THE INFLUENCE OF ALPHA-AMYLASE ON THE QUALITY OF BAKERY PRODUCTS

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Abstract

In order to determine the activity of α-amylase, for the experiment carried out on four types of flour, the falling-number Hagberg method was chosen. It is a viscosimetric method based on the autolytic degradation of starch in starch milk by the α-amylase. A high α-amylasic activity has as a result a reduced viscosity, which is measured taking into consideration the time in which a metallic rod falls through the starch gel.

Kez words: alpha-amylase, viscosity, starch hydrolisis, alpha-amylase activity

Rezumat

În scopul determinării activităţii α-amilazice, pentru experimentul efectuat pe patru tipuri de făină, s-a adoptat metoda Hagberg – Falling Number. Este o metodă vâscozimetrică bazată pe hidroliza amidonului sub acţiunea α-amilazei. O înaltă activitate amilazică are ca rezultat reducerea vâscozităţii, care este determinată luând în considerare timpul în care greutatea metalică străbate stratul de gel de amidon.

Résumé:

La méthode Hagberg- Falling Number a été utilisée pour déterminer l'activité α-amylase dans l'expérience effectuée sur quatre types de farine. C'est une méthode viscosimétrique basée sur l'hydrolise de l'amidon sous l'action de l' α-amylase. Une intense activité amylasique a comme résultats la diminution de la viscosité qui est déterminée e fonction du temps pendant lequel le poids métallique parcourt la couche de gel d'amidon.

Mots clef : aplpha-amylase, viscosité, hydrolise de l'amidon, activité de l'alpha-amylase

Introduction

Enzymes are regarded as functional ingredients for several reasons. For instance, enzymes are natural components of many ingredients used in bakery. If an enzyme is added, it is often destroyed by heat during the baking process. In both situations producers can attain the functional benefits of the enzymes while maintaining the image of 'clean product' for the final product.

Starting from the normal biochemical composition of wheat flours compared to the deficiencies which these can have, we can say that enzymes are the most important natural supplements which are involved in the obtaining of flours with the desired qualities, depending on the nature of their use.

There are endogenous enzymes, originating within the wheat flour, and exogenous enzymes, added in order to improve the performance of flours towards the desired aim.

All these enzymatic preparations or improvers which contain them, are designed exclusively for use within the technological process of obtaining bakery products. Especially in recent times, in milling and bakery industrial units which have had their grinding systems retechnologized, the improving of flour takes place right at the mills.

Endogenous enzymes contribute to the quality and characteristics of processing of grain raw materials. Often, endogenous enzymes weakened the processing properties of cereals, thus, except for malting, the handling of the issue consisted in the minimization of the effects that they had. However an increasingly better understanding of inducing, localization, specificity and their action mechanisms could make the control of the endogenous enzymes easier and improve their exploitation.

Among the causes which lead to a variation of the activity levels of the endogenous enzymes in grain raw materials, the following can be mentioned:

- variation in types
- environmental conditions during cultivation
- environment in which they are stored

- fractionalization by grinding
- processing conditions

Among the endogenous enzymes, the amylases play the most important part within the technological process of obtaining bakery products. The amylases become active once water is added during the technological process of dough preparation. Only the α-amylase is able to degrade the native starch, but the speed at which the process develops is rather low. If the activity of α-amylase is low, the quantity of degraded starch grains represent a limitating factor. In this situation, the addition of α-amylase improves the conditions of dough proofing. The production of fermenting glucides depends, therefore, on the quantity of existing enzymes and on the degradation state of the starch grain.

The dough proofing, and especially the resulting of carbon dioxide are related to the presence of these fermenting glucides, having a slower speed of transforming the maltose than the glucose. Dextrins also contribute to the peculiar taste of the crumb and the color and flavor of the crust, through caramelization reactions and Maillad reactions.

An excessive α-amylasic activity has important effects upon the water absorption capacity of the dough and upon the formation of the crumb. An excessive activity generates an overproduction of dextrins which leads further to a colored crumb with large pores and a very colored crust. A very high amylolytic activity has effects also on the rheological properties of dough.

The relation between the activity of the α- and β-amylase influence the bread quality.

