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Chemical Industry & Chemical Engineering Quarterly 14 (4) 257–259 (2008) CI&CEQ

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SHORT COMMUNICATION

UDC 664.01.3/.8:664.656

THE BEHAVIOR OF DIFFERENT FIBERS AT BREAD DOUGH FREEZING

Three different types of commercial fibers (inulin originated from artichoke with long and short molecule chains and Fibrex - originated from sugar beet) were incorporated into the dough formula as flour supplements at the level of 5 %. The influence of fiber characteristics on yeast dough (proving time and stability) and bread quality (volume and crumb quality) during 60 days freezing is presented. Data show that the addition of fibers in frozen yeast dough is positively contributing to preserving the quality of the final product and their influence depends on the characteristics of fibers.

Key words: fibrex; inulin; frozen dough; bread quality.

Fresh bread is a product with a short shelf-life and during its storage a number of chemical and physical alterations occur, known as stalling. As a result of these changes it's freshness and crispiness deteriorate while crumb firmness and rigidity increase. Over the past few years, the bakery industry has exploited the advantages of the freezing technology. Frozen bakery products are expected to be characterized by the quick preparation time and an affordable price. They look and taste as if they are freshly and home made [1]. In frozen dough preparation, where a prolonged frozen storage intervenes between the dough formation and bread baking, many factors still have not been fully investigatied so bakery products result in the loss of the consumer acceptability [2,3]. The technology of frozen dough is helping in broadening the variety of products, particularly the specialty type of bakery products, *i.e.* the products with altered nutriative attributes.

The objective of this research is to present the influence of three types of fibers (fibrex, inulin HPX and GR) at the level of 5 % in the yeast dough on dough characteristics at the proof and quality of bread during the freezing process.

MATERIALS AND METHODS

Material

White flour (ash and protein content 0.45 and 11.2 % d.m. basis, respectively), salt and compressed yeast were of commercial grade, as used in the bread production. Fibrex is a commercial product originated from sugar-beet, produced by Denisco Sugar AB. Inulin HPX (molecule chains of more than 10 sugar units) and inulin GR (molecule chains with 2 to 5 sugar units) are commercial products from the root of Jerusalem artichoke, produced by „Orafti Active Food Ingre-dients", Belgium.

Dough characteristics

The rheological properties of frozen (30 and 60 days) and non frozen dough during the fermentation were determined using a Maturograph (Brabender, Duisburg, Germany). The parameters determined were: proving time and proving stability.

Baking procedure

Bread was baked according to the AACC method. The samples of dough were prepared in the farinograph bowl according to dough formula: flour (100-95 %), fibers (fibrex, inulin HPX or inulin GR) (0-5 %), salt (2 %), yeast (2.5 %). Water was added according to farinograph absorption, *i.e.* to 500 BU: no fiberes (60.4 %), fibrex 5 % (68.0 %), inulin HPX 5 % (56.6 %), and inulin GR 5 % (52.3 %). Dough pieces of 150g mass were frozen in the freezing chamber (Koma, Koeltechnishe Industrie, B.V., the Netherland) at -20 °C. Bread crumb quality was evaluated by a group of trained panelists.

Statistical analysis

All samples were prepared and analyzed in 3 measurements and the average was reported [4].

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Paper received: October 09, 2008.
Paper revised: October 29, 2008.
Paper accepted: October 30, 2008.

RESULTS AND DISCUSSION

The effect of fibers on the behavior of frozen dough at the final proof

As it has been stated that freezing adversely affects the protein matrix and yeast viability [3,5], the behavior of dough at final proof after a certain period of freezing has been presented by proving time and proving stability, Table 1. Mean value, standard deviation and the test of conclusion show that duration of final proof depends on the sample type, that is on the type of fibers incorporated into the dough and the length of storage at low temperatures.

In the stage of dough preparation, the dough without fibers, along with the dough with inulin GR have the highest values of the measured final proof and the dough with fibrex has the lowest value. These data are influenced by the interaction between the gluten network and fibers molecules that are interrupting the gluten configuration pointing at the highest adverse effect of fibrex, therefore contributing to the low dough ability to hold gases generated during the fermentation stage (Table 1). In this phase the yeast viability is affected neither by low temperatures nor by a dough formula, but proof stability is prolonged only in the dough with inulin HPX indicating to better interactions between this type of inulin and gluten.

At keeping dough in a frozen condition for a longer period of time, from 30 to 60 days, the duration of final proof is prolonged with all samples and the dough with inulin GR has higher values, and according to statistical data it differs significantly from other analyzed samples, while the dough with fibrex has the lowest values. The duration of final proof of the dough with inulin GR is 2 to 3 times longer than with fibrex (Table 1).

At freezing of the dough for a longer period of time, from 30 to 60 days, proof stability of the dough with fibrex and inulin HPX is almost twice shorter than with the dough which was frozen for 0 day, while the time of final proof is prolonged with the dough with inulin GR. Data from Table 1 indicate that the greatest effect on the fermentation stability has the dough with inulin HPX, and the least the dough with inulin GR (Table 1). During storing in a period of 60 days, final proof of the dough without fibers or with inulin GR is significantly prolonged, pointing that low temperatures are adversely affecting the yeast activity.

