Is there a synergistic effect of plant surfactants and antibiotics against bacterial cells?

Antibiotics are pharmaceutical products, widely used today in human and animal medicine. One of the unfavorable and disturbing phenomena associated with their widespread use is the increasing antimicrobial resistance (AMR). As a result concentrations of pharmaceutical substances enabling to achieve a therapeutic effect needs to be constantly increased. An alternative to these actions a change in the way drugs are delivered, as one of the main factors limiting the effectiveness of antibiotics, is their difficult penetration through the cell membrane. Improving this process could significantly contribute to more effective antibiotics. The use of surfactants of natural origin, such as saponins, is an interesting approach as these compounds do not pose a threat to human health and the environment, but have desirable properties to increase the transport of substances through the cell membrane. Therefore, **the aim of the project is to investigate the mechanism of influence of plant surfactants containing saponins, in cooperation with selected antibiotics, on the membranes of Gram-negative bacteria that can cause infections in humans**. In addition, the result of synergistic action of plant surfactants that may increase the bactericidal effectiveness of antibiotics will be analyzed. As a consequence, the smaller the amount of antibiotics, the lower their emission into the environment. As a consequence, the risk of spreading antibiotic resistance among various groups of environmental microorganisms is significantly reduced.

The research will be carried out in three stages. The first stage will include the preparation of plant surfactants from soapwort (*Saponaria officinalis*), ivy (*Hedera helix*), and licorice (*Glycyrrhiza glabra*), their extraction and purification of saponins. Then, their impact on bactericidal action of aminoglycosides, polypeptides and fluoroquinolones antibiotics will be tested. The research will include flow cytometric analyses, biofilm formation tests, evaluation of minimal inhibitory concentration as well as changes in genome of bacteria. After selection of plant surfactant-antibiotic pairs of synergistic action the second and third stages of project will be conducted to learn about their mechanism of action. The interaction of plant surfactants with tested antibiotics on model biological membranes in two-dimensional and three-dimensional systems, so-called liposomes, will be tested. The third stage of the project is research on the influence of plant surfactants on the transport of antibiotics through the membrane of bacterial cells. It will include extensive analyses of changes in membrane fatty acids and proteins profiles of microorganisms, as well as modifications of cell membrane permeability and adhesion properties of bacterial cells.

Multifaceted analysis of interactions between surfactants and antibiotics, using advanced research on model systems and real biological membranes, will enable complete knowledge and understanding of the processes of transporting antibiotics through bacterial membranes. The cooperation of specialists from many renowned research centers in this interdisciplinary project, which combines scientists from the Poznań University of Technology and Adam Mickiewicz University in Poznań, will contribute to obtaining valuable and reliable results. Moreover, the application of various and advanced research techniques will ensure the innovative character of the research and will allow for an in-depth understanding of the processes analyzed within the project. **As a consequence, the results obtained will allow us to enrich the knowledge about the interaction of antibiotics and saponin on the membranes of Gram-negative bacteria cells.** The measurable effect of the project will be significant extensions of the current state of knowledge and the development of science, as well as high noted scientific publications and conference presentations. **This will enable the development of smaller doses of therapeutic active substances, which will be of great importance for society, which will gain new tools to effectively combat the increase in resistance of pathogenic bacteria to antibiotics, and simultaneously protect the environment and human health.**