Highly-Stablized Nanocapsules for siRNA Delivery

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SUMMARY

UCLA scientists have developed novel nanocapsules that facilitate efficient siRNA delivery into cells. The invention represents a significant advancement in realizing therapeutics based on targeted reduction of gene expression.

BACKGROUND

Short interfering RNA (siRNA), possessing the unique capability to specifically knock down the undesired expression of genes, holds great promise as therapeutics for human diseases. However, its clinical applications are constrained by the lack of a delivery vehicle that is safe, stable, and efficient. To date, various delivery systems have been proposed, including cationic liposomes, cell-penetrating peptides (CPP), and cationic polymers. Cationic liposomes and lipids are used widely for in vitro studies with high effectiveness; however, their toxicity and low efficiency restrain in vivo application. For the CPP-based approach, siRNA-CPP complexed particles exhibit significantly improved delivery efficiency but remain generally unstable, particularly, against serum nucleases. For the cationic-polymer-based approach, siRNA is assembled with cationic polymers mainly through the electrostatic interactions, which improves intracellular delivery efficiency. However, like the CPP-based approach, such assembled systems are unstable, which may readily dissociate and release their siRNA payload before reaching the cytoplasm of the target cells. Therefore, in spite of such intensive efforts, the design and synthesis of an effective delivery vehicle for siRNA remains challenging.

INNOVATION

The novel capsulation method developed by UCLA scientists uniquely stabilizes siRNA molecules at a neutral pH, thereby preventing extracellular degradation in serum. In addition, the crosslinked polymerized shell of the nanocapsule degrades in acidic environments, like that found in late endosomes, allowing exclusive release of siRNA to occur within cells. These properties promote efficient delivery of therapeutically relevant concentrations of siRNA molecules. In practice, the proprietary nanoparticles exhibited greater knockdown of gene expression than lipofectamine in cells cultured with human serum. The results corroborate the promising utility of the nanoparticles for therapeutic siRNA delivery.

APPLICATIONS

- Intracellular delivery of siRNA
  - Therapeutic applications
  - Research reagents

ADVANTAGES

- Protects siRNA from hydrolysis
- Efficient cellular transduction of siRNA
- Preferential intracellular release of siRNA payload

STATE OF DEVELOPMENT

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OTHER INFORMATION

KEYWORDS

siRNA, nanoparticles, drug delivery, therapeutics, research reagents

CATEGORIZED AS

- **Medical**
  - Delivery Systems
- **Nanotechnology**
  - NanoBio
- **Research Tools**
  - Nucleic Acids/DNA/RNA

RELATED CASES

2010-904-0

The nanoparticle components and capsulation process have been optimized and tested for delivery of siRNA molecules. Proof-of-concept experiments have been performed in HEK293 cells in culture and in the presence of human serum.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,782,357	10/10/2017	2010-904

Additional Patent Pending

RELATED MATERIALS

- Single siRNA Nanocapsules for Enhanced RNAi Delivery. JACS (2012)
- Keeping the Faith: A New Hope for siRNA Delivery. BioTechniques (2012)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Voltage-Responsive Coating for Lithium-Sulfur Battery
- Hierarchially Porous Carbon Particles for Electrochemical Applications
- Making Nanostructured Porous Hollow Spheres with Tunable Structure
- Hyperbranched Polyglycerol Encapsulated Proteins for Oral Protein Delivery
- A Method Of Making Carbon Coated Oxides As High-Performance Anode Materials
- Viral Vector Nanocapsule for Targeting Gene Therapy

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