In bakery, the addition of α-amylase is done for two reasons:

- to increase the amount of fermenting glucides in the dough
- to make the freshness of flour last longer

In the first situation, the addition is made when flours with a reduced state of starch grain degradation are turned into bread, these proving resistant to the attack of α-amylase and lacking active α-amylase or whose contents are insufficient to produce a normal amylolysis. These flours are characterized by a low maltose index, 1,5-2%, and a high falling number. They are flours with a low capacity of forming fermenting glucides and therefore of forming gases, called 'fire-resistant flours'. Basically α-amylase is added to healthy flours.

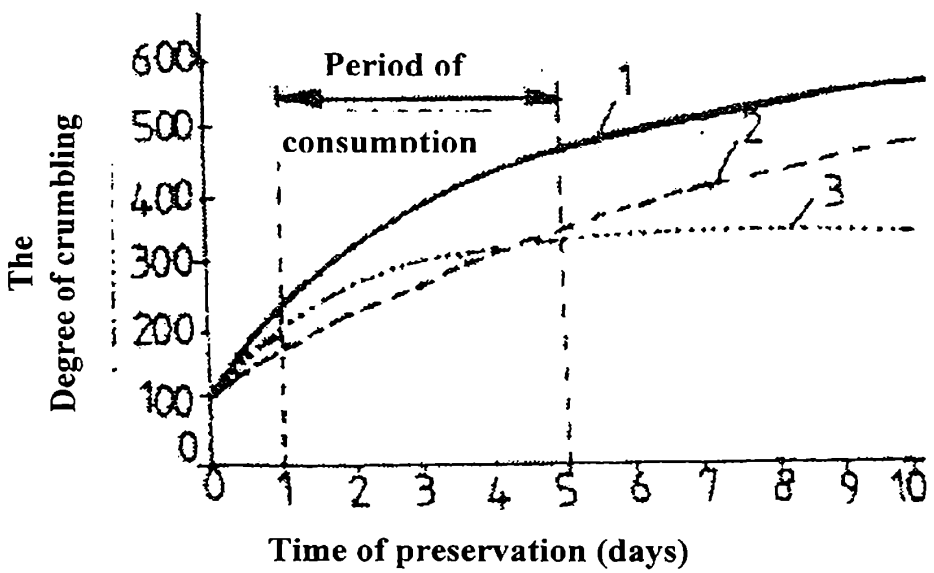

Figure 1: Effect of α-amylase addition on freshness of bread
1-witness; 2-fungic and grain; 3-bacterial

Figure 1 displays *crumblingness* vertically and the *storing period* (days) horizontally. The consumption time is represented from day 1 to day 5.

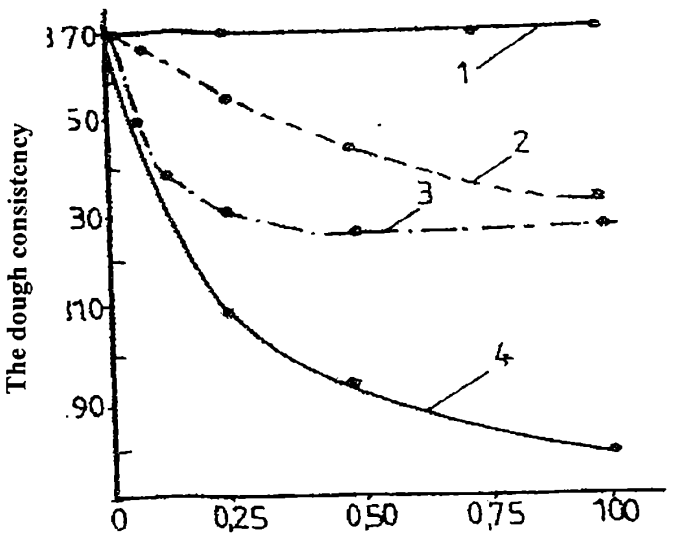

Figure 2: Effect of fungic α-amylase on dough consistency

Figure 2 displays *dough consistency* vertically, and the *relative concentration of the fungic enzymatic preparation* horizontally; 1-inactivated enzymatic extract; 2-extract with inactivated α-amylase, but with active protease; 3-extract with inactivated protease, but with active α-amylase; 4-extract with both enzymes, active protease and active amylase.

