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INFLUENCE OF LONG LASTING FREEZING TO BAKING QUALITY

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ABSTRACT

Foodstuff adapted by freezing is able to use for final setting immediately and its important contribution is sparing of working action and time connected to their next setting in our households or in catering corporations. In frame of this topic some baking experiment were realized with application of the main component – smooth wheat flour T 650 and the raw yeasting. It was monitored the baking quality of loafs made of fresh dough and loafs made of dough which was frozen one, two, three, four, five, six and nine months in -18°C. The biggest decline of the quality of bread made from frozen dough was monitored right after the first month. Decline of its size was 19.0%. Strong decline of size was monitored after five months (18.1%) and after six months of storage in freezer (23.8%). Decline of baking quality during storage was mainly caused by declining activity of yeasts and by the loss of their yeasty ability. These conditions cased gradual decline of the solidity of the dough.

Keywords: Freezing, frozen, baking yeasts, quality of baking products

INTRODUCTION

Cooling and freezing are the anabioz conservation, which is characterized as an indirect inactivation of microorganisms (**Revenue Ministry and the Ministry of Healthno 981/1996-100**). **Paveleková *et al.* (2006)** cite that the ways of modification of food environs could have physical, physical-chemical, chemical or biological character. Conservation methods based on using of lowered temperature - cooling and freezing of foodstuff are classified as a physical and physical-chemical anabiotic conservation methods. The influence of low temperature to microorganisms and consequential degradation of their living conditions are important factors for sustainment of foodstuff.

Drdák *et al.* (1996) point to the fact that deep-freezing is such a method of preservation, that has less affect to taste changes, but improper defrosting can have visible changes to the structure, which causes deterioration of the nutritional value.

Crystal growth during the storage may results to increased protein concentration of the polymer matrix and the separation of gluten from the starch granules (**Zounis *et al.*, 2002**), and therefore several authors (**Balaštík, 2001; Horčin, 2004**) are highlighting the importance of rapid freezing, especially in the temperature range from 0 to -5°C, where is the risk of large crystals forming, distorting the texture of bakery products. Freezing of dough at -20°C and storage at the same temperature showed a higher activity of yeasts and better baking properties as freezing of dough at but using -30°C and stored at -20ºC (**El-Hady *et al.*, 1996**).

The quality of frozen products depends primarily on the selection of raw materials and appropriate technology process. Particularly important is the time required for freezing the dough, the number and vitality of yeast (**Ribotta *et al.*, 2001**). Fermentation of the dough just before freezing is several authors consider as harmful and they recommended leave out, threatens the vitality of the yeast and mention that the greater stability of unfermented dough (**Merritt, 1960; Kline *et al.*, 1968; Hsu *et al.*, 1979**).

Buchtová *et al.* (2009) argue that frozen food allow to maintain a varied diet regardless of season, which is an important factor in saving labor and time associated with their further preparation in home kitchens and restaurants. The basic condition for ensuring the health safety of frozen food is keeping the temperature chain not only during the freezing, but especially for their subsequent handling during the storage, transport and marketing.

