Development of liposomes using microfluids for delivery of miR-205

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Abstract

The therapeutic application of microRNA(s) in the field of cancer has generated significant attention. miR-205 functions as a tumor suppressor in various types of cancers. However, the delivery of miR-205 is an unmet clinical need. Thus, the development of liposomal formulation platform to deliver miR-205 is highly sought. The most common applications of liposome formulations are vaccines and anticancer formulations (e.g., mRNA, siRNAs, biomacromolecules, and small molecule drugs). However, large-scale production with precise control of size and size distribution of the lipid-based drug delivery systems (DDSs) is one of the major challenges in the pharmaceutical industry. The objective of this study is to develop liposomal formulation with precise size and optimal for delivery of microRNA 205 (miR 205).

Hypothesis

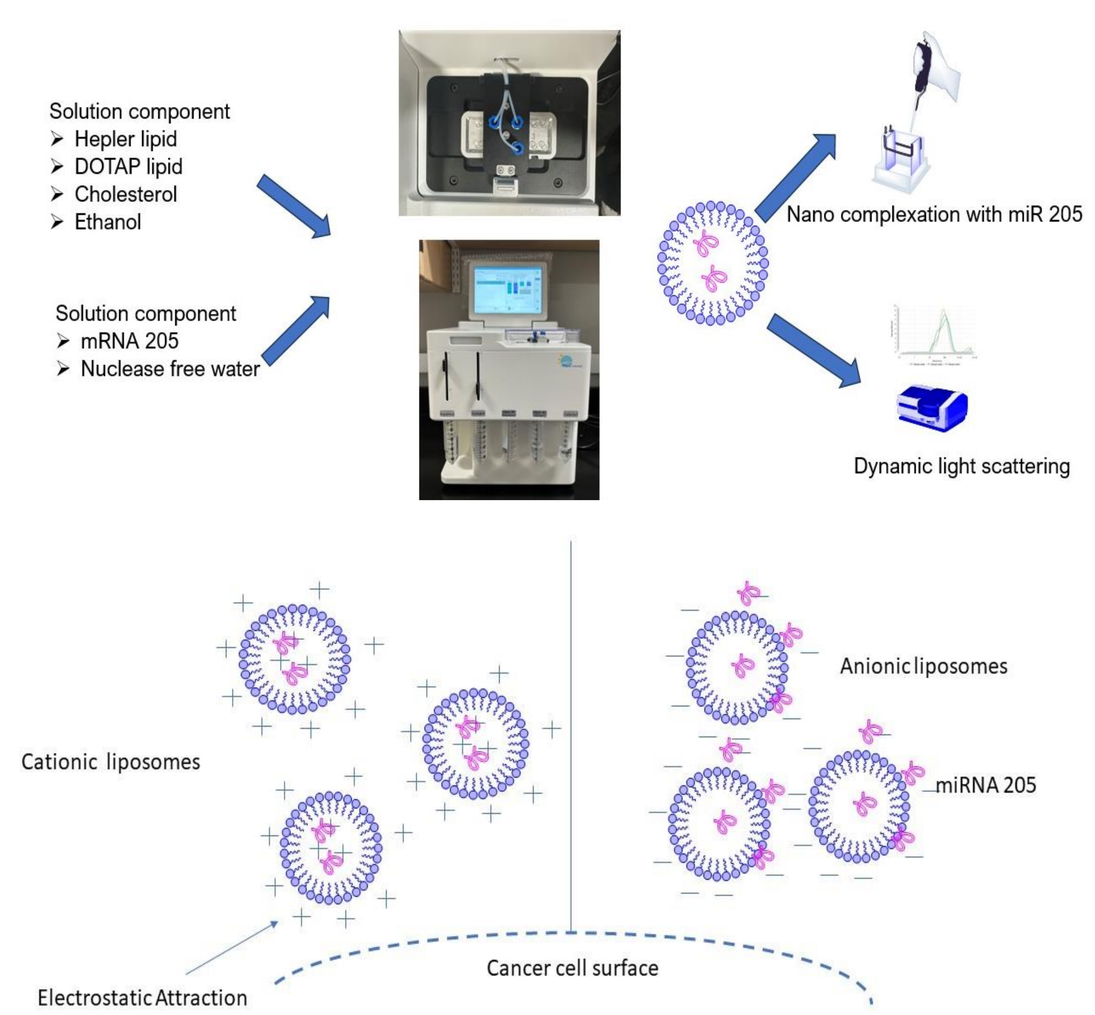

Fig. 1. **(a)** Schematic representation of liposomes-miR 205 complex formulation strategy for miRNA formation and **(b)** Charge–conversion cationic–liposome complexes for miR 205 nano-complexation

Methods

- Microfluidics chip designed based on commercial microfluidic device platform was employed for preparation of liposomes.
- The device is set for the synthesis of liposome at total flow rate (FRR) 10 ml min−1 and 1:3 flow rate ratio (TFR).
- To determine the optimal conditions, the effect of different factors including FRR, TFR, and total lipid concentration (lipid and cholesterol) on particle size and size distribution is investigated.
- Liposomes are also produced by a bulk method to compare the properties of the liposomes formed through these methods.
- The obtained formulations were tested to analyses physiochemical properties and optimized liposomal formulation was confirmed by examining the intracellular accumulation.

