Department of Biophysics of Immune System

Institute of Biophysics of the Czech Academy of Sciences

DBIS IBP
Department of Biophysics of Immune system
Institute of Biophysics

IBP

Department structure

Head of the department:
doc. Mgr. Lukáš Kubala, Ph.D.

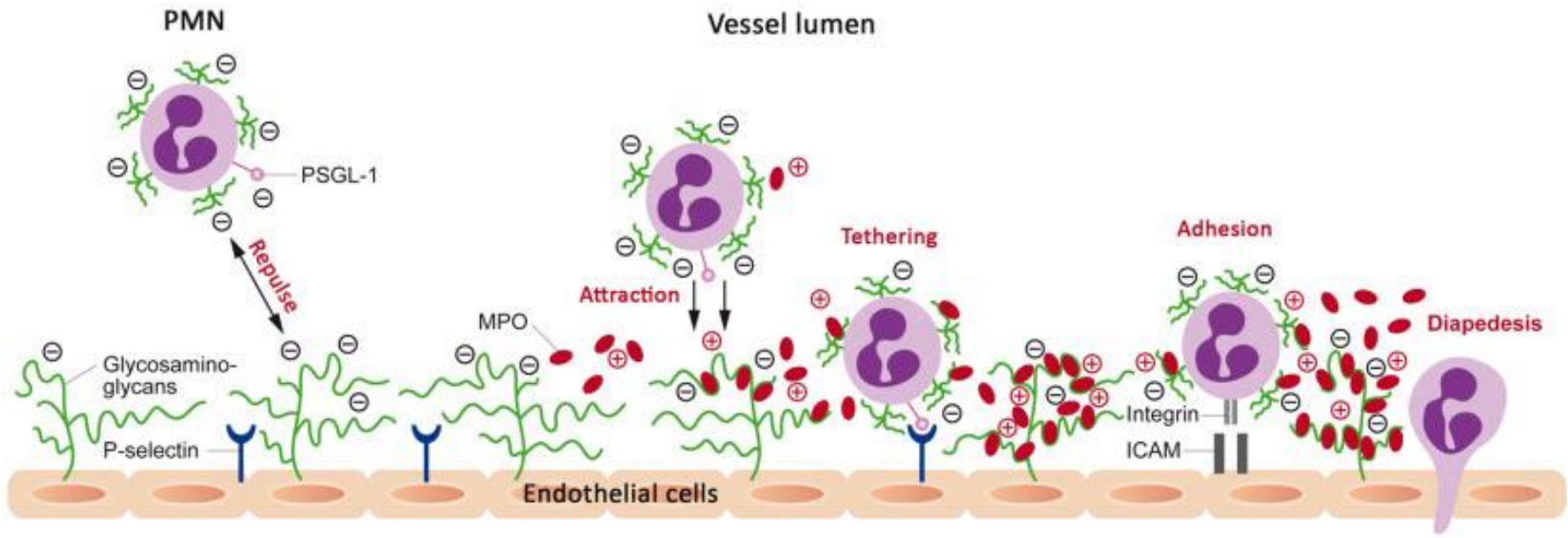
Scientists:
Mgr. Gabriela Ambrožová, Ph.D.
RNDr. Lenka Šindlerová, Ph.D.
Mgr. Ondřej Vašíček, Ph.D.
Mgr. Jan Víteček, Ph.D.
Mgr. Kristýna Turková, Ph.D.

