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

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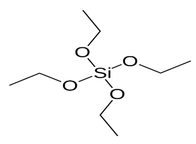
Despite the in vitro efficacy of various essential oils (EOs), their practical use to control toxigenic *Fusarium* spp is limited by their high volatility and sensitivity to UV and oxidation. Their nano-encapsulation can provide protection for the active volatile molecules and allow for a gradual release 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 solvant at room temperature

Caracterisation of the nanoproducts

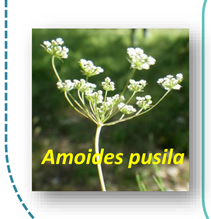
N2 physisorption measurements at 77K:

* 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

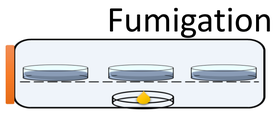


Evaluation of antifungal (*F. avenaceum*) eand antimycotoxins (enniatines) activities

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

Contact

Fumigation



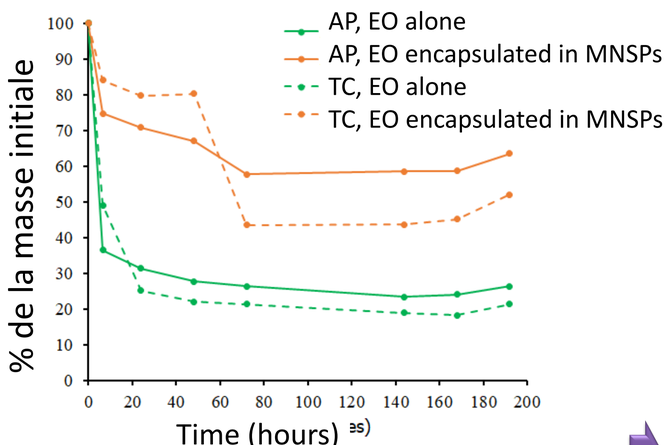
Chakroun et al. 2021, Molecules . https://doi.org/10.3390/molecules26226906

Mycelial growth

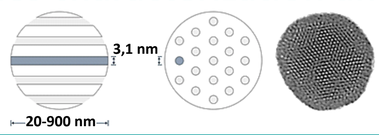
Measures

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

Mesoporous silica nanoparticles characterization and yield of HEs' encapsulation



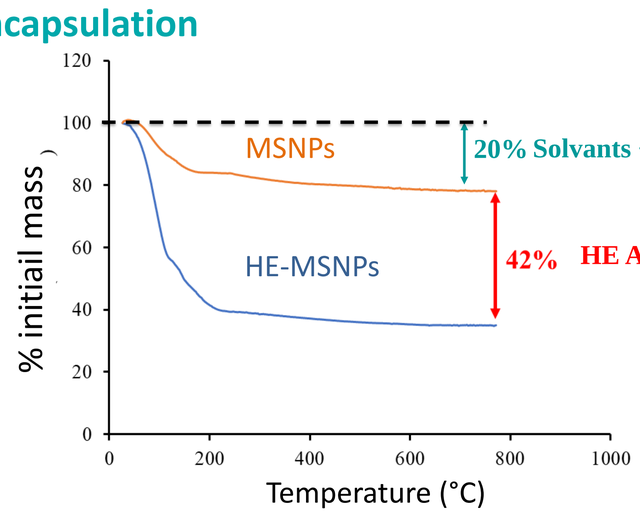
Loss of mass at room temperature



Confirmation of the mesopourous structure
Specific surface area = 486,97 $m^2 g^{-1}$
Mean por size: 3,1 nm

Confirmation of Eos 'encapsulation
encapsulation yield for AP = 42 %
encapsulation yield for TC = 69 %

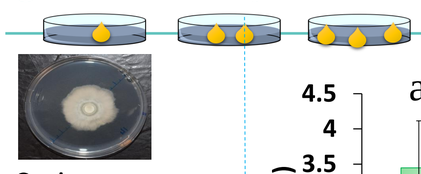
Increased diffusion time of EO after encapsulation in MSNPs

