Pectic substances and their functional role in bread-making from frozen semi-finished products

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Abstract

Freezing of bread semi-finished products is accompanied by a variety of adverse events, such as denaturation of proteins or yeast cell death. For the reduction of adverse events dough is combined with cryoprotectants. This article presents the research findings of pectin's influence on rheological properties of dough and physicochemical quality parameters of bread. The obtained data allow recommending pectin in production technology of bread from frozen semi-finished products.

Keywords: cryoprotectants, pectin, yeast, test semi-finished products, bread.

Introduction

Bread production is a socially important sector of national economy. The majority of bakery plants producing a leading variety of breads meet the strategic objective of supplying as many people as possible with cheap bread. Important are also the new tendencies in bread production technology: freezing, using under-baked bread with further baking at the baker's shop, applying instant bread-mixes and new kinds of fortifiers. As any business, bread production tends to change and develop (Lukomskaya, 2010).

The share of frozen bakery products on the Russian market currently stands at a total of 2-3% (according to various experts) as against new-baked ones and continues to grow (Obergan, 2011).

Freezing of bread semi-finished products is known to be accompanied by a variety of adverse events, such as denaturation and aggregation of proteins causing loss of their functional properties, as well as ice crystal formation and moisture loss leading to yeast cell death. Thus, freezing of bread semi-finished products must be carried out with added cryoprotectants (Daniluk, 2011).

Carbohydrate cryoprotectants are most commonly used for adjustment and storage stability of optimal properties of dough and the end product. We have undertaken a study of possible application of such polysaccharide as pectin as cryoprotectant in production technology of wheat bread from frozen semi-finished products. It should also be noted that pectin is associated with the improvers of surfactant action (Donchenko, 2000; Shamkova, 2006).

The goal of the research is the development of production technology of bakery semi-finished products with using pectin as cryoprotectant.

Materials and methods

For the purpose of comparison tests of pectin as cryoprotectant, influence of fructose and sorbitol was also studied. As a research instrument for studying pectin's influence on rheological properties of dough farinograph «BRABENDER» was used. Straight white wheat flour was used in the experiment. Influence of improvers added at rates of 0.5%; 1.0%; 1.5%, 2% (as against the quantity of flour) was studied. Experimental tests have shown that

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the best results of structural-mechanical properties of dough were obtained with improvers being added at a rate of 1.5%; the results are presented in table 1.

Table 1. Structural-mechanical properties of dough with the addition of different cryoprotectants.

Sample	Farinograph				
	Water absorption, %	Dough formation time, min	Dough resistance, min	Dough dilution, UF	Valorimetric value
Control	64.7	8.5	11.5	85	68
Control + pectin 1.5%	69.8	10.0	12.5	75	76
Control + fructose 1,5%	64.8	7.0	12.0	70	62
Control + sorbitol 1,5%	65.0	8.5	13.0	80	68

The presented data analysis shows that the application of pectin in the process of dough mixing leads to an increase in dough water absorption based on all samples compared with control. Apparently, this is caused by the formation of protein-polysaccharide complexes, which are capable of binding moisture. The presence of pectin keeps water bound up, thus optimizing bound and unbound moisture ratio in dough. In addition, gluten membranes become thin and flexible, easily stretched and rupture-resistant. This is confirmed by high valorimetric value that characterizes elastic properties of dough (Judith A. Evans, 2010).

As a research instrument for studying the influence of fructose, sorbitol and pectin on flour strength alveograph «Chopin» was used. Improvers were added in the process of dough mixing in the same doses as in the previous experiment – 0.5%; 1.0%; 1.5%; 2% (as against the quantity of flour). The analysis of flour strength has shown that the best results were obtained with improvers being added at a rate of 1.5% (table 2).

Table 2. Flour strength readings with the addition of different cryoprotectants.

Sample	Alveograph		
	Strength	Maximum overpressure, mm	P/L ratio
Control	227	71	0.70
Control + pectin 1.5%	245	95	1.40
Control + fructose 1.5%	225	65	0.57
Control + sorbitol 1.5%	230	67	0.62

According to the analysis results, application of fructose leads to a decrease in flour strength compared with control. Application of sorbitol in the process of dough mixing is marked by a beneficial effect of increase in flour strength. The best results were observed with the application of pectin.

Dough viscoelasticity is evaluated by P/L ratio. This ratio was the best with the application of pectin at a rate of 1.5%; with the application of fructose and sorbitol the ratio was at the control's level.

Thawing and proofing of bread semi-finished products have their own features. The process may be carried out in a variety of temperature-time conditions (Matveeva, 2011). For studying the optimal thawing conditions two regimes were compared: the first – thawing and proofing in a shop type environment at a temperature of 22-25 °C, the second – super-high frequency thawing and proofing. The objects of research were yeast dough samples with different cryoprotectants, which were added in the process of dough mixing at a rate of 1.5% as against the quantity of flour (table 3).

Table 3. Physicochemical quality parameters of bread.

