Abstract

The growing interest of consumers in healthy food and its positive impact on the human body induces the introduction of health-promoting food products to the market. Wheat bread, as a basic element of the daily diet, plays an important role in human nutrition, and therefore can be considered as an appropriate carrier of valuable and health-promoting substances necessary for the human body. Currently, bread and other wheat products are made of refined flour, devoid of important nutrients, i.e. dietary fiber and polyphenolic compounds. The above-mentioned nutrients are included in the fiber preparations. The use of fiber preparations and their components for the supplementation of wheat bread can be considered as the waste management from cereal and/or fruit and vegetable production, which is in line with the policy of the European Union. Important components of fiber preparations are polyphenolic compounds that have strong antioxidant properties. Polyphenolic compounds can be added to the dough in the form of extracts or food colors. Understanding the basic mechanism of interaction of polyphenolic compounds with individual components of bread dough may in the future enable the creation of an appropriate technology for the production of bread that will be characterized by health-promoting properties and at the same time will have the quality desired by consumers.

The quality of bread is closely related to the structure of gluten proteins. The proteins' structure also affects the rheological properties of the dough. The research, concerning effects of the dietary fiber preparations on the structure of gluten proteins in wheat dough showed that the observed structural changes in the these proteins are mainly related to the presence of polysaccharides. Therefore, studies were performed in which pure polysaccharides were used. The observed changes in the structure of gluten proteins did not fully coincide with the changes caused by the dietary fiber preparations. For this reason, the aim of the present research was to determine the effect of selected phenolic acids, differing in the amount and type of functional groups at the aromatic ring (cinnamic, caffeic, ferulic, chlorogenic, coumaric acid) as well as the size of the molecule (gallic, ellagic and tannic acid) on the structure gluten proteins in the model and gluten dough. Moreover, the influence of these polyphenols on the rheological properties of the dough was investigated. The researches were carried out on model flour (wheat starch: wheat gluten in the proportion 80:15 w/w) and wheat gluten (without the presence of wheat starch) in order to eliminate the influence of other ingredients naturally present in wheat flour (dietary fiber, lipids, polyphenols) on obtained results. These studies were carried out using spectroscopic methods (Fourier transform infrared spectroscopy (FT-IR) and Raman spectroscopy (FT-Raman)) and the farinographic method 7.

The results of farinographic studies showed a change in the behavior of the dough in the presence of phenolic acids, which was regarded as a "dough breakdown". This phenomenon was the fastest in the case of caffeic acid, and the slowest in the case of p-coumaric acid, which are characterized by the highest and the lowest antioxidant activity, respectively. Dough breakdown was also observed in the case of the benzoic acid series (gallic and ellagic acid). Only tannic acid (the largest molecule) showed a different behavior and stabilized the gluten network.

The results of spectroscopic studies showed that the changes observed in the structure of the gluten network as a result of the dough supplementation with phenolic acids depend on the number and type of functional groups present at the aromatic ring of the acids, their antioxidant activity, as well as molecular size.

Keywords: gluten, phenolic acids, FT-IR, FT-Raman, secondary structure, tertiary structure, farinograp