

Michał Arabski

Division of Medical Biology

Jan Kochanowski University

Poland

Laser interferometry system in biological studies

Seminar of the Institute of Physics JKU

April 5, 2023

Facts

4
GRANTS


2/3
SYSTEMS

5
INSTITUTIONS

15
YEARS OF
COOPERATION

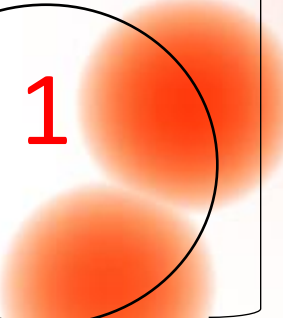
6
TOPICS

2/5



31
PUBLICATIONS

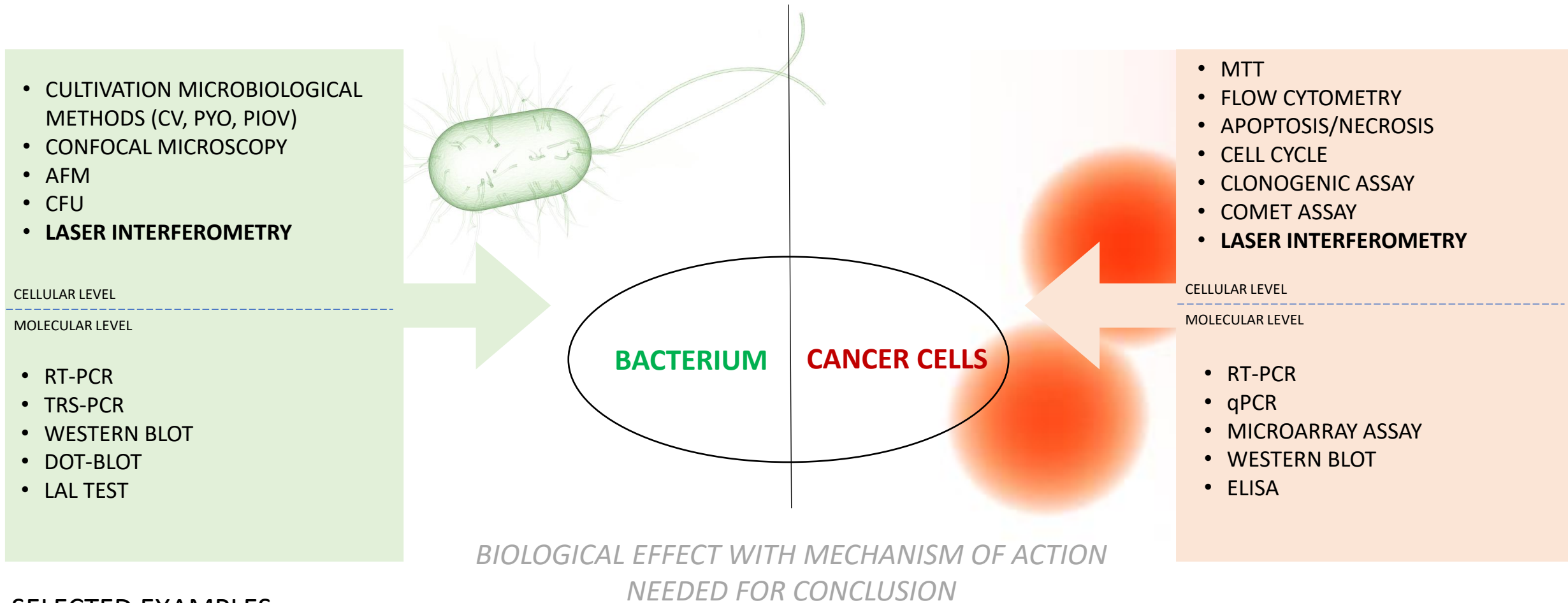
1



Testing of new agents

- nanoparticles
- transition metals complexes
- recombinant proteins
- bacteriophages
- antibiotics
- liposomes
- polymers

STRATEGIES OF NEWLY SYNTHETIZED **ANTIBACTERIAL**/**CYTOTOXIC** AGENTS TESTING



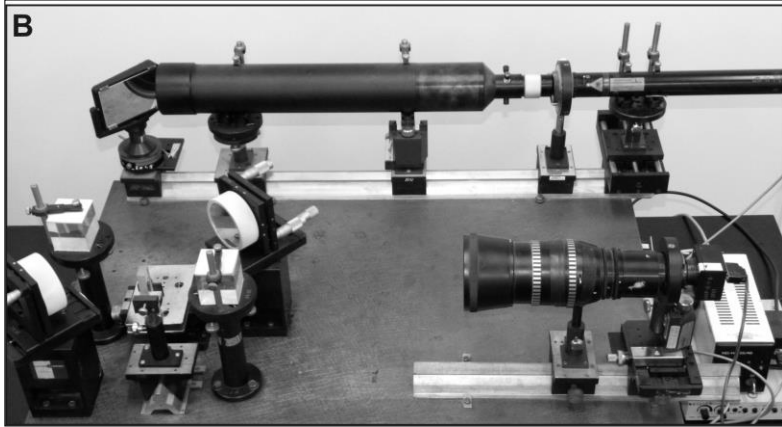
SELECTED EXAMPLES

- **BACTERIAL BIOFILM DEGRADATION**
- **BACTERIAL ENDOTOXIN INTERACTION WITH ANTIBIOTICS AND POLYMERS**

- **DRUGS DIFFUSION THROUGH CELL MONOLAYER**

LASER INTERFEROMETRY SYSTEMS

I



II

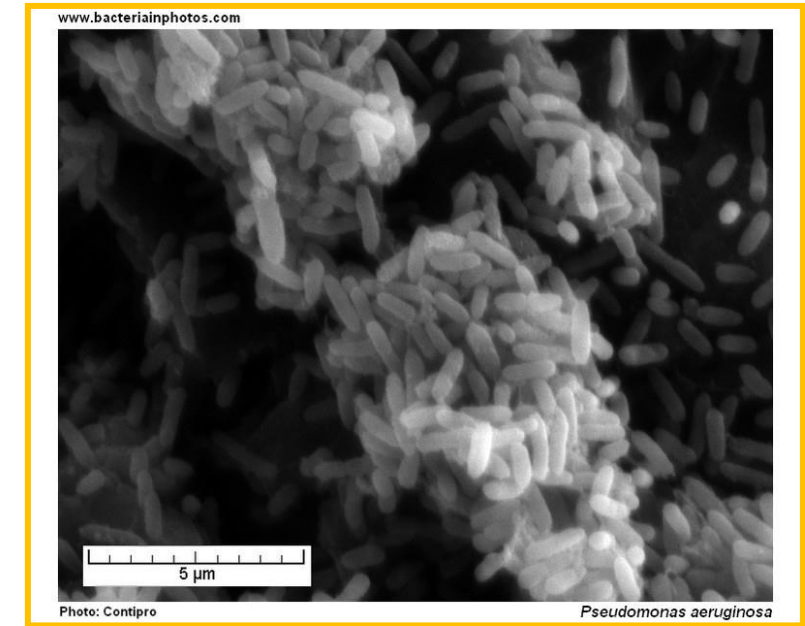
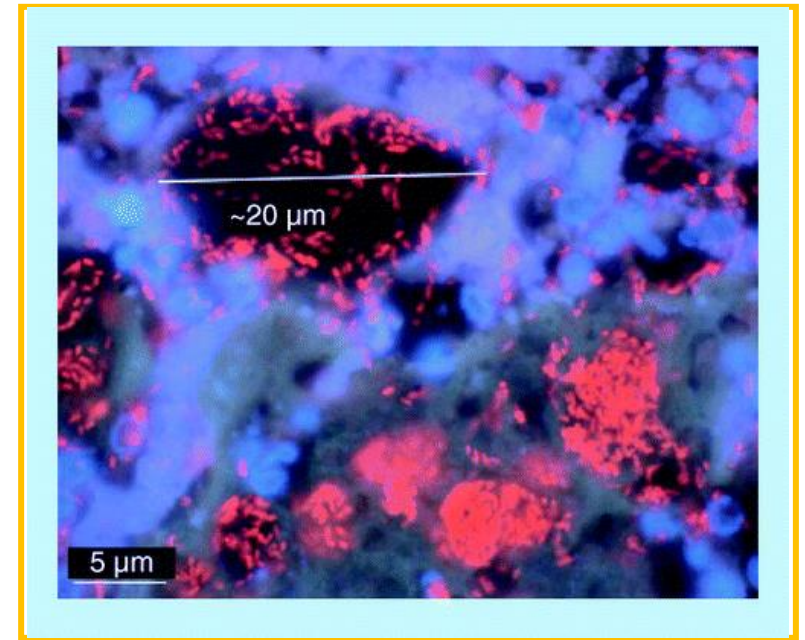
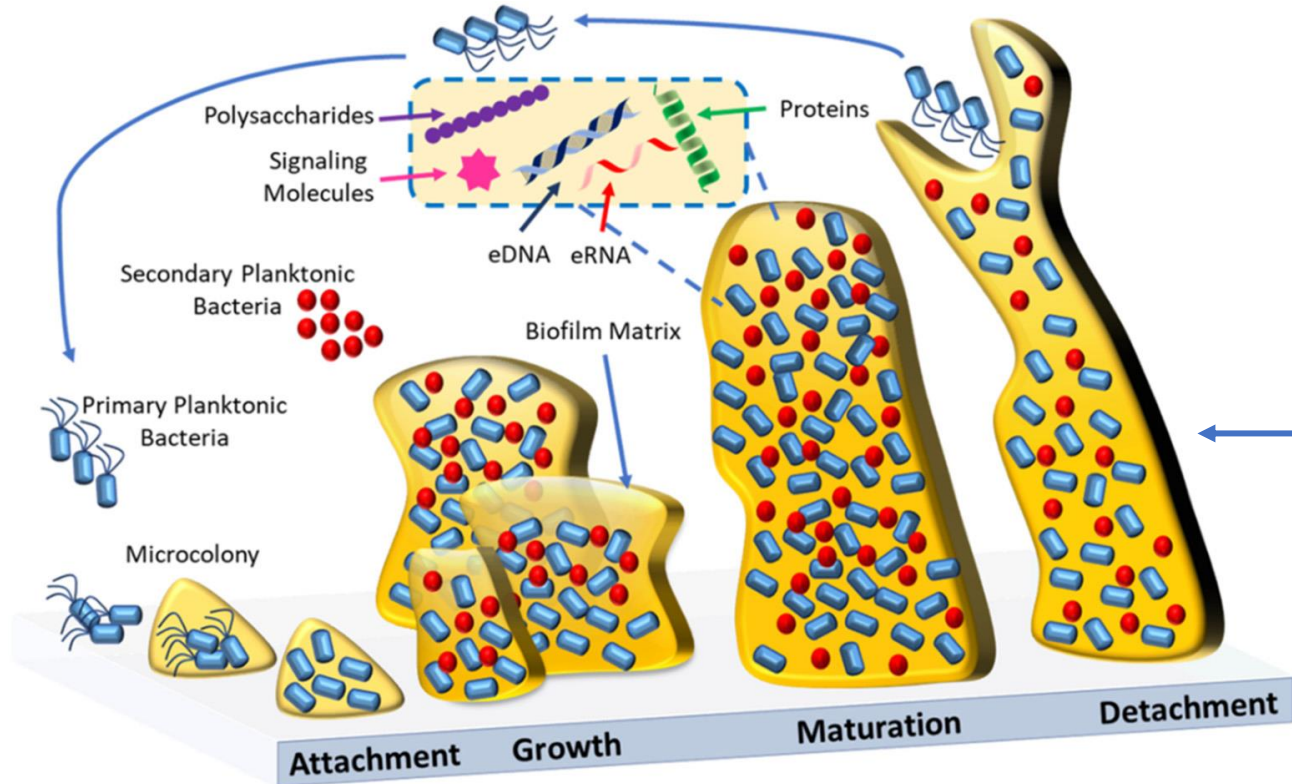


