The Influence of Xylanase Supplementation on Dough Rheology Concerning its Consistograph Parameters

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Abstract
In this study we determined the influence of xylanase supplementation on dough rheology concerning its consistograph parameters: maximum pressure (Pr max), (mb) and water absorption (Wa), %. The consistograph analyses were conducted at constant hydration and consistency of 500UF. Determinations were made on 4 types of flour and optimal enzyme dosages were determined. Then we added the optimal enzyme dose for each type of flour as follows: F1, F2, F3, F4: P1-8100U.FXU/100kg flour, P2-16200U.FXU/100kg flour, P3-24300U.FXU/100kg flour. Fungal xylanase used in these concentrations led to the improvement of bread quality properties: finer texture of the crumb, extending freshness of bread, improving the colour and flavour, improving the slicing ability.

Keywords: bread, xylanase, quality parameter.

1. Introduction

Bread is a basic food obtained by baking, steaming or roasting dough. The dough consists of wheat flour, yeast, which is then let to grow, after which it is baked in the oven [2,3]. Because of the high gluten level which confers the dough a sponge-like, elastic consistence, wheat is the most commonly used cereal for bread, but other cereals such as rye, corn or oat, can be used in combination with wheat flour. The minimal ingredients are flour and a yeasting agent such as yeast [4,8,5].

In the prospect of diversifying the pastry products, new sortiments appeared on the romanian market, which, allthough not traditional, have esatblished themselves through nutritive quality and high level of digestibility. Among these is the bread with supplement of xylanase.

In the present paper we determined the influence of supplement of xylanase on the rheology of dough concearning its constitograph parameters: maximum pressure (Pr max), (mb) and water absorption (Wa), %. The analysis on the Chopin consistograph were made for constant hydration of 500 UF. Determinations were made on 4 types of flour and optimal dosages were found for each enzyme, after which we prepared the optimal dosage of the enzymes in the compund for flour F1, F2, F3, F4: P1-8100U.FXU/100kg flour, P2-16200U.FXU/100kg flour,P3-24300U.FXU/100kg flour.

2. Materials and methods

We used 4 types of flour as control samples, with the following features: Yeast – Pakmaya (commerce). Salt – extrafine grocery salt (commerce). Water – drinking water from the network. Enzyme: Belpan XILA L – a fungaous standardized xylanase of microorganical origin, obtained by immersed fermentation of an A*spergillus* strain [6].

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Table 1. Flour features

Characteristic	F1	F2	F3	F4
Humidity, %	14.60	13.77	14.08	14.42
Ashes, %	0.64	0.48	0.55	0.38
Protein level, %	13.25	13.44	13.37	10.60
Moist gluten, %	27.5	28.5	27.6	24.85
Deformation of the moist gluten, mm	13	5.5	4.5	5
Sedimentation index- Zeleny,ml	48	37	44	36
Acidity, %	2.5	2.6	2.4	2.3
Gluten index,%	56.54	78.51	71.92	75.04
Falling Number:				
-Drop index	451	394	296	270
Alveograph:				
-Energy W*10^{-4}J	104	185	108	223
-Maximum pressure (P), mm	72	81	69	101
-Extensibility (L), mm	46	74	50	65
-P/L ratio	1.58	1.09	1.39	1.55
-Elasticity index (Ie),%	27.4	44.6	30.7	48

The enzyme contains pentosanase, endo and exo-xylanase, hemicelullase, which promote the hydrolysis of pentosans turning the insoluble pentosans into soluble ones, thus increasing the elasticity module of the dough with an enzyme activity of 2700 FXU/g FXU – fungal xylanase units. Then we determined the enzyme as follows: we added 1 g enzyme to 99 g flour and mixed 20 minutes. The outer limits for using the enzymes were determined through tries for each one, obtaining the optimum dosage. Enzyme dosage was necessary because the enzyme quantity for the determination was very small.

Four samples were prepared, one being the control without the enzyme and 3 with following mixture dosages: for flour F1, F2, F3, F4: P1-8100U.FXU/100kg flour, P2-16200U.FXU/100 kg flour, P3-24300U.FXU/100kg flour.

We obtained the dough through direct process [1] following this basic procedure: 675 g flour, 13.5 g yeast, 13.5 g salt 365 g water. The yeast was mixed with 50 ml water, the salt was solved in 50 ml water, the enzyme was added in various proportions, according to the flour quantity.

Operational program: slow kneading 12 minutes in a laboratory mixer; fast kneading 4 minutes, fermentation 20 minutes; 25-30 °C re-kneading 20 s; manual distribution – 1000 g; manual rounding; pre-yeasting – 20 minutes (rest). In order to appreciate the quality of the dough, we determined the following parameters on the consistograph: maximum pressure (Pr max) and water absorption (Wa)%.

