PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

INFLUENCE OF MUCINS ON THE MEMBRANE INTERACTION OF CONJUGATED NANOPOLYMER

Melissa Lima Barros (lima.melissa@unifesp.br)

Laura Péres (laura.peres@unifesp.br)

Matheus Elias Rosa (matheus.elias@unifesp.br)

Luciano Caseli (lcaseli@unifesp.br)

Elodie Boisselier (elodie.boisselier@fmed.ulaval.ca)

Nature-inspired strategies offer valuable insights into how nanomaterials interface with complex biological systems. For this purpose, conjugated nanopolymers such as poly(3-hexylthiophene) (P3HT) have emerged as promising materials in biomimetic systems due to their unique attributes of electrical conductivity, mechanical flexibility, and biocompatibility [1]. In this context, the influence of mucins on the interactions of nanopolymers was investigated, implementing Langmuir monolayers as a membrane model, containing dipalmitoylphosphatidylethanolamine (DPPE) and 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (DOPE), which compose a large fraction of bacterial membrane phospholipids [2]. The goal was to comprehend how mucins, which are the main proteins of mucosal surfaces [3], affect the behavior of nanopolymers in biological environments, particularly in the context of biocidal devices and antimicrobial applications. P3HT was converted into a nanostructured form utilizing the nanoprecipitation technique. First, several experimental conditions of the method were optimized, including the rate of

polymer addition to water, inserting it drop by drop with the aid of a syringe, the volume of the solution used (1 mL of polymer to 9 mL of water), the type of glassware (using glasswares with narrower openings), and the solvent (tetrahydrofuran, THF). Subsequently, experiments with different nanopolymer concentrations were conducted to determine the saturation concentration, that was set at 75 µg/mL. The influence of stirring and different buffer solutions on the kinetics of the process was studied; both the stirring and the use of phosphate-buffered saline (PBS, pH = 7.4) were essential to increase the surface pressure, accelerating the binding kinetics of the system. Following that, a ternary system of Langmuir monolayers containing lipids (DPPE or DOPE), mucins and the nanopolymer were used to explore the interaction between these elements as models of microbial cell membranes. These Langmuir films were analyzed using surface tensiometry, allowing the determination of binding parameters such as the maximum insertion pressure (MIP) and the synergy. The polymer exhibits a better interaction with DOPE than DPPE monolayers, since the MIP values were 26.46 and 39.61 for DPPE and DOPE, respectively. The value observed in the presence of DPPE indicates that the nanopolymer have a low insertion capacity into this lipid monolayer. In contrast, P3HT nanopolymer has preferential interactions with unsaturated lipid chains (such as DOPE) over saturated ones (like DPPE). The addition of mucins in the subphase did not significantly change the values of surface pressures, likely due to the large size of the protein when compared to the other components. This work highlights the potential of interactions between conjugated polymer nanomaterials tailored for mucosal antimicrobial applications, contributing to the development of biointerfaces with applications in biosensing and biotechnology.

Acknowledgements

This work was supported by FAPESP (2025/27044-5; 24/08372-9; 24/19912-4); INEO; CNPq (408449/2024-1; 31156002/2023-0).

References

[1] DENG, HM. P3HT-PbS nanocomposites with mimicking enzyme as bi-enhancer for ultrasensitive photocathodic biosensor. Biosensors & bioelectronics, v. 197, p. 113806, 2022.

[2] EPAND, R. M., EPAND, R. F. Lipid domains in bacterial membranes and the action of antimicrobial agents. Biochimica et Biophysica Acta (BBA) - Biomembranes. v.1788, p. 289-290, 2009.

[3] CORFIELD, A. P. Mucins: A biologically relevant glycan barrier in mucosal protection. Biochimica et Biophysica Acta (BBA) - General Subjects, v. 1850, p. 236-252, 2015.

Palavras-chave: langmuir monolayers; conjugated polymer; mucins.