The aim of the project is to determine which parameters are crucial for appearance of synergistic bactericidal activity of naphthoquinones and silver nanoparticles against *Staphylococcus aureus*. The reason to use a combination of naphthoquinones and silver nanoparticles is the phenomenon of antibiotic resistance of human pathogenic bacteria. *S. aureus* is one of the examples of drug resistant pathogens. Strains of *S. aureus* (especially hospital-associated) shows resistance to many commercially available and frequently used antibiotics like methicillin, vancomycin and ciprofloxacin. However the use of antibiotics is necessary, as human body is unable to combat infectious diseases, such as burn wounds infections. When infection is causes by drug resistant bacteria, the list of treatment options is narrowed and it becomes a life-threatening infection.

The scientific research on new drugs and treatments of infections associated with drug-resistant pathogens is very important for human health and life. Besides the synthesis of new derivatives of known antibiotics, scientists are searching for new substances able to combat antibiotic resistant microbes. Plant tissues are valuable sources of substances called secondary metabolites with biological potential. There are many plant-derived compounds with antimicrobial activity. The example is a group of 1,4-naphthoquinones produced by plants like carnivorous sundews (*Drosera sp*.). Some of naphthoquinones are very potent in killing *S. aureus*. However, using them as a treatment of bacterial infections is limited due to their high cytotoxicity towards human cells. Nevertheless, antibacterial potential of naphthoquinones can be revisited when they are used in combination with silver nanoparticles. Silver nanoparticles are particles of metallic silver with size between 1 and 100 nm and high bactericidal and fungicidal activity. Many methods of nanoparticles synthesis have been already developed. It allows to obtain nanostructures characterized by different shapes, sizes and coated with different ligands. So far, it has been observed that some naphthoquinones and silver nanoparticles coated with fatty acids derivatives lead used simultaneously reveal bactericidal effect in lower concentrations. This phenomena is a result of synergy of this two antimicrobials. It allows to use of lower doses of drugs and reduce the fallouts (cytotoxicity towards human cells).

It is planned to determine which ligands coating silver nanoparticles and which naphthoquinones are able to act in synergistic way towards *S. aureus*. The antimicrobial doses of tested antimicrobials and their combinations towards staphylococcal planktonic cultures and *S. aureus* grown in biofilm (the structure consisting of bacterial cells immersed in protein or polysaccharide matrix) will be evaluated. As the mechanism of bactericidal activity of combination of silver nanoparticles and naphthoquinones is unknown it is planned to determine two parameters: oxidative stress level and membrane damage. What is more, nothing is known about the mechanism of synergy. Preliminary results showed that possible mechanism is based on aggregation of silver nanoparticles and naphthoquinones. To verify this outcomes two experiments will be performed: measurement of hydrodynamic diameter of aggregates by Dynamic Light Scattering (DLS) and measurement of shifts in spectra of absorption at wavelengths of ultraviolet and visible light. The last stage of the research will be focused on the analysis of cytotoxicity of tested compounds and their combinations towards *in vitro* cultured human keratinocytes. At the final step, toxic effect of naphthoquinones, silver nanoparticles and their combinations will be examined on the living model organism – the nematode *Caenorhabditis elegans.*

Obtained results will have an impact on the insight into the possible use of potent naphthoquinones and silver nanoparticles, Additionaly, determination of the mechanism responsible for synergy of these two antimicrobials will be relevant for development of research on synergistic combinations of antimicrobial drugs. Generally, research outcomes will let to deepen the knowledge about materials in nanoscale and about the use of natural plant-derived products for treating bacterial infections caused by drug resistant microorganism - *S. aureus*.