Ph.D. students
pregradual students

Lukáš Kubala

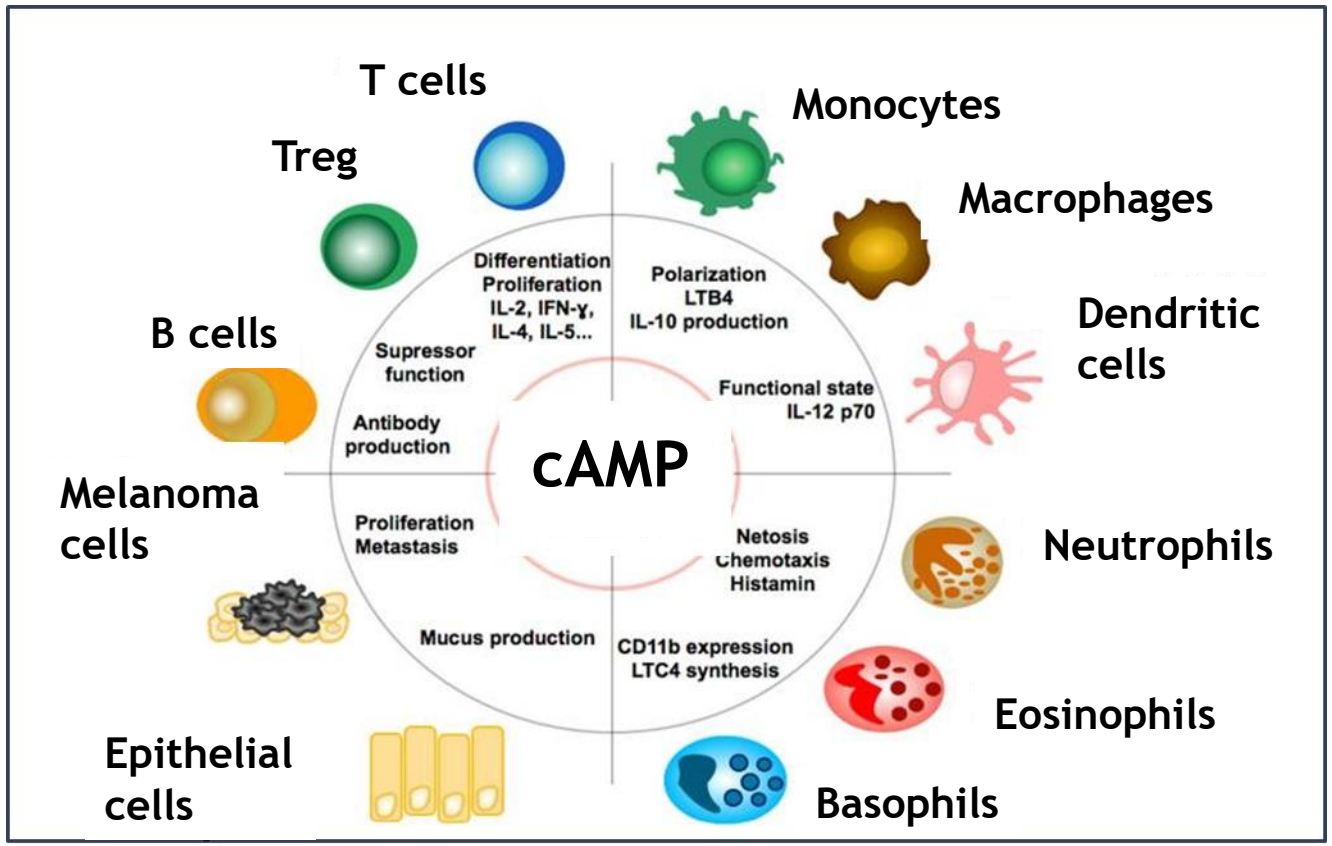
1. Role of myeloperoxidase (MPO) in the development of inflammatory and cardiovascular diseases

MPO damages protective layer on the surface of endothelial cells (glycocalyx)
MPO changes viscosity, charge and other properties of glycocalyx components
MPO activates hypertrophy and proliferation of smooth muscle cells => vessel hypertrophy
MPO damages function of cardiac muscle cells (cardiomyocytes)



Lukáš Kubala

2. Significance and function of cAMP in immune cells



- Regulation of specific and nonspecific immunity → immunosuppressor
- dominant isoforms in immune cells → **AC7, AC9**
- Pharmacological potentiall: autoimmune diseases, chronic inflammation, allergies, tumour diseases

Lukáš Kubala

3. Hyaluronan biology - role of hyaluronan and its receptors in inflammatory processes

Hyaluronan – key component of extracellular matrix in tissues

Active component
of face creams

Stimulates skin regeneration
and wound healing

Hyaluronan
Native (high molecular)

degradation
inflammation

Hyaluronan
low molecular, oligosacharides

Role of low molecular hyaluronan in inflammation regulation, wound healing, skin regeneration

Product use in clinics and cosmetics

Active cooperation with biotechnology industry:

Contipro, a.s.
Dolní Dobrouč 401
561 02 Dolní Dobrouč

International cooperation:

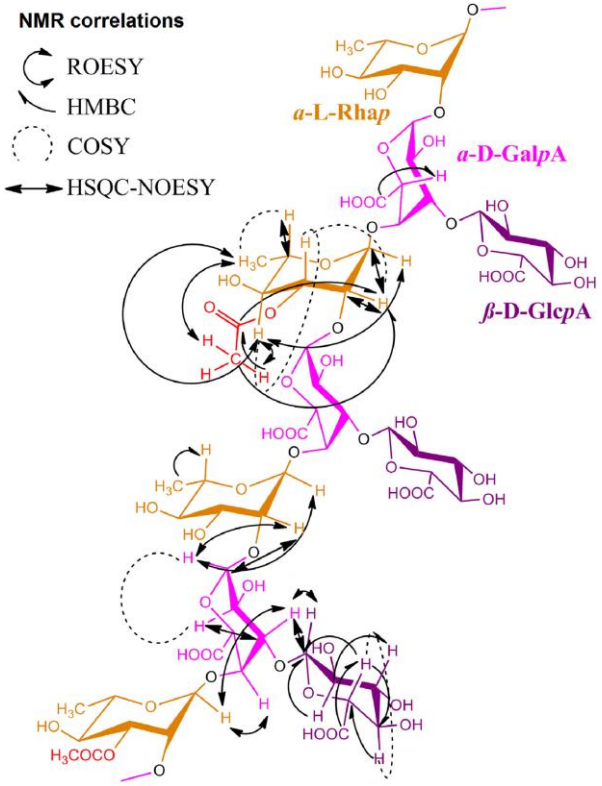
Department of Cardiovascular Physiology
Georg-August University Göttingen, Germany
Role of hypoxia in regulation of cardiomycytes physiology

