Streszczenie w języku angielskim

Dendrimers are branched polymer structures that have been extensively studied as carriers for drugs and nucleic acids. Currently, scientists are trying to develop new dendrimer-based therapeutics that possess required characteristics for biomedical applications, such as improved bioavailability, low toxicity, and high transfection efficiency. The unique properties of carbosilane dendrimers as drug carriers have already been demonstrated, and their effectiveness has been further enhanced by conjugation with polyphenols — secondary plant metabolites with a broad range of biological activities, including antioxidant activity beneficial to human health. The research presented in this doctoral thesis focuses on characterization of two types of carbosilane dendritic systems. The first group contains one or two caffeic acid residues and ammonium groups on the surface, making them water-soluble. The second group additionally contains one or two PEG chains, which increases the system's biocompatibility. Both types of polyphenolic dendrimers showed low cytotoxicity and protected erythrocytes from oxidative hemolysis. Furthermore, the dendrimers reduced AAPH-induced ROS production in human fibroblasts. The results indicated that the dendrimer with two caffeic acid units and PEG exhibited best antioxidant properties.

The application of dendrimers as carriers for drugs and nucleic acids requires an understanding of their interactions with various biological systems such as serum proteins and biological membranes. Therefore, the interactions of a new class of dendrimers functionalized with caffeic acid residues with human albumin and biological membranes were studied. The results showed that polyphenolic dendrimers interact with human albumin, altered its secondary structure insignificantly. The presence of caffeic acid and PEG in the dendrimer structure influenced the thermodynamic properties of the lipid membrane.

In the final stage of the study, the potential of polyphenolic dendrimers to deliver pro-apoptotic siRNAs to A549 cancer cells was evaluated. The dendrimers formed stable complexes with siRNA and protected the nucleic acids from degradation by nucleases. All the studied dendrimer/siRNA complexes inhibited A549 cell migration and adhesion, while also increased the population of early apoptotic cells. Among the four tested compounds, the dendrimer containing two caffeic acid residues complexed with siRNA had the best transfection profile. In conclusion, it appears this dendrimer can be a promising candidate for delivering siRNA to cancer cells.