

# Department of Immunobiology

## Workers/employees

- prof. dr hab. Małgorzata Cytryńska - head of the Department
- dr hab. Mariola Andrejko, prof. UMCS
- dr hab. Marta Fiołka, prof. UMCS
- dr hab. Aneta Ptaszyńska, prof. UMCS
- dr hab. Iwona Wojda, prof. UMCS
- dr hab. Agnieszka Zdybicka-Barabas, prof. UMCS
- dr Sylwia Stączek
- mgr Magdalena Kunat
- mgr Monika Koziej
- mgr Wojciech Brzana

## PhD Students

- mgr Sylwia Mieszawska-Wójcik
- mgr Bartłomiej Iwański
- mgr Jakub Kordaczuk
- mgr Michał Sułek



# Thesis supervisors

dr hab. Mariola Andrejko, prof. UMCS

prof. dr hab. Małgorzata Cytryńska

dr hab. Marta Fiołka, prof. UMCS

dr hab. Aneta Ptaszyńska, prof. UMCS

dr hab. Iwona Wojda, prof. UMCS

dr Sylwia Stączek (Bachelor thesis)

dr hab. Agnieszka Zdybicka-Barabas, prof. UMCS

## Research models



Honey bee  
*Apis mellifera*



The greater wax moth  
*Galleria mellonella*

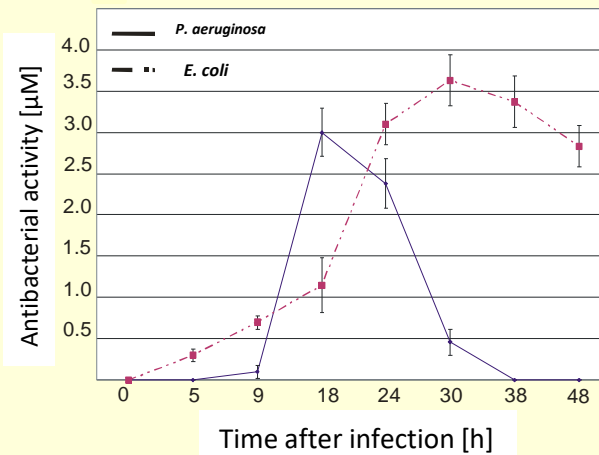
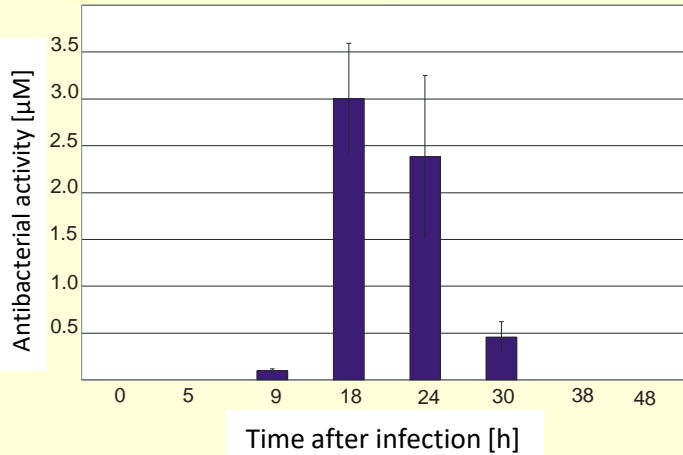


earthworm  
*Dendrobaena veneta*

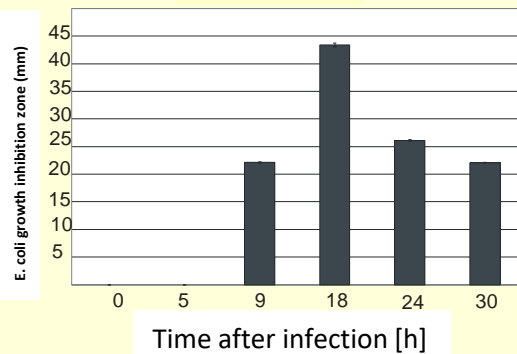
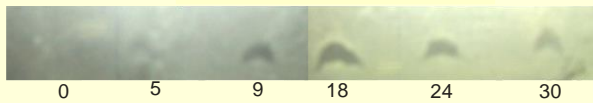


