

Analysis of lipid nanoparticles in mRNA vaccine formulations using isoelectric focusing in capillary electrophoresis

● Scientific Background.

mRNA-loaded lipid nanoparticles (LNPs) have revolutionized the vaccine industry, a process accelerated by the COVID-19 pandemic. Their main advantage lies in their ability to encapsulate and protect mRNA from degradation by endonucleases, whilst facilitating its entry into target cells. The size and surface charge of LNPs are considered important critical parameters (Critical Quality Attributes, CQAs) by regulatory agencies. Capillary zone electrophoresis (CZE) and Taylor dispersion analysis (TDA) can be used to determine the effective charge and size of LNPs, respectively. The isoelectric point (pI) is also an important parameter for characterizing LNPs and their physicochemical composition. This technique would facilitate the release of LNP production batches by providing a better characterization leading to better reproducibility. It will also enable the study of interactions between LNPs and serum proteins, a challenging but important topic at the heart of the delivery efficiency.

● Objectives & Methodologies.

1. Investigation and optimization of the experimental conditions for cIEF to ensure the integrity of the LNPs in the presence of ampholyte. The integrity of the LNP in the presence of ampholyte will be verified by Taylor Dispersion Analysis.
2. Implementation of cIEF for a panel of LNPs with different chemical compositions likely to cause variations in pI.
3. Investigation of the impact of adding serum proteins on the pI.

● Research Environment.

The work placement will take place at the Balard Chemistry Centre on the CNRS Campus, within the DSBC team at the IBMM in Montpellier, under the supervision of H. Cottet and L. Leclercq. https://ibmm.umontpellier.fr/dsbc/recherche_en.html

● Required Profile.

The candidate must have an interest in analytical chemistry and interdisciplinary research (analytical methods, physicochemical characterization, proteins, liposomes, pharmaceutical applications). Motivation is the most important criteria in our selection of students.

● Remuneration.

Training period over 2 months are remunerated about 4.5 euros per working hour (~680 euros gross salary per month).

● How to apply?

Please send in a single PDF file (CV, cover letter, undergraduate grades) to herve.cottet@umontpellier.fr and laurent.leclercq@umontpellier.fr.