Streszczenie w języku angielskim

The increasing drug resistance of microorganisms is becoming one of the most significant challenges for modern medicine. Consequently, new therapeutic approaches are being sought to effectively combat drug-resistant microorganisms while minimizing the risk of resistance development. One area that is attracting particular attention is nanotechnology, particularly the use of nanoparticles as an alternative for treating infections. Metallic nanoparticles offer unique properties that make them a promising tool in the fight against infections. Their size at the nanometer scale allows for targeted delivery of drugs to sites of infection, increasing the effectiveness of therapy. In addition, nanoparticles as drug carriers show the ability to overcome biological barriers such as cell membranes and complex biofilm structures, making them potentially effective against resistant strains of microorganisms.

This study aimed to evaluate the antimicrobial and antifungal activity of rod-, peanut-, and star-shaped gold nanoparticles whose surface was functionalized with ceragenins CSA-13, CSA-44, and CSA-131. Antimicrobial activity against ESKAPE bacteria and *Candida* strains was determined by evaluating MIC/MBC/MFC, and a colony counting assay (killing assay) and growth kinetics evaluation with resazurin was performed against bacterial strains. The antimicrobial activity of the tested nanosystems was also evaluated against extracellular bacteria using an adhesion assay and intracellular bacteria using an internalization assay with A549 cells. In addition, serial passaging of *Candida* cells with the tested nanosystems was carried out to determine the potential for resistance development. The primary mechanism of action of the gold nanoparticles was determined by evaluating the production of ROS, cell membrane permeability, and release of the intracellular protein. To assess the potential toxicity of the gold nanoparticles, an MTT assay was performed against A549, and the release of hemoglobin from red blood cells was measured.

As a result of the functionalization of the surface of the gold nanoparticles and modification of their shape and size, an increase in antimicrobial and antifungal activity was observed against both extracellular and intracellular pathogens compared to ceragenins in free form and antibiotics. It was shown that the mechanisms of antimicrobial action of the studied nanoparticles include the production of reactive oxygen species, which is associated with changes in membrane structure and leakage of intracellular contents. The results confirm the low risk of resistance induction among the tested pathogens while maintaining strong antimicrobial activity against multidrug-resistant microorganisms. In addition, the tested nanosystems at bactericidal and fungicidal doses show low toxicity against human red blood cells and A549 cells, highlighting their significant potential in developing innovative methods for fighting infections.