



## Active packaging: controlled release of microbial agents from packaging materials

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# ACTIVE PACKAGING: CONTROLLED RELEASE OF MICROBIAL AGENTS FROM PACKAGING MATERIALS

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Mia Kurek, Valerie Guillard, Nathalie Gontard



# NextGenPack

Next generation of advanced active and intelligent bio-based packaging for food



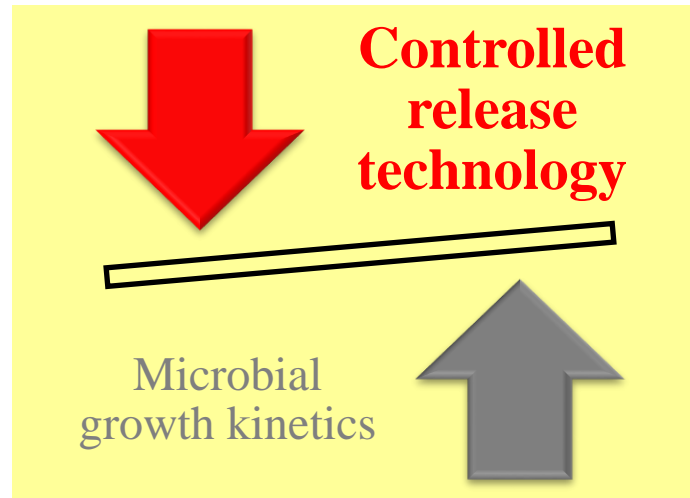
## ACTIVE ANTIMICROBIAL PACKAGING

How to create an optimised AP?

AC mass transfer rate  $\ll$  MO growth rate  
↓

$$C_{AC} < C_{critical}$$

MO will grow instantly, before AC is released



AC mass transfer rate  $\gg$  MO growth rate  
↓

$$C_{AC} > C_{critical}$$

→ activity

# Active NGP film design



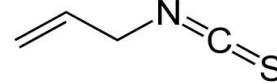
BioPE or PLA film



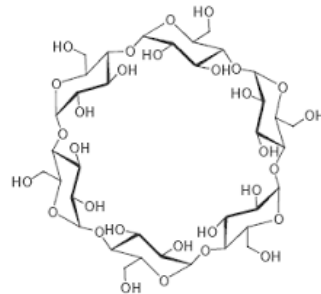
Active volatile compound

encapsulation

Allyl isothiocyanate



Why AITC?  
strong AM activity  
in vapour state



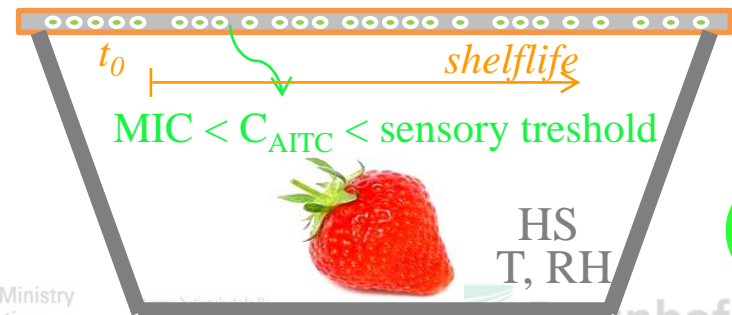
Why  $\beta$  cyclodextrine?

- Protection against thermal degradation
- To avoid premature release
- AC release  $\rightarrow f(\text{headspace RH})$



