

Testing of some enzymatic mixtures used for the improvement of wheat flours

Received for publication, September 3, 2004

Accepted October 9, 2004

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Abstract

The amelioration of the wheat flours is strictly necessary for the improvement of its technological characteristics. The experiment consisted in the amelioration of a sample of wheat flour type 650, by using a mixture of five enzymes (two hemicellulases, one of them with xylanasic activity, amylase, lipase and glucoxydase) and ascorbic acid, prepared in six variants.

Following the baking tests, the quality indicators of bread (volume, porosity, elasticity) were evaluated to all the six experimental variants. The best results, especially concerning the increasing of bread volume, were obtained at the mixture with low ascorbic acid and glucooxydase content, but with well-balanced xylanase-hemicellulase content. Thus, the best quantitative ratio xylanase/hemicellulase found, was 0.73.

The best results obtained were confirmed by retesting the optimal variants of improvement mixture, on a sample of wheat flour from another origin.

The total removal of the xylanase from the improvement mixture caused a low decreasing in volume and porosity of bread. However, the quality indicators were higher comparative to the control sample.

Keywords: improvement, wheat flours, enzymes, quality indicators, volume, porosity, elasticity, baking test etc.

Introduction

The technological potential of the flours obtained from Romanian wheat need to be increased by using diversified improvement additives. In bakery are used enzymatic or non enzymatic improvement additives. The purposes of the enzymes addition in wheat flour are: the increasing of bread volume (α -amylases, lipases, hemicellulases, proteases), the improvement of crumbs structure (hemicellulases, proteases, lipases, α -amylases), the delay of the guarantee term of bakery products (α -amylases, hemicellulases), as well as the improvement of flavour and crust colour (α -amylases, proteases, lipoxygenases, lipases, glucooxydases, hemicellulases). [2,4]

The use of the hemicellulasic conditioner studied in the current research, leads to a better knead tolerance of the dough, to an improvement of baking behaviour, to the increasing of the bread volume, to the improvement of crumbs structure and to slowing down the speed of bread rustiness. [6,4]

Ascorbic acid also used in the experimented mixtures, in the presence of ascorbatoxydase and oxygen, oxidized the thiolic groups of the proteins, leading to an increasing of resistance and extensibility of gluten. The adjustment of oxygen amount, available for ascorbic acid is usually made by addition of glucooxydase. Besides, producing peroxide of hydrogen, glucooxydase may have an independent effect, concerning the increasing of resistance and elasticity of glutenic proteins. Generally, the improvement recipes

utilized in this experiment, combined the effects of hemicellulasic activity with those of ascorbic acid and glucozoydase. [1]

The objectives of the current research were:

1. Improving the bakery qualities of some wheat flour samples, by using enzymatic mixtures (amylase, lipase, glucozoydase, different types of hemicellulase), in order to prove that these can successfully replace other kind of non enzymatic mixtures;
2. Establishing the optimal quantities of added enzymes, respectively some types of hemicellulases, necessary for obtaining a high quality product;
3. Establishing the optimal ratio between the two kinds of hemicellulases, concomitantly utilized for the improvement of wheat flours;
4. Verifying the effect of the variants of the mixture supposed to be optimal, on other wheat flours, similar as extraction degree, but different as origin.

The baking test was considered to be the most sensible evaluation method of the enzymatic amelioration effect on the improvement of bakery qualities of the wheat flour, so that it was utilized in this experiment.

Materials and Methods

The experiment consisted in comparison of technological characteristics of some unimproved (the control sample) and improved (with different mixtures of enzymes and ascorbic acid) wheat flours, by evaluating the quality indicators of the obtained bread. The results of the baking tests were correlated from the quantitative and qualitative point of view, with the additives utilized. [3,7]

The experiment was developed in two stages. **In the first stage**, a commercial flour type 650 purchased from S.C. Moara Loulis S.A. was used as control. This flour was improved by adding five variants of mixtures, prepared with enzymes and ascorbic acid, in different ratio. We have used enzymatic conditioners from DSM Bakery Ingredients (table 1). Ascorbic acid was purchased from Roche Vitamins Limited.

