



Mesoporous silica nanoparticles for the encapsulation of essential oils and the improvement of their activity against *Fusarium avenaceum* and its production of enniatins

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Mesoporous silica nanoparticles for the encapsulation of essential oils and the improvement of their activity against *Fusarium avenaceum* and its production of enniatins

Despite the in vitro efficacy of various essential oils (EOs), their practical use to control toxigenic *Fusarium* spp is limited by their high volatility and sensitivity to UV and oxidation. Their nano-encapsulation can provide protection for the active volatile molecules and allow for a gradual release into the environment. Mesoporous silica nanoparticles (MSNPs) are inert, mechanically stable, stable in suspension in an aqueous medium and their specific surface area is very suitable for functionalization. We have used them for the encapsulation of EOs with antifungal and antimycotoxin activity

Mesoporous silica nanoparticles synthesis

Sol-gel Method

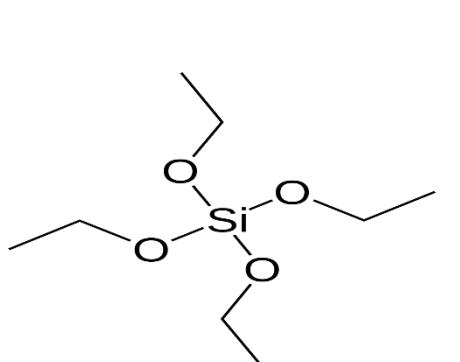
Precursor:

tetraethyl orthosilicate (TEOS)

Surfactants:

Cetyl trimethyl ammonium bromide (CTAB)

Pluronic P123 (P123)



Essential oil encapsulation using impregnation

EOs : Hydrodistillation of *Thymus capitatus* (TC) and *Ammoides pusila* (AP) [aerial parts]

EOs dissolution in hydroalcoholic solution

Addition drop by drop to MSNPs

Evaporation of the solvent at room temperature

Characterisation of the nanoproducts

N2 physisorption measurements at 77K:

* Specific surface area: Brunauer-Emmett-Teller (BET)

* Pore size distribution: Barrett-Jorner-Halenda (BJH)

Thermogravimetric Analyse

In vitro release of EO in liquid and evaporation

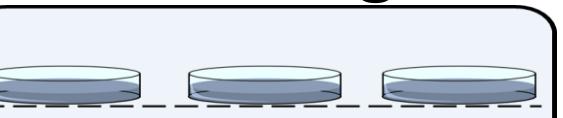
Evaluation of antifungal (*F. avenaceum*) and antimycotoxins (enniatines) activities

