Diseases of the respiratory system are a big social and medical problem due to ongoing increase in the number of affected people and deaths caused by these diseases. As a result of civilization progress and human activity, air pollution of anthropogenic origin (including the so-called ‘smog’) plays an increasingly important role among factors causing respiratory diseases. The most common treatment method allowing to alleviate the symptoms of these diseases, such as asthma or chronic obstructive pulmonary disease – COPD, is inhalation (or: aerosol) therapy.

Among the techniques used in aerosol therapy, an important role is attributed to nebulization, i.e. dispersion of liquid medicines into small droplets (mist) intended for inhalation. Nebulized medicinal preparations are either solutions or suspensions. They contain, in addition to the active drug, also substances that stabilize the formulation (e.g., synthetic surface-active compounds). Such formulations are sprayed in nebulizers of various types, where pneumatic (air-jet) and mesh devices are the most commonly used. The effectiveness of inhalation treatment depends on the place of deposition of inhaled fine droplets within the respiratory system, and it is primarily influenced by the size distribution of droplets produced in nebulizers, which – in turn - is dependent on the physicochemical properties of the atomized formulation.

In this project, studies on the properties of biosurfactants and natural compounds changing the viscosity of the aqueous phase, what may impact the atomization process, are planned. The research focused on the influence of these compounds on the predicted deposition of generated aerosol droplets in the respiratory system and interactions with the model pulmonary surfactant (a natural substance of the pulmonary alveoli) will be also undertaken by engineering approach (computations and *in vitro* experiments). The particularly important parameters for controlling the size of inhalation droplets and the stability of the formulations are the rheological properties of the liquids, their surface tension and electrolytic conductivity. A possible substitution of typically used excipients currently used in nebulized formulations by natural adjuvants may be an attractive alternative to improve the stability of the formulations and obtain better parameters characterizing the aerosol-cloud. The proposed approach allows conducting basic research, leading to the extension of knowledge in the field of chemical engineering in application to the generation and mechanics of medical aerosols.

An important element of the project will be the development and production of liquid mixtures based on selected natural substances that will allow to obtain physicochemical characteristics of these mixtures which will be analyzed within the project. The above parameters will be correlated with the properties of the inhalation aerosol generated in nebulizers, and then - after determining the doses of the sprayed solutions which can reach the lungs - studies of the effect of these substances on the surfactant properties will be carried out using the model lung surfactant. The results obtained in this way will provide important information on the predicted interactions of nebulized fluids with the surface of the lungs. Overall, the proposed concepts may be used in the future to obtain a more beneficial parameters of inhalation aerosols sprayed in nebulizers, mainly due to the narrowing the width of the size distribution of released drops, and thus - increasing their deposition efficiency in given regions of the respiratory system.