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Nanotechnology based delivery systems for peptides and vaccines

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Poor oral absorption and rapid enzymatic degradation are the major hurdles in to deliver peptide drugs orally and vaccines via the mucosa. We developed stable, orally available peptide drugs through the chemical addition of specifically designed lipids and carbohydrates, creating amphiphilic compounds capable to reassemble to form nanoparticles. Fertility is controlled by decreasing the level of circulating Gonadotropin-Releasing Hormone (GnRH) or stimulating the down-regulation of GnRH receptors on gonadotrope cells. Using two independent approaches we regulated the action of GnRH on gonadotropic cells, thereby controlling fertility in mice and rat models.

We have also developed an oral vaccine delivery system to prevent infection by Group A streptococcus (GAS) by encapsulating lipid core peptide (LCP) antigens into the liposomes. We synthesized the LCP construct by attaching C-16 lipoamino acid (Toll-like receptor 2 agonist) to J-14 (B-cell epitope derived from GAS M-protein) and P25 (CD4+ T helper cell epitope). Blank liposomes were formulated and optimized for charge and lipid content using a thin film formation method. Optimized liposomes were coated with oppositely charged polyelectrolytes (positively charged trimethyl chitosan (TMC) and negatively charged sodium alginate) in a layer-by-layer approach. These formulations were subsequently characterized by dynamic light scattering (DLS) and transmission electron microscopy (TEM). Spherical-shaped liposomes surrounded by films of TMC and sodium alginate were observed by TEM. DLS analysis of coated liposomes showed monodispersed particles with a polydispersity index of 0.24, hydrodynamic diameter 230 nm and zeta potential of -40 mV. Optimized formulations will be further investigated for their efficiency of uptake by intestinal immune cells and ability to induce mucosal IgA and systemic IgG responses.

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