RETE ALTA TECNOLOGIA
EMILIA-ROMAGNA
HIGH TECHNOLOGY NETWORK

CIPACK

CIPACK

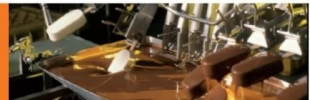
UNIVERSITÀ DEGLI STUDI DI PARMA

Packaging attivo: coating antimicrobici a rilascio controllato

Nicola Zucchetto

ASTER

PIATTAFORMA
AGROALIMENTARE



ACTIVE PACKAGING

ASSORBITORI D'OSSIGENO

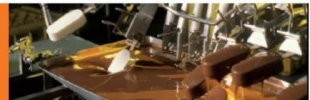
BARRIERE AI GAS

FILM ANTIMICROBICI

EMETTITORI E ASSORBITORI DI CO_2

ASSORBITORI DI UMIDITA'

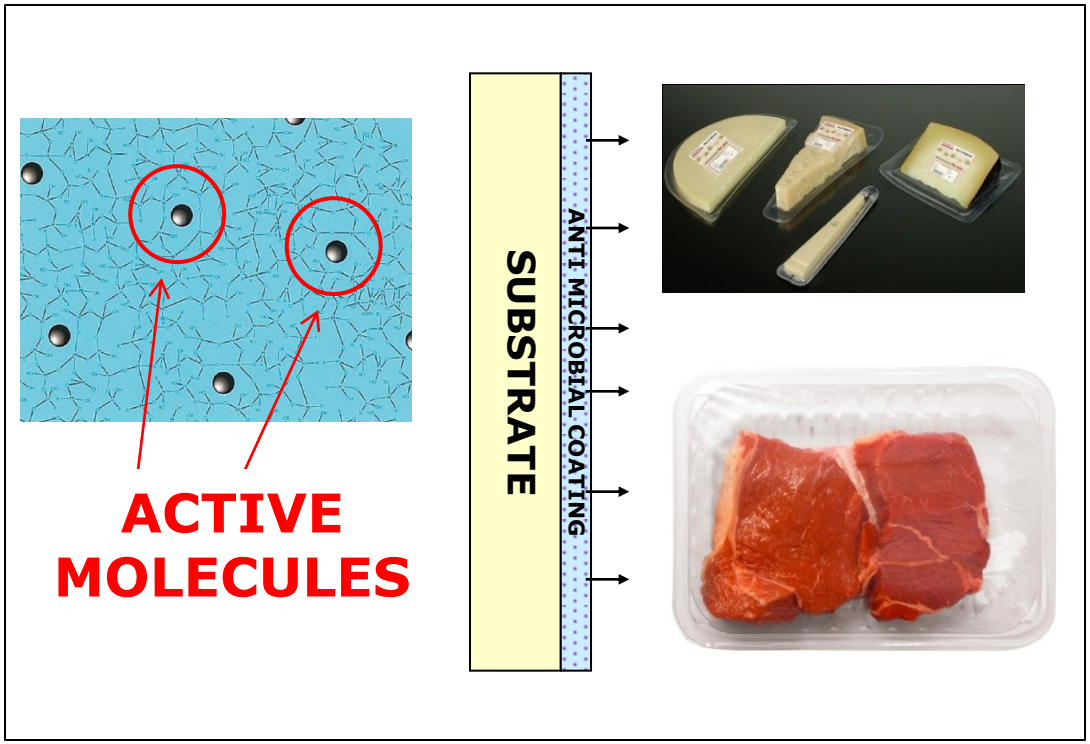
ASSORBITORI DI ETILENE



L'IDEA: DEPOSITARE UN COATING MICROMETRICO CONTENENTE MOLECOLE ATTIVE PER PRESERVARE IL CIBO CONFEZIONATO

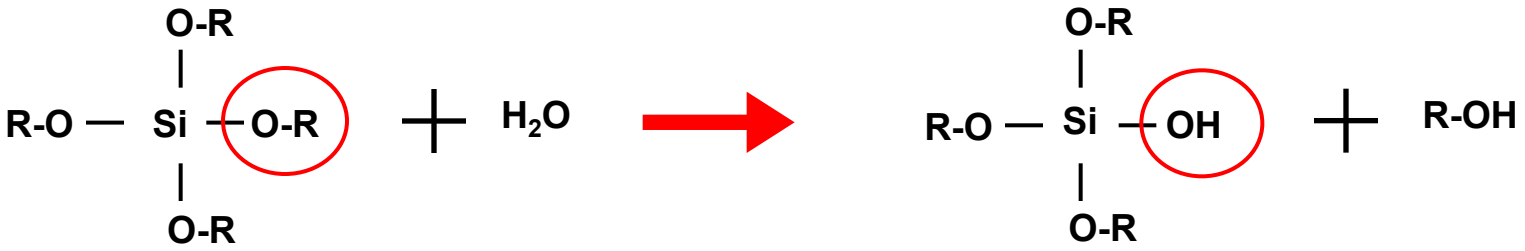
MODELLO DI STUDIO

Depositare su un substrato di PET un SOL (soluzione colloidale) contenente Lisozima, per ottenere un coating uniforme e misurarne il rilascio nel tempo

