The lipid fraction of the pulmonary surfactant enriched with fatty acids as a biomimetic drug carrier from the physicochemical perspective

It is generally known that systemic drug administration is associated with **unavoidable side effects**. One of the possibilities to reduce the negative impact on the whole organism **is to develop new drug delivery systems** supplying a pharmaceutically active substance to the part in the body, where it is exactly needed. Currently, the attention of scientists is attracted by the improvement of the effectiveness of the drug carriers. Research in the area of physicochemistry and surface science (involved in this project) is a helpful tool in the development of pharmaceutical formulations. **Investigating the morphology, structure, and rheological (viscoelastic) properties leads to making a conscious decision on vehicle composition related to optimal properties and performance.** The main objective of this project is to **develop the drug delivery system composed of the lipid fraction of lung surfactant by its enrichment with fatty acids**. Pulmonary surfactant coats the inner layer of the lung alveoli. It is a complex mixture of phospholipids (80%), neutral lipids (like cholesterol – 10% and trace amounts of fatty acids), and surfactant-associated proteins (10%). The pulmonary surfactant acts as a factor reducing the surface tension (the same phenomena is responsible for the floating of insects or coins on the water surface), preventing the collapse of the alveoli during exhalation. Thus, it plays a crucial role in breathing. The deficiency of the pulmonary surfactant due to the incomplete development of the respiratory system in premature infants is known as respiratory distress syndrome. This fatal disorder is successfully treated by the surfactant replacement therapy based on the administration of the exogenous surfactant preparations. This fact contributed to consider the pulmonary surfactant as a potential drug carrier for inhalation administration.

The project assumes using the Langmuir technique and substances having an amphiphilic character. Among the amphiphilic molecule, a hydrophilic and hydrophobic part can be distinguished. Thus after dissolving the substance in a volatile solvent and evaporation of the solvent, the Langmuir monolayer is formed on the surface of the water. The Langmuir technique allows creating a layer of one molecule thickness and enables nanoscale studies. The monolayer created of the components of the pulmonary surfactant lipid fraction will reflect the structure of the native layer lining the alveoli with good effects. There is some evidence in the scientific literature, that the addition of fatty acid may improve the spreadability of the surfactant inside the lungs (which is associated with the monolayer viscoelasticity). **The idea of improving the properties of the lung surfactant by adding various fatty acids** (differing in chain length, position, and a number of double bonds) **and its thorough examination in terms of morphology and rheology is a scientific novelty.** Moreover, it should be noted that not only the properties of probable drug vehicles need to be thoroughly tested. The possible adverse interaction between the therapeutic agent and pulmonary surfactant seems to be equally important. Thus, in the research plan, there are indicated exemplary active pharmaceutical substances used in the therapy of respiratory diseases, which will be investigated when interacting with the vehicle. The area of the project result application concerns pharmaceutical and medical sciences, but it should be emphasized that the idea is to apply knowledge of surface chemistry and an engineering approach to add a technical contribution to the drug design. The project implementation will contribute to the explanation of the **interactions between the drug carrier components and between carrier and drug**, which are crucial for designing the functional and effective pharmaceutical formulations.