Novel Liposomal Encapsulation of Biologic Molecules via Microfluidics

Edward Weaver[1], Shahid Uddin[2], Andrew Hooker[2], Dimitrios A. Lamprou[1]

[1] School of Pharmacy, Queen's University Belfast, 97 Lisburn Road, Belfast, BT9 7BL, UK;
[2] Immunocore, 92 Park Drive, Milton, Abingdon, OX14 4RY, UK

Background: The therapeutic delivery of biologic molecules including insulins, serum albumins and monoclonal antibodies, is severely restricted due to issues surrounding bioavailability and unpredictable pharmacokinetics. Formulation of these biologic molecules within nanocarriers, for example liposomes, could assist the active pharmaceutical ingredients (APIs) in overcoming these barriers, to produce a drug delivery system with improved properties and efficacy. The use of microfluidics to achieve this approach of formulation is a novel one, and according to our initial studies, it appears to be a potent one. Barriers witnessed for previous biologic encapsulation methods have included unpredictable sizes and low encapsulation efficiencies, which are both mandatory characteristics that must be controlled during a synthesis method.

Methods: In this research, a microfluidic setup has been employed to successfully encapsulate both bovine serum albumin (BSA) and trypsin (TRP), which act model APIs to initiate research within this field. Alterations of various parameters during the formulation stage, for example total flow rates (TFR), flow rate ratios (FRT) and lipid choice (e.g., dimyristoylglycerophophocoline (DMPC), dipalmitoylphohatidylcholine (DPPC), distearoylphosphatidylcholine (DSPC) and dioleoylglycerophosphocoline (DOPC), allowed characteristics of the liposomes to be changed.

Results: It was clear from the studies that DPPC was the superior choice from the four lipids used, allowing a reproduceable formulation via microfluidics with enhanced encapsulation efficiency as compared to traditional formulation methods such as the sonication method. The lipids were chosen as they allowed a direct comparison between the effect that was exhibited by altering the hydrocarbon tail length within formulation. The DOPC further introduced an additional influencing factor as it exists as an unsaturated hydrocarbon; hence the effect on particle characteristics due to this could be explored. Release studies suggested a controlled release *in vitro*, which was expected; however, given the improved encapsulation efficiency, the formulation could be appropriate for prolonging the release further for medications.

Conclusions: The study marks the beginning of research within this area, acting as a basis for further work to probe into the promise that has already been displayed. It is our aim following this study to continue our research with other biologic parameters, and to advance our knowledge of the parameters used to optimise the process.

Save the filename using your surname followed by your forename e.g., Albert Einstein would save his abstract submission as Einstein_Albert.docx