Cultures in FDM-Agar medium, 25°C, 10 j

Contact



Fumigation



Mycelial growth



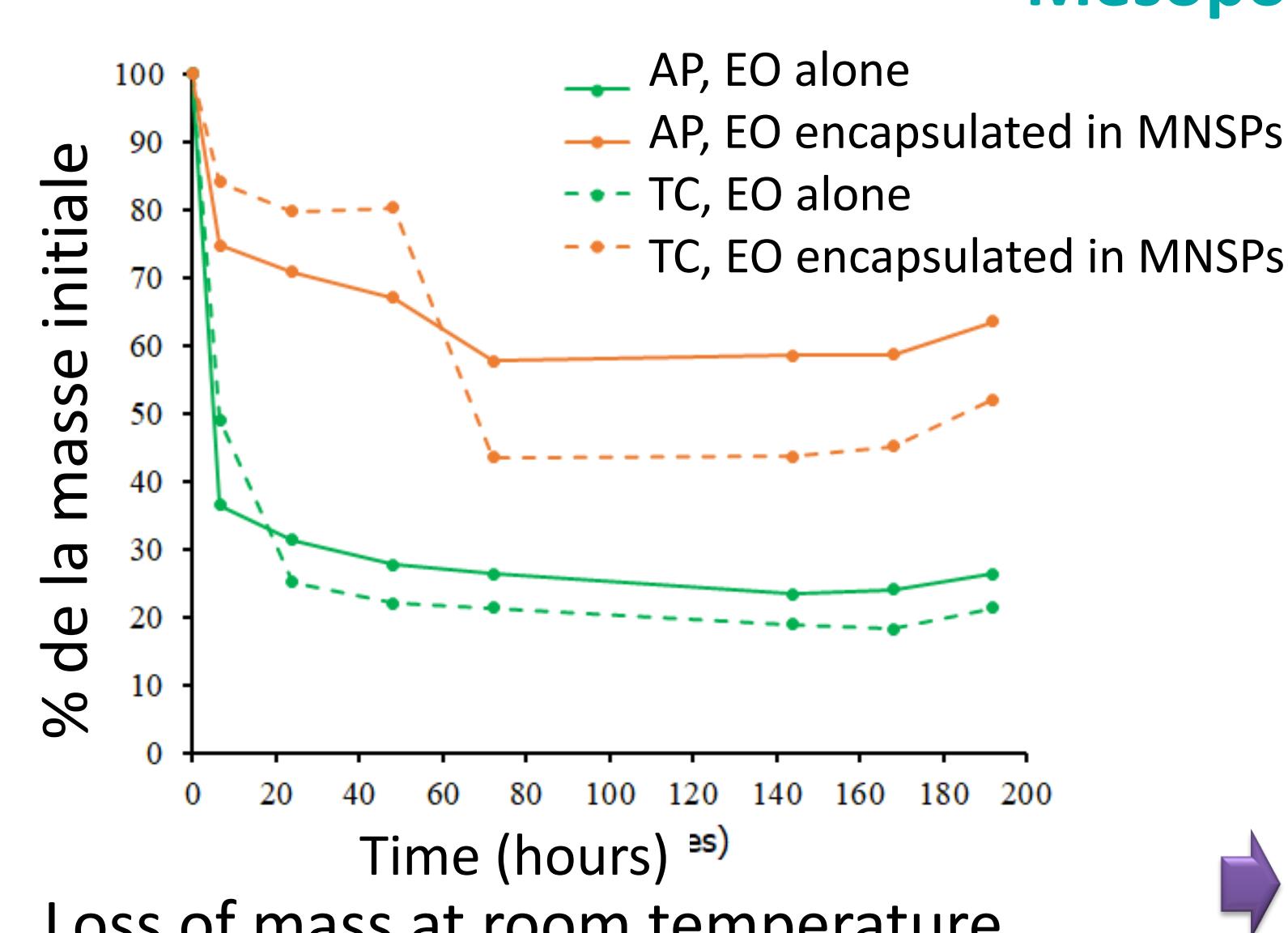
Measures

Enniatins B1+B2+B3 (ENN)
In Agar- UPLC-DAD



Chakroun et al. 2021, Molecules . <https://doi.org/10.3390/molecules26226906>

