STUDIES CONCERNING SURFACTANTS INFLUENCES ON PART BACKED FROZEŃ QUALITY

Delia Andronic[1], Mircea Bulancea[2], Adriana Dabija[3], Anca Miron[1]
[1]S.C.Pambac S.A., Moinesti Street, 14, Bacau, Romania
[2]"Dunarea de Jos" University of Galati, Domneasca Street, 111, Galati, Romania
[3]University of Bacau, Marasesti Street, 157, Bacau, Romania

Abstract

The quality of part backed frozen is conditioned, besides obtainment technology, by the establishment of an optimum recipe which contains those ingredients which can remove the negative effects of frosting and defrosting. The paper shows own researches concerning DATEM and SSL addition in the manufacturing recipe of pre-baked frozen bread, emphasizing on the influence over the finished products' quality.
The finished products were physical-chemical characteristics analyzed regarding volume, porosity, core elasticity, humidity and acidity.
Keywords: *pre-backed frozen bread, finished products 'quality frozen.*

Introduction

Part baked bread is incompletely baked bread. After the incomplete baking process the part baked bread has a stabile shape and volume, a partly formed crust of a very thin layer, little or without any colour. It is commercialized under this form, being subsequently transformed in a finished product, after the final bake. Generally, the nutritional characteristics of normally baked bread are superior than those of part baked bread.

In order to improve the quality of part baked bread, some experiments were made to perfect its manufacturing recipe through an addition of various ingredients.

Surfactants, also known as active surface substances or surface agents are by definition substances with the property to stabilize emulsions (Bordei, 2004).

In the dough, the surfactants can form, because of the existence in their molecule of hydrophilic and hydrophobic groups, extra bonds in its polar and un-polar zones, influencing dough's rheological properties and bread quality. There can be formed bonds type protein-water, protein-protein, protein-lipids, protein-glucides which determine the appearance of

compact surfaces, impenetrable to gases, an increase of water's bonding quality in the dough, its fixing in the core of the frosted products (Kulp, 1995; Neyreneuf, 1991).

The paper shows own researches in using two surfactants: DATEM (acetic acid esters of mono – and diglycerides) and SSL (sodium steroyl-2-lactylate) in the manufacturing recipe of frozen pre-baked bread, emphasizing its influence on the finished product's quality.

Experimental

The researches were made within S.C. Pambac S.A. Bacau on an existing technological line for obtaining pastry products.

The raw materials and manufacturing recipe used for obtaining the part baked bread needed for experiments were: flour 650 – 1 kg; bakery yeast – 1.9%; salt – 1.7%; water – 55%.

DATEM is acetic acid esters of mono – and diglycerides of fatty acids. They have of great capacity to form complexes with glutenic proteins in wheat flour dough, which improves the dough's capacity to retain gas, being among the most efficient dough conditioners. It also shows anti-staling properties. Their composition is: 80% acetic acid esters of mono – and diglycerides of fatty acids; 20% calcium carbonate (Grandvoinnet, 1997).

Sodium steroyl-2-lactylate (SSL) represents a mixture of sodium salts of the reaction products formed through the combining of fat acids with lactic acid. The mixture contains fat acids salts, fat acids' esters salts with polimerizated lactic acid. They are very efficient dough fortifying agents, as well as good anti-staling agents.

The technological characteristics of obtaining frozen part baked bread require the following operations: pre-baking, cooling, frosting, defrosting and final baking. Following repeated experiments this optimum possibility was reached: pre-baking ¾ of baking time followed by quick cooling, quick frosting and slow defrosting. Pre-baking is made in order to coagulate proteins and to gelatinize starch. Knowing the traditional baking duration in the classic procedure for a 0.300kg bread is 16 minutes, in the experiments - for obtaining part baked bread - the baking process was interrupted at ¾ of baking duration, 12 minutes.

The pre-baking temperature used was 190 – 200^0C, inferior to that used in the classic process: 220 – 230^0C.

After oven placement a 1 minute steaming process was made in order to prevent premature formation of crust and to subsequently obtain a shiny and uniformly colored crust. Quick cooling was made in a acclimatized

environment to a temperature of 4 - 6^0C for 30 – 35 minutes, and quick frosting at a temperature of -30 - -35^0C, for 120 – 130 minutes. The products underwent a slow defrosting, of a 100 – 110 minute duration, at a 28 – 30^0C temperature. After defrosting, the products were baked in the rotary oven for 4 minutes at 220 – 230^0C.

