diseases, diarrhea, irritable bowel syndrome and duodenal ulcer can be prevented or cured with high fibers diet.

Fibers have protective effect against colonic cancer. Colonic bacteria can produce carcinogens either by metabolizing dietary substrates or from secretions produced in response to diet. Faecal bile acids were suggested as possible carcinogens. Prolonged transit time increases the degradation of bile acids to carcinogens (Jenkins et al., 1986). The bulking effect of fibers dilutes oncogenic potential of carcinogens by reducing their interactions in the intestinal mucosa and hence prevents colonic cancer. Dietary fibers in colon are metabolized or fermented to produce short chain fatty acids (acetic, propionic and butyric acid) and gases (hydrogen, carbon dioxide and methane). Butyrates have antitumor properties and propionates are implicated in lipid and glucose metabolism (Lanza and Butrum, 1986). The consumer awareness about the importance of fibers in diet increased the demand of high-fiber foods. Most of the research for use of fibrous material in bakery foods was focused on bread because it is a sensitive product in which the differences are easily noticeable. Fibers act as bulking
agents and it serves to reduce the calorie content in food. The bulking nature and water retention properties of dietary fibers results in the formation of low calorie soft-type products that retains more moisture after baking and require lesser force to break than the control (Bullock et al., 1992; Dougherty et al., 1988). Numerous high fibers ingredients are available to the food industry and their functionality have been tested in various baked products.

Some problems occur when fibers are introduced in bread, many of these are rheological. The flours could be usually replaced in bread formulation in 10% proportion, the results vary depending on the nature of the replacement. The bread must be valuable nutritionally but also must have good eating properties so it is necessary to know how different fibers affect the dough rheology and bread properties. The aim of this study is to observe how is influenced the rheological properties of dough by different fibers addition.

MATERIALS AND METHODS

The wheat flour used in experiments was provided from Cibin Mill, Sibiu, 13.4% moisture, 29.6% wet gluten, 263 s Falling Number and 0.65 ash d.b. The fibrous material used in experiments had different sources: oat (Oat HF, J.Rettenmair Sohne), potato (Potato KF, J.Rettenmair Sohne), wheat (Wheat WF, J.Rettenmair Sohne), apple (Apple AF, J.Rettenmair Sohne) and pea (Exafine, Cosucra). The fibers were added in 10 and 15% flour ratio.

The water retention capacity was determined according to AACC method no. 56-20, modified; the separation was made by filtration instead centrifugation. For the farinographic evaluation was used the equivalent apparatus Flourgraph E6, Haulbelt and the test were run according to ICC no. 115/1 method.

RESULTS AND DISCUSSION

The water binding capacity of fibers was determined. The results are presented below (tab. 1). Form the fibrous products available were selected for further experiments the products with larger water binding capacity, from each fiber sources.

<table>
<thead>
<tr>
<th>Fibers</th>
<th>Water binding capacity, %</th>
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<th>Water binding capacity, %</th>
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<tbody>
<tr>
<td>Vitacel Apple AF12</td>
<td>150,2±6,2</td>
<td>Vitacel Potato KF200</td>
<td>230,5±4,3</td>
</tr>
<tr>
<td>Vitacel Apple AF401</td>
<td>133,4±6,7</td>
<td>Vitacel Wheat WF200</td>
<td>89,9±1,6</td>
</tr>
<tr>
<td>Exafine Pea</td>
<td>128,8±1,5</td>
<td>Vitacel Wheat WF400</td>
<td>117,4±4,5</td>
</tr>
<tr>
<td>Vitacel Oat HF200</td>
<td>138,7±3,6</td>
<td>Vitacel Wheat WF600</td>
<td>97,1±3,5</td>
</tr>
<tr>
<td>Vitacel Oat HF401</td>
<td>71,7±2,3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitacel Oat HF600</td>
<td>113,4±4,2</td>
<td>Vitacel Wheat WF600-30</td>
<td>84,9±3,7</td>
</tr>
</tbody>
</table>

The fibers addition lead to higher water absorption of dough (Fig. 1) and, as we expect, the water absorption was higher when fibers were added in 15 % than the doughs with 10% addition. Fibers bind water in dough in different proportion, depending on their sources. Cereal fibers bound higher amount of water than pea and apple fibers. We were interested about that the water absorption of dough with fiber is in relation with the ability of fibers to retain water. The correlations between dough water adsorption and fibers water retention are presented below (Fig. 2). At 10% fibers addition a very weak correlation was observed between the water bind by fibers and water absorption of dough with fibers. At 15% addition, no correlation was observed. The method to measure the water binding of fibers it is not very
accurate because the separation of excess water was done by filtration instead centrifugation. The presence of other compound (soluble and insoluble), other than fibers, could influence the dough rheology in different way.

Another important parameter for dough development is development time. All fibers increased dough development time when were added (fig 3). The fibers need time to absorb water and, also compete with flour components for water. It is necessary some time to realize equilibrium of water between dough components. The main components of fibers are polysaccharides, like cellulose and hemicelluloses, with a great affinity for water. The development time increased when larger amount of fibers was added, due even higher competition for water, which inhibited gluten hydration and development. In addition, fibers probably act as bulking agent and inhibit gluten development but that it is not the main cause because at the same addition we observed great differences in development time of dough with different kind of fibers. The hydration rate for every fibers is different and the time to fully hydrate in dough modify the development time of dough. Some soluble compound from fibers could act on gluten and increase or decrease the time necessary for gluten development. The development time of dough prepared with fibers from pea and apple increased very little when the proportion increased from 10% to 15%. In the case of fibers from oat, wheat and
potatoes the growth of development time was more pregnant. The fibers from pea and apple it is possible to contain substances with antagonist action to fibers.

The dough stability was affected also by fibers interaction with flour component (fig. 3). The product Apple AF12 reduce the dough stability. It is possible to contain some traces of sulphites, which act as reducing agent. Product Exafine could also contain sulphites because the dough stability decreased when the proportion fibers added increased from 10% to 15%. The sulphites explain also, why these products did not have great development time as the doughs with cereal fibers. For dough with cereal fibers in formulation, the dough stability increased when fibers proportion was higher. Apparently, this it is not available for wheat fibers but a degradation of gluten network occur during significant larger development time.

The dough stability is reflected also by the degree of softening. The product Apple AF12 increased significantly the dough degree of softening similar to a reducing agent (fig. 4). All other product decreased the degree of softening, the smallest effect was observed at
Exafine addition. For doughs with wheat fibers the degree of softening could not be determined because the time of testing was too short, the instruments could not register for such a long time. The dough with wheat fibers had a very long development time and a very good stability and the degree of softening could not be measured. The same problems occurred for the dough with 15% oat fiber added.

CONCLUSIONS

The water absorption of dough depends on the nature of fibers not only in their capacity to bind water, the interactions with gluten and other dough components are very important. These interaction changes all farinographic characteristics of doughs. Similar behaviors have cereal fibers, which are fibrous and reach in cellulose while the pea and apple had a different aspect (powder and respective small flakes). As a general and common effect, all fibers increase development time due the competition for water between fibers and gluten and also the stability are increased, probably because of competition and increases of dough viscosity.

The oat, potato and wheat fibers had similar effects on dough rheology but the effects of fibers obtained from oat and wheat are more closed. These fibers are very similar but still they had different behavior in dough. The differences between fibers from different sources are even higher when we compared them.

We observe a pattern in the behavior of fibers from the same classes but the similarities are fewer when all fibers were compared. In the process of fiber selection for the addition in products prepared from wheat flour are needed tests, to observe how they interact with flour components.

REFERENCES
