

UMR 1313 - GABI

GeMS

Team leader

Fany Blanc

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Global theme

The GéMS team studies the interactions between genetic variations in the host, gut microbiota and immunity, and their effects on the health and robustness of pigs and chickens. To achieve this, it combines 'omics' approaches with precision and/or high-throughput immunophenotyping of animals, in vivo and in vitro.



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PARIS-SACLAY

Attached to the **Université Paris-Saclay**

Attached to the **ABIES doctoral school** (Agriculture, Biology, Environment, Health) et **SDSV** (Structure and dynamic of living systems)



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France
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Member of Institut Carnot
France Futur Elevage

Génétique animale et biologie intégrative (GABI) Genetics, Microbiota, Health Team

Scientific questions

1- Research and characterisation of individual variability in health-related phenotypes

We seek to characterise individual variability and identify signatures of responses to health challenges such as vaccinations, infections (Salmonella, Eimeria, etc.), weaning, and melanoma. Our target species are pigs and chickens, and through collaborations, we also study other farm animal species. We are working to gain a detailed understanding of the immune mechanisms involved in responses to these different challenges through transcriptomic studies of target tissues at the single-cell or spatial level. We are also evaluating the predictive potential of immune parameters measured before challenges in order to determine indicators of animal immunocompetence. Finally, we seek to highlight the trade-offs between health and production performance, as well as between health and animal behaviour/welfare.

2- Effects of host genetics, their microbiota and interactions with the environment on the health of farm animals

The objective is to characterise the determinism and causality of health phenotype variability, taking into account the interactions between host genetic factors and their microbiota in diverse and changing environments. We combine genomic and metagenomic methods to study immunity, robustness and pathogen resistance traits, as well as the biomarkers identified in 1. We work under various experimental and field conditions (e.g. conventional vs. organic production). On the host side, we assess the impact of genetics on health phenotypes by conducting genome-wide heritability and association studies with the aim of identifying candidate causal mutations. On the microbiota side, the effects of the metagenome are studied through microbiability, differential abundance and metagenome-wide association studies to estimate the main relationships between the microbiota and host phenotypes. We are also studying the determinism of host genetics on microbiota ecosystems, using genetic correlation approaches (phenotypes vs. microbiota) and association analyses on microbiota descriptors. This combined approach is part of the concept of hologenomics, which we are exploring through studies on divergent lines selected for porcine intestinal enterotypes or health phenotypes. The possibilities for implementing hologenomic selection experiments are also taken into account in our studies, with collaborative theoretical approaches. Finally, we are working to improve knowledge of genomes and their variability (e.g., FAANG, PigGTEx, ChickenGTEx initiatives), using a generic approach but also targeting the immune response and MHC genes in pigs and chickens. We are also contributing to the improvement of reference catalogues of metagenomes for the microbiota studied by our team.



Centre

Île-de-France - Jouy en Josas - Anthony



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Facilities

- Experiments with the GenESI (Le Magneraud; pigs) and PEAT and PFIE (Nouzilly; chickens) EUs.

- Production of genomic data with INRAE @BRIDGe, Jouy-en-Josas and GeT-PlaGe, Toulouse, and metagenomic data with MetaGenoPolis.



3- In vitro Genotype-to-Phenotype (G2P) approaches for traits of interest to health

This theme is consistent with our participation in international genome annotation efforts and the development of organoid production and CRISPR/Cas9 genome editing strategies in pigs. The aim is to establish a causal link between genetic and epigenetic variability in the functional elements of the genome (coding and, above all, regulatory elements) and the phenotypes of interest that can be measured in in vitro systems, such as the organoids on which we are developing CRISPR/Cas9 techniques. This G2P approach is in line with the ethical principles of the 3Rs and complements animal experimentation. The development of in vitro CRISPR/Cas9 tools will also be very useful for testing candidate variants defined by the team's other research themes on the most suitable in vitro systems. The desired openings aim to increase the complexity of organoids, modulate them in space (Organ-on-Chip) and study them using imaging and single-cell transcriptomics, in order to increasingly enrich the range of measurable phenotypes.

4- Epidemiogenetic approaches and modelling of group-reared populations

We are developing an epidemiogenetic approach to assess the impact of individual health characteristics on group health. Indeed, an animal's susceptibility and infectivity to an infectious disease not only affects its own health but also influences the health of its peers through the process of contagion. We are initially developing a 'chicken-coccidiosis' model using an individual-centred epidemiological modelling approach. Next, animal experiments will be conducted to estimate the genetic parameters of traits related to the ability to transmit the disease. In the medium term, we will expand our research to other pathogens of interest in poultry and/or pig production. The research team's intensified efforts in infectious disease management are part of an agroecology-oriented approach and will inform discussions in a One Health context.

Expertise

Our team has developed expertise in the design of experimental devices, the phenotyping of immune parameters in large animal cohorts, and functional genomics and metagenomics.

Partner

The GéMS team collaborates with other teams from the GABI unit, INRAE research units from several departments (GA, PHASE, SA, MICA) and national and international academic partners.

It also has partnerships with industrial players (selection, animal feed, pharmaceutical industry).).

Publications

<https://gabi.jouy.hub.inrae.fr/les-equipes/gems/publications-de-l-equipe-gems>



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