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Structural transitions in mixed Phosphatidylcholine/Pluronic micellar systems and their in vitro therapeutic evaluation for poorly water-soluble drug

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ABSTRACT

The self-assemblies of phosphatidylcholine (PC) liposomes and Pluronic polymers with varying compositions have been studied. The micellar transition formed in the mixed PC and Pluronics (F127, P123, and mixed F127/P123) systems was investigated through dynamic light scattering (DLS), small-angle neutron scattering (SANS), rheology, and transmission electron microscopy (TEM) measurements. Results indicated that the PC appeared to be perfectly large bilayer vesicles. With an increasing concentration of Pluronics, the PC vesicle is also transformed into spherical micelles. The transitions from large lamellar vesicles to spherical micelles have been found with all the mixed systems, in which mixed F127/P123 performed better. The mixed PC/Pluronic micellar systems (PCFP) are being investigated for the problems associated with curcumin delivery, such as poor solubility and stability. The solubilization of curcumin in the PCFP systems has been examined and found to be better. The curcumin-loaded PCFP micellar system was synthesized through the thin-film method and evaluated in-vitro. Nuclear magnetic resonance(NMR) analysis indicated location of curcumin has found in the core of the PCFP micelles. The curcumin-loaded PCFP showed a slower and more sustained drug release under physiological conditions. The resistance to the oxidation of curcumin-loaded PCFP micelles is considerably higher than that of pure curcumin. Results also revealed that the curcumin-loaded PCFP effectively inhibits the cell proliferation of human breast adenocarcinoma cells (MCF-7) and induces cell death. This study suggests that the curcumin-loaded mixed PC/Pluronic micellar system enhances the bioavailability of curcumin.

1. Introduction

Phospholipid-based systems have substantially impacted drug delivery applications in recent years [1–3]. The most important advantage of this liposomal system is that phospholipids are compatible with human membranes both inside and outside the human skin (external membrane). The cell membrane comprises a double layer of phospholipid amphiphilic molecules with their hydrocarbon chains aligned inwards to create the lipophilic phase. Their polar heads are oriented outwards to create the inner and outer hydrophilic boundaries that face the surrounding aqueous environment. According to liposome research, phospholipids are the only class of excipients that provide distinct benefits for a surface-active component because they are nontoxic, well-tolerated parenterally, and have excellent biocompatibility [4,5]. On the other hand, phospholipid liposome structures are micelles that might be used to solubilize a high amount of a lipophilic drug [6,7]. The stability of liposomes incorporating lipophilic drugs inside the bilayer may be changed in terms of interactions between the drug and phospholipid derivatives [8].

When phospholipids and phospholipid derivatives like phosphatidylcholine (PC) are mixed with the right surfactants, they form mixed micellar structures, including large vesicles as well

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