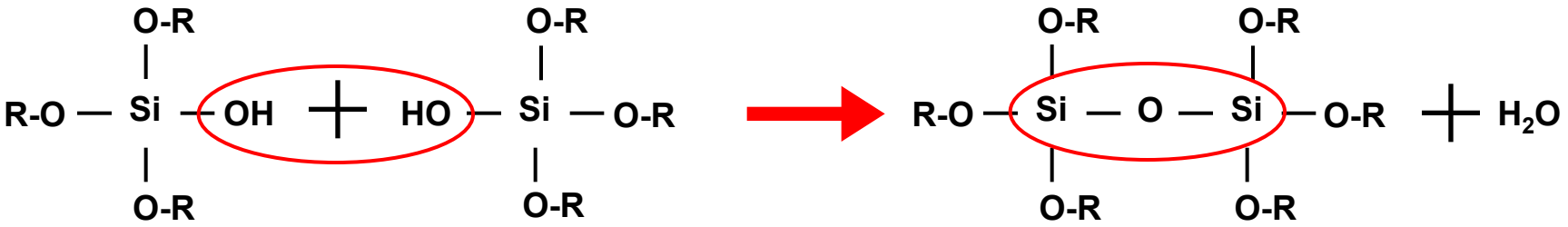


TECNICA SOL-GEL: REAZIONE CHIMICA

IDROLISI



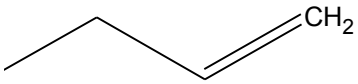
CONDENSAZIONE



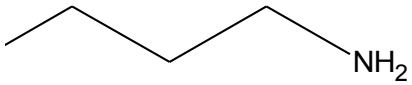
SOL-GEL : IBRIDI ORGANICI-INORGANICI

MONDO INORGANICO

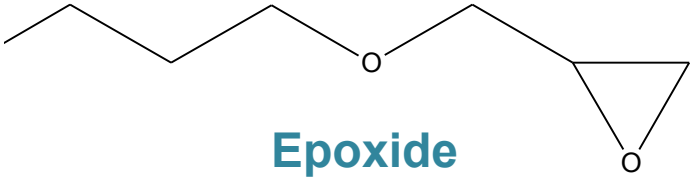
MONDO ORGANICO



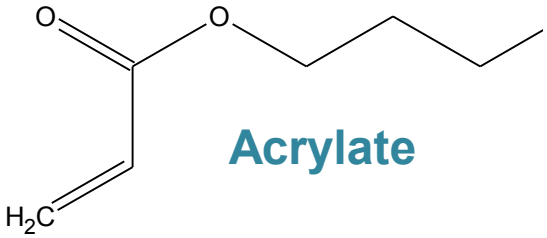
Allyl



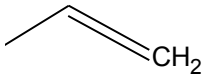