In bakery fungic amyloglucosidase is used, obtained from *Aspergillus niger* and *Aspergillus delemar*. They have a better thermic stability and it remains active for up to 70°C, which causes their effect on the bread volume to be higher.

The extent of the effects on bread quality depends on the origin of the enzymes and the quantity added. Small amounts of α-amylase of all origins generate increase in bread volume and improve the crumb elasticity and porosity structure, whereas in the case of large amounts, the increase in bread volume is accompanied by a reduction in the crumb elasticity and increase of its stickiness.

Amylases have also side effects, sometimes undesired in the dough. Their addition reduces the consistency of the dough and modifies its rheological properties. It raises its extensibility and reduces the dough resistance, and the more α-amylase is added, the more the specific consumed mechanical work is.

These effects are due to the fact that α-amylase preparations are accompanied by a certain proteolytic activity, generally a low one, which varies along with the ways of obtaining preparations and the type of preparation, but are also due to the fact that the maltose formed through hydrolysis of starch exerts on the gluten in the dough a dehydrating action, resulting in an increase of the free water quantity which reduces the consistency and worsens the rheological properties. The reduction of the elasticity state and of dough resistance, paralleled by an increased extensibility, is beneficent for strong flours, but is not desirable in the case of low quality flours.

In order to determine the activity of α-amylase, one can resort to several methods, and the reason for which the activity is determined will influence the choice of a certain method.

Experimental

For the experiment carried out on four types of flour, the falling-number Hagberg method was chosen. It is a viscosimetric method based on the autolytic degradation of starch in starch milk by the α-amylase. A high α-amylasic activity has as a result a reduced viscosity, which is measured taking into consideration the time in which a metallic rod falls through the starch gel. The method is used broadly, in order to measure the degree of the grain germination.

Determining the falling number is an empirical test based on the capacity of endogenous α-amylase of reducing the viscosity of flour suspensions treated in warmth. It is largely used in milling and baking industry in order to estimate the quality of the flour used for bread making. The falling number is reversely proportional to the α-amylasic activity of flour and the acceptable domain depends on the grain product.

For instance, in germinated wheat with a low falling number, dextrins formed through the action of α-amylase have as a result a sticky and gummy bread crumb. Grain germination before harvesting represents a process with influence on the milling and bakery industry.

Experimentally, at test IV which requested addition of improver (α-amylase), it is observed that the rheological properties did not improve qualitatively, but only quantitatively. The falling number decreased.

At the promylograph (the device with which the four types of flour were obtained), the maximum stability is 500, where it has to remain for a while. If it decreases immediately, then the rheological properties are weak and a soft, little fermented bread will result.

Following the checking through the baking test, an observation sheet of this was made and it contains:

- Dough characteristics
- Bread characteristics
- Output in bread volume, related to 100 grams flour

The data contained in the sheet of the baking test completes the other quality indices of wheat flour.

The following analyses are made to the four types of flour:

- Humidity
- Hydrating capacity
- Acidity
- Falling number
- Wet gluten
- Resistance, by means of the promylograph
- Deformation

Results and discussions

Table 1: The Baking Test

Type of Analysis	Test I	Test II	Test III	Test IV (with improver)
Humidity	12,88%	14,3%	14,8%	14,61%
Acidity	3,2%	3%	3%	3%
Hydrating capacity	58%	53%	53%	51%
Falling number	275s	308s	337s	306s
Gluten	18,2%	24%	23%	26%
Deformation	1,5 mm.	2 mm.	4 mm.	4 mm.

