Physicochemical properties of DNA-lipid complexes with biotechnology applications" (P09-FQM-4698)

The fosfolipidic vesicles (liposomes) and the micelles are colloidal systems that give rise to a great deal of interest within the pharmaceutical, cosmetics and food industry, and in the area of biomedicine as they are biocompatible structures to encapsulate, store, pack and distribute proteins, nucleic acids, drugs, etc. For this reason, the complex formed by liposomes and/or micelles and DNA molecules are now a viable alternative to the cloning vectors (or vehicles) to introduce DNA fragments into eukaryotic cells in order that they can replicate independently. In this regard, recent studies have shown that the efficiency of these processes for gene transfer is closely related to the physico-chemical properties of liposome-DNA (lipoplex) complexes.

The Project occurring involves an extensive experimental and theoretical study of the compaction process and non-viral vectorization of the DNA molecule, by formation of complexes between colloidal nanoaggregates (liposomes) and the biopolymer. The experimental analysis will be mainly the responsibility of the group of investigation of the Universidad Complutense de Madrid and it will be based on the physico-chemical characterization of these nanoestructures, for which the thermodynamic, electrochemical, structural, microscopic and kinetic aspects of the compaction process will be analyzed. For this purpose, a significant number of experimental techniques of high precision will be used: sound velocity, density, electrophoretic mobility-zeta potential, conductivity, fluorescence spectroscopy, fluorescence anisotropy, FRET, UV-VIS spectroscopy, ultrasonic relaxation, dynamic (DLS) and static (SLS) light scattering, nephelometry, electronic transmission microscopy (TEM and cryo-TEM with negative staining), fluorescence confocal microscopy and atomic force microscopy (AFM). Finally, as the primary mechanism of interaction in the formation and stability of these complexes is the result of a balance between electrostatic interaction and its mechanical properties, the experimental results will be supplemented by computer simulation studies (Monte Carlo, *Metropolis algorithm*) aimed at quantifying these forces of interaction.

Accordingly physico-chemical, experimental and theoretical analysis, of self-organized media will fructify in results that will allow to evaluate the potentiality of the studied nanoaggregates as genic transfer therapeutic vectors (lipoplexes) in the treatment of various diseases such as cancer, hemophilia, cystic fibrosis, neuromuscular disorder, etc.