BACTERIAL BIOFILM DEGRADATION

BACTERIAL BIOFILM

Biofilm aggregates of *Pseudomonas aeruginosa* in a chronic infected cystic fibrosis lung.

red – bacteria
blue – inflammatory cells



1) Direct bacterial killing

2) QS: signalling molecules target; action anti-earlier biofilm constituents

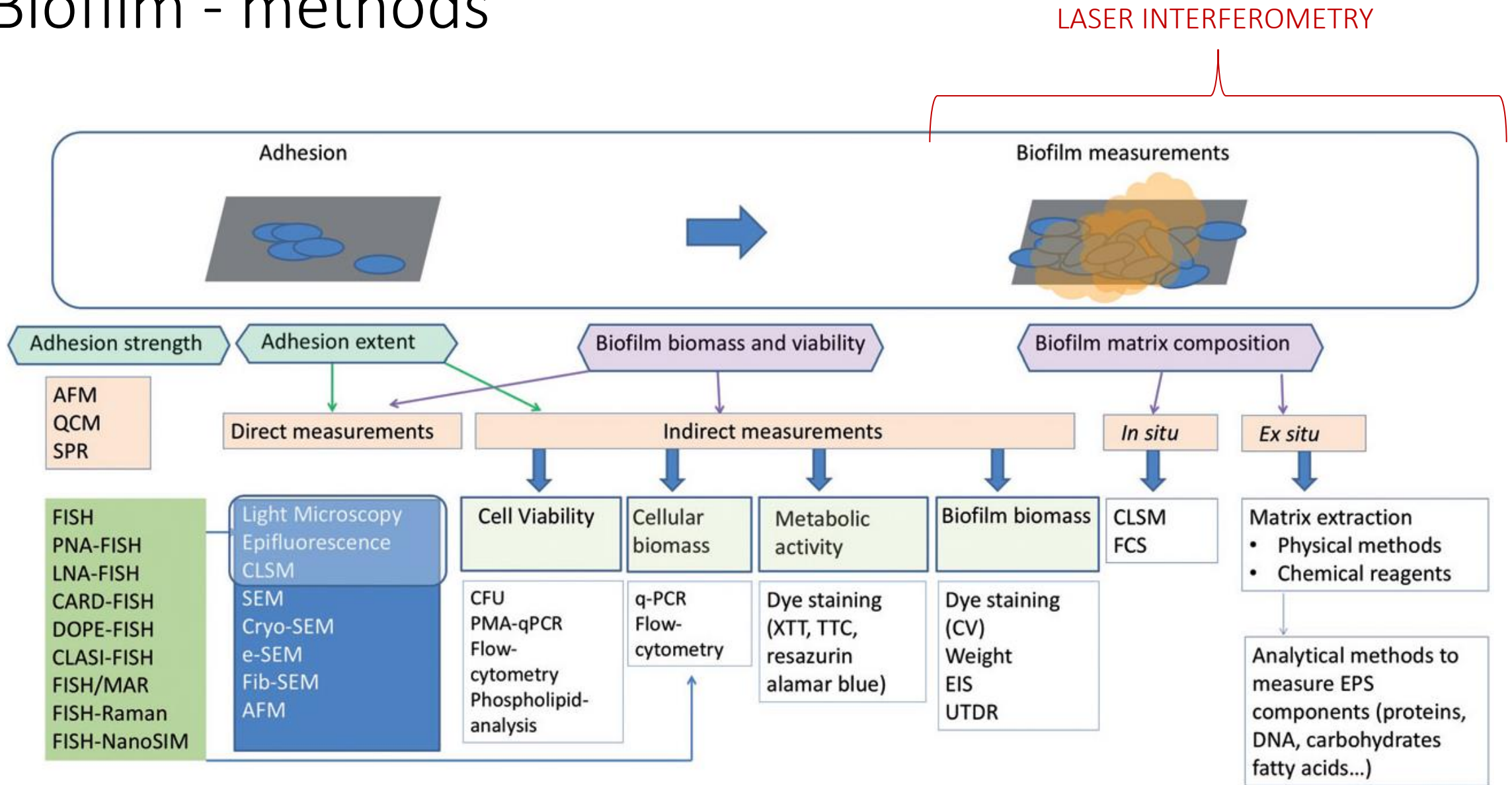
3) Anti-biofilm matrix agents; dispersing agents

