Cancer is the second leading cause of death worldwide, right behind cardiovascular diseases. According to the World Health Organization (WHO), the number of cases of cancer and the related mortality increases with each passing year. It is estimated that in 2025 the number of cases will rise to 19 million per year, while in 2035 the number will reach 24 million. The group of malignancies includes about 100 different diseases.

In the cancer treatment the surgical methods, radiation or pharmacotherapy are applied. The first two methods are limited only to the local action, whereas the drug has the potential to impact every cell of the body. Unfortunately, current therapies are burdened with multiple side effects and complications such as nausea, vomiting, skin lesions, anemia or hair loss.

In presented project, we propose basic research that can contribute to the development of new targeted therapy, *i.e.* one that strikes directly at cancer cells, while being neutral for the functioning of healthy cells. Unlike normal cells, cancer cells do not undergo a process of self-destruction. However, research show that the surface of tumor cells as opposed to normal, is enriched in a protein called nucleolin. Nucleolin can interact with nucleic acid molecules that are rich in guanosines, inhibiting the proliferation of cancer cells. Such molecules tend to form specific highly-ordered structures called G-quadruplexes which are characterized by a variety of structures with maintaining a fixed element *i.e.* quadruplex core. It is well known that the anticancer properties of some G-quadruplexes are related to the specificity of their interaction with nucleolin. Nevertheless, there are no studies so far showing any structural requirements which are necessary for effective interactions with surface nucleolin. These facts led us to propose research that will clarify the relationship between the structural motifs of G-quadruplexes and their ability to interact with nucleolin as well as the inhibition of proliferation of cancer cells at a molecular level. We assume that different types of loops and various positioning of nucleic acids strands within G-quadruplexes will increase or reduce their potential to interact with surface nucleolin. After determining the structural preferences needed for the most effective interaction between the G-quadruplexes and nucleolin we also intend to test how slight changes in the chemical composition of the building blocks of G-quadruplexes might improve interaction with nucleolin and the stability of the molecules under physiological conditions (resistance to degradation by cellular enzymes). Initial research will be carried out *in vitro*. Next, we are going to validate the results of our studies on a number of different cell lines (cervical carcinoma, breast cancer, colorectal cancer) to test universal character of G-quadruplexes antiproliferative properties.

The results of our study will expand the scope of knowledge of the interactions between nucleic acids which form the highly ordered structures, and proteins. Detailed studies, as the planned basic research, will definitely contribute in the future to facilitate the design of oligonucleotide-based drugs with anticancer properties. They will also provide a basis for the development of the most promising targeted therapy, which at the moment is considered to be the most potent way to destroy tumor cells.