Department of Internal Medicine – Heart centrum
University Hospital of Cologne, Germany
Role of myeloperoxidase in development of cardiovascular diseases

Ondřej Vašíček - Pharmacological regulation of immune response

1. Study of immunomodulatory effects and biochemical mechanisms of immunomodulation by heteropolysacharides

- *Haberlea rhodopensis*
- *Geranium sanguineum*
- *Macrolepiota procera*



Acetylated Glucurono-Rhamnogalacturonan I (PSIII)

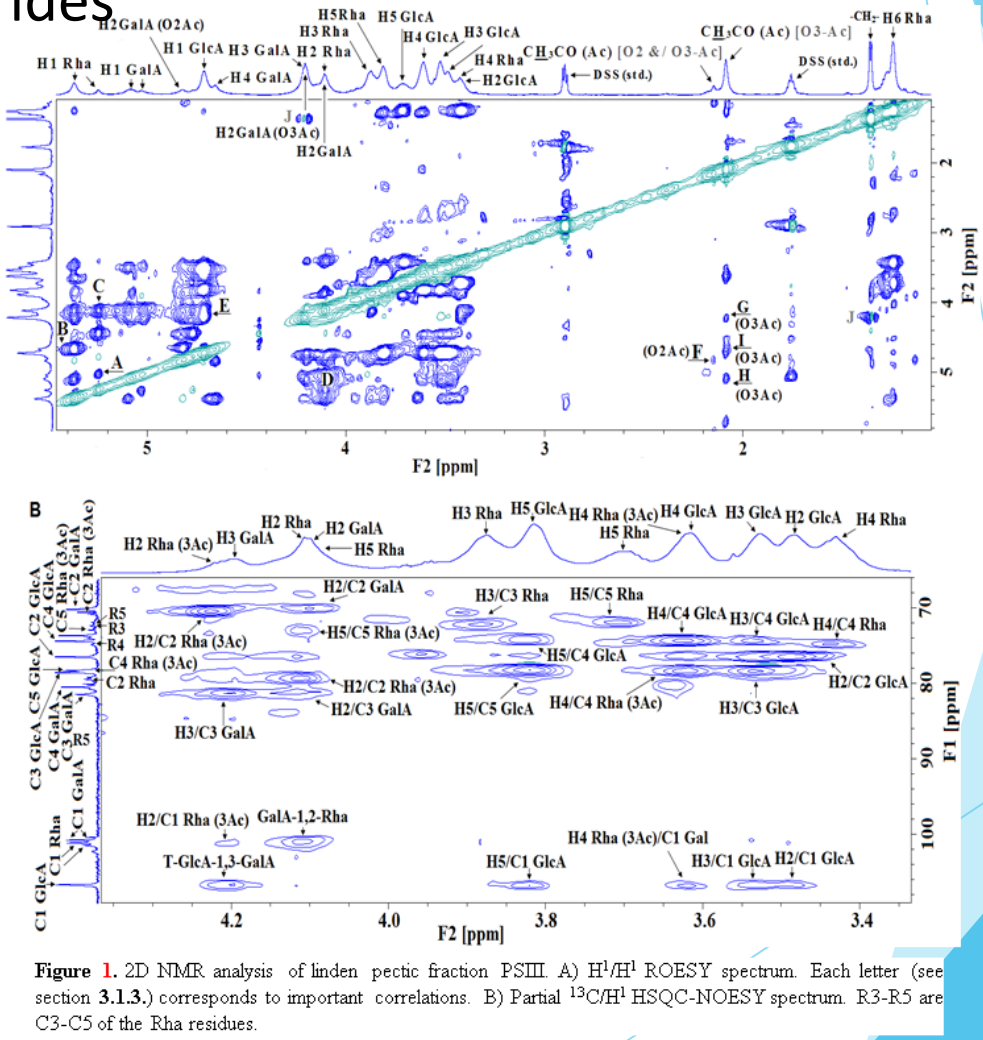
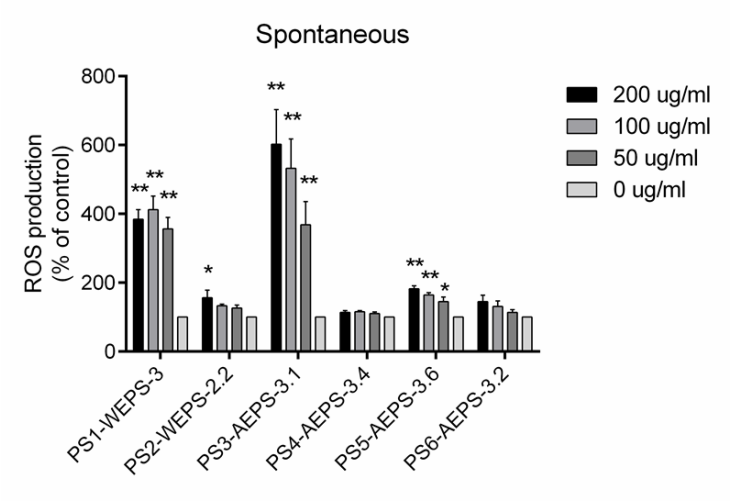


