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STUDIES REGARDING AMYLOLYTIC ENZYMES INFLUENCES ON MILLING AND BAKERY PRODUCTS

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Abstract

The use of exogenous enzyme in the milling and bakery industry forestall the deficiencies which may appear in the obtainment technologies of various products concerning the lack of these enzymes in raw materials. The amylolytic enzymatic preparats are usually used for standardising the α-amylases content in flour. This paper shows theoretic and practice aspects regarding the influence of amylolytic enzymes in the obtainment of some milling and bakery products.
Keywords: *bakery products, amylolytic enzymes*

Introduction

The controlled introduction of enzymes in bread is more than a hundreds years old. Jago (1886) has presented the use of malt flour in bread, for his diastatic action. Starting from that moment malt flour has been currently used, in order for trying in to bring the wheat flour's amylolytic activity to the desired values (Stauffer, 1990, Banu, 2000). Presently there is a remarkable interested in the research and development of bakery enzymes. The first International Congress regarding the use of enzymes in cereal processing took place in Holland in December 1996 and many papers concerning the applications of enzymes in bakery were presented.

Amylolytic enzymes have various functions in the technology of bakery products from the first stages of dough obtainment through the catalyst role of starch decomposing with maltose yield, the main factor of gas formation, of core, taste, crust colour, flavour and bread volume conditioning as during the next stages of the technological process over starch gelatinized through heat from baking phase, even having an important role in prolonging bread freshness (Giurca, 2002).

α-Amylase and β-amylase activities within the dough are not independent. The effects of the two amylases are additive when their activities are low but that at higher concentrations, the quantity hydrolized and the hydrolysis rate are higher than the sum of those produced when the enzymes are working separately. The role of amylases in bread quality was recognized by the end of the 19th century. A survey of the literature since 1982 shows that very few new data are available (Kruger, 1987).

Table 1. Some Characteristics of Amylolitic Enzymes in Breadmaking

Enzyme	Substrate Linkage Broken	Products	Optimum temperature (°C)	Inactivation Temperature		Ratio of Dextrins to Oligosaccharide
				Beginning (°C)	End (°C)	
α-Amylase: - Cereal - Fungal - Bacterial	Starch α 1,4	Oligosaccharides dextrins	 60-65 55 70	 65 55 70	 80-90 80 >100	 3.5 13 14
β-Amylase (cereal)	Starch α 1,4	Maltose dextrins	55	55	75	-
Glucoamylase	Starch α 1,4 Starch α 1,6	Glucose	55-60	65	80	-

Sound wheat flour contains an adequate level of β-amylase but is deficient in α-amylase for optimum bread quality. Bread supplementation with α-amylase intensifies amylolysis and thus increases dough's fermentable glucides' quantity, through maltose formation, capable of assuring gas formation through the whole technological process, including in its final phases, at a level that would guarantee quality bread obtainment (Kruger, 1987).

Bread made with α-amylase addition stays fresh for a longer period of time, fact due to dextrins accumulated in the core and some better gelatinisation of the starch not hydrolyzed, which will degrade more slowly in this state and will consequently lead to a slower stalling. Also, the bread obtained has a bigger volume, improved core porosity and elasticity, a more intense crust colour, a more pronounced flavour and a prolonged freshness compared to any sample (Bordei, 2004).

Amylolytic enzymes can also have side-effects, unwanted in the dough, because they reduce its consistency and modify its rheological properties by increasing extensibility and reducing resistance as enzyme addition is increased. Large doses of differently sourced enzymes lead to elasticity decrease and stickiness increase because of dextrin content increase. For a dose of 20 SKB units of α-amylase of different sources, core dextrin content rises 1.25 times for a fungi α-amylase, 1.5 times for a malt α-amylase and 7 times for a bacterial α-amylase. The unwanted effects are mostly due to the fact that enzymatic preparats are accompanied by a certain proteolytic activity, as well as due to the fact that the maltose obtained from starch hydrolysis exerts a dehydration action on gluten, thus increasing the quantity of free water, reducing the consistency to a certain enzyme concentration and worsening dough's rheological properties.

Depending on the desired effect in the technological process of bread manufacturing, certain amylases from various sources will be used, presented in the order of effect decrease:

- glucose formation: malt, bacterial, fungi;
- gas formation: bacterial, malt, fungi;
- thermal stability: bacterial (at 90°C stays 10% from activity), malt (at 80°C is deactivated) fungi (at 70°C is deactivated) (Wakeren, 2004).

In order to show the role of amylolytic enzymes over flour's characteristics we used the addition of some commercial enzymatic preparats in the dough.

Experimental

The determinations were made in the testing laboratory at S.C. Pambac S.A. The used wheat flour was type 650 white flour with the following main characteristics: humidity - 14%; ash - 0.65%; humid gluten content - 25.8%; deformation index - 5 mm.