Mesoporous silica nanoparticles characterization and yield of HEs' encapsulation



Confirmation of the mesoporous structure

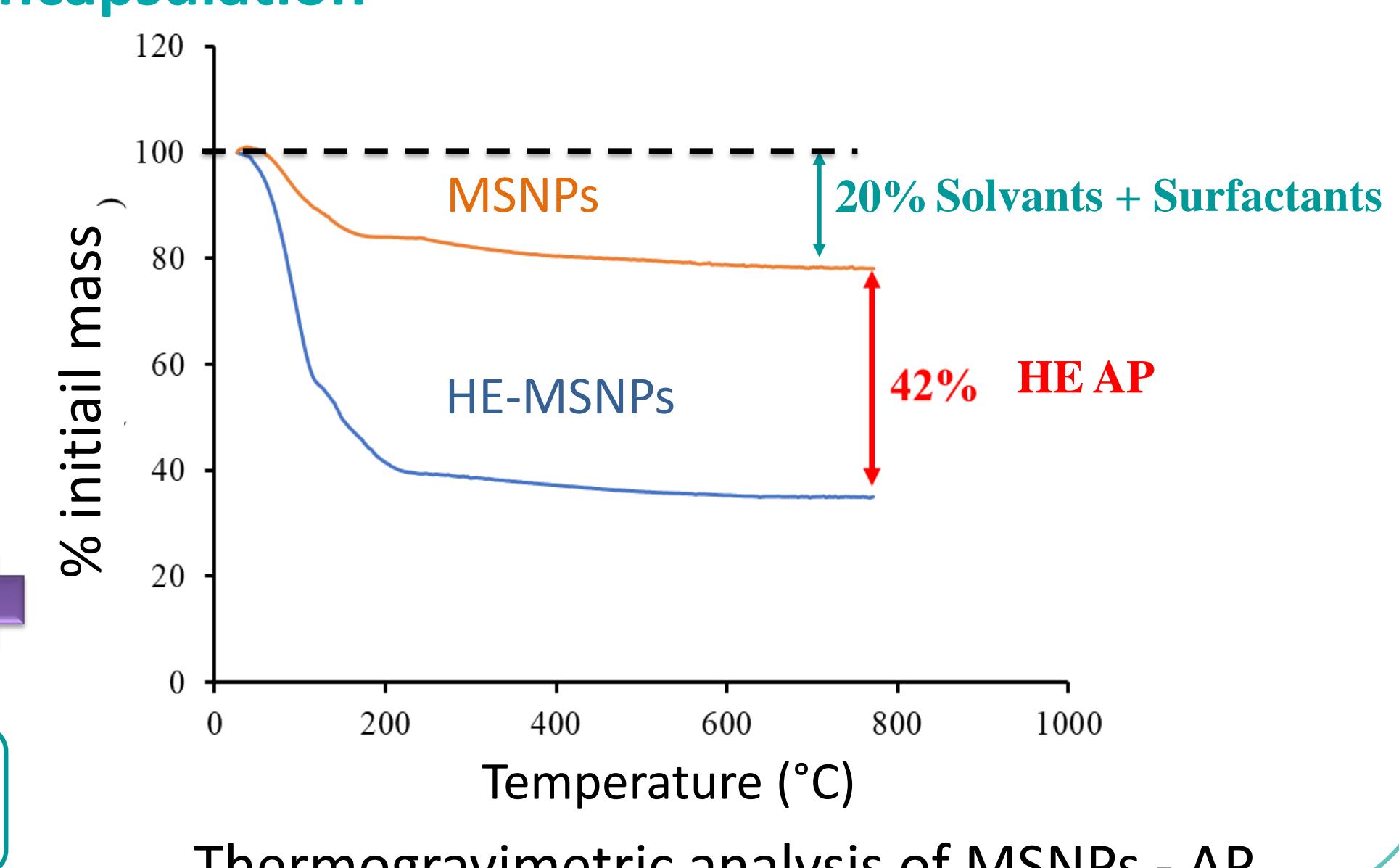
Specific surface area = 486,97 m² g⁻¹