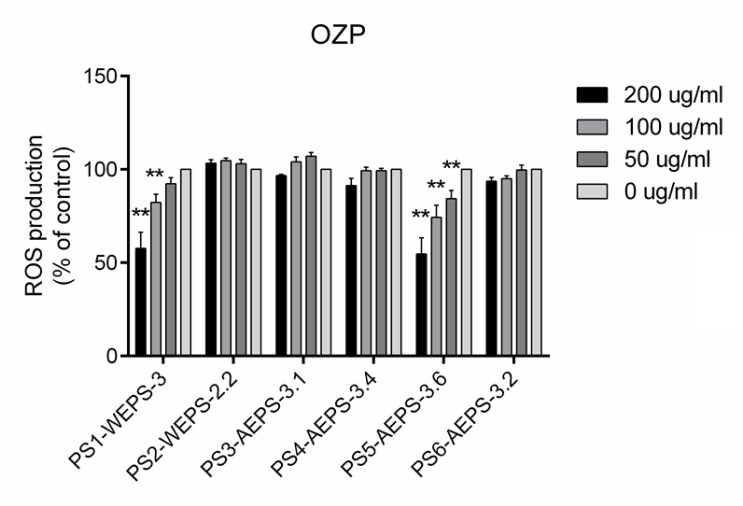
Figure 1. 2D NMR analysis of linden pectic fraction PSIII. A) H^1/H^1 ROESY spectrum. Each letter (see section **3.1.3.**) corresponds to important correlations. B) Partial $^{13}C/H^1$ HSQC-NOESY spectrum. R3-R5 are C3-C5 of the Rha residues.

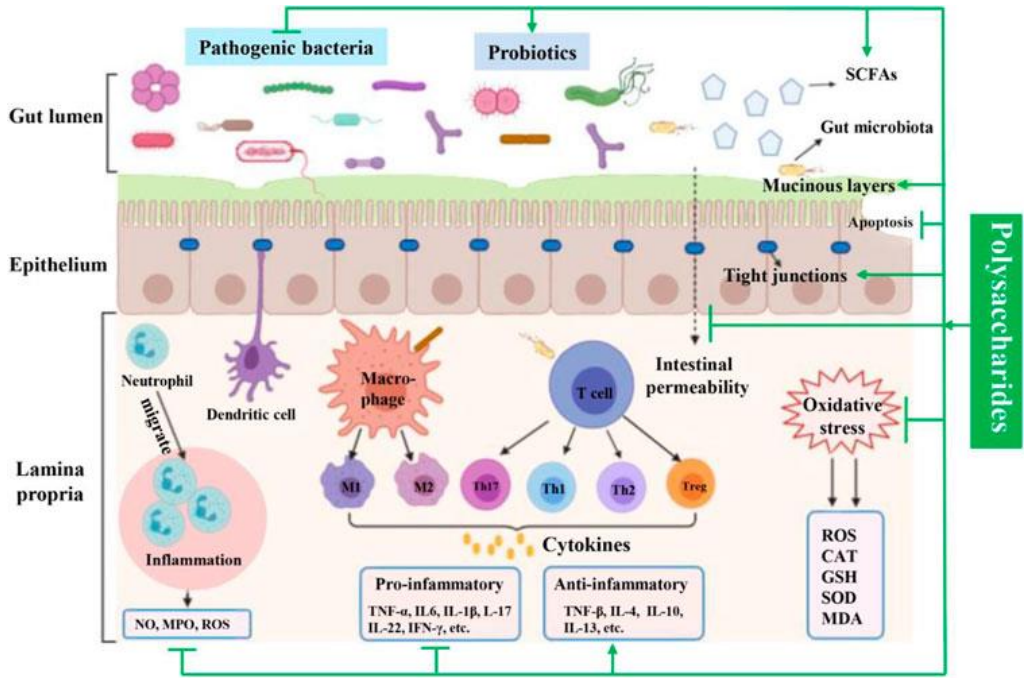
Cooperation: Chief Assist. Prof. Eng. Yordan Georgiev, PhD

