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Study on the improvement of hypoenzymatic wheat flour

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Abstract

Due to the changes that occurred in the baking industry and the growing demand for natural products, "clean label" enzymes have gained more importance in the bread-making recipes in replacing additives such as oxidants or emulsifiers. The use of amylase from cereal, fungal or bacterial sources is known for many years. However, it is well acknowledged that cereal amylases, such as β-amylase from soy flour or malt α-amylase and fungal ones have a limited effect against aging, whereas bacterial thermostable α-amylase has adverse effect on the quality of the finished products, leading to gummy and sticky crumb. Commercial amylases used in the baking industry are, in general, α-amylase, which hydrolyzes specifically, α-1,4-glycosidic linkages of amylose and amylopectin molecules in the starch. Based on these considerations, the aim of this study was to study the effect of lack of α- amylase in wheat flour used in the process of bread making. In this context, we intended to study the rheological behaviour of dough, together with technological peculiarities during the processing of flour when using three types of enzymes, Belpan MOPA, Belpan AS and Belpan G as additives for bakery. The influence of exogenous α-amylases added in variable doses added to dough preparation has been assessed based on the changes of dough rheological parameters and the experiments aimed to determine the baking flour potential which was found to be weak in terms of the index fall. This practical study showed that a series of changes in the chemical composition, reflected in the final product – bread, are due to the action of α-amylase on substrate. These changes could generate differentiated functional properties and could print different physicochemical properties of dough and bread

Keywords: enzymes, α-amylase, dough, rheological parameters

1. Introduction

Bread is one of the most common traditional foods all over the world with relatively low cost. Nowadays, bread has made the junction with biotechnology, enzymes being the common denominator. Enzymes such as malt and fungal α-amylase have been used in bread making even for tens of years. Due to the changes that happened in bread making as well as to the high demand of natural products, enzymes have gained an important role in bread recipes.

The latest discoveries from biotechnologies have led to new enzymatic preparations available for the bread manufacture industry [1] .

Many food producers consider the use of enzymes as new and innovating. This fact is true for many categories of food products, the bread manufacture industry has a long history of studying and using enzymes. Indeed, there are references about the use of enzymes in bread products which are over 100 years old [2].

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In the modern society the consumer's needs have changed: preference for breads with a low level of artificial additives, low fat content, high fiber content, briefly for wholesome bread. In some European Community countries wholesome wheat bread put out from the market the traditional white bread. At present, the bread manufacture industry is facing the need to produce a variety of fresh high quality products with a limited content of "process chemical helpers" (potassium bromate as well as polyethylensorbates have been banned as improvers in a few countries) [3].

In other words, the bread manufacture industry needs natural additives, by specifying the differences: the miller needs correction agents whereas the food processor "process helpers". The miller has to provide the food processor with high quality flour, thus enabling the latter one to make a variety of bakery products which should comply with the quality standards.

For decades and decades, enzymes and emulsifiers have been used as agents against aging in bread manufacture. Due to the changes that happened in this field and to high demand for more natural and "clean label" products, enzymes have gained greater importance in bread making recipes where they replace additives such as oxidants or emulsifiers [4]. The use of amylases from cereal, fungal or bacterial source has been acknowledged for many years. However, it is also acknowledged the fact that cereal amylases such as β-amylase in soy and malt flour or fungal α-amylase have a limited effect against aging, whereas bacterial thermostable α-amylase has adverse effect on the quality of the finished products, leading to gummy and sticky crumb [5]. Having in view these considerations, the effect of α-amylase lack in wheat flour used in the technological bread manufacture process was studied. Therefore, it were determined experimentally the characteristics of the flour lacking α-amylase, of bread added by exogenous α-amylase and the influence of this flour on the technological process of bread making and bakery products. It was also determined the extent to what different commercial mixes of α-amylase can be used as bakery improvers at industrial level.

The practical study demonstrates that due to the action of α-amylases on substrate there are changes in the chemical composition, reflected in the finished product – bread. These changes can generate functional differentiated properties and can provide doughs and bread with different physico-chemical properties. In this context, we intended to study the rheological behaviour of dough, together with the technological peculiarities during the processing of flour when using three types of enzymes, Belpan MOPA, Belpan AS and Belpan G as additives for bakery. The influence of exogenous α-amylases added in variable doses added to dough preparation has been assessed based on the changes of dough rheological parameters and the experiments aimed to determine the baking flour potential which was found to be weak in terms of the index fall.

