Changes in structural groups in dough and bread from wheat flour with the addition of rice flour

Shevchenko Anastasiia
PhD, Associate professor of the Department of Bakery and Confectionery Goods Technologies
National University of Food Technologies, Kyiv, Ukraine

Litvynchuk Svitlana
PhD, Associate professor, Head of the Department of Physics
National University of Food Technologies, Kyiv, Ukraine

Bakery industry is developing rapidly, being one of the main branches in the food industry, the range of products is increasing, and technologies are being improved. Traditionally, in the technology of bakery products, wheat flour is used as a main raw material with gluten content, which is able to form the gluten framework of products. However, other types of flour are also used, in particular rice flour [1]. Rice flour is widely used in the technology of gluten-free products for celiac patients [2], however, it is also recommended for replacing a part of wheat flour in the manufacture of bakery products for people suffering from inflammatory bowel diseases, since this raw material contains a small amount of dietary fiber, which is not recommended for use in case of these diseases. Also, in diet therapy, along with reducing the amount of dietary fiber, it is recommended to include phospholipids, the source of which is sunflower lecithin [3].

Since rice flour and sunflower lecithin differ significantly from wheat flour in their chemical composition, especially the protein component, it is advisable to investigate the influence of this raw material on the redistribution of functional groups during conformational transformations in dough semi-finished products during fermentation and finished bakery products.

For the research, samples of dough and bread were prepared with the replacement of 30% of wheat flour with rice flour and with the addition of lecithin (3% by weight of flour). Sample with lecithin and without rice flour was the control sample. Determination of conformational transformations in dough semi-finished products and finished products was carried out by the method of infrared spectroscopy in the near-infrared region.

Analyzing the reflection spectra of the dough after kneading, after 3.5 hours of fermentation and finished bread (fig. 1), reflection maxima were observed at the wavelengths: 1460 nm (the first overtone of the valence vibrations of the O-H group), 1770 nm (the first overtone of the S-H group), 1930 nm (the second overtone of O-H deformation vibrations), 2100 nm (the second overtone of N-H deformation vibrations), 2270 nm and 2350 nm.

It was established that the conformational transformations take place to a greater extent in the bread sample with 30% replacement of wheat flour with rice and the control bread sample, which indicates that the protein structure changes significantly under the influence of high temperatures. Dough samples during the fermentation

process also undergo changes in the protein structure compared to samples immediately after kneading.

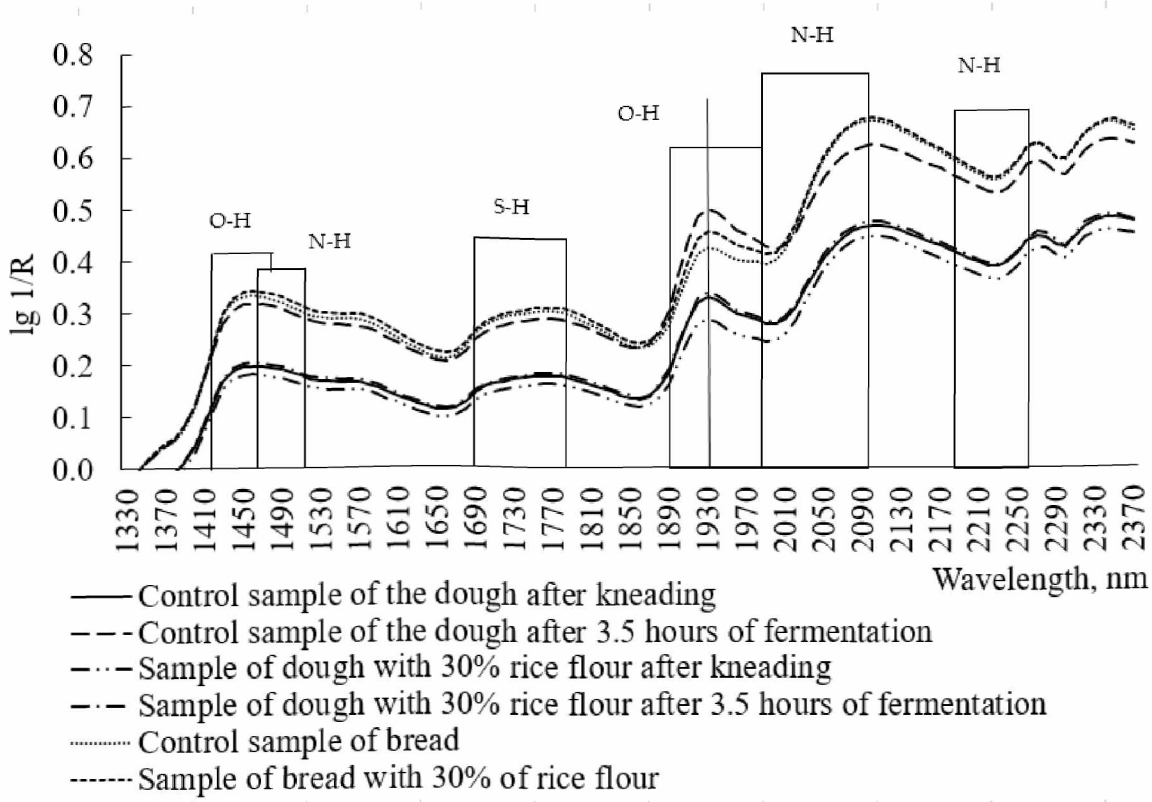

Fig. 1. Changes in structural groups in dough after kneading and after 3.5 hours of fermentation and in bread

Thus, it can be concluded that the difference in the chemical composition and technological properties of rice flour affects the conformational transformations in the structure, in particular, of the protein groups of wheat dough and bread. Rice flour is also a promising raw material for replacing part of wheat flour in order to reduce the amount of dietary fiber in bread for people with inflammatory bowel diseases.

References:

1. Shevchenko, A., & Litvynchuk, S. (2022). Influence of rice flour on conformational changes in the dough during production of wheat bread. Ukrainian Journal of Food Science, 10(1), 5–15. https://doi.org/10.24263/2310-1008-2022-10-1-3.

2. Grischenko, A., & Mykhonik, L. (2016). Gluten-free bread with cereal crops flour. In Food Science for Well-being (CEFood 2016): 8th Central European Congress on Food 2016. National University of Food Technologies.

3. Partridge, D., Lloyd, K. A., Rhodes, J. M., Walker, A. W., Johnstone, A. M., & Campbell, B. J. (2019). Food additives: Assessing the impact of exposure to permitted emulsifiers on bowel and metabolic health – introducing the FADiets study. Nutrition Bulletin, 44(4), 329–349. https://doi.org/10.1111/nbu.12408.