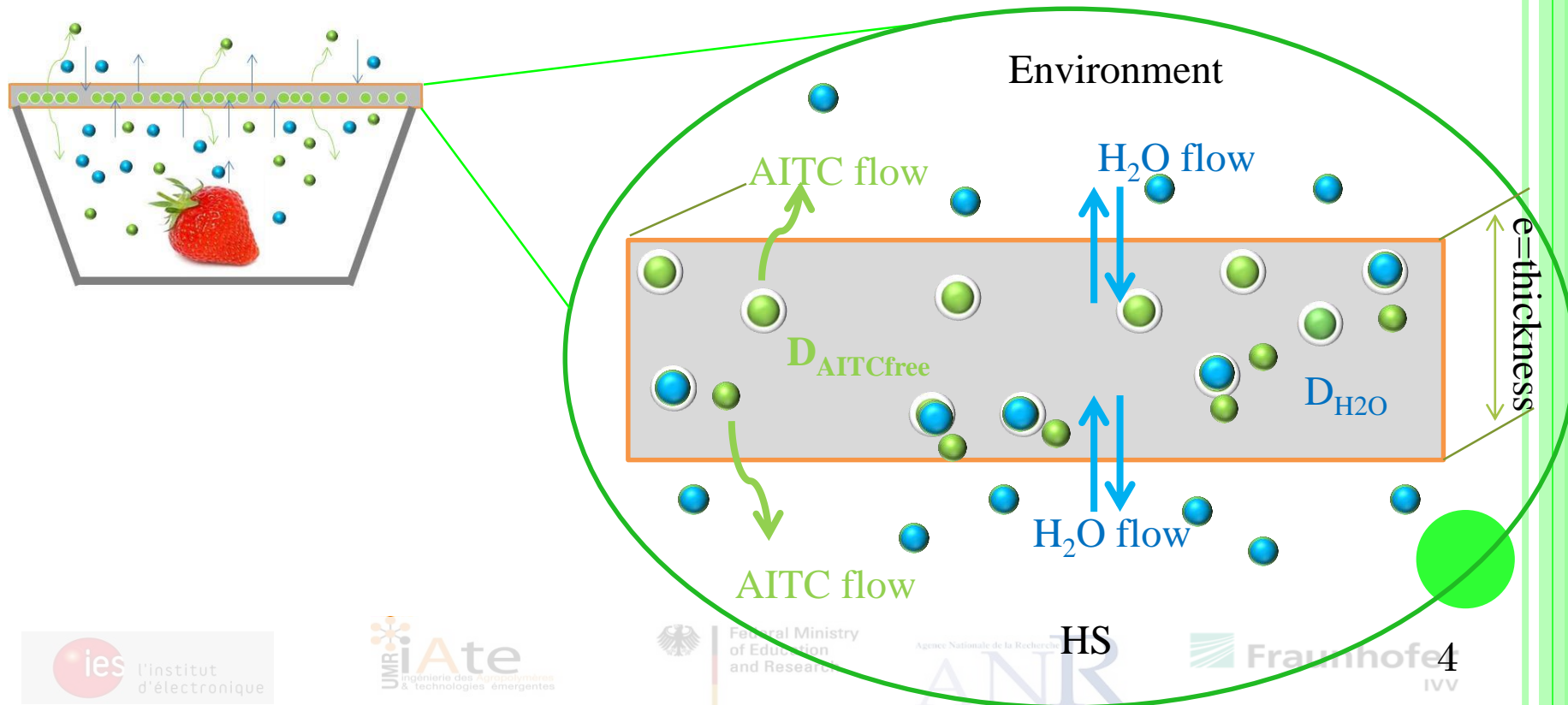
Active BioPE or PLA film

Environment T, RH



# STEPS

- To model  $H_2O$  transfer into active film
- To model the release of AITC from  $\beta$ -CD as function of RH
- To model AITC transfer through active film
- To couple mass transfers & AITC release kinetic to predict AITC release into HS



# OUTPUTS:

→ allows calculation of active complex needed for the optimisation of packaging design

✓ evolution of AITC in the HS allows to determine the activity profile →  $C_{aitc} > MIC$

