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Interaction of two fully water-soluble chitosans with bacterial membrane models using Langmuir monolayers

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Langmuir monolayers are useful for studying events in a biological membrane at the molecular level. They simulate half of a membrane, and are especially suitable to evaluate the interaction of membrane lipids and other biomolecules, such as proteins, peptides, saccharides, drugs and nanomaterials. (1) Here, we assess the effect of two fully water-soluble chitosans (Ch35% and Ch15%, with degrees of acetylation of 35% and 15%, respectively) on bacterial membrane models, using Langmuir monolayers. These polysaccharides were obtained by Fiamingo *et al.* through the deacetylation and partial reacetylation of chitin molecules, generating molecules with a quasi-ideal random pattern of acetylation. (2) The monolayers were composed by *Escherichia coli* total lipid extract or lipopolysaccharide (LPS). They were deposited on subphases containing either acetate buffer pH 4.5 or PBS pH 7.4, with different concentrations of Ch35% or Ch15%: 0, 10^{-5} , 10^{-3} and 10^{-1} mg mL⁻¹. The incorporation of these chitosans caused monolayer expansion, independently of composition. On acetate buffer, expansion was higher for the Ch15% since it displays a smaller percentage of acetylation, which confers a higher degree of protonation. This chitosan possesses a higher net charge, and therefore the interaction with the negative charges of the monolayer lipids is enhanced. Under these conditions, the interaction was considerably more effective on LPS monolayers. At its highest concentration, Ch35% caused a larger disruption on monolayers on PBS than on acetate buffer. With a lower degree of protonation on less acidic pH, Ch35% occupies a larger volume. It is interesting to point out that the stability and the rigidity of LPS monolayers decreased for the highest concentration of Ch35%, while they increased for the other concentrations and on *E. coli* lipids monolayer. Overall, the results show that the net charge of chitosans molecules may contribute to its action as antimicrobial agents. Even though the interaction with the inner membrane was not strong, the interaction with LPS, which composes the outer membrane, is significant for chitosans with a higher net charge.

Palavras-chave: Langmuir. Bacterial membrane models. Chitosan.

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