## *Galleria mellonella* - a model organism in the study of *Pseudomonas aeruginosa* virulence factors

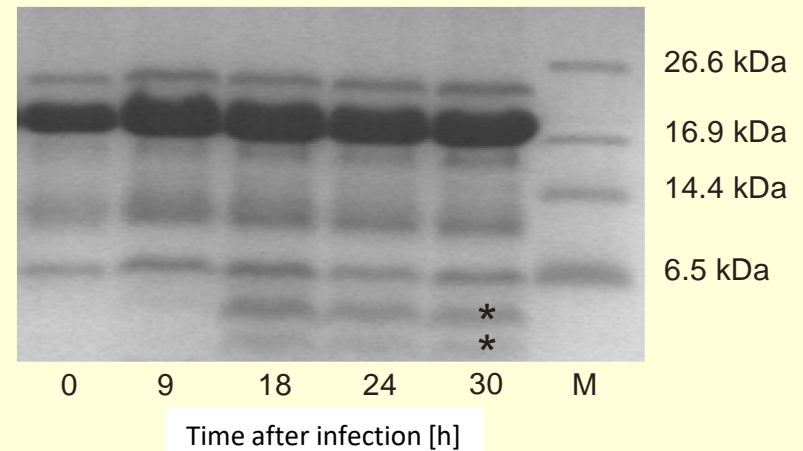
*Pseudomonas aeruginosa*



*Pseudomonas aeruginosa*

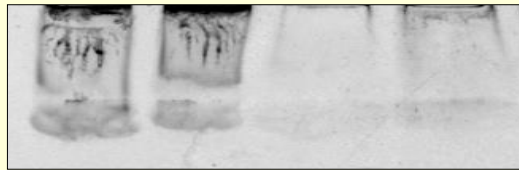


*Pseudomonas aeruginosa*





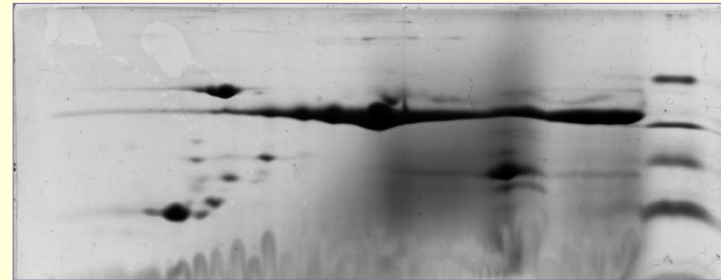
## The role of *P. aeruginosa* alkaline protease in overcoming the immune mechanisms of *G. mellonella*



NH    zPa    NH+AP    zPa+AP

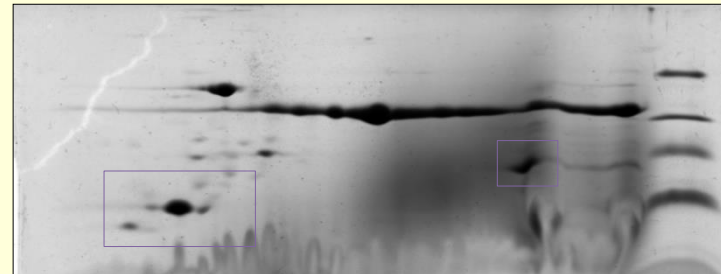
**Inhibition of the melanogenesis process in *G. mellonella* hemolymph (*in vitro* conditions).** Electrophoretic image and image of a fragment of 96-well plate used to measure phenoloxidase activity after incubation of alkaline protease (AP) with hemolymph of non-immunized (NH) and *P. aeruginosa*-injected caterpillars (zPa).

control



26.6 kDa  
17.0 kDa  
14.4 kDa  
6.5 kDa

insects immunized with *P. aeruginosa* alkaline protease



26.6 kDa  
17.0 kDa  
14.4 kDa  
6.5 kDa

**Differences in polypeptide profiles of extracts of insect hemolymph collected 24 hours after alkaline protease injection - 2D electrophoresis.** Caterpillars' hemolymph extracts: non-immunized (control) and after injection of alkaline protease (1.6 µg/caterpillar). The areas of quantitative and/or qualitative changes of spots corresponding to the proteins/peptides are marked with the boxes.

