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Comparative exposure of mussels to chlorpyrifos through microplastic and microalgae particles

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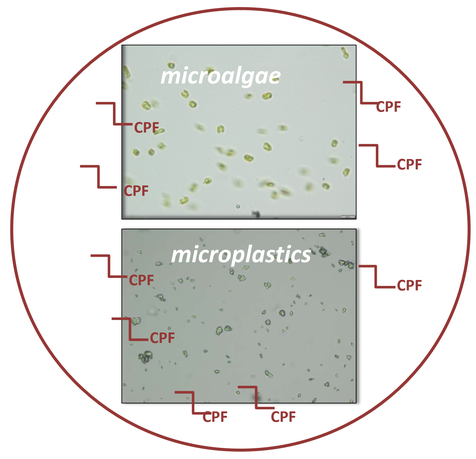
Scope

One of the most concerning aspects of microplastic pollution (MP) in marine habitats is that they might act as vectors of pollutants to marine organisms, as they can easily adsorb hydrophobic organic contaminants (HOCs). However, other particles composing the marine seston, with high affinity for HOCs, as phytoplankton cells, might also act as vectors of chemicals. HOCs bioaccumulation might be dependent on the nature of the particle where the chemical is transported. We have compared the sorption capacity of the organophosphate chlorpyrifos (CPF) onto microplastic or microalgae surfaces. Pre-exposed microplastic and microalgae particles to CPF were offered to the suspension-feeder *Mytilus galloprovincialis* and the accumulated CPF was measured at 7 and 21 days of exposure.



Material & Methods

MODELS

PLASTIC

Micronized virgin polyethylene , PE

MP suspension:
•dispersant (12.5 µg/mg MP)
•magnetic stirrer
•particle size: 4-6 µm

PHYTOPLANKTON

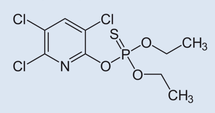
Isochrysis galbana, clone t-ISO

Cultured microalgae (MA):
•growth medium: Walne
•continuous illumination
•6 L glass vessels
•particle size: 4-5 µm

HOC

Chlorpyrifos (CPF):

O,O-diethyl *O*-3,5,6-trichloropyridin-2-yl phosphorothioate



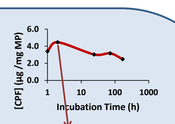
TEST ORGANISM

(4 cm-length) Mytilus galloprovincialis

SORPTION

1. Incubation

CPF



2. Partitioning

particles

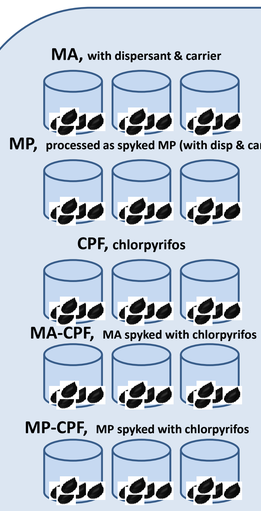
water

3.CPF quantification

Solvent extraction:
•MA (penthane/dichloromethane)
•MP (methanol)
•Water (isooctane)

GC-MS

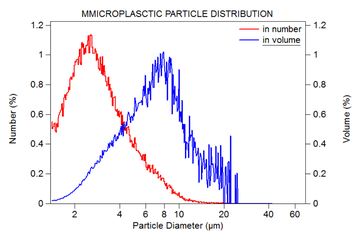
MUSSEL EXPOSURE

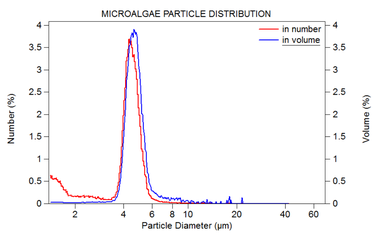


EXPOSURE CONDITIONS:
- ❖ 17 L circular metachrylate aquaria
- ❖ Daily food ration (t-ISO): 4.5 % of mussel dw
- ❖ Natural seawater (0.5 µm filtered)) ay 18 ºC
- ❖ Daily water renewal and redosing
- ❖ Daily MA & MP charged with CPF
- ❖ Sampling times: days 0, 7, 21

