Széchenyi Plan Plus Let's build Hungary together!

GOVERNMENT OF HUNGARY

Co-funded by the European Union

HUNGARIAN NATIONAL LABORATORY

Agribiotechnology and precision breeding for food security NL

RRF-2.3.1-21-2022-00007

Ervin Balázs, MHAS, leader of NL project

AGRI-BIOTECH

Project sections

MICROBIOLOGY
Ferenc Olasz
head of section

ANIMAL BIOTECHNOLOGY
Elen Gócza
head of section

PLANT BIOTECHNOLOGY
Zsófia Bánfalvy
head of section

FOOD SAFETY
András Szabó
head of section

HUN REN | ATK AGRÁRTUDOMÁNYI KUTATÓKÖZPONT

MATE MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM

SZBK

ISOLATION OF MICROORGANISMS WITH PROBIOTIC PROPERTIES, IDENTIFICATION, MICROBIOLOGICAL AND MOLECULAR BIOLOGICAL CHARACTERISATION AND THEIR UTILISATION

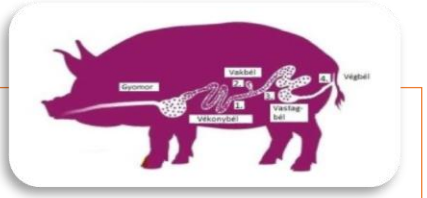
- **Concept**
  - The microbiota of wild boars in natural populations could be a potential source for the development of probiotics for pigs
  - domestic pigs and wild boars being taxonomically the same species
  - bacteria with physiologically beneficial effects lost during the domestication of pigs but may be present in wild boars

Cooperation MATE Institute of Phytology and Nutrition: Submission of a joint patent

Sampling

wild boar

4 intestinal tract

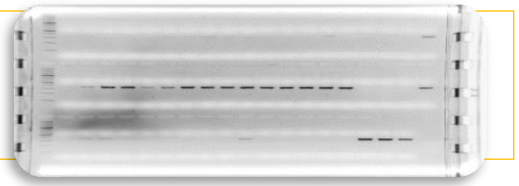


Isolation

Establishing a collection of strains using selective media

Identification

Using genus-specific primer pairs and 16S rDNA sequence determination



Characterisation

Probiotic and non-applicability testing using molecular and microbiological tests, bioinformatic analysis of sequencing data