Before being introduced in the technological process the surfactant added flour was analyzed from a rheological and technological point of view, with Chopin alveograph and Brabender farinograph in the testing laboratory.

The bread final product was determined for volume, porosity, core elasticity, humidity and acidity compared to known standards.

Results and Discussions

The influence of DATEM addition. This surfactant has a big capacity of bonding with gluten proteins founding wheat flour dough, leading to an improvement of dough's capacity to retain gas, thus being one of the most efficient dough conditioner.

In the manufacturing recipe, the surfactant has been added in three distinct quantities: 0.2g/100 kg, 0.4g/100 kg and 0.6g/100 kg, compared to lour quantity. After dosing according to flour, the mixture was then mixed and homogenized.

After the obtainment of a homogenized mixture, it was analyzed in the testing laboratory. The results obtained are shown in tables 1 and 2.

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.

Table 1: The influence of DATEM addition over rheological properties of raw material flour

Sample number	DATEM addition [g/100 kg flour]	Alveogram characteristics			
		P [mm]	L [mm]	W [10^{-4}J]	P/L
1	0.2	86	86	248	1.00
2	0.4	88	93	259	0.95
3	0.6	84	97	253	0.87

From the alveograph, an improvement of energy absorbed by the dough and an increase of its resistance is observed.

Table 2: The influence of DATEM addition over technological properties of raw material flour

DATEM addition [g/100 kg flour]	Farinogramme characteristics					
	Absorption capacity [%]	Development [min.]	Stability [min.]	Elasticity [U.B.]	Softening [U.B.]	Power
0.2	54.7	1.15	4.00	110	65	50
0.4	54.5	1.15	8.45	110	50	52
0.6	54.0	1.00	5.15	100	50	54

The farinograph shows a decrease of dough's softening value and an improvement of power at an increase of DATEM quantity added.

From the analysis made, an improvement of dough's rheological properties and an increase of its resistance to mechanic processing can be ascertained.

The bread samples obtained with DATEM addition were analyzed from a physical-chemical point of view in the research laboratory of S.C. Pambac S.A. The results obtained were synthesized in tables 3, 4 and 5.

Table 3: Physical-chemical indicators of pre-baked bread ¾ with a 0.2% DATEM addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	306	81.1	82.4	43	1.2
20	303	80.8	82	43.2	1.2
30	305	80.8	82.6	43.1	1.2
45	302	80.4	83	43	1.2
Control sample	360	83.1	86	41	1.2

Table 4: Physical-chemical indicators of pre-baked bread ¾ with a 0.4 % DATEM addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	344	82.4	84.9	43	1.2
20	347	82	83	43.2	1.2
30	350	82.1	87.9	43	1.2
45	345	82.8	87	43.1	1.2
Control sample	393	84.5	92	41	1.2

Table 5: Physical-chemical indicators of pre-baked bread ¾ with a 0.6 % DATEM addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	386	85.1	89.4	43	1.2
20	387	85.4	90.5	43	1.2
30	384	85.4	91.9	43.2	1.2
45	387	85.7	90.4	43.4	1.2
Control sample	453	87.9	96	41	1.2

From the results obtained in the experiments it can be observed that the samples' volume is smaller than the control sample's volume, no matter the DATEM quantity added or storage duration.

Comparing to the samples with 0.2% DATEM addition, the samples' volume improved by 14% at 0.4% DATEM addition, respectively by 27% at 0.6% DATEM addition. Comparing to the martor sample a decrease of averagely 2.7% of bread porosity at DATEM addition is ascertained.

Increasing DATEM quantity from 0.2% to 0.4% and 0.6% has led to an improvement of sample's core porosity by 1.9%, respectively by 5.7%.

Prolonging storage duration in a frozen state from 10 days to 20 days, 30 days and 45 days does not influence the value of the quality indicator.

It was observed that, increasing DATEM quantity positively influenced core elasticity. Thus, the 0.6% DATEM addition led to a core elasticity improvement of 9.8% comparing to the0.2% DATEM addition samples, as shown in fig. 8.53.

