PHARINOGRAPHIC CHARACTERISTICS OF WHEAT DOUGH WITH NATURAL ADDITIVES

T. BOJŇANSKÁ, M. TOKÁR, R. GAŽAR
Slovak University of Agriculture in Nitra,
Faculty of Biotechnology and Food Science
Trieda A. Hlinku 2, 949 76 Nitra, Slovak Republic
E-mail: Tatiana.Bojnanska@uniag.sk

INTRODUCTION

Bread is one of the most important foods consumed all over the world. Measuring the rheologic properties of dough intended for bread production is relatively complicated, connected with exploitation of specific equipment. Rheology studies relations between tension which the material is exposed to, final dimension of material deformation and time. It is very important to understand the rheologic behaviour of bread dough as well as mechanical properties of the dough and control finished products (Příhoda et al., 2003, Mirsaeedghazi et al., 2008).
The main aim of rheologic measurement is to obtain quantitative description of mechanical properties of material, gain information related to molecular structure and composition of material as well as to characterise and simulate efficiency of material during the production and the quality check (Dobraszczyk, Morgenstern, 2003). Rheology is now well established as the science of the deformation and flow of matter. All materials have rheologic properties. These properties are described by rheometers. Many rheometers are used for the measurement of the dough rheologic properties such as penetrometer, consistometer, amylograph, farinograph, mixograph, extensigraph and alveograph (Mirsaeedghazi et al., 2008). The influence of additives of non bakery crops on the dough rheology is related mainly to their different (in comparison to wheat) saccharide and protein complex. The effect of hydrocolloids on rheologic properties of wheat dough and final quality of bread have been observed with some interesting findings, which showed that hydrocolloids might become suitable additives as quality enhancers in bread production. Generally, with addition of natural additives the rheological properties have worsen (Izydorczyk et al., 2001, Sindhuja et al., 2005, Dongovski et al., 2005, Jacob - Leelavathi 2006, and other.)
The paper gives the results of rheological evaluation of dough intended for bread production prepared with the addition of selected non bakery raw materials of high nutritive value.

MATERIALS AND METHODS

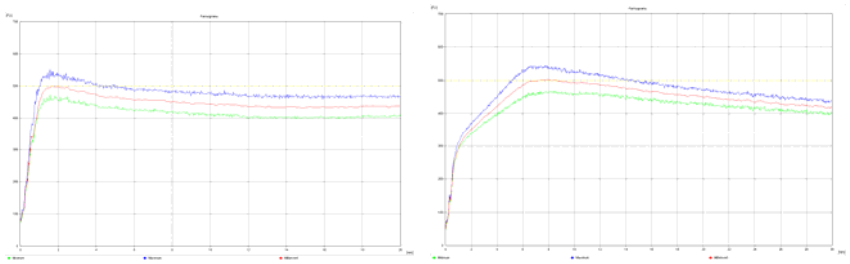
In the experiment we used white wheat bread flour blended with 10 - 50 % of finely grained and homogenised buckwheat flour. Produced blends were evaluated on Farinograph-E, Brabender OhG, Duisburg, Germany (ICC-Standard 115/1, 1992, AACC Method 54-21, 1995). All analyses were performed with the constant farinographic water absorption 58.1 % based on water absorption of wheat flour without additives. Sigma blades of farinograph worked with 3 different speeds: standard - 63 revs. min^{-1}, low - 45 revs.min^{-1} and high - 120 revs.min^{-1}. Following properties have been evaluated: changes of dough consistency (in FU – Farinographic unit) at constant water absorption of 58.1 %, development time (in min), stability (in min) and degree of softening (in FU). Tests were repeated three times and the results presented are means of the three realized measurements.

RESULTS AND DISCUSSION

Gluten removal from the recipes in bread production leads to significant technological problems. Gluten proteins play a key role in guaranteeing the bakery quality of wheat and influence water absorption, cohesion, viscosity, extensibility, elasticity, resistance to deformation, tolerance to kneading, ability to gas retention and dough strengthening properties (Lazaridou et al., 2007, Wieser, 2007). Also non bakery crops content elements (mainly of saccharide complex), which can either positively or negatively influence the rheological properties of dough prepared with addition of these crops.

The influence of non bakery crops added to composite flours on properties evaluated by farinograph was significant. With increasing portion of buckwheat dough consistency decreased statistically significantly (in comparison to wheat flour). In that case the addition of water 58.1 % was redundant; dough became weaker and the resistance against the farinograph blades was lower (Figure 1).