<https://doi.org/10.3390/antibiotics10121482>

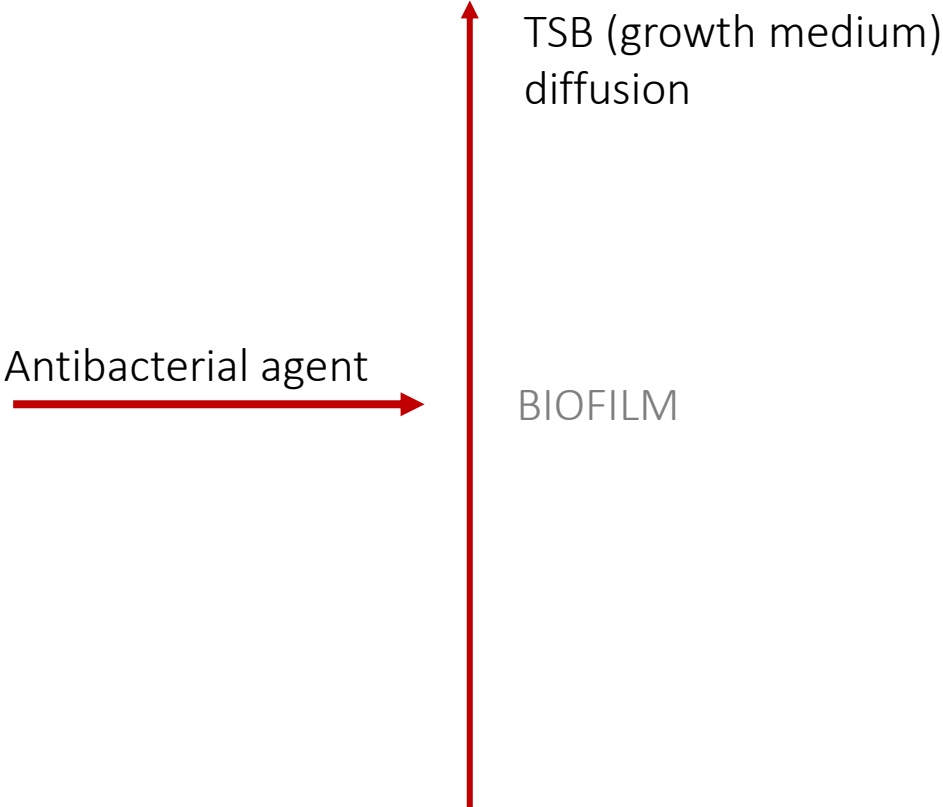
<https://doi.org/10.4155/fmc.15.6>

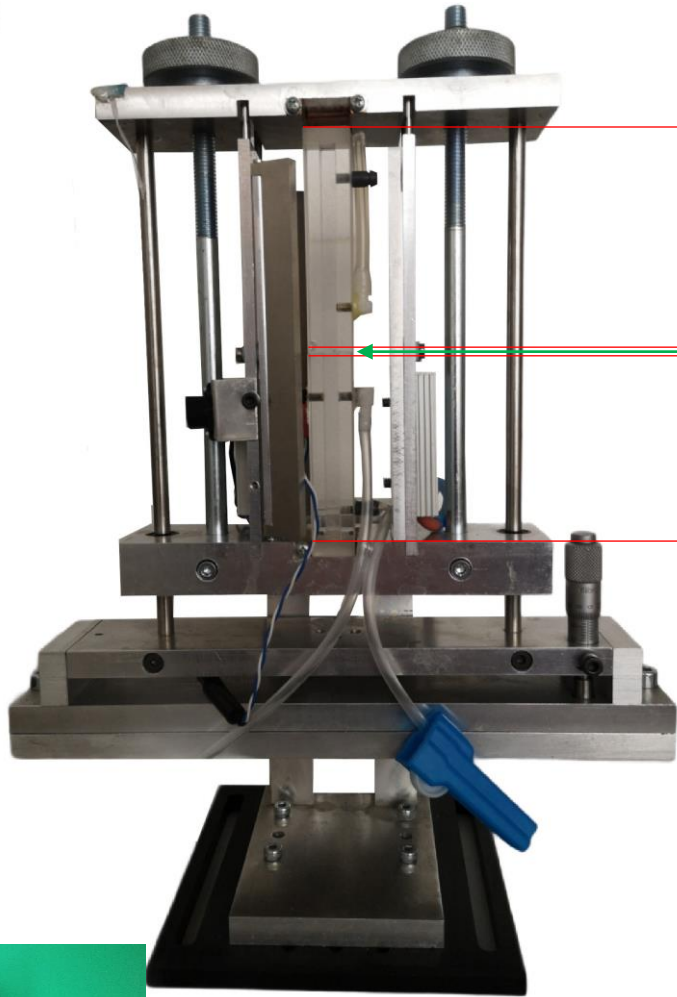
<http://www.bacteriainphotos.com/>

Biofilm - methods



LASER INTERFEROMETRY SYSTEM





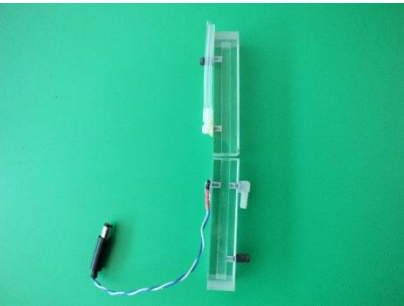
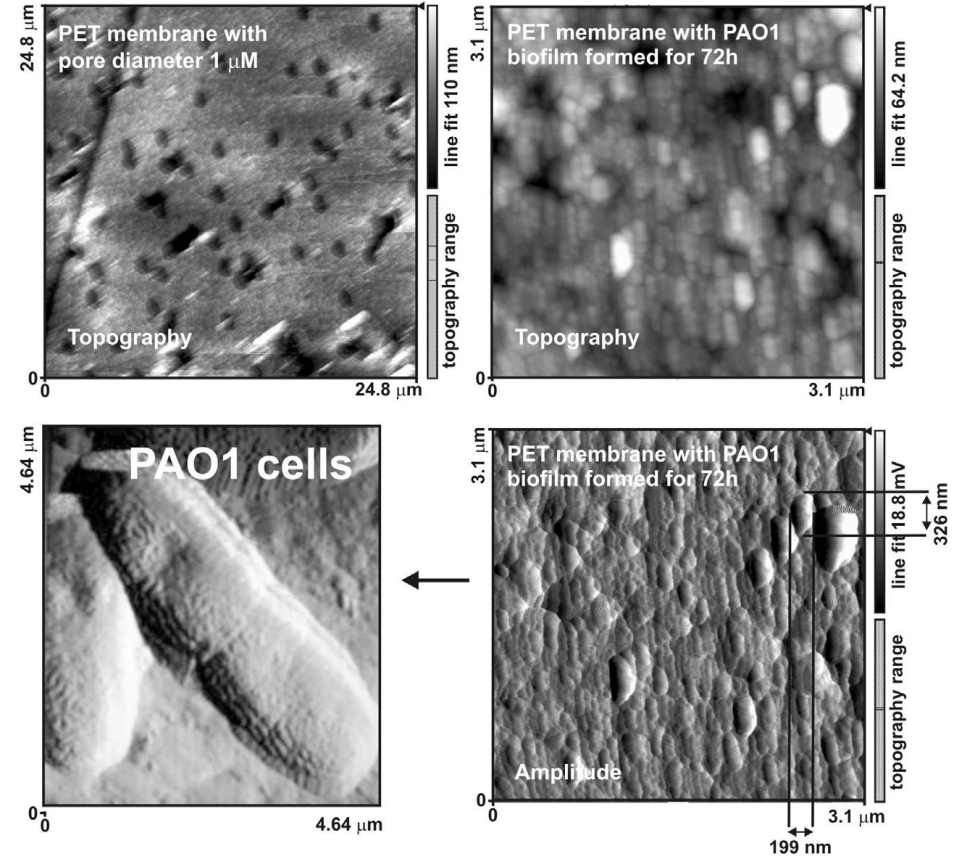
Cuvette II

diffusion direction

PET membrane with formed biofilm

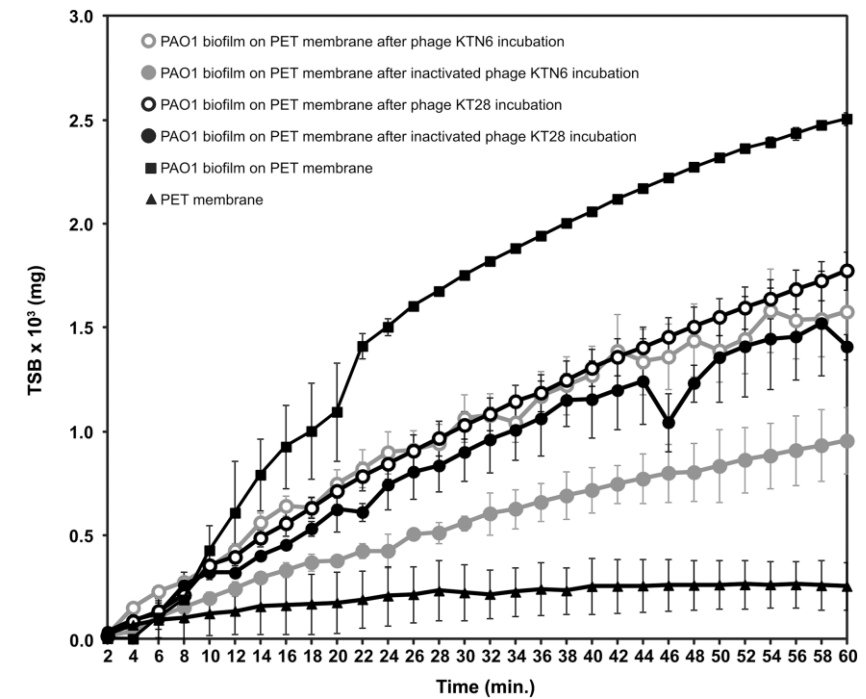
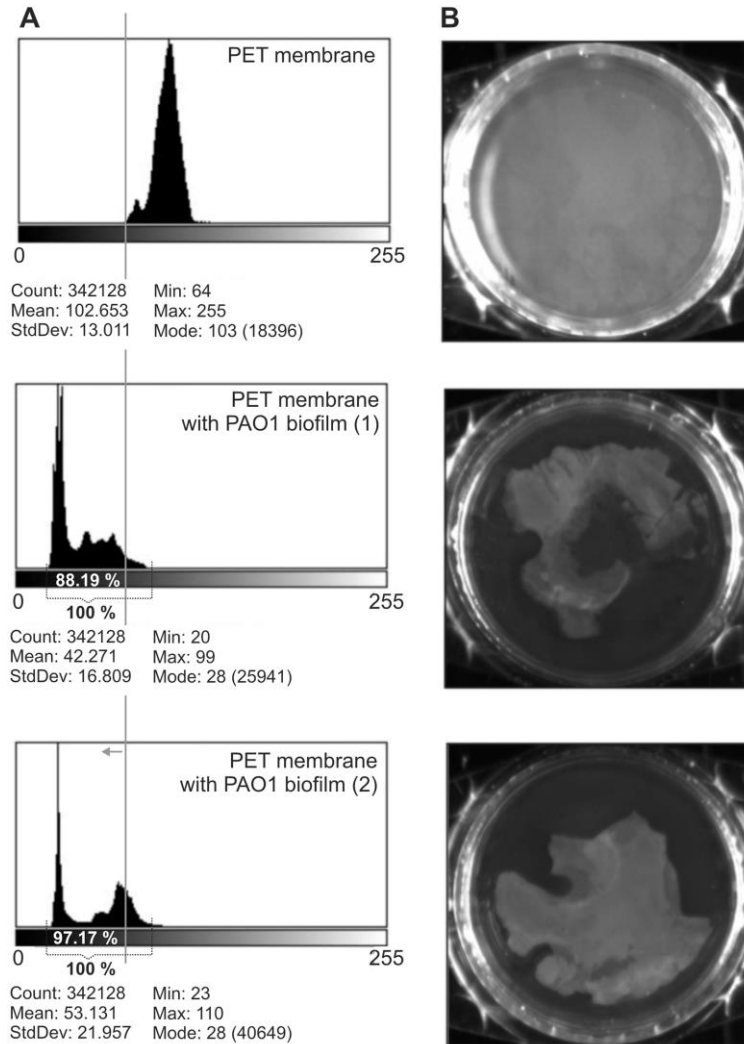
Cuvette I

