# Novel nanoparticle platform proves effective in delivering protein-based drugs

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(Phys.org) —A research team led by Brigham and Women's Hospital (BWH) has developed and tested a novel nanoparticle platform that efficiently delivers clinically important proteins in vivo in initial proof-of-concept tests. Nanoparticles, which are particles measuring nanometers in size, hold promise for a range of applications, including human therapeutics. The key advantage of the new platform, known as a thermosponge nanoparticle, is that it eliminates the need for harsh solvents, which can damage the very molecules the particles are designed to carry.

The study is published online October 21 in *Nano Letters*.

"A central challenge in applying nanoparticle technology to protein therapeutics is preserving proteins' biological activity, which can be inactivated by the organic solvents used in nanoparticle engineering," said Omid Farokhzad, MD, Director of the BWH Laboratory of Nanomedicine and Biomaterials. "Our research demonstrates that the thermosponge platform, which enables the solvent-free loading of proteins, is a promising approach for the delivery of a variety of proteins, including highly labile proteins such as IL-10."

Protein-based therapeutics form an important class of drugs to treat a range of human diseases. However, significant challenges in their development have generally resulted in very slow development paths. To overcome these challenges, Farokhzad and his colleagues sought to create improved nanoparticle methods for delivering protein therapies.

The new thermosponge nanoparticles (TNPs) they developed are composed of biocompatible and biodegradable polymers. These polymers include a central, spherical core, made of the polymer poly(D,L-lactide), and an outer "thermosponge," made of a polaxomer polymer. The core can be either positively or negatively charged, to allow for the delivery of negatively or positively charged proteins, respectively. Importantly, the thermosponge shell can expand or contract as temperatures change, which permits the solvent-free loading of proteins onto the TNP.

The researchers selected a range of different proteins for loading onto the TNPs, including positively-charged interleukin-10 (IL-10) and erythropoietin, and negatively-charged insulin and human growth hormone. The proteins showed similar patterns of sustained release for four days after loading, indicating that the TNPs are able to effectively deliver a variety of proteins.

Further tests showed that the proteins loaded onto the TNPs retained their bioactivity throughout both loading and release from the TNPs.

Importantly, in studies of pre-clinical models, loading of IL-10 or insulin onto the TNPs resulted in dramatic increases in systemic exposure to the proteins, reduced clearance, and increased circulating half-life of the proteins compared to the native protein without TNP.

"The TNPs have been designed and nanoengineered with protein bioactivity in mind, where we optimized a solvent-free nanotechnology that can entrap proteins of various size and charges based on temperature differences into the shell of the nanoparticles. This methodology is amenable for the delivery of a range of therapeutic proteins and can potentially lead to the facile clinical translation of nanoparticles for biologics delivery," said Won IL Choi, Ph.D., a postdoctoral fellow in the BWH Laboratory of Nanomedicine and Biomaterials.

Provided by Brigham and Women's Hospital