Amino



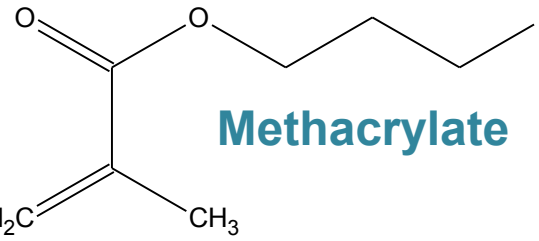
Epoxide



Acrylate



Vinyl

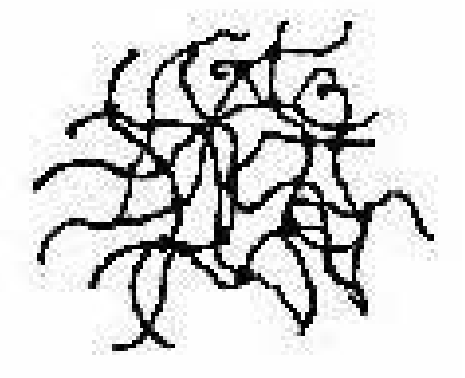


Methacrylate

NETWORK E DEPOSIZIONE

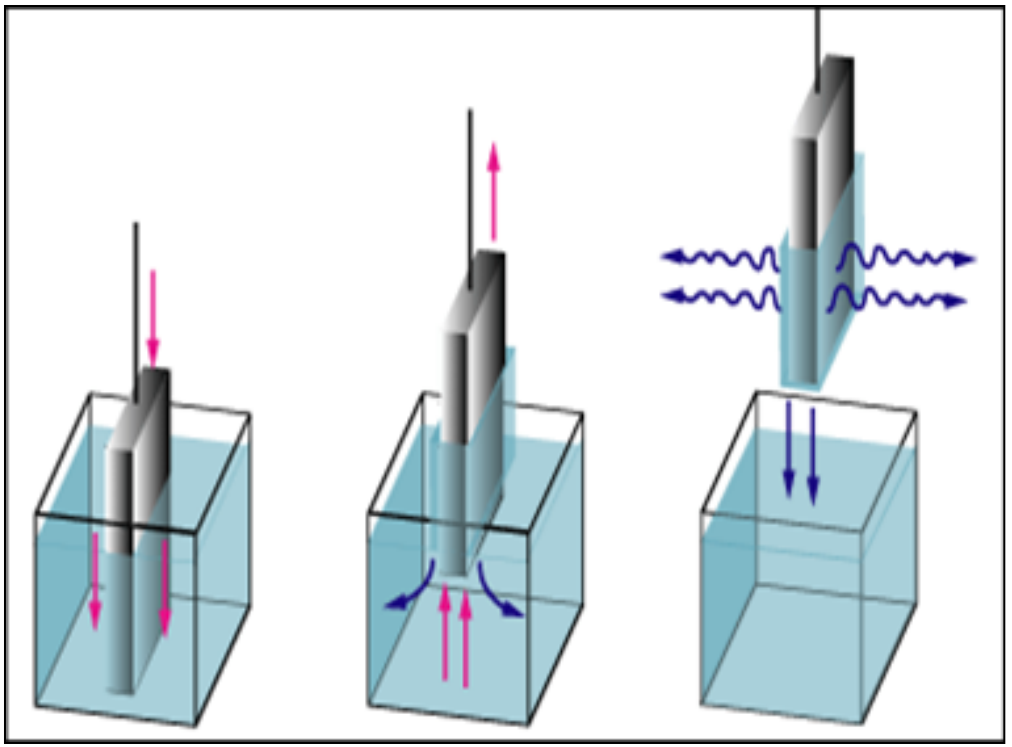
Struttura nanoporosa

Pori ~ 2nm



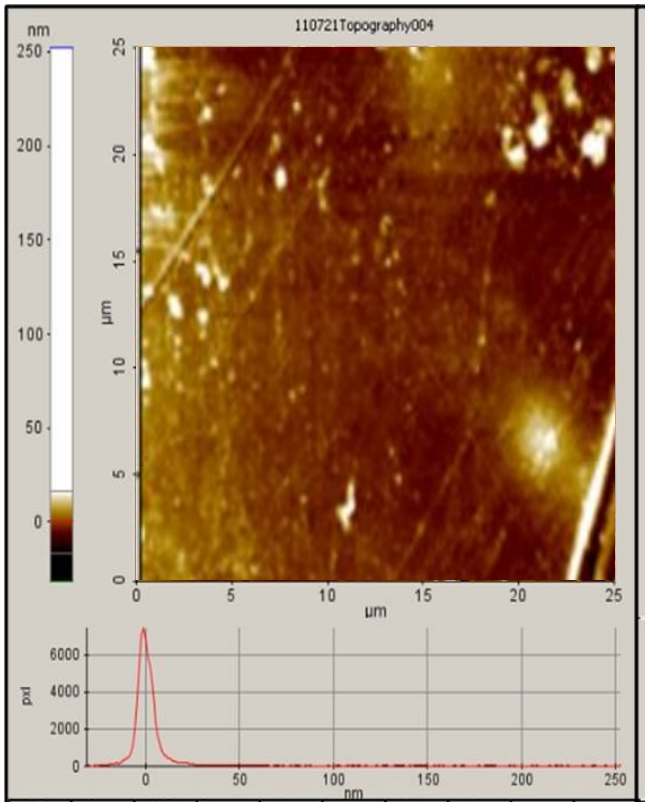
SPESSORE COATING
≤ 1 micrometro

DIP-COATING



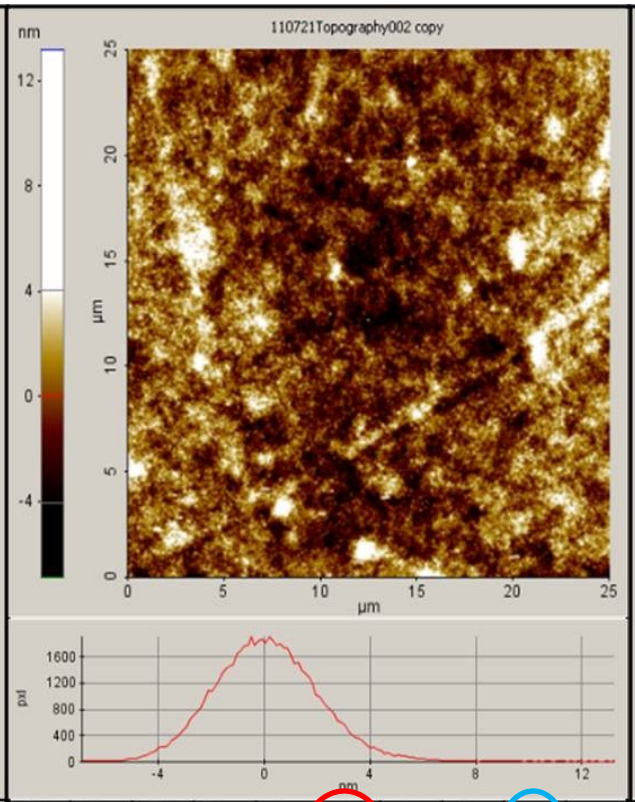