BIOFILM degradation testing system



Lytic bacteriophages KTN6 and KT28 and their efficacy against *Pseudomonas aeruginosa* biofilm

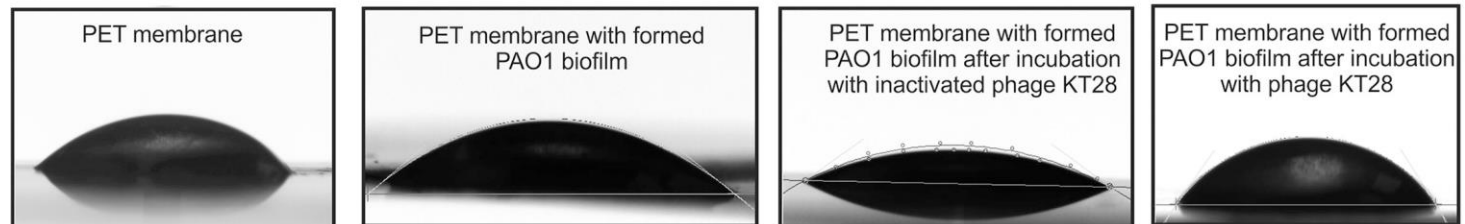
DOI:10.1371/JOURNAL.PONE.0127603



A

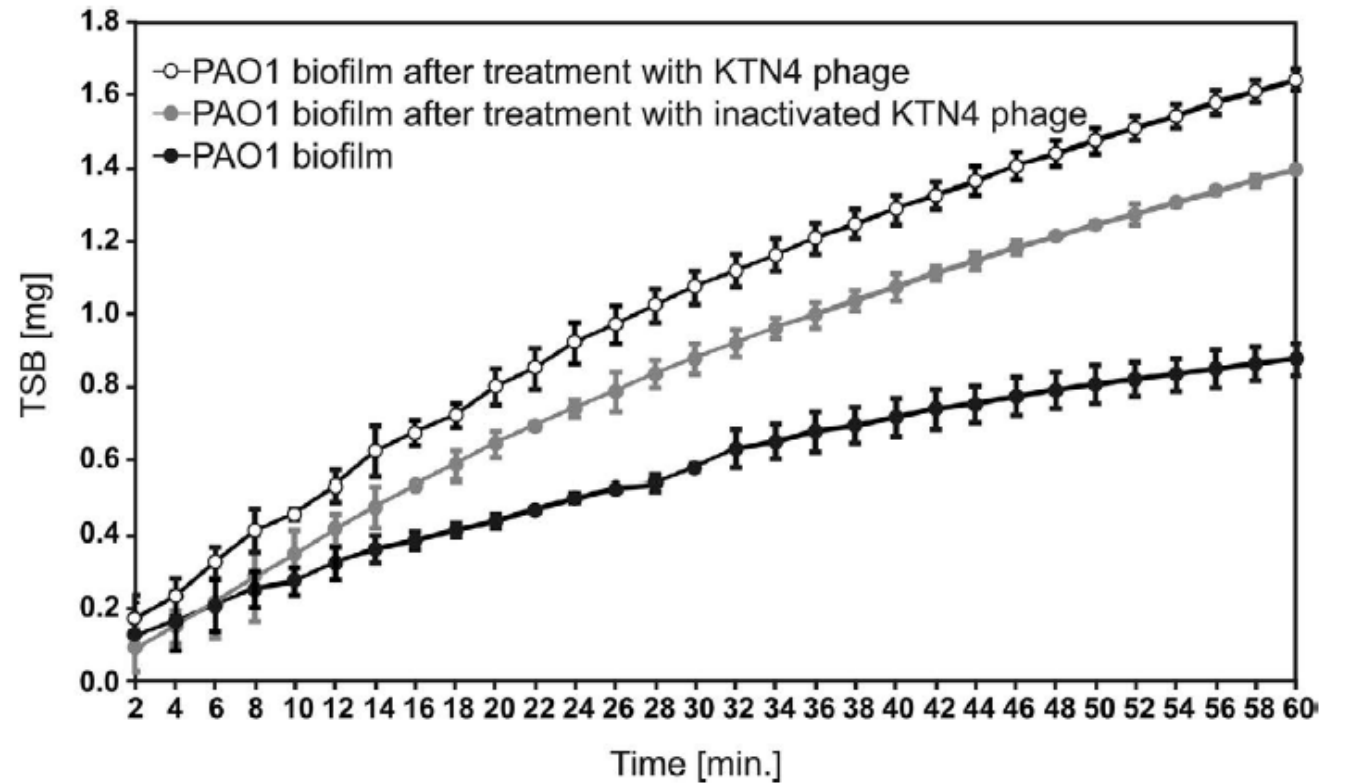
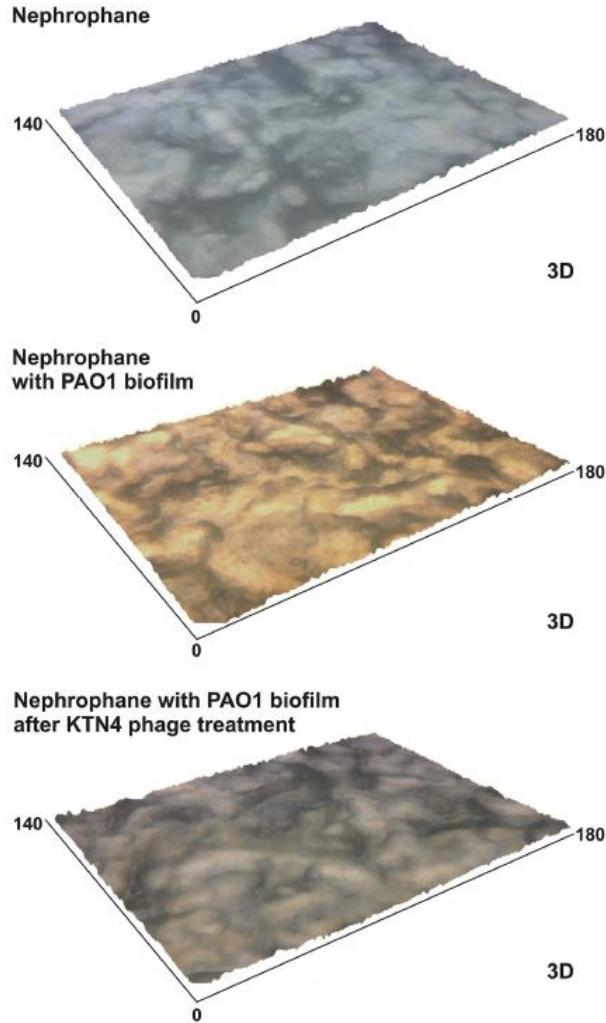
Probes	Value of contact angle	
	Right side of drop	Left side of drop
PVDF membrane (control)	133.0 ± 4.2	134.2 ± 3.1
PET membrane (control)	43.3 ± 3.0	46.0 ± 1.1
PET membrane with formed PAO1 biofilm	35.8 ± 8.5	32.5 ± 7.2
PET membrane with formed PAO1 biofilm after incubation with inactivated phage KT28	32.0 ± 0.7	30.7 ± 2.4
PET membrane with formed PAO1 biofilm after incubation with phage KT28	41.6 ± 6.4	40.2 ± 5.1
PET membrane with formed PAO1 biofilm after incubation with inactivated phage KTN6	33.5 ± 2.6	32.0 ± 0.6
PET membrane with formed PAO1 biofilm after incubation with phage KTN6	40.3 ± 5.8	39.4 ± 7.4