Utilisation

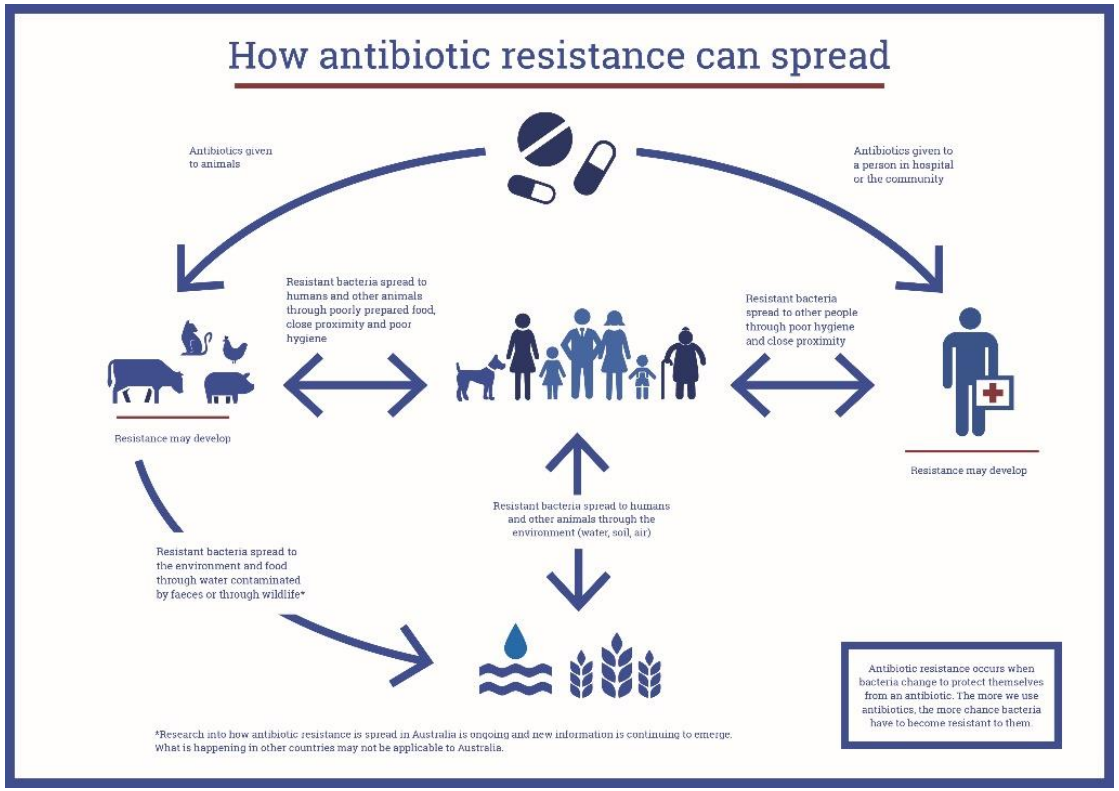
Animal experiments, use as probiotics

CHALLENGING ANTIBIOTIC RESISTANCE SPREAD (AR)

- **Objective 1: Spread of AR resistance according to the one health EU guidelines**
  - Molecular characterisation of bacterial strains with acquired antibiotic resistance.
  - Presence and dynamics of antibiotic resistant bacteria in environmental samples
  - Estimation of the association between antibiotic resistance genes and mobile genetic elements
  - Investigation of the association between the multi-resistance salmonella genomic island 1 (sgi1) and the incc conjugative plasmids responsible for horizontal transfer
- **Objective 2: Replacing antibiotics**
  - Bacteria can produce bioactive substances that are not considered antibiotics
  - Previous studies have resulted in a collection of strains of microorganisms that produce bioactive substances that are not antibiotics
  - Microbiological, molecular biological methods are used to characterise these strains
  - Potential use of components of the strains to replace antibiotics.

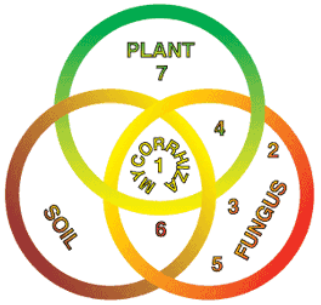
CHALLENGING ANTIBIOTIC RESISTANCE SPREAD (AR)

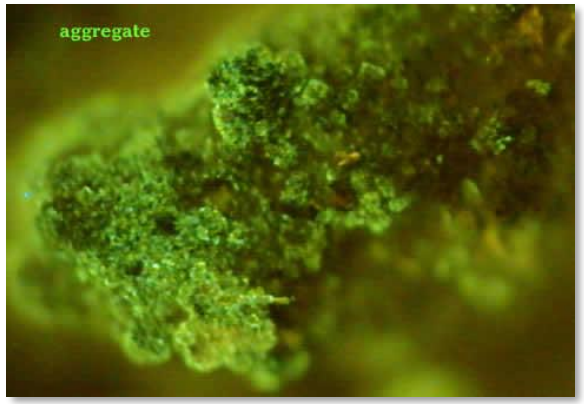
- **The Microbiology Section intends to meet the challenges on the following topics:**
  - Antibiotic resistance research - emergence of new pathogens
  - Probiotic bacteria - emergence of new pathogens, stress factors
  - Mycorrhizal symbiosis - climate change, stress factors