dr hab. Mariola Andrejko, prof. UMCS

### Sample topics of master's theses

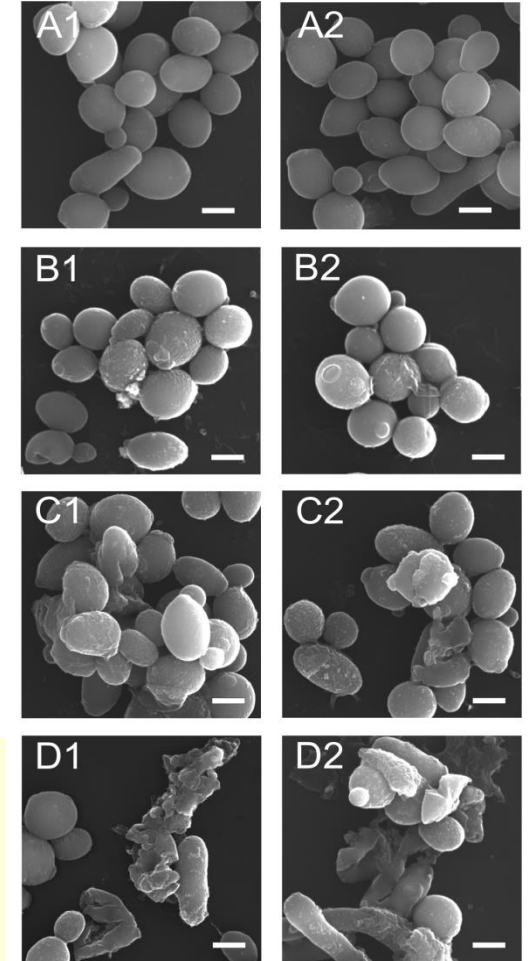
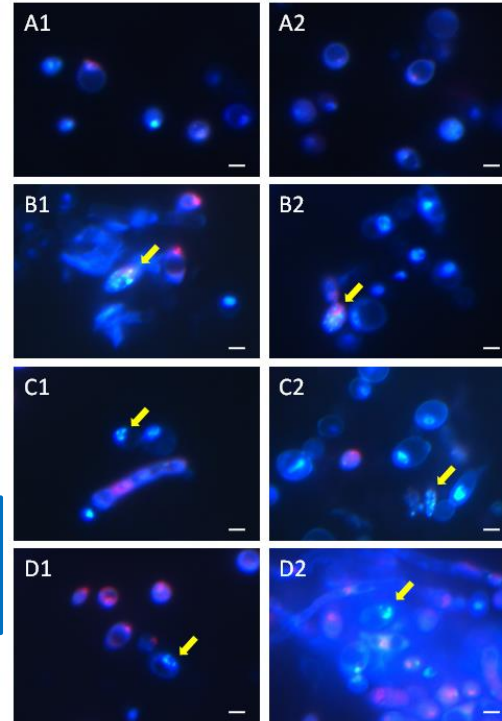
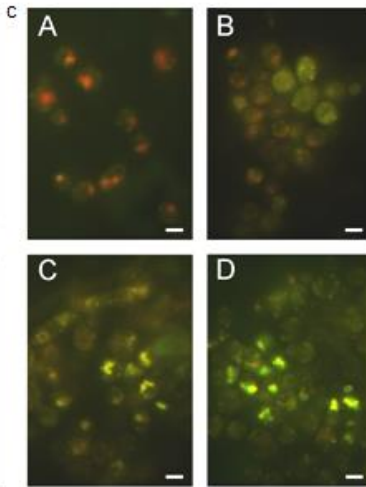
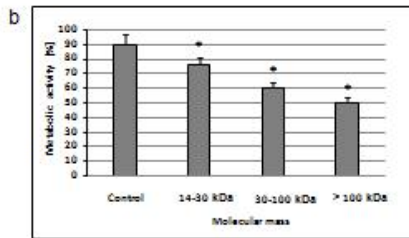
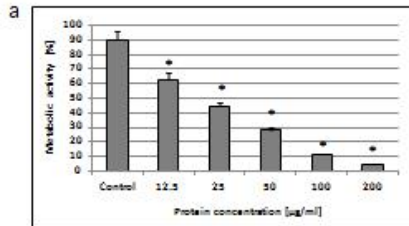
- Sensitivity of proteins and peptides of the *Galleria mellonella* humoral response to selected virulence factors of the pathogenic bacterium *Pseudomonas aeruginosa*
- Participation of the alkaline protease and exotoxin A of *Pseudomonas aeruginosa* in the degradation of *Galleria mellonella* antimicrobial proteins and peptides
- Cellular response of *Galleria mellonella* caterpillars following administration of *Pseudomonas aeruginosa* exotoxin A

### Sample topics of bachelor's theses

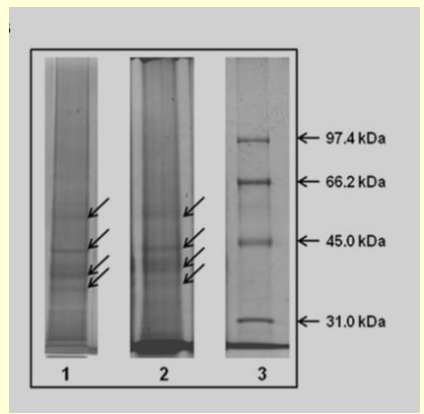
- Human microbiome and its influence on depression and autism
- Medical aspects of the use of marijuana
- The microbiome - a way to overcome skin diseases
- Vaccinations - an important aspect of public health
- Influence of the microbiome on the occurrence of mental and neurodegenerative diseases
- The healing and addictive properties of cannabis



Effect of the protein-polysaccharide fraction of *Dendrobaena veneta* celomic fluid on *Candida albicans* cells



Analysis of the metabolic activity of *C. albicans* cells after treatment with fractions of various protein concentrations.