Table 1. The used enzymatic conditioners

Commercial designation	Enzyme
Bakezyme BXP 5000	Bacterial hemicellulase (xylanase)
Bakezyme HSP 6000	Fungal hemicellulase
Bakezyme GO 1500	Fungal glucozoydase
Bakezyme P 180	Fungal α – amylase
Bakezyme PH 800	Fungal lypase and phospholypase

Table 2 shows the quantities of enzymatic conditioners and ascorbic acid (six different recipes), used for the improvement of 650 wheat flour. One can notice that all the mixtures contain the same quantity of amylase (Bakezyme P 180) and lipase (Bakezyme PH 800), so that is emphasized the effect of the two different kinds of hemicellulases (Bakezyme BXP 5000 and Bakezyme HSP 6000). We mention that quantitatively speaking, the enzymes were used within the limits recommended by the producers (in ppm).

Table 2. The experimental variants of improvement mixtures

Variants	I	II	III	IV	V	VI
Bakezyme BXP 5000 (ppm)	0	25	100	55	35	35
Bakezyme HSP 6000 (ppm)	0	80	0	40	55	75
Bakezyme GO 1500 (ppm)	45	80	45	45	45	45
Bakezyme P 180 (ppm)	20	20	20	20	20	20
Bakezyme PH 800 (ppm)	25	25	25	25	25	25
Acid ascorbic (ppm)	50	70	50	50	50	50

The enzymes were added to the baking formula during the mixing stage. For the procurement of bread it was used the method described by the Romanian Standard. The results of baking test were interpreted related to the organoleptic aspect of final product and based on the analysis methods described by the Romanian Standard concerning bread, bakery goods and baking specialties. Thereby, we evaluated: the volume, the porosity and the elasticity of bread. Concerning bread volume evaluation, we used Fernet apparatus and the analysis methods presented in the same Standard.

In the second stage of the experiment, the experimental variants of improvement mixtures that registered the best backing tests results, were retested on wheat flour type 650 obtained from another provider, namely S.C. Boromir S.A. The baking tests were also made for these last variants.

Results and Discussion

The obtained results of the baking tests, made on the control sample, as well as on the wheat flour improved with the enzymatic mixtures in six variants, are synthesized in table 3.

Table 3. The quality parameters of bread obtained in the baking tests

Variants	Volume (cm ³ /100g)	Porosity (%)	Elasticity (%)	Observations
Control Sample	500	83.6	96	firm dough
I	485	83.4	96	sticky dough
II	490	84	96	firm dough
III	495	83.8	95	hard, sticky dough
IV	550	84.4	96	hard, sticky dough
V	520	83.4	95	hard, sticky, smooth dough
VI	522	83.7	96	hard, sticky, smooth dough

A comparison between the bread volumes, obtained in the baking tests using the six variants of wheat flour, is presented in figure 1.

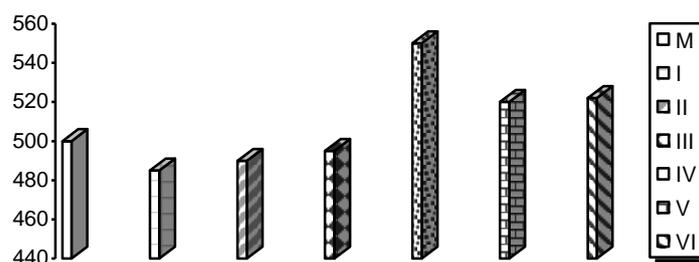


Figure 1. The improvement influence of the flour on bread volume

One notice that the best result, concerning the parameter bread volume, was registered in variant IV, which reveals an increasing of 10 %, comparative to the control sample. Significant improvements of this quality parameter where also noticed in variant V (4 %) and VI (4.5 %). In the other variants, the decreasing of bread volume in comparison with the control, was noticed as follows: with 3 % in variant I, which doesn't contain hemicellulasic conditioners; with 2 % in variant II, which contains a high quantity of hemicellulase (80 ppm), to the detriment of xylanase; with 1 % in variant III, which contains only xylanase (100 ppm) and no hemicellulase (Bakezyme HSP 6000).

