Chemical Effects in Targeted Drug Delivery: The roles of anticancer drugs, carriers and conjugates on biomimetic membrane organization

In recent years, nanoparticles have become the subject of intense research because of their wide range of practical applications, mainly in the medical, pharmaceutical, food, cosmetics, electronics and environmental protection technologies. The tremendous range of applications involving nanomaterials has led to a steady increase of products with their participation. The forecast for nanomaterial production for 2011-2020 is estimated at 58 million kilograms, whereas in 2004 this production was only 2 million kilograms.

The rapid development of nanotechnology requires knowledge regarding the existence of risks associated with the penetration of nanostructures into structures within the body. Questions arise regarding the toxicity of nanoparticles, the likelihood of degradation of the natural environment, risk assessment methodologies, and the need to take legislative action to regulate norms of environmental and occupational exposure. Despite the research conducted thus far, it remains difficult to assess these and other risks. The toxicity of individual nanoparticles can be highly variable because it is not easy to establish a common criterion. Each nanostructure, depending on the size, the type of material, structure, shape, surface, physical and chemical characteristics can exhibit different cytotoxicity. It is believed that nanoparticles could also have a genotoxic effect on the body, both directly through oxidative stress and indirectly by inflammatory reactions.

The objective of this project is to broaden the knowledge of the interactions of anticancer drugs and nanoparticles used as drug carriers with lipid-protein structures which are homological to natural biological membrane-bound proteins.

Mechanisms for penetrating these membranes depends on many factors, including the physico-chemical properties of the nanoparticles, and the effect of the nanostructures on the content and organization of the membrane. This knowledge will facilitate the design and synthesis of nanoparticle-drug comjugates with greater targeting efficiency and reduced side effects.

The project will consist of 4 main parts: a) design, preparation and characterization of biomimetic membranes; b) syntesis and characterization of nanoparticles; c) modification of obtained nanoparticles by drugs and functional groups; d) study the interaction of nanocarierrs with lipid-protein structures.