Study of the Interactions between a Bilipid Membrane and a Drug Nanovector in an Aqueous Environment by the aid of Molecular Dynamics Simulations

The investigation of the associative behavior of complexes comprised by drug nanovectors and bilipid membranes via atomistic level molecular dynamics, may lead to new insights regarding the static and dynamic properties of those systems, which may constitute the basis for innovative scientific observations and future technological applications. In this context we have examined by means of molecular dynamics simulations a fully atomistic model of aqueous solution of the anticancer drug Doxorubicin with a PEGylated hyperbranched polyester and a bilipid membrane (dipalmitoylphosphatidylglycerol- DDPG) in physiological conditions of pH and at body temperature. This work constitutes a continuity of a previous work which examined a system similar to the one examined here, but without the presence of the bilipid membrane. Monitoring the static and dynamic properties, offers the possibility to assess the effects of the presence of the DPPG membrane in the spatial arrangement and the transport properties of all the moieties that have been described in the previously examined system.

The results of the present study reveal that different proportions of both drugs have penetrated and associated with the overcharged PEGylated hyperbranched polyester and the lipid membrane. However, several differences were noted between the membrane- free system and that with the DPPG presence. The nature of hydrogen bonds between polymer- drugs molecules has changed and the drug clustering behavior has been reinforced. Different characteristics were also observed in the dynamic behavior of the drugs with the membrane presence. The findings described in this thesis may serve as a basis for future relevant work. Different types of membranes, regarding the structure and charge behavior, can be utilized in order to examine alternative interactions within the particular system. Moreover, to examine the possibility of improving the drug transport properties and their penetration through the nanocarrier, different polymeric hosts can be used in combination with varying drug concentrations. Finally it would be useful to investigate other parameters being related to the membrane, such as possible changes in the membranes' surface tension, and the degree of its mechanical deformation as a function of the strength of the interactions between the latter and the nanovector and / or the drug molecules.