JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2014, 20(2), 165-170

Journal of Agroalimentary Processes and Technologies

The influence of different types of amylase on the bread dough determined through alveographic method

Ioan David[*1], Alexandru Rinovetz[1], Gabriel Bujancă[1], Corina Mişcă[1], Marcel Danci[2], Corina Costescu[1]

[1]*Banat University of Agricultural Sciences and Veterinary Medicine, Faculty of Food Processing Technologies, Calea Aradului 199, Timişoara, Romania*
[2] *Banat University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture, Calea Aradului 199, Timişoara, Romania*

Received: 23 April 2014; Accepted: 24 May 2014

Abstract

This study presents the action of α, β and γ amylase on bread dough. The determination of the rheological characteristics of the dough is obtained by alveographic method. Addition of amylase enzymes in bakery products results in larger loaf volume, also the effect of amylase on the bread volume improvement results from redistribution of water from the gluten phase that gives the gluten more extensibility. In the presence of amylase the fermentable sugars from the dough increase, due to the hydrolysis of starch and thus ensure the formation of enough gas in the final dough fermentation and in the first part of the baking phase, which is necessary for obtaining a loose product, well-developed. The remaining unfermented sugars contribute to taste and flavor of the product and the crust color. The amylase enzyme are specialy used for obtaining bread with low fat content, low sintetic aditiv content and high fiber content. Also they are used for improving bakery products texture and flavore. The influence of amylase enzyme in the dough for bread can help evaluate and improve the insufficiently developed technology and the nutritive value of the products.

Keywords: bread, α-amylase,β-amylase,γ-amylase, alveograph method

1. Introduction

Enzymes applications have grown to be a common practice in the baking industry with advantage of being considered as natural additives. The exogenous enzymes are being used in the baking industry to improve dough-handling properties. The synthetically additives can be replaced with natural additives, as enzymes.

Addition of amylase in dough leads to: extension of freshness; the increase of the quantity of fermentation sugars, capable of forming gases during the entire period of the technical process inside the chains of amylopectine; the obtaining of finite products with a more pronounce color of crust, by increasing the quantity of fermentation sugar; the increase of carbon dioxide quantity. Amylase hydrolysis the α-1,4-glycosidic connections from the amylose and amylopectine structures and helps forming dextrine and maltose, witch in normal quantity have a favorable effect on dough, by increasing the capacity of water retention and improving the aspect of the middle part (soft, fluffy) [2]. The reduction of dough's consistency through the addition of amylases leads to the increasing of extensive character and decreasing of the resistance of dough. This behaviour is due to the fact that the maltose obtained by starch hydrolysis realizes a dehydrating action on gluten. The quantity of free water in dough will increase, reducing consistency.

Corresponding author: *e-mail:* neda_university@yahoo.com, Tel:+40-744 586 970

Amylase is deactivated in the oven, before the amidon's gelatinization. Therefore, this excludes the risk of excessive dextrinization that could live to a sticky content.

The enzyme addition of flours presents the advantage of constant quality flour, which does not modify the technological process, does not affect the health of consumers. The enzymes are used in small quantities and do not influence to a great extent the price of bread. They can be successfully used in the place of chemical additives for synthesis.

2. Materials and methods

2.1. Samples preparation. Materials used for the preparation of the dough samples are wheat flour 650, salt, water, yeast and amylase.

The following enzymatic preparations were used:

- Alphamalt A – enzymatic preparation based on α – amylase. The characteristics of this product are: stimulates the rise in the oven; reduces the dough's firmness.
- Betamalt - enzymatic preparation based on β – amylase. The characteristics of this product are: stimulates the rise in the oven; extends the product's validity.
- Alphamalt GA - enzymatic preparation based on γ – amylase. The characteristics of this product are: stimulates the rise in the oven; increases the browning of the crust.

There were prepared four dough samples as follows:

- one sample contains 250g of flour mixed with a solution of salt, yeast. This sample is considered the Blank sample.
- three samples containing 250g of flour mixed with a solution of salt, yeast and enzymatic preparation (α, β şi γ - amylase).

The samples are mixed in a laboratory mixer 15 min to form dough. The amount of water was adjusted according to the water absorption capacity of flour.

Each dough sample is divided in five circular consecutive dough patties witch are rested 20 min in the alveograph in a temperature-regulated compartment at 25 °C. Each dough patty is tested individually and the result is the average of the five dough patties.

2.2. Methods of analysis. The determination of the rheological characteristics of the dough was obtained by alveographic method. The alveographic method relies on measuring the resistance to biaxial stretch under air pressure of a dough sample prepared in standard conditions.

