Preparation of liposomes by membrane and microfluidic micromixing

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Liposomes are lipid vesicles made of phospholipid bilayers, which act as colloidal carriers. They are formed upon spontaneous hydration of phospholipids which can be achieved by mixing an ethanolic solution of phospholipids with large volume of water. Liposomes have been used extensively for the encapsulation of drugs in the pharmaceutical industry, and controlled release of flavour and antimicrobial compounds. The factors that determine the loading capacity of certain drugs in liposomes includes miscibility of the drug and lipid, chemical and physical structure of the solid lipid matrix, and polymorphic state of lipid material. Determination of the amount of drug encapsulated within the liposomes would involve the destruction of the lipid bilayer and subsequent quantification of the released material.

Liposomes can be produced by dispersing the organic phase into water through the membrane using a Dispersion Cell [1]. In this research, microengineered nickel membrane with uniform interpore distance was used. Some of the advantages of Dispersion Cell over microfluidics in the production of liposomes are in the difficulty in setting up the tools for microfluidic operation. Systems that involve several fluid inputs, different fluid phases or complicated flow control can make set up of microfluidic usability a bit difficult to achieve. Dispersion cell has also been shown to produce high entrapment efficiencies. The advantages of microfluidic devices for the synthesis of micro- and nano- particles (and liposomes) include enhanced processing accuracy and efficiency, rapid sample turnaround, opportunity for functional integration of many unit operations on a single chip, cost savings from reduced consumption of materials, and inherently safer operation due to reduced amounts of hazardous chemicals during synthesis [2]. They have been made possible to continuously vary reaction conditions and add multiple reagents at precise time intervals and locations during reactions. This can be achieved by manipulating the flow rates, temperatures or concentrations of the fluids or varying the configuration of microfluidic channels and flow patterns.

References
