RESEARCH ON HEMICELLULOLYTIC ENZYMES INFLUENCE UPON DOUGH RHEOLOGIC PROPERTIES

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Abstract

Xylanase is the most efficient hemicellulase in the bread manufacture process. It hydrolizes both water soluble araboxylans and water insoluble araboxylans, in relatively high oligomers. The breaking up into smaller fragments occurs intensely with these types of enzymes. Regarding the effect of xylanases, they have positive effect upon bread bulk, improve the dough stability and tolerance to prolonged fermentation. Even at small doses they increase significantly gluten coagulation, the resulted gluten having superior performances at baking tests.
Keywords: *xylanase, bread, dough, rheologic properties.*

Introduction

Enzymes have been considered for long time as a means of improving cereal processing and products properties and their use is on the increase.Bread is the most ordinary food product of all traditional ones all over the world, of relatively low costs. Today, bread has joined hands with biotechnology, enzymes being the common denominator. Enzymes have been used in bread making for decades. Due to changes that have occured in bread making as well as to increased demand for genuine products, enzymes have gained a well-deserved importance in bread recipes.Latter-day discoveries in biotechnologies have led to obtaining of new enzymatic preparations available in bread making industry.

In Romania thousands of milling and bread making units are operating. In this field the activity of ensuring bakery products quality is given priority to, under conditions when almost two thirds of the flour resulted from annual wheat harvests do not comply with quality requirements. The use of complex additives to improve quality of end products in bread making process has been focused on until relatively recent times. Lately, due to the great variability of wheat flour lots, qualitative correction of flours directly in the mill has been imposed as a necessity.

Many food producers consider the use of enzymes as a new and innovating method. This is true for many categories of products, bread

making industry has a long history of enzymes study and usage. Enzymes are regarded as functional ingredients for many reasons. For example, enzymes are the natural components of many ingredients used in bread making. If an enzyme is added, it is often destroyed by heat during the baking process. In both situations, producers can take advantages of functional benefits of enzymes while maintaining the „ clean product" image of the end product. Enzymes are also specific to a certain function, thus removing undesired effects.

However, the creation of enzymes meant mostly to be used in bread making requires better comprehension of enzymes actions. Starting from the normal biochemical composition of wheat flours as compared to the drawback they might have , we may say that enzymes are the most important natural additions which interfere in obtaining some desired characteristics, depending on their area of usage. There are endogenous enzymes, natively contained in wheat flour and exogenous enzymes, added to improve the performance of flours for the purpose desired. All these enzymatic preparations are meant exclusively to be used in the technological process of obtaining bakery products.

Lately, especially in milling and bread making plants which have derived advantage from re-engineering of milling equipment, the flours have been directly improved in the mill.

Hemicelluloses are a class of enzymes with large aplicability in bread making. They catalyse the hydrolisis of hemicellulases, being enzymes which break down cell walls, in the case of flour, both the cells from endosperm and cells from cover particles. It has been demonstrated that the use of enzymatic preparations containing hemicellulase leads to improvement of dough properties, rise of the final volume of bakery products, extending bread freshness and obtaining improved texture and homogeneous structure.

Xylanase is the most efficient hemicellulase in the bread manufacture process. It hydrolizes both water soluble araboxylans and water insoluble araboxylans, in relatively high oligomers. The breaking up into smaller fragments occurs intensely with these types of enzymes.

Regarding the effect of xylanases, they have positive effect upon bread bulk, improve the dough stability and tolerance to prolonged fermentation. Even at small doses they increase significantly gluten coagulation, the resulted gluten having superior performances at baking tests. Adding xylanases into doughs rich in fibres leads to obtain bread with improved bulk, high quality crust and finer structure of crumb.

The paper focuses on hemicellulolytic enzyme influence upon dough and bread rheologic properties. Thus, the effects of these enzymes in doughs and breads made of type 650 white wheat flour have been taken into consideration.

Experimental

In the experiment we used a commercial white wheat flour type 650, low flour leading to dough with labile glutenic network and high deformation.The flour physical-chemical characteristics have been appreciated as follows: moisture 14,4%; content of wet gluten 26%; gluten deformation index 4mm; ash 0,65%, deformation index 362.

As additives for this flour, two hemicellulolytic enzymes were used, of different percentages, namely fungic hemicellulase and fungic xylanase as well as an additive made of the two enzymes.

The dough rheologic behaviour from the blank flour and the flour improved by different doses of hemicellulase, xylanase and mixture containing both enzymes has been determined by the help of Chopin alveo-consistograph and Brabender farinograph.

