

Chitosan as Therapeutical Excipient in Cancer Nanomedicine Development

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The United States Food and Drug Administration defines nanomaterial or nanoparticle being characterized by at least one external dimension or an internal or surface structure, in the range of about 1 nm to 100 nm, or exhibit properties or phenomena, that are attributable to a dimension up to 1000 nm. Nanoparticles have been adapted to encapsulate, stabilize, and targeted delivery of various cancer chemotherapeutics. They can be formulated to provide passive as well as active targeting elements with the aim to improve drug efficacy and minimize adverse off-target reactions. The ultimate application of nanoparticles is to raise the drug bioavailability at tumour sites against the non-cancerous regions. In recent years, erythrocytes, platelets and exosomes have been proposed as the drug targeting devices. Nevertheless, nanoparticulate system remains as the system of choice since erythrocytes, platelets and exosomes are met with neoplastic risks and production hiccups.

Chitin is the second most abundant biopolymer after cellulose. It is biologically extracted from marine crustacean shell, insects and invertebrate exoskeleton. It composes of a β -(1-4) linked linear cationic heteropolymer consisting of 2-acetamide-2-deoxy-D-glucopyranose (N-acetyl-D-glucosamine) and randomly distributed units of 2-amino-2-deoxy-D glucopyranose (D-glucosamine). Despite highly biodegradable and biocompatible, the use of chitin as the nanomatrix material for cancer drug delivery is limited by its poor aqueous solubility. Reducing its molecular weight and degree of acetylation could raise its aqueous solubility and chemical reactivity. On this note, chitosan as deacetylated chitin with lower molecular weights receives a widespread application in cancer nanomedicine design.

Chitosan exhibits an inherent pH-dependent solubility which confers drug targeting at tumour microenvironment. Being a cationic polyelectrolyte, it displays anti-cancer activity synergizing cancer cytotoxic drug actions. Over the past 20 years, the chitosan has been functionalized with covalent conjugates or complexes and processed into nanoparticles to encapsulate and control drug release, to mitigate premature drug clearance, to target delivery of drugs to cancer site at tissue, cell and subcellular levels, and to promote cancer cell uptake through cancer cell membrane permeabilization and cancer surface receptor binding. Nanomedicine developed using functionalized chitosan translates to significant preclinical improvements. Future studies related to its structural modification are expected to lead to the development of a more effective anti-cancer excipient with drug delivery capacity.

Reference

1. Yazid Zaiki, Athirah Iskandar, Tin Wui Wong. Functionalized chitosan for cancer nano drug delivery. *Biotechnology Advances* 67, 108200, 2023.
2. Choon Fu Goh, Chiau Ming Long, Nur Aisyah Humaira Fedelis, Halimatun Hamdan, Soo Cheng Chuah, Sook Fern Yeo, Cheng Ling Tan, Tin Wui Wong. Critical insights of nano-based pharmaceutical, cosmeceutical and nutraceutical products: Empirical evidence from the consumption values perspective. *Journal of Retailing and Consumer Services* 72, 103270, 2023.

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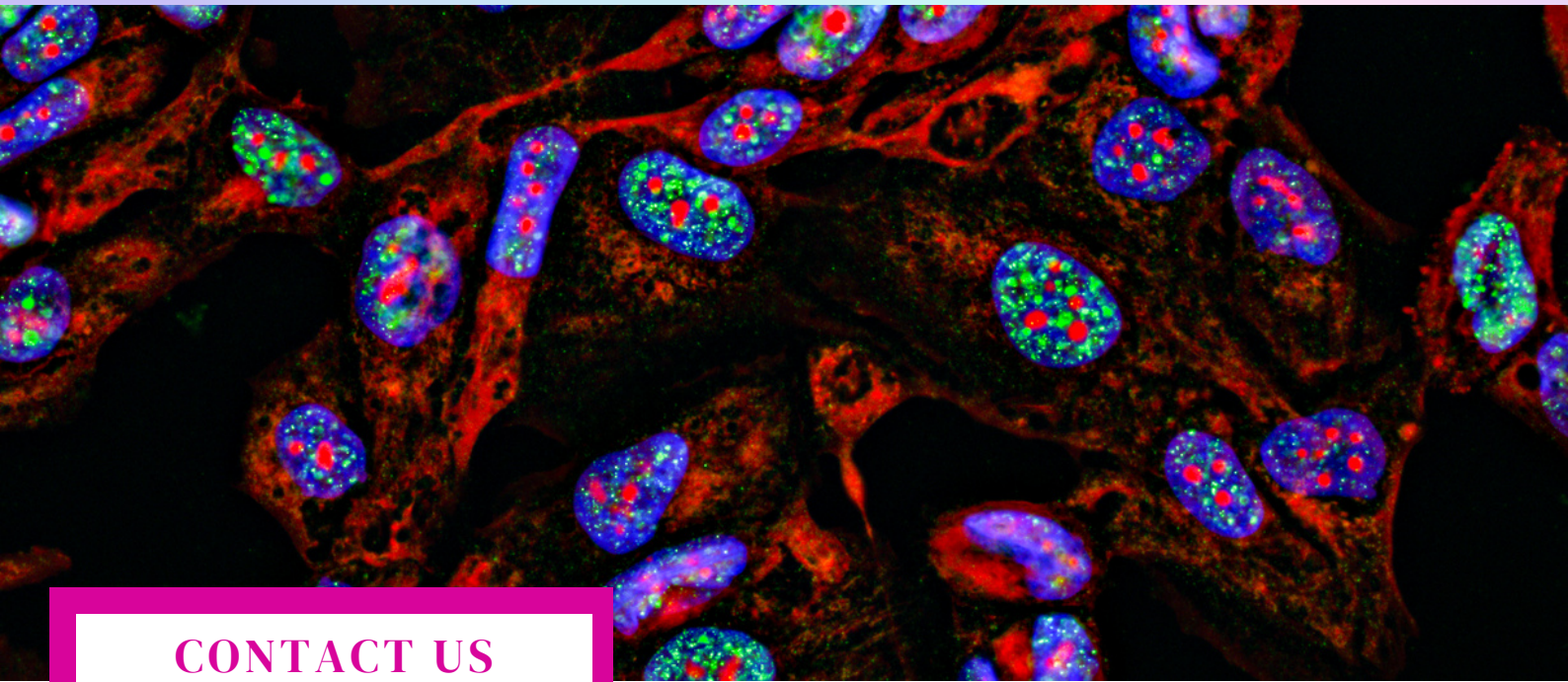


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