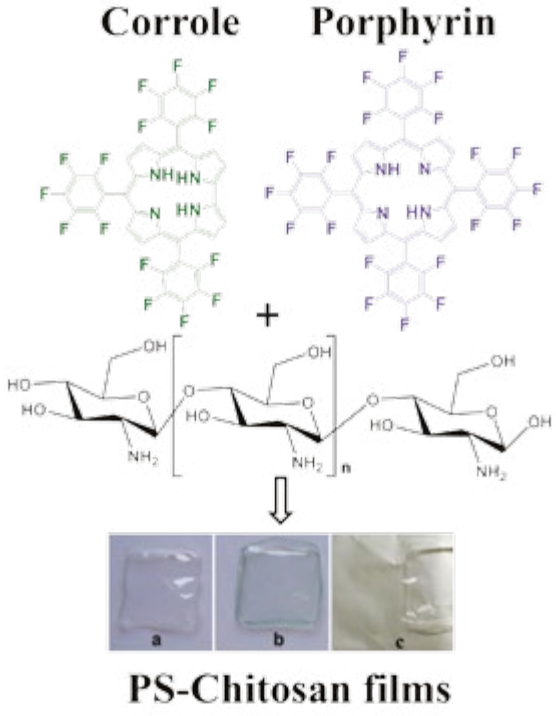
New functional bio-based materials with promising photodynamic antifouling and bacteriostatic activity

Joana F.B. Barata[1], Kelly A.D.F. Castro[1], Nuno M.M. Moura[1], Vanda I.R.C. Vaz Serra[1], Maria A.F. Faustino[1], Mário M.Q. Simões[1], Maria da Graça P.M.S. Neves[1], José A.S. Cavaleiro[1], Ana Fernandes[2], Adelaide Almeida[2], Ângela Cunha[2], Ricardo J.B. Pinto[3], Armando J.D. Silvestre[3], Tito Trindade[3], Carmen S.R. Freire[3]

1 — Department of Chemistry & QOPNA, University of Aveiro
2 — Department of Biology & CESAM, University of Aveiro
2 — Department of Chemistry & CICECO, University of Aveiro

In the past decade, rapid and increasing advances in the design and fabrication of functional biobased materials afforded new solutions for biomedicine and high-tech applications. In particular, extensive research has been carried out on the development of cutting-edge materials through the use of biopolymers, like polysaccharides and proteins, due to their abundance, biodegradability, biocompatibility, and specific properties. In this perspective, the use of the non-toxic and biodegradable chitosan, the deacetylated derivative of chitin, is an excellent choice due also to its intrinsic antimicrobial properties, biocompatibility, and film forming ability. The antimicrobial activity of chitosan based materials can be further improved by the incorporation of bioactive compounds.



Porphyrins and other tetrapyrrolic macrocycle systems are fairly spread in nature in different biological systems playing important roles. These compounds are already applied in a wide variety of areas, including biomedicine. Corroles are aromatic tetrapyrrolic macrocycles belonging to the porphyrinoid family, with distinctive structural properties, conferred by their lower symmetry. In the last years, porphyrins and derivatives have also been successfully explored as photosensitizers for the photodynamic inactivation of microorganisms, namely viruses, Gram-negative and Gram-positive bacteria, and fungi.

In the present study, new functional materials were obtained through the incorporation of porphyrins and/or corroles adequately substituted into chitosan films. The corrole grafted-chitosan films demonstrated potential bacteriostatic effect against S. aureus, with an increased response when compared with chitosan and corrole controls.1 The efficiency of these films to prevent Listeria innocua biofilm development was verified on the phases corresponding to cell adhesion and biofilm maturation.2 The antiseptic effect of chitosan, associated with the efficiency of porphyrins to inactivate planktonic cells resulted in promising photodynamic materials.