Ondřej Vašíček - Pharmacological regulation of immune response

1. Study of immunomodulatory effects and biochemical mechanisms of immunomodulation by heteropolysacharides







Lenka Šindlerová

1. Proinflammatory effects of LPS from cyanobacterial water bloom

Cooperation with RNDr. Pavel Babica, Ph.D. from RECETOX MUNI

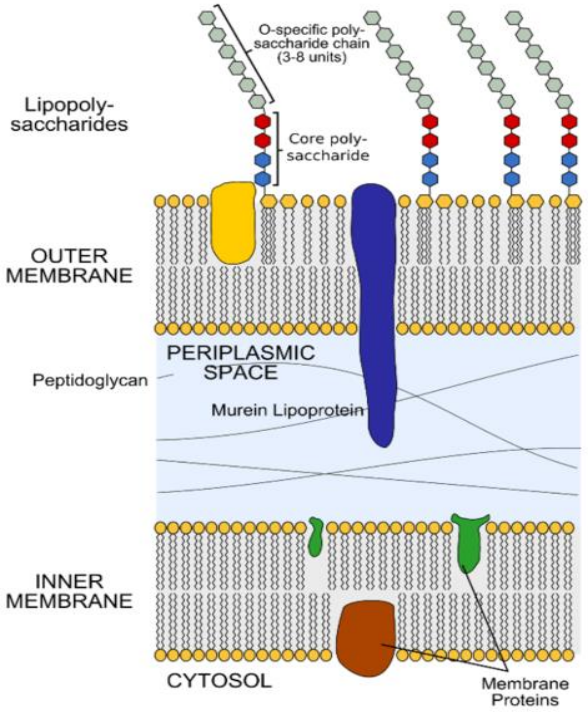
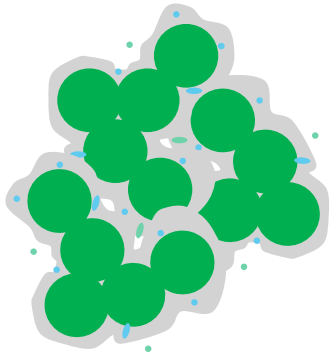


Figure 1: Gram-negative cell wall. The LPS is integrated into the outer membrane: Lipid A anchors it to the membrane, the outer (O) antigen (O-specific polysaccharide chain) is exposed to the exterior.

https://natoxaq.ku.dk/toxin-of-the-week/endotoxins/

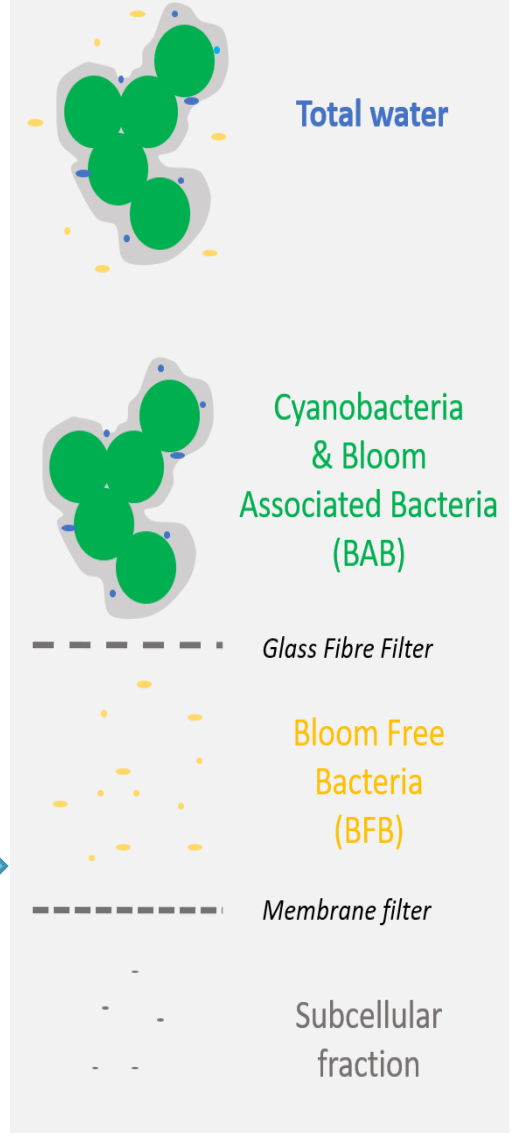
Sample processing

Net plankton



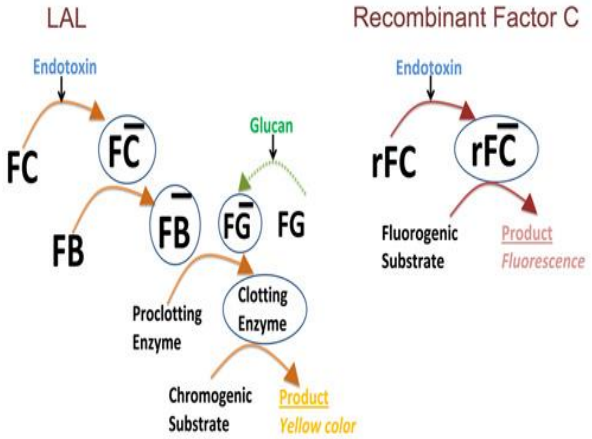
Lyophilization

LPS isolation



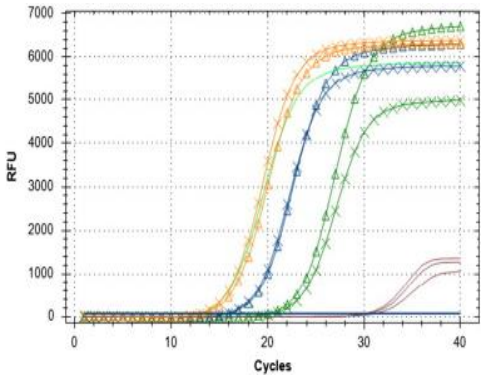
Heterotrophic Plate Counts (R2A, YEA)
DIN EN ISO 6222

