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Már Másson

Professor Már Másson is a leading scientist in medicinal chemistry and biopolymer research, with an international academic trajectory spanning Iceland, Denmark, and Japan. He earned his Bachelor of Science in Chemistry from the University of Iceland in 1987, followed by a *Cand. Scient.* (M.S.) in Organic Chemistry from the University of Copenhagen in 1990. In 1995, he completed a Doctor of Engineering in Biotechnology at the Tokyo Institute of Technology, where his research focused on bioelectronics and biosensors.

After returning to Iceland, Professor Már Másson dedicated the first decade of his career to drug delivery systems, particularly those based on cyclodextrins. He joined the Department of Pharmacy at the *University of Iceland* in 1995 as a Postdoctoral Researcher, became Associate Professor of Medicinal Chemistry in 1998, and has served as Professor of Medicinal Chemistry at the Faculty of Pharmaceutical Sciences since 2005.

Professor Másson leads a research group internationally recognized for its work on the synthesis and characterization of chitosan derivatives. Under his direction, the group developed the influential TBDMS protection strategy, enabling chemoselective and highly controlled modification of chitosan. His team investigates a wide range of applications, including antimicrobial chitosan derivatives, permeation enhancers acting on tight junctions in pulmonary epithelium, chitosan nanocarriers for photochemical internalization, and chitosan-based coatings for regenerative medicine.

Beyond biopolymer chemistry, Már Másson collaborates with engineers and mathematicians to develop numerical modeling frameworks for drug delivery systems, including transdermal and ophthalmic applications. He is co-founder, together with his Ph.D. student Vivien Nagy, of the spin-off company Minamo, which is based on his patented invention (PCT application) and focuses on antimicrobial coatings for silicone medical devices. Professor Másson has also played an important role in the international chitin and chitosan community. He co-organized the 14th International Conference of the European Chitin Society (EUCHIS 2023) and the 15th International Conference on Chitin and Chitosan (ICCC)/1st Conference of the International Federation of Chitin and Chitosan Societies (IFCCS), held in Siglufjörður, Iceland, in September 2023.

Professor Másson is the author or co-author of more than 110 ISI-indexed publications, and inventor or co-inventor on 5 patent applications and 1 granted patent. His scientific impact is reflected in an H-index of 41 (ISI) and 50 (Google Scholar). Beyond his research achievements, Professor Másson plays a central role in the European scientific community as a vice-president of the European Chitin Society (EUCHIS) and editor of the prestigious journal *Carbohydrate Polymers*.

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Talk 1. Antimicrobial chitosan and chitosan derivatives

This presentation provides an overview of the current state-of-the-art in antimicrobial chitosan and chitosan derivatives, with particular emphasis on how structural modifications influence biological activity and toxicity. It discusses the various synthetic strategies used for the chemical modification of chitosan and highlights the most common functional groups introduced. The antimicrobial derivatives are classified according to the type of functional group attached to the polymer backbone. Key factors affecting antimicrobial performance, (such as molecular weight, pKa and cationic charge density, deacetylation degree, substitution degree, positioning of the cationic charge, hydrophobicity, multiple functional groups, effects of anionic, polar and peptide groups) are examined, together with the proposed mechanisms of antimicrobial action and cytotoxicity. In addition, the presentation outlines the main applications of antimicrobial chitosan and its derivatives, and based on the collective evidence, identifies future research directions aimed at deepening the understanding of their bioactivity and enabling the development of more effective chitosan-based conjugates.

Talk 2. Nanoparticles from chitosan-photosensitizer conjugates for photochemical internalization in cancer drug delivery

Photochemical internalization (PCI) uses photosensitizers and light to release endocytosed therapeutics from intracellular vesicles, thereby enhancing their access to cellular targets. We developed chitosan-based nanoconjugates containing covalently linked photosensitizers for PCI and anticancer drug delivery. TBDMS-protected chitosan enabled efficient synthesis of conjugates with tetraphenylporphyrin (TPP) and tetraphenylchlorin (TPC). The conjugates self-assembled into nanoparticles of approximately 100–300 nm and enhanced PCI-mediated gene delivery in human colon carcinoma cells. TPC conjugates, which permit activation at longer wavelengths, also demonstrated photodynamic therapy and PCI effects with bleomycin in preliminary tumor models. Furthermore, TPC–chitosan conjugates formed biodegradable nanoparticles with high loading and retention of mertansine or cabazitaxel. Drug-loaded nanoparticles showed greater cytotoxicity than free drugs in breast cancer cell lines and accumulated in tumors in mice. These results demonstrate the potential of photosensitizer-chitosan nanoconjugates as multifunctional platforms for light-activated combination cancer therapy and targeted drug delivery.