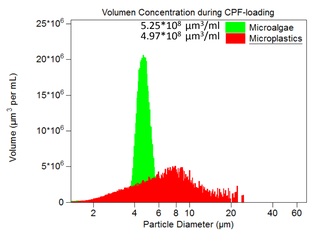
Results

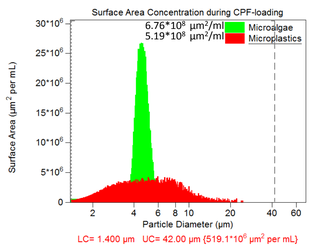
Particle characterization





Different particle size distribution in MP suspension when considered *in number* or *in volumen*
MP particle size: 7.7 µm
MA particle size: 4.9 µm

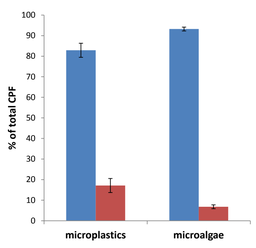




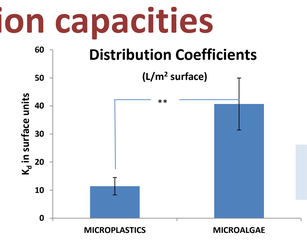
•CPF-loading at the **same** concentration in terms of **particulated volume: 0.5 mm³/ml**

•Sligh higher **surface area** in **MA=7 cm²/ml (MP=5 cm²/ml)**

Differential Adsorption capacities

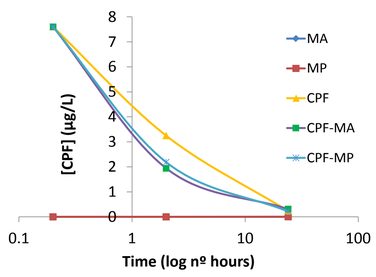


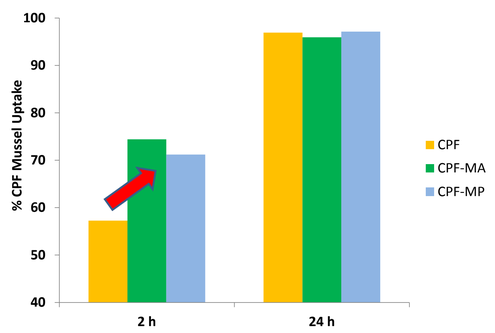
Recovery of CPF in each compartiment after incubation



> 3-fold affinity of CPF onto algal surfaces

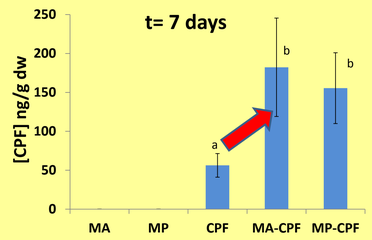
CPF Uptake

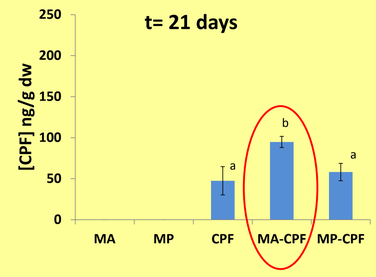




Higher CPF uptake when pollutant is offered through particles

CPF Bioaccumulation





Higher CPF accumulation when pollutant is offered through particles, especially through microalgae

Conclusions

- ✓ Higher affinity of CPF onto MA particles cells
- ✓ Sorption of CPF was almost complete (higher than 80%) onto both types of particles, with a light higher proportion in microalgae cells
- ✓ CPF uptake by mussels is facilitated when pollutant is carried by particles
- ✓ Mussels accumulated more CPF when pollutant was sorbed onto particles in comparison than when it was dissolved
- ✓ Mussels accumulated more CPF when pollutant was sorbed onto microalgae cells than sorbed to plastic particles

Microplastics really act as vectors of pollutants but in a similar way (or even less) as other particles of the seston

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