THE STICKNESS OF WHEAT DOUGH WITH DIFFERENT EXOGENOUS ENZYMES

Daniela DIACONESCU*, Voicu GIURCĂ**

* Arad *Aurel Vlaicu* University, Food Engineering, Tourism and Environmental Protection Faculty, 3, Elena Dragoi St., tel. 0257219331, e-mail rectorat.uav@inext.ro
** Sibiu *Lucian Blaga* University, 7-9, Dr. Ioan Rațiu, tel. 0269211338.

Abstract
A very important side effect of some enzyme preparations is the increasing of the stickiness of wheat dough. When the stickiness increase is to big, it may handle problems of the dough, risen flour consumption and rejects. In the present work we have studied the stickiness of dough with several exogenous enzymes. Generally, the dough stickiness increases simultaneously with the intensity increase of positive effects in bread quality brought by added enzymes. Glucose oxidase and amyloglucosidase does not increase the stickiness of dough with or without wheat bran. Excepting xylanase, all the hemicellulases used here increase the dough stickiness.

Key words: stickiness, handling problems, glucose oxidase, amyloglucosidase, hemicellulases, enzyme mixtures, bread quality.

Résumé
L'adhérence de la pâte faite de farine de blé a un effet secondaire trés important déterminé par certaines enzymes exogènes. Si la viscosité est trop accentuée, il se peut que, pendant la préparation de la pâte, apparaissent des problémes telle une consommation trop grande de farine et une quantité plus grande de rebuts. Cet ouvrage traite le probléme de la adhérence des pâte à certaines enzymes exogènes. En général, la adhérence des pâte à certaines enzymes exogènes s`accentue à mesure que s`accroît l`intensité des effets positifs des enzymes sur le pain. Glucose-oxydase et amylo-glucosidase ne font pas croître la adhérence de la pâte à ou sans son de blé. Excepté la xylanase, tous les autres hémicellulases utilisée accentuent la adhérence.

Rezumat
Lipiciozitatea aluatului din făină de grâu este un efect secundar foarte important adus de unele preparate enzimatice. La o creştere prea mare a lipiciozității pot apărea probleme la prelucrarea aluatului, mărirea consumului de făină şi rebuturi. În această lucrare am urmărit lipiciozitatea aluaturilor cu anumite enzime exogene. În general, lipiciozitatea creşte odată cu creşterea intensității efectelor pozitive în pâine, aduse de enzime. Glucozoxidaza şi amiloglucozidaza nu măresc lipiciozitatea aluatului cu sau fără tărâță de grâu. Cu excepția xilanazei, toate hemicelulazele utilizate aici măresc lipiciozitatea.

1. Introduction

Until not long time ago, the use of exogenous enzymes in the baking industry was limited to the addition of amylase for adjustment of flour quality. But now, several industrial enzyme producers offer a wide range of enzymes produced for breadmaking. Exogenous enzymes can be used to improve the quality of baked products, especially in today's conditions, when consumers increasingly prefer bread without chemical improvements.

The bakers have often limited knowledge of the enzyme preparations existing on the market, and in addition, the side effects of enzymes in dough or bread, other than the main are not always declared or even known. So, it is difficult to control the final result.

A very important side effect of some enzyme preparations is the increasing of the stickiness of wheat dough. The presence of α-amylase activity in enzyme preparations has been reported to cause sticky doughs (Chen, 1992; Rouau *et al*, 1994). Also, some hemicellulases increased the stickiness of doughs (Laurikainen *et al*, 1998). When the stickiness increase is to big, it may be appear handling problems of the dough and, of course, risen flour consumption and rejects.

In the present work we use several exogenous enzymes like glucose oxidase, hemicellulases and amyloglucosidase with a view to improve the quality of wheat bread with or without bran supplement. Besides that, we study the stickiness of doughs in the presence of enzymes.

Glucose oxidase is an oxidizing enzyme that has an effect similar to that of chemical oxidants such as potassium bromate, which has been prohibited. Oxidizing agents have a beneficial effect on dough development and dough quality that is important for the volume and crumb structure of the bread. Glucose oxidase catalyzes the conversion of glucose and oxygen into gluconolactone and hydrogen peroxide. The hydrogen peroxide formed acts by oxidizing the thiol groups in the gluten proteins forming disulfide bonds (Haarasilta and Pullinen, 1992). This leads to increase dough strength.