Indicator name	SHF thawing				Thawing in a shop type environment			
	Control	+ pectin	+ sorbitol	+ fructose	Control	+ pectin	+ sorbitol	+ fructose
Crumb moisture, %	42.4	43.0	43.5	42.3	41.6	40.0	40.5	41.5
Crumb acidity, deg	1.6	1.6	1.4	1.6	1.6	1.4	1.6	1.6
Crumb grain, %	77.1	81.4	78.6	77.0	77.4	78.2	73.8	74.8

It should be noted that under the conditions of SHF thawing the process of dough fermentation with pectin was more intensive and faster compared with other test samples. The process of thawing and proofing of dough products with pectin was also more active compared with other test samples under the conditions of thawing in a shop type environment (Kenijz, Sokol, 2011).

The proofing time of frozen dough after thawing is extended as compared with the traditional approach. This is due to the lower temperature of thawed products placed in a proofing cabinet, a certain decrease in gas-retaining ability of dough and yeast efficiency influenced by thawing. According to the analysis results, the cause of irregular fermentation might be a large temperature gradient in dough for bakery products (Kenijz, Sokol, 2011).

Proofing of frozen semi-finished products thawed at super-high frequencies lasted 35–40 minutes; in a shop type environment – 85–90 minutes. The proofed dough was baked at a temperature of 210 °C.

According to the data resulting from the experiment, bread with added pectin possessed the best quality parameters both at super-high frequencies and in a shop type environment thawing. Organoleptic evaluation of useful qualities of bread has shown that based on the parameters of color, size, taste and smell sample with added pectin was the best (figure 1).

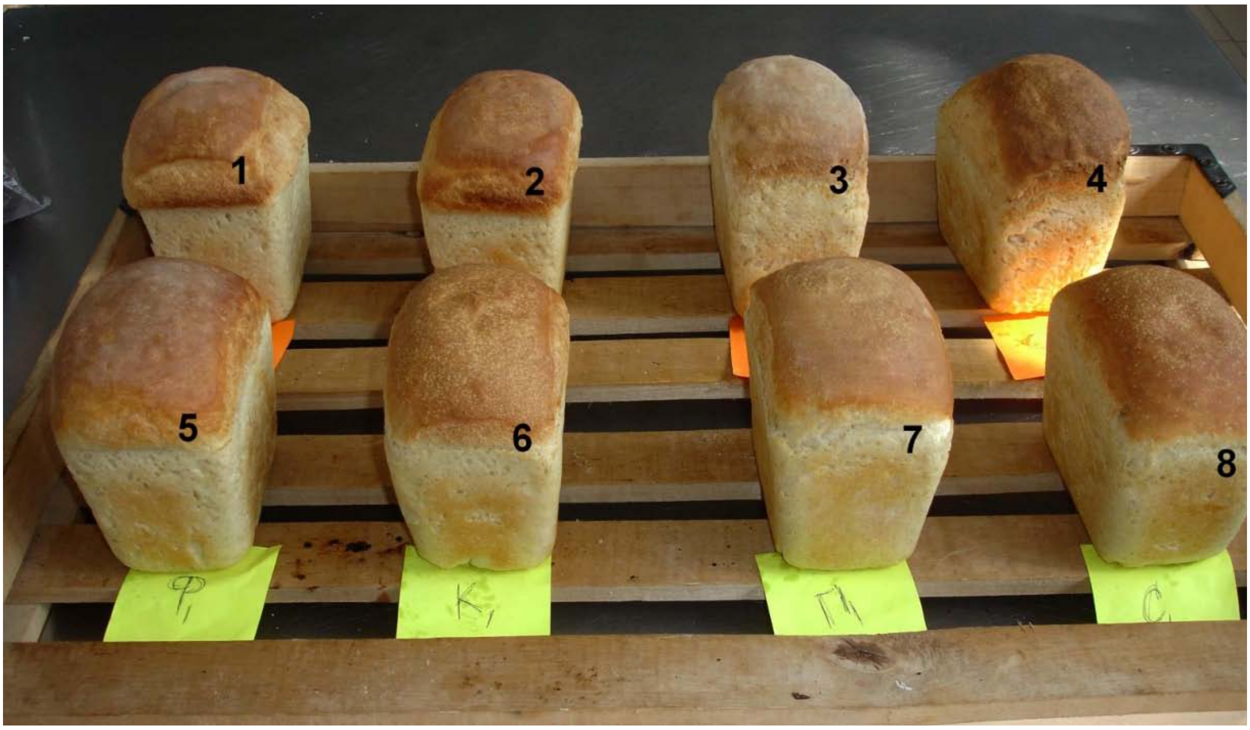

Figure 1. End products (SHF thawing: 1- with added fructose, 2- control sample, 3- with added pectin, 4- with added sorbitol; 5- with added fructose, 6- control sample, 7- with added pectin, 8- with added sorbitol).

Conclusions

Therefore, the conducted research affords ground for concluding that pectin can be used as cryoprotectant in the production technology of bakery semi-finished products. Application of pectin increases gas-production and gas-retaining abilities of dough and has a beneficial effect on unbound moisture distribution, thus helping to avoid formation of rough ice crystals, which disrupt gluten structure, and consequently obtain a high-quality product.

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