The dough patty is placed on the alveograph, witch blows air into it. The dough patty expands into a bubble that eventually breaks. The pressure inside the bubble is recorded as a curve on graph paper. The alveograph determines the gluten strength of dough by measuring the force required to blow and break a bubble of dough. From the alveogram the following indicators were obtained:

- P Value is the force required to blow the bubble of dough. It is indicated by the maximum height of the curve and is expressed in millimeters (mm). It is also known as the viscosity or the value of maximum pressure that is in relationship to the resistance of the deforming dough (mm H_2O);
- L Value is the extensibility of the dough before the bubble breaks. It is indicated by the length of the curve that begins from the origin until the perpendicular point that corresponds to decreasing pressure due to rupture of air bubble and is expressed in millimeters (mm);
- G Value is the expansion index G being the average of the expansion index on the graphic of cellules and corresponds to breaking the abscise L, G =2.226L, where L – air volume (cm^3) used to stretch the dough under bubble form;
- P/L Ratio is the balance between dough strength and extensibility. It is the rapport of configuration of the curve;
- W Value is the area under the curve. It is a combination of dough strength (P value) and extensibility (L value) and is expressed in joules. It represents the action of deformation of the dough, based on a gram of dough, evaluated at 10^{-4} joule, calculated as follows: W= 1.32 x (V/L) x S, where V- air volume in

mm^3; L- the average abscise at breaking point in mm; S- surface of the curve, cm^2;

- Ie – elasticity index, represents the raport between the measured pressures, expressed in mm H_2O to form bubbles after the insufflations of 200 cm^3 of air in dough form, that correspond to a length L of 40 mm or an index of expansion G from 14,1 and the maximum of the curve P: Ie%= P200/Pmax. [3]

3. Results and discussions

The dough samples alevograms are represented in *Figure 1, Figure 2, Figure 3* and *Figure 4*.

In *Figure 1* the alveograme of the dough sample Blank represents the dough sample that does not contain any amylase. The alveogram's characteristics for flour used for bread have the following values: P = [65 – 75mm], L = [130 – 150mm], G = [20 – 30], P/L = [0,5 – 0,6] and W > $180x10^{-4}$J. [1]

In comparison with the standard rheological characteristics of the dough used for bread we can notice low values for the following indicators of the Blank Sample:

- the resistance of the deforming dough (P_0) is lower by 8 mmH_2O;
- the dough extensibility (L_0) is lower by 69mm;
- the expansion index (G_0) is lower by 9.5;
- the total quantity of absorbed energy during the dough deformation (W_0) is lower by $49x10^{-4}$J

Moreover the balance between dough strength and extensibility (P/L ratio) is 0.93, which is a value higher by 0.28 compared to the standard rheological characteristics of the dough used for bread.

In this case the dough is sensitive to stretch and can easily brake. Therefore it cannot be used for bread making.

In *Figure 2* the alveogram of dough sample P1 – with α-amylase represents the dough sample that contains an enzymatic preparation based on α-amylase.

There is a noticeable increase in all the indicators in comparison with the Blank sample – no amylase that suggests the improvement of the dough.

It can be seen that:

- the dough resistants to deformation (P_1) has increased by 11mmH_2O
- the dough extensibility characteristics (L_1 and G_1) are higher by 74mm and 8.9.
- the elasticity index (Ie_1) has increased with 21.4%
- the total quantity of absorbed energy during the dough deformation (W1) is higher with $54x10^{-4}$J then the value of dough sample Blank – no amylase.

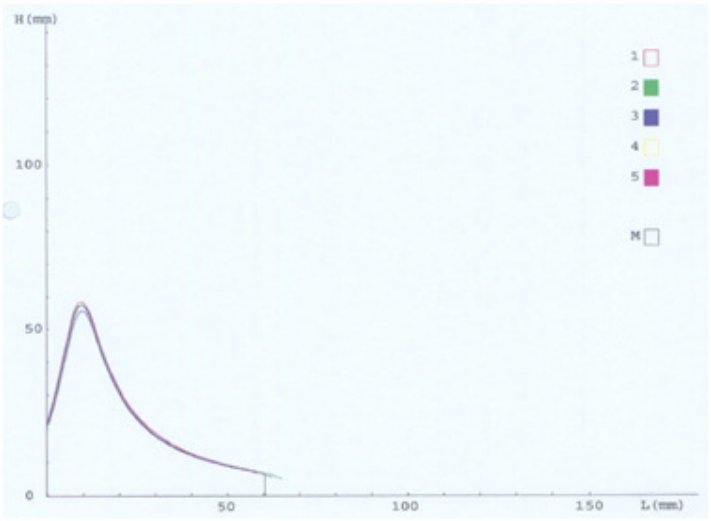
These results express the advantages of using α-amylase in the preparation of the dough for bakery. The reduction of dough's consistency through the addition of α-amylase leads to the increasing of extensive character and decreasing of the resistance of dough. Therefore this dough can be used for bread making.

