

Propionic acid fermentation as a method for shaping the nutritional and functional value of selected food industry by-products

Food production is associated with the generation of significant amounts of by-products. In line with the circular economy trend, these products are mainly used as animal feed. They are often a source of many substances that benefit human health. This suggests the possibility of using them more effectively, using their potential in food production. However, the addition of native by-products often causes negative changes in the physicochemical properties of food. One way to eliminate this problem is to use fermentation. Traditionally, the food industry is dominated by the use of lactic acid fermentation, which is responsible for the production of lactic acid and the creation of specific flavour and aroma compounds. Another group of microorganisms with great potential are propionic bacteria. Despite their common use in cheese production, their use in other sectors of the food industry is still negligible. The propionic acid produced by these bacteria has fungistatic properties. The substrates for its production are sugars, glycerol and lactic acid. The use of lactic acid fermentation as a source of lactic acid before propionic fermentation or carrying out both fermentations simultaneously may affect the dynamics of propionic acid formation and the fungistatic properties of the fermented products. While the metabolism of propionic acid formation by propionic bacteria is known, there is still a lack of knowledge on how fermentation using *Propionibacterium* spp. affects the fermented matrix.

This project aims to comprehensively evaluate the effect of fermentation of micronized rye bran and linseed cakes using propionic bacteria (in monoculture) and propionic bacteria supported by lactic acid bacteria (sequential and mixed fermentation) on their fungistatic, nutritional and technological properties, as well as the profile and availability of bioactive compounds.

The selected raw materials for the project are micronized rye bran and flaxseed cake. These raw materials will be fermented using the propionic bacteria *Propionibacterium freudenreichii* ssp. *shermanii* and the lactic acid bacteria *Lactiplantibacillus plantarum*. Three fermentation variants will be used: monoculture fermentation (propionic), sequential (propionic preceded by lactic acid) and mixed (simultaneous lactic and propionic fermentation). The impact of fermentation conditions on the dynamics of formation and content of organic acids, including propionic acid and fungistatic properties of fermented products will be assessed. In subsequent stages, the impact of propionic fermentation conditions on proteins, fats and carbohydrates contained in micronized rye bran and flaxseed cake will be analyzed. The fermented products will also be characterized in terms of technological properties, phenolic compound content (phenolic acids and lignans), antioxidant properties, and, in the case of flaxseed cakes, also the degradation of cyanogenic glycosides. The last stage of the project will determine the effect of adding fermented bran and flaxseed cakes on the rheological properties of dough and the properties of model wheat bread. As part of this last task, analyses of the physicochemical properties of the bread, its nutritional value and the bioavailability of phenolic compounds will be carried out. To determine whether the additive used in bread has fungistatic properties, tests of the microbiological durability of the bread will also be carried out.

The comprehensiveness of the research will allow for obtaining broad knowledge on the influence of different variants of propionic fermentation on the components and technological features of micronized rye bran and flax cake. The results of the project may contribute in the future to more effective use of by-products of the food industry, such as rye bran and flax cake, transforming them into ingredients of high nutritional and functional value, which can increase the durability of food thanks to natural fungistatic properties.