Biophotonics-based characterization of liposomes for the treatment of neurological disorders

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The characterization of nanoparticle-based drug delivery systems is crucial to have a comprehensive overview of their physical, chemical, and biological features and to evaluate their efficacy and safety in biological systems. In this study, we propose two biophotonic techniques, Surface Plasmon Resonance Imaging (SPRi) and Raman Spectroscopy (RS), as innovative tools for the characterization of dual-targeting-peptide liposomes (LPs) designed to control neuroinflammation and associated microglial dysfunctions in Glioblastoma and Alzheimer's disease. Indeed, LPs loaded with selected drugs were functionalized with mApoE and with a metallo-protease sensitive peptide, respectively to enable the crossing of the blood brain barrier and to guarantee a localized release of the encapsulated drugs in diseased areas. SPRi analysis was performed in order to evaluate the binding affinity and kinetics of the LPs to their target receptors, whereas RS was used to verify the quality and reproducibility of LP synthesis. SPRi results confirmed the presence of mApoE on liposome surface, thanks to its specific interaction with the selected receptors. A preliminary test for assessing the binding kinetic between LPs and mApoE targets showed that mApoE-LPs have a higher affinity compared to mApoE-lacking LPs. A multivariate analysis on the Raman dataset allowed to statistically discriminate spectra collected from different formulations, demonstrating that RS can differentiate each LP-component. In conclusion, our results validated the proposed biophotonics technologies as quality control tools, thus helping the optimization of liposome synthesis.

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