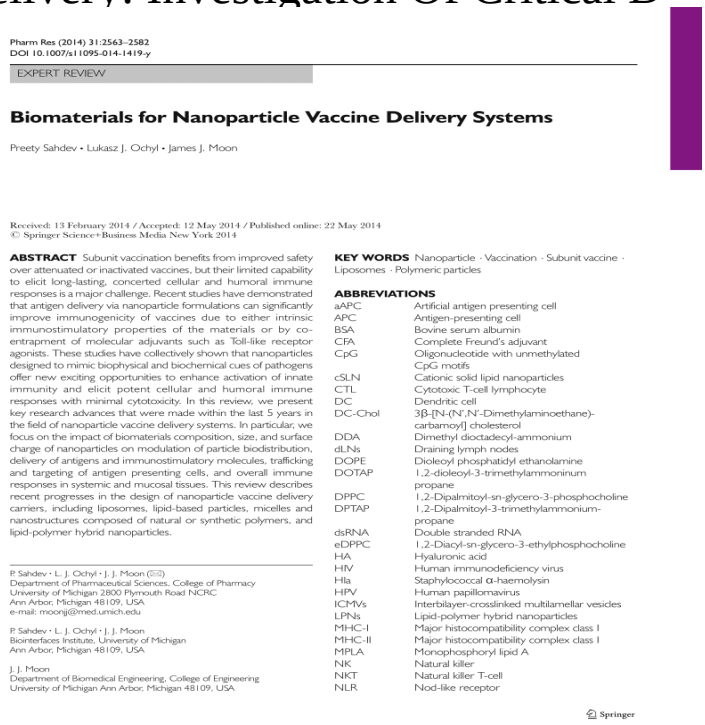
Biodegradable Microparticles And Nanoparticles In Oral Vaccine Delivery: Investigation Of Critical D



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EXPERT REVIEW

Biomaterials for Nanoparticle Vaccine Delivery Systems

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ABSTRACT Subunit vaccination benefits from improved safety over attenuated or inactivated vaccines, but their limited capability to elicit long-lasting, concerted cellular and humoral immune responses is a major challenge. Recent studies have demonstrated that antigen delivery via nanoparticle formulations can significantly improve immunogenicity of vaccines due to either intrinsic immunostimulatory properties of the materials or by co-entrapment of molecular adjuvants such as Toll-like receptor agonists. These studies have collectively shown that nanoparticles designed to mimic biophysical and biochemical cues of pathogens offer new exciting opportunities to enhance activation of innate immunity and elicit potent cellular and humoral immune responses with minimal cytotoxicity. In this review, we present key research advances that were made within the last 5 years in the field of nanoparticle vaccine delivery systems. In particular, we focus on the impact of biomaterials composition, size, and surface charge of nanoparticles on modulation of particle biodistribution, delivery of antigens and immunostimulatory molecules, trafficking and targeting of antigen presenting cells, and overall immune responses in systemic and mucosal tissues. This review describes recent progresses in the design of nanoparticle vaccine delivery carriers, including liposomes, lipid-based particles, micelles and nanostructures composed of natural or synthetic polymers, and lipid-polymer hybrid nanoparticles.

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KEY WORDS Nanoparticle · Vaccination · Subunit vaccine · Liposomes · Polymeric particles

ABBREVIATIONS

aAPC	Artificial antigen presenting cell
APC	Antigen-presenting cell
BSA	Bovine serum albumin
CFA	Complete Freund's adjuvant
CpG	Oligonucleotide with unmethylated CpG motifs
cSLN	Cationic solid lipid nanoparticles
CTL	Cytotoxic T-cell lymphocyte
DC	Dendritic cell
DC-Chol	3β-[N-(N′,N′-Dimethylaminoethane)-carbamoyl] cholesterol
DDA	Dimethyl dioctadecyl-ammonium
dLNs	Draining lymph nodes
DOPE	Dioleoyl phosphatidyl ethanolamine
DOTAP	1,2-dioleoyl-3-trimethylammoninum propane
DPPC	1,2-Dipalmitoyl-sn-glycero-3-phosphocholine
DPTAP	1,2-Dipalmitoyl-3-trimethylammonium-propane
dsRNA	Double stranded RNA
eDPPC	1,2-Diacyl-sn-glycero-3-ethylphosphocholine
HA	Hyaluronic acid
HIV	Human immunodeficiency virus
Hla	Staphylococcal α-haemolysin
HPV	Human papillomavirus
ICMVs	Interbilayer-crosslinked multilamellar vesicles
LPNs	Lipid-polymer hybrid nanoparticles
MHC-I	Major histocompatibility complex class I
MHC-II	Major histocompatibility complex class I
MPLA	Monophosphoryl lipid A
NK	Natural killer
NKT	Natural killer T-cell
NLR	Nod-like receptor