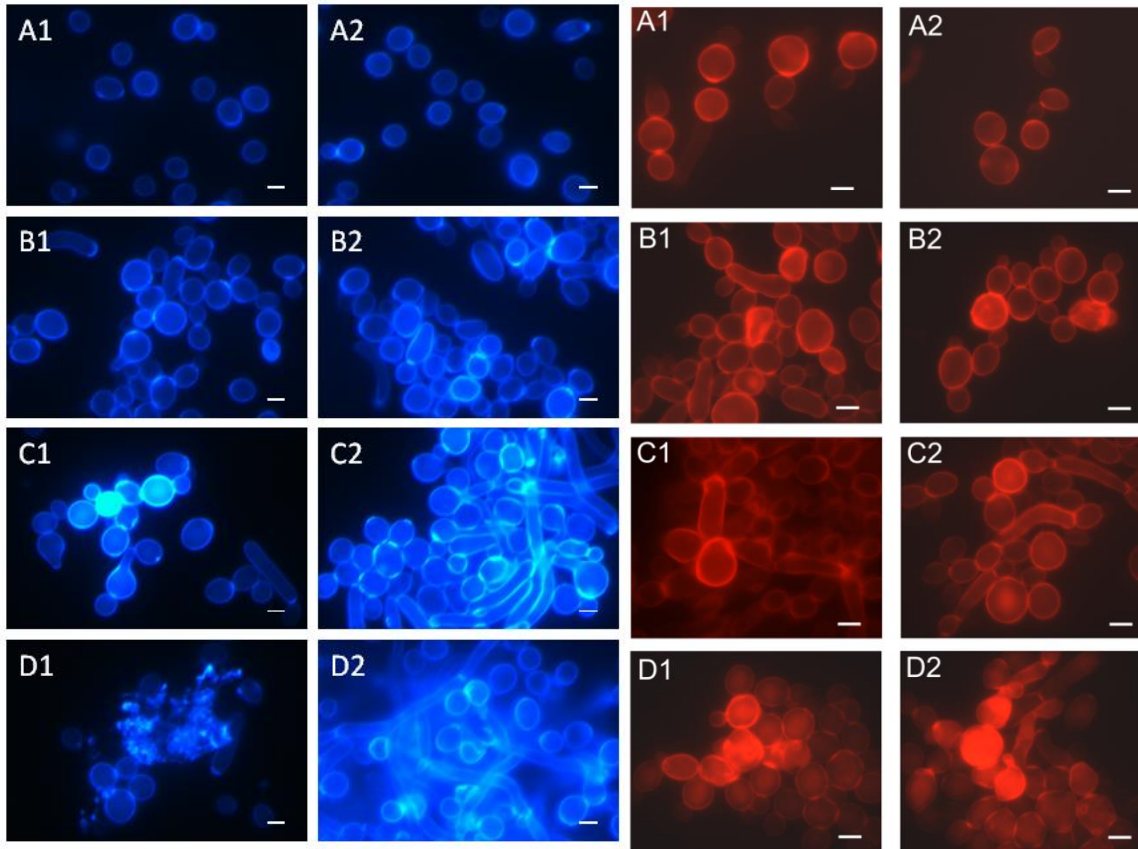


Apoptosis and necrosis of *C. albicans* cells after treatment with fractions of various protein concentrations; cells undergoing apoptosis are indicated by arrows.

SDS electrophoretic analysis of proteins (1) and sugars (2) of the active fraction of the celomic fluid.