MATERIAL AND METHODS

Experimental loafs were prepared from the mixture of smooth wheat flour T 650 (Mlyn Pohronský Ruskov a.s. Hlavná 76, 935 62 Pohronský Ruskov, SR) (500 g), saccharose (5 g), salt (9 g), yeast (20 g) (Trenčianske droždie, company: OLD HEROLD HEFE, s.r.o. Bratislavská 36, 911 05 Trenčín, SR) and water according *Farinography waterabsorption* of flour. Used flour was characterized by these indexes: *content of dry mass*, % (**ICC Standards No. 110/1 (1976)**), *the content of ashes*, *%* **(ICC Standard No. 104/1, (1990))**, *number of decline*, *s* (**Falling Number, measurer FN 1800, Perten, according ICC Standard No. 107/1, (1995)**), *sedimentation index according Zeleny*, cm^3 (**ICC Standard No. 116/1, (1994)**), *content of wet gluten*, *%* (**Glutomatic 22000, Perten, ICC Standard No. 155, (1994)**) and *crude protein*, *%* (**ICC Standard No. 159, (1995)**). Baking experiment was made without using of enzyme based preparations and another improvement factors. Dough was worked out in laboratory kneader Diosna SP 12 brand. Than the dough was formed into loafs, which were rising in rising machines 20 minutes with the temperature of 30°C and were baked on 240°C in time 20 minutes and steamed over in the oven Miwe Condo brand. This was the process of the preparation of control samples of wheat loafs. Remaining loafs were inserted into freezer with the temperature of - 18°C (AFG 070 AP, company: Whirlpool Slovakia spol. s.r.o., 820 09 Bratislava 29, SR) before fermentation. Then they were stored one, two, three, four, five, six and nine months in freezer. Defrosting of loafs before rising and baking was practised 2 hours in temperature 22°C ±2°C.

Baked loafs were evaluated by objective methods used for valuation of baking quality during freezing storage. It was set *volume of products* (cm^3), *valuating volume of products* ($cm^3.100g^{-1}$), *volume extraction* ($cm^3.100g^{-1}$ of flour), *extraction of baking products* (%), *baking losses* (%) and *vaulting* (proportion of height and width of loafs). Valuation was made by standard processes and calculation which use to be ordinarily used on solution working places.

RESULTS AND DISCUSSION

Results of determination chemical composition of used flour as the most important material for production of experimental loafs are resumed in scheme 1. Used flour was middle strong up to strong class and was suitable for separate using for production of rising baking products, but also for improvement of the quality of poorer flour mixtures and for producing of dough used for freezing storage. (**Muchová *et al.*, 2011**).

Scheme 1 Analysis of smooth wheat flour T 650 used for baking experiment

	Farinography waterabsorption %	Falling number s	Sedimentation index by Zeleny cm^3	Wet gluten %	Crude protein %	Ash content %
Flour T 650	60.0	324.0	40.0	32.6	11.5	0.49

Marston (**1978**) and **Benešová *et al.*** (**1999**) said that flour is negatively influenced by freezing and defrosting during the production of frozen dough besides normal damage of flour during mixing, dividing and shaping. They advice to use strong quality flour with content of proteins 13% until 14% and other authors recommended to improve the quality of flour by using of vital gluten, but they also warn not to use too much of it, because it can negatively influence the colour, taste and the texture of baking product (**Innoue *et al.*, 1991**). The practical importance of gluten in baking technology is in helping to produce small pellicles during dough production process. These pellicles are holding fermentation gas, allowing rising of dough, helping to baking process and providing spongy structure of baking product (**Bojňanská, 2004**). **Wolt *et al.*** (**1984**) as the first referred that the quality of proteins in flour is very important for production of bread from frozen dough. **Neyreneuf *et al.*** (**1991**), **Inoue *et al.*** (**1992**) and some others are identifying with this opinion.

Related to flour quality **Benešová** (***et al.* 1999**) referred, that the flour with high amylase activity (low number of decrease) is not suitable for production of frozen products. The flour T 650 used for experiment had the ordinary amylase activity (number of decrease 324 seconds) which is optimal number for flour suitable for rising baking products.

Results of baking experiments and changes of individual indexes of baking quality during freezing storage with the temperature of -18°C are presented in Scheme 2. Result of the measuring is the decrease of the quality of baked loafs. The most important changes of frozen dough are connected to yeasts. Because the frozen process damaged cells and they release glutathione which reduce the structure of gluten and cause worse retention of gases and lengthen the time of fermentation (**Kline *et al.*, 1968; Hsu *et al.*, 1979; Autio *et al.*, 1992; Pepe *et al.*, 2005**;). Worsen retention of gases was practically expressed by the small volume of experimental loafs.

