

Internship proposal Engineer / Master 2 (6 months)

Period : **from January 2022**

Title of the project: *Formulation of antimicrobial functionalized nanoparticles by microfluidic process*

Description of the scientific background:

Resistance to traditional antimicrobial therapies is a rapidly increasing problem that in a few years could make infections impossible to treat and bring the state of medical care back to the pre-antibiotic era from the beginning of the last century. Indeed, the extensive use of antimicrobials worldwide (such as antibiotics) during the last decades has led to the apparition of a growing multiresistance phenomenon. In addition, medicine is faced with many obstacles that the development of new therapeutic systems tries to overcome. Hence, **Drug Delivery Systems (DDS)** definitely took an important place in human therapeutics during the last decades. DDS are obtained by the effective encapsulation of drugs in carriers allowing a **safe and efficient controlled delivery in the body**. Hence, it is necessary to develop formulation process which are green, flexible and respectful of Good Manufacturing Practices.

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Description of the organization of the projects

The **CarboMIC** project is organized through the following axes:

- Carry out the parametric study of the process producing nano-carriers for antimicrobials encapsulation (**Work Package 1**).
- Develop the formulation process according to an eco-design approach (**Work Package 2**).
- Investigate the physicochemical and biological characterization of the nano-carriers (**Work Package 3**).

This internship will be focused on the WP1 through (i) the optimization of microfluidic process parameters (pressure, temperature, flows, etc...) and their impact over the final characteristics of lipid nanoparticles (liposomes) (ii) the surface functionalization of nanoparticles by "layer-by-Layer" (LbL) technique using polyelectrolytes by means a Tangential Flow Filtration process (TFF). Potentially depending on the internship progress, (iii) functionalization by LbL will be extended to other types of nanoparticles such as lipid nanocapsules and nanocomplexes. The liposomal encapsulation of vancomycin, an antimicrobial molecule of interest in the CarboMIC project, could also be studied.

Moreover, the student will perform the physicochemical characterization of the formulated nano-carriers (WP3): size and size distribution of particles by dynamic light scattering (DLS), surface charge of functionalized nano-carriers, especially for controlling the various filtration steps. Chromatographic analyses will also be performed in order to assay both the encapsulated antimicrobial drug (UPLC-UV) and phospholipids of nanoparticles (HPLC-MS). Finally, the stability of the formulated nano-carriers will be controlled over time and in various biomimetic media.

For this internship, the candidate must have knowledge and / or skills in nano-carriers formulation and physico-chemistry. A profile of physicochemist or pharmacist will be appreciated. An interest in physico-chemistry, process engineering and formulation will be an advantage to achieve this mission.

Institution

MINT Laboratory UMR INSERM 1066 - CNRS 6021, University of Angers, France

Supervisor(s) of the project

Pr. Brice CALVIGNAC, Dr. Jean-Christophe GIMEL, Dr. Guillaume LEFEBVRE, Dr. Marie BONNIN and Dr. Florence DUMAS

Contact / candidature

Contact : brice.calvignac@univ-angers.fr