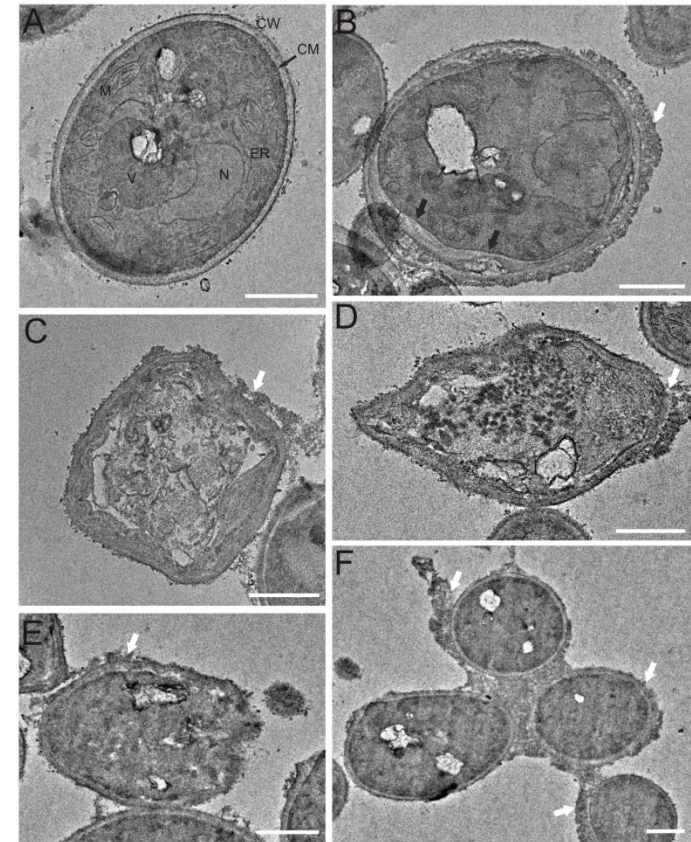
Scanning microscope images of *C. albicans* cells (control - A1-A2 and after treatment with fraction of different protein concentration - B1-D2).

Effect of the protein-polysaccharide fraction of the celomic fluid of *Dendrobaena veneta* on *Candida albicans* cells – imaging using various microscopic techniques



Images of *Candida albicans* cells obtained after staining with Calcofluor white fluorochrome: controls (A1-A2) and after incubation with the active fraction of various protein concentrations (B1-D2).

Images of *Candida albicans* cells obtained after staining with Congo red fluorochrome: controls (A1-A2) and after incubation with the active fraction of different protein concentration (B1-D2).



Images of *C. albicans* cells obtained with the use of transmission electron microscopy: control (A) and after the treatment with fractions with different protein concentration (B-F).

dr hab. Marta Fiołka, prof. UMCS

### Sample topics of master's theses

- Comparison of the antifungal activity of the protein-polysaccharide fraction of the celomic fluid of *D. veneta* with the activity of known antifungal antibiotics
- Morphological and physicochemical characteristics of Alaska snow algae and preparation of the polysaccharide fraction for use in biomedical research
- Snow algae of Svalbard, their parasitic fungi and obtaining the polysaccharide fraction from the studied samples
- Changes in the metabolic activity and viability of *Candida albicans* cells after treatment with the protein-polysaccharide complex obtained from the celomic fluid of *Dendrobaena veneta*

### Sample topics of bachelor's theses

- Tardigrades - the most resistant animals on Earth
- Candidiasis - a pseudo-disease or a real threat
- Earthworms - a source of bioactive compounds with medical application potential





# Bees and wild pollinators

## Research team

dr hab. **Aneta Ptaszyńska**, prof. UMCS  
head of research team

**mgr Magdalena Kunat**  
research and teaching assistant

**and graduate students**

Recently, a decrease in the number of bee colonies in the world has been observed. This is due to many factors, including environmental pollution, nutritional stress and climate change. In addition, honeybees are constantly exposed to a wide spectrum of pathogens. To prevent this, our team tests various natural and synthetic substances that could help the bees to survive and protect against diseases. Additionally, we conduct research on the expression of immune-related genes in honeybees. We also conduct research on the antibacterial and antifungal activity of various types of honey, and we also search for biologically active substances in honey.



dr hab. Aneta Ptaszyńska, prof. UMCS, mgr Magdalena Kunat

### Sample topics of master's theses

- Effect of porphyrin compounds on honeybee nosemosis (*Apis mellifera*)
- Antimicrobial properties of *Arctostaphylos uva-ursi* extracts
- Effect of oligosaccharide preparations on the development of nosemosis in insects

### Sample topics of bachelor's theses

- Natural healing substances used to combat nosemosis in honeybee (*Apis mellifera*)
- Parasite strategies to avoid the immune response of the host organism
- Contemporary problems related to the phenomenon of antibiotic resistance

**Our team actively participates every year in popular science events:** Biologists' Night (Noc Biologów), Lublin Science Festival (Lubelski Festiwal Nauki), UMCS Open Doors (Drzwi Otwarte UMCS).

