New Biotechnology 44S (2018) S56–S57

Contents lists available at ScienceDirect

New Biotechnology

journal homepage: www.elsevier.com/locate/nbt

Symposium 21: Formulation, Package and Delivery

O21-1

Development of amphiphilic dextran-based nanoparticle and *in vitro* cytotoxicity in human colon adenocarcinoma cell

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Nanoparticles are widely used in various applications such as packaging materials for food, nutrient encapsulation in cosmetics, and drug delivery in therapeutic purpose. In pharmaceutical perspective, nanoparticle can be applied as a carrier of therapeutic molecules to provide protection, enhance stability, and increase efficiency of those molecules. Along with other natural materials, dextran (Dex) is recognized for its biodegradable, biocompatible, and low cytotoxic properties. However, alteration of dextran hydrophobicity is required in order to allow self-assemble nanoparticle formation. In this study, the long alkyl chain esters of vinyl laurate and vinyl decanoate were added to dextran by lipase-catalyzed transesterification reaction to obtain amphiphilic dextran. Both dextran laurate ester (Dex-L) and decanoate ester (Dex-D) were characterized and used for nanoparticle formation. Modified dextran nanoparticles were prepared by nanoprecipitation followed by dialysis for Dex-L, and nanoprecipitation followed by solvent evaporation for Dex-D. The results from TEM and DLS suggest that both Dex-L and Dex-D nanoparticles were in spherical shape with average size distribution of less than 200 nm in diameter. The low cytotoxicity effect on cell viability of both modified dextran nanoparticles were observed *in vitro* in human colon adenocarcinoma cell line using MTT assay. Our results provide an alternative approach in synthesizing dextran-based nanoparticles that can be further developed for biomedical application.

https://doi.org/10.1016/j.nbt.2018.05.060

O21-2

A platform technology for the bioconjugation of nanoparticles in cancer theranostics

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The coupling of nanoparticles (NPs) to cancer-targeting biomolecules (e.g. antibodies) is fundamental to their use in cancer theranostics. However, conventional bioconjugation techniques such as physical adsorption or cross-linking often lead to the attachment of biomolecules with altered conformations and random orientations causing a reduction/loss of function.

We have established a versatile bioconjugation platform technology based on a peptide (referred to as the 'Linker') that binds with nanomolar affinity to a range of silica materials. The linker (L-) sequence can be genetically-fused to a protein of interest and the resulting recombinant fusion protein (L-Protein) exhibits strong binding to silica. Herein, the linker was fused to either (i) Protein G (PG), which binds antibodies, or (ii) Barstar (Bs), which binds proteins tagged with its binding partner Barnase (Bn). The fusion proteins L-PG and L-Bs, mediated the orientated immobilisation of antibodies or Bn-tagged proteins onto silica surfaces, respectively. This bioconjugation occurred within minutes and without the need for any complex chemical reactions.

Using L-PG and L-Bs, antibodies or Bn-tagged proteins that target cancers were attached to the surface of silica-coated NPs with differing modalities (i.e. fluorescent dye-doped, lanthanide-doped upconversion, and superparamagnetic). These functionalised NPs were successfully applied in the targeted imaging of a variety of cancer cell types, including brain, breast, colorectal, and bladder cancers. Additionally, the functionalised NPs remained stable and retained functionality in complex biological fluids such as mouse whole blood. Thus, this unique and robust bioconjugation platform shows promise for *in vivo* cancer theranostic applications (e.g. drug delivery).

https://doi.org/10.1016/j.nbt.2018.05.061