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EFFECT OF LYSOMAX FORMULATION ON RHEOLOGICAL BEHAVIOUR OF DOUGH

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Abstract

Lysomax is a commercial product of bacterial non-GM strain phospholipase A2 (activity = 500 PLA2 units/g), acting on lecithin's sublayer with conversion into 2-lysolecithins and fatty acids. It is a natural conditioner, which could be used like bread improver in order to accomplish similar tasks with certain chemical emulsifiers. Previous results, concerning the comparative effects of DATEM and Lysomax in terms of rheological behaviour of dough, loaf volume increasing and improved properties of bread-crumb, showed that Lysomax can be used successfully as a replacement of DATEM. The main questions regarding Lysomax using in bakery like bread improver refer to formulation that could be used and the quality of raw material. In these experiments were used different doses of Lysomax, with and without additional exogenous lecithins, on control flour with a weaker potential for bread-making. Effect of Lysomax formulation was carried out in respects of rheological behaviour of doughs.
Keywords: *bread improver, PLA2, dough rheology*

Introduction

Wheat flour contains approximately 2.2 – 2.9 % lipids, and flour lipids can be divided into starch lipids and non-starch lipids (1.3 – 2.1 %). Whereas the starch lipids consist mainly of polar lyso-phospholipids, the non-starch lipids consist of about 40 % neutral triglycerides and 40 % phospho- and galactolipids (www.dsm.com). Consequently, phospholipids (PL) are some of the minor compounds of wheat flour, of which effect on bakery was recently revised.

It is known that phospholipids contain in their molecules glycerol, fatty acids, phosphoric acid and preferential nitrogenous bases, reason

for which they are amphophilic properties. Phospholipids are comprised in wheat flour like traces. Accordingly, many researchers expressed their point of view concerning the fact that phospholipids quantity is not enough to reach a significant effect by themselves on doughs' properties and end-products' quality. There are theories, which remark that only addition of lecithins, using like exogenous phospholipids, can be able to perform emulsifier effect in bread-making (Cauvain and Young, 2004; Pyler, 1988). Generally, like exogenous sources of lecithins are used soybean (8 % PL) and soy products, as well as egg yolk (10 % PL). There are many ranges of soy products like fluid and powder lecithins, de-oiled (hydrophilic) or non-de-oiled lecithins, acetylated or hydroxylated (chemical modified) lecithins, enzyme-modified lecithins.

Because of their HLB, lecithins interact simultaneously through hydrophilic-hydrophobic links with the main compounds of flour during mixing, conditioning and baking processes. The emulsifier effect of lecithins in baking are proved in terms of dough strengthen, gas retention improvement, crust formation, loaf volume increasing, as well as bread-crumb properties improving (softness, texture, and self life) (Cauvain and Young, 2004). By enzymatic modification of lecithins into lysolecithins, HLB and water-oil miscibility are changed. Lysolecithins contribute in a larger way like wetting agent in bread-making process, aid in handling and shortening dispersion of baked goods, extend shelf life of bread loaves.

Conversion of lecithins in lysolecithins is biocatalyzed by phospholipase A2 (PLA2), which acts at interface of micro-emulsion. For technological application in food processing Lysomax is a commercial product, GRAS noticed by FDA, which comprised true PLA2 from bacterial non-GM strain of *Streptomyces violaceoruber*, with an enzymatic activity of 500 PLA2 units/g (minimum).

Previous researches mentioned that effect of PLA2 through the conversion of lecithins into lysolecithins and ability of lysolecithins complex to act on dough during bread-making can be approximate to effect of the certain chemical bread improvers, like DATEM.

Many questions about Lysomax using in bakery like bread improver refer to formulation that can be used and quality of raw material. In previous studies there were used certain doses of Lysomax in different formulation with soy-lecithins and egg yolk addition for

flour improving in bread-making process, using like start material flours with an average quality (Sîrbu, 2005).

In these experiments were used different doses of Lysomax, with and without additional exogenous lecithins, on control flour with a weaker potential for bread-making. Effect of Lysomax formulation was carried out in respects of rheological behaviour of dough.

Experimental

For experiments there were chosen flour with a weaker potential for bread-making like raw material; like bread improvers were added Lysomax (PLA2) and exogenous sources of lecithins namely powder egg yolk and non-de-oil soy flour (Provaflor).