2. Materials and method

650-type non-added white flour with good bakery potential but high falling number, over 400 seconds was used. This flour is representative qualitatively as regards the quality standards assessed by the annual reports of the Institute of Food Bio Resources, in terms of the quality of wheat crops for the years previously mentioned. As exogenous α-amylase sources, commercial enzymatic preparations of microbial nature from genetically non-modified cells such as Belpan AS (diastase malt flour and fungal amylase), Belpan MOPA (fat-extracted soy flour with enzymatic activity, diastase malt flour) and Belpan G (fungal amylase) were used.

The following raw materials were used as ingredients which are complying with the manufacture recipes to make the baking samples: bakery yeast, food salt, high falling number flour, over 400 seconds, enzymatic preparations in different proportions and of various types. The exogenous enzyme addition is required by the correction of this drawback, thus being able to establish the optimum proportions for each improver used, by determining the falling number of exogenous added flour and by bringing it to an optimum value. The results will be valorized in the bread making technological process. In this sense, 9 sets of samples, grouped in 3 categories depending on the type of the improvers used were studied. The doses of improvers used are shown in table 1.

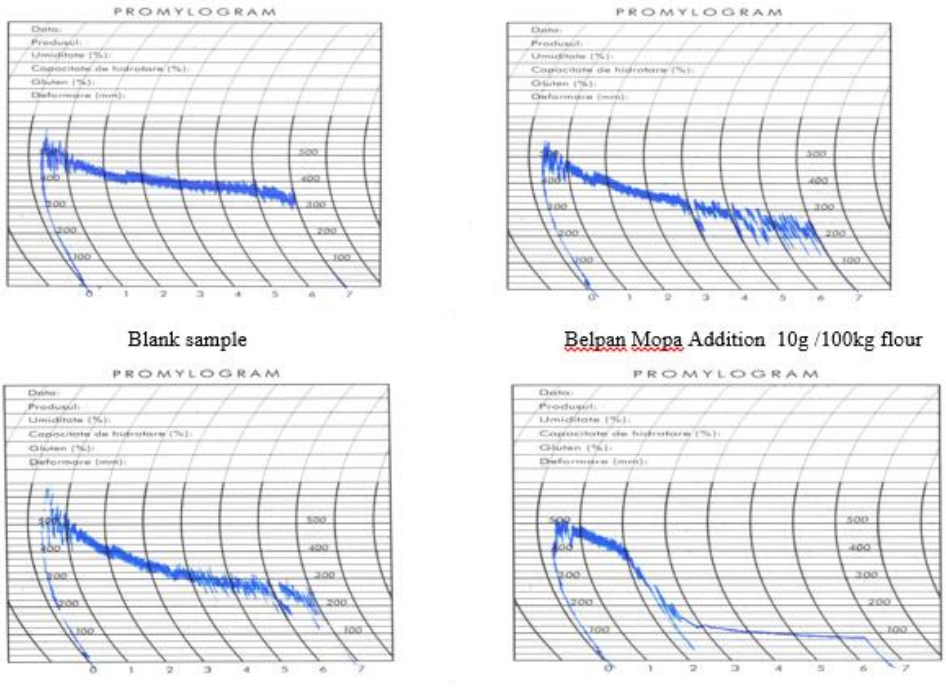
3. Results and Discussion

A few observations on the use of improvers directly in flour can be made: the optimum quantity of bakery improvers can be chosen so that a desiderate of 250-300 seconds to be reached. When choosing the quantity of improvers for practical samples, the economical yield of using the improvers, the ratio price/desired technological effect respectively, will be taken into consideration.

Dough rheological properties were assessed by means of the promylograph T 3, obtaining initially the blank promylogram (figure 1). For samples P1 – P3, the improver *Belpan MOPA* was used, following the effect of exogenous enzyme addition on dough rheology.