The influence of sodium steroyl-2-lactylate addition. In the manufacturing recipe SSL was added in three distinct quantities: 0.3 %, 0.5 % and 0.6 %, compared to flour quantity. After the dosage in flour was made, the mixture was blended and homogenized.

After forming a homogenous mixture, it was analyzed in the research laboratory. The results obtained are shown in tables 6 and 7.

Table 6: Alveogram results for SSL addition

Sample number	SSL addition [%]	Alveogram characteristics			
		P [mm]	L [mm]	W [10^{-4}J]	P/L
1	0.3	93	75	237	1.24
2	0.5	98	72	244	1.36
3	0.6	99	78	260	1.27

The alveograph shows an improvement of deforming power (W).

Table 7: Farinogram results for SSL addition

SSL addition [%]	Farinogram characteristics					
	Hydration capacity [%]	Development [min.]	Stability [min.]	Elasticity [U.B.]	Softening [U.B.]	Power
0.3	54	1.15	4	110	75	48
0.5	54	1.15	3.30	110	75	47
0.6	54	1.00	2.45	120	90	47

The farinograph shows a decrease of dough stability and an increase of softening value.

The bread samples obtained with SSL addition were analyzed from a physical-chemical point of view in the research laboratory at S.C. Pambac S.A. The results obtained were synthesized in tables 8, 9 and 10.

Table 8: Physical-chemical indicators of pre-baked bread ¾ with a 0.3 % SSL addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	295	77.9	77.6	43	1.2
20	298	78.3	77	43.4	1.2
30	294	78.1	77.8	43.5	1.2
45	296	78.1	77.2	43	1.2
Control sample	333	81.4	81.6	42	1.2

Table 9: Physical-chemical indicators of pre-baked bread ¾ with a 0.5 % SSL addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	314	77.2	77.8	43.2	1.2
20	323	77.8	79.1	43.1	1.2
30	320	76.8	78.8	43.4	1.2
45	318	77.6	79	43.5	1.2
Control sample	345	80	82.5	42	1.2

Table 10: Physical-chemical indicators of pre-baked bread ¾ with a 0.6 % SSL addition

Storage duration [days]	Physical-chemical indicators of sample bread – finished product				
	Volume [cm^3/100g]	Porosity [%]	Elasticity [%]	Humidity [%]	Acidity [degrees]
10	307	76.6	78	43.4	1.2
20	316	76.6	78.4	43	1.2
30	309	75.9	77.6	43.1	1.2
45	311	75.5	78.9	43.3	1.2
Control sample	338	79.6	82.8	42	1.2

The samples' volume improved by 7.8% at an increase of SSL quantity from 0.3% to 0.5% and only by 5% at a dosage increase from 0.3%

to 0.6%. A dosage increase over 0.5% SSL is not recommended. The storage duration did not influence the value of this indicator.

By adding SSL the samples' porosity and that of the control sample generally remains unchanged, but for the addition of 0.3% the highest value was obtained for both samples and control sample. The samples' porosity is smaller than that of the control samples at the same amount of SSL added quantity, more obvious at the 0.3% addition and less obvious at the 0.6% one.

Concerning the elasticity of the samples obtained, there is a great difference between the samples and the control sample at the same amount of SSL added. An increase of SSL quantity did not lead to an increase of core elasticity in the obtained samples.

Conclusions

DATEM addition contributes to the volume improvement of finished products obtained after baking the pre-baked products. Also, an improvement of porosity structure and core texture is obtained, by increasing DATEM added quantity. At the same amount of DATEM added, the volume, porosity and elasticity are smaller than that of the control samples, while humidity increases than that of the control samples. Storage duration has a minimal influence on the samples' quality indexes, regardless the DATEM added quantity. DATEM addition improves tolerance to the quality variations of the flour used.

SSL addition contributes to the volume improvement of finished products obtained after baking the pre-baked products and had a minimal influence on core porosity and texture. At the same amount of SSL added, the volume, porosity and elasticity are smaller than that of the control samples, while humidity increases than that of the control samples. Storage duration has a minimal influence on samples' quality indexes, regardless the SSL added quantity.

