Abstract of the PhD Thesis in English

Modern pharmacy and cosmetology face the challenge of developing new active substances (AS) characterized by high biological activity and efficacy. The effectiveness of formulations containing active substances is determined by a variety of physicochemical and biological factors, such as solubility, bioavailability, permeability, and metabolism in the human body. One of the important routes of administration is the transdermal route, which allows for the local delivery of active substances directly to the target site. However, its effectiveness is limited by the skin barrier, which significantly restricts the penetration of active compounds.

To overcome this barrier, various types of carriers have been applied as transport systems. Particular attention has been given to liposomes, microspheres, and lipid nanoparticles, which enable the incorporation of specific active substances, ensuring their high stability and enhanced bioavailability. Due to their small size and high affinity for skin components, lipid nanoparticles demonstrate excellent skin tolerance, high stability, and the ability to modulate the release of active compounds at the target site.

In this doctoral dissertation, lipid nanoparticles were used as carriers for active substances to enhance their penetration through the skin and to control their release. The research focused on two novel sesquiterpene lactones — costunolide and dehydrocostus lactone — which exhibit diverse biological properties and have not previously been applied in cosmetic or pharmaceutical formulations. For the first time, the influence of encapsulation of these compounds within lipid nanoparticles on their biological activity was investigated, opening up the possibility of developing innovative cosmetic and therapeutic formulations.

During the course of this research, lipid nanoparticles containing the selected active substances were prepared and comprehensively characterized in terms of their physicochemical and biological properties. They were then incorporated into newly developed cosmetic formulations. The composition of the carriers was optimized, encapsulation efficiency was determined, the stability of the obtained systems was evaluated, and the release profiles of the active compounds were analyzed. Furthermore, transdermal permeation studies were performed, and the results were compared with those obtained for formulations containing the same active substances in their non-encapsulated forms. Application and usability tests, involving the measurement of selected skin parameters during the use of the prepared formulations, clearly confirmed the potential of lipid nanoparticles as effective carriers in transdermal delivery systems for active substances.