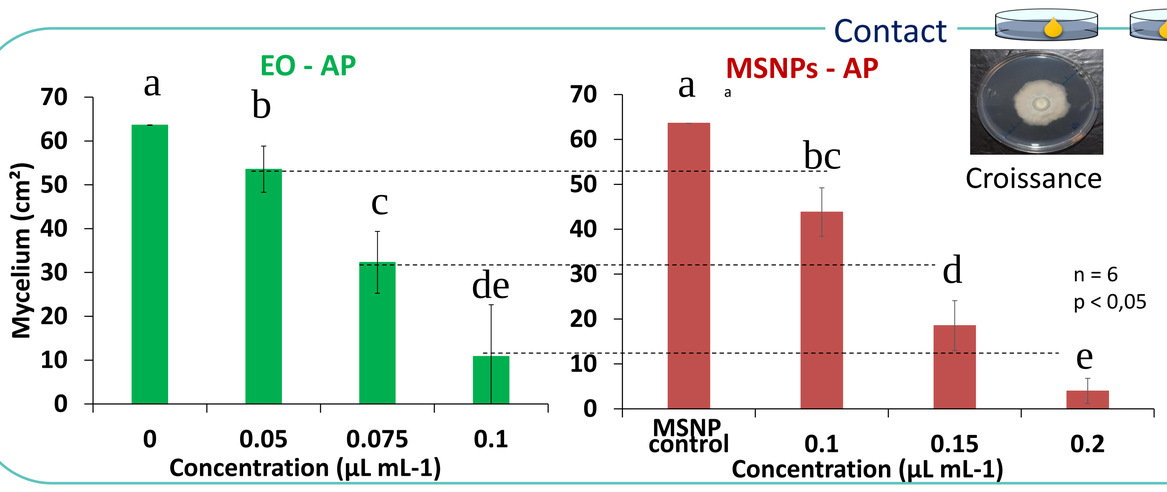


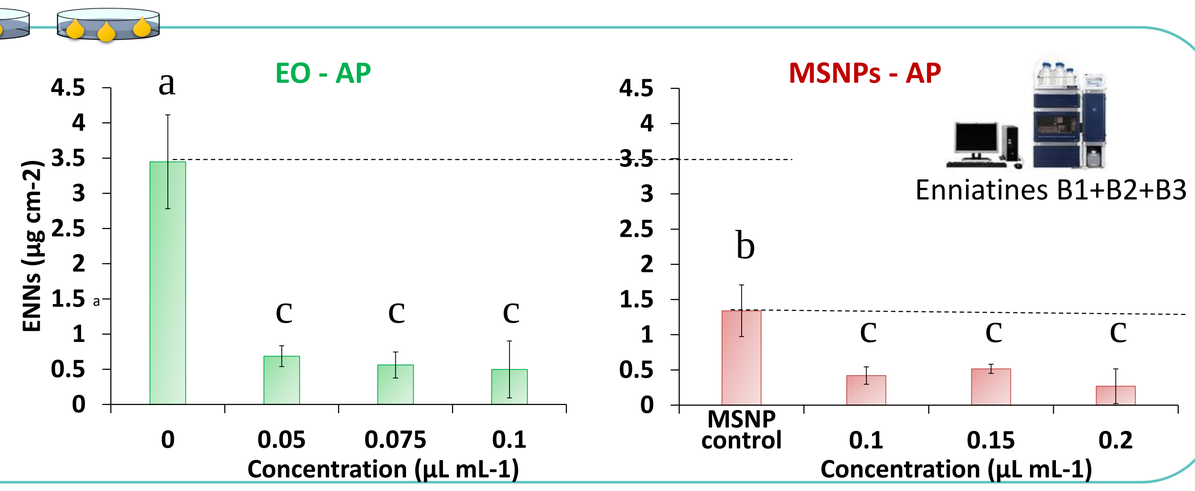
Thermogravimetric analysis of MSNPs - AP

Antifungal and antimycotoxin activities

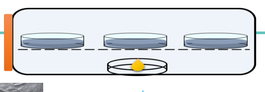
Contact

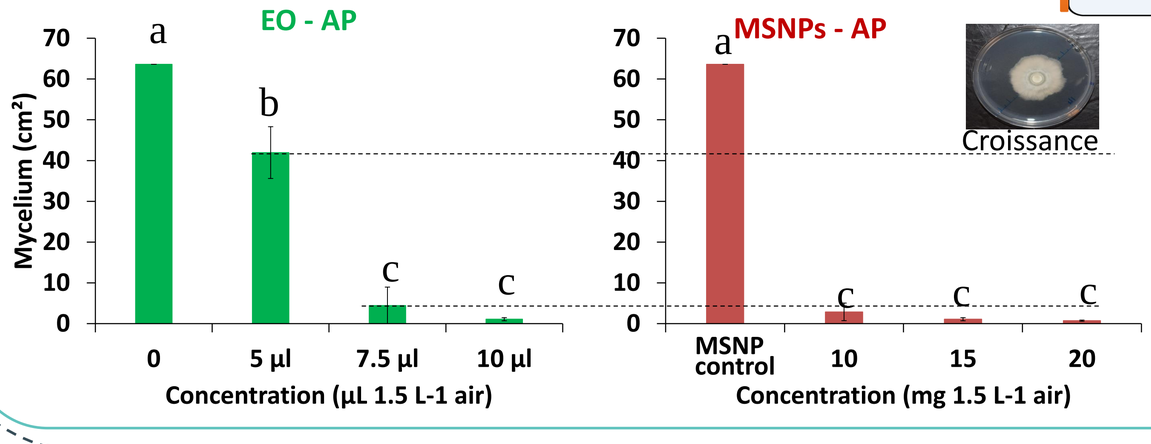


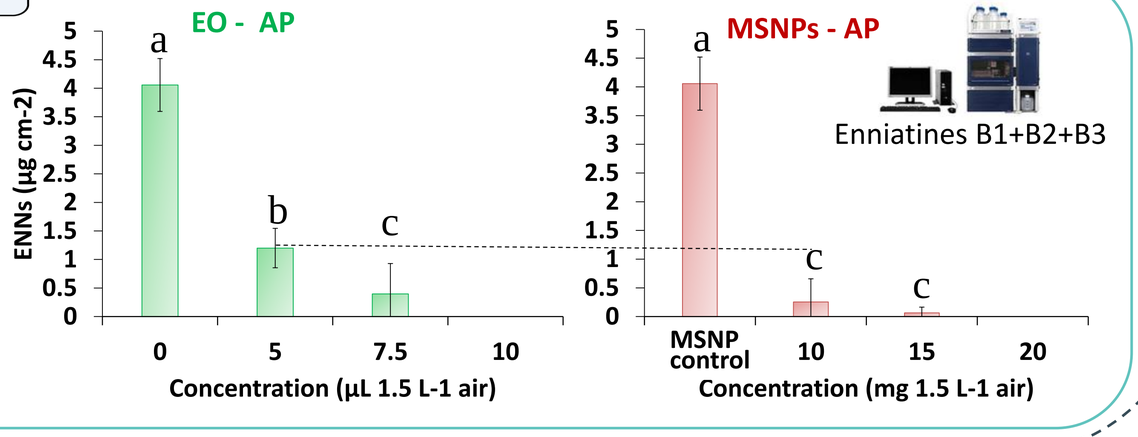




Fumigation







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

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

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