Synthetic Bacterial Nanoparticles as Drug and Vaccine Delivery Vehicles

Summary (1024-character limit)

Engineered bacterial spores can provide many useful functions such as the treatment of infections, use as an adjuvant for the delivery of vaccines, and the enzymatic degradation of environmental pollutants. Researchers at the National Cancer Institute's Laboratory of Molecular Biology have developed a novel, synthetic spore husk-encased lipid bilayer (SSHEL) particle that is uniquely suited for a variety of these functions. NCI seeks partners to license and/or co-develop this technology toward commercialization.

NIH Reference Number

E-098-2015

Product Type

- Therapeutics
- Vaccines
- Devices

Keywords

- Nanoparticle, Bacterial Spore, Synthetic Spore Husk-encased Lipid Bilayer, SSHEL, Drug Delivery, Vaccine Delivery, Ramamurthi

Collaboration Opportunity

This invention is available for licensing and co-development.

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Description of Technology

Bacterial spores can be modified to display molecules of interest, including drugs, immunogenic peptides, antibodies and other functional proteins of interest (such as enzymes). The resulting engineered bacterial spores can provide many useful functions such as the treatment of infections, use as an adjuvant for the delivery of vaccines, and the enzymatic degradation of environmental pollutants.

Researchers at the National Cancer Institute's (NCI) Laboratory of Molecular Biology have developed a novel, synthetic spore husk-encased lipid bilayer (SSHEL) particle that is uniquely suited for a variety of these functions. The assembly of SSHELs involves the insertion of the bacterial spore coat protein

SpoVM into a lipid bilayer that is located on a synthetic core particle. SpoVM serves as a structural element and recruitment factor for the bacterial spore coat protein SpoIVA. When SpoIVA is conjugated to streptavidin, the SSHEL can bind to another molecule through a biotin linkage. This leads to the creation of a specialized SSHEL that can serve a particular biological function. The lab's pre-clinical work has demonstrated that SSHELs loaded with Doxorubicin reduced the tumor burden in a mouse tumor xenograft model of HER2-positive ovarian cancer. By varying the ratio of streptavidin-conjugated and unconjugated SpoIVA protein used in the manufacture of the SSHEL, it is possible to tailor the amount of functional molecule that is present in the SSHEL. This affords greater control over the level of activity that is provided by the SSHEL, thereby allowing the fine tuning of its function.

Potential Commercial Applications

- Applications for this technology are only limited by the molecules bound to the nanoparticle (SSHEL)
- Use of SSHELs that display a therapeutic agent to treat a disease, e.g. Doxorubicin for HER2-positive cancer
- Use of SSHELs to deliver vaccines to patients
- Use of SSHELs to provide particles with enzymatic functions

Competitive Advantages

- The ability to display multiple types of therapeutic agents provides diversity of function
- The ability to vary the amount of SpoIVA that can bind to a functional agent (e.g. Doxorubicin through a streptavidin-biotin interaction) allows fine tuning, high targeting efficiency, and reduced toxicity
- Lack of extraneous cell surface proteins on SSHELs avoids potential interference between the SSHEL and its target
- Non-living delivery system avoids complications associated with using a living organism

Inventor(s)

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Development Stage

- Discovery (Lead Identification)

Publications

Wu et al. A Versatile Nano-Display Platform from Bacterial Spore Coat Proteins [PMID: 25854653]

Patent Status

- **U.S. Provisional:** U.S. Provisional Patent Application Number 62/127,738, Filed 03 Mar 2015
- **U.S. Patent Filed:** U.S. Patent Application Number PCT/US2015/044316, Filed 07 Aug 2015
- **U.S. Patent Filed:** U.S. Patent Application Number 15/555,283, Filed 01 Sep 2017
- **Foreign Filed:** Canada - Patent Application 2977493, Filed 08 Jul 2016
- **Foreign Filed:** Australia - Patent Application 2015384786, Filed 08 Nov 2017

Therapeutic Area

- Cancer/Neoplasm
- Infectious Diseases