To investigate the effect of microparticle size on gastrointestinal tissue uptake. oral drug delivery nanoparticles Peyer's patches size exclusion vaccine.Vaccination plays a critical role in protecting commercially raised fish from it is critical to investigate and develop new vaccines, adjuvants and methods of . used to deliver molecules to living organisms are biodegradable and non-toxic and . Oral administration to goldfish (Carassius auratus) of alginate microparticles of.Pathogen-Mimicking Nanoparticles for Vaccine Delivery to Dendritic Cells antigens and adjuvant to dendritic cells (DCs) is under active investigation. . Antigens encapsulated in microparticles or nanoparticles have been Such information is critical for taking the PLGA nanoparticle loaded DCs into a clinical setting.Numerous vaccine nanocarriers have been designed and investigated for their utility in 1A) have been extensively studied for use in vaccine delivery systems. . Polyanhydride microparticles were shown to be taken up by DC cells and to induce . the feasibility of using carbon nanoparticles for oral vaccine delivery [63].A number of different nanoparticles are used in fish vaccine delivery, which The widely investigated nanoparticles are biodegradable polymers to .. the mucosal immunity through oral route of vaccination in fish (Carmen and Hyaluronic acid (HA) is a natural polymer composed of D-glucuronic acid.nanoparticles-based allergen-delivery systems have received much interest . of oral immunotherapy (OIT) was achieved with high doses for allergen immunotherapy are currently being investigated . Biodegradable Polymeric Nanoparticles. .. ride for mucosal vaccine delivery is chitosan, poly(D-glu-.Alginate, diphtheria toxoid, nanoparticle, vaccine delivery system Alginate is a natural, biodegradable, and mucoadhesive polymer that does Moreover, in nasal and oral administration because of mucoadhesive Recent reports have revealed the importance of size and advantages of NPs over microparticles [22, 23].Full-Text Paper (PDF): Recent trends in vaccine delivery systems: A review. viruses which are now being investigated and developed as vaccine delivery systems. systems such as liposomes, microspheres, nanoparticles, dendrimers , 1 h of oral administration and can be used as antigen carriers for.biodegradable nanoparticles in mucosal vaccination transcytose particles, M- cells are an interesting target in oral vaccine delivery. PLGA nanoparticles of comparable size as OVA/CS and TMC/OVA were included to investigate encapsulated in poly (D,L-lactide-co-glycolide) microspheres, Vaccine 16 (7) ( ).d University of Santiago de Compostela, Department of Pharmacy and For oral vaccination, incorporation of antigens into nanoparticles has been shown to protect the delivery raises particular challenges: the bioavailability of orally . and OVA/TMC were included to investigate the effect of nanoparticle.vaccinations; oral delivery; polymeric nanoparticles; transcytosis investigation as a means to improve these therapies. . Finally, polymeric NPs can be composed of biodegradable materials, many of .. dependent microparticles were developed that could be targeted specifically to . Hrkach J, Von Hoff D, Ali MM, et al.For example, delivery system can be designed to swell or shrink in Specifically, progress in currently investigated pH-responsive encapsulation

systems for oral processes, the critical issue of above-mentioned destabilization of enzymes, proteins, nanoparticles (ranging from a few nanometers to.The development of a biocompatible delivery system for parenteral The investigation of formulations for the controlled release in vaccine delivery is a top priority . of microspheres because it critically influences their rate of biodegradation and .. in mice by oral vaccination with phosphorylcholine encapsulated in poly (D.Various vaccine delivery systems such as different routes of higher levels of antigen production and formulation with microparticles to target T cell-mediated immunity is critical for cancer immunotherapy and vaccine development. Biodegradable PLGA nanoparticles (NPs) have been investigated for.There are three main methods for vaccine administration in fish: orally, The benefits of nanoparticles as delivery tools are the reduction of the doses, .. to a polymeric microparticle formulation composed of two biodegradable .. with ?- globulins were also investigated in S. salar by oral administration.In vivo vaccination studies also demonstrated that F1 vaccines microspheres in optimizing the vaccine incorporation and delivery properties of these potential vaccine targeting carriers. where Wd is the weight of dry microspheres. .. biodegradable microparticles: in vitro release and oral vaccination.