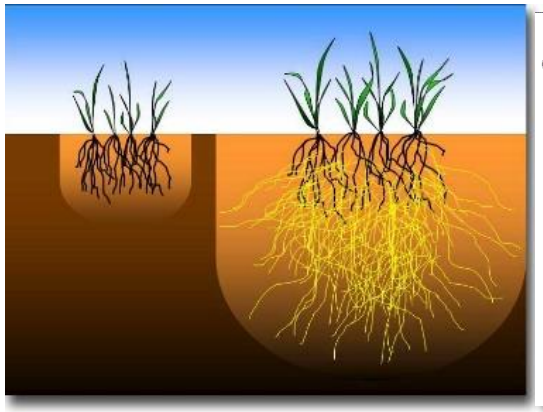


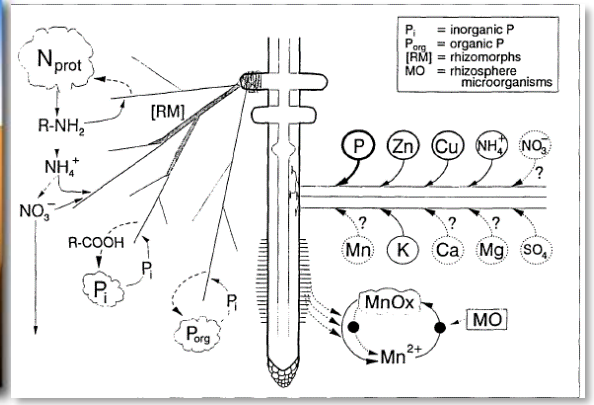
ARBUSCULAR MYCORRHIZAL (AM) FUNGI AS AN USEFUL BIOTECHNOLOGICAL TOOL FOR INCREASING PLANT DEFENCE MECHANISMS TO ALLEVIATE DIFFERENT STRESSES

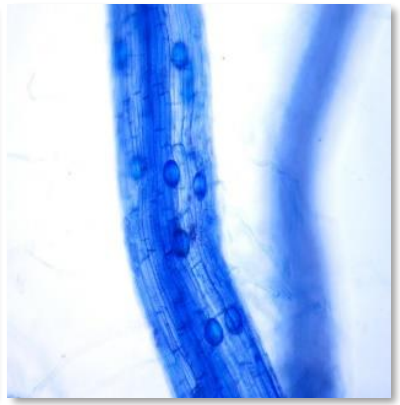
The beneficial effects of AM are well known, including enhanced **uptake of water and nutrient** - mostly phosphorus -, moreover increased **resistance to different environmental stresses**









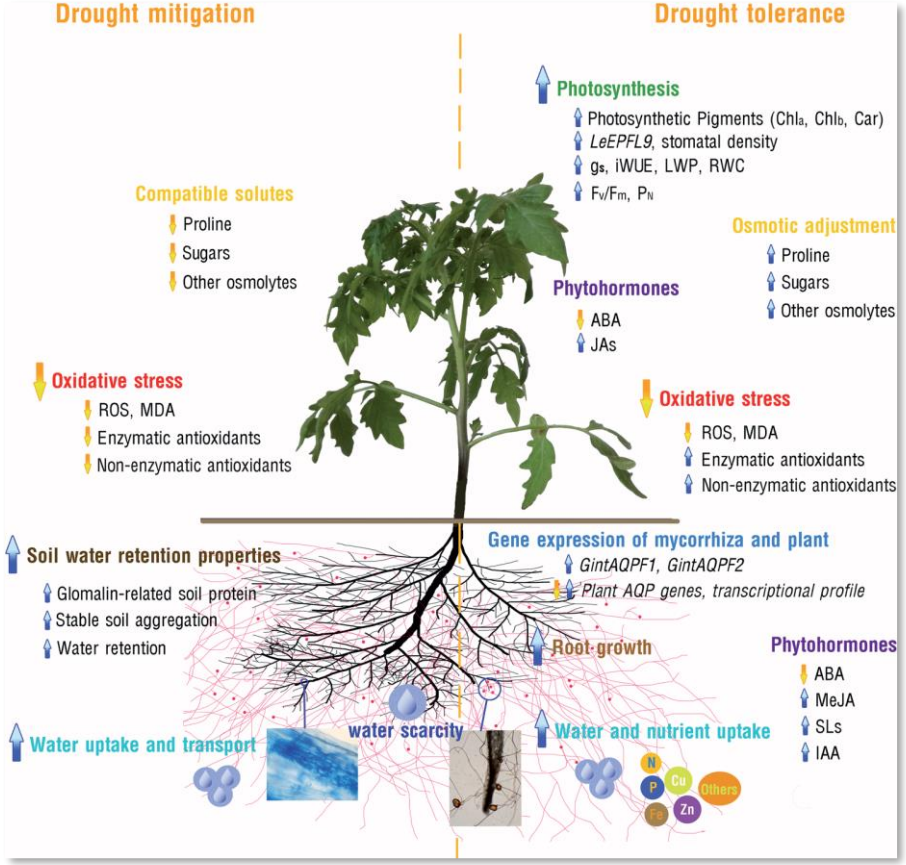


Focusing on:

- heat (heat stress, heat shock) and drough stresses
- alone or combined stresses

ARBUSCULAR MYCORRHIZAL (AM) FUNGI AS AN USEFUL BIOTECHNOLOGICAL TOOL FOR INCREASING PLANT DEFENCE MECHANISMS TO ALLEVIATE DIFFERENT STRESSES