Pyrogene rFC

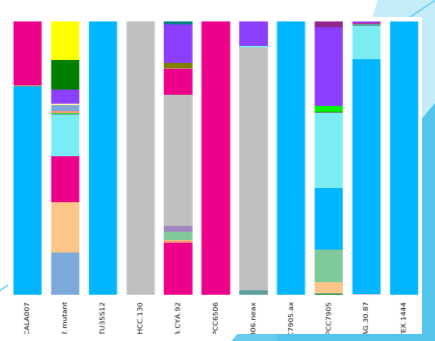


Cyanotoxin analysis (LC-MS/MS)

qPCR for total, G- bacteria, cyanobacteria

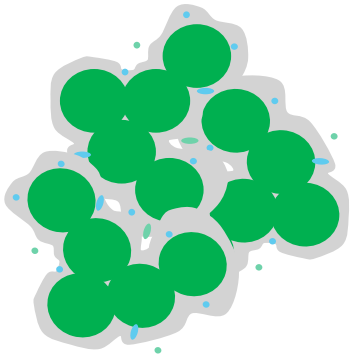


16S rDNA NGS



Sample processing

Net plankton



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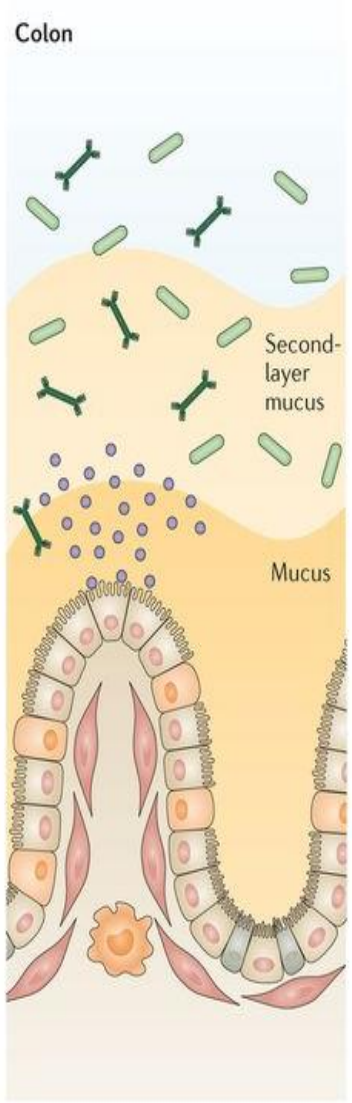
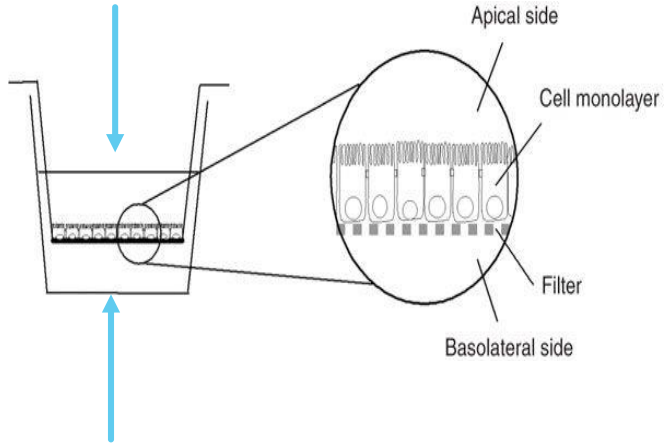


Peterson & Artis 2014
Nature Reviews Immunology 14; 141-153

Differentiated Caco-2 cells



Monocytes from human peripheral blood

- Monocytes differentiation
- Pro-inflammatory cytokines in both compartments
- Changes in permeability of the monolayer
- Changes in TJ proteins expression

Jan Víteček

1. Cell functions (phagocytes and endothelial cells) in microfluidic conditions

- Long-term cell cultivation in flow conditions
- Development of microfluidic system

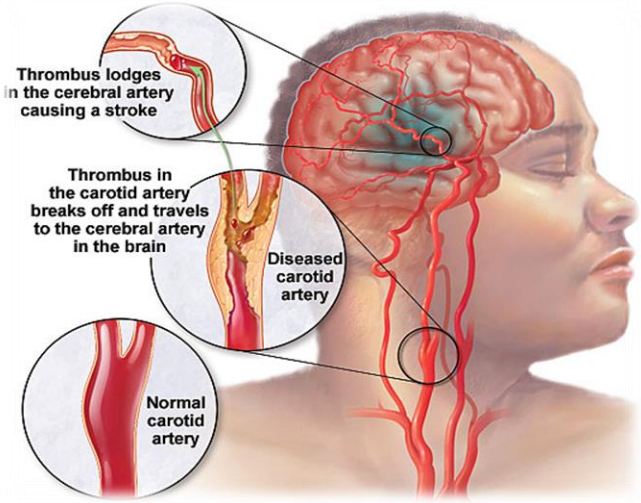
Jan Víteček

2. Thrombolysis mechanisms

STROKEBRNO

www.strokebrno.com

- Study of thrombolysis using *in vitro* models
- Static and flow models
- Testing of new thrombolytics
- Cooperation with St. Anne´s University Hospital Brno