Lysomax is a commercial product of PLA2, which was supplied by Enzymes & Derivates Romania Ltd. For enzymatic hydrolysis of phosphatidyl choline (PC) and phosphatidyl ethanolamine (PE) by using Lysomax, optimum temperature is 45… 50°C, broad pH range for PC conversion and pH = 8.0 for PC one (Birschbach, 2004).

Powder of egg yolk is a commercial product obtained by separation of fresh yolk from egg-white, pasteurization and dry. It was supplied by KUK Romania Ltd. Provaflor is a commercial product, which comprises crude soy flour (30 % lipids content) that is enzymatic active (more than 500 units lypoxygenase/g) (supplier - Enzymes & Derivates Romania Ltd.).

Control flour was analyzed by performing Romanian standards methods: STAS 6124-73, STAS 90-88, STAS 6283-83 and SR ISO 3093:1997. In experiments was used a flour with 15 % moisture, and 9.82 % crude protein content. The determined values for physical-chemical properties are mentioned as following: ash content 0.60 %, wet gluten content 24 % and gluten deformation 17 mm, and falling number 258 s. Data acknowledge that the control flour has a weaker potential for bread-making from that point of view.

Starting from chosen flour for analysis, there were used in experiments different samples of flour, improved by the following scheme, indicated in table 1.

Table 1. Working scheme

Sample	Formulation			
	Flour control (F)	Lysomax, g % F	Provaflor, g % F	Egg yolk powder, g % F
S0	x			
S1	x	2		
S2	x	4		
S3	x	6		
S4	x	8		
S5	x	10		
S6	x	2	300	
S7	x	4	300	
S8	x	6	300	
S9	x	8	300	
S10	x	10	300	
S11	x			210
S12	x	8		210

Rheological behaviour of dough prepared from wheat flour on basis of above-mentioned formulation scheme was carried out on Brabender farinograph and Chopin alveograph according to SR ISO 5530-1:1998 and, respectively, SR ISO 5530-4:1998.

Results and Discussions

During those experiments on started from the previous obtained data regarding PLA2 using in different formulation, with certain exogenous sources of lecithins for dough conditioning (Sirbu, 2005 and 2006). The quantities of bread improvers used in formulation are based on those data, too. The rheological behaviour of dough can be more complete defined by using both farinograph and alveograph methods. Nevertheless, in certain conditions alveograms seem to be more accurate for indicating those modifications of dough rheology.

There were performed both farinograms and alveograms for control flour and samples based on single Lysomax addition (S0…S5). For flour samples improved with Lysomax and Provaflor, like exogenous soy-lecithins, there were carried out only alveograms, while the flour samples with both added Lysomax and egg yolk powder were analyzed only through farinograph method.