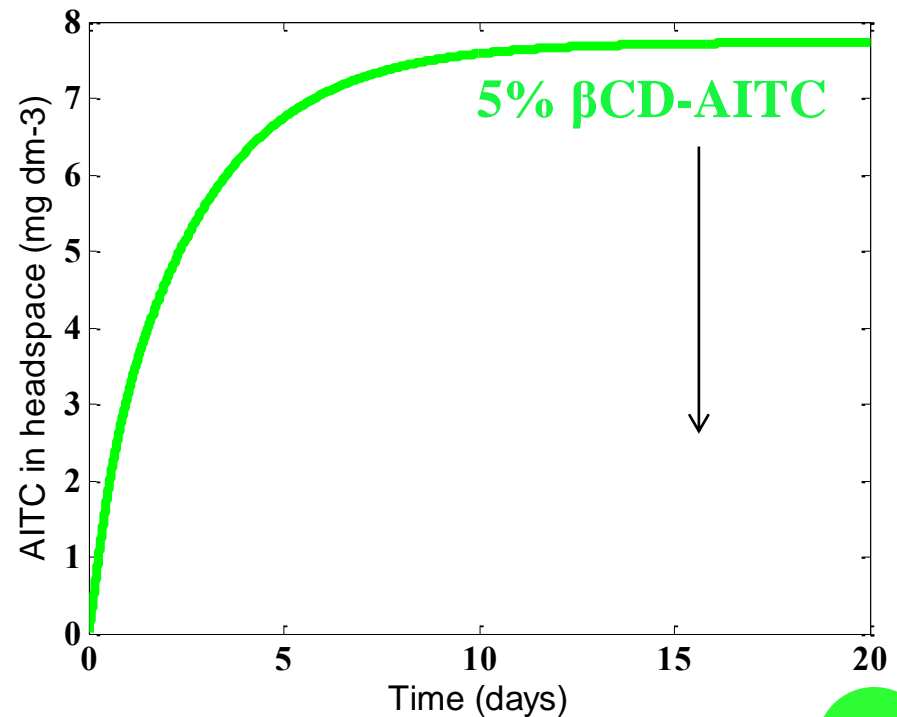
Example:

**BioPE**



By changing:

**Film composition**



# OUTPUTS:

→ allows calculation of active complex needed for the optimisation of packaging design

✓ evolution of AITC in the HS allows to determine the activity profile →  $C_{aitc} > MIC$

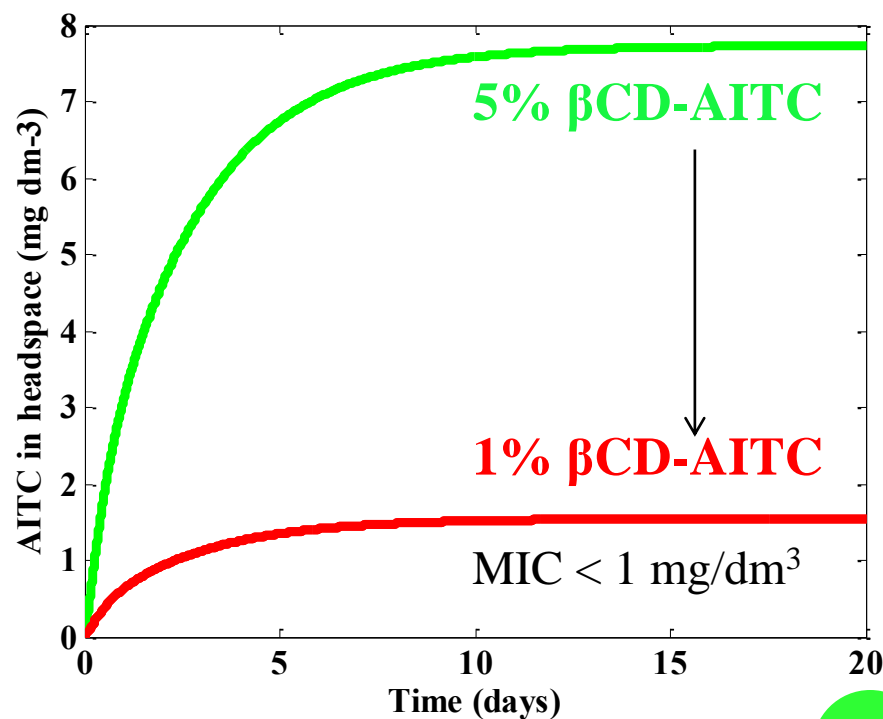
Example:

