CYSS
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synthesis • theory • characterization • application

Degradation of polyphenolic contaminants using a natural polymeric dye of riboflavin-5'-phosphate cross-linked chitosan as photosensitizer

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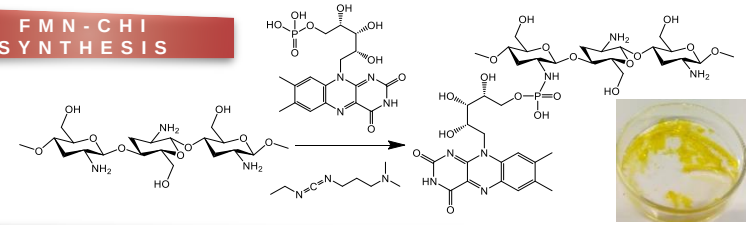
INTRODUCTION

The use of photosensitized processes for the degradation of pollutants can be considered as emergent green processes.[1] The sensitizer or the dye, in presence of UV o Vis radiation can act as a photosensitizer capable of generating highly oxidizing species. The dyes used in the photodegradation processes have the disadvantage of remaining in the environment after the photo-degradative process. This problem can be solved by using **polymeric dyes** (PD), whose solubility in water varies with pH of the solution, allowing its removal. [2] In this work the development of a PD is presented, this PD is made up of natural products, flavin mononucleotide as photosensitizer (FMN), and chitosan polysaccharide (CHI) as a polymeric support, thus obtaining a polymeric dye called FMN-CHI.

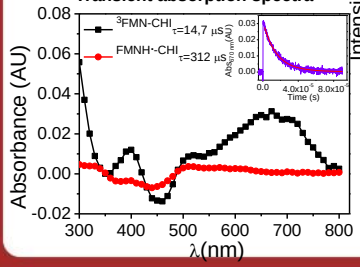
FMN-CHI SYNTHESIS



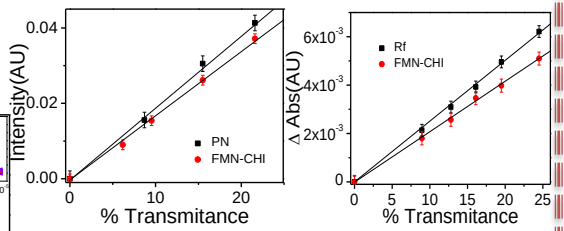
FMN-CHI CHARACTERIZATION

FMN-CHI is more photostable than free sensitizer

Transient absorption spectra



Determination of ϕ_Δ and $^3\phi$



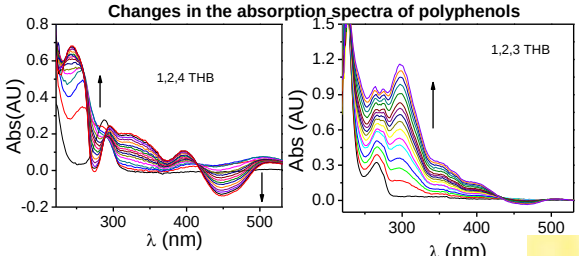
Photophysical characterization of FMN-CHI

Sensitizer	$^1\phi_f$	$^1\tau$ (ns)	$^3\phi$	$^3\tau$ (μs)	ϕ_Δ
FMN-CHI	0.353	4.69	0.305	14.7	0.87
FMN	0.352	4.69	0.345	15	0.82

PHOTOSENSITIZATION

In this study, we investigated the use of **FMN-CHI** as polimeric sensitizer in the photodegradation of polyphenolic compounds at 20 minutes of irradiation with blue Led's

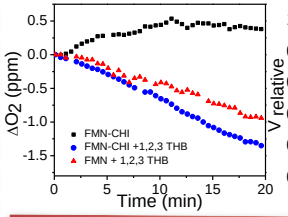
Changes in the absorption spectra of polyphenols



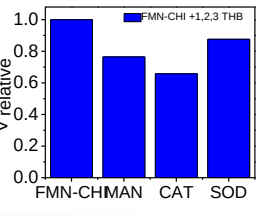
Determination of ^{3}kq by Laser Flash Photolysis

Sensitizer	1,2,3 THB ($M^{-1}s^{-1}$)	1,2,4 THB ($M^{-1}s^{-1}$)
FMN-CHI	$2,8x10^9$	$3x10^9$
FMN	$2,8x10^9$	$2,5x10^9$

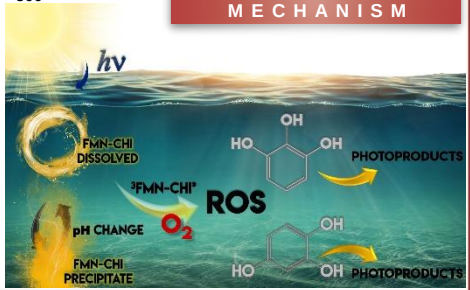
Oxygen consumption upon photoirradiation



Photogenerated ROS



PROPOSAL MECHANISM



CONCLUSIONS

- The synthesis of an FMN-CHI polymeric dye was achieved.
- An important feature is that the PD has a higher ϕ_Δ and is more photostable than free FMN, this may be due to the binding of the sensitizer to CHI. These results are reflected in a faster degradation of polyphenolic compounds when the PD is uses in place of FMN. The pollutant degradation may be attributed to their reaction with $^1O_2$ or excited triplet state of the PD.
- The polymer obtained can be removed after its used, and it can be reused several times which turns it into a novel and promising photocatalytic material

References:

[1] M. Luisa Marin, Lucas Santos-Juanes, Antonio Arques, Ana M. Amat, and Miguel A. Miranda *Chemical Reviews* **2012** *112* (3), 1710-1750

[2] Ferrari, G.V., Andrada, M.E., Natera, J., Muñoz, V.A., Paulina Montaña, M., Gambetta, C., Boiero, M.L., Montenegro, M.A., Massad, W.A. and García, N.A. . *Photochem Photobiol* **2014** *90* (6), 1251-1256.

Acknowledgment

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