References

Bordei, D. (2004). Tehnologia moderna a panificatiei, Editura AGIR, Bucuresti

Grandvoinnet, P., Pratx, B. (1997). Les ingredients des pates. Farines et mixes, Paris

Kulp, K., *et al.* (1995). Frozen & Refrigerated Dough and Batters, American Association of Cereal Chemists, Inc. St. Paul, Minnesota, USA

Neyreneuf, O., Van der Plaat, J. B. (1991). Preparation of frozen dough with improved stability , *Cereal Chemistry*, 68, 60-65

Autio, K., (2006). Functional Aspects of Cereal Cell-Wall Polysaccharides. In *Carbohydrates in Food*, Taylor & Francis, LLC.
Banu, C. ş.a., (2000). *Biotehnologii în industria alimentară*. Editura Tehnică, Bucureşti.
Banu, C.ş.a., (2000). *Aditivi şi ingrediente pentru industria alimentară*. Editura Tehnică, Bucureşti.
Bordei, D.ş.a., (2000). *Ştiinţa şi tehnologia panificaţiei*. Editura AGIR, Bucureşti.
Carvajal-Millan, E., Guilbert, S., Doublier, J.L., Micard, V., (2006). Arabinoxylan/protein gels : Structural, rheological and comtrolled release properties. *Food Hydrocolloids, 20,* p. 53-61.
Chaplin, M., (2004). Water Structure and Behavior. London South Bank University. London. http://www.lsbu.ac.uk/water/.
Courtin, C., Delcour, J.A., (2002). Arabinoxylans and endoxylanases in wheat flour bread-making. *Journal of Cereal Science, 35,* p.225-243.
De Vries, R.P., Visser, J., (2001). Aspergillus Enzymes Involved in Degradation of Plant Cell Wall Polysaccharides. *Microbiology and Molecular Biology Reviews, Vol.65, No. 4,* p.497-522.
Egi, A., Speers, R.A. and Schwarz, P.B., (2004). Arabinoxylans and Their Behavior During Malting and Brewing. *MBAA TQ vol. 41, no. 3,* p. 248–267.
Figueroa-Espinoza, M.C., Rouau, X., (1998). Oxidative Cross-Linking of Pentosans by a Fungal Laccase and Horseradish Peroxidase: Mechanism of Linkage Between Feruloylated Arabinoxylans. *Cereal Chem., 75 (2).*
Izydorczyk, M., Biliaderis, C.G. and Bushuk, W., (1991). Physical properties of water soluble pentosans from different wheat varieties, *Cereal Chem.*, 68, p.145.
Izydorczyk, M. S., Biliaderis, C. G., (1995). Cereal arabinoxylans: Advances in structure and physicochemical properties. *Carbohydrate Polymers, 28,* 33–48.
Jeffries, T.W., (1994). Biodegradation of lignin and hemicelluloses. În *Biochemistry of Microbial Degradation*, p.233-277, Kluwer Academic Publishers.
Loosveld, A.-M.A., Delcour, J.A., (1999). The effects of wheat flour arabinogalactan-peptide on mixing characteristics of wheat flour dough and the resulting breads. *2nd European Symposium on Enzymes in Grain Processing ESEPG-2,* p.293-297.
Miller, K.A., Hoseney, R.C., (1999). Effect of oxidation on the dynamic rheological properties of wheat flour-water doughs. *Cereal Chemistry, 76, ian.-febr.,* 100-104.
Moore, A.M., Martinez-Munoz, I., Hoseney, R.C., (1990). Factors Affecting the Oxidative Gelation of Wheat Water-Solubles. *Cereal Chem., 67 (1),* p.81-84.
Palonen, H., (2004). Role of lignin in the enzymatic hydrolysis of lignocellulose. *Doctoral Dissertation – Helsinki University of Technology, ESPOO Finland.*
Rimsten, L., (2003). Extractable Cell-Wall Polysaccharides in Cereals, with Emphasis on β-Glucan in Steeped and Germinated Barley. *Doctoral thesis-Swedish University of Agricultural Sciences.*
Stauffer, C.E., (1990). *Functional additives for bakery foods.* Van Nostrand Reinhold, New York.
Vardakou, M., et al., (2004) - Synergy between enzymes involved in the degradation of insoluble wheat flour arabinoxylan. *Innovative Food Science and Emerging Technologies, 5,* p.107-112.
Wang, M., (2003). Effect of pentosans on gluten formation and properties. *Thesis Wageningen University.*