Baking tests also have been made. In order to analyse the effects of hemicellulolase enzymes, a sample of 650 type flour, a blank sample (no enzyme preparation) and three samples with the following levels of enzymatic preparations: 3 g xylanase and 5 Hemi C were made. The bread tests were made by direct method, according to the following recipe: flour 800 g, yeast 13 g, salt 13 g, water 470 ml. The yeast was suspended into 50 ml of water, the enzyme preparations were added to the flour.

Operating program:

- kneading 3-4 min in laboratory kneader-mixer ;
- fermentation 60 min, 25°C - 30°C;
- re-kneading 20 s;
- manual- division – 1000g;
- manual rounding;
- preleavening - 15 min;
- mechanized modelling –long format ;
- final fermentation 60 min., 25°C - 30°C in tunnel leavener
- baking 35 min., 250°C in tunnel oven;
- room temperature cooling.

Results and Discutions

➢ *Effects of hemicellulase and xylanase addition in dough and bread of wheat flour*

The flour type 650 is a flour with normal bread making features. The effect of hemicellulase , xylanase addition as well as the enzymatic mixture of the two, upon the dough rgeologic properties was determined by the help of Chopin alveo-consistograph and Barbender farinograph, results that can be seen in the images below (figure 1,2 and 3):

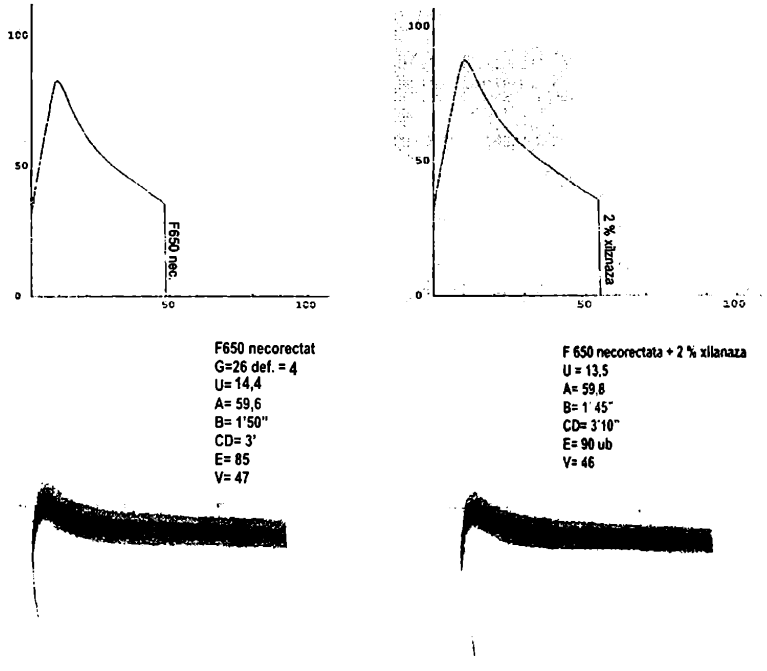


Fig.1: Alveoconsistograph and pharinograph images

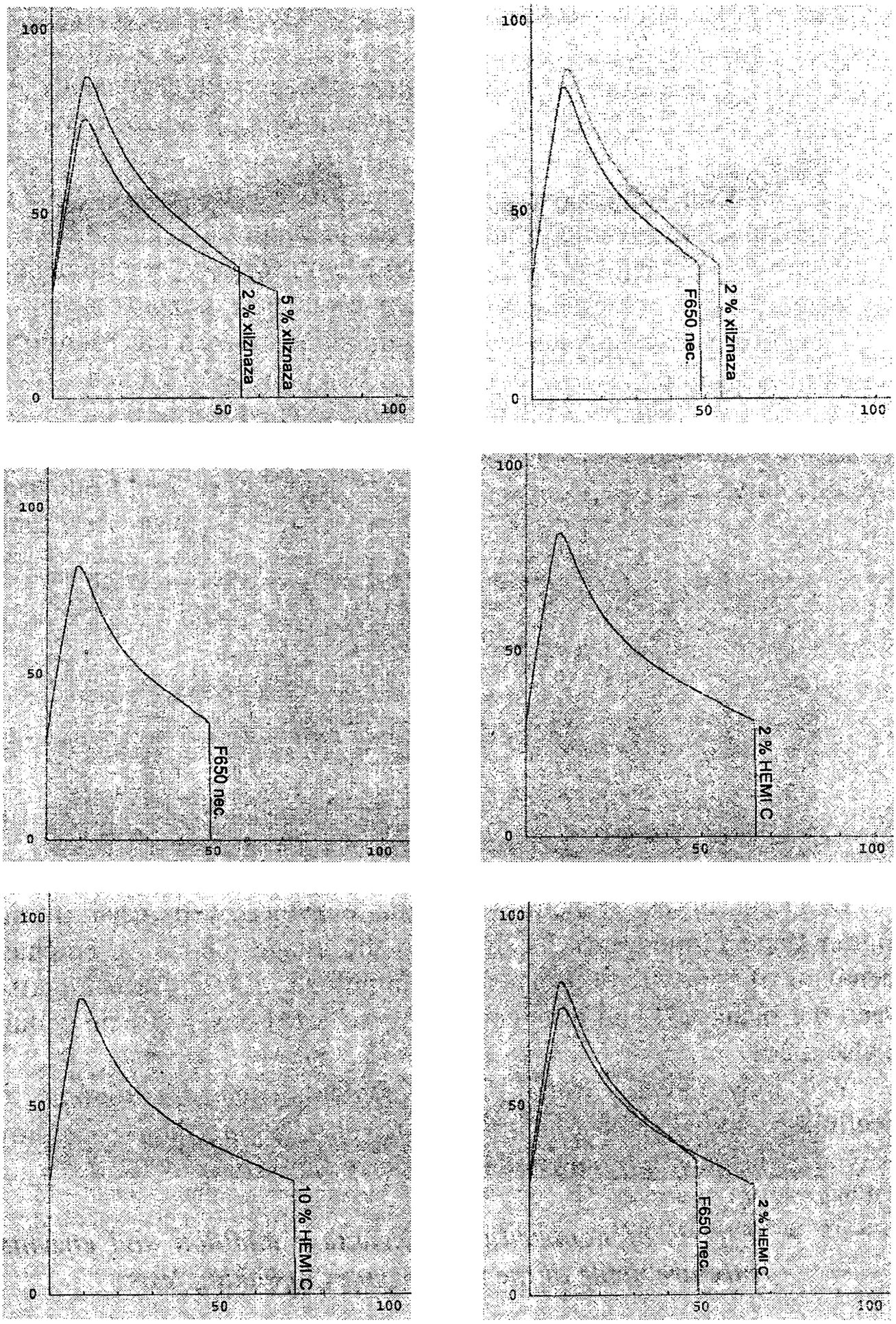


Fig.2: Alveoconsistograph images

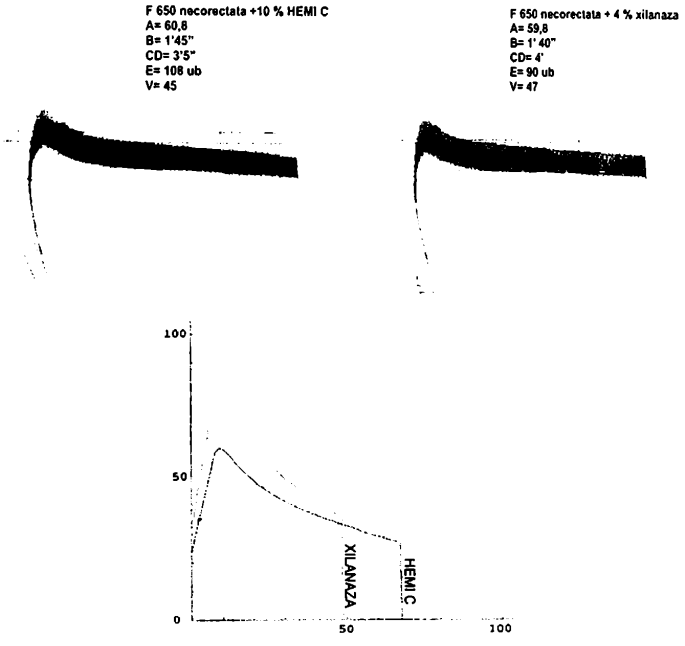


Fig.3: Alveoconsistograph and pharinograph images

Different doses of hemicellulolytic enzymes were used in these alveograms and farinograms, as shown in the images above, to emphasize the behavior of 650 type flour when it is improved. A series of comparisons between the blank test and tests containing different doses of hemicellulase were also made.

We may notice from the alveograms and farinograms that hemicellulase and xylanase addition provides higher bulks, improved porosity and elasticity as compared to the blank sample.

- ***Effects of hemicellulase, xylanase addition and enzymatic mixture made of the two enzymes in baking tests***

In the case of the baking tests, all samples containing enzymes or enzymatic mixture had also higher volume, improved porosity and elasticity

as compared to the blank sample. Their crumb was spongier, velvetier than that of the blank.

Their freshness was also longer even after 72 hours.

