Can Polymeric Nanoparticles protect Porphyrinic Compounds from reacting with Proteins? – An NMR Spectroscopic Investigation

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In Photodynamic therapy (PDT), porphyrinic compounds can be used as photosensitizers (PSs), owing to favourable features such as low dark toxicity, high singlet oxygen quantum yield and absorption bands in the spectral region of red light. To overcome a major drawback of porphyrinic compounds, which is self-aggregation in aqueous media and as consequence a diminishing effect on these favourable features, polymeric nanoparticles have been used for encapsulating and thus monomerizing them. [1]

Previously, we tested systems consisting of serine chlorin e6 (SerCE), an amphiphilic PS, and either kolliphor 188 (KP), a micelle forming poloxamer, or polyvinylpyrrolidone (PVP) as carriers for their capability of protecting the PS from reacting with five abundant human proteins. [2] In addition, the interaction between the PS and phospholipid bilayers was probed, where an affinity towards the membrane could be observed. For these investigations ^{1}H - and DOSY-NMR measurements were performed. The results suggested that without being embedded in a carrier system, SerCE reacts immediately with all five proteins tested. Different results were obtained in the presence of the carrier systems KP and PVP. PVP was able to protect the PS from reacting with all the proteins. In the presence of KP micelles, a reaction between the PS and serum albumin occurred immediately and a delayed one with myoglobin. These results demonstrated the importance of the carrier as a protective system against proteins and potentially other molecules. The lack of stability observed for the SerCE-KP system against HSA and Mb led us to the hypothesis that increasing the affinity between the PS and the polymer may enhance the stability of poloxamer-based micellar carrier systems,

Therefore, our current investigation is focused on the more hydrophobic compounds chlorin e6 dimethyl- and trimethyl ester, chlorin e4 and chlorin e6 mono ethylene diamine monoamide. They are investigated with respect to incorporation into polymeric carrier systems, loading capacity, and stability against proteins. For these hydrophobic chlorin derivatives, the carrier is essential for overcoming the problem of insolubility in aqueous media. Moreover, a higher affinity towards cell membranes is expected for these compounds, owing to their more lipophilic nature. Preliminary results obtained with this class of compounds will be presented and compared to the previously investigated amphiphilic SerCE.

[1] T.A. Debele, S. Peng, H.-C. Tsai, *Int. J. Mol. Sci.*, **2015**, 16, 22094-22136.
[2] M. Vermathen, L. Sauser, I. Gjuroski, J. Furrer, *Chimia*, **2016**, 70 (S7-8), MC-150.