Table 1. Enzymatic treatment scheme of initial flour sample and variation of falling number

Sample No.	Code	Enzymatic formulation	Enzymatic formulation quantity g / 100 kg flour	*Initial falling number flour (sec)*	*Falling number after the addition of enzymatic improver*
1-1	P1	Belpan MOPA	100	*430*	*340*
1-2	P2	Belpan MOPA	150	*430*	*324*
1-3	P3	Belpan MOPA	400	*430*	*275*
2-1	P4	Belpan AS	100	*430*	*260*
2-2	P5	Belpan AS	150	*430*	*231*
2-3	P6	Belpan AS	200	*430*	*209*
3-1	P7	Belpan G	100	*430*	*279*
3-2	P8	Belpan G	150	*430*	*250*
3-3	P9	Belpan G	200	*430*	*240*



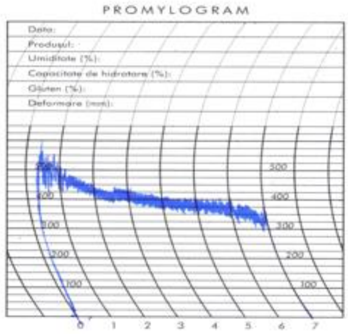
Blank sample

Belpan Mopa Addition 10g /100kg flour

Belpan Mopa Addition 150 /100kg flour

Belpan Mopa Addition 400g /100kg flour

Figure 1 Influence of Belpan MOPA addition on dough rheological properties



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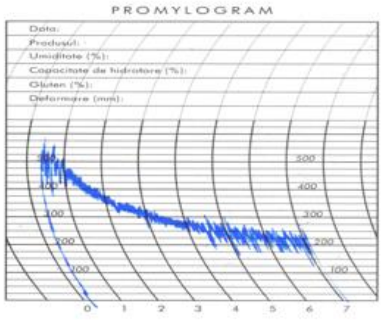
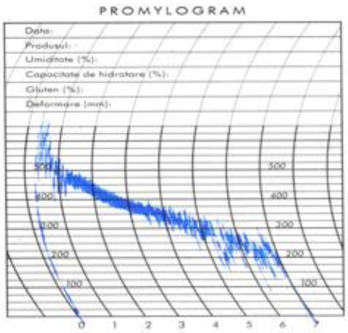
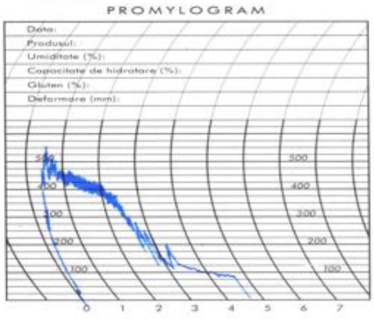


Belpan AS Addition 100g /100kg flour

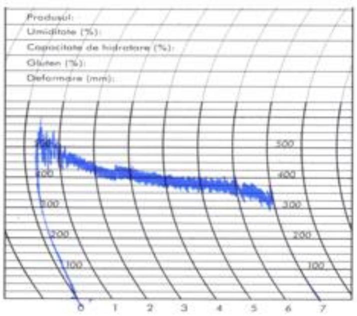


Belpan AS Addition 150g /100kg flour

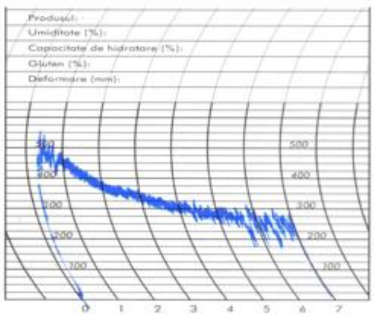


Belpan AS Addition 200g /100kg flour

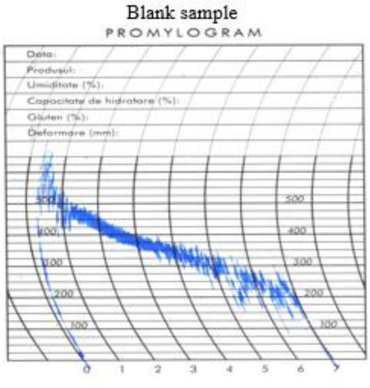
Figure 2. Influence of Belpan AS addition on dough rheological properties



