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Preparation and characterization of cholesterol-free liposome nanoparticles for therapeutic drug carriers

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Purpose: The cholesterol-free Liposome Nanoparticles (LNP) have been prepared and characterized for use as therapeutic drug carriers.

Methods: The cholesterol-free LNP composed of different ingredients, with varying molar ratios were prepared by heating under the N_2 atmosphere. The particle size, shape, zeta potential, surface morphology, structural elicitation and biocompatibility of cholesterol-free LNP were analyzed by Dynamic Light Scattering (DLS), Differential Scanning Calorimetric (DSC) and Thermo gravimetric (TGA), X-ray Diffraction (XRD), Fourier Transform Infrared (FT-IR) spectral, Scanning Electron Microscopic (SEM), Atomic Force Microscopic (AFM) analysis and Cell viability assay in order to develop a therapeutic drug carrier.

Results: The particle size analysis showed that the cholesterol-free LNPs were in the size ranges between 20 -300 nm. They exhibit an increase in the denaturation peak temperature when compared to native liposome. The XRD and TGA pattern of the LNP revealed the phase composition of both the phospholipids, cholesterol, withanolides components. FT-IR was used to analyze possible changes in the structure of phospholipids by analyzing the frequency of different functional groups and by investigating the acyl chains and head-group region of the lipid molecule in the presence or absence of withanolides. We considered withanolides effectively increases the order of saturated alkyl chains of phospholipids (ordering effect) and the membrane surface density (condensing effect) and this effect essential for withanolides to maintain proper fluidity, reduce passive permeability and increase the mechanical strength of the LNP. The phospholipids withanolides complex was proposed to be maintained by electrostatic interaction between the zwitterionic polar heads of LNP, the phospholipids, cholesterol and withanolides used for making LNP in various ratios. The cell viability assay showed more than 90% fibroblast viability (NIH 3T3) after 24 and 48 hours of culture on LNP when compared with native liposome.

Conclusion: These carriers expecting a new, non-toxic, scalable and robust, and could be used as targeted and controlled/sustained release of drug. The lipases such as phospholipases are generally unable to hydrolyze the LNP and reduce the uptake of liposome by the mononuclear phagocytic system (MPS), resulting in an improved circulation half-life time, while simultaneously get piggybacking specificity. The use of LNP also could have many benefits, including improving penetration, diffusion and selective transport of active ingredients, longer release time, greater stability of active, reduction of unwanted side effects and high biocompatibility. However, studies on an animal model needs to be carried out before using those devices.