MiCo: new microbe-colloids for oral delivery of probiotics

According to the Food and Agriculture Organization (FAO) and World Health Organization (WHO) definition, probiotics are live strains of carefully selected microorganisms that, when administered in appropriate amounts, bring health benefits to the host. Probiotic bacteria supplemented therapeutically and prophylactically, are used to improve the health of both animals and humans through the modulation of the intestinal microbiota. The probiotic preparations are mostly taken orally (tablets or capsules) and prepared by freeze-drying and spray drying processes. However, these methods lead to a significant decrease in viability of microorganisms and reduce the therapeutic efficacy of the probiotic preparations. To improve the properties of the probiotics, alternative methods of their preparations and storage are being sought. Considering how much probiotics are beneficial to our health, and their use is often the only way to improve our well-being, it is necessary to ensure that the probiotic preparations taken are of the best quality. Unfortunately, it is still a major technological challenge. A promising alternative might be the preparation of the colloid systems that contain the specific stabilizers/protectants (STBs/PRTs) and the probiotic bacteria cells. It is worth mentioning that colloidal systems are already successfully used in pharmacy and medicine for other types of drugs and pharmaceutical formulations. Such solutions could prevent premature inactivation of probiotics both during their storage and already in the digestive system.

The main scientific aim of the proposed research project is to develop modern, functional, and stable colloidal systems containing probiotic bacteria (microbe-colloids). The research work will be focused mainly on hydrogels. The determination of physicochemical stability of prepared colloidal probiotics and assessment of the impact of the STBs/PRTs on the properties of the bacterial cells will be performed. Specifically, this project aims to select the most favorable STBs/PRTs and to define the mechanisms of interaction between the bacterial strains and the selected compounds in the created systems.

In the first stage of the proposed research, an analysis of the effect of additives commonly used in the production of probiotics in the form of dry biomass on the viability of reference probiotic bacteria cells will be carried out. In addition, new strains of bacteria with potential probiotic properties will be isolated from homemade silage and used in further research. The next step will involve the development of colloidal systems containing probiotic bacteria. The produced MiCo (microbe-colloids) will be subjected to a thorough microbiological and physicochemical analysis. As part of the last research stage, the obtained probiotic systems will be compared with other methods of producing probiotic preparations, including those commonly used in the industry. Then, an analysis of the prepared MiCo during long-term storage and in a simulated digestive system will be carried out. Another key element of the research will be a thorough analysis of the surface of bacterial cells in prepared colloidal systems. Several advanced analytical, microscopic and microbiological methods will be used.

The research within the project will significantly widen and deepen the current state of knowledge on colloidal systems, probiotic microorganisms, and methods of producing probiotics. The results of the studies will fill the research gap, which will be important for the development of science. Although, the results obtained within the project will be purely cognitive, they may be helpful in further designing of producing technologies of such preparations with the highest possible functional properties. Due to the potential high utility value of the solutions proposed, they may be extended in the future with the application aspect. The implementation of this project will therefore bring direct and measurable benefits to the entire society.