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**REGULAR ARTICLE**

# TEXTURE ANALYSIS OF SPELT WHEAT BREAD

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## ABSTRACT

The bread quality is considerably dependent on the texture characteristic of bread crumb. Texture analysis is primarily concerned with the evaluation of mechanical characteristics where a material is subjected to a controlled force from which a deformation curve of its response is generated. It is an objective physical examination of baked products and gives direct information on the product quality, oppositely to dough rheology tests what are inform on the baking suitability of the flour, as raw material. This is why the texture analysis is one of the most helpful analytical methods of the product development. In the framework of our research during the years 2008 – 2009 were analyzed selected indicators of bread crumb for texture quality of three *Triticum spelta* L. cultivars – Oberkulmer Rotkorn, Rubiota and Franckenkorn grown in an ecological system at the locality of Dolna Malanta near Nitra. The bread texture quality was evaluated on texture analyzer TA.XT Plus and expressed as crumb firmness (N), stiffness ($N.mm^{-1}$) and relative elasticity (%).Our research proved that all selected indicators were significantly influenced by the year of growing and variety. The most soft bread was measured in Rubiota, whereas bread crumb samples from Franckenkorn were the most firm and stiff. Relative elasticity confirmed that the lowest firmness and stiffness was found in Rubiota bread. The spelt grain can be a good source for making bread flour, but is closely dependent on choice of spelt variety.

**Keywords:** bread, spelt, texture, firmness, stiffness, relative elasticity

## INTRODUCTION

The bread is one the most popular food products in the world, and it has more than thousand-year history. Bread used to be one of the essential foods for the people. Therefore, maintaining good bread quality is very important. The bread quality is considerably dependent on the texture characteristic of bread crumb (**Nagy *et al*., 2006; Barrett *et al*., 1994; Scanlon *et al*., 1997**). The bread crumb has a reasonably complex rheological structure. Mostly the elastic and viscous properties prevail; accordingly the bread crumb shows viscoelastic features. However, in a certain extent, the plastic behavior can be observed (**Scanlon and Zghal, 2001; Hayman *et al*., 1998; Chen *et al*., 1994**). Bread crumb is comprised at a macroscopic level of two phases a fluid and a solid. Looking at the cross section of bread crumb, the solid phase is entirely connected, the air cells are isolated. The volume fraction of the phases and the character of their connection determine the structure and the mechanical properties of the bread. Therefore there is need for rapid and simple test methods being suitable for practical applications (**Meretei *et al*., 2003; Zheng, 2004**). Texture analysis is primarily concerned with the evaluation of mechanical characteristics where a material is subjected to a controlled force from which a deformation curve of its response is generated. These mechanical characteristics in food can be further sub-divided into primary and secondary sensory characteristics which have proven to be correlated to sensory perception. Texture analysis is an objective physical examination of baked products and gives direct information on the product quality, oppositely to dough rheology tests what inform on the baking suitability of the flour, as raw material (**Carson and Sun, 2001**). This is why the texture analysis is one of the most helpful analytical methods of the product development, as it is suitable to quantify the effects of flour blends and additives on physical properties of crust and crumb of the breads. It is also suitable to examine the effects of storing on different sensory properties of these products and hence it is suitable to analyze the results of different recipes in product development (**Sipos *et al*., 2008**). The objective of this study was to determine the texture of spelt wheat bread.

## MATERIAL AND METHODS

In the framework of our research during the years 2008 – 2009 we analyzed selected indicators for bread texture quality of three *Triticum spelta* L. cultivars – Oberkulmer Rotkorn, Rubiota and Franckenkorn grown in an ecological system at the locality of Dolna

Malanta near Nitra. The bread texture quality was evaluated on texture analyzer TA.XT Plus and expressed as crumb firmness (N) – the maximum force needed to compress the bread crumb sample, stiffness ($N.mm^{-1}$) – the linear part of the slope of the force/deformation curve and relative elasticity (%) – ratio between the remaining force measured 20 seconds after the maximum force was reached and the maximum force. They were evaluated in six replicates and the results presented are means of the six realized measurements. All data were statistically analysed by analysis of variance (ANOVA) and Fischer test. The least significant difference at the 5% probability level (P value<0.05) was calculated for each parameter.

## RESULTS AND DISCUSSION

Evaluation of the mechanical properties of bread crumb is important not only for quality assurance in the bakeries, but also for assessing the effects of changes in dough ingredients and processing condition and also for describing the changes in bread crumb during storage (**Meretei *et al.*, 2003; Szczesniak, 2002**).

Bread crumb is a complex viscoelastic foam material and its texture is an important quality indicator, as consumers prefer different bread taste. Mostly breads with softer texture are required, it means that low maximum forces by compression of the crumb sample is in demand (**Sipos *et al.*, 2008; Scanlon *et al.*, 2000**). Our research proved that all selected indicators were significantly influenced by the year of growing and variety of *Triticum spelta.*

Crumb texture is an important quality indicator, as consumer prefer different bread taste. Diverse request for the specific taste is mostly caused by cultural, traditional as well as individual habits (**Różyło and Laskowski, 2011**). The bread texture quality was evaluated and expressed as crumb firmness, stiffness and relative elasticity.

