Pickering emulsion-based drug delivery formulations

Aim
The aim of this project is to use lipids as the oil phase in Pickering emulsions to solubilize target drugs. These Pickering delivery systems are well suited for oral administration and thus their dispersion and digestive fate will be investigated in vitro.

Background
Poorly water-soluble compounds constitute ~40% of newly developed drug candidates and are associated with poor oral bioavailability and erratic effects in vivo. Formulation strategies exist to nevertheless enable oral delivery of such drugs, e.g. lipid-based formulations. In recent years, emulsions stabilized by colloidal particles at the oil/water (O/W) interface, the so-called Pickering emulsions (Fig. 1), have demonstrated high potential as drug delivery systems or imaging agents. The beneficial properties of such formulations include high stability, adjustable permeability, improved biocompatibility without the addition of surfactants as well as controlled and targeted release of active substances. Pickering particles are typically rendered partially hydrophobic in order to be adsorbed at the oil/water (O/W) interface in emulsions, mostly by the use of surfactants.

Methods
This project will capitalize on previous work on chitosan-modified silica particles as Pickering stabilizers (Fig. 1). Drugs will be dissolved in lipid-based formulations and this will constitute the oil phase in subsequent emulsions produced by high-pressure homogenization. Particle properties like zeta potential will be tailored to form stable emulsion and emulsion droplet size will be measured by laser diffraction as a function of time. Emulsions will be visualized by confocal microscopy. The digestive fate and drug release profiles will be characterized in an in-vitro lipolysis set-up. Here, drug concentration in oil and aqueous phase will be determined with HPLC.

My tasks
To produce stable emulsions with four different lipid-based formulations (type II, IIIA, IIIB and IV) and one model compound using modified silica nanoparticles. To characterize emulsion size and perform in-vitro lipolysis of the produced hybrid formulations.

Expected results
Develop novel hybrid lipid-nanocarrier drug delivery systems based on Pickering emulsions and increase the understanding of their fate upon oral administration. If time allows, silica nanoparticles could even be replaced with plasmonic or magnetic nanoparticles adding further functionality to the formulations.

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