Compressed Fluids for the Production of Vesicles with High Structural Homogeneity

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In the past 30 years, the explosive growth of nanotechnology has promoted challenging innovations in pharmacology, which is currently revolutionizing the delivery of biologically active compounds through the development of new drug nanocarriers or drug delivery systems (DDS) that enhance the bioavailability of drugs [1].Vesicles constitute one of the most studied DDS since their discovery in the mid 60s. However, a high grade of structural homogeneity, not only in size or morphology, but also in their membrane composition and supramolecular organization is required for an optimal performance of these self-assembled structures as functional materials. Attending to this, methods for the preparation of homogeneous vesicular systems, not only in terms of size and morphology, but also regarding the supramolecular organization of the membrane constituents are required for fully exploiting the potential of these self-assembled structures as functional materials.

In the early 90's, compressed fluid (CF)-based processes emerged as an alternative to conventional methods using liquid solvents, attracting enormous interest for the production of micro- and nanoparticulate materials [2]. Our research group has experience in using these novel technologies for the controlled nanostructuration of materials to be used in drug delivery [3]. Recently, a CF-based method, DELOS-susp, has been developed for the production of vesicular systems. This one-step process allows the achievement of stable, nanoscopic and unilamellar cholesterol-rich vesicles [4], which present higher structural homogeneity regarding size and morphology than those produced by a conventional multi-step hydration method. In this work, by analyzing the membrane composition and supramolecular organization of vesicles prepared by both methodologies, we demonstrate that apart from size and morphology, the superior homogeneity observed for vesicular systems produced by CFs is also present in the molecular assembly of the membrane constituents, which is crucial for an optimum performance of these supramolecular structures as pharmaceutical carriers.

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