Ischemic stroke

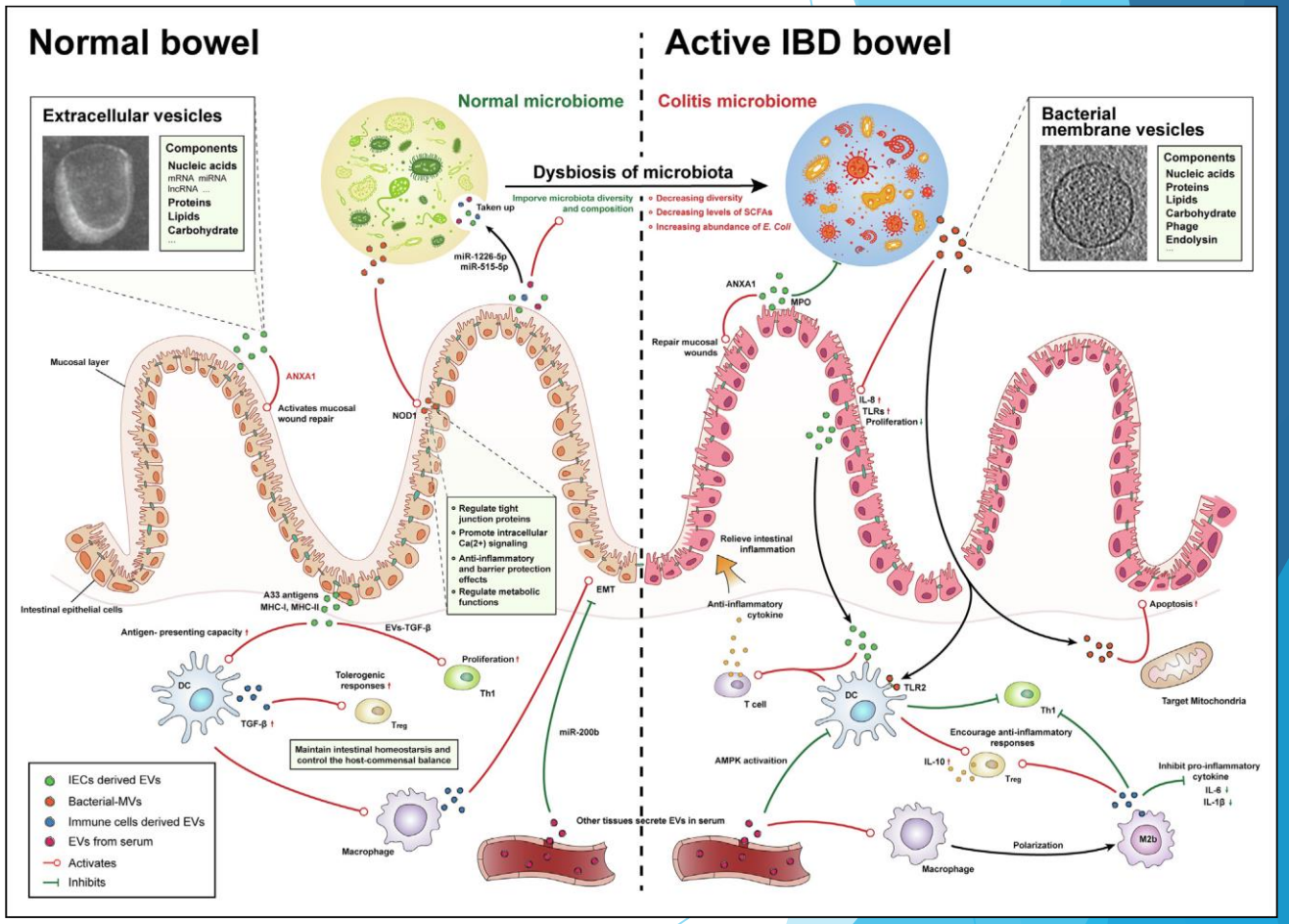
Vessel model (middle cerebral artery)

Gabriela Ambrožová

Bacteria-derived extracellular vesicles in intestinal inflammation

- **Inflammatory Bowel Disease**
  - uncontrolled activation of intestinal immune cells in a genetically susceptible host
  - very complex disorder
  - biological mechanisms still unknown

- **EVs - mediators of intercellular communication**
  - produced by both eukaryotic cells and bacteria
  - role of bacteria-derived EVs in IBD remains unknown



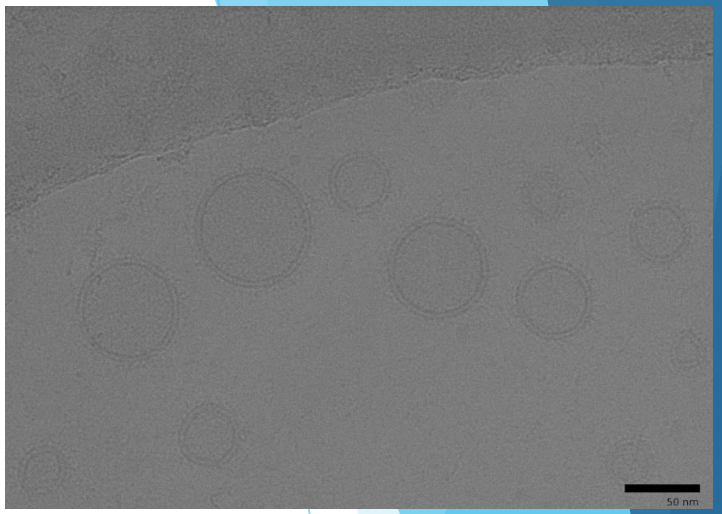
Shen, 2021

Gabriela Ambrožová

Bacterial extracellular vesicles in intestinal inflammation

1. Isolation, purification and characterization of bEVs
2. Effects of bEVs on intestinal epithelium
3. Effects of bEVs on immune cells response
4. Revealing of the mechanism responsible for the effects bEVs in intestinal inflammation