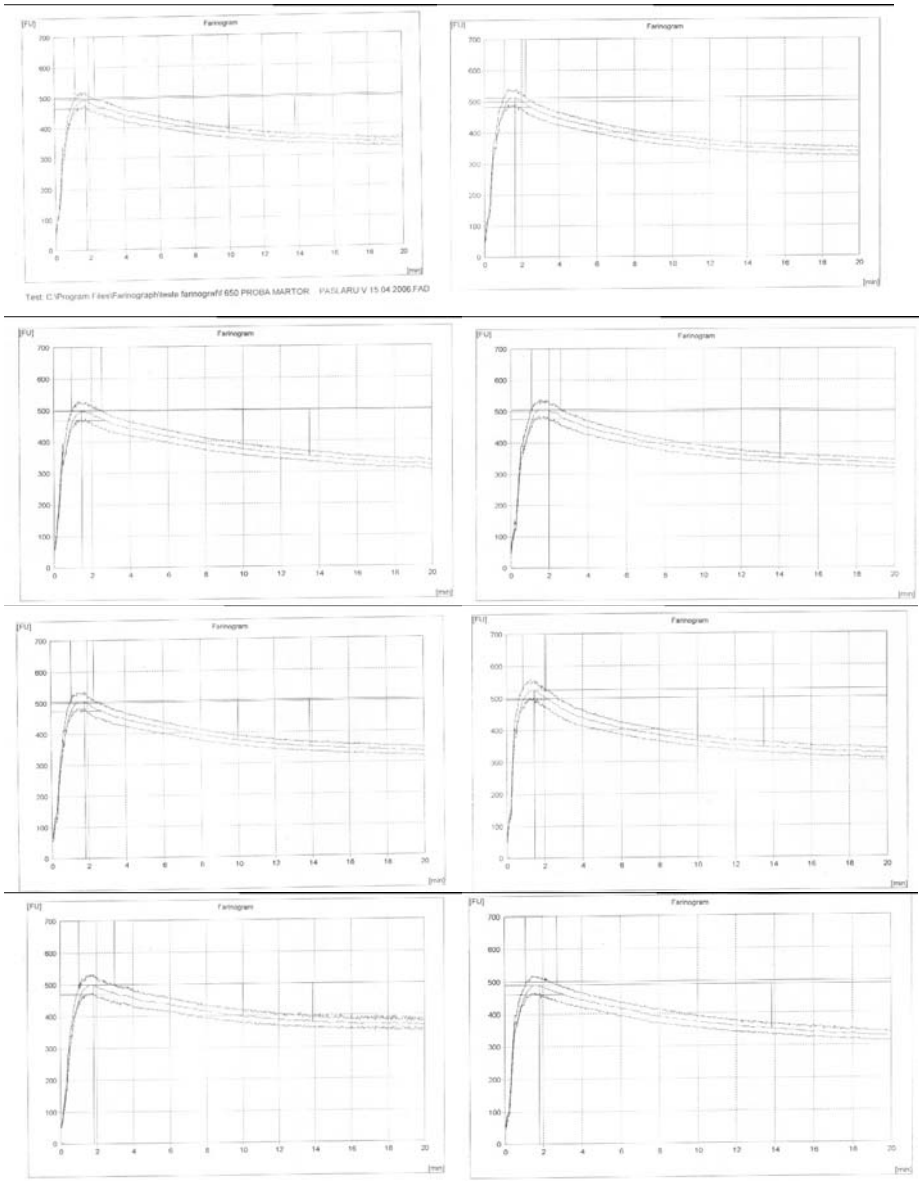

Fig. 1. Farinograms of analyzed samples

The curves performed by rheological behaviour assessment of dough through farinograph method are shown in figure 1. The

alveograms, which were registered by rheological assessment of dough, are shown in figure 2, too.

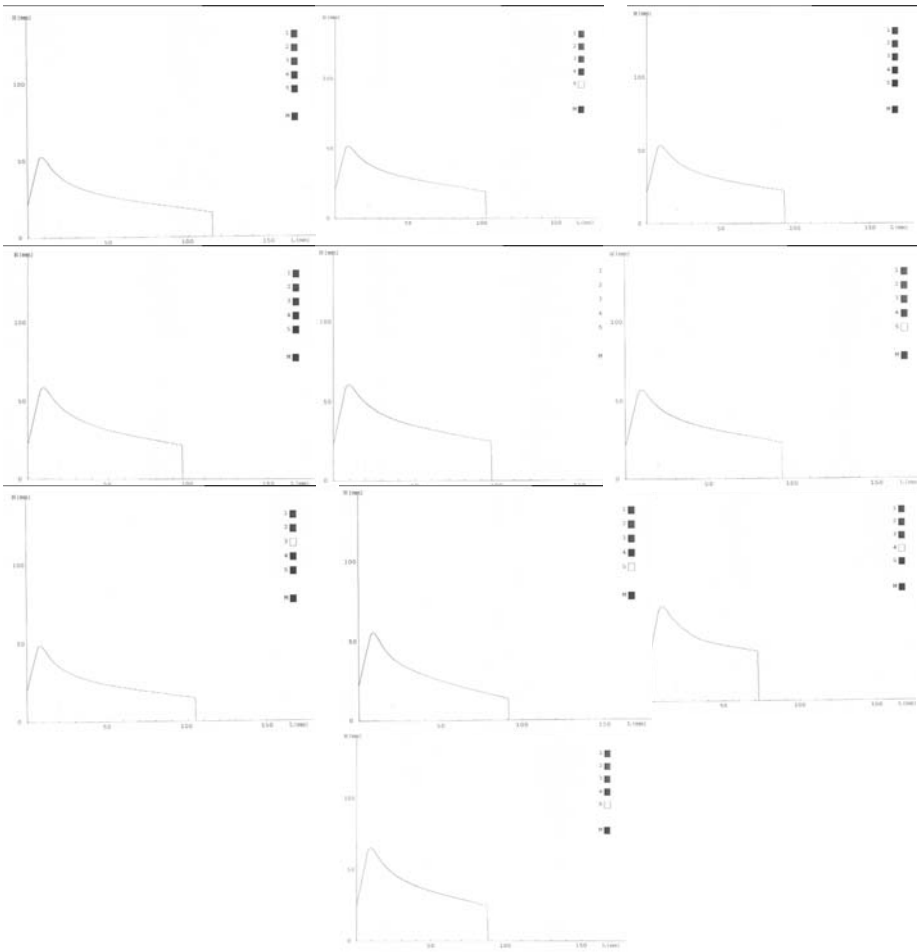

Fig. 2. Alveograms of analyzed samples

The conditioning effect of bread improvers on dough's rheological behaviour on basis working scheme was studied in relationship with rheological parameters accordingly. Generally speaking, the results registered on basis of farinograph determination were unsatisfactory, while the other results, which were obtained on basis of alveograph

methods, showed a certain improvement of dough conditioning in terms of its strengthener, but not in a wide range.