In *Figure 3* is represented the alveogram of dough that has in composition an enzymatic preparation based on β-amylase. Compared with the sample Blank – no amylase there is a small improvement of the rheological characteristics as follows:

- the dough strength (P_2) increased by 6 mmH_2O,
- the extensibility characteristics (L_2 şi G_2) have increased by 32mm and 0.5
- the elasticity index (Ie_2) has increased with 26.7%
- the total quantity of absorbed energy during the dough deformation (W_2) is higher with 46x10 – 4J then the value of dough sample Blank – no amylase.

Using β- amylase improves the stability of dough and its tolerance for fermentation and decreases of dough viscosity which makes it much easier to handle. Unfortunately the standard rheological characteristics of the dough used for bread are not achieved

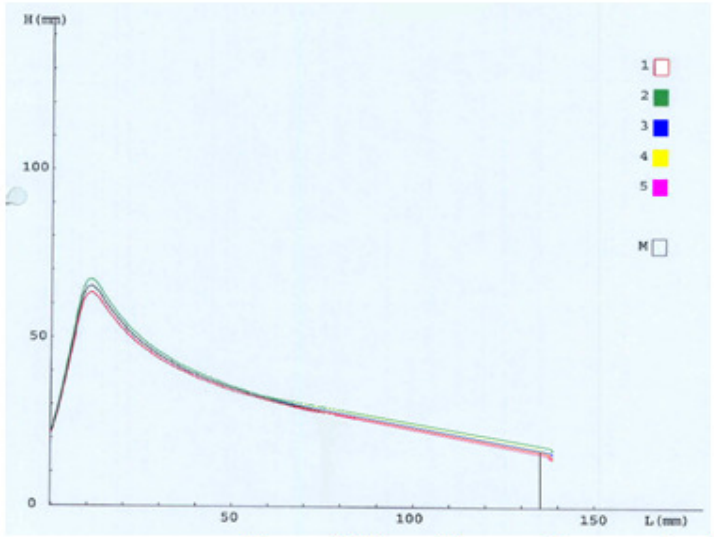
Sample Blank (no amylase)



Results
$P_0 = 57$ mmH_2O
$L_0 = 61$ mm
$G_0 = 16.5$
$W_0 = 171 \times 10^{-4}$J
$P/L_0 = 0.93$
$Ie_0 = 36.8$ %

Figure 1. Blank (no amylase) sample alveograme

Sample P1 – with α-amylase



Results
$P_1 = 68$ mmH_2O
$L_1 = 135$ mm
$G_1 = 25.4$
$W_1 = 225 \times 10^{-4}$J
$P/L_1 = 0.50$
$Ie_1 = 58.2$ %

Figure 2. P1 – with α-amylase sample alveograme

Table 1. Alveograph results of the dough samples: Blank - no amylase, P1- with α-amylase, P2 – with β-amylase, P3 – with γ – amylase

Sample	**Blank - no amylase**	**P1- with α-amylase**	**P2 – with β-amylase**	**P3 – with γ – amylase**
P(mmH_2O)	57	68	63	61
L(mm)	61	135	93	91
G	16.5	25.4	21.5	18.4
W(10^{-4}J)	171	225	217	179
P/L	0.93	0.50	0.68	0.67
Ie(%)	36.8	58.2	63.5	49.2

Sample P2 – with β-amylase

Results

P_2 = 63 mmH2O
L_2 = 93 mm
G_2 = 21.5
W_2 = 217x10 – 4J
P/L_2 = 0.68
Ie_2 = 63.5 %

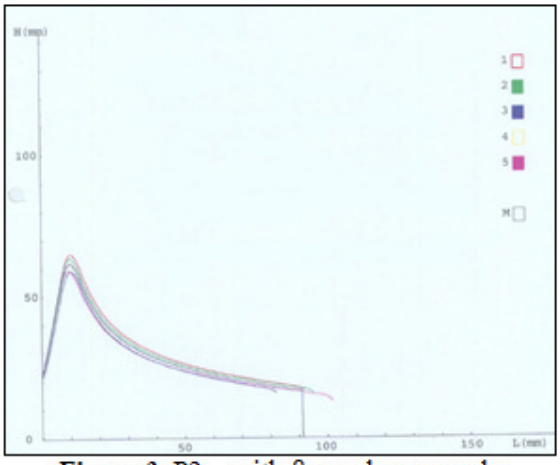


Figure 3. P2 – with β-amylase sample alveograme

Sample P3 – with γ-amylase

Results

P_3 = 61 mmH_2O
L_3 = 91 mm
G_3 = 18.4
W_3 = 179x10 $^{-4}$J
P/L_3 = 0.67
Ie_3 = 49.2%