Results

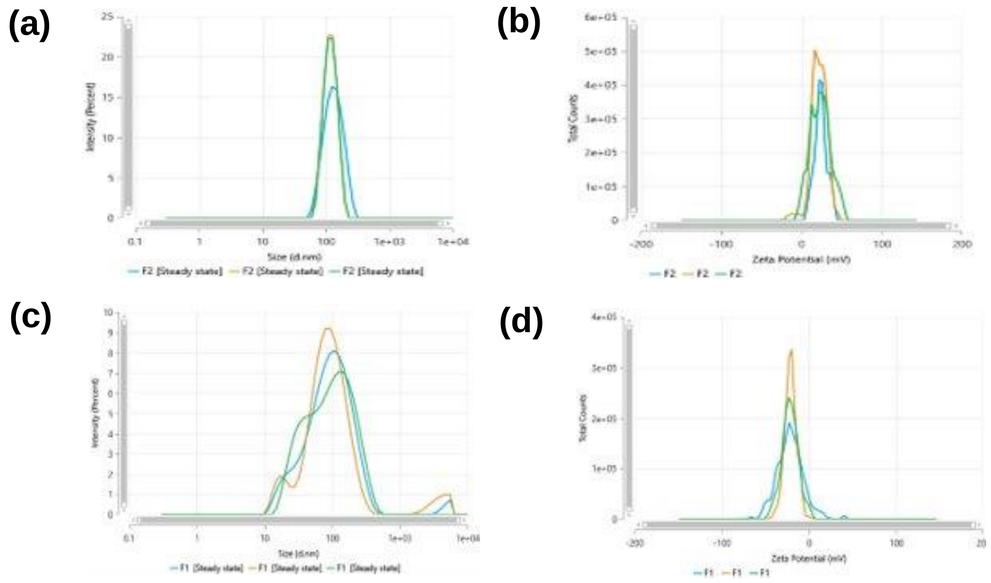

Fig. 2. **(a, c)** Particle size of cationic and anionic liposomes and **(b, d)** Zeta potential of cationic and anionic liposomes, respectively

Table 1. DLS measurement of cationic and anionic formulation measured using Malvern zeta sizer

S.N	Formulation name	Particle size	Polydispersity Index	Zeta Potential (mV)
1	Cationic formulation	130.8±4.56	0.3041±0.005	23.58±1.05
2	Anionic formulation	69.44±0.88	0.4114±0.005	-21.24±0.29

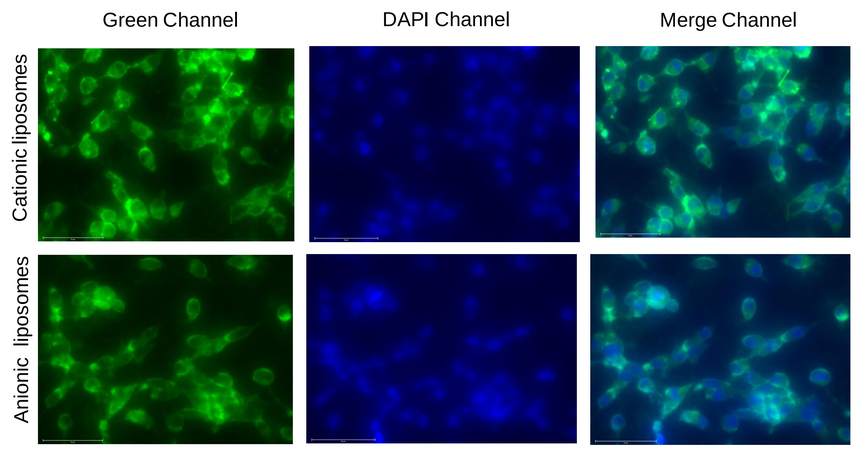

Fig. 3. Investigation of cellular uptake of cationic and anionic liposomes in C4-2B cells

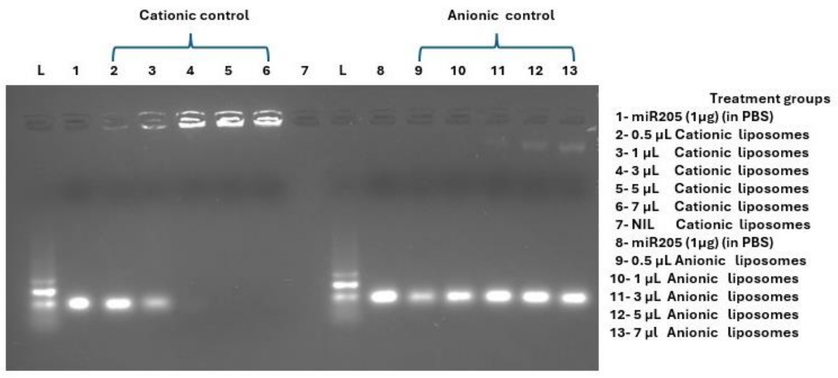

Fig. 4. Cationic liposomes promote superior complexation with miR 205

Conclusions

The obtained results demonstrated that the liposomes can effectively deliver miR 205 into cancer cells. Therefore, the microfluidic devices platform are promising devices for reproducible and scalable manufacturing of liposomal formulation.

Future Studies

- Physiochemical properties (FTIR, DSC, and TGA),
- Morphology studies by TEM
- Stability studies
- In vitro and animal testing using this formulation

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