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Method for Production of Self-Replicating, Nucleic Acid-Loaded Virus-Like Particles in plants

Vaccines are an essential tool in preventing and controlling many diseases. Most approved vaccines are inactivated or live attenuated type, however, alternative platforms like mRNA and virus-like particles (VLPs) are being increasingly explored and approved because they generate potent immune responses with great safety profiles. VLPs are particularly useful because they resemble the size and shape of viruses yet are non-infectious. Further, VLPs are amenable to heterologous sequence insertions allowing the display of an antigen of interest on the surface, broadening the scope of diseases that can be targeted.

Researchers at the Biodesign Institute of Arizona State University have developed a novel self-replicating, nucleic acid-loaded VLP vaccine and drug delivery platform. This plant production-based platform can deliver products for gene therapy and vaccination for multiple different viruses or virus serotypes depending on manipulation of the system. This platform creates a combination vaccine and synergizes the potency of VLP and DNA vaccines.

This novel platform with its use of VLPs which can be nucleic acid-loaded has broad applications in vaccines, drug delivery as well as gene therapy.

Potential Applications

- Vaccines
- Drug delivery (nucleic acids, proteins, CRISPR/Cas9, etc.)
  - Can be optimized to target specific tissue and cell types
- Gene therapy delivery
  - Repress gene expression through RNAi
- Plant optimization
  - Can be used to improve or introduce a trait of agronomic interest such as herbicide resistance drought resistance, male sterility or fertility, higher seed yield

Benefits and Advantages

- Easily adaptable and versatile vaccine platform
- Can develop diverse and multivalent vaccines from one VLP
- Vaccine can be made to offer protection from multiple serotypes of the same virus
- Possible to mix and match vaccine targets for different diseases that circulate together, e.g. influenza and SARS-CoV02
  - Fewer doses need to inoculate against multiple viruses
  - Reduced cost of production and simplified logistics
- Subverts safety concerns of antibody dependent enhancement of infection for dengue infections
- Can integrate shRNA and siRNA into the platform for RNAi gene silencing
- VLP can be optimized to target specific tissue or cell types for delivery
- Greater safety profile vs adenovirus associated platforms because of the inability of plant viruses to infect mammalian cells
  - Minimized off site target effects
- Can be used to package and deliver nucleic acids, protein, antibodies, CRISPR/CAS9 and drugs

For more information about the inventor(s) and their research, please see

Dr. Chen's departmental webpage