The used enzymatic preparats were 3 commercial enzymatic preparats which show the same α-amylase enzymatic activity of 140000 SKB, in variable doses, 1-5g/100kg of flour.

Rheological and technological properties of the dough obtained from the control sample and sample flours with enzymatic preparats addition were determined with the Chopin alveograph and Brabender farinograph – according to STAS 90-88.

The alveogram shows the following characteristics:

- height, P, measured in mm corresponding to dough bubble's maximum pressure and is interpreted as deformation resistance or as dough stability;
- width, L, in mm is interpreted as dough extensibility;
- deformation energy, W, in cm, is strongly tied to flour power, flour hydration capacity. Dough deformation action is calculated in 10^{-4}J.

Showing the activity of amylolytic enzymes is made by determining the falling number. The falling number is defined as the time necessary to fall in seconds, of a stirrer through a wormed flour gel, on a distance given, in a viscosimeter. The optimum values recommended for the falling number of wheat flours for bakery are 230-280 sec. for flour destined for bakery.

Results and Discussions

The results of the determinations are synthesised in tables 2 and 3.

Table 2. The influence of enzymatic preparats addition over rheological properties of raw material flour

Sample	α-Amylase addition (g/100 kg flour)	Falling Number (sec)	Alveogram characteristics			
			P (mm)	L (mm)	W (10^{-4}J)	P/L
Control sample	-	407	94	78	362	1.20
Enzymatic preparats 1	1	389	92	79	276	1.17
	2	332	89	83	246	1.08
	3	301	93	84	288	1.10
	4	271	83	91	309	0.91
	5	260	81	97	248	0.84
Enzymatic preparats 2	1	400	96	80	302	1.20
	2	350	97	82	283	1.19
	3	310	96	89	286	1.08
	4	300	107	95	294	1.13
	5	280	82	99	276	0.83
Enzymatic preparats 3	1	405	82	70	290	1.17
	2	368	86	73	276	1.18
	3	323	82	78	288	1.05
	4	297	89	86	268	1.04
	5	274	85	90	251	0.95

Table 3. The influence of enzymatic preparats addition over technological properties of raw material flour

Sample	α-Amylase addition (g/100 kg flour)	Farinogramme characteristics					
		Absorption capacity (%)	Development (min)	Stability (min)	Elasticity (U.B.)	Softening (U.B.)	Power
Control sample	-	56.6	1.3	6.15	130	70	50
Enzymatic preparat 1	1	56.6	1.3	5.3	130	75	48
	2	56.5	1.3	5.0	130	90	47
	3	56.5	1.2	4.3	120	115	47
	4	56.6	1.3	3.0	130	120	45
	5	56.5	1.3	2.0	130	130	44
Enzymatic preparat 2	1	56.6	1.15	5.15	130	70	48
	2	56.4	1.3	4.3	130	80	48
	3	56.5	1.3	4.0	125	80	47
	4	56.6	1.15	4.0	125	105	47
	5	56.4	1.3	3.15	120	120	46
Enzymatic preparat 3	1	56.3	1.3	4.15	130	80	49
	2	56.4	1.15	4.15	125	85	48
	3	56.5	1.3	4.0	125	95	46
	4	56.6	1.15	3.3	120	115	46
	5	56.6	1.15	3.0	115	130	45

The flour used in the experiments show a low α-amylases activity (Falling number = 407 sec.).

The exogene α-amylases addition reduces dough consistency and modifies its rheological properties. Also, an increase of extensibility (L) can be observed and a decrease of dough resistance (P), as α-amylases addition is bigger. This effect is due to the presence of α-amylases preparats and to a generally small proteolytic activity, as well as due to the fact that the malt formed through starch hydrolysis exerts a dehydration action over dough gluten.

It can be observed that a 4g addition of enzymatic preparat/100kg of flour lead to the improvement of dough's rheological properties, an increase in dosage over this step having a negative effect over the dough's bakery qualities. An increase in dosage of enzymatic preparats leads to a decrease of dough stability, to an increase of dough softening degree and to a decrease of flour power.

Conclusions

The obtainment of constant quality bakery products, starting from various quality flours represents a present-day problem of specialists from the bakery industry. In these conditions the addition of additives in order to correct any quality deficiencies of flour has become a stringent necessity.

Control of amylase activities is essential for bread making and for maintaining or improving the quality of the final products.

In order to correct the flour's amylolytic activity an addition of exogene enzymatic preparats is recommended, especially at processing flours with low amylases activities which contain starch with small degree of deterioration, the so-called "fire hard" flours. The results can be improved when the synergic effect of amylolytic enzyme preparats is capitalized along with other additives used in bakery industry.

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