According to the latest report by the European Medicines Agency (EMEA) and the European Centre for Disease Prevention and Control (ECDC), the emerging and growing multidrug resistant microorganisms poses a huge threat to the health and lives of patients both in Europe and around the world. Just 70 years after the introduction of the first antibiotic, we are faced with the prospect of a future lacking of effective antibiotics in the fight against the most common human pathogens. The problem of bacterial infections continues to grow, especially in the case of multidrug resistant strains. Multidrug resistant strains of microorganisms belonging to the so-called alert group pathogens ESKAPE (*Enterococcus spp.*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa* and *Enterobacter spp.*) are the most common etiological agent of many infections and according to the report by EMEA/ECDC studies concerning development and creation of therapeutic options leading to a reduction in the use of antibiotics and to reduce the ratio of accumulation of drug resistance mechanisms should be one of the main directions of research. Our proposed research project lies within this direction. **Preliminary studies conducted by our research team demonstrated that the treatment of microorganisms with the visible light significantly sensitizes them to chemotherapeutic agents against which they showed a high resistance.** This makes it possible to restore a treatment with the antibiotics that have been excluded because of widespread drug resistant microorganisms. We strongly believe that sequential treatment of microorganisms with the visible light and then routinely used chemotherapeutic agents, can significantly reduce the level of drug resistance and facilitate microbial eradication from the site of infection. Mechanism underlying this phenomenon is not clarified at the stage of preliminary tests, however, we have shown that the treatment of microbes with the visible light, depending on the experimental conditions, can cause bacterial damage to a variety of cellular structures. Experimental conditions may be optimized to mainly promote damage of cellular envelopes, damage of genetic material, or cause damage to both structures simultaneously. Therefore, in the proposed project we will attempt to explain which mechanism of light treatment is necessary for the process of microbes sensitization to the chemotherapeutic agents, and which has the highest potential of the synergistic cooperation with antimicrobial drugs. In addition, we believe that research on prokaryotic and eukaryotic cells, will demonstrate that the proposed approach is extremely safe to host cells and exhibits a low mutagenicity against microbial cells. Such expectations result from the preliminary studies and recently published studies of our team (Grinholc et al., 2015). In addition, within the project, we plan to verify the obtained results in *in vivo* studies using a mouse wound model infected with multidrug resistant strain of *S. aureus* or *P. aeruginosa*.

In summary, this project focuses on the following objectives:

- Determination of the effect of microbial treatment with the visible light on the level of drug susceptibility of bacteria from the ESKAPE group.
- Evaluation of cytotoxic and phototoxic effects of proposed therapy towards eukaryotic cells.
- Verification of the obtained results in *in vivo* testing using a mouse model of wound infected with multidrug resistant *Staphylococcus aureus* or *Pseudomonas aeruginosa*.

We believe that this approach will allow us to demonstrate a high potential of light inactivation of microorganisms in microbial sensitization towards the routinely used chemotherapeutic agents and to confirm the efficacy of their sequential use in the eradication of infection in an animal model.