Scheme 2 Results of baking experiment on backed loafs after freezing storage

Time of storage temperature -18°C	Volume of product cm^3	Measuring volume of product cm^3.100g	Volume recovery of product cm^3.100g flour	Vaulting of the product /	Recovery of product %
Baked immediately (control)	262.5	297.1	420.0	0.58	141.3
1 month	212.5	231.9	340.0	0.48	146.5
2 months	225.0	258.3	360.0	0.54	139.3
3 months	240.0	264.6	384.0	0.55	145.1
4 months	235.0	283.7	380.0	0.59	133.9
5 months	215.0	239.1	344.0	0.50	143.8
6 months	200.0	230.9	320.0	0.46	138.5
9 months	240.0	261.2	360.0	0.45	137.7

Benešová *et al.* (**1999**) agree with previous authors and in addition they note possible damage of yeasts by alcohol, which came from the fermentation. The biggest volume decrease was noticed after the one month freezing of dough up to 19% in comparison to loaf immediately baked (according to control). Moderate decrease was detected after two, three and four months of dough storage in freezer in comparison to the control. After five months of storage it was detected considerable decline in volume (up to 18.1%) and after six months it was up to 23.8% in comparison to the control. Volume decline after nine months of dough storage was just 8.6% in comparison to control. But this phenomenon is possible to explain by marbling which is created by the unbind water in dough. During defrostation air blisters are created and rising during the baking. Thanks to the air blisters the volume is bigger, so figures as skewed (picture 1). This is the reason why vaulting figure is more deciding in evaluation of the quality of frozen loafs.

Hampl *et al.* (**1981**) notice causes of blistered baking products. One reason can be the application of fresh immature flour, or the flour made of germinated cereals. Another reason can be the cold dough. We can avoid this mistake when we mix flour and keep dough in temperature of 29-31°C.

Scheme 2 shows that baked experimental leafs after two, three and four months of storage in freezer have suitable results of vaulting which achieve comparable ratio of height and width of loafs. Frozen and baked loafs after one, five, six and nine months were evaluated as products with unsuitable vaulting according **Muchová *et al.*** (**2011**) a **Hampl *et al.*** (**1981**) The next Picture 1 shows general quality of loafs which is the sum of selected criterions during the observation time.

The picture shows strong decline of baked loaf quality after one month of storage. If we compare it to control, the decline was more moderate during the storage time. The reason is the bigger activity of expected lower number of yeasts during the fermentation process in second, third and fourth month of storage. We can see at the Figure 1 that the general quality of baked product after five, six and nine months of freezing reach the lower technological quality in comparison to control.

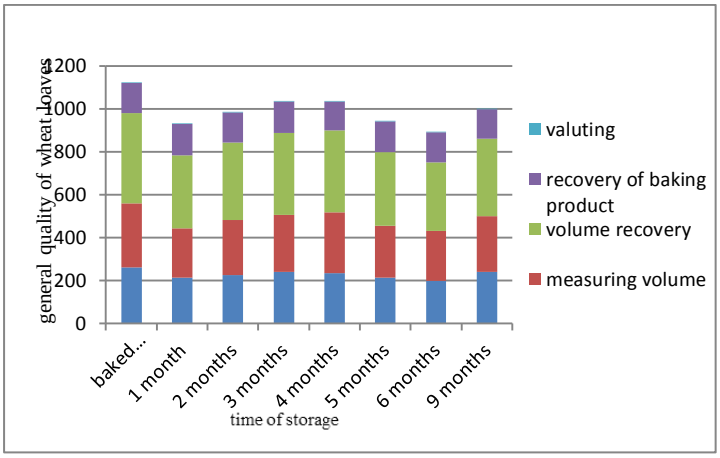

Figure 1 Transformation of wheat loaf quality during the freezing storage

CONCLUSION

Thanks to our research we can pronounce that the quality of wheat loaf decrease with increasing time of freezing storage. Noticeable decrease of general quality was noticed after the first month of storage and after five, six and nine months of freezing storage. According of these facts we recommend storage of frozen pieces of yeast dough no longer as four months. If we store the dough longer unacceptable blisters are created and the quality of dough is not technically sufficient.

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