B

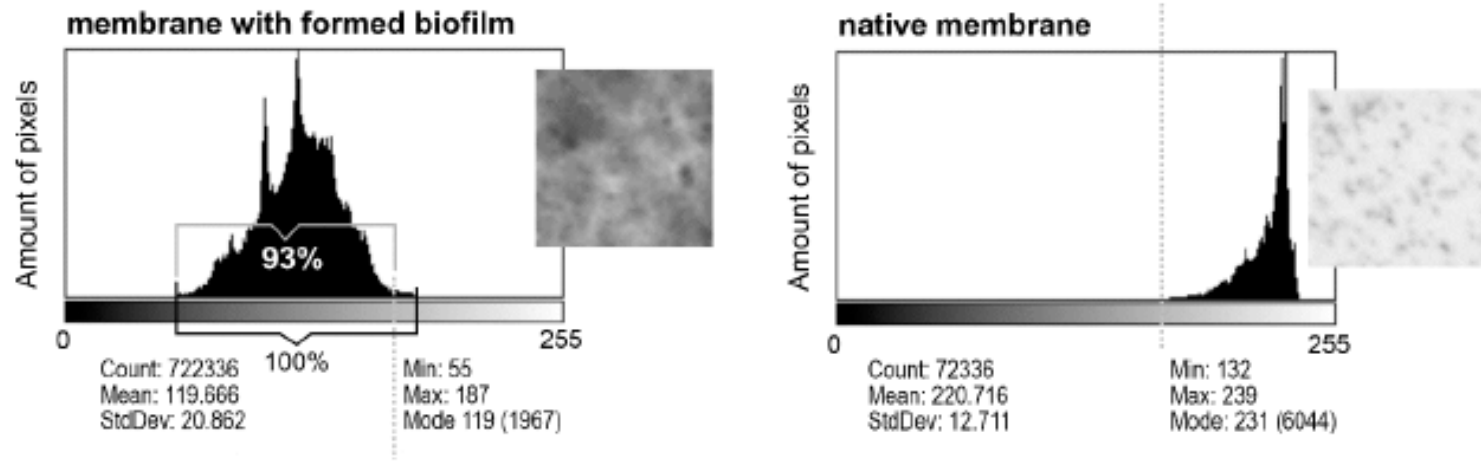


Preclinical evaluation of phage therapy in *Pseudomonas* infections

DOI: 10.1038/SREP28115

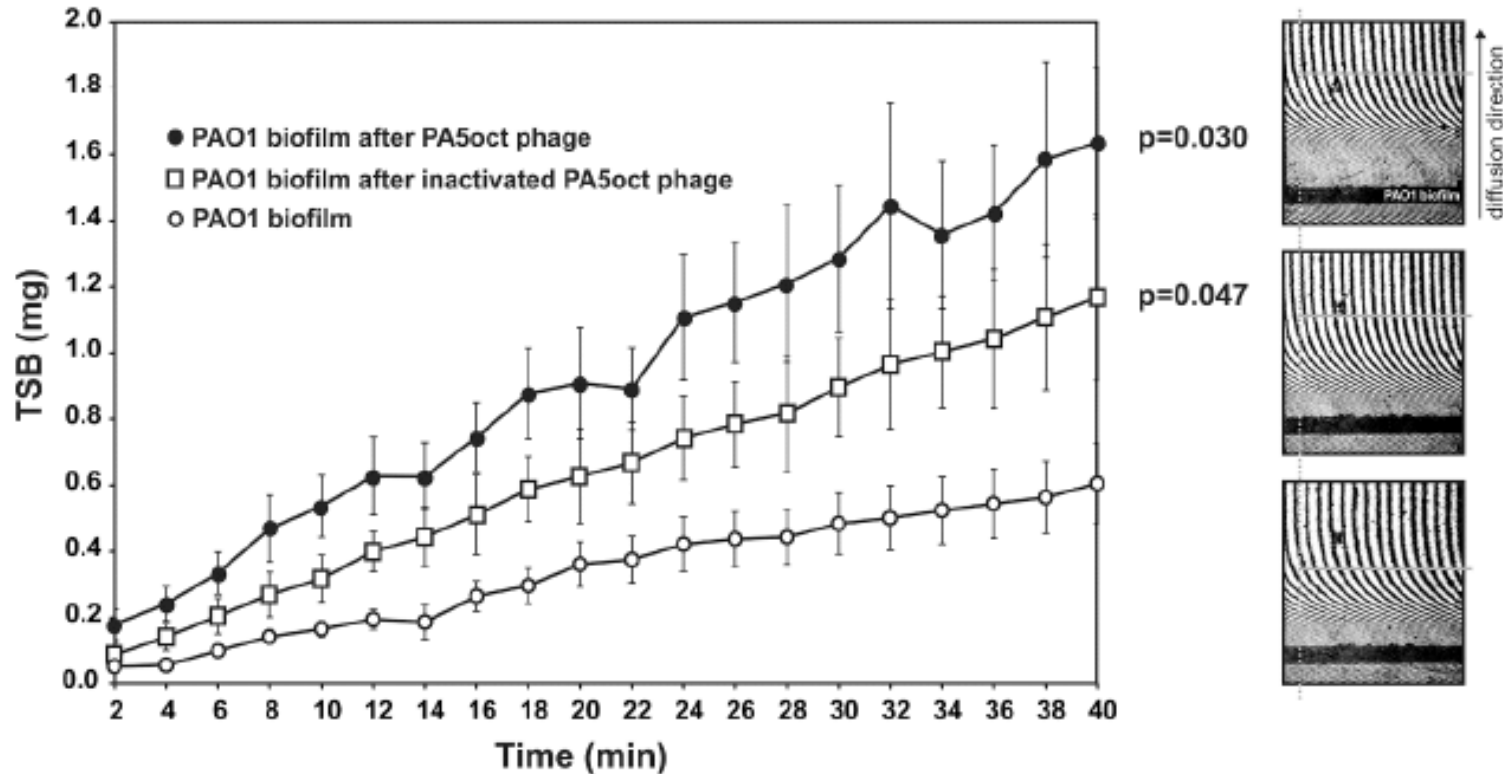


ZETA-20 profiler used in biofilm surface geometry assay

A

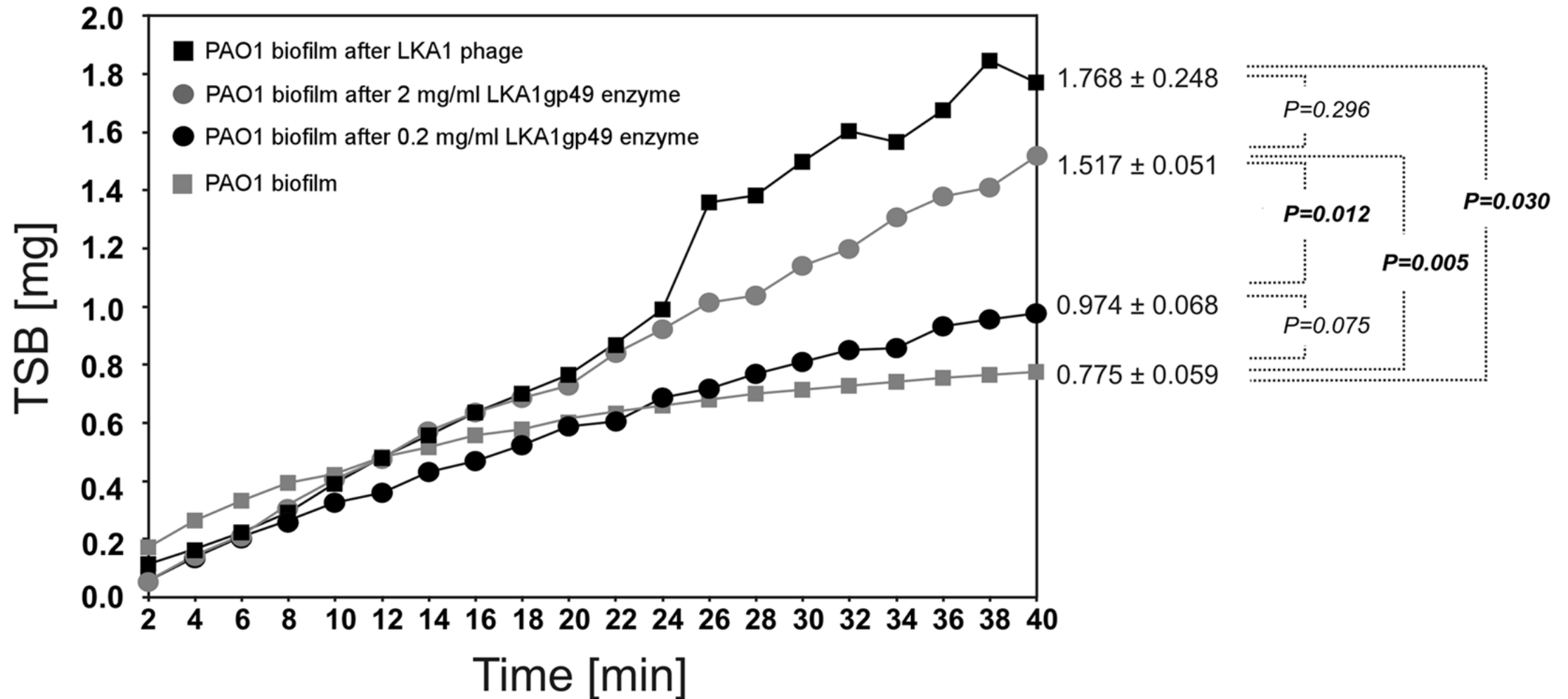
P. aeruginosa PA5oct
jumbo phage impacts
planktonic and biofilm
population