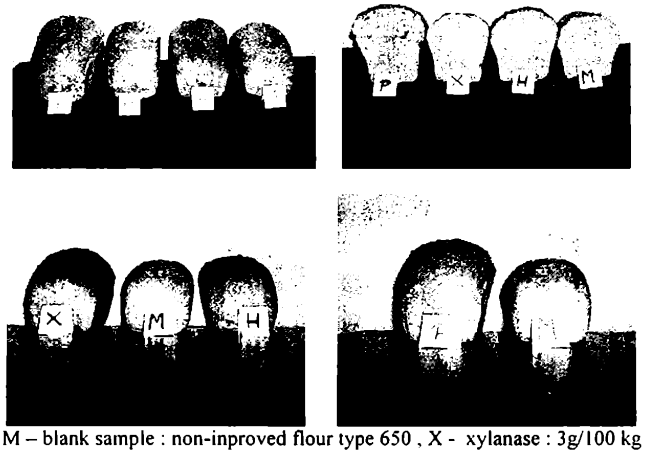
What was noticeable in these cases was the fact that the development of samples in oven was by far better than that of the blank one, before being put in the oven they had visibly almost the same volume.

All baking tests made in the laboratory pointed out the effects caused by hemicelluloses used for flour qualitative improvement.

These baking tests used the following doses: 3 % xylanase, 5% hemicellulase and mixture containing the two enzymes of same doses.

All baking tests had good results, still that containing the mixture of the two hemicelluloses had the best results.

The pictures below emphasize these results, drawing a comparison between the blank sample and the other samples wherein hemicellulolytic enzymes were used.



M – blank sample : non-inproved flour type 650 , X - xylanase : 3g/100 kg of flour
H – hemicellulase : 5g/100 kg of flour, P - mixture of hemicellulase and xylanase

Fig. 4: Bread samples images

We may notice from the following table that hemicellulase and xylanase addition decreases the viscosity P and increases extensibility L, as

compared to the blank sample. At the same time it increases hydration capacity, A, dough making time, B, its softening and stickiness according to determination of organoleptic properties.

Table 1: Determination results

No	Quality index	Blank sample	20 ppm xylanase	30 ppm xylanase	50 ppm HEMI C	30 ppm Xyl + 50 ppm HEMI C
1	P, mm H2O	91	96	84	90	87
2	L, mm	49	55	65	66	72
3	W, 10E – 4J	174	204	202	216	225
4	P / L	1,86	1,75	1,29	1,36	1,21
5	A, %	58,5	59,8	60,5	59,8	60,8
6	B, min.	1' 50"	1' 45"	2'	1' 40"	1' 45"
7	CD, min.	3'	3' 10"	3' 25"	4'	3' 15"
8	E, ub	85	90	90	90	108
9	V,	47	46	47	47	48

The figure 5 shows the results of physical-chemical analyses namely the volume, porosity and crumb elasticity are improved by hemicellulase addition.

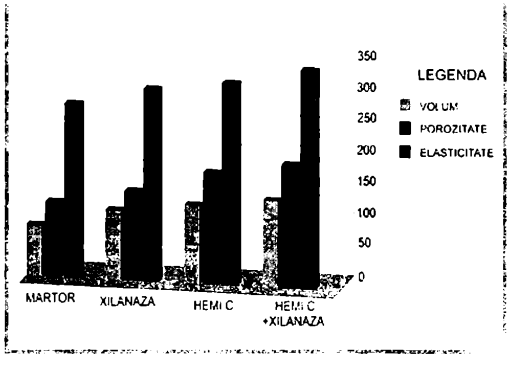


Fig. 5: Evolution of bread characteristics

The mixture sample had the best results of all samples analyzed: significant increase of volume, porosity and elasticity.

Conclusions

The action of fungic hemicellulase and xylanase in dough determines a decrease of its resistance as well as of the energy consumed for its volume increase, these changes led to amplification of system capacity to retain the gases resulted from fermentation.

In all cases, the hemicelluloses used in proper doses increased the bread volume and improved the crumb structure. Bread with high quality crust and dough higher stability was obtained.

Hemicellulase and xylanase used in mixture have registered the best results ensuring high quality bread.

References

Bordei, D, Teodorescu,F, Toma, M,2000 Stiinta si tehnologia panificatiei, Editura Agir, Bucuresti.

Banu, C si altii, 2004 Importanta pentru panificatie a araboxilanilor si a enzimelor de degradare a acestora, Anuarul Asociatiei Specialistilor din Morarit si Panificatie, p. 127-137

Diaconescu, D, Moraru,C. 2003 Different action of exogenous hemicelulases in white bread and bran-enriched bread. Analele Univ. „Dunarea de Jos", Galati.

Enuta Iorga, Gh. Campeanu, Utilizarea enzimelor in panificatie, Universitate de Stiinte Agronomice si Medicina Veterinara, Bucuresti.

Hamer, R.J.1991, Ennymes in the baking tehnology. In: Enzymes in Food Processing. G. Tucker and L.F.J..Woods, eds Blackie and Son, Glasgow, Scotland, U.K. pg 16-193