Bread crumb firmness is expressed as the maximum force needed to compress the bread crumb sample. The low maximum force indicates soft bread crumb texture. The average bread crumb firmness was 15.48 N. Statistical analysis confirmed significant differences among evaluated breads prepared from three spelt varieties. Rubiota bread had the softest crumb (Tab 1). Contrary, the most firm bread crumb (more than 18 N) was found in Franckenkorn. Crumb firmness was better in 2008 (10.49 N) as compared with 2009 (20.48 N), when 51.2% higher firmness was achieved.

**Table 1** Texture analysis of spelt wheat bread, average values for 2008-2009

| VARIETY | Crumb firmness (N) | Crumb stiffness ($N.mm^{-1}$) | Relative elasticity (%) |
|---|---|---|---|
| **Oberkulmer Rotkorn** | 15.81 b | 1.07 b | 95.74 ab |
| **Rubiota** | 12.16 a | 0.80 a | 96.20 b |
| **Franckernkorn** | 18.48 c | 1.24 c | 95.37 a |
| **YEAR** | | | |
| **2008** | 10.49 a | 0.71 a | 97.11 b |
| **2009** | 20.48 b | 1.37 b | 94.44 a |
| **AVERAGE** | **15.48** | **1.04** | **95.77** |
| **standard error** | ±6.39 | ±0.44 | ±1.65 |

Crumb stiffness is an important property of bread because of its close human precipitation of freshness. Stiffness is described as the resistance to deformation. The higher is the resistance, the harder is the bread crumb. The average bread crumb stiffness was 1.04 $N.mm^{-1}$ and ranged between 0.8 – 1.24 $N.mm^{-1}$. The lowest crumb stiffness (less than 1.0 $N.mm^{-1}$) was observed in Rubiota. Crumb stiffness was significantly higher in 2009 (1.37 $N.mm^{-1}$) than in 2008 (0.71 $N.mm^{-1}$).

The influence of the variety as well as weather condition on the relative elasticity of bread crumb values was statistically significant. The lowest relative elasticity was found in Franckenkorn and Oberkulmer Rotkorn (Tab 1). The softer bread crumb with higher elasticity generally better satisfies consumer´s requirements. In this case there is a large deformation under the compression force. Furthermore, the elastic deformation within the whole deformation is also large when the loading is stopped. However, the plastic deformation in the bread crumb is relatively small. The ratio of elastic deformation to the maximal deformation is the creep-recovery coefficient, namely the elasticity (**Nagy *et al.*, 2007; Nussinovitch and Steffens, 1992**). As the relative elasticity express ratio between the remaining force measured 20 seconds after the maximum force was reached and the maximum force, we could conclude that the bread crumbs of those two varieties were the most soft. The highest relative elasticity was found in Rubiota (96.2%). In overall evaluation of bread crumb we could suppose that spelt bread crumb was resist to the compression. Better relative elasticity was found in 2008 than in 2009 (97.11% vs. 94.44%).

High correlation coefficient ($0.99^{++}$) confirmed the dependence among bread crumb firmness and stiffness (Tab 2).The higher was the firmness, the higher was also the resistance to deformation. Correlation analysis showed strong negative correlation between relative elasticity and bread crumb firmness as well as bread stiffness ($-0.89^{++}$, $-0.88^{++}$).

**Table 2** Correlation analysis of spelt wheat bread crumb texture

| | Bread firmness (N) | Bread stiffness ($N.mm^{-1}$) | Relative elasticity (%) |
|---|---|---|---|
| **Bread firmness** | 1.00 | $0.99^{++}$ | $-0.89^{++}$ |
| **Bread stiffness** | | 1.00 | $-0.88^{++}$ |
| **Relative elasticity** | | | 1.00 |

## CONCLUSIONS

Our research proved that all selected indicators were significantly influenced by the year of growing and variety. Favourable air temperatures and sufficient precipitation in 2008 reflected into the better baking quality and texture of spelt wheat bread when compared with 2009 (significantly higher value of relative elasticity and lower values of bread firmness and stiffness). The used firmness test method was found to be suitable for the evaluation of the bakery products texture. The most soft bread was measured in Rubiota, whereas bread crumb samples from Franckenkorn were the most firm and stiff. The highest firmness and stiffness of Franckenkorn is probably due to more compact crumb structure than in other varieties. Relative elasticity confirmed that the lowest firmness and stiffness was found in Rubiota bread. The spelt grain can be a good source for making bread flour, but it is closely related to the choice of spelt variety.

The test method developed provide a reliable evaluation procedure of bread crumb texture quality for research purposes and the bakeries, as well. Texture analysis is suitable analytical method for evaluation of bakery products and, after several references data, may be suitable to determine the type of unknown samples. The results of instrumental measurements are comparable to sensory analysis, but more independent laboratory results can be obtained for further statistical analysis.

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