ANALISI SUPERFICIALI

PET



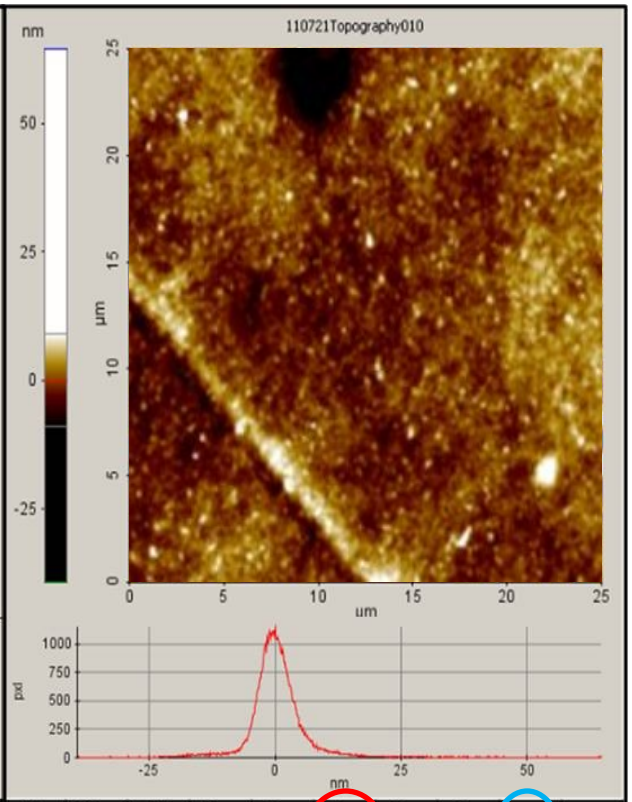
Min (nm)	Max (nm)	Mid (nm)	Mean (nm)	Rpv (nm)	Rq (nm)	Ra (nm)	Rz (nm)	Rsq	Rku
-31.0	252.0	110.0	0.000	283.0	8.0	4.0	260.0	-9.95	213.1

PET CON COATING

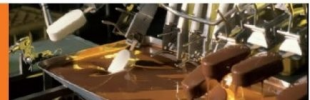


Min (nm)	Max (nm)	Mid (nm)	Mean (nm)	Rpv (nm)	Rq (nm)	Ra (nm)	Rz (nm)	Rsq	Rku
-6.9	13.2	3.2	0.00	20.1	1.95	1.54	18.9	-0.295	3.588

