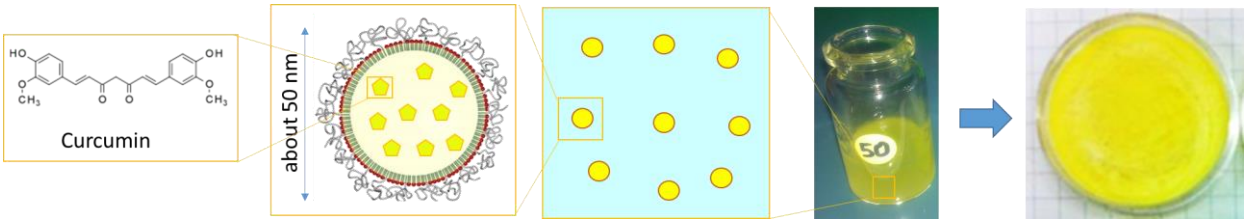
An approach of nanomedicine: synthesis and characterization of curcumin-loaded lipid nanoparticles and their formulation for topical delivery

Tutors: Dorothée Jary, Isabelle Texier

Curcumin, a traditional Chinese medicine extracted from plants, exhibits some antimicrobial, antioxidant, antiseptic and anti-inflammatory properties [1], and has recently aroused much interest for wound healing applications [2]. However, curcumin is acknowledged for its low solubility and high chemical degradation rate in aqueous environment, along with low tissue absorption and short plasma lifetime. These properties make its formulation for wound healing applications a challenging task [3]. Therefore, different formulations of curcumin based on its encapsulation in polymer microparticles [4], nanoparticles [5], or nanomicelles [6, 7], have been developed and loaded in biomaterial scaffolds for wound healing applications.

In this practical, curcumin will be encapsulated in lipid nanoparticles (LNP) [8]. LNP are core-shell particles made of human-used approved ingredients, that can be produced at the lab scale by sonication and at industrial scale by high pressure homogenization [9, 10]. LNP have been shown to act as drug reservoirs for the stratum corneum both in intact and damaged skin [11]. Preliminary reports indicate that their lipid core may play positive roles in wound healing [12, 13] by affecting the penetration rate of the encapsulated drugs [11]. However, curcumin-loaded LNP dispersions as such do not present suitable rheological properties for long residence time on the wound site [14]. Therefore, we will load them in a biocompatible gel, in order to obtain topical formulation presenting suitable rheology and spreadability.



In this tutorial we propose:

Morning:

- the “lab-scale” synthesis (sonication) of the drug-loaded lipid nanoparticles (LNP);
- the purification of the nanoparticles;
- characterization of the nanoparticle dispersion by Dynamic Light Scattering
- visit of the installation for “large scale production” of the nanoparticles (high pressure homogeneizer).

Afternoon:

- analysis of particle drug payload;
- inclusion of the nanoparticles in gel formulation;
- rheological characterization of the gel;
- discussion on the potential medical applications of the particles.

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