One observes that, the excessive utilization of one of the two types of hemicellulases in the improvement formula, affects the bread quality. Therefore, the combining in well-balanced proportions of these enzymes is advisable, as the results obtained in variants IV, V and VI proved.

In variant II, the reducing of bread volume was determined by the increasing of ascorbic acid and glucosoydase quantity in the baking formula. This effect was probably due to the supplementary oxidizing of the thiolic groups of the proteins in the dough, followed by an increasing of dough resistance.

The most important increasing of bread porosity (figure 2) was registered also in variant IV.

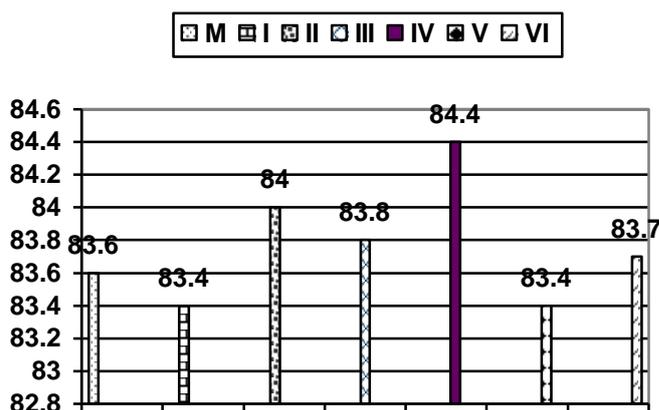


Figure 2. The improvement influence of the flour on bread porosity

The differences between the variants are low concerning bread elasticity. Still, the variants III and V registered a small decreasing, comparative to the control sample (figure 3).

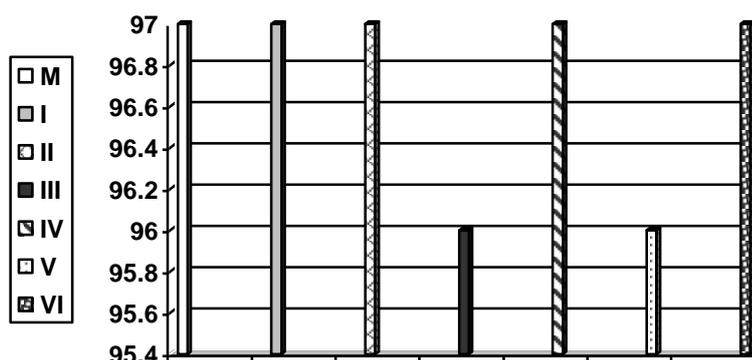


Figure 3. The improvement influence of the flour on bread elasticity

The best results in the baking tests were obtained in variants IV, V and VI, characterized by different ratio between the quantities of hemicellulase (Bakezyme HSP 6000) and xylanase (Bakezyme BXP 5000) in the flour, while the same level of ascorbic acid, amylase, glucosoydase and lipase was kept unchanged.

The quantitative ratio hemicellulase/xylanase from the improvement formula influenced decisively the quality indicators of bread, at least in the respects of volume and porosity.

In figure 4 one notice that the values of these quality indicators are higher when the hemicellulase/xylanase ratio is 0.73 (variant IV). As the added quantity of hemicellulase increases, the bread volume and porosity decrease, till the ratio hemicellulase/xylanase reach the value 1.57 (variant V).

At the higher values of this ratio, the bread volume remains relatively constant till value 2.14 of the ratio (variant VI), then continuously decreased till 3.25 (variant II). The bread porosity decreased as the hemicellulase/xylanase ratio increased between 0.73-1.57 (from variant IV to V), then the porosity increased as the hemicellulase/xylanase ratio increased (variants VI and II).

