The consistographic determinations of different types of amylase on the bread dough

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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 consistographic 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 specialty 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 flavor. 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.

Key words    bread, α-amylase,β-amylase,γ-amylase, consistograph method

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 amylpectine; 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 amylpectine 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. 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.

Materials and Method

Samples preparation

Materials 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 rested 20 min in the consistograph in a temperature-regulated compartment at 25 °C.

Methods of analysis

The determination of the rheological characteristics of the dough was obtained by consistographic method. The consistographic method is used to determine the consistency of dough and water absorption capacity of flour and observing changes in the process of kneading dough.

The equipment used to determine consistograms is Alveo-Consistograph NG.

From the consistograme the following indicators were obtained:
- flour moisture (H₂O)
- maximum pressure (Pr MAX)
- hydration potential of the flour (HYDRA)
- time to reach the maximum pressure (Pr T MAX)
- tolerance or dough stability (TOL)
- pressure drop compared to PrMax after 250 seconds or the degree of softening of the dough after 250 seconds (D 250)
- pressure drop compared to PrMax after 450 seconds or the degree of softening of the dough after 450 seconds (D 450)

- water absorption capacity WAC.[3]

The following classification of flour based on the time to reach maximum pressure (Pr T MAX) and dough tolerance (TOL)
- Weak flour: T Pr MAX between 1-3 minutes TOL between 1 - 4 minutes
- Medium flour: T Pr MAX between 3-8 minutes TOL between 4 - 5 minutes
- Strong flour: T Pr MAX between 8-15 minutes and 10-15 minutes TOL.

Results and Discussions

The dough samples consistograms are represented in Fig. 1, Fig. 2, Fig. 3 and Fig. 4.

In Fig. 1 the consistograme of the dough sample Blank represents the dough sample that does not contain any amylase and are shown the dough’s rheological characteristics of a sample that contains no enzyme.
- Humidity is 14.40%;
- The time at which the maximum pressure is reached 138s;
- Tolerance or stability of the dough is 198s;
- The pressure drop compared to PrMax after 250s and after 450s, or the degree of softening at 250 and 450 seconds is high (350 or 597 mb) and water absorption capacity is 53.6% base 15% H₂O.

When the maximum pressure is reached (TPRMAX₀) and dough tolerance (TOL₀) is lower compared to the optimal conditions, indicates that the sample Blank has weaker features due to lack of enzymatic activity.

The dough obtained from this type of flour shows a low extensibility and low tensile strength, suggesting that it is not resistant and bread obtained is undeveloped, flat shape with cracks in the upper crust.
**Sample Blank (no amylase)**

Fig 1. Blank (no amylase) sample consistogram

**Sample P1 – with α-amylose**

Fig 2. P1 – with α-amylose sample consistogram

**Sample P2 – with β-amylose**

**Results**

- $H_2O_{P2} = 14.40\%$
- $HYDHA_{P2} = 53.8\% \ b 15\%H_2O$
- $PRMAX_{P2} = 1995 \ mb$
- $TPRMAX_{P2} = 156 \ s$
- $TOL_{P2} = 244 \ s$
- $D250_{P2} = 186 \ mb$
- $D450_{P2} = 633 \ mb$
- $WAC_{P2} = 55.3 \% \ b 15\%H_2O$

**Sample P3 – with γ-amylose**

**Results**

- $H_2O_{P3} = 14.40\%$
- $HYDHA_{P3} = 52.4\% \ b 15\%H_2O$
- $PRMAX_{P3} = 1963 \ mb$
- $TPRMAX_{P3} = 142 \ s$
- $TOL_{P3} = 232 \ s$
- $D250_{P3} = 203 \ mb$
- $D450_{P3} = 604 \ mb$
- $WAC_{P3} = 56.8 \% \ b 15\%H_2O$
In Fig. 2 the consistogram 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.

We can notice an improvement of rheological properties of dough due to the addition of this enzyme compared to the Blank sample. It can be seen that:

- The humidity remains constant (14.40%),
- Maximum pressure (PRMAX) shows an increase to 2291 mb;
- Time for complete hydration (TPRMAX) is 204s.
- Tolerance of the dough (TOL) shows an increase to 350s.
- D250 has decreased to 160 mb and D450 also decreased to 445 mb compared to the Blank sample.

Thereby demonstrating that the enzyme preparation based on glucoamylase improved dough quality compared with standard sample. When dough elasticity and extensibility is high enough, it results in loose bread, with developed volume and a core containing pores with thin walls.

This sample P1 contains the optimal conditions used in bread dough. 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 Fig. 3 is represented the consistogram 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, but not achieving the parameters of P1 or the normal conditions for bread dough. The results show:

- The same moisture content as the other two samples;
- The time at which it reaches the maximum pressure is 156s;
- Tolerance or stability of the dough is 244s;
- The degree of softening at 250 and 450 seconds is 186, or 633 mb;
- Water absorption capacity is 55.3% base 15% H₂O.

Compared with standard sample parameters were improved, but compared to P1 or optimal values for bread dough, these parameters do not qualify for bread dough. Bread made from this dough has a small volume, pale, and with a dense core. 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.

In Fig. 4 is the consistogram 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 same moisture content as the other samples;
- The time at which it reaches the maximum pressure is 142s;
- Tolerance or stability of the dough is 232s;
- The degree of softening at 250 and 450 seconds is 203, or 604 mb;
- Water absorption capacity is 56.8% base 15% H₂O.

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

In Table 1. there are presented the results of the dough samples obtained by consistographic method.
From all the samples, the sample P1- with α-amylase presents the best values for the the maximum pressure (PRMax), the time at which it reaches the maximum pressure (TPRMax), the Tolerance or stability of the dough (TOL), and also the improvement of the rheological characteristics. 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.

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.

References

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