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Solid Lipid Nanoparticles as Drug Delivery Systems for MicroRNA

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MicroRNA-based medicines have drawn attention as a promising tool for the treatment of various diseases. Due to the poor biomembrane permeation, cellular uptake, and enzymatic instability of naked microRNA, the clinical success of gene therapy is mostly dependent on formulating efficient and safe transfection vectors [1]. Therefore, we aimed to develop cationic solid lipid nanoparticles (SLN) for gene therapy purposes.

SLN containing 0.15% of stearylamine, 4.85% of Precirol ATO 5 (solid lipid), 1% of Tween 80, and 1% of Poloxamer 188, as non-ionic surfactants, were produced using a high-pressure homogenization process (800 bar and three cycles). microRNA 27-a was further complexed with SLN in the following SLN/microRNA ratios: 1:5, 1:2.5, 1:1, 2.5:1, 5:1, 10:1, 25:1 and characterized using dynamic light scattering, electrophoretic light scattering, and gel retardation assay.

The SLN had a mean diameter of 112 ± 0.5 nm (PDI of 0.202 ± 0.011) and a zeta potential (ZP) value of +30.6 ± 1.25 mV. Complexation of SLNs with microRNA decreased a particle size from 244.8 ± 2.7 to 120.4 ± 0.4 nm with an increasing weight ratio of SLNs, while the biggest particle size was observed in 1:1 ratio (1146 ± 110.2 nm) due to low ZP values (3.45 ± 0.2 mV). Further, ZP increased from -14.3 ± 0.4 mV to + 39.7 ± 0.5 mV. Both ELS data and gel retardation assay results revealed that complete complexation could be attained above the weight ratio of 5:1. Our investigations suggest that SLN poses a high potential to be non-viral gene carriers in miRNA replacement therapy.

References

1 Zhang, Y. et al. J Control. Release. 172, 962−74. (2013)

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