CBMNet Vacation Studentship: Bacterial mimicking liposomes

The Challenge

The need to combat bacteria is widespread, in the food industry, in the pharmaceutical industry and many more. A common approach in personal care product formulation is to use a model liposome system as mimetic bacteria, and use it to test the efficacy of natural and manmade antimicrobial agents (AMAs).

The challenge of this summer project is to refine the model liposome system, and in particular, to investigate how dye molecules (specifically fluorescein) can be encapsulated in the liposomes. By exposing these fluorescent liposomes to AMAs and analysing the fluorescence of the ruptured liposomes, we can evaluate how effective P&G AMAs are. Such information is invaluable to the formulation design of a vast array of products.

The Research

Dr Wuge Briscoe is a Reader in Physical Chemistry at the University of Bristol. Understanding self-assembly of lipids and polymers at interfaces and how the interfacial structures mediate interactions is a central theme in his group's research activities.

The main objective was to explore methods for synthesis of fluorescein-dextran complexes with a well-defined molar ratio. A second challenge was to incorporate the synthesized fluorescent dextran in liposomes, prepared via the extrusion method. Here are two different routes we adopt. (1) A monofunctionalized dextran was coupled with a fluoresceinamine; (2) The same monofunctionalized dextran was coupled with a carboxyfluorescein functionalized by a diamine.

To incorporate the fluorescent dextran in liposomes, it was added to the aqueous solution in the process before the extrusion step of the liposome fabrication. The obtained liposome dispersions were dialysed to remove the fluorescent dextran molecules outside the liposomes, retaining those encapsulated inside.

"It was a real pleasure to be part of this project. I discovered a different side of the chemistry thanks to this internship, more precisely about the chemistry regarding polysaccharides. Thanks a lot to my coworkers, who helped me and without who this internship would have not been possible. I wish I could stay longer for this internship and have more results."

Erman Azad, CBMNet Studentship Scholar

The Result

A fluorescent dextran is synthesized by end-coupling dextran with fluorescein, and it demonstrates a novel route to potentially control the molar ratio between dextran and fluorescein, and in turn the self-quenching effect inside the liposomes. In addition, fluorescent liposomes have also been fabricated successfully by incorporating the synthesized fluorescent dextran via the extrusion method.

The Future

The next step is to refine the liposome fabrication process to optimize them for AMA tests. The results have further stimulated interactions between Bristol and an industrial collaborator, leading to a successful partnership in a recently funded Marie Sklodoska- Curie Innovative Training Network (MSCA-ITN). Azad Erman, the project student, commenced a PhD thesis in October 2016 in the field of nanocomposites at the CNRS (Centre National de la Recherche Scientifique) in Paris. This summer research project has helped him to develop skills in general chemistry beneficial to his future research.

"It has been such a fruitful project, addressing an industrially relevant and scientific interesting problem, providing the training opportunity for a talented student, and consolidating and developing collaborative relationships between Bristol and P&G – the industrial project partner."

Wuge Briscoe, University of Bristol