**We cordially invite students to cooperation:** undergraduates, graduate students, volunteers/trainees.

**More information:**

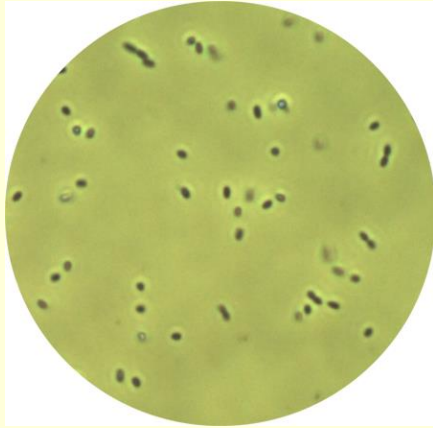
<https://www.umcs.pl/pl/pszczoły-i-dzikię-zapylacze,17016.htm>

<https://www.facebook.com/beerresearchpl/>



dr hab. Iwona Wojda, prof. UMCS

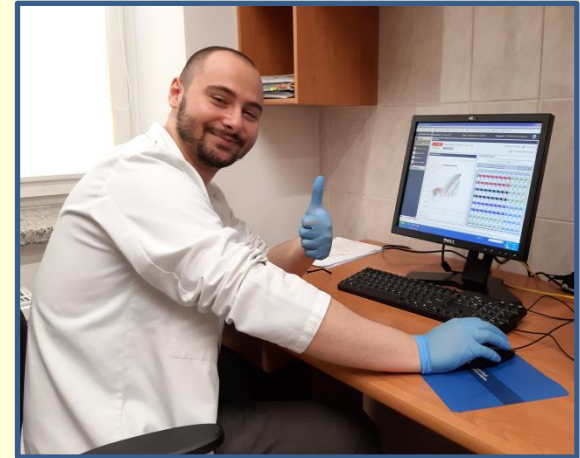
PhD students: mgr Jakub Kordaczuk, mgr Michał Sułek



*Pseudomonas entomophila*



Infection of *G. mellonella* larva by the oral route.



Analysis of gene expression by RT-qPCR  
(in the photo: Michał Sułek, PhD student in Doctoral  
School of Quantitative and Natural Sciences, UMCS)



*G. mellonella* infected with *P. entomophila* by the oral route (A and B), and a control caterpillar (C).

## Research topics

1. Study of the mechanisms regulating the *G. mellonella* response to *Pseudomonas entomophila* infection.
2. Research on the phenomenon of immune priming. Insects as model organisms to study the capacity of innate immune mechanisms for remembering infections.

dr hab. Iwona Wojda, prof. UMCS

### Sample topics of master's theses

- *Escherichia coli* peptidoglycan as a stimulator of the *Galleria mellonella* immune response
- Selected aspects of priming of the greater wax moth *Galleria mellonella* immune system with *Candida albicans*
- *Pseudomonas entomophila* - general characteristics and analysis of the biotechnological use of a new entomopathogenic bacterium
- Susceptibility of the entomopathogenic bacterium *Pseudomonas entomophila* to selected bioactive compounds