3. Results and discussion

The influence of xylanase supplementation on the maximal pressure of dough is presented in Table 2 and Figure 1.

Maximum pressure exerted by the dough is depending on dough consistency. By adding xylanase, we recorded a decrease in the maximum pressure in F1 and F2 flours for all D1, D2 and D3 doses.

Table 2. The influence of supplement of xylanase on the maximal pressure of dough

Flour sample	Maximum pressure (Pr max), (mb) at an supplement of xylanase (U. FXU /100 kg flour) of:			
	M	P1-8.100	P2-16.200	P3-24.300
F1	2807	2501	2590	2423
F2	3045	2772	2872	2815
F3	3072	2886	3102	2976
F4	3117	3261	3320	3068

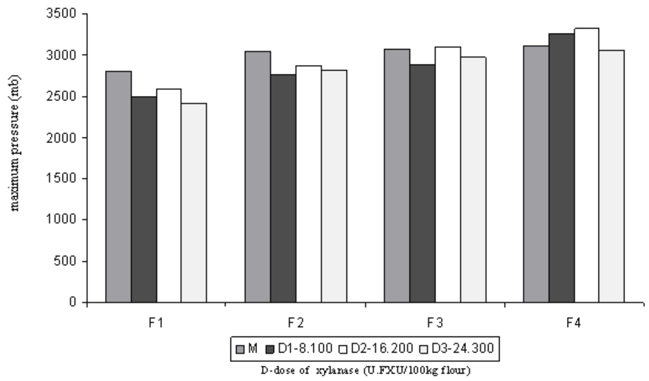

Figure 1. The influence of xylanase supplementation on the maximum pressure of the dough

For F3 flour, for the first D1 dose a decrease of maximum pressure is recorded compared to the control pressure sample, for the D2 dose an increase of pressure relative to the control sample is recorded and for the D3 dose maximum pressure decreases.

In the case of F4 flour we recorded an increase of maximum pressure relative to the control sample, for D1 and D2 and D3 doses, the maximum pressure decreases.

In conclusion, for the flours with higher content of wet gluten, the addition of enzyme lowers the consistency of dough, as a result of hydrolysis reactions of pentosans and in the case of flours with lower quantities of gluten, increase the consistency of dough.

The influence of the associated supplement of α-amylase and xylanase on the water quantity absorbed by the flour is presented in Table 3 and Figure 2.

Table 3. The influence of xylanase supplementation e on the water absorption

Flour sample	Absorbed water (Wa)% at an associated supplement of xylanase (U. FXU /100 kg flour) of:			
	M	P1-8.100	P2-16.200	P3-24.300
F1	56.4	55	55.4	54.7
F2	57.4	56.2	56.7	56.4
F3	57.6	56.7	57.7	57.1
F4	57.8	58.4	58.7	57.6

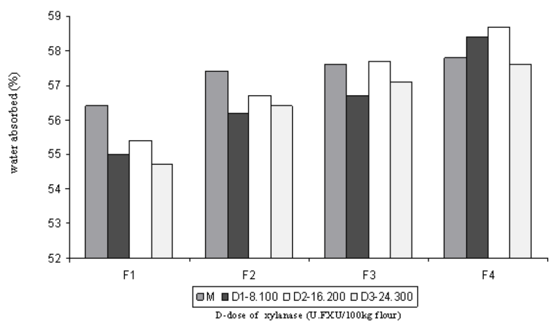

Figure 2. Influence of xylanase supplementation on the quantity of water absorbed by the flour

The water absorption (which represents the water volume necessary to be added to achieve a standard dough consistency) records a decrease for F1, F2, F3 flours compared with the control samples at all dosages as a result of hydrolysis reactions of pentosans.

In the case of F4 flour a growing of absorbed water is recorded comparing to the control sample for xylanase D1 and D2 dosages and remains practically at the control level for D3.
The variations on the amount of absorbed water are lower as compared with the control sample. Decreased water absorbed from kneading dough is explained through the hydrolysis of a part of flour pentosans on the xylanase added presence, which reduces the capacity to absorb water, knowing the fact that the pentosans, despite their presence in small quantities in flour, have a very important role in the water absorption in dough.

4. Conclusions

For all four flours the maximum pressure decreases as a result of the synergic action of the two associated enzymes which produce a slight liquefaction of the dough. The experimental data show a decrease of the quantity of water absorbed by the flour for all studied flours in comparison with the water absorbed by the witness sample in different percentages: for F1 the decrease of absorbed water is between 2% for P3, 3% for P1 and 4% for P2. For F2 the decrease of the water absorbed in comparison with the control sample is 1% for P1, 2% for P3 and 6% for P2. For F3 the decrease of absorbed water is 3% for P1, 0.08% for P2 and 1% for P3. For F4 the decrease of the percentage of absorbed water in comparison with the water absorbed by the witness sample is constant (1%) for all samples.

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