Mean por size: 3,1 nm

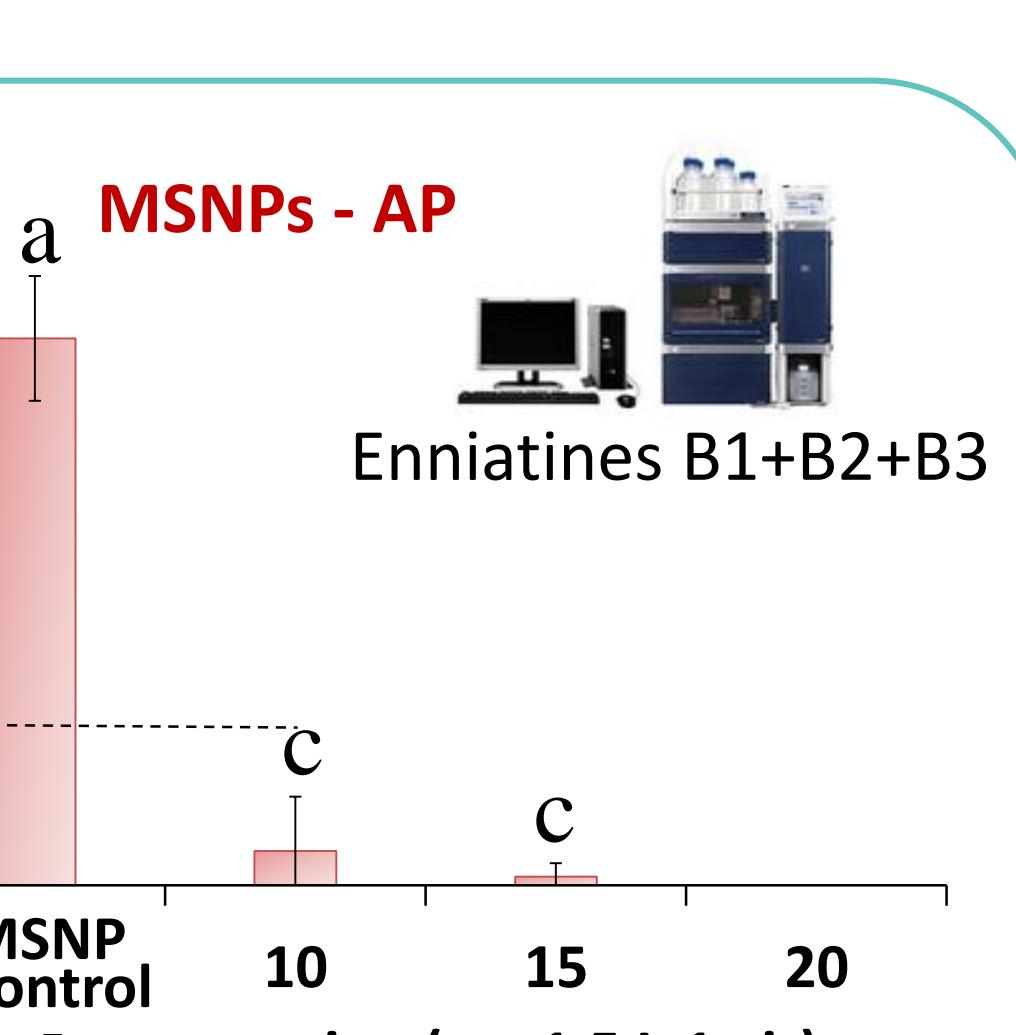
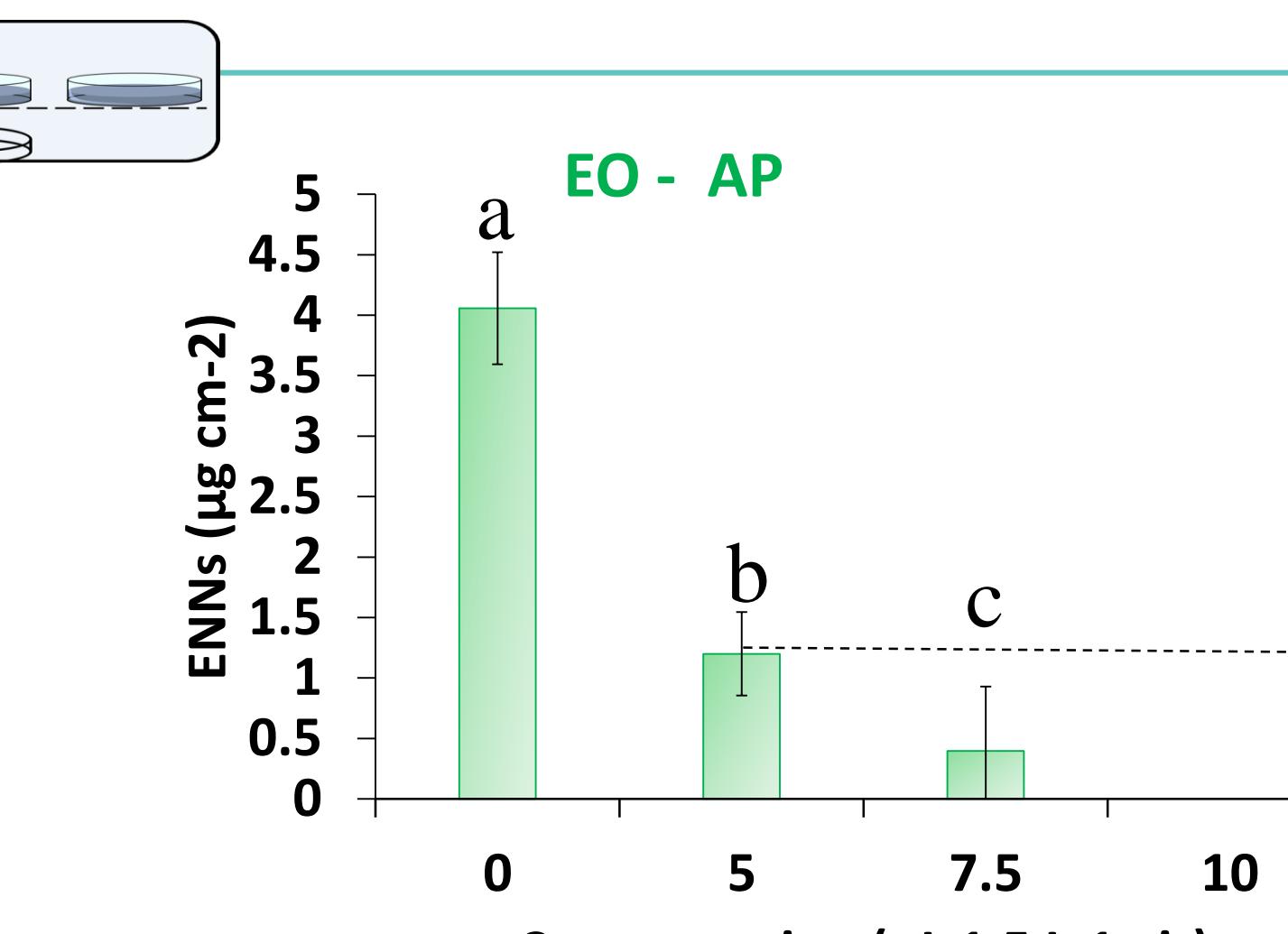
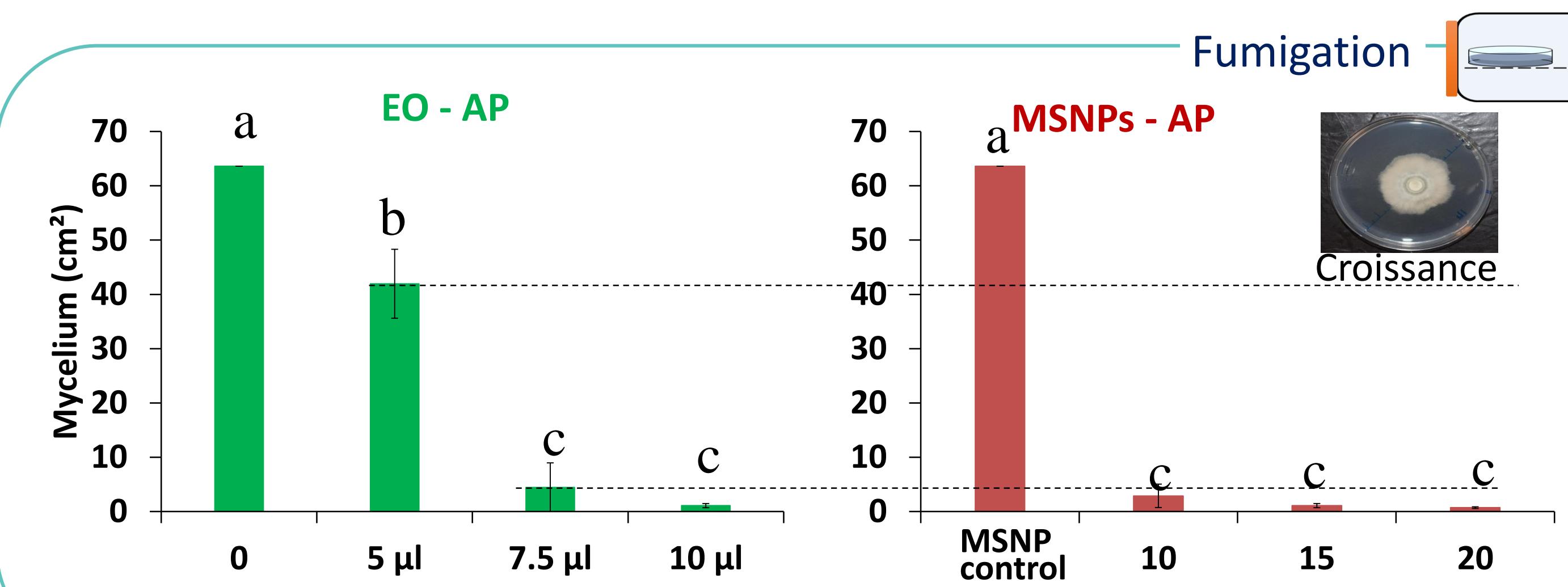
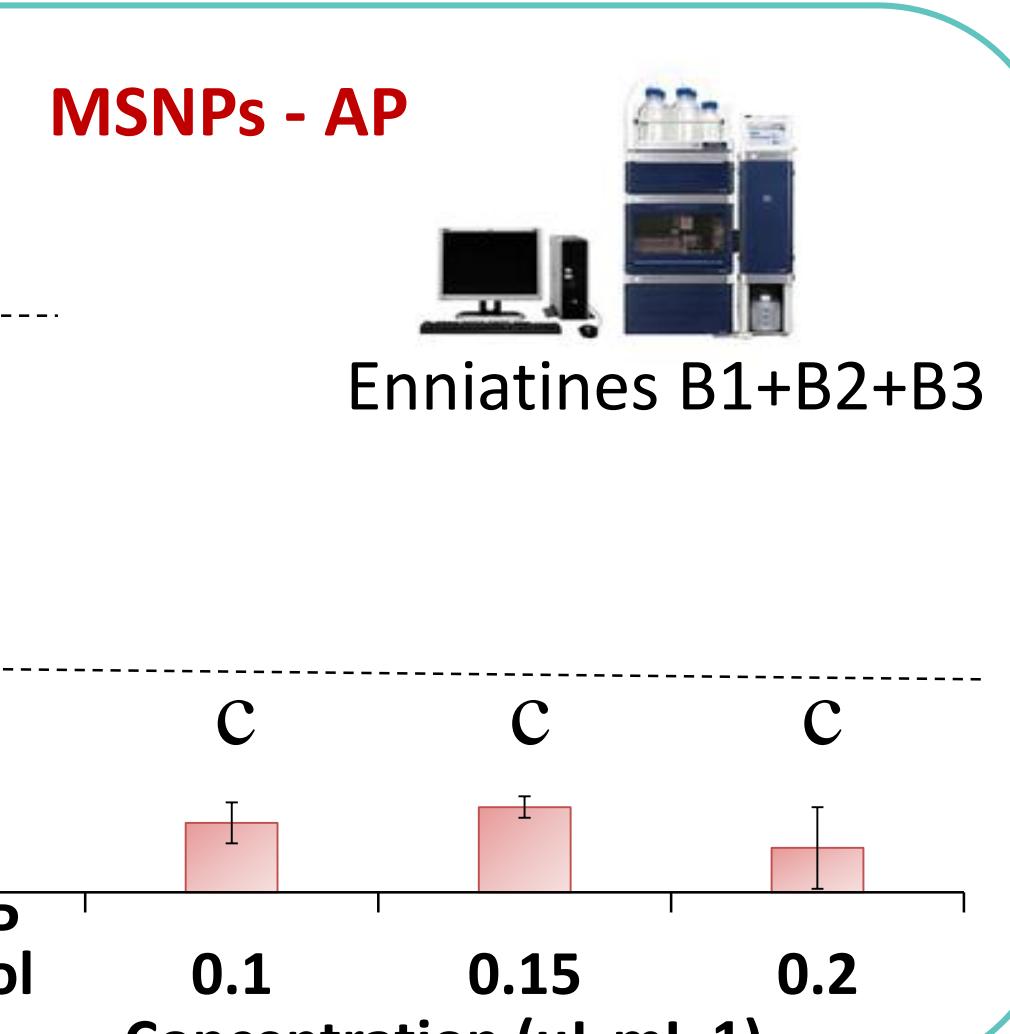
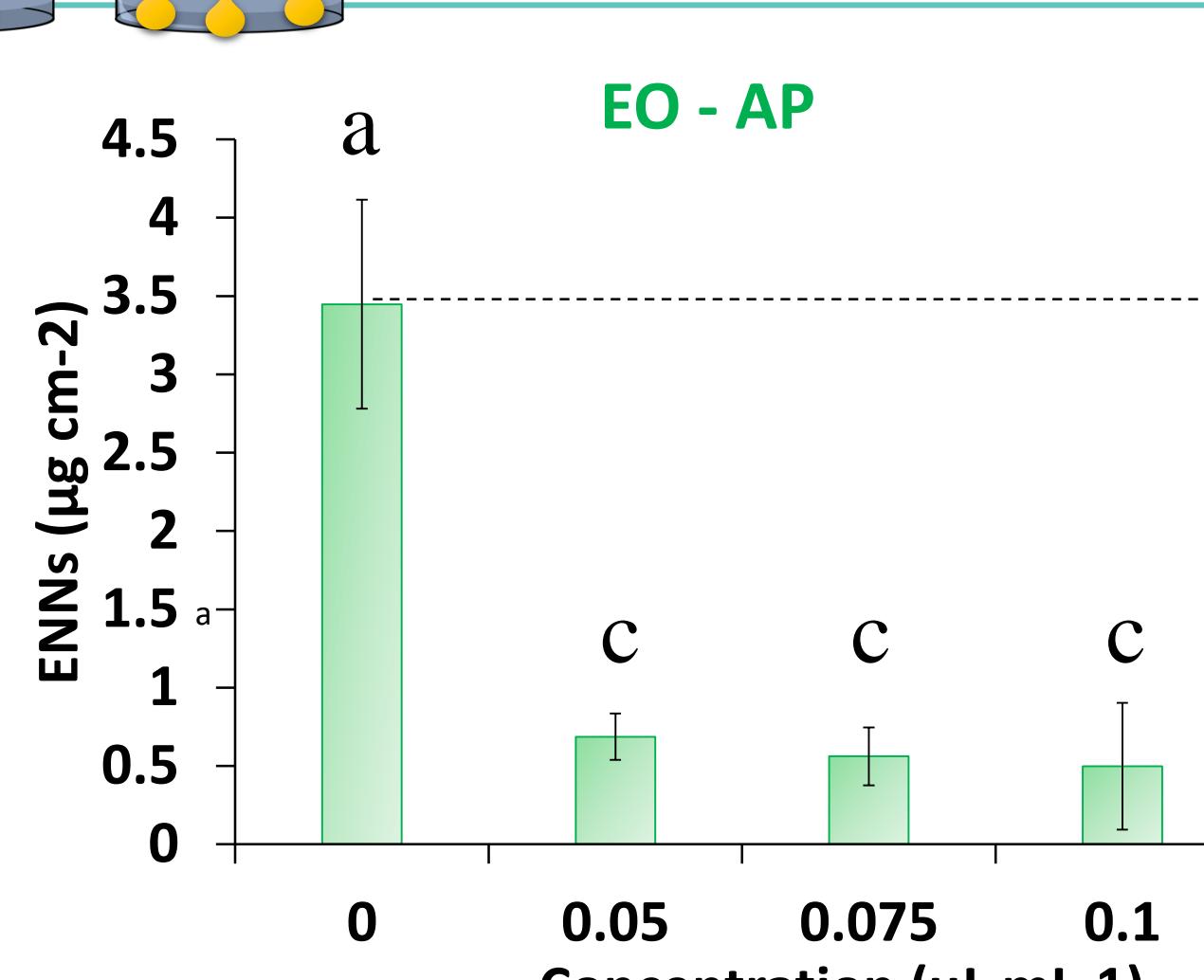