DOI:10.3390/V11121089

B

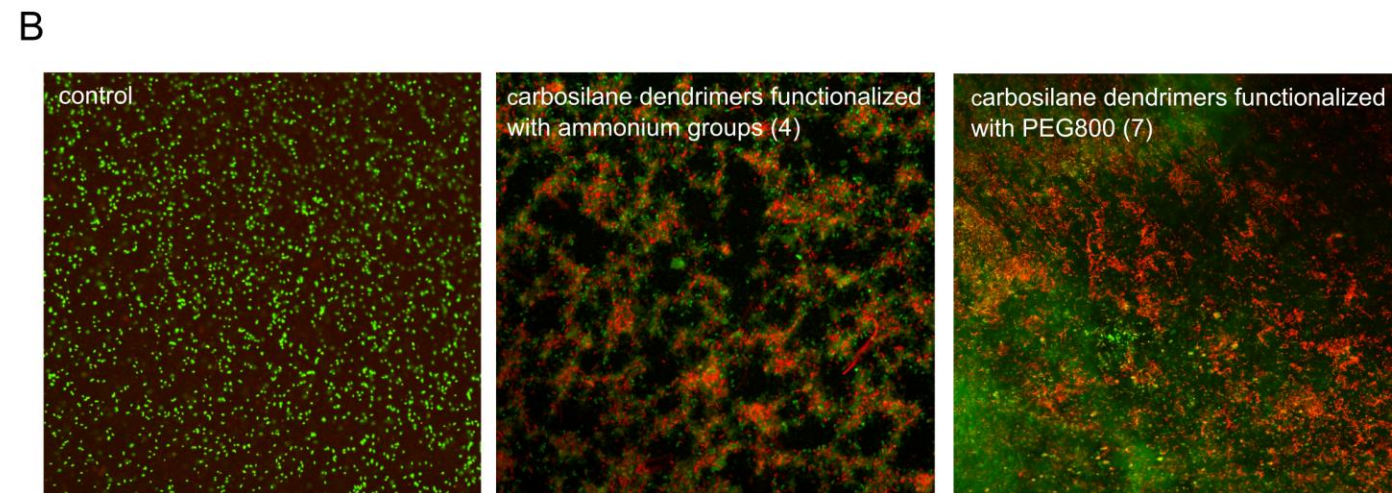
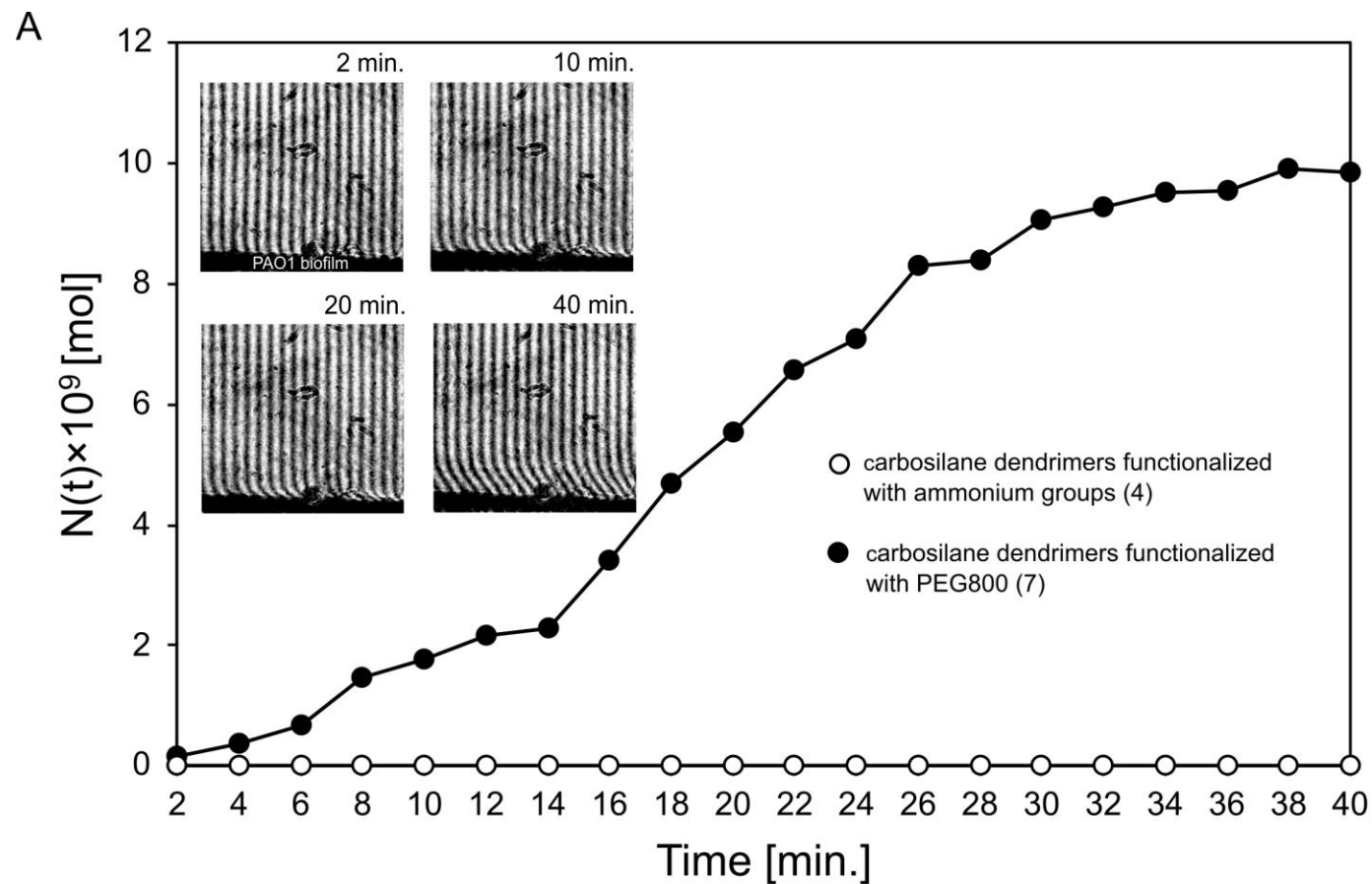
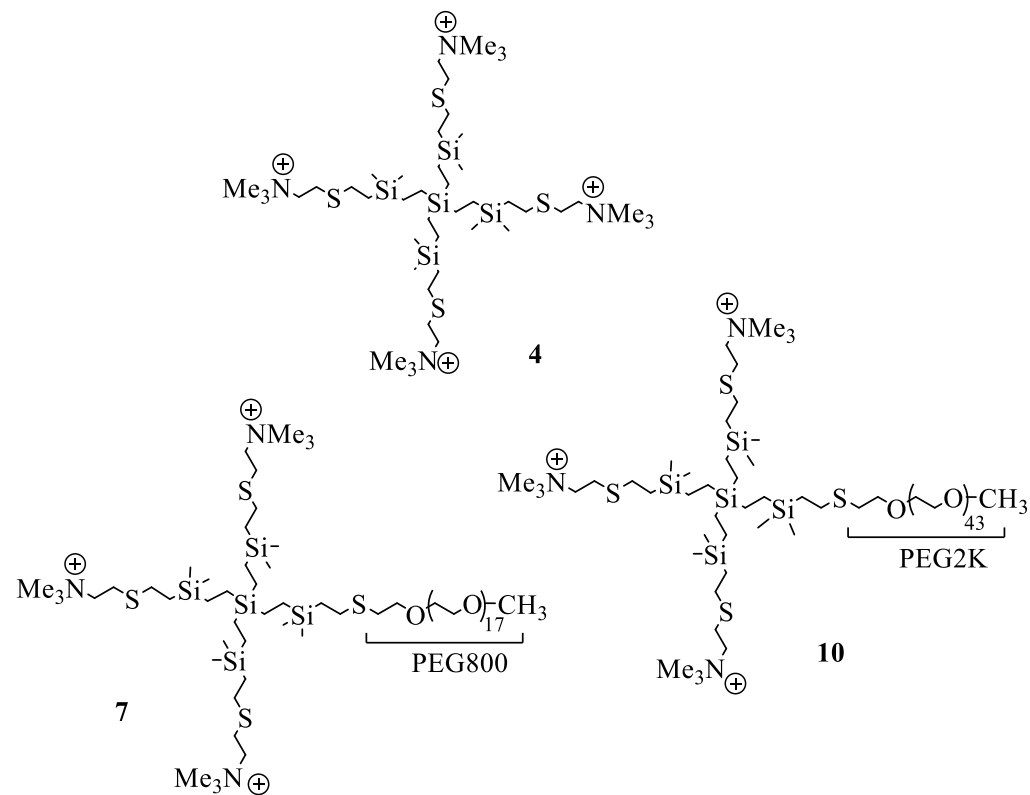
Lyase from the phage LKA1 tailspike reduces *Pseudomonas* virulence