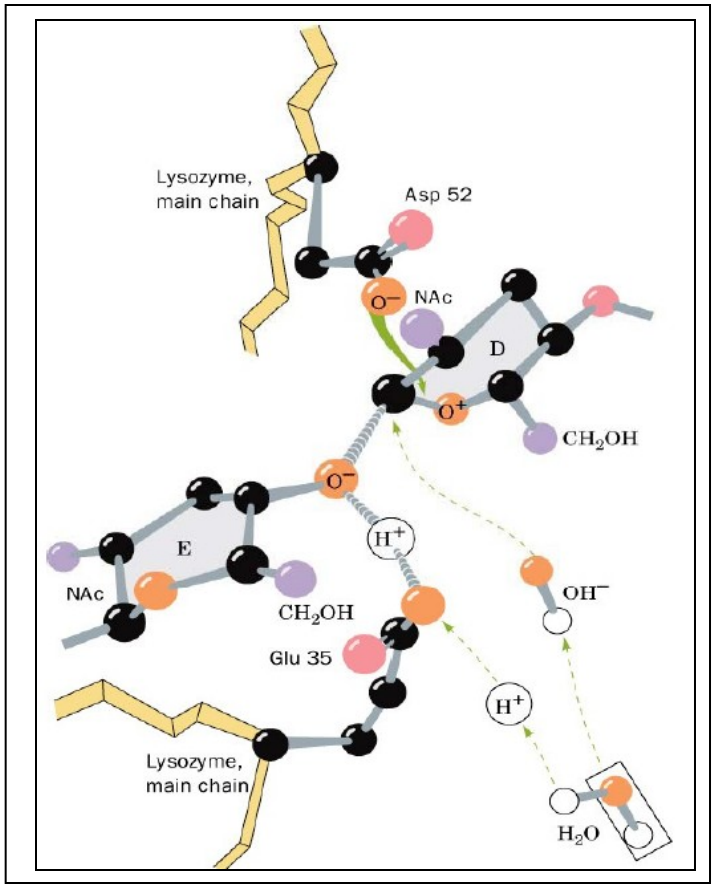
PET CON COATING DOPO TEST DI RILASCIO



Min (nm)	Max (nm)	Mid (nm)	Mean (nm)	Rpv (nm)	Rq (nm)	Ra (nm)	Rz (nm)	Rsq	Rku
-39.0	65.0	13.0	0.00	104.0	5.0	3.0	80.0	-0.460	10.24

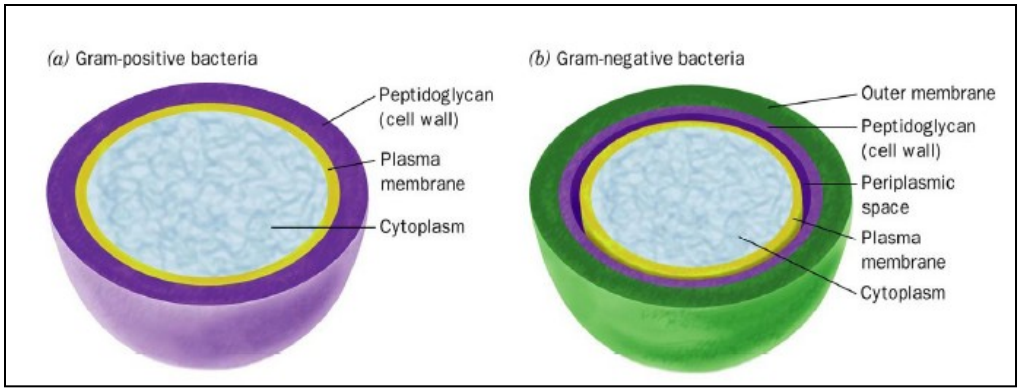


LISOZIMA

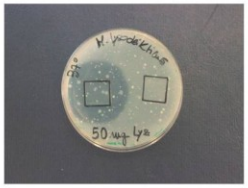
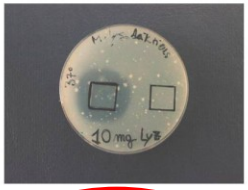
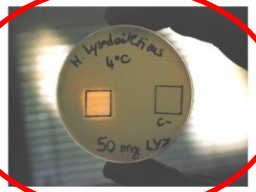
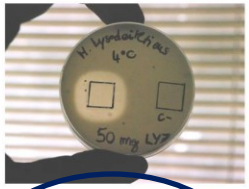
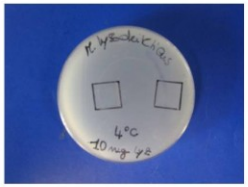
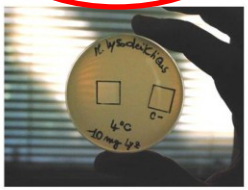
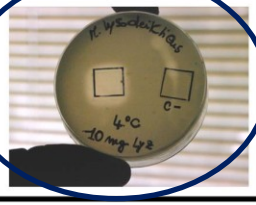