The hemicellulases are hydrolases who catalyzes the hydrolysis of hemicelluloses, which are found in cell walls from both endosperm and aleuronic layer. Hemicellulases are used in baking due to their ability to decrease water absorption of the dough by hydrolysing the hemicellulases. Hemicellulases are reported to soften dough (McCleary *et al* 1986), increase the loaf volume and improve crumb structure (Haseborg and Himmelstein, 1988). Specific *Trichoderma reesei* xylanase slightly increased the stickiness of wheat dough both with and without rye bran, but the increase was not significant (Laurikainen *et al*, 1998). Addition of hemicellulolytic culture filtrate of *Trichoderma reesei* significantly increased the stickiness of the wheat doughs without rye bran (Laurikainen *et al*, 1998). Anyway, the wheat dough with rye bran was stickier than that without bran. The increased stickiness brought by *Trichoderma reesei* culture filtrate was due to the increased solubility of cell walls (Laurikainen *et al*, 1998).

The amyloglucosidase has the capacity to generate glucose from dextrins which results in improving the volum, taste and coloure of bread.

2. Materials and methods

Materials: Two commercial white flours with normal breadmaking properties was used: F1 with 12,75% proteins and F2 with 13,18% proteins.

The used wheat bran (B) had 12,85% moisture content and 2,1% particle smaller than 192 μm.

The enzyme preparations used were:
Fermizyme GO1500 (G) – an enzyme preparation extracted from *Aspergillus niger* which comprise glucose oxidase with 1500 SARRET UNIT/g enzymatic activity (Overseas Bakery & Ingredients Romania SRL Bucharest);
Fermizyme AG 800 (Ag) – an enzyme preparation extracted from *Aspergillus niger* which comprise amyloglucosidase with 65000 AGI/g enzymatic activity (Overseas Bakery & Ingredients Romania SRL Bucharest);
Fermizyme I (H-Tv) – an enzyme preparation extracted from *Trichoderma viridae* which comprise hemicellulase with 4100 XTU/g enzymatic activity (Overseas Bakery & Ingredients Romania SRL Bucharest);
Fermizyme HB 2000 (H-Ao) – an enzyme preparation extracted from *Aspergillus oryzae* which comprise hemicellulase with 2000 LYX/g, enzymatic activity (Overseas Bakery & Ingredients Romania SRL Bucharest);
Bel'Ase C (X) – a pure concentrate of xylanase (Beldem Food Ingredients Romania);
X503 (X+αA) – a standard mixture of α-amylase and xylanase (Puratos Romania);
Fermizyme HE 400 (X+C) – a standard mixture of xylanase and cellulase with 4000 LYX/g, 400 XVU/g enzymatic activity (Overseas Bakery & Ingredients Romania SRL Bucharest).

Baking test: The dough was comprised of 95% wheat flour, 5% bran (optional), 1,6% compressed bakers` yeast, 1,6% salt on flour basis. The amount water was adjusted according to the water absorption capacity of flour. The using limits of each enzyme preparations were founded by attempts and just the interval, which had effects, was elected. For each level of enzyme preparation was made a double number of samples.

The doughs without bran were mixed in a laboratory mixer for 3 min. After fermentation time – 60 min. at 25-30°C – dough pieces at 1000g were shaped in a long shape by hand and allowed to stay in the leavening chamber – 60 min. at 25-30°C. The breads were baked at 35 min. at 250°C.

The doughs with bran were mixed in a laboratory mixer for 5 min. After fermentation time – 60 min. at 25-30°C – dough pieces at 660g were moulded by hand and proofed – 75 min. at 30-35°C in rectangular pans. The breads were baked at 35 min. at 250°C.
Analyses: The stickiness was analyzed by sensory evaluation.

3. Results and discussion

The effects of enzymes on the stickiness of wheat dough are given in table no. 1.

The stickiness evaluation given in this table was made for those dough samples, which gave the bread samples with the best quality.

Table 1.Effects of enzymes on the stickiness of wheat dough

Enzyme preparation	Used flour	Stickiness*
Glucose oxidase	F1	0
Glucose oxidase	FI + wheat bran	0
Amyloglucosidase	F2	0
Amyloglucosidase	F2 + wheat bran	0
Hemicellulase from *Trichoderma viridae*	F1	2
Hemicellulase + Glucose oxidase	F1	1
Hemicellulase from *Trichoderma viridae*	FI + wheat bran	3
Hemicellulase from *Aspergillus oryzae*	F2	1
Hemicellulase from *Aspergillus oryzae*	F2 + wheat bran	1
Xylanase	F2	0
Xylanase	F2 + wheat bran	0
Xylanase + α-amylase	F2	2
Xylanase + α-amylase	F2 + wheat bran	2
Xylanase + cellulase	F2	1
Xylanase + cellulase	F2 + wheat bran	1

*Sensory stickiness evaluation reported to corespondent control dough: 0 – not stickier; 1 – slightly stickier; 2 – sticky; 3 – very sticky.