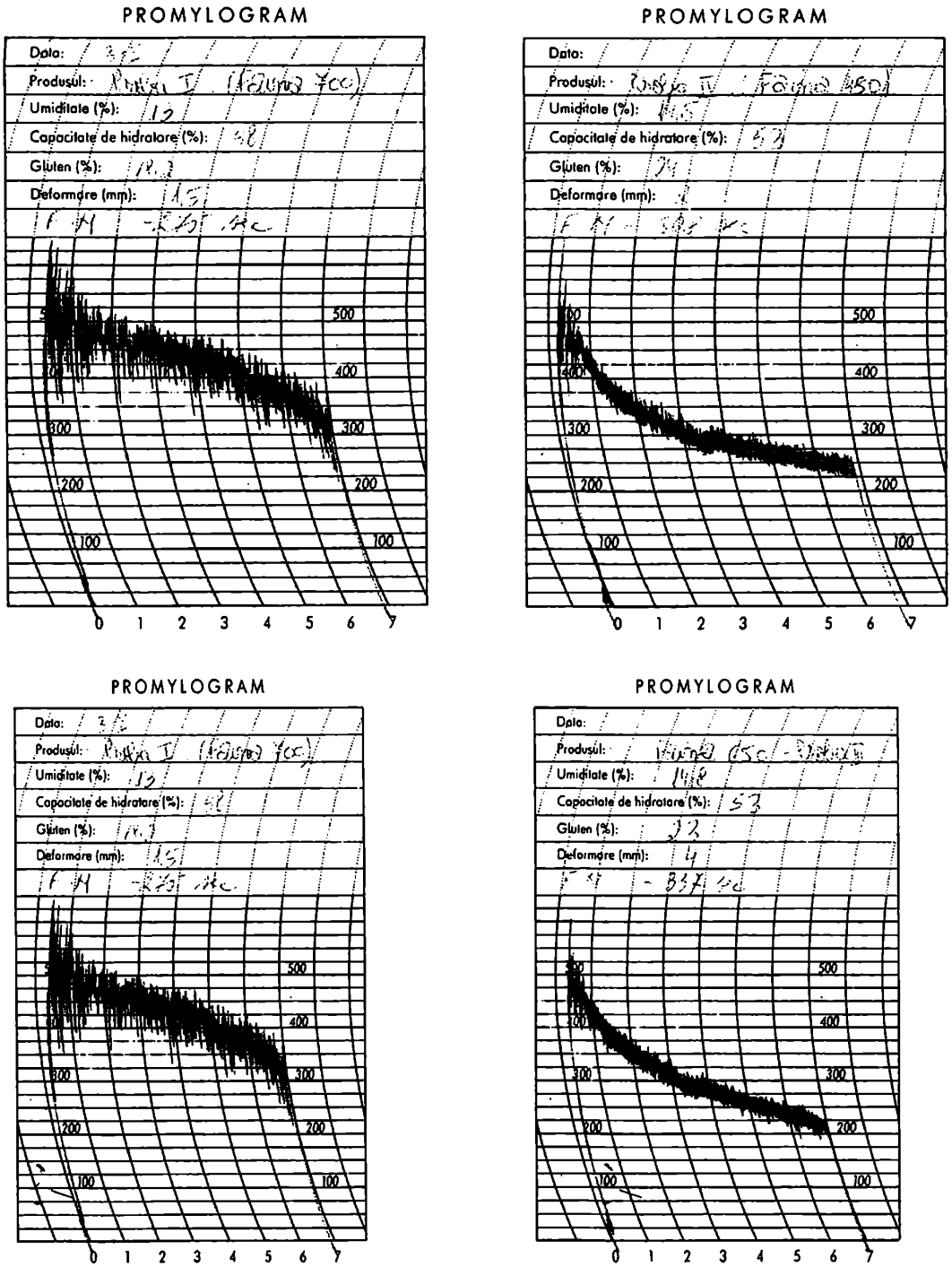

Figure 3: Data resulting from analyses, in regard to product, humidity, hydrating capacity, gluten, deformation

