Infectious Diseases 2015 : The antimicrobial peptides delivery strategies based on nanotechnology to treat infectious diseases - Groo Anne-Claire - University of Angers

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Due to the increasing problem of resistance to traditional antibiotics, antimicrobial peptides (AMPs) have a huge potential as new therapeutics against infectious diseases as they are less prone to induce resistance due to their fast and non-specific mechanisms of action. The delivery strategies based on nanotechnology has the potential to improve the efficiency and stability of AMPs in clinical development. Moreover, nanocarriers were particularly promising for peptide delivery, controlled release strategies and technologies against proteolytic degradation of peptides. The Polymyxin B is a well-known antimicrobial peptide and was used as model peptide in our study. Lipid nanocapsules (LNCs) are a new generation of biomimetic nanocarriers and were used to deliver the peptide. The aim of the present study was to produce the LNCs with antibacterial activity. We have developed peptide-loaded reverse micelles and incorporated in LNCs by phase inversion process. In order to evaluate the antimicrobial activity, the minimum inhibitory concentration (MIC) was determined via a broth micro-dilution method. The activity of Polymyxin B solution and Polymyxin B-loaded LNCs were studied against the following bacterial Gram-negative strains: Pseudomonas aeruginosa (reference strains), Pseudomonas aeruginosa (clinical strains), Escherichia coli (reference strains), Acinetobacter baumannii AYE (reference strains). Polymyxin B was efficiency encapsulated in LNCs using reverse micelles and the antimicrobial activity was intact. The study shows that LNCs are an excellent candidate to deliver AMPs.Nanotechnology (or "nanotech") is manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, widespread description of nanotechnology mentioned the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now mentioned as molecular nanotechnology. A more generalized description of nanotechnology was subsequently established by the National Nanotechnology Initiative, which defines nanotechnology because the manipulation of matter with a minimum of 1 dimension sized from 1 to 100 nanometers. This definition reflects the actual fact that quantum mechanical effects are important at this quantum-realm scale, then the definition shifted from a selected technological goal to an enquiry category inclusive of all kinds of research and technologies that affect the special properties of matter which occur below the given size threshold. it's therefore common to determine the plural "nanotechnologies" also as "nanoscale technologies" to ask the broad range of research and applications whose common trait is size. Nanotechnology as defined by size is in fact very broad, including fields of science as diverse as surface science, chemistry , biology , semiconductor physics, energy storage, microfabrication, molecular engineering, etc. The associated research and applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale. Scientists currently debate the longer term implications of nanotechnology. In 1960, Egyptian engineer Mohamed Atalla and Korean engineer Dawon Kahng at Bell Labs fabricated the first MOSFET (metal–oxide–semiconductor field-effect transistor) with a gate oxide thickness of 100 nm, alongside a gate length of 20 µm. In 1962, Atalla and Kahng fabricated a nanolayer-base metal–semiconductor junction (M–S junction) transistor that used gold (Au) thin films with a thickness of 10 nm. The term "nano-technology" was first employed by Norio Taniguchi in 1974, though it had been not widely known. Inspired by Feynman's concepts, K. Eric Drexler used the term "nanotechnology" in his 1986 book Engines of Creation: the approaching Era of Nanotechnology, which proposed the thought of a nanoscale "assembler" which could be ready to build a replica of itself and of other items of arbitrary complexity with atomic control. Also in 1986, Drexler co-founded The Foresight Institute (with which he is not affiliated) to help increase public awareness and understanding of nanotechnology concepts and implications. The emergence of nanotechnology as a field within the 1980s occurred through convergence of Drexler's theoretical and public work, which developed and popularized a conceptual framework for nanotechnology, and high-visibility experimental advances that drew additional wide-scale attention to the prospects of atomic control of matter. Since the popularity spike within the 1980s, most of nanotechnology has involved investigation of several approaches to making mechanical devices out of alittle number of atoms. Within the 1980s, two major breakthroughs sparked the expansion of nanotechnology in era. In 1987, Bijan Davari led an IBM research team that demonstrated the primary MOSFET with a ten nm gate oxide thickness, using tungsten-gate technology. Multi-gate MOSFETs enabled scaling below 20 nm gate length, starting with the FinFET (fin field-effect transistor), a three-dimensional, non-planar, double-gate MOSFET. The FinFET originates from the research of Digh Hisamoto at Hitachi Central lab in 1989. At UC Berkeley, FinFET devices were fabricated by a gaggle consisting of Hisamoto alongside TSMC's Chenming Hu and other international researchers including Tsu-Jae King Liu, Jeffrey Bokor, Hideki Takeuchi, K. Asano, Jakub Kedziersk, Xuejue Huang, Leland Chang, Nick Lindert, Shibly Ahmed and Cyrus Tabery. The team fabricated FinFET devices right down to a 17 nm process in 1998, then 15 nm in 2001. In 2002, a team including Yu, Chang, Ahmed, Hu, Liu, Bokor and Tabery fabricated a ten nm FinFET device. Within the early 2000s, the sector garnered increased scientific, political, and commercial attention that led to both controversy and progress. Controversies emerged regarding the definitions and potential implications of nanotechnologies, exemplified by the Royal Society's report on nanotechnology. Challenges were raised regarding the feasibility of applications envisioned by advocates of molecular nanotechnology, which culminated during a debate between Drexler and Smalley in 2001 and 2003.

Biography

Groo Anne-Claire studied Pharmacy at the University of Reims in France and then, formulation of colloidal systems at the University of Paris XI in France. She received her Ph.D. in Pharmaceutical Sciences from university of Angers, France, specialising in the nanocarrier optimization for oral delivery in 2013. Her main research interests during her thesis are the development and the evaluation of anticancer drug nanoparticles, for crossing the mucus layer and for improving oral bioavailability. She is a post-doctoral researcher and develops nanocarriers to encapsulated antimicrobial peptides to treat bacterial infection diseases.

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