These changes were caused by decreasing of the absorption capacity of composite blend so in the hydrocolloids presented in buckwheat hydrating processes were slower, have lower hydrating ability. With other additives (oat, lentils, chickpea) the dough consistency increased. The change of consistency was reflecting indirectly in the changes of farinographic water absorption, which shows the flour ability to absorb a certain amount of water within its structure while reaching consistency of 500 FU. Decrease of farinographic water absorption is from the economic point of view undesirable since it increases the amount of flour needed to produce bread of the same weight.



wheat flour wheat flour with 50 % buckwheat

Figure 1
Farinograph wheat flour and farinograph wheat flour with 50 % buckwheat

In order to optimize dough properties related to different rotation speed of farinograph blades, the experiment was provided with three different speeds. The lower amount of energy put in the wheat flour dough system manifested itself at lower revs (45 revs per minute) by decreasing of dough consistency. The energy needed to trigger physico-chemical reactions produced by lower revs was not able to incorporate itself efficiently to the dough structure, which caused lower consistency and viscoelastic dough properties. Lower kneading speed slowed the hydration, swelling and process of chemical reactions among proteins, starch, polysaccharides of non starch type and other flour elements but aided the occurrence of chemical bond by weaker power of intermolecular bonds. This was manifested by prolongation of dough development time in all evaluated doughs. Higher rotation speed of doughs with additives decreased significantly dough development time which is important considering kneading as a high energy-consuming process. On the other hand dough stability was prolonged at lower revs. It means that lower revs can be recommended as suitable to obtain stable dough with additives of non bakery crops. Key factor affecting the rheological properties of doughs with additives is the correct time of kneading. Non adequate time can negatively influence stability; can cause higher degree of dough softening and dough stickiness. The degree of dough softening significantly increased with higher speed of kneading what is from the technological point of view undesirable considering the need of further manipulation with dough during forming and fermentation of products (Dodok, Szemes, 1998).

CONCLUSIONS

Based on the results obtained by observing the rheological properties of tested doughs can be stated that use of natural additives worsened the physical properties of doughs what prediction worsening of the technological quality of

final products. Some parameters have been compensated by adjusting the regime of kneading, in particular by lowering the speed of kneading.

REFERENCES

DOBRASZCZYK, B. J., MORGENSTERN, M. P. Review: rheology and the breadmaking process. In *Journal of Cereal Science*, vol. 38, 2003, p. 229–245.

DODOK, L., SZEMES, V. *Laboratórne kontrolné metódy pre pekárenskú a cukrársku prax*. CPaC, Pezinok, 1998, 80 s.

DONGOWSKI, G., DRZIKOVA, B., SENGE, B. et al. Rheological behaviour of β-glucan preparations from oat products. In *Food Chemistry* 93, 2005, p. 279-291

IZYDORCZYK, M. S., HUSSAIN, A., MacGREGOR, A. W. Effect of Barley an Barley Components on Rheological Properties of Wheat Dough. In *Journal of Cereal Science*, vol. 34, 2001, p. 251-260.

JACOB, J., LEELAVATHI, K. Effect of fat-type on cookie dough and cookie quality. In *Science Direct, Journal of Food Engineering,* vol. 79, 2007, p. 299-305.

LAZARIDOU, A. – DUTA, D. – PAPAGEORGIOU, M. – BELC, N. – BILIADERIS, C. G. 2007. Effects of hydrocolloids on dough rheology and bread quality parameters in gluten-free formulations. In *Journal of Food Engineering*, vol. 79, 2007, p. 1033 – 1047.

MIRSAEEDGHAZI, H., EMAM – DJOMEH, Z. and MOUSAVI, S.M.A. 2008. Rheometric Measurement of Dough Rheological Characteristics and Factors Affecting It. In *International Journal of Agriculture & Biology,* vol. 10, 2008, p.112-119. ISSN Online: 1814–9596

PŘÍHODA, J., SKŘIVAN, P., HRUŠKOVÁ, M. *Cereální chemie a technologie I. Cereální chemie, mlynská technologie, technologie výroby těstovin*. Praha: Vysoká škola chemicko-technologická v Praze, 2003. ISBN 80-7080-530-7.

SINDHUJA, A., SUDHA, M.L., RAHIM, A. Effect of incorporation of amaranth flour on the quality of cookies. In *European Food Research and Technology,* Springerlink*,* vol. 221, 2005, no. 5, p. 597-601. ISSN – 1438-2385.

WIESER, H. 2007. Chemistry of gluten proteins. In *Food Microbiology*, vol. 24, 2007, p. 115-119.

AKNOWLEDGEMENT

The study was carried out with the financial support of the granted project VEGA 1/0282/10.