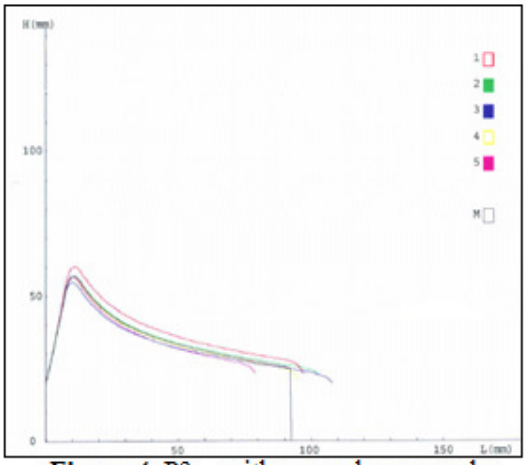


Figure 4. P3 – with γ-amylase sample alveograme

In *Figure 4* is the alveograme for the dough sample that has an enzymatic preparation based on γ-amylase. The following characteristic have a small positive change compared to the sample Blank – no amylase:

- the dough strength (P_3) increased by 4 mmH_2O,
- the extensibility characteristics (L_2 şi G_2) have increased by 30mm and 0.9
- the total quantity of absorbed energy during the dough deformation (W_3) is higher with

$8x10^{-4}$J then the value of dough sample Blank – no amylase.

- the balance between dough strength and extensibility (P/L ratio) is lower by 0.26

Addition of γ-amylase shows an improvement of all the indicators but it does not achieve the standard values for bread making.

In Tabel 1. there are presented the results of the dough samples obtained by alveographic method.

From all the samples, the sample P1- with α-amylase presents the best values for the dough strength (P_1), the dough extensibility characteristics (L_1 and G_1), the total quantity of absorbed energy during the dough deformation (W_1). Also the balance between dough strength and extensibility (P/L_1 ratio) and the elasticity index (Ie_1) are improved. The samples P2 – with β-amylase and P3 – with γ – amylase show improvement of the rheological characteristics in comparison with the Blank sample, but they are below the values of sample P1- with α-amylase and also under the standard values for the flour used for bread.

4. Conclusions

The additive actions of complex enzymes as ameliorator on flour have positive effects on the rheological characteristics of dough. The alveograph test provides results that are common specifications used by flour millers and processors to ensure a more consistent process and product.

Addition of α-amylase (P1 – with α-amylase) in dough improves the extension of freshness, increases of the quantity of fermentation sugars that can make finite products with a more pronounce color of crust.

Moreover α-amylase decreases the dough viscosity and improves the quality of the technological process which leads to an improvement of the quality of the bread by increasing of volume and reducing of the aging process.

By using β-amylase (P2 – with β-amylase) the enzymatic activity has increased in comparison with the Blank sample – no amylase but compared to P1 – with α-amylase it is lower which suggests damaged starch granules represent a limiting factor and the dough's fermentation conditions are not accomplished. The production of fermentable sugars depends on the tip and the quantity of the enzyme addition and on damaged stat of the starch granules.

By using γ-amylase (P3 – with γ-amylase) there is also an improvement of the rheological characteristics in comparison with the Blank sample – no amylase but compared to P1 – with α-amylase and P2 – with β-amylase the enzymatic activity initiated by γ-amylase is very low, having important effects on the core formation and elasticity and also on the dough's capacity of retaining water. A low enzymatic activity determines a low dextrin production, leading to a pal core with small pores and a very pal crust.

Selecting a correct tip of amylase will be made in conformity with the rheological characteristics of dough and the proportions from the dough will be added so that they would be maximal. The enzyme preparations are used to obtain bakery products with "clean label", more natural, this products being the product that enjoys the greatest interest from consumers.

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 and/or animal subjects (if exists) respect the specific regulations and standards.

References

1. Banu, C., *Biotechnologies in food industry*, Tehnical Publishers, Bucharest, 2000, pp. 622
2. Mencinicopschi, Gh., David, I., Brăgărea, Şt., Zarnea, G., *Food biotechnologies. Vol II*. Mirton Publisher, Timişoara, 2008, pp. 353-355
3. Roumanian Standards ISO 5530-4:2005. *Wheat flour. Phisical characteristics of the dough. Part 4: Determination of the rheological characteristics using the alveograph*