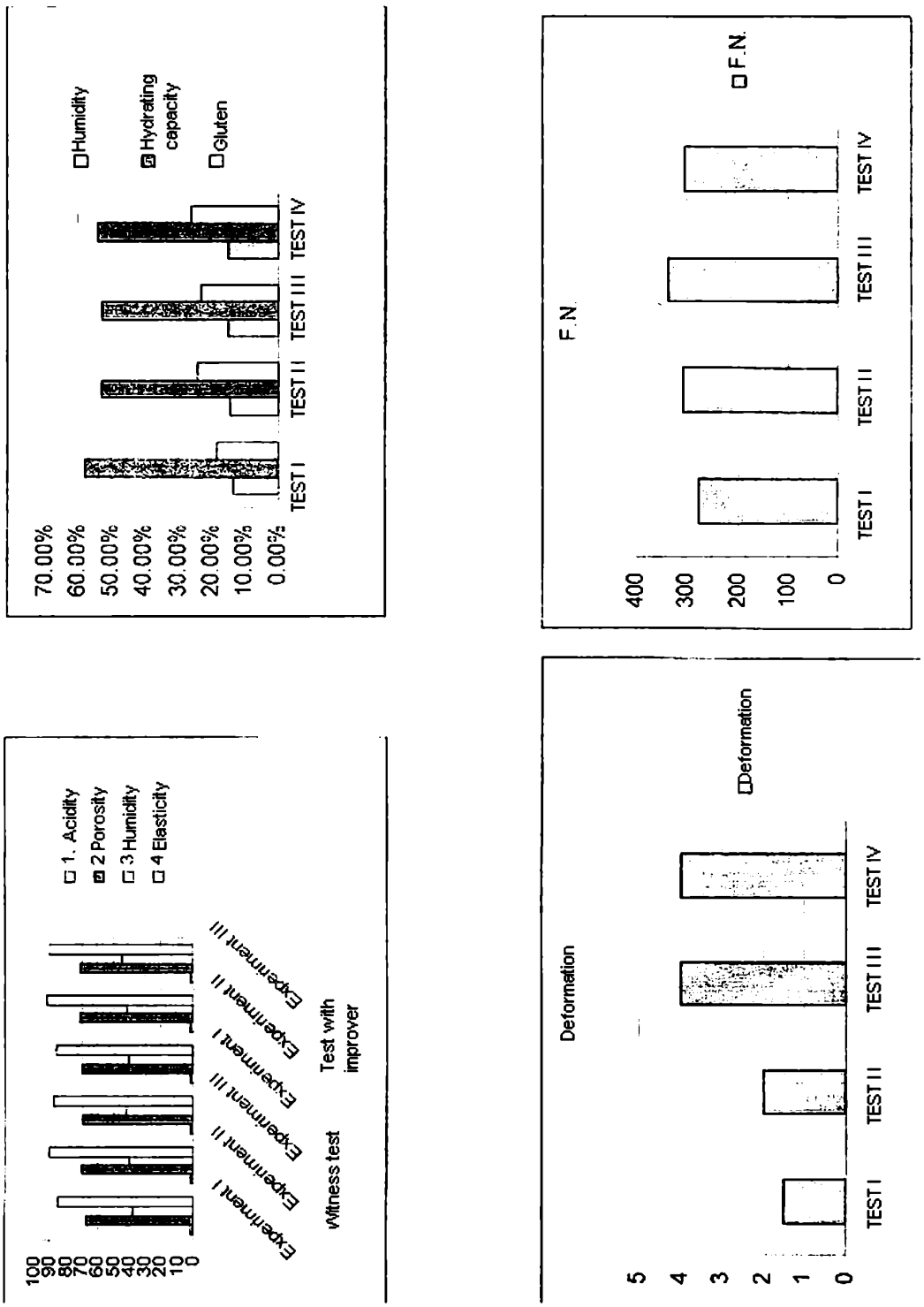

Figure 4. Baking Test

Conclusions

Supplementing flour with α-amylase intensifies amylolysis and thus increases the amount of fermenting glucides in dough by forming maltose, and these being capable of assuring the formation of gases throughout the technological process, including its final stages, and at a level which assures the obtaining of good quality bread. Small amounts of α-amylase of all origins have a positive effect on bread quality. But in large amounts, a raise of the volume is accompanied by a decrease in the crumb elasticity and an increase in its stickiness. Bacterial α-amylase leads to a sticky crumb when it is present in much smaller amounts than fungic and malt α-amylase, due to the large amount of dextrins accumulated in the crumb. In the case of bacterial α-amylase the increased content of dextrins in the crumb is due to the strong character of dextrinogen the enzyme presents, as well as due to its high thermostability which makes it action duration longer.

The use of exogenous enzymes as supplements is based on their ability to act on the flour ingredients.

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