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Francisco M. Goycoolea

Professor Francisco Goycoolea earned a BSc in Chemistry/ Pharmacy/ Biology from Universidad La Salle/UNAM, Mexico (1988), an MSc in Food Science from the University of Reading, UK (1990), and a PhD in Food Polysaccharides from Cranfield University, UK (1994). Since 2023, he has been appointed Distinguished Professor at the Faculty of Biology, *Universidad de Murcia, Spain*, under the “Beatriz Galindo” Fellowship. He was a Professor of Biopolymers at the University of Leeds (2016-2023).

Previously, he was a tenured Research Scientist and Group Leader at CIAD, Mexico (1995–2010), held visiting positions at the Universidad Complutense de Madrid and Universidad de Santiago de Compostela, where he was awarded an international incoming Marie Curie Fellowship (2008-2010). As Junior Professor at the University of Münster (2010–2016), he was part of an international graduate school “Molecular and Cellular Glycosciences” and a principal investigator in three international projects.

Professor Francisco Goycoolea is an authority in biopolymer science, nanobiotechnology and food structure, with more than 30 years of experience. His research work focuses on sustainable biomass-derived polymers, particularly chitin and chitosan, as building blocks for soft materials, such as colloidal nanoparticles, hydrogels, and bioinspired materials for biomedical, food and biotechnological applications. He has led projects on microplastic remediation, crustacean-waste valorization and chitosan nanoencapsulation for anti-quorum-sensing applications. His research spans bioactive delivery, interactions with mucosa, epithelia and biofilms, microfluidic cell phenotyping, antibiotic-free antimicrobial strategies.

Professor Francisco Goycoolea has authored more than 200 peer-reviewed publications and book chapters, supervised 23 PhD theses, and collaborated with universities, research centers and industry worldwide. He has held leadership roles in the *European Chitin Society* and the *Iberoamerican Chitin Society* and editorial positions in prestigious journals, such as *Food Hydrocolloids* and *Pharmaceutics*.

Talk 1. Designing chitosan nanosystems: From molecular interactions to nanoparticles, nanocapsules and chitosomes

Chitosans offer unique properties for the formulation of colloidal nanoparticles by different routes. These include matrix-type systems such as those obtained harnessing ionotropic gelation, nanoprecipitation, polyelectrolyte complexation or electrokinetic methods. Emulsion-based methods include solvent displacement: spontaneous emulsification, reversed emulsion physical gelation and Pickering emulsion stabilization. Liposomes coated with chitosan (chitosomes) are yet another well-established platform of this kind. In this lecture, I will address

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the principles of the formation and will also demonstrate how the concepts and tools of nanobiotechnology and soft matter physics help us understand the role of chitosans characteristics (molecular weight, degree of acetylation and pattern of acetylation) on each. With reference to concrete examples, I will show how these principles are used to guide the rational design of the physical properties of these systems. Emphasis will be given to the key techniques of characterization of the biophysical properties.

Talk 2. From nanoformulation to function: Chitosan-based nanosystems for health, food and bioengineering

Chitosans currently offer a sustainable alternative for the design and development of versatile tools based on flexible structures relevant to food, pharmaceuticals, and biomaterials. In this lecture, I will address how chitosans of varying structural characteristics (molecular weight and degree of acetylation) can be designed to control structure, stability, and functionality of applied systems. I will refer to examples of nanoparticles designed for the oral delivery of phytochemicals and active pharmaceutical ingredients, with a focus on improving bioavailability, modulating bioactivity, and targeting specific biological interfaces. I will also show how to leverage the interactions of biopolymers with epithelial barriers, mucous membranes, and bacterial biofilms, opening new opportunities for antimicrobial and antivirulence strategies that go beyond the use of conventional antibiotics. Finally, I will connect these advances with the current challenges and potential synergies with aquaculture research at the University of Murcia.

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