UTILIZZO INDUSTRIALE

- *Grana Padano*
- *Produzione del vino*

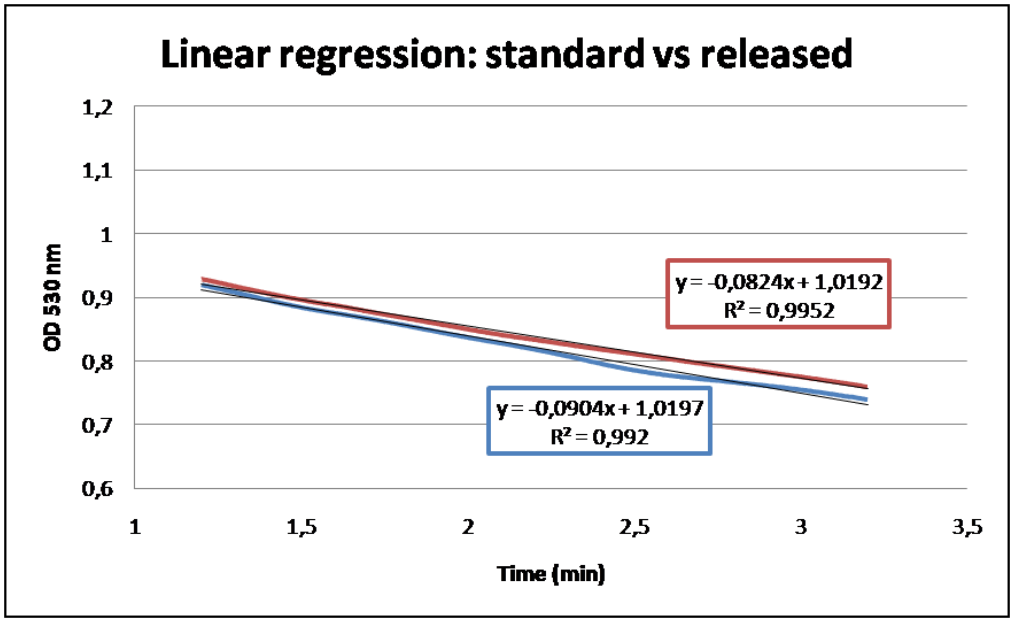


TEST MICROBIOLOGICI QUALITATIVI

Test Temperature	Lysozyme concentration in the sol	24 h	48 h	182 h (7 days)
RT	1.25 mg/ml			
	0.25 mg/ml			
4°C	1.25 mg/ml			
	0.25 mg/ml			

TEST MICROBIOLOGICI QUANTITATIVI

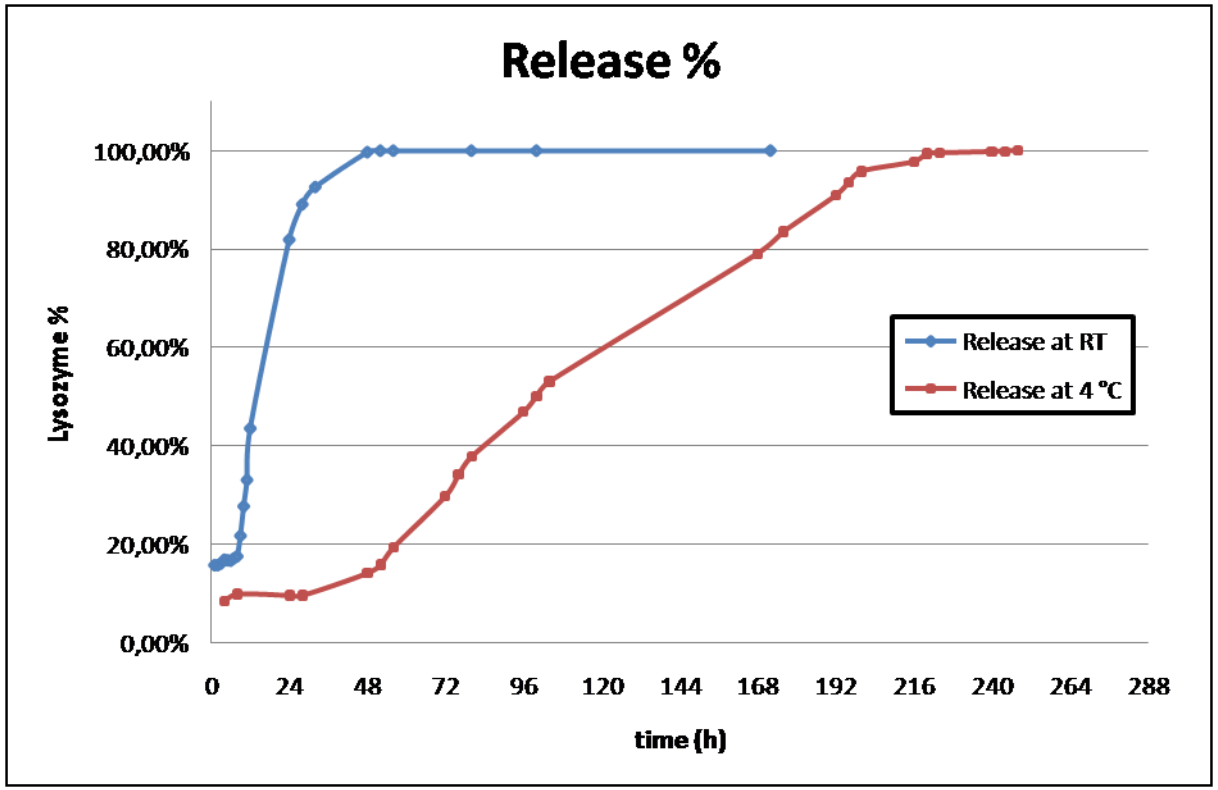
Grazie ad un metodo spettrofotometrico è possibile confrontare l'efficacia del lisozima contenuto in una soluzione standard rispetto al lisozima rilasciato nel simulante



ATTIVITA' SPECIFICA%
86%

PROVE DI RILASCIO

La temperatura di refrigerazione influenza il rilascio di lisozima, che arriva al plateau dopo circa 10 giorni