Mechanisms of AMF mitigate drought stress in host plants

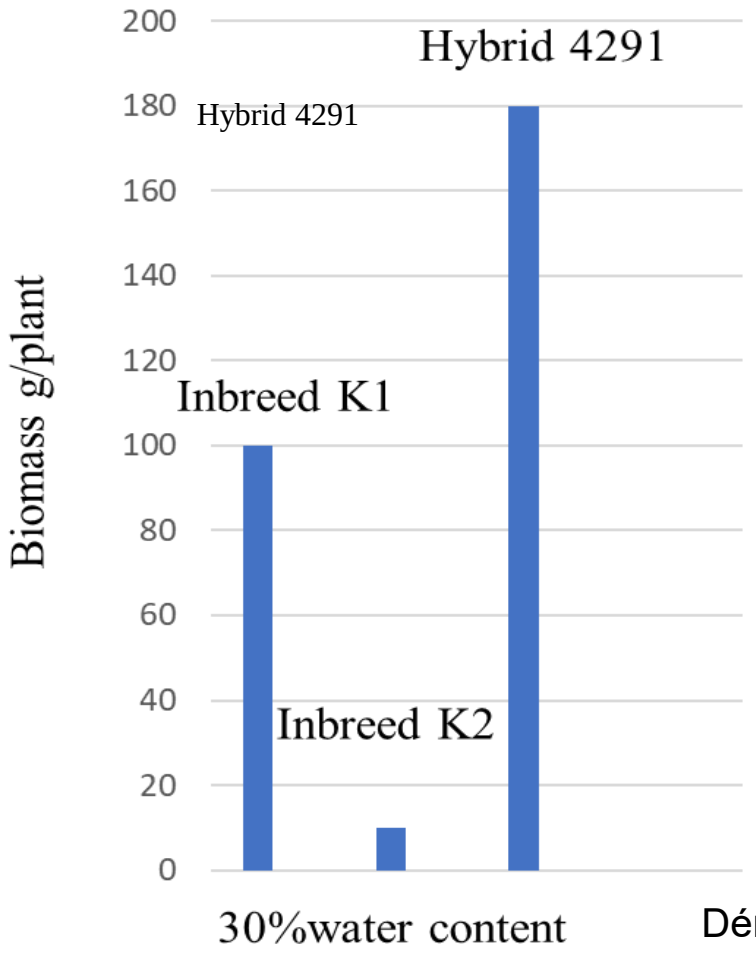


Cooperation within this and other NL projects

- Study the positive effect of the relationship between stress and mycorrhiza on the fruit qualities of tomato / maize (Martonvásár)
- Exploring the mycorrhizal sensitivity of drought-tolerant hybrid and parental maize lines (Szeged)
- Challenges of the fungal symbiont
- Application are highlighted for
- Practical use in crop production

IDENTIFICATION AND TARGETED EDITING OF MAIZE GENE INVOLVED IN DROUGHT RESPONSE

1. RNA-Sequencing data to search for genes involved in drought tolerance



Distribution of the differentially expressed genes unique in the drought-tolerant (K1) and drought-sensitive genotype (K2) role of hybrid vigor

