The development of materials engineering has significantly intensified the work on new tools for diagnostic and therapeutic applications, in particular precision medicine and personalized medicine. The use of nanotechnology allows for more precise delivery of drugs (to organs, tissues, cells, and cell organelles) while enhancing the therapeutic effect. Recently, electrospun polymeric nanofibers have proven to be an interesting strategy for drug delivery applications. The high surface-to-volume ratio of nanofibers can improve some processes, such as cell binding and bioavailability, drug loading, and mass transfer processes. The applications of nanotechnology to medicine provide an opportunity to improve the safety, efficiency, and sensitivity of conventional medical therapeutics. It should be emphasized that cytotoxic drugs are often used in high doses to eliminate cancer cells, but can also damage normal cells. **Therefore, an advantage of the solutions proposed in this project is the reduction of side effects related to the cytotoxicity of drugs against normal cells.** A serious problem observed during the use of radiotherapy and chemotherapy is the possibility of inducing premature senescence of normal and neoplastic cells in response to the applied doses of the therapeutic agent. The therapeutic agent may act as an inducer of cell death (in high doses), but also cause cell cycle arrest and a change in cell phenotype. The altered cells are characterized by specific metabolic activity, including the ability to produce pro-inflammatory cytokines that affect neighboring cells. The process of premature cellular senescence in response to chemotherapeutic agents plays an important role in cancer progression, including the acquisition of drug resistance by cells. Neoplastic processes are characterized by numerous secondary chromosomal aberrations. Senescent neoplastic cells secrete numerous proteins in their surroundings, such as MMP-3, which promote invasion of neoplastic cells and metastasis. Effective strategies to eliminate these harmful effects of the presence of senescent cells are currently being investigated.
Therefore, we **propose a new strategy for the clearance of chemotherapy-induced senescent breast cancer cells using an electrospun nanofiber-based nanoplatform for the delivery of new nutraceutical derivatives with nanomagnetic particles to enhance the senolytic / senostatic effect**.
More recently, we have shown that quercetin surface functionalized Fe_3O_4 nanoparticles promoted the elimination of oxidant-induced senescent human fibroblasts accompanied by increased activity of AMPK and decreased levels of pro-inflammatory factors such as IL-8 and IFN-β. Therefore, structural optimization is also needed to develop more potent senolytic agents, such as synthetic analogues of quercetin and other natural compounds.
During the project implementation, we want to answer the following questions.

- Can the modification of natural compounds result in the obtaining of 'new compounds' with improved senolytic/senostatic activity?
- Incorporation/blocking of which functional groups in compounds with well-documented senolytic/senostatic properties may potentiate senolysis-based effect in drug-induced senescent cancer cells?
- Are functionalized biodegradable nanofibers containing magnetite nanoparticles capable of improving the senolytic / senostatic activity of 'new compounds'?
- Which method of combining bioactive compounds with nanofibers is the most effective in promoting the properties of the obtained senolytics/senostatics?
- Which of the nanomaterials obtained is the most biocompatible with respect to normal cells?
- What is the molecular mechanism of action of the obtained senolytics/ senostatics?
- Is the senolytic / senostatic action of tested compounds modulated by the cancer cell genotype and accompanying mutations?

We believe that our project will have an impact on new knowledge on the technology of drug delivery to senescent neoplastic cells. The obtained results will be useful for the pharmacological, chemical, and biological sciences.