Porphyrin-loaded acetylated lignin nanoparticles: preparation, characterization and antimicrobial activity

Nidia Maldonado-Carmona[a], Tan-Sothea Ouk[a], Nicolas Villandier[a], Claude Alain Calliste[b], Mário J. F. Calvete[c], Mariette M. Pereira[c], Stéphanie Leroy-Lhez[a]
[a] PEIRENE Laboratory, Faculty of Sciences and Techniques, University of Limoges, 87060 Limoges, France
[b] PEIRENE Laboratory, Faculty of Pharmacy, University of Limoges, 87025 Limoges, France
[c] Coimbra Chemical Center, Universidade de Coimbra, Coimbra, France

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Introduction. Lignin valorization is a topic that has started to attract attention from the scientific community, due to the easiness of lignin chemical tuning and due to its low cost of production. Lignin has appeared as an interesting material for biomedical applications, namely, as a drug carrier. Several examples have demonstrated that lignin nanoparticles are able to transport antineoplasic drugs, pesticides, and even photosensitizers. Although it has been demonstrated the feasibility of encapsulation of 5,10,15,20-tetrakis (4-hydroxyphenyl)-21H,23H-porphine (**THPP**), the extensiveness of this result to other types of photosensitizers needs to be analyzed.

Porphyrin-loaded nanoparticles: Physical characterization

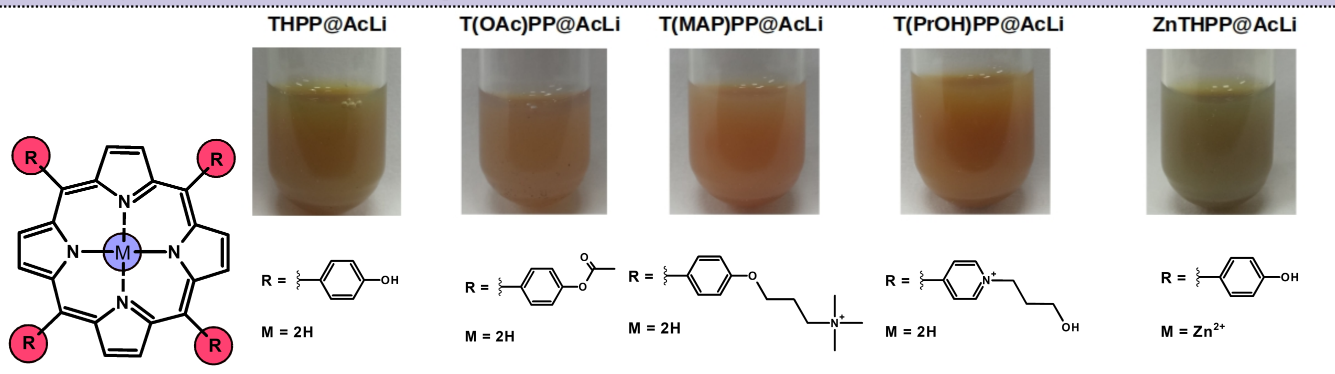

Figure 1. Scherme with the different porphyrins encapsulated along this project and the macroscopic aspect of the obtained suspension.

Nanoparticles	Size (nm)	Zeta potential (mV)
THPP@AcLi	160.4	-20.8
T(OAc)PP@AcLi	199.6	-21.180
T(MAP)PP@AcLi	886.2	-2.808
T(PrOH)PyP@AcLi	1348	-9.962
ZnTHPP@AcLi	208.2	-24.140

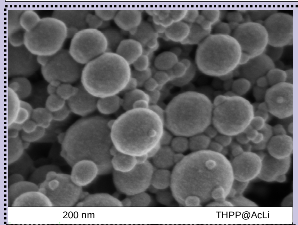

Figure 2. Transmission electron microscope micrographies of acetylated lignin nanoparticles loaded with THPP. A wide range of sizes are observed among the spheric objects.