RISULTATI OTTENUTI

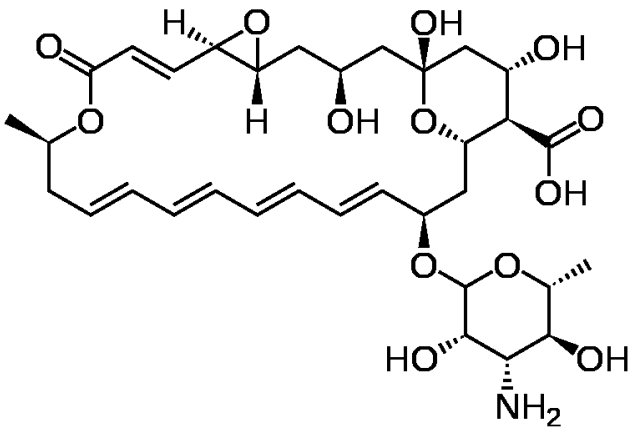
- Test qualitativi su piastre affermano l'efficacia del rilascio
- Studi analitici in simulanti alimentari confermano il rilascio controllato
- Studi microbiologici dimostrano che l'attività antimicrobica permane nel tempo

APPLICAZINI

- Già in studio utilizzo su PE, PP e PLA.
- Possibilità di modulare la struttura del coating per accelerare, rallentare o fermare il rilascio della sostanza.
- Utilizzo di agenti antimicrobici naturali.

LAVORI IN CORSO: PACKAGING PER FORMAGGI

NUOVO ANTIMICROBICO UTILIZZATO: NATAMICINA



- La Natamicina è usata nell'industria alimentare come conservante naturale
- E' un additivo alimentare: E235
- L'Unione Europea approva l'utilizzo della Natamicina per la conservazione di alcuni formaggi e salumi

COME MODULARE IL RILASCIO?

Per ottenere un rilascio controllato sono stati preparati differenti SOL variando la concentrazione di Silano e il rapporto tra Silano e Additivo.

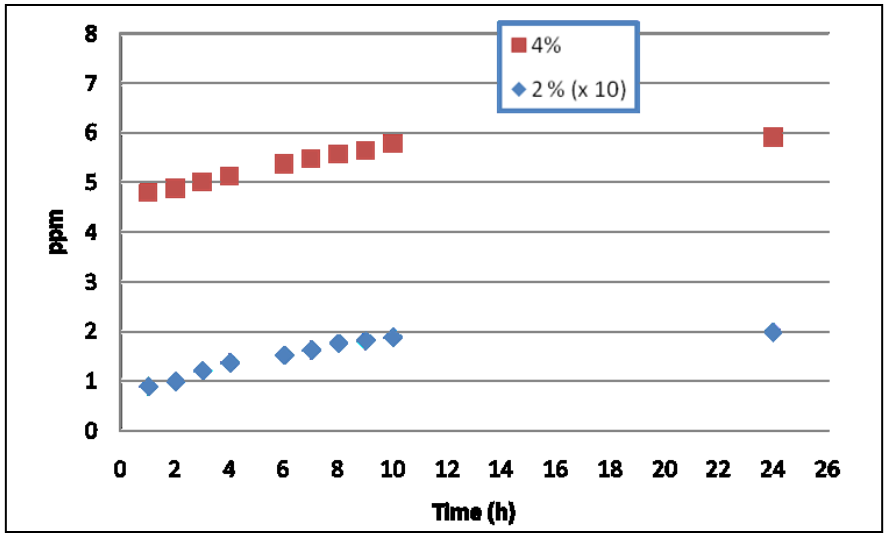
SOL - A Sil/Add max
SOL - B
SOL - C
SOL - D Sil/Add min

