The Sweetest Polymer Nanoparticles: Opportunities Ahead for Glycogen in Nanomedicine

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There is a compelling need for non-toxic and biodegradable nanomaterials in healthcare and medicine, where innovations in the bioengineering of first-generation nanoparticles have primarily focused on synthetic non-degradable polymers, which can have undesirable interactions with our immune system in human blood [1] . In our work, we look to leverage biology against itself in nanomedicine, done so through the use of biomaterial glycogen nanoparticles. Glycogen is a unique biological polysaccharide nanoparticle fabricated by nature through a bottom-up approach [2] , which is markedly different from other natural biomaterials. Glycogen is inherently biodegradable, nontoxic, and can be functionalised with diverse surface and internal motifs for enhanced biofunctional properties. [3] In our work, we show how to functionalise glycogen nanoparticles for a therapeutic purpose, before re-integrating them back into biological contexts. These particles have been devised for targeting cancer cells [4] , delivering siRNA in tumour spheroids [5] , and as highly adhesive biomaterial films [6] . We have proved these nanoparticles to be essentially invisible to our immune system in human blood [7] , which leads for them to be used as in-blood active nanoparticles for treating thrombosis and as fibrinolytic (blood clot-busting) agents [8] . Together, our work shows how sugary glycogen nanoparticles can be nano-engineered for functional therapeutic purposes, taken from nature, and reintegrated into biology with a new purpose.

Keywords:
Glycogen, Nanomedicine, Hemocompatibility, Blood Interactions, Colloidal Nanoparticles

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