

The problem of airway-born allergy affects people all over the world and still, despite many scientific studies conducted over several decades, it remains unsolved. It is estimated that every 15-20 years the number of people suffering from allergic diseases doubles. This phenomenon is explained by the increasing air pollution with sulfur and nitrogen compounds, which damage the mucosa of the respiratory tract, facilitating the penetration of allergens into the body. Allergens are invisible compounds like plant pollen, house dust mites, fungal and mold spores, as well as animal hair or feathers. The symptoms of air-borne allergy are not specific and are therefore often mistaken for a cold. The symptoms include a runny nose, scratching the throat, paroxysmal sneezing, dyspnea, conjunctivitis, and less often diarrhea or vomiting. Untreated air-borne allergies lead to complications in the form of asthma, which is a chronic disease that requires long-term medication. According to data from the World Health Organization, about 235 million people worldwide suffer from asthma, in Poland there are 4 million asthmatic patients. One way to prevent asthma is to treat allergy, which is currently associated with several years of desensitisation therapy via painful injections, which in some patients does not work. Therefore, such a widespread problem requires searching for new solutions.

Over the past several decades, attention has been paid to the unique properties of probiotic bacteria. These bacteria have long ceased to be only a supplement consumed to rebuild the microflora during antibiotic therapy. Their use in the treatment of obesity, eczema, necrotising enteritis, autoimmune diseases, depression or hypertension is being investigated. These numerous applications result from the unique immunomodulatory properties of probiotic bacteria, their metabolites and structural components. The above properties are also of interest to our Laboratory. Quite recently, it has been proven that probiotic bacteria, including *Bifidobacteria*, have one more interesting feature, namely they produce extracellular vesicles, the biological properties of which we know nothing about. So far, research on extracellular vesicles has been focused around vesicles of eukaryotic origin, e.g. they are tested for cell-to-cell signaling in a cancer context. Studies on vesicles of prokaryotic origin have mainly focused on pathogenic bacteria. However, very little is known about these structures derived from commensal or probiotic bacteria.

As part of our project, we will thoroughly characterize bacterial vesicles of the genus *Bifidobacterium*, and examine their influence on the development of allergies in *in vivo* and *in vitro* experiments. The research will be carried out with our foreign partner (Gnotobiology Laboratory in Nový Hradek, Czech Republic), with whom we have been cooperating for years in the field of probiotic bacteria. The result of the project will be the verification of the possibility of using extracellular vesicles of probiotic bacteria in the treatment of air-born allergy. The proposed research is innovative and will provide new knowledge in the field of immunology and microbiology.