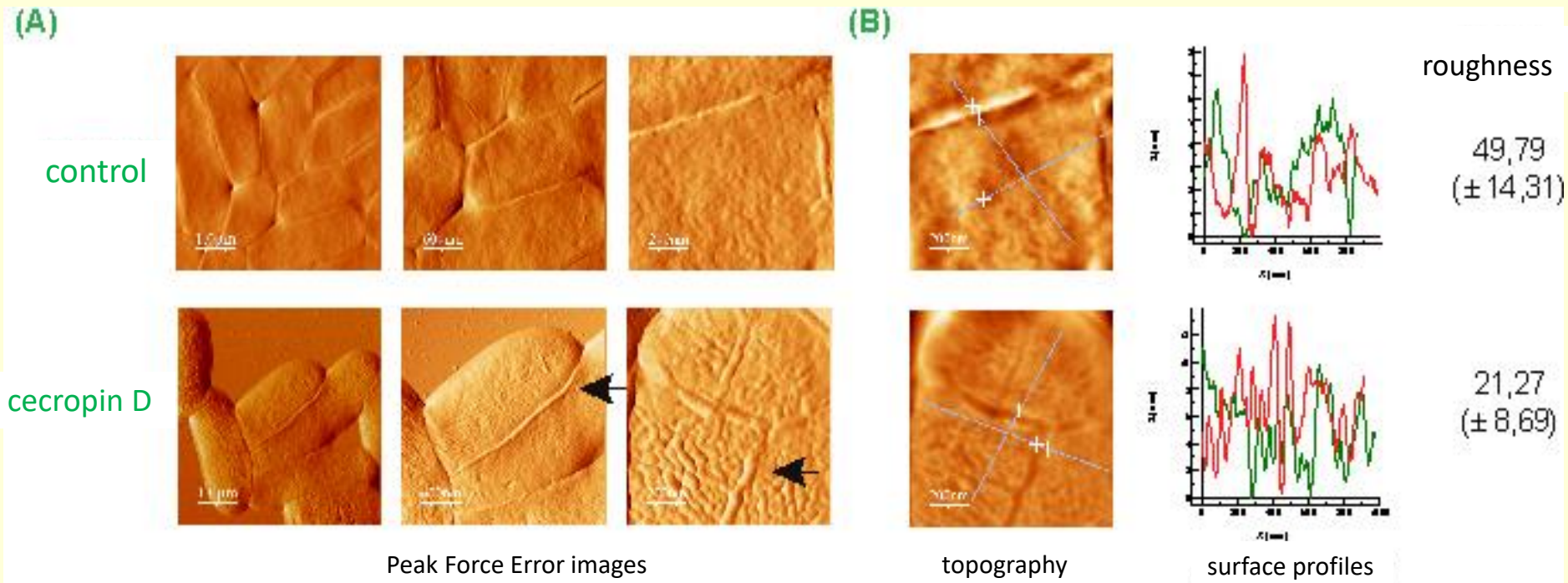
### Sample topics of bachelor's theses

- Vaccines and diseases of the modern world
- The immune system of annelids
- Defense peptides
- Selected methods used in the treatment of malignant neoplasms



prof. dr hab. Małgorzata Cytryńska, dr Sylwia Stączek  
dr hab. Agnieszka Zdybicka-Barabas, prof. UMCS

## The role of antimicrobial proteins and peptides in *G. mellonella* immunity Mechanisms of action of immune peptides and proteins

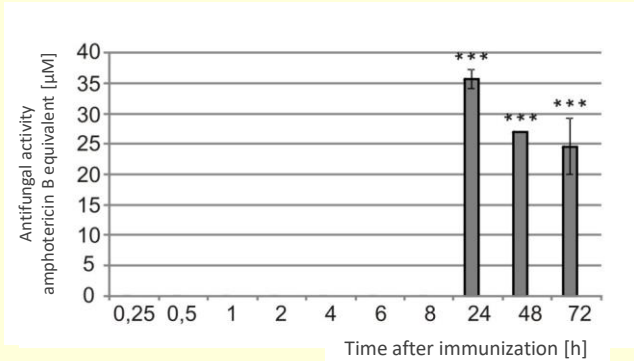


Imaging the surface of *Escherichia coli* cells by atomic force microscopy (AFM).

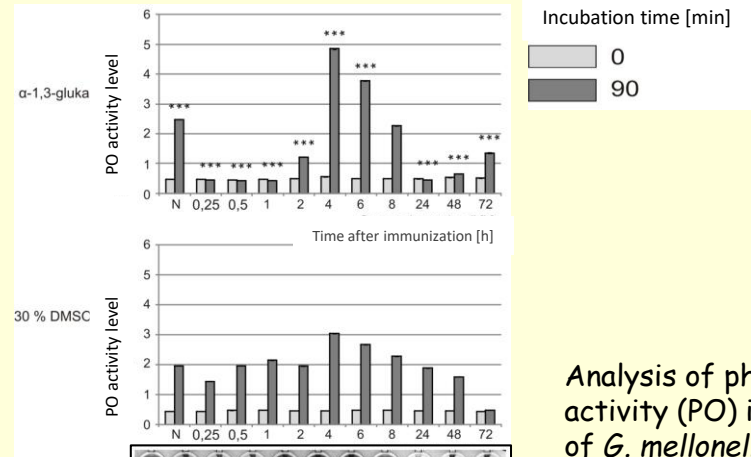
Research financially supported by NCN (Opus) No 2012/05/B/NZ1/00033.

Zdybicka-Barabas A., Pawlikowska-Pawłęga B., Stączek S., Sowa-Jasiłek A., Gruszecki W.I., Skrzypiec K., Mendyk E., Mak P., Cytryńska M. (2015) Interactions of *Galleria mellonella* cecropin D-like peptide with bacterial cells. *Amino Acids* 47(8): 1645.