QUANTITA' EFFETTIVA DI NATAMICINA

0% natamicina
ADD : SILANO
SOL A

2% natamicina
ADD : SILANO
SOL A

4% natamicina
ADD : SILANO
SOL A



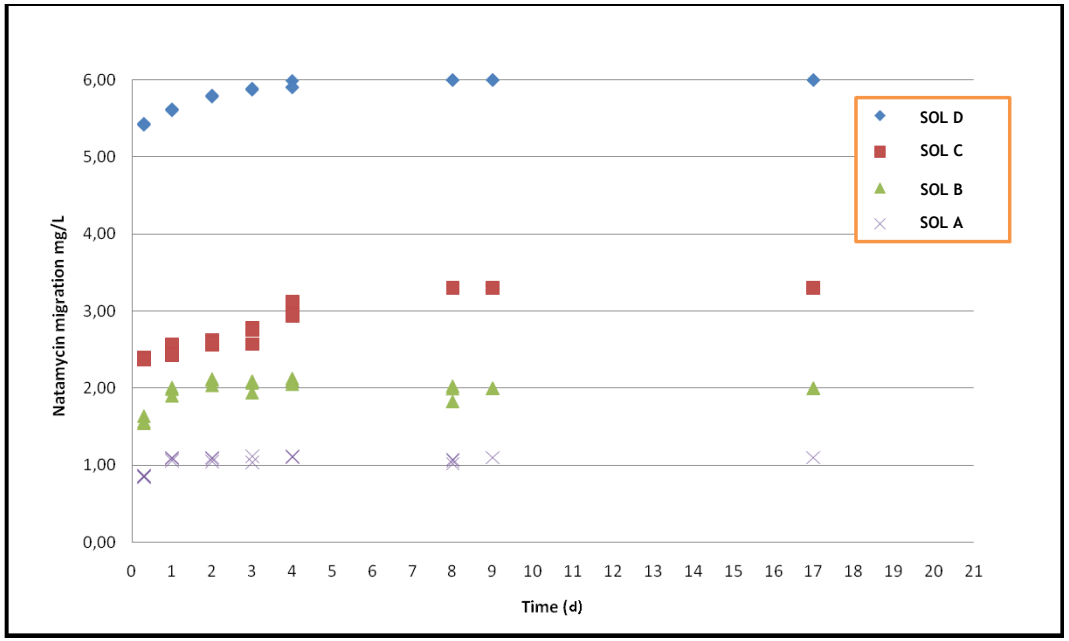
NATAMICINA RILASCIATA

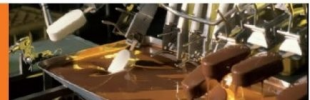
4% natamicina
ADD : SILANO
SOL A

4% natamicina
ADD : SILANO
SOL B

4% natamicina
ADD : SILANO
SOL C

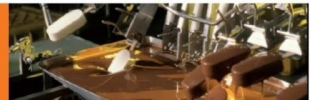
4% natamicina
ADD : SILANO
SOL D





RISULTATI

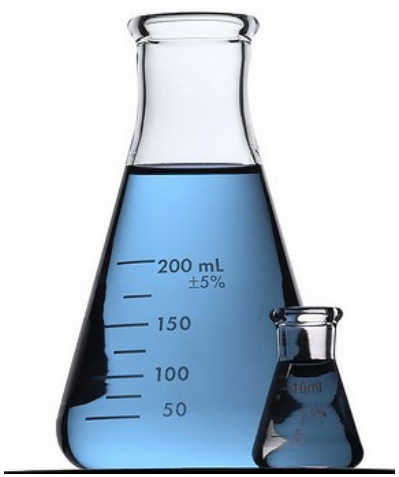
- Studi con simulanti alimentari confermano il rilascio controllato
- Test qualitativi con formaggi a pasta molle mostrano l'efficacia dell'active packaging
- E' possibile modulare la struttura del coating per accelerare, decelerare o fermare il rilascio delle molecole attive dal packaging
- I coating sono stati depositati su differenti substrati: PE, PP and PLA. I risultati ottenuti sono comparabili.
- Si può modulare l'antimicrobico a seconda dell'alimento da confezionare



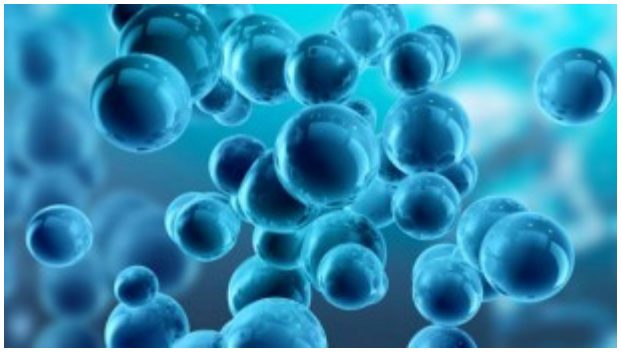
NUOVI SOL, NUOVI ANTIBATTERICI!

TRATTAMENTI PER CARTONCINO

SOL SU MISURA



UTILIZZO DI NANOPARTICELLE



IONI E NANOPARTICELLE

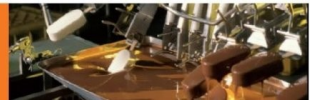
ARGENTO

RAME

BATTERI

OSSIDO DI ZINCO

MUFFE



FOOD CONTACT COATING E NON SOLO!

SPESSORE COATING

< 1 μm

COATING DEPOSITATO

Da 1 mg a 4 mg al dm^2

FOOD CONTACT COATING E NON SOLO!

IL MATERIALE TRATTATO RIMANE RICICLABICILE!!!

THANKS FOR YOUR ATTENTION!

FOR MORE INFORMATION

nicola.zucchetto@unipr.it

WWW.CIPACK.IT