Photophysical characterization and in vitro anti-leishmanial effect of 5,10,15,20-tetrakis(4-fluorophenyl) porphyrin and the metal (Zn(II), Sn(IV), Mn(III) and V(IV)) derivatives

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Abstract

In this report 5 compounds were synthesized and structural and their photophysical characterization was performed (Φ_Δ and Φ_f). Furthermore, in this in vitro study, their biological activity against Leishmania panamensis was evaluated. The photophysical behavior of these compounds was measured and high Φ_Δ and low Φ_f was observed. Besides, DFT quantum calculations on the electronic structures were performed. Finally, the biological activity was determined by means of the compounds capacity to inhibit the viability of parasites using the MTT assay. The inclusion of the metal ions substantially modified the photophysical and biological properties in comparison with the free metal porphyrin (1). In fact, Zn^{2+} porphyrin derivative (2) showed a marked decrease of Φ_f and increase of Φ_Δ. In this sense, using TDDFT approaches, a luminescent process for Sn^{4+} derivative (3) was described, where emissive states involve the ML-LCT transition. So, this led to a decrease in the singlet oxygen production (0.82–0.67). Biological results showed that all compounds inhibit the viability of L. panamensis with high efficiency; the decrease in the viability was greater as the concentration of exposure increased. Finally, under light irradiation the IC_{50} of L. panamensis against the Zn(II)-porphyrin (2) and V(IV)-porphyrin (5) was lower than the IC_{50} of the Glucantime control (IC_{50} = 2.2 and 6.95 µM Vs IC_{50} = 12.7 µM, respectively). We showed that the use of porphyrin and metalloporphyrin-type photosensitizers with exceptional photophysical properties can be successful in photodynamic therapy (PDT) against L. panamensis, being the diamagnetic ion Zn^{2+} a candidate for the preparation of metalloporphyrins with high singlet oxygen production. © 2021, The Author(s), under exclusive licence to Springer Nature B.V.

Author keywords

DFT; Leishmania panamensis; Metalloporphyrins; Photodynamic therapy; Porphyrins