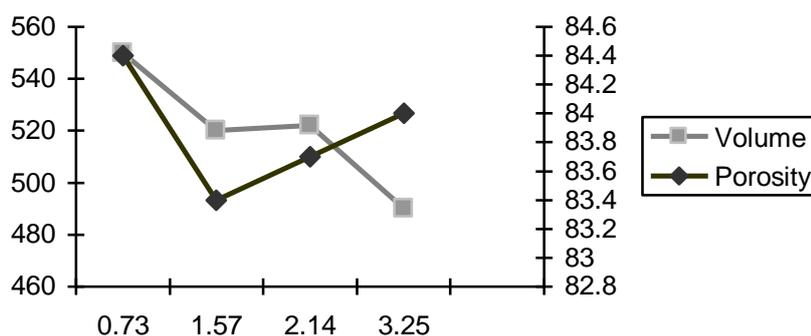


Figure 4. The influence of the hemicellulase/xylanase ratio on the quality of the bread

Figure 5 shows the aspect of bread resulted from the baking tests, concerning the wheat flour ameliorated in the worst (I) and in the best variants (IV, V, VI) vs. control sample.

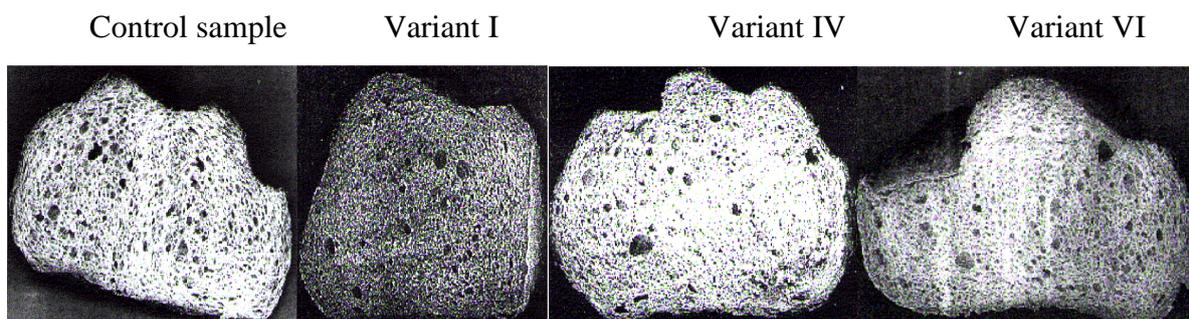


Figure 5. The aspect of bread resulted from the baking tests, in the first stage of the experiment

The variant IV, considered the best, was retested in the same formula on another sample of wheat flour type 650, with a different origin. Also, the variant VI was retested, modified (VI*) by removal of the xylanase (preparate Bakezyme BXP 5000). The results are presented in table 4 and figure 6.

Table 4. The quality parameters of the bread in variants IV and VI* (modified) retested on other sample of flour

Variant	Dough aspect	Volume (cm ³ /100g)	Porosity (%)	Elasticity (%)	Bread aspect
M	hard, sticky, short structure	573	87.1	95	golden crust, hardly pale,
IV	extensible, consistent, hard sticky	590	88	95	very good taste and colour
VI* (without xylanase)	hard sticky	580	86.1	95	very good taste and colour

