Interaction of Charged Dendrimers with DPPC Lipid Membranes

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Abstract

Dendrimers are smart polymeric nanoparticles characterized by highly ramified structures, which are suitable for the development of molecular level synthetic prototypes for the control of organization and dynamical properties on the colloid size scales, as well as a versatile platform to investigate self-assembly processes in complex nanomaterials[1],[2]. In spite of the broad variety of applications of dendrimer nanocarriers, a major problem is related with their disruptive effect toward bio-membranes, which bring out some cytotoxicity issues connected with their employment in bio-medical applications[3],[4]. With the aim to study how different typology of charged dendrimer scaffolds can affect model bio-membranes, the self-assembly processes of a mixtures of charged polyamidoamine (PAMAM) dendrimers and dipalmitoylphosphatidylcholine (DPPC) lipids were investigated by means of Zeta potential analysis, Raman and Small Angle X-ray Scattering techniques. Interestingly DPPC liposomes showed different behaviours during their interaction with negatively charged sodium carboxylate terminated [-COO^- Na^+] or positively charged amino terminated [-NH_2] dendrimers. More specifically the obtained results evidence sensitive interactions between charged dendrimers and lipid molecules at the surface of the liposome (with an enhancement of the liposome zeta potential), as well as in the hydrophobic region of the bilayers (with a perturbation of the lipids alkyl chains of the liposome). Analysis of the dendrimers electrostatic potential allow an estimation of an effective charge of PAMAM dendrimers, while only a fraction of this charge (about 1/7) contribute to the liposome zeta-potential increase with increasing amount of included PAMAM dendrimers. The findings of our investigation may be applied to rationalize the effect of the nanoparticles electrostatic interactions in solution environments for the design of new drug carriers for drug delivery technology[5],[6]

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