May 8th, 12:30 PM - 1:30 PM

Maltoheptaose Promotes Nanoparticle Internalization by Escherichia coli

H. Surangi N. Jayawardena
University of Massachusetts Lowell

Et al.

Maltoheptaose Promotes Nanoparticle Internalization by *Escherichia coli*

*H. Surangi N. Jayawardena, Kalana W. Jayawardana, Xuan Chen, Mingdi Yan**
Department of Chemistry, University of Massachusetts Lowell, Lowell, MA 01854
Fax: (978)-334-3013; Tel: (978)-334-3647; E-mail: mingdi_yan@uml.edu

Abstract: Nanoparticles conjugated with D-maltoheptaose (G7) showed a striking increase in the surface adherence and internalization by *E. coli*. This applies to silica nanoparticles (SNP), magnetic nanoparticles (MNP), silica-coated magnetic nanoparticles (SMNP) and silica-coated quantum dots (SQDs) ranging from a few to over a hundred nanometers in size, as well as wild type *E. coli* ATCC 33456, ORN 178, ORN 208 with the maltodextrin transport channel and the LamB mutant JW 3392-1 (Fig. 1).[1] TEM images including the thin section samples revealed the uptake of nanoparticles in cell walls and inside the cytoplasm (Fig. 2). Unfunctionalized nanoparticles and nanoparticles functionalized with β-cyclodextrin (CD) showed little or no binding to the *E. coli* cell surface, and no obvious internalization of the nanoparticles was observed. D-Mannose-functionalized nanoparticles bound to the pili of *E. coli* ORN 178 through the well-known Man-binding lectin (FimH) rather than cell internalization. Surface ligands that can improve the uptake of nanomaterials to bacterial cells should provide a powerful means of targeting a payload delivery to a potential disease causing strain. Work is underway to develop nanomaterial delivery systems for multidrug resistance bacteria.[2]

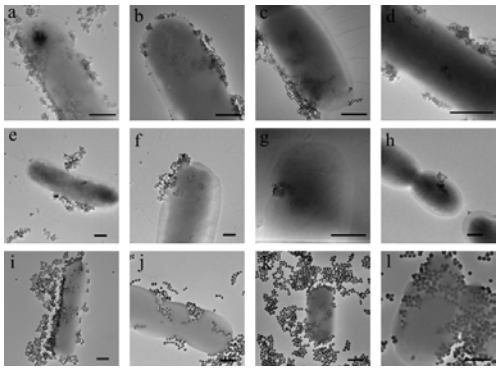

Figure 1. TEM images of G7-SMNP incubated with *E. coli* strain (a) ATCC 33456, (b) JW3392-1, (c) ORN 178, (d) ORN 208; G7-SQD incubated with *E. coli* strain (e) ATCC 33456, (f) JW3392-1, (g) ORN 178, (h) ORN 208; G7-SNP incubated with *E. coli* strain (i) ATCC 33456, (j) JW3392-1, (k) ORN 178, (l) ORN 208. Scale bars: 500 nm.

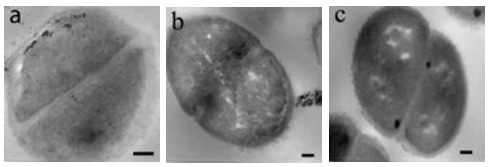

Figure 2. TEM thin section images of ATCC 33456 after treating with (a) G7-MNP and (b) CD-MNP. (c) TEM thin section image of ATCC 33456. Scale bars: 100 nm.

References

(1) Jayawardena, H. S. N.; Jayawardana, K. W.; Chen, X.; Yan, M. *Chem. Commun.* **2013,** *49*, 3034-3036.
(2) Yan, M.; Jayawardena, H. S. N.; Jayawardana, K. W.; Chen, X. Maltoheptaose Promotes Internalization of Nanoparticles in *Escherichia coli*. US Povisional Patent USSN 61766176, 2013.