Regarding development time (DDT) of dough performed by farinograph method, there was not registered an increment of DDT as on expected (figure 3). For samples with Lysomax addition, the development time registered values with a decreasing trend by increasing quantity of PLA2. A slight improving of DDT trend was obtained for sample with addition of Lysomax and powder egg yolk, but there can be rather a consequence of egg yolk input than PLA2.

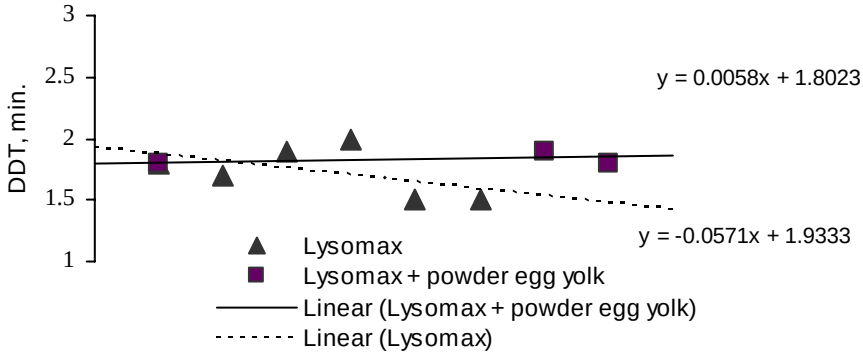

Fig. 3. Dough development time by farinograph determination

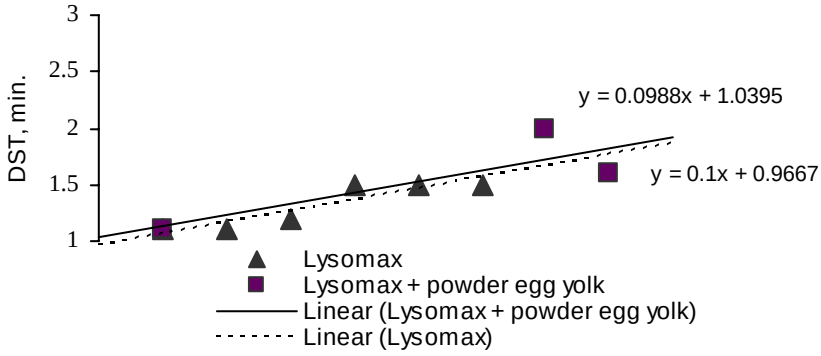

Fig. 4. Dough stability time by farinograph determination

As it is shown in figure 4, dough stability time performed by farinograph method increased slightly in both cases, by addition of Lysomax and Lysomax + powder egg yolk with a similar trend.

Because there are not significant differences between tendency to variation of dough stability with and without exogenous sources, a question raised about the possibility to use Lysomax without addition of sublayer of exogenous lecithins in bread-making. For all sample, weakening of dough, which were expressed by either degree of softening at 10 min. after begin, or degree of softening at 12 min. after max, decreased with an average ratio of 10 %. Consequently, general farinograph data indicated an alteration of rheological behaviour of those samples.

If on pays respect to technical principles which are on basis of methodology in order to assess rheological behaviour of dough by farinograph and alveograph, conditioning effect of bread improvers might be more obvious in terms of alveograph data. Indeed, in case of alveograph data, the results are closer to the expected ones.

There were registered an increment of dough tenacity by using bread improvers, as it is shown in figure 5. The effect of bread improvers on strengthening of dough became obviously when used quantity of Lysomax was higher than 4g/ 100 kg flour, correspondent to more than 2000 PLA2 units % flour. The equations of linear regression for samples with Lysomax and, respectively, Lysomax plus Provaflor indicated better results obtained when Lysomax was used by itself, without additional lecithin sublayer.

