PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

THEORETICAL STUDY OF MELANIN-ZN^{2+} COMPLEXES: INVESTIGATING IONIC CHELATION AND ACTIVATION INTERACTION WITH BACTERIAL LIPOPOLYSACCHARIDES

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Melanin-like dopamine compounds are widely used for the design of biomaterials, presenting a huge potential for biomedical applications. It is mainly due its biocompatibility and presence of active functional groups which allows effective interactions with molecules, enzymes and/or ions. A relevant aspect is the melanin capacity of ion chelation, which allows the formation of a variety of bioactive complexes1. In particular, it has been reported the use of melanin+Zn+2 complexes as an effective antibacterial agent2. Despite the number of works in the literature, there is still a notable gap regarding the role of ion-melanin interactions for biological applications, mainly due to the difficulty of experimentally analyzing such systems. In this report, we use density functional theory (DFT) based calculations to evaluate melanin+Zn+2 (oligomeric) complexes, to better understand the influence of metal ion on the electronic properties of such materials, and underline possible relevant mechanisms that rule their biological activity. The calculations were performed using the hybrid

B3LYP functional, as it is sufficient for this type of structural calculations, and the 6-31G(d,p) basis set, which is also well-established within our research group. The PCM model was also used for the solvation and the Empiric Dispersion Correction (GD3) as well. All fundamental melanin monomers with different oxidation states were fully optimized. The local reactivity, electrostatic potential map, and adsorption energy of these monomers with zinc ions were analyzed. These data were used alongside docking studies and previous research to construct the dimeric structures3. Similar analyses were performed for the possible dimers, both before and after the incorporation of the zinc ion, with the addition of Frontier Molecular Orbital (FMO) analysis. The results show that the presence of the metal center on the oligomers affects the structural properties and the local reactivity of the melanin-based systems, leading to an intense electric polarization, and activation of the metal (increase of its local reactivity), which play a relevant role in their interaction with typical lipopolysaccharides present in gram-negative bacterias. Our data are also compatible with other experimental spectroscopic results associated with such systems, allowing us to interpret additional effects of ion chelation on the electronic structure of the complexes.

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Palavras-chave: melanin; antibacterial; dft; electronic structure; zinc chelation.