Synthesis of porphyrin-polyethylenimine conjugates as antimicrobial agents

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OBJECTIVES

*Synthesize porphyrins substituted in the *meso*-positions of the tetrapyrrolic macrocycle by pentafluorophenyl groups.
*Form conjugates of synthesized porphyrins with polymers substituted by amine groups as precursors of positive charges.
*Study UV-visible absorption and fluorescence emission properties of the conjugates.
*Evaluate the photodynamic activity of the conjugates using molecular proof to detect reactive oxygen species.

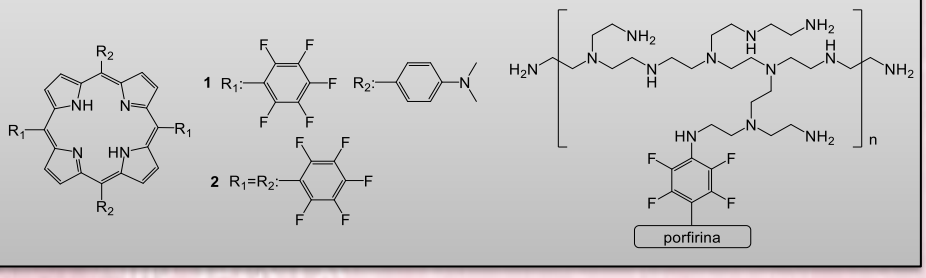
INTRODUCTION

Increasing of resistant bacteria to clinical antibiotics has conducted to establish new treatments for infections [1]. One of them includes photodynamic inactivation (PDI) of microorganisms [2]. PDI is founded in the administration of a photosensitizer and the aerobic irradiation produces cell inactivation. In general, the presence of positive charge precursor groups allows improving the photoinactivation due to an increase in interaction with microbial cells [3].

SYNTHESYS

5,15-di(4-(*N*,*N*-dimethylaminophenyl)-10,20-di(pentafluorophenyl)porphyrin (**1**) and 5,10,15,20-tetrakis(pentafluorophenyl)porphyrin (**2**) were synthesized from the condensation of 4-pentafluorobenzaldehyde and 5-(pentafluorophenyl)dipyrromethane or pyrrole catalysed by boron diethyl etherate in dichloromethane. After oxidation with 2,3-dichloro-5,6-dicyano-1,4-benzoquinone and purification using flash chromatography, porphyrin **1** and **2** were isolated in 24% and 36%, respectively.

An aromatic nucleophilic substitution reaction was used to obtain conjugated polymers based in these porphyrins covalently linked to polyethylenimine (**PEI-1** and **PEI-2**). The reaction was carried out in *N*,*N*-dimethylformamide (DMF) giving 100% conversion.



SPECTROSCOPIC CHARACTERISTICS AND PHOTODYNAMIC PROPERTIES

PS	λ_{max}^{Soret} (nm)	λ_{max}^{Em} (nm)	$\Phi_F^{DMF a}$	$\Phi_\Delta^{DMF b}$	k_{obs}^{DMF} (s^{-1}) Trp
PEI-1	418	643	0.0084±0.0008	0.25	7.96×10^{-5}
PEI-2	420	657	0.034±0.003	0.31	1.55×10^{-4}

[a] Fluorescence quantum yield, [b] singlet molecular oxygen quantum yield, [c] observed rate constant of Trp photooxidation.

CONCLUSION

These conjugates showed the Soret absorption band and the four characteristic Q bands of porphyrins. Moreover, they emit red light. Photodynamic studies indicated that **PEI-2** is more effective than **PEI-1** to produce singlet molecular oxygen and decompose L-tryptophan (Trp) with a significant contribution of a type II mechanism. In addition, *in vitro* PDI studies demonstrated that both polymers are effective phototherapeutic agents for the eradication of bacteria.

REFERENCES

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