# Molecular mechanisms of gut-liver axis in chicken.

The gastrointestinal tract and the liver are anatomically linked with each other. There is also a functional relation between these two important organs. However the knowledge on the mechanisms regulating communication between gut and the liver are unknown.

The gastrointestinal tract is inhabited by a community of microorganisms called microbiota. This community of microorganisms consists of commensal, symbiotic and pathogenic microorganisms. Colonization of the gastrointestinal tract with microbiota is a key factor in the development and regulation of host organism immunity, digestion, absorption of nutrients and their metabolism. The beneficial intestinal microbiota helps not only in the digestion of food compounds but it also reduces the potential of pathogen colonization in the guts. The knowledge on the function and impact of the microbiota on host organisms is already quite large and is still growing. We know already that the impact of the microbiota is not restricted to the gastrointestinal tract itself but it stretches to other organs e.g. tissues related with immune system, or brain. However the knowledge on the interaction between gut microbiota and the liver is still very limited. The intestinal microbiota does not influence the host's metabolism directly, but acts via metabolites and other signaling molecules. The metabolites reach liver by the portal vein and are included in hepatic metabolism.

Our team performed several projects aiming at understanding the interaction between gut microbiota and broiler chicken host organism. We have analyzed an impact of an early (*in ovo*) stimulation of chicken microbiota with various bioactive compounds (prebiotics (indigestible oligosaccharides), probiotics (bacteria), and synbiotics (composition of both prebiotic and probiotic)). The idea of this methodology is to modify the composition of the gut microbiota before the hatch. Thanks to this, the young chicks is better prepared for the burdens of the environment outside of the eggshell. The beneficial impact of this stimulation was detected in several chicken lines and many traits: morphology and histology of the intestinal, muscular and immune tissue, physiological and molecular modulation.

In this project we would like to **explain the mechanisms which regulate the communication between chicken gut and the liver**.

Therefore we will use already established and functioning *in ovo* model to stimulate the gut microbiota in chicken during embryonic development. The microbiota stimulation will be done with compounds called prebiotics. Prebiotics can selectively modulate the entire microbial ecosystem in the gut, which results in creating a new metabolic environment. Early stimulation of the gut microbiota via *in ovo* delivered prebiotic assures that the modulation of the gut microbiota is stable in long-term, so that it reprograms metabolic responses of the chicken organism. Thus, the rationale of such experimental approach is to obtain sufficient biological contrasts (i.e., *in ovo* stimulated vs. control groups) that are necessary to answer the research question. The research goal will be verified in two tasks.

**TASK 1 aims at the analysis of the impact of various prebiotics on gut microbiota and selection of the two most potent bioactive compounds.**

**TASK2 will focus on: molecular mechanisms of communication between gut and liver mediated by microbiota and their metabolites; and on the effects of the gut – microbiota – liver interaction on host organism.**

**Results of this project will help to understand the modulatory effects of prebiotics delivered *in ovo* on the metabolic status of the host organism and the interactions between gut - microbiota, and the liver.** As such, we aim to describe the molecular mechanisms of the gut-liver axis in the chicken. We will also pinpoint prebiotics with the largest potency to trigger metabolic pathways. **All data collected in the project can be further developed into solutions for poultry industry.**