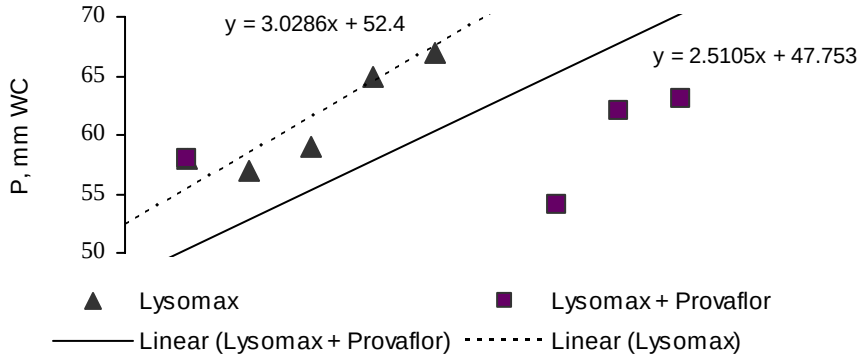

Fig. 5. Tenacity by alveograph determination

Effect of chosen bread improvers on dough extensibility, measured by standard alveograph method, is shown in figure 6. Lysomax, as well

as Lysomax with Provaflor addition contributed to a decreasing trend of extensibility. As it happened in case of dough tenacity, rheological behaviour modification was registered by using more than 4g Lysomax / 100 kg flour.

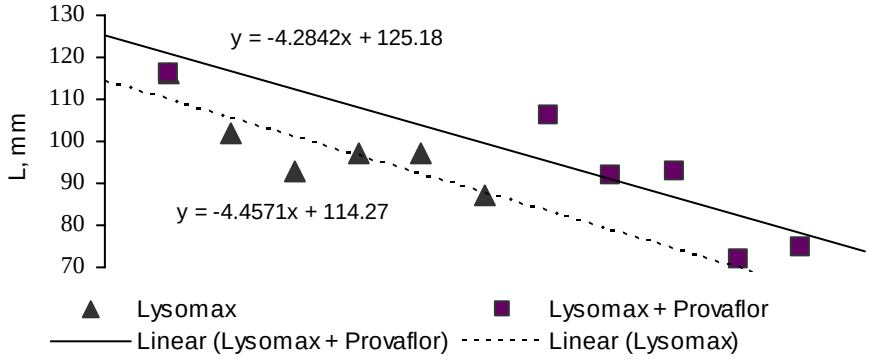

Fig. 6. Extensibility by alveograph determination

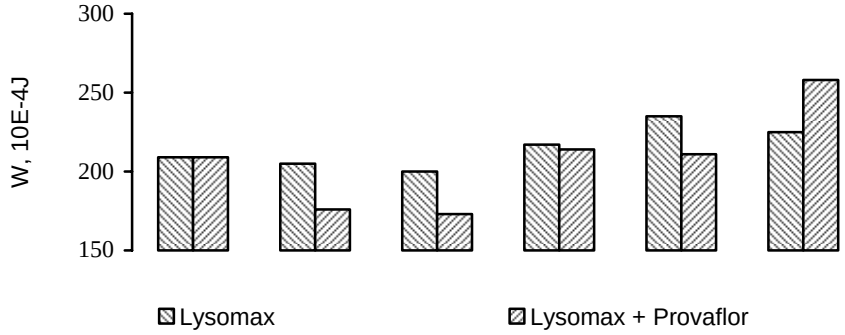

Fig. 7. Baking strength by alveograph determination

Dough strengthened in terms of tenacity increasing and extensibility decreasing, and the configuration ratio of the alveograms was changes in favor of tenacity increment, but without a general aggravation of dough properties, especially for samples improved by Lysomax in a single formulation. The results are confirmed also by baking strength data, as it is indicated in figure 7.

General data on basis of alveograph and farinograph assessment indicated better results on rheological behaviour of dough for a dose of 8 g % flour of Lysomax in a single formulation.

Conclusions

Even similar results can be assessed by using both methods, in case of alveograph, in comparison with farinograph, can be clearly explained in which sense their changes are occurred. It is not necessary all the time to add lecithins, like an exogenous source. Probability to have enough quantity of endogenous lecithins is not really considerable, but it is possible to influence other enzymatic reactions with a cumulative effect on dough rheology. If on compares these results with previous ones (Sirbu, 2005 and 2006) in aim to obtain an obvious effect like bread improver, it seems that the necessary dose of Lysomax is higher and is not requested perforce additional lecithin sources for flours with a weaker potential for bread-making in comparison with flours with an average quality.

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