DOI:10.1038/s41598-017-16411-4



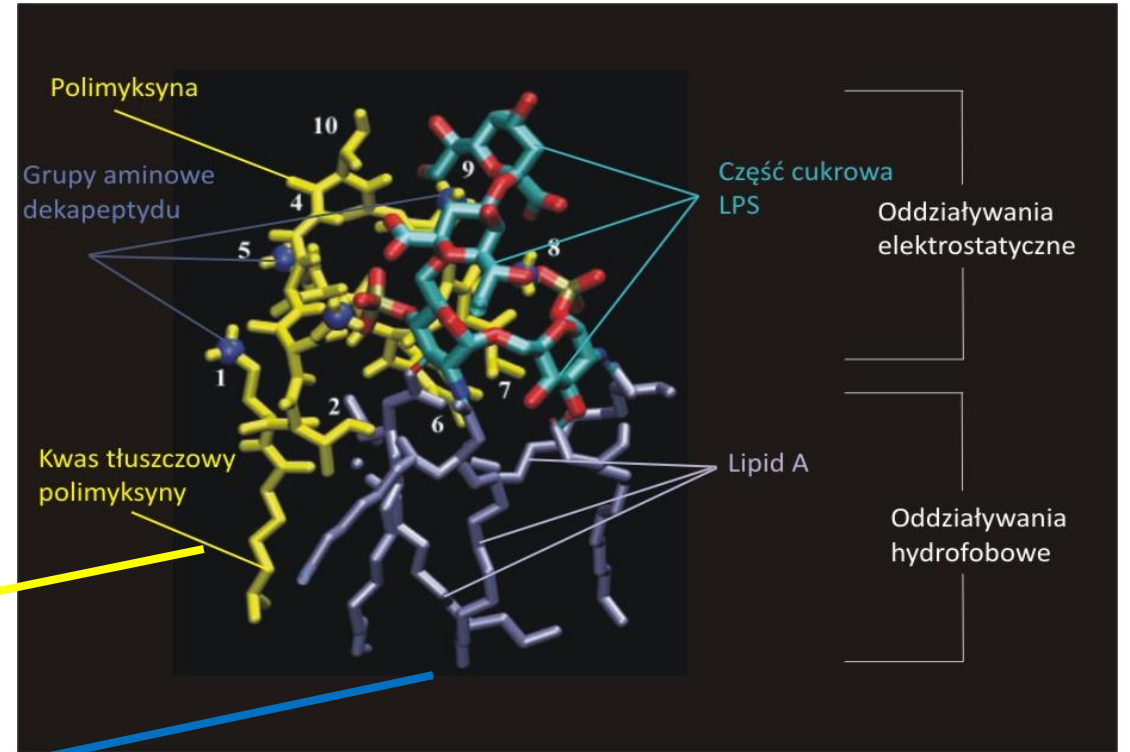
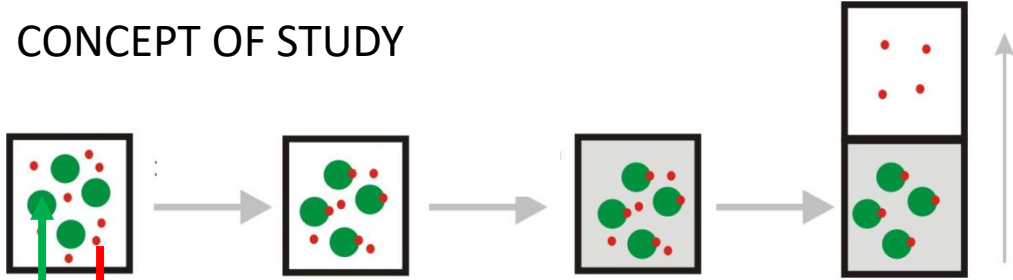
Antibacterial Effect of PEGylated Carbosilane Dendrimers on *P. aeruginosa* biofilm

DOI.ORG/10.3390/IJMS23031873



BACTERIAL ENDOTOXIN INTERACTION WITH ANTIBIOTICS AND POLYMERS

CONCEPT OF STUDY



Mares J., Kumaran S., Gobbo M., Zerbe O. Interactions of lipopolysaccharide and polymyxin studied by NMR spectroscopy. *Journal of Biological Chemistry* 2009;284: 11498-11509.

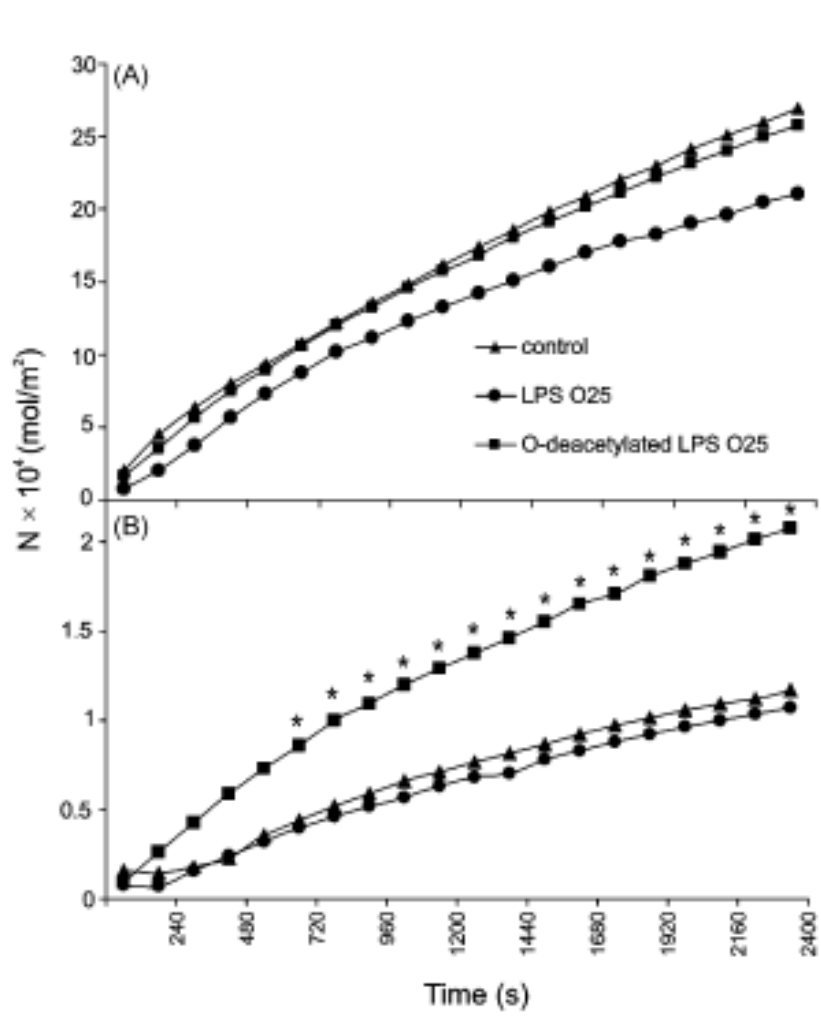
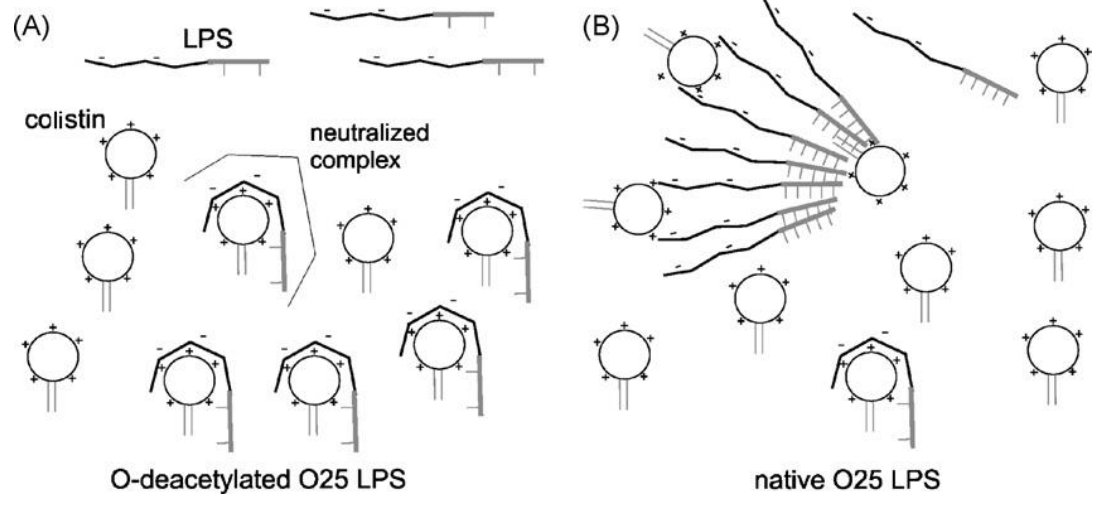
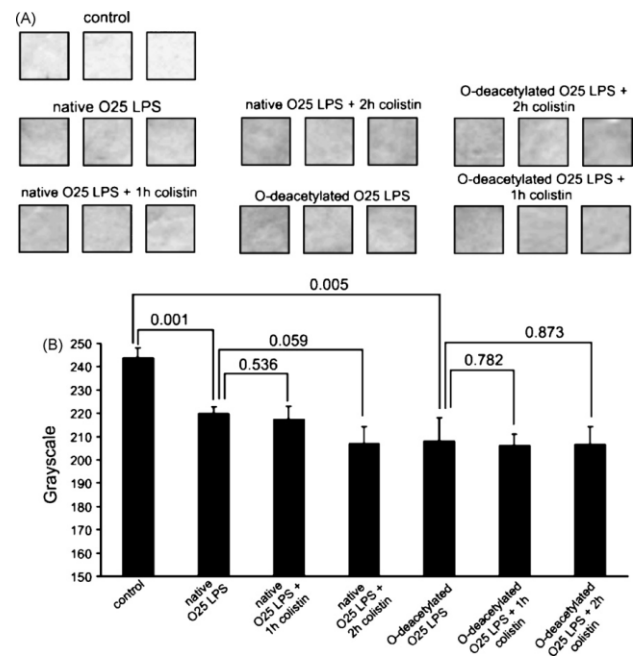
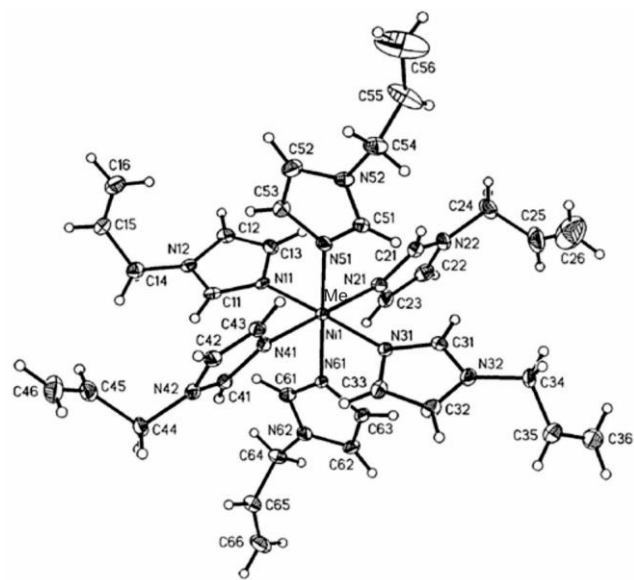