Dénes Dudits, MHAS
project leader

HUNGARIAN NATIONAL LABORATORY

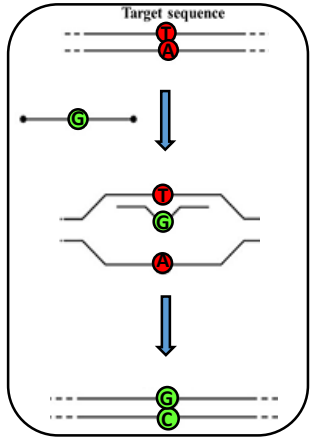
AGRI-BIOTECH

PLANT BIOTECHNOLOGY

IDENTIFICATION AND TARGETED EDITING OF MAIZE GENE INVOLVED IN DROUGHT RESPONSE

2. Synthetic gene specific oligonucleotide used for targeted mutagenesis

2.1. TARGETED MUTATION

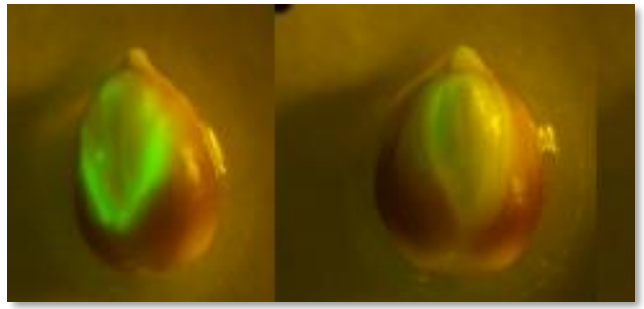


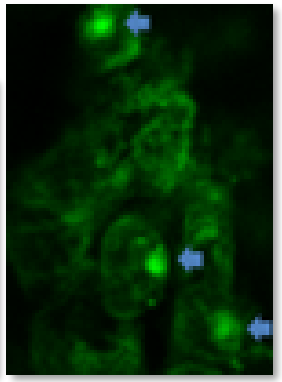
2.3. DROUGHT RESISTANCE AND YIELD INCREASE BY KNOCKING OUT THE *ABNORMAL CYTOKININ RESPONSE REPRESSOR 1 GENE (ARE1):*

ZmARE1 wild: CCG CTG CGC TTC **CCC** ATA **GAG** GGA AGC AGG ACC…
Pro **Glu**

ZmARE1 mutant: CCG CTG CGC TTC **CCT** ATA **TAG** GGA AGC AGG ACC…
Pro **STOP**

2.2. OLIGONUCLEOTIDE CAN BE TAKEN UP BY MATURE MAIZE EMBRYOS





Nuclear accumulation

HUNGARIAN NATIONAL LABORATORY

2.4 DNA SEQUENCING IN M1 GENERATION

Collaboration with
Kiskun Kutatóközpont Kft.
(maize breeding company)

AGRI-BIOTECH

PLANT BIOTECHNOLOGY

GENERATION OF POTATO LINES RESISTANT FOR *RALSTONIA SOLANACEARUM* INFECTION

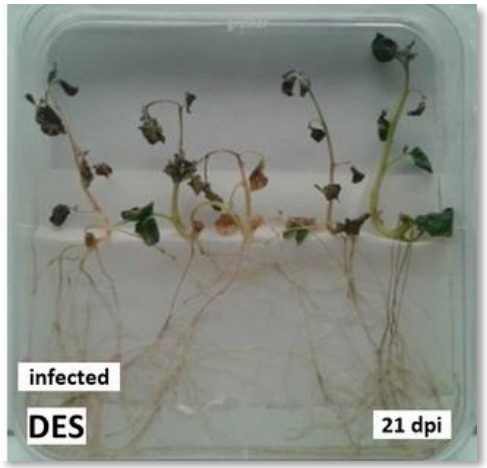
- The global economic losses due Rs is ~1 billion USD per year
- In Europe, Rs has been a quarantine pest since the early 1990s
- Chemical control of Rs is ineffective
- The use of resistant crops is a cost-effective and environmentally friendly form of control

Susceptibility genes (S-genes) are utilized by *Rs* during infection

↕

Knockout of S-genes induces resistance in plants

Rs sensitive



Research strategy:

- Identification of putative S-genes in potato

  PPO, DND1, miR396, WRKY27, WAT1, MEKK1, MAP9, etc.
- Targeted knockout of S-genes in potato cultivars: Désirée, Balatoni Rózsa, Botond