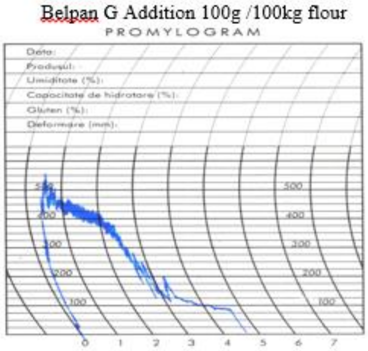
Blank sample



Belpan G Addition 100g /100kg flour



Belpan G Addition 150g /100kg flour



Belpan G Addition 200g /100kg flour

Figure 3. Influence of Belpan G addition on dough rheological properties

Table 2. Proportions and types of improvers used in the study

Nr.crt.	***Improver Type and quantities used***
1.	Sample no.2, code P2: Belpan Mopa, 150 g / 100 kg flour;
2	Sample no.4, code P4: Belpan AS, 100 g / 100 kg flour;
3	Sample no.6, code P6: Belpan G, 100 g / 100 kg flour;

Table 3. Centralizer assessment of baking samples' characteristics P1 – P3

Sample	**Determined Value**		
	Porosity (%)	**Elasticity (%)**	**Acidity (acidity grades/100g product)**
Blank	78,4%	96%	1,6
P1	82,9%	95%	1,8
P2	77,9%	95%	1,8
P3	75,8%	96%	2

For progressive additions of 100, 150 and 400 g/100 kg flour respectively the following interpretations can be made: the *curve width* of promylograms is maximum for the minimum improver dose, so good *elasticity* of dough is obtained by reduced doses. For additions higher than 150 g / 100 kg flour, the curve loses rapidly its *stability* which means deterioration of dough properties. The decision taken is not to use Belpan MOPA improver doses higher than150 g / 100 kg flour in the practice of bakery product manufacture. Curve falling is higher than 150, after the first three additions reaching over 250,

It can be seen that the deterioration of dough structure when adding over 100 g / 100 kg flour of Belpan AS improver, correlated with the falling number value, leads for the technological variant in bread manufacture to the choice of addition quantities of only 50, 100 g / 100 kg flour respectively.

The samples with maximum improver addition cannot be analyzed because of the fast "falling" time of dough.

For samples P7 – P9, *Belpan G* improver was used and the effect of exogenous enzyme addition on dough rheology was analyzed.

As regards the quantitative addition of Belpan G improver, it is obvious that the optimum dose is of 100 g/ 100 kg flour, since when using higher which leads to high softening degree. The processing time is also short 1 – 2 minutes. The quantity considered optimum to make determinations is P2 150 g improver / 100 kg flour.

For samples P4 – P6, the improver *Belpan AS* was used and the effect of exogenous enzyme addition on dough rheology was analyzed (figure 2).

The manufacture recipe used to obtain the finished product, white bread, is kept, including 650-type flour, with the same characteristics for all samples, water, yeast and salt, the type and quantity of improvers varying according to the table 2 and 3.

4. Conclusions

The aim of this study was to study the effect of lack of α- amylase in wheat flour used in the process of bread making. In this context, it were study the rheological behaviour of dough, together with technological peculiarities during the processing of flour when using three types of enzymes, Belpan MOPA, Belpan AS and Belpan G as additives for bakery. The influence of exogenous α-amylases added in variable doses added to dough preparation has been assessed based on the changes of dough rheological parameters and the experiments aimed to determine the baking flour potential which was found to be weak in terms of the index fall.

This practical study showed that a series of changes in the chemical composition, reflected in the final product – bread, are due to the action of α-amylase on substrate. These changes could generate differentiated functional properties and could print different physicochemical properties of dough and bread.

From sensory analysis I could make assessments about the appearance, shape and volume, color and appearance shell, core porosity, aroma, smell, taste, and the presence of foreign bodies. Samples have been welcomed and made up almost all sensory characteristics analyzed, except in volume, appearance and color sample 3. From the sensory point of view, sample 3, P3, can be considered eliminated, while samples 1, 2 are considered the best. Samples P2 and P3 have provided the most spectacular results and comparing them to the original analysis of the flour, the same types of enhancers had the best results in lowering the falling value, it can be concluded that the addition of exogenous enzyme preparations of the two Belpan respectively MOPA and Belpan AS optimal for studying technology.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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