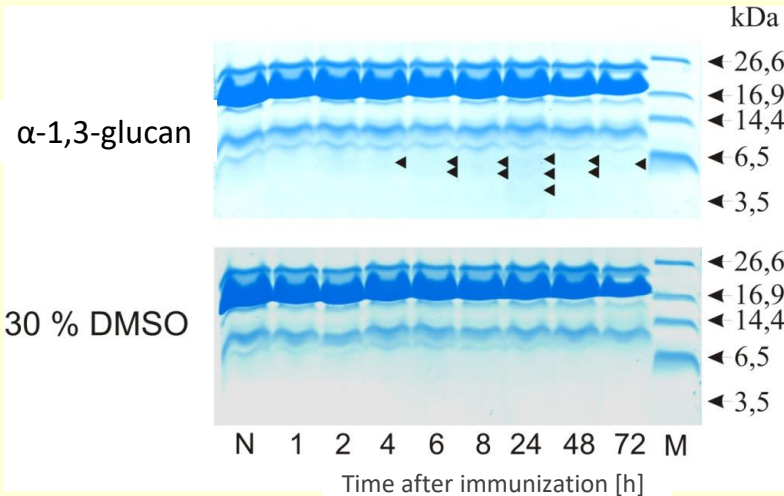
## The immune response of *G. mellonella* larvae to $\alpha$ -1,3-glucan of the *Aspergillus niger* cell wall



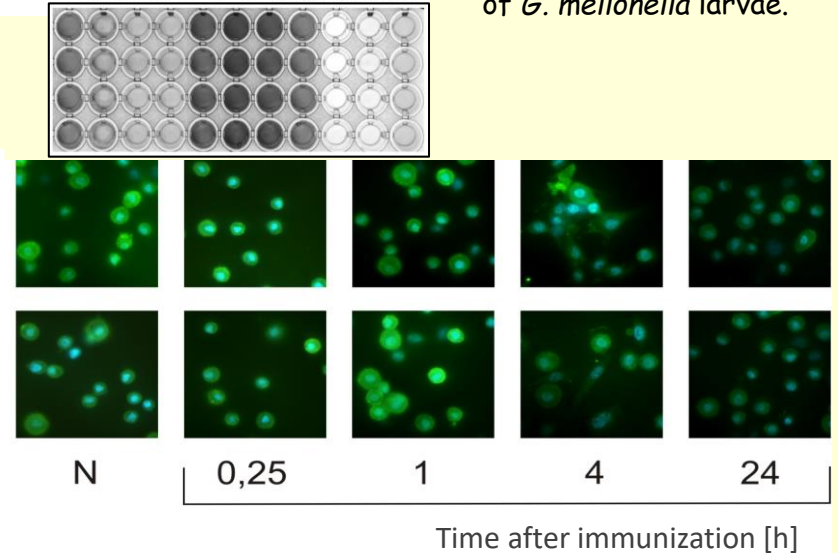
Antifungal activity in *G. mellonella* hemolymph after *A. niger*  $\alpha$ -1,3-glucan injection.



Analysis of phenoloxidase activity (PO) in hemolymph of *G. mellonella* larvae.



Protein and peptide profiles of hemolymph of *G. mellonella* larvae immunized with *A. niger*  $\alpha$ -1,3-glucan and DMSO.



Immunolocalization of apolipoprotein III in hemocytes of non-immunized *G. mellonella* larvae (N) and at various times after  $\alpha$ -1,3-glucan injection.

prof. dr hab. Małgorzata Cytryńska, dr Sylwia Stączek  
dr hab. Agnieszka Zdybicka-Barabas, prof. UMCS

### Sample topics of MA theses (supervisor - prof. dr hab. Małgorzata Cytryńska)

- Participation of apolipoprotein III and phenoloxidase system in the immune response of *Galleria mellonella* to *Candida albicans* infection
- Analysis of antimicrobial activity of *Galleria mellonella* hemolymph and synthetic cecropin D
- Participation of defense proteins and peptides in *Galleria mellonella* response to polycation DG2 after infection with *Aspergillus brasiliensis*

### Sample topics of BA theses (supervisor - prof. dr hab. Małgorzata Cytryńska)

- Invertebrates as model organisms in studies of pathogenesis of human diseases
- Insect antimicrobial peptides and classic antibiotics
- Autoimmune hair loss and the use of biotechnological methods in therapy
- Toxic effects of selected addictive substances on the human body

### Sample topics of MA theses (supervisor - Agnieszka Zdybicka-Barabas, prof. UMCS)

- The role of antimicrobial peptides in insects and methods used for determination their antimicrobial activity
- Immunomodulatory properties of *Aspergillus niger* glucooligosaccharides - the use of *Galleria mellonella* as a model organism
- Assessment of the antifungal potential of itraconazole against *Aspergillus brasiliensis* in the *Galleria mellonella* model

### Sample topics of BA theses (supervisor - Agnieszka Zdybicka-Barabas, prof. UMCS)

- Selected therapies used in the treatment of cancer
- Vaccines "in a nutshell" - do they protect or harm?
- Defense peptides - possible application in cancer therapy
- Strategies for overcoming multidrug resistance of neoplastic cells

### Sample topics of BA theses (supervisor - dr Sylwia Stączek)

- Cannabinoids - properties and production technologies
- Colors of biotechnology