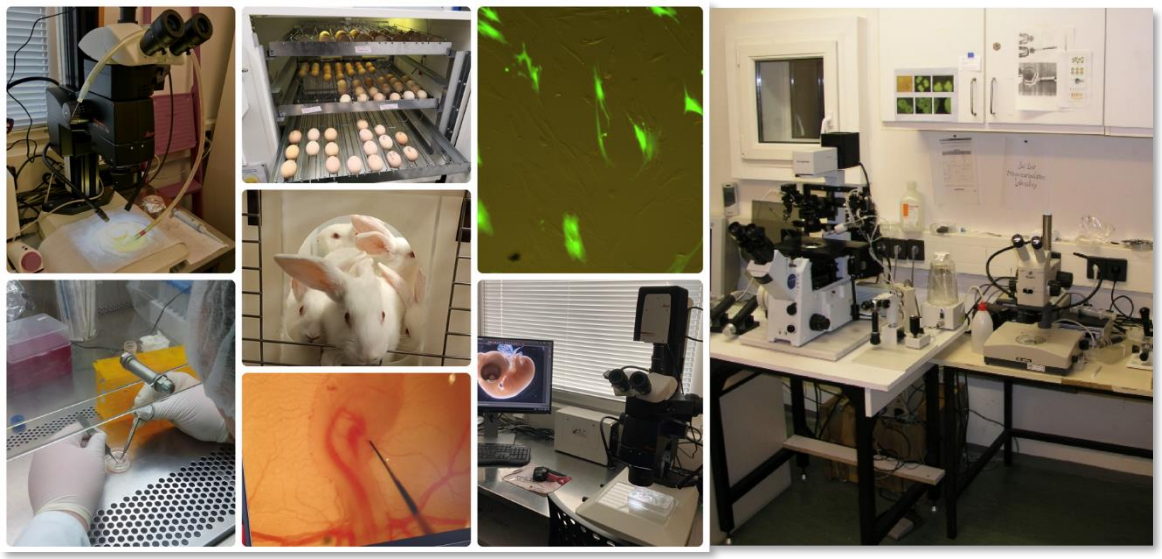
Rs resistant

Animal biotechnology section

Head of the Animal Biotechnology Section:
Elen Gócza, corresponding member of HAS

Mammal working group leader: Orsolya Ivett Hoffmann, PhD

Poultry workgroup leader: Bence Lázár, PhD

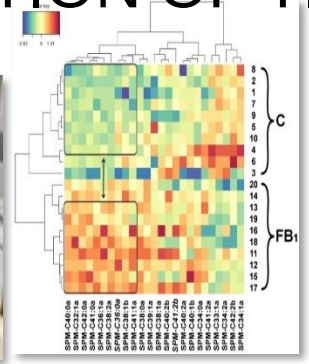


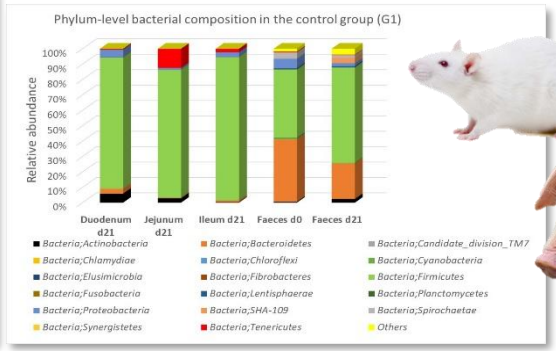
- Development of precision breeding technologies to create model animals and cell cultures supporting agricultural and biomedical research in mammals and birds.
- Development of an *in vitro* test system for monitoring the effects of mycotoxins.
- Creation of an e-database to register cell cultures, RNA, and DNA samples stored in our mammalian and avian gene banks.
- Establishment of an experimental embryology teaching laboratory to support practical education for MSc and PhD students.
- Production of e-textbooks and videos for practical education purposes

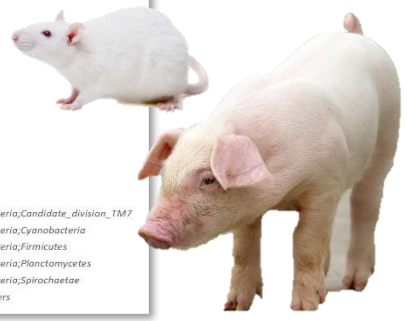
COMPLEX ANALYSIS OF THE MECHANISM OF ACTION OF MYCOTOXINS: INTERACTION WITH THE INTESTINAL MICROBIOTA AND MODIFICATION OF THE COMPOSITION OF TISSUE LIPIDS











- **Effect of fumonisin B1 (FB1) on the microbiota / microbiome**
  - Detailed exploration and analysis of the interaction between fumonisins and gut microbiota in pigs.
  - Effect of the toxin on gut integrity.
  - Isolation of potential probiotic and at the same time mycotoxin binding / metabolizing bacteria, for their practical application (in collaboration with GBI).
  - Investigation other intervention strategies for preventing patho-mechanisms that drive FB_1 toxic manifestations.

- **The effects of fumonisin B mycotoxins on the renal and hepatic lipidomic profile**
  - Detailed exploration of the tissue lipidomic profile in rats and piglets (in collaboration with BRC).
  - Evaluation of the mycotoxin exposure time- and dose dependence on the lipidomic profile perturbation.
  - Seeking for possible new lipidous biomarkers indicative of fumonisin toxicosis.
  - Microarray-aided gene expression-based evaluation of the metabolic pathways affected.

Melinda Kovács, MHAS
project leader
FOOD SAFETY

HUNGARIAN NATIONAL LABORATORY

AGRI-BIOTECH