Novel Nanocarriers Strengthen Therapeutic Delivery, Improves Efficacy

Overcoming limited durability and variant response in vaccine development and delivery

Covid-19 vaccines were successfully developed rapidly to respond to the global pandemic. Yet, researchers have identified limitations with the existing Covid-19 vaccines including but not limited to durability and variant response. These challenges could be answered by improving vaccine delivery. This technology is an innovative development of a cationic and degradable nanoparticle (PAL nanoparticle) made from a chemically synthesized polysaccharide-amino-acid-lipid amphiphilic copolymer. The nanoparticle design enables a dual-loading method and delivery of multiple therapeutic agents, which translates into a more significant effect as the loaded vaccine and its adjuvant can have a synergistic utility. In addition, the likelihood of immunotoxicity is reduced and the agents' half-life is increased due to the camouflaging effect of the degradable and chemically modified polysaccharide.

Biodegradable nanoparticle delivery vehicle provides multiple loading options to increase the effectiveness of vaccines and other biotech

The polysaccharide-amino-acid-lipid degradable nanoparticles have a unique key design, a chemically and functionally synthesized amphiphilic polysaccharide-amino-acid-lipid copolymer from chitosan which is a base polymer and containing these individual chemical functionalities-lipid, amino acid, disulfide linker. This amphiphilic copolymer self-assembles into the nanoparticle system, where outer surface and inner core can be loaded with therapeutic and contrast agents. The outer cationic surface loads the ionically charged molecules like nucleic acids, while the inner core contains hydrophobic drugs.

Vaccine delivery benefits when an adjuvant is loaded secondarily as it can protect from rapid catabolism and induce an anti-inflammatory, immune response. The effective degradable polymeric nanoparticles, with the buffering benefit of its amino acids and biodegradability, also position this technology as a promising prospect for gene delivery or contrast reagent transport.

Summary Bullets

- Greater therapeutic effectiveness is due to the synergistic work of multiple therapeutic agents (hydrophobic/hydrophilic charged) that can be delivered via this dual-loaded biomaterial.

- The risk of immunotoxicity to a vaccine is reduced because an adjuvant, which can induce the body's anti-inflammatory immune response, may be loaded and simultaneously delivered with the vaccine.
- The novel nanocarrier has broad market application since it can deliver vaccines, gene therapy, small molecule drugs, and even contrast agents.

Solution Advantages

- **Improved efficacy**: Loading allows for multiple therapeutic agents (hydrophobic/hydrophilic charged) to be delivered simultaneously, so they work synergistically to provide a more potent therapeutic effectiveness.
- **Increased half-life**: The biomimicking of the polysaccharide nanoparticles during delivery of the therapeutic agents can increase the half-life.
- **Low toxicity**: Chitosan, the base polymer, will be modified with higher-order amines to reduce immunotoxicity and enhance immunogenicity.
- **Wide application**: The novel nanocarrier can be utilized to deliver vaccines, gene therapy, small molecule drugs, and even contrast agents.

Potential Commercial Applications

- Vaccine delivery
- Drug delivery
- Gene therapy delivery
- Medical imaging: delivery of contrast agents

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Publications

A Polysaccharide-Amino Acid-Lipid based multi-adjuvant intramuscular-prime intranasal-boost SARS-Cov-2 subunit nanovaccine generates strong systemic and mucosal immune responses in mice, CRS 2022 Annual Meeting (poster presentation) - July 11-15, 2022

Images

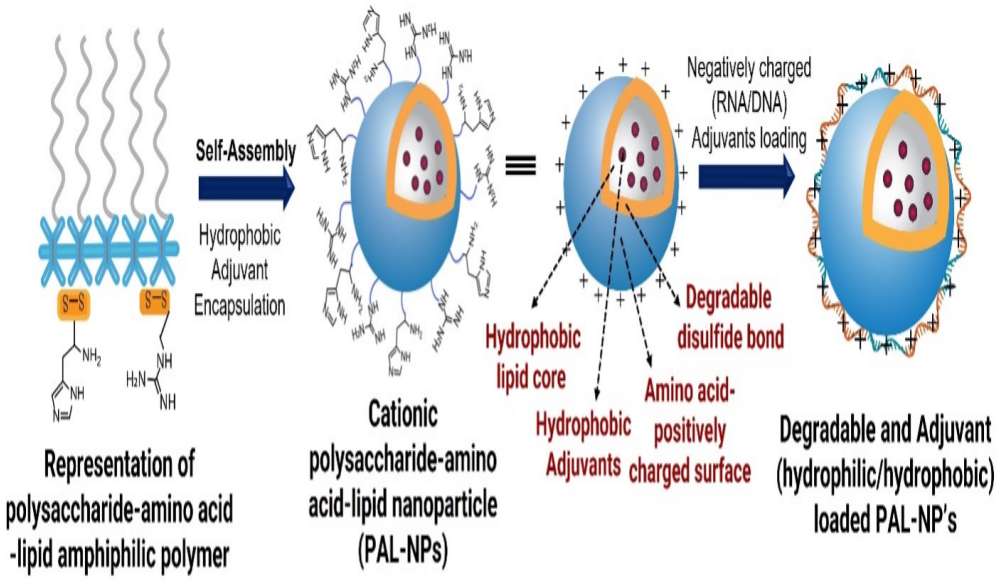

Figure 1. Polysaccharide-Amino Acid-Lipid Nanoparticles assembly

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