BioPE



By changing:

Film composition



# OUTPUTS:

→ allows calculation of active complex needed for the optimisation of packaging design

✓ evolution of AITC in the HS allows to determine the activity profile →  $C_{aitc} > MIC$

Example:

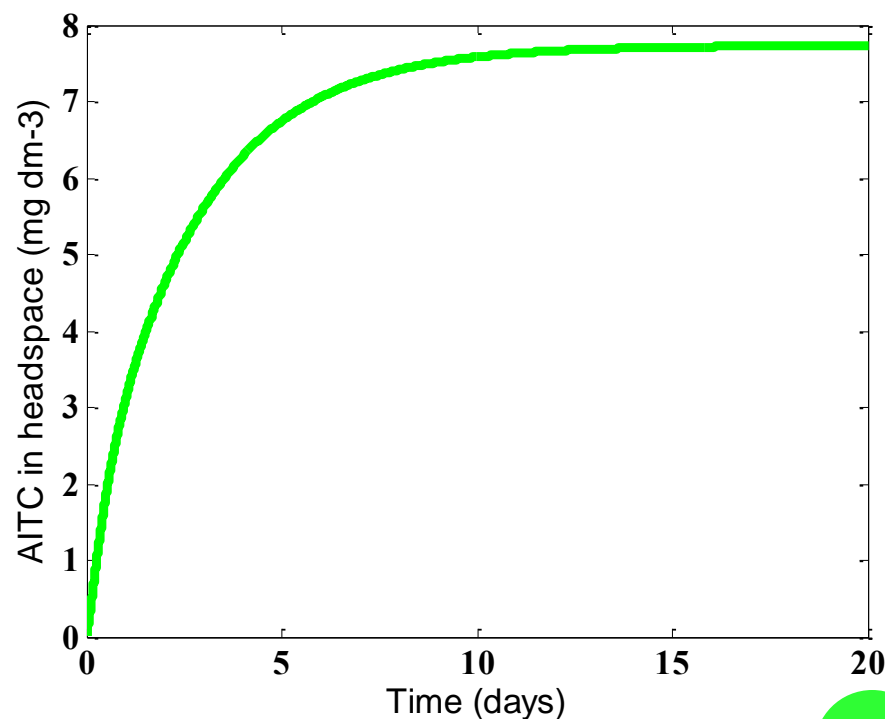
**BioPE**



By changing:

Film composition

Headspace volume



# OUTPUTS:

→ allows calculation of active complex needed for the optimisation of packaging design

✓ evolution of AITC in the HS allows to determine the activity profile →  $C_{aitc} > MIC$

Example:

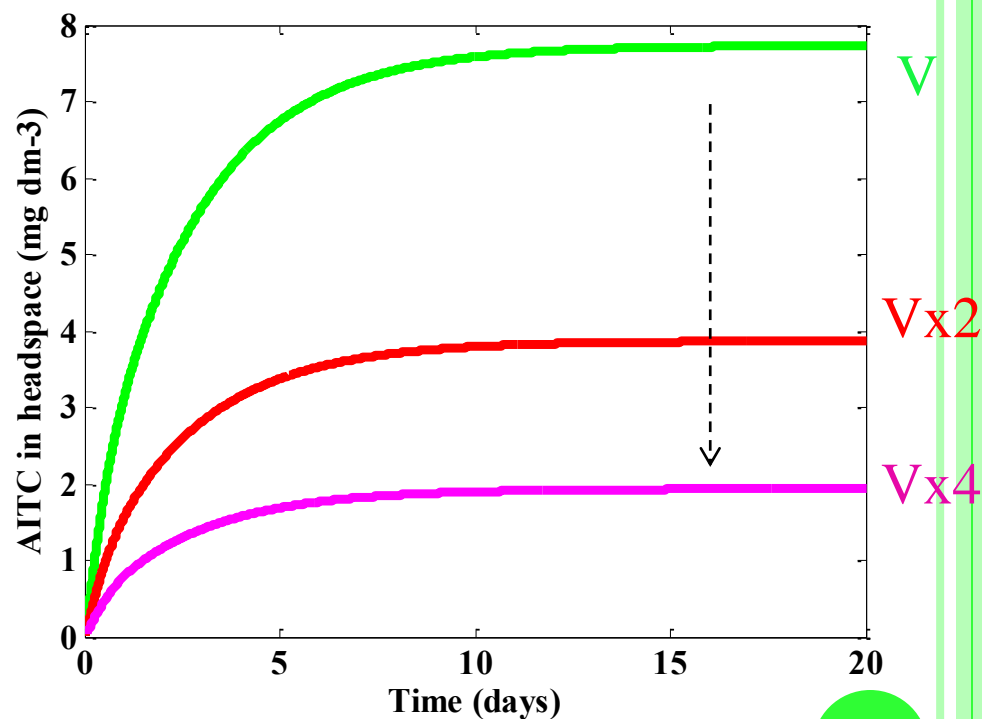
BioPE



By changing:

Film composition

Headspace volume



# OUTPUTS:

→ allows calculation of active complex needed for the optimisation of packaging design

✓ evolution of AITC in the HS allows to determine the activity profile →  $C_{aitc} > MIC$

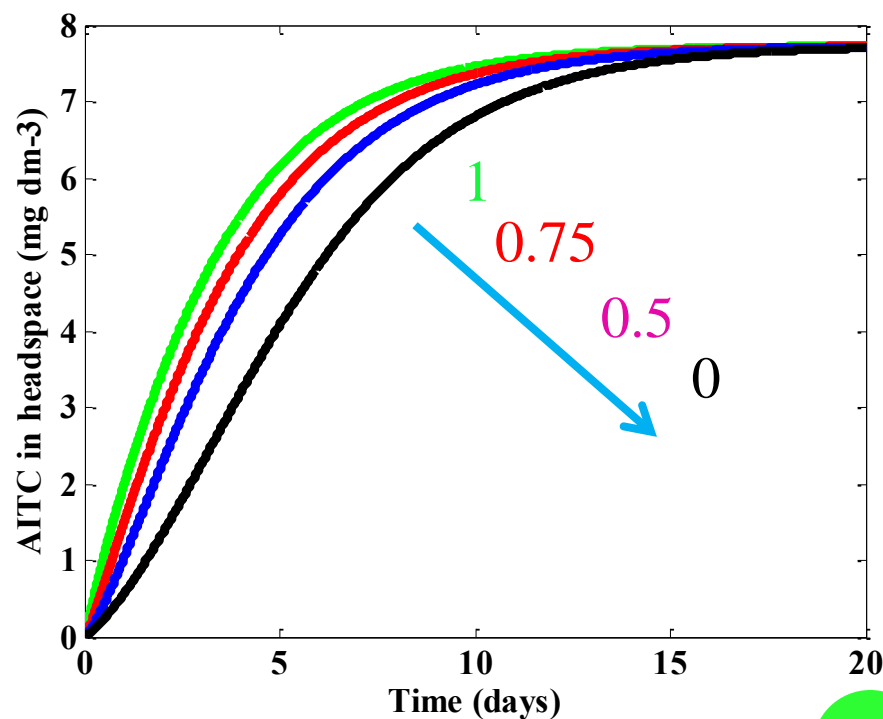
Example:

BioPE



By changing:

Film composition  
Headspace volume  
 $a_w$  of the HS



# CONCLUSIONS

- 1) **Developed mathematical model successfully describes controlled release of AC in the HS in order to reach MIC**
- 2) **The rate of release depends on the moisture content of the system**
- 3) **H<sub>2</sub>O and AC distribution profiles can help in understanding the release kinetics**
- 4) **The model can be used to optimise design of active packaging**



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# Thank you for your attention

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