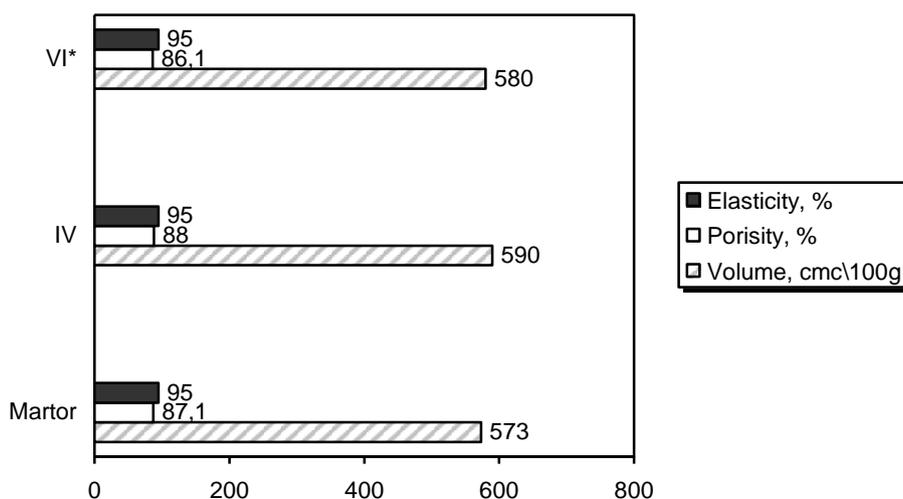


Figure 6. The quality parameters of bread obtained by retesting the improved formula on other sample of flour

The absence of xylanase from the enzyme mixture in variant VI* modified, led to a low decreasing of bread volume and porosity in comparison to variant IV, which contains this enzyme. However, the quality parameters of the bread, obtained from a sample of the improved flour in variant VI*, were superior to those registered with the bread obtained from the control sample, even in absence of the xylanase. The bread elasticity did not show significant variation in none of the analyzed cases.

Figure 7 shows the aspect of bread resulted from the baking tests, concerning the wheat flour (type 650, different origin) ameliorated in the second stage of the experiment (variant IV retested, variant VI* modified) vs. control sample.

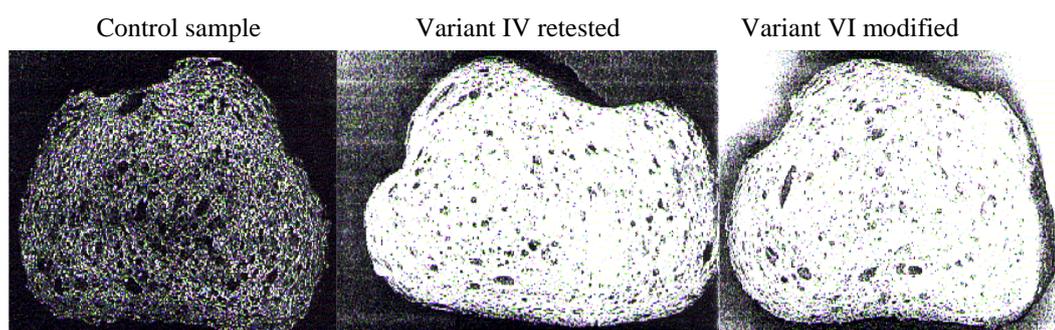


Figure 7. The aspect of bread resulted from the baking tests, in the second stage of the experiment

Conclusions

1. The best results concerning the increasing of bread volume were noticed in variants IV, V and VI, which contain well-balanced quantities of enzymatic conditioners Bakezyme BXP 5000 (xylanase) and Bakezyme HSP 6000 (hemicellulase), while the quantities of amylase, lipase, glucoxydase and ascorbic acid were maintained constant;
2. The hemicellulase/xylanase ratio has a major influence on the characteristics of bread volume and porosity;
3. The most efficient improvement hemicellulase/xylanase ratio registered a value of 0.73 (variant IV);
4. The synergistic influence of the combination hemicellulase/xylanase was kept also in the case of retesting on other flour sample;
5. The absence of xylanase in the enzymatic formula (variant VI*) did not significantly influence the value of bread elasticity, but affected the quality in the respects of bread volume and porosity, compared to the variant of complete formula;
6. The utilization of the improvement formula, that contains xylanase and hemicellulase, determined the modification of reological properties of the dough, which became more sticky (variants I, III, IV, V and VI). The increasing of the quantity of ascorbic acid and glucoxydase in the improvement formula, determined the dough to become less sticky (variant II);
7. The increased quantity of ascorbic acid and glucoxydase in the improvement formula (variant II) determined a depreciation of the porosity and volume parameters, comparative with the other variants, which contain lower quantities of these two additives.

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