SuperSomes optimized to produce controlled diameter nanoliposomes

Sonia Sarnelli, Ernesto Reverchon, Lucia Baldino*

Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy

*Corresponding author information:

E-mail: lbaldino@unisa.it

Abstract

Liposomes are among the most versatile and promising platforms in the field of drug delivery, due to their high biocompatibility and ability to simultaneously encapsulate both hydrophilic and hydrophobic molecules. These features make them versatile carriers for a wide range of therapeutic agents, from small to large biomolecules (e.g., proteins, nucleic acids, antibiotics, peptides, as well as anti-inflammatory and antioxidant agents). Conventional methods commonly employed to produce these vesicles include thin-film hydration, ethanol injection and reverse-phase evaporation, as they are easy to perform and do not require sophisticated equipment. However, there are some important limitations associated to these techniques: poor control over particle size, low drug encapsulation efficiency and the use of large amounts of solvent. Consequently, post-processing steps are required to reduce vesicles size and remove residual solvent.

In this work, SuperSomes process is proposed as an innovative, eco-friendly and industrially scalable alternative to conventional production methods. Indeed, thanks to the unique properties of supercritical carbon dioxide (SC-CO_2), this process allows the production of liposomes with controlled physicochemical properties. This study was carried out by combining fluid-dynamic analysis of the atomization regime with modelling the results through Response Surface Methodology. The experiments were performed operating at 100 bar and 40°C, varying two atomization parameters: injector diameter (80, 100, 120, 140 μm) and water flow rate (2, 4, 7, 10 mL/min). The obtained results underline the presence of a dimensional plateau at high Weber numbers, identifying a stable operating region for the production of liposomes with a mean hydrodynamic diameter of 200 nm, in agreement with the standards for pharmaceutical applications.

Keywords: liposomes; SuperSomes; supercritical CO_2; atomization.