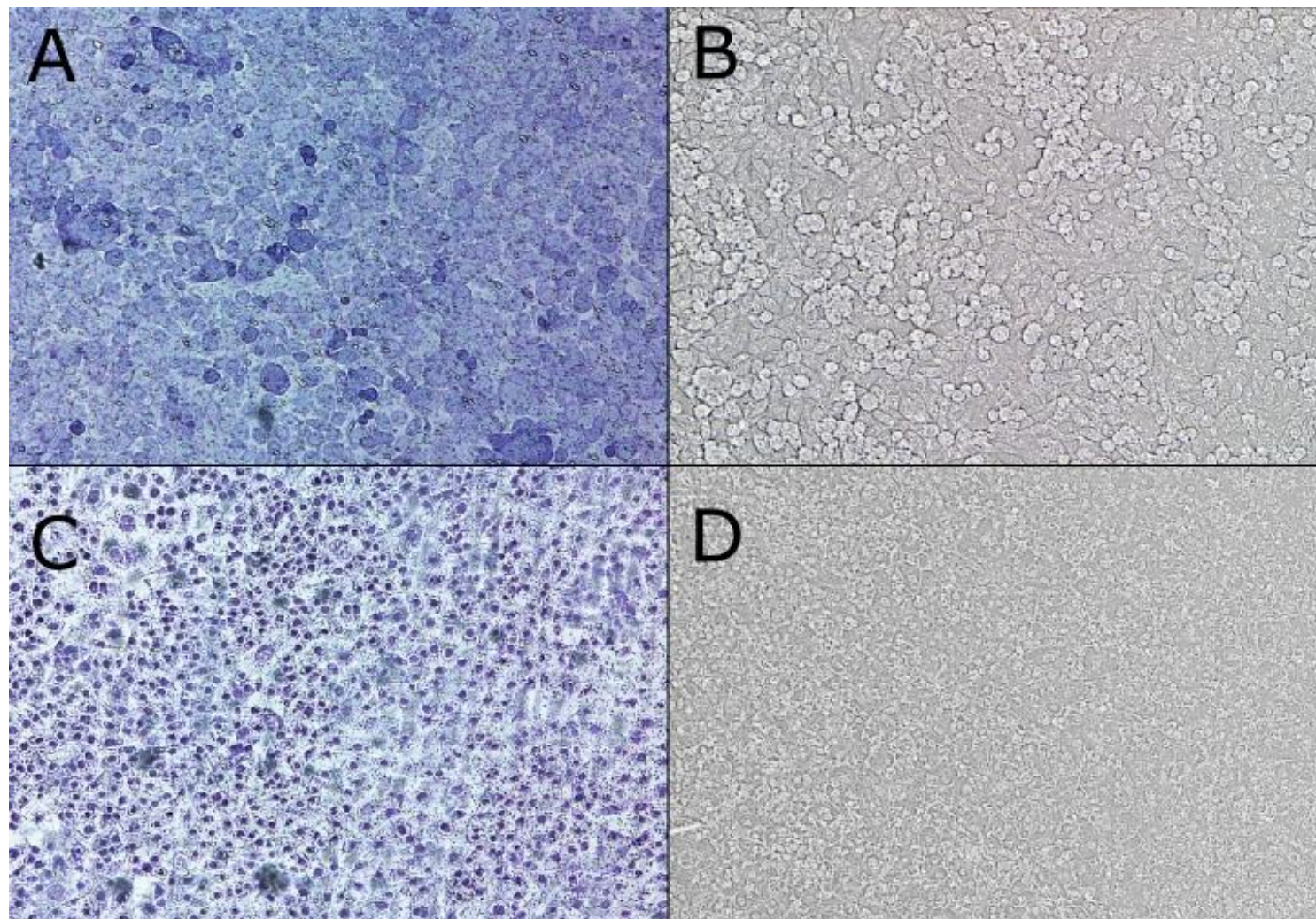
Fig. 4. The amount of ampicillin (A) and colistin (B) transported through the BioFill membrane in the presence of native and O-deacetylated *Proteus vulgaris* O25 LPS in 40 min at room temperature measured by the laser interferometric system. The results displayed are the mean of three independent experiments. * $p < 0.05$.

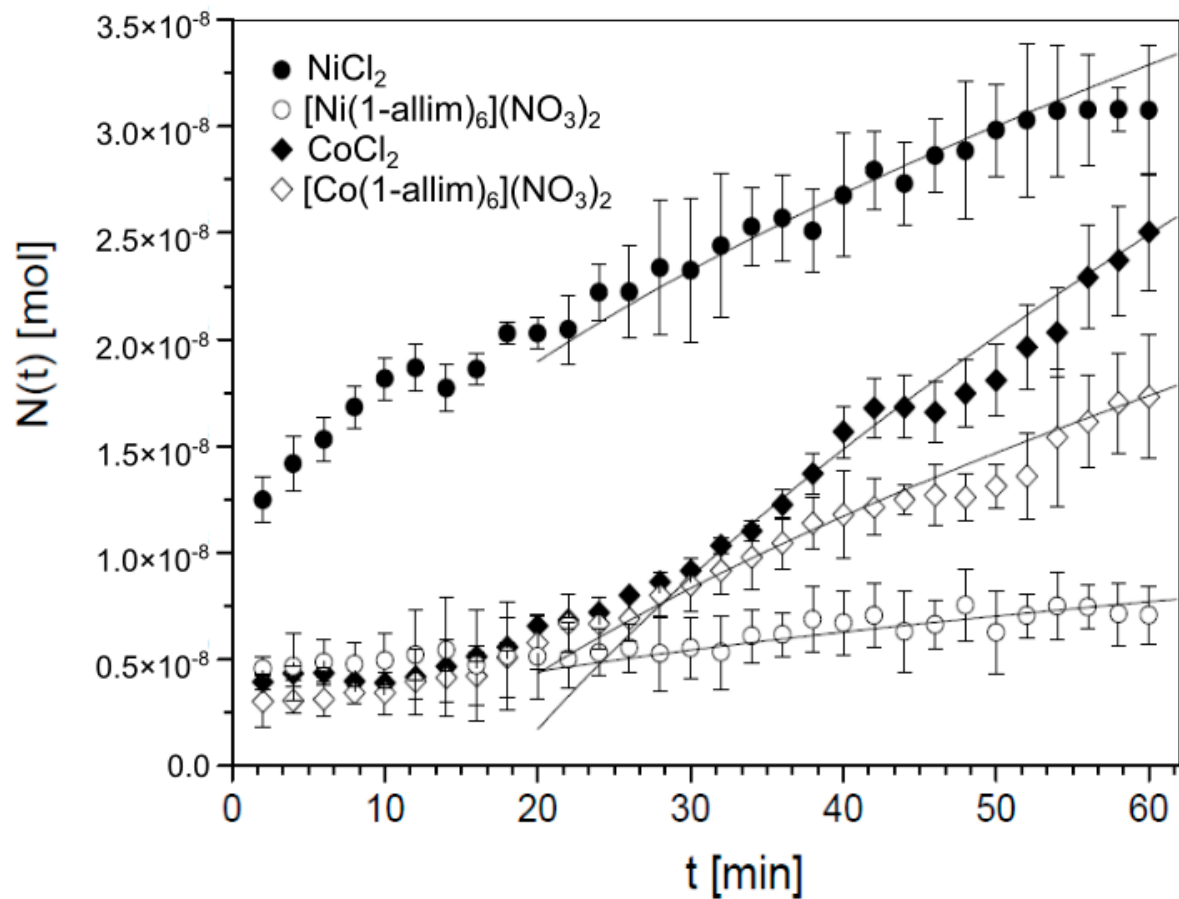


DRUGS DIFFUSION THROUGH CELL MONOLAYER



$[\text{Me}(1\text{-allim})_6](\text{NO}_3)_2$
 Me = Ni(II) or Co(II)





PLANS

QPI {

- LASER INTERFEROMETRY SYSTEM
- DIGITAL HOLOGRAPHIC MICROSCOPY
- OPTICAL DIFFRACTION TOMOGRAPHY

Polish Metrology, "Development of metrological basics of biomedical measurements with the use of selected methods of quantitative phase imaging"

CONCLUSIONS

The technique of laser interferometry allows for quantitative analysis of the diffusion process in real-time.

&

Laser interferometry could be used, among other things, to measure bacterial biofilm degradation and diffusion through cell monolayer.

&

...