Dried doughs, non sticky, with a better tolerance to mixing, fermenting and moulding were obtained in both cases: with and without wheat bran, by adding glucose oxidase

The doughs both with and without wheat bran containing amyloglucosidase had not presented differences in report to corespondent control doughs. But, addition of hemicellulase from *Trichoderma viridae* in dough without bran caused significant increase of dough stickiness. Fermizyme I is an enzyme preparation which does not content α-amylase, so the increase of dough stickiness is due to the increased solubility of cell walls. To improve the effects of this enzyme we had added also glucose oxidase and the dough obtained was less sticky.

The addition of hemicellulase *from Trichoderma viridae* in dough with bran makes the dough hardly to process and increases the stickiness quite lot.

Using a hemicellulase from *Aspergillus oryzae* we found that the doughs both with and

without wheat bran was less sticky than corespondent doughs with hemicellulase from Trichoderma viride.

The xylanase does not increase the stickiness of doughs with or without wheat bran, but neither does brings a significant rise of breads quality. So, we had added the xylanase together with α-amylase or cellulase. The xylanase-α-amylase mixture brought a significant increase of dough stickiness with or without wheat bran. Anyway, the xylanase-α-amylase mixture was more efficient in white bread than individual xylanase, but was not more efficient in bran-enriched bread (Diaconescu *et al,* 2001-a). The xylanase-cellulase mixture slightly increased the stickiness of wheat dough both with and without bran and it was more efficient in bran-enriched bread than individual xylanase, but was not more efficient in white bread (Diaconescu *et al,* 2001-b).

4. Conclusions

Glucose oxidase and amyloglucosidase does not increase the stickiness of dough with or without wheat bran. They act like improvers especially in white bread (Diaconescu, 2001b). Excepting xylanase, all the hemicellulases increase the dough stickiness. The stickiness of bran-enriched dough with hemicellulase from *Trichoderma viridae* was more significant than the stickiness of dough without bran containing the same enzyme. In this case the dough became hardly to process. But the hemicellulase from *Aspergillus oryzae* brought a slighter stickiness of the doughs both with and without bran than hemicellulase from *Trichoderma viridae*.

Regarding the xylanase, the xylanase – α-amylase mixture brought a more stickiness of the doughs both with and without bran than the xylanase – cellulase mixture.

Generally, the dough stickiness increases concomitantly with the intensity increase of positive effects in bread quality brought by added enzymes. In this way, we must try to find the proper dosage of enzyme preparation and the proper enzyme mixtures to improve the bread quality without simultaneous impairing of dough handling properties.

So, from table no. 1 it is obvious that by adding together hemicellulase from *Trichoderma viridae* with glucose oxidase the increase of dough stickiness was less significant. In addition, to obtain less sticky doughs we can add hemicellulase from *Aspergillus oryzae* instead hemicellulase from *Trichoderma viridae* and xylanase – cellulase mixture instead xylanase - α-amylase mixture.

5. References

Chen, W. (1992). Dough stickiness-causes and measurements. *Dissertation Department of Grain Science and Industry*, Kansas State University, Manhattan, Kansas, pp. 33-40.

Diaconescu, D., Giurcă, V., Cărăban, A. (2001 a). Studiu comparativ al efectelor xilanazei şi amestecului de xilanază şi α-amilază asupra pâinii. *Analele Universităţii din Oradea.***VIII**:121-127.

Diaconescu, D., Giurcă, V., Cărăban, A. (2001 b). Efectele amestecului de xilanază şi celulază asupra pâinii. *Analele Universităţii din Oradea.***VIII**:127-133.

Haarasilta, S., and Pullinen, T. (1992). Novel enzyme combinations. A new tool to improve baking results. *Agro-Food-Industry Hi-Tech.* **3:**12-13.

Haseborg, E., Himmelstein, A. (1988). Quality problems with high-fibre bread solved by use of hemicellulase enzymes. *Cereal Food World* **33**:419-422.

Laurikainen, T., Härkönen, H., Autio, K., and Poutanen, K. (1998). Effects of enzymes in fibre-enriched baking. *J. Sci. Agric.* **76**:239-249.

McCleary, B. V., Gibson, T. S., Allen, H., Gams, T. C. (1986). Enzymic hydrolysis and industrial importance of barley β-glucans and wheat flour pentosans. *Starch Stärke,* **38**:422-437.

Rouau, X., El-Hayek, M. L., Moreau, D. (1994). Effect of an enzyme preparation containing pentosanases on the bread-making quality of flours in relation to changes in pentosan properties. *J. Cereal Sci.* **19**, 259-272.