Malignant tumors, including breast cancer, are one of the most significant challenges facing modern medicine. Despite enormous advances in treatment, many cancers remain difficult to treat, especially in advanced stages. The main obstacles are the resistance of cancer cells to drugs, low bioavailability of active substances, their poor solubility, and toxicity to healthy tissues. Therefore, it is necessary to continuously improve methods for searching for and creating new compounds with high anticancer activity, including those capable of overcoming multidrug resistance.

In recent years, the trace element selenium has garnered interest in various fields of medicine, including oncology, due to its unique biological properties. It is necessary for maintaining homeostasis in the body, and its multidirectional action is manifested mainly through specific proteins and amino acids in which it is incorporated. Enzymes containing selenium in their active centers are responsible for many vital functions in the body, including immunity, proper reproductive system function, and maintaining balance in thyroid hormone metabolism. However, the most crucial role of these selenoproteins is to maintain the proper oxidative status in cells, and their prominent representatives are glutathione peroxidases and thioredoxin reductases. It is thanks to the presence of selenium in the catalytic center of these enzymes that free radicals can be neutralized, thereby preventing damage to the genetic material of cells and acting as a chemopreventive agent for many types of cancer. Importantly, this microelement has anticancer properties as an adjuvant. Selenium supplementation in nutritional doses, when combined with conventional oncological therapies, enhances the effectiveness of cytostatic drugs while reducing their side effects and improving the patient's overall condition. Therefore, it should come as no surprise that **this project aims to develop innovative anticancer compounds – new derivatives of 1,3-selenazol-2-one – and incorporate them into self-emulsifying drug delivery systems (SEDDS)**. 1,3-selenazol-2-one derivatives are chemical compounds obtained through chemical synthesis, exhibiting high structural distinctiveness that is significantly different from the structure of most currently used anticancer drugs. This distinctiveness offers hope for the identification and development of a new class of chemotherapeutics. As a result of our preliminary research, we selected the two most active derivatives from a broad library of derivatives: Les-903 and Les-957. Our in vitro observations clearly showed that the new 1,3-selenazol-2-one derivatives may be more effective than the preparations used to date, including the reference drug cisplatin. They statistically significantly reduced the viability of the two breast cancer cell lines studied: MCF-7 and MDA-MB-231. Notably, the new derivatives exhibit lower cytotoxicity towards normal human breast epithelial cells (MCF-10A) than towards the tested cancer cells. Additionally, the compound Les-903 exhibits high selectivity toward breast cancer cells. Its cytotoxic activity is four times higher in drug-resistant MDA-MB-231 cells compared to MCF-7. The use of SEDDS technology is crucial for the effectiveness of these compounds - it increases their solubility, facilitates transport through cell membranes, and allows for higher concentrations of the substance at the site of action without the need to increase the dose. SEDDS formulations can spontaneously form emulsions in contact with body fluids, making them an attractive carrier for poorly soluble compounds as well. This not only increases the effectiveness of treatment but also reduces side effects.

As part of this project, we will initially attempt to evaluate the physicochemical properties of novel 1,3-selenazolo-2-one derivatives embedded in SEDDS. We will then conduct a comprehensive molecular and biochemical analysis of the mechanisms responsible for the observed anticancer activity of these compounds. In the final stage, we will analyze pharmacokinetic parameters as well as acute and chronic toxicity.

The project has the potential to set a new direction in cancer therapy—not only by developing more effective and less toxic drugs but also by introducing advanced carrier technologies that can also be used for other active substances. The project will yield new therapeutic tools and knowledge that can serve as the basis for further preclinical and clinical research. The implementation of the project will contribute to the advancement of modern oncology, and its results may be utilized in the future to treat patients with challenging forms of breast cancer.