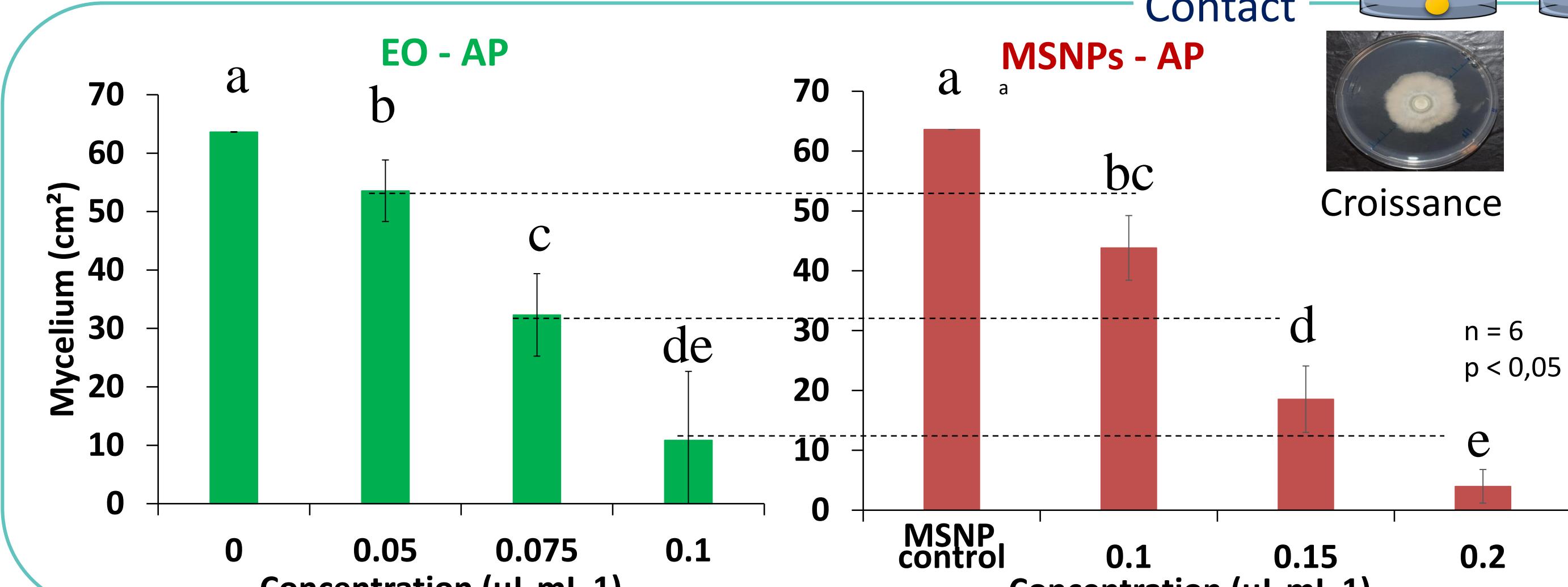
Confirmation of Eos 'encapsulation

encapsulation yield for AP = 42 %
encapsulation yield for TC = 69 %

Increased diffusion time of EO after encapsulation in MSNPs



Antifungal and antimycotoxin activities



MSNPs (without) in contact inhibited significantly the accumulation of enniatins by *Fusarium avenaceum*

Encapsulation in MSNPs improved the antifungal and anti-enniatins activity of *Ammoides pusila* on *Fusarium avenaceum*

1



2



3



9ÈME ÉDITION DES JOURNÉES MYCOTOXINES
22-23 septembre 2022 - MARSEILLE

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Issue de la these de Yasmine Chakroun (2022) : Activité antifongique et antimycotoxine d'huiles essentielles tunisiennes sur des souches de *Fusarium* productrices d'enniatines et évaluation de leur potentielisation par nanoencapsulation



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