In a shorter time of storing, the dominant effect of the high content of water in the dough has been noticed, as well as the influence of formed ice crystals on the activity of yeast, which is a characteristic for fibrex (decreased proving stability after 30 days) and this data is in accordance with the statement of Kulp [6]. The protective effect of fibrex and inulin on the activity of yeast can been noticed in a longer period of storing at freezing temperatures (Table 1).

The effect of fibers on the behavior of frozen dough on bread quality

The positive effect of both types of inulin and fibrex on the bread volume in the technology of frozen yeast dough is illustrated by data presented in Table 2.

Table 1. Effect of fibers on dough properties at freezing

Freezing time, days	Final proving time, min				Proving stability, min			
	Mean value	Confidence interval		*p**	Mean value	Confidence interval		*p**
				0% Fibres				
0	84.00±2.83	81.03	86.97	0.996	9.00±2.1	6.80	11.20	0.988
30	109.67±24.64	83.80	135.53	0.936	6.67±2.73	3.80	9.53	1
60	151.67±1.51	150.09	153.25	0.862	8.33±2.34	5.88	10.79	0.926
				5 % Fibrex				
0	38.33±5.28	32.79	43.87	0.997	7.67±2.66	4.88	10.46	0.721
30	79.67±2.34	77.21	82.12	0.998	4.67±1.63	2.95	6.38	0.959
60	74.67±3.27	71.24	78.1	0.999	4.67±2.07	2.50	6.84	0.681
				5 % Inulin HPX				
0	78.33±1.51	76.75	79.91	0.833	17.67±5.85	11.52	23.81	0.950
30	119.67±3.2	116.30	123.03	0.959	9.00±2.10	6.80	11.2	0.988
60	111.67±4.63	106.80	116.53	0.924	10.33±4.97	5.12	15.55	.626
				5 % Inulin GR				
0	95.00±3.29	91.55	98.45	0.978	7.00±2.1	4.80	9.20	0.988
30	171.00±10.64	159.83	182.17	0.928	8.33±4.27	3.85	12.82	0.958
60	210.33±27.02	181.97	238.7	1	8.33±2.34	5.88	10.79	0.926

*Test of conclusion

Table 2. The effect of fibers on baking properties of bread at freezing

Storing period/parameter of quality	Quantity of fibers, %			
	0	5		
		Fibrex	Inulin HPX	Inulin GR
		0 day		
Bread volume, ml	337.5±41.23	292.5±25.16	374.4±30.20	294.1±27.35
Bread crumb quality*	6.35±0.66	5.25±1.73	5.9±0.70	6.25±0.20
		30 days		
Bread volume, ml	400.5±25.82	282.5±34.16	343.1±38.15	360.00±40.20
Bread crumb quality*	5.28±1.46	5.28±0.97	4.7±0.35	2.28±0.65
		60 days		
Bread volume, ml	335.0±75.72	300.0±32.66	392.8±42.2.	325.6±44.75
Bread crumb quality*	5.28±1.46	5.28±1.02	6.7±0,20	3.1±0.75

*Scores: 7 - the best, 0 - the worst

The characteristics of fibers, *i.e.* their interaction with gluten matrix, as well as their protective role in preserving the yeast activity can be followed by the scores for the bread crumb quality. During freezing, bread crumb deteriorates more rapidly if fibers are not incorporated into the dough or if not the appropriate fiber is added, like inulin GR. By incorporating fibrex at the level of 5 %, in the period of 60 days, frozen dough is keeping the same quality, not the highest but it is not varying. That way fibrex is enabling a uniform quality of specialty type of the yeast leavened bakery products. Concerning inulin, the data from Table 2 point to the importance of fiber characteristics, in this case, to the molecule size and its interaction with dough constituents. Over a longer period of storing inulin HPX is beneficial in preserving the quality of final products made from the dough that had been stored at -20 °C at the initial level and the adverse effect of the fiber on bread crumb quality is not evident.

CONCLUSIONS

On the basis of the obtained results and their statistical interpretation, the following conclusions can be drawn:

Fibers in the dough interrupt gluten matrix and therefore decrease the quality of dough and bread, but the adverse effects depend on fiber characteristics.

The protective effect of fibres on the yeast activity can be followed by the influence of fibres on the final proof and it is constant and uniform in a period of 60 days of freezing.

Yeast dough with fibrex at the level of 5 % in the period of 60 days of storing in a frozen stage is keeping uniform but not the highest quality.

Over a longer period of storing inulin with longer molecular chains is beneficial in preserving the quality of final products at the initial level and the adverse effect of fiber on bread crumb quality is not evident.

Bakery products enriched with fibers can be successfully produced by the frozen dough technology, enabling quick preparation of a wider variety of fresh and appealing final products on larger areas, thus positively contributing to special nutritive consumers needs.

Acknowledgements

These results are part of the project supported by the Ministry of Science and Technological Development of the Republic of Serbia, TR 20068.

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