Photophysical properties

Porphyrin	Soret's band		Fluorescent quantum yield
	Absorption coefficient (M^{-1} cm^{-1})	Wavelength (nm)	
THPP@AcLi	12.9984 × 10^4	434	0.0103
T(OAc)PP@AcLi	12.0609 × 10^4	426	0.0690
T(MAP)PP@AcLi	20.7684 × 10^4	432	0.0310
T(PrOH)PyP@AcLi	1.3472 × 10^4	448	-
ZnTHPP@AcLi	18.5219 × 10^4	435	0.0101

Values determined in phosphate buffer 0.01 M, pH 7

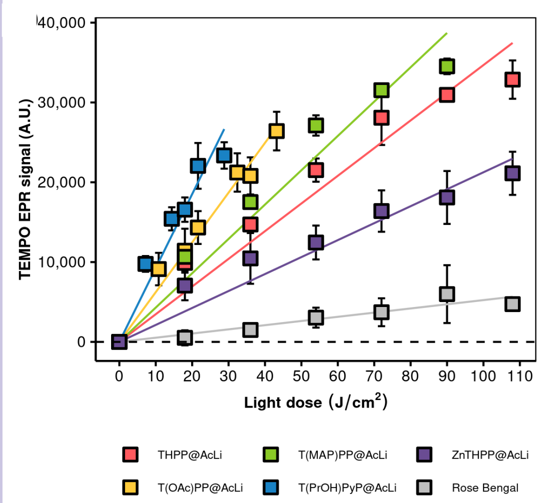

Figure 3. Production of singlet oxygen, determined by EPR, through the quenching with TEMP. Nanoparticles suspension (25 µM) in phosphate buffer 0.01 M, pH 7, supplemented with TEMP 12.5 mM, were irradiated with blue light (455 nm) over time. Singlet oxygen production was determined as the production of TEMPO.

Antibacterial activity against *Staphylococcus aureus*

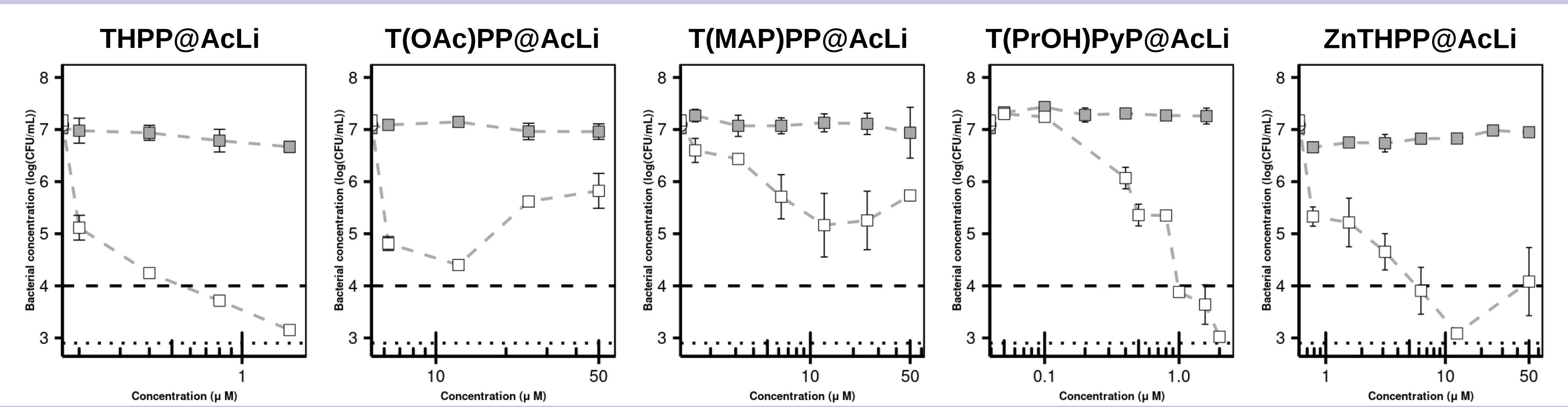

Figure 4. Antibacterial effect of the nanoparticles when tested against *S. aureus* (10^7 CFU/mL) when irradiated (white symbols) with blue light or incubated in the dark (dark symbols). The presented results are the average of three independent experiments and a duplicate in time. The dashed line represents a reduction of 3-logarithmic scales, while the dotted line represents the limit of quantification of the method used. Bacteria and nanoparticles were irradiated with blue-LED ligh (455 nm), with a fluence of 500 mW/cm², during 30 seconds, accounting for a light dose of 15 J/cm².

Related publications

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