Anaerobic chamber



cryo-EM (Dr. Nováček, CF CEITEC)

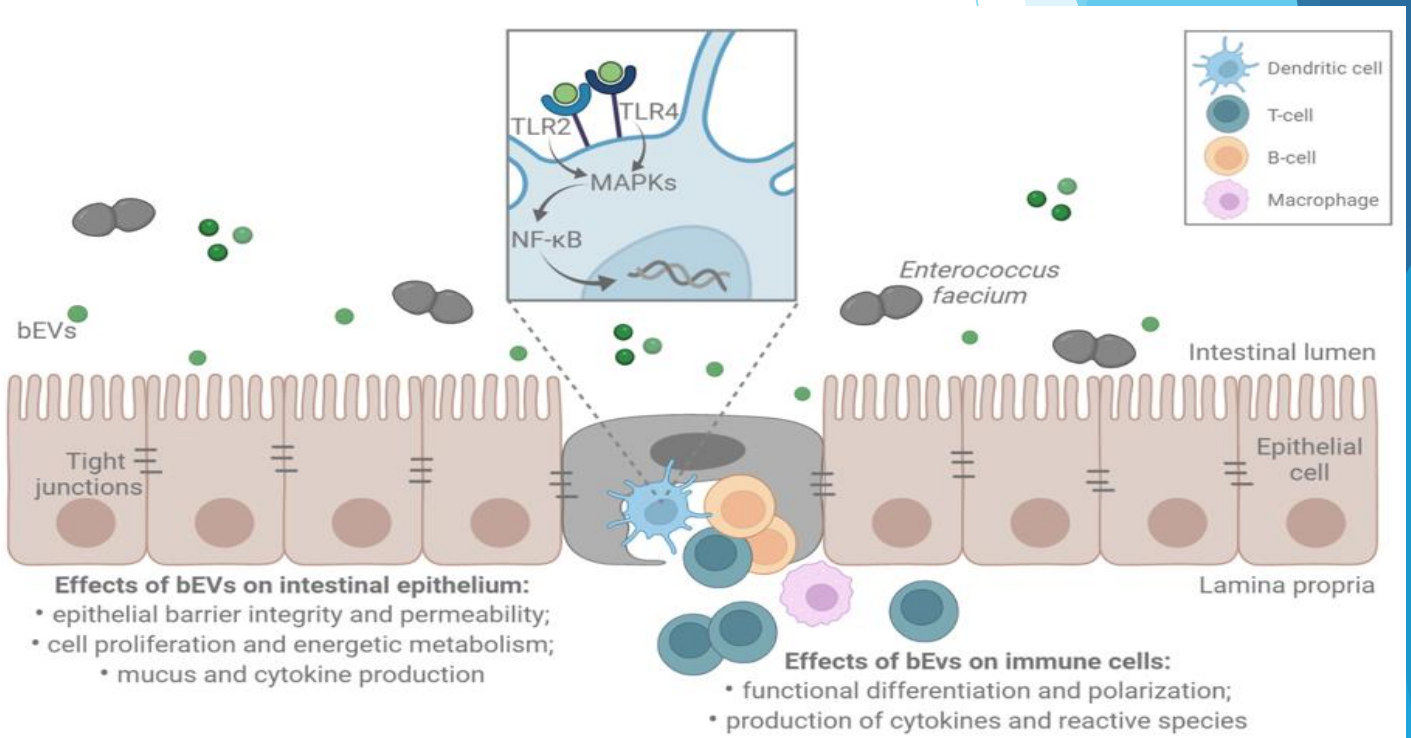


Figure 1: The presumed pathways by which Enterococcus-derived EVs can affect intestinal inflammation (made in BioRender)


CHATA SOKOLA HUSOVICE
VÝJEZDNÍ SEMINÁŘ
DBIS
2021
HEROLTICE

Contacts:

Oddělení Biofyziky imunitního systému
Biofyzikální ústav Akademie věd ČR
Královopolská 135, Brno

Dr. Gabriela Ambrožová ambrozova@ibp.cz
doc. Dr. Lukáš Kubala kubalal@ibp.cz
Dr. Lenka Šindlerová sindler@ibp.cz
Dr. Ondřej Vašíček ondrej.vasicek@ibp.cz
Dr. Jan Víteček jan.vitecek@ibp.cz

https://www.ibp.cz/cs/vyzkum/oddeleni/biofyzika-imunitnich-systemu/informace-o-oddeleni

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