Designing and synthesis of modern delivery systems for biologically active substances (i.e. drugs, diagnostics, dyes, and anti-inflammatory agents) with specific functional properties are currently the main trends and challenges of a number of renowned research groups and numerous industrial concerns. Many years of experiments on the border of pharmacy, colloid chemistry, physiochemistry of dispersing stems, medical chemistry as well as nanobiotechnology, focus on creating carriers with specific functionality, whose appropriate size, surface charge, and exceptional architecture will be able to provide maximum health benefits while the simultaneous diagnosis of potential pathological changes in the target human skin cells in transdermal delivery.

According to the latest scientific reports and research experiments, nanocontainers based on natural components, manufactured in accordance with the assumptions of green and sustainable chemistry, are characterized by the most beneficial and key functional features, i.e. biocompatibility, biodegradability, improved permeability through natural barriers. biological in skin transport, with low energy and raw material expenditure. Thus, there are many strategies for replacing synthetic emulsifiers, including the introduction of bio-products into the surfactant molecule, e.g. derivatives of "green" omega-3 fatty acids, which weaken the synthetic nature, toxicity, and harmfulness of traditional chemical technologies. In the case of pharmaceutical applications, the most attractive surfactants include sugar-based emulsifiers i.e. sorbitol derivatives - assigned to the group of sugar alcohols, which naturally occur in fruits, such as plums, pears, and apricots, but also in algae and mushrooms.

Therefore, the proposed project will develop a new generation of lipid nanocarriers with advanced architecture and unique stability and functionality, using ultra-modern synthetic techniques based on microfluidic procedures and stabilized with specialized "green" sugar surfactants with the intended physicochemical and functional properties. The planned experiments, conducted in accordance with the latest research trends, will lead to the production of hybrid nanoemulsion and lyotropic liquid crystal systems that are unique on a global scale.

The planned approach based on a miniaturized environment will significantly reduce the energy costs, as well as the amount and concentration of the substrates used - necessary during the optimization process, maintaining very high synthetic efficiency and repeatability. Thanks to the proposed strategy, we will receive the so-called "custom-made nanoproducts", i.e. intelligent hybrid systems with well-defined architecture and specific functional characteristics such as an appropriate size of 150-200 nm, hydrophilic surface, high loading capacity, controlled and/or targeted release, biocompatibility, biodegradability as well as maximum colloidal stability and application potential. The proposed project is modern and interdisciplinary because it will be implemented at the border of dynamically developing scientific fields such as chemical, biological, and pharmaceutical sciences. Its successful implementation will have a significant impact on the scientific community in Poland and abroad, also thanks to the partial realization of the planned research with cooperation with scientists from renowned scientific Groups in Italy (University of Cagliari) and Switzerland (Federal University of Technology in Zurich, ETH).