



Presentation of French research on ruminants and pigs

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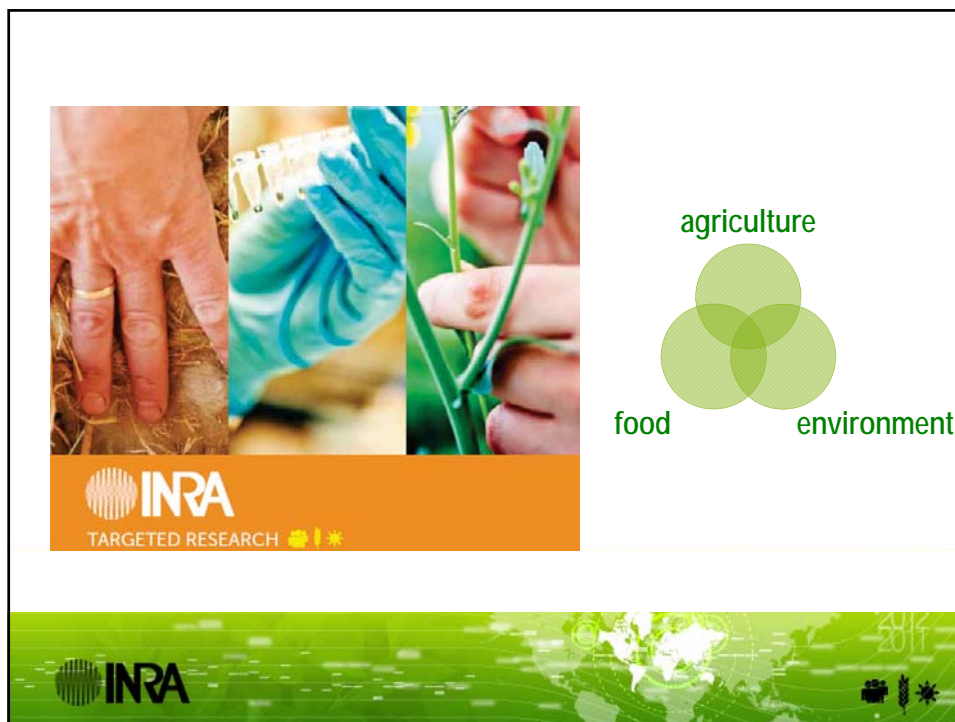


Plan of the presentation

- ❑ INRA, French National Institute for Agricultural Research

- ❑ UMR1348 PEGASE
Physiology, Environment and Genetics for the Animal and Livestock Systems
 - ✓ Experimental facilities
 - ✓ Research teams

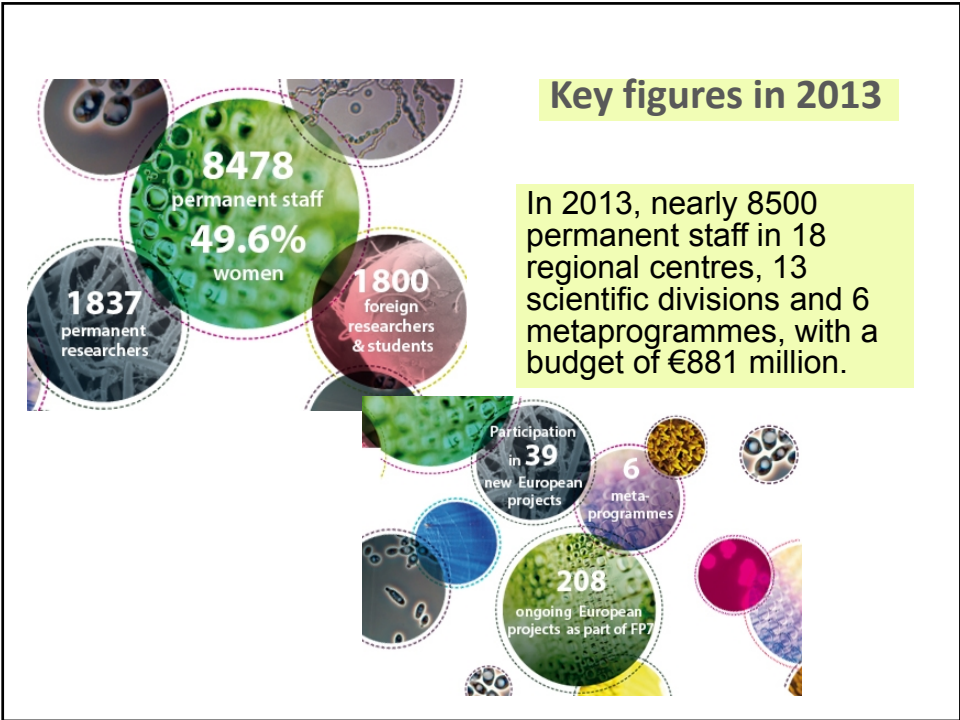
- ❑ Agrocampus Ouest: Higher education and research for life and environmental sciences



INRA, an international public research institute



- ❖ **INRA is a public scientific and technological establishment (EPST)** (joint authority of the Ministry of Higher Education and Research and the Ministry in charge of Agriculture)
- ❖ **Goals :**
 - to produce and disseminate scientific knowledge and innovation
 - to contribute to education and training, to promote scientific and technical culture and participate in the science/society debate
 - through its expertise, to advise decision-making by public and private sector actors



14 research divisions ensure scientific management

- 
- Nutrition, Chemical Food Safety and Consumer Behaviour (ALIMH)
 - Plant Biology (BV)
 - Science and Process Engineering of Agricultural Products (CEPIA)
 - Environment and Agronomy (EA)
 - Forest, Grassland and Freshwater Ecology (EFPA)
 - Animal Genetics (GA)
 - Plant Breeding and Genetics (GAP)
 - Applied Mathematics and Informatics (MIA)
 - Microbiology and the Food Chain (MICA)
 - Animal Physiology and Livestock Systems (PHASE)
 - Animal Health (SA)
 - Science for Action and Sustainable Development (SAD)
 - Social Sciences, Agriculture and Food, Rural Development and Environment (SAE2)
 - Plant Health and Environment (SPE)

Our collective goal :
Ensuring sustainable food security for 2050

- During the 21st century, mankind will face a triple challenge: to provide sufficient high quality food for 9 billion people while preserving the environment and natural resources in a world with increasingly scarce fossil fuel resources.
- High priority research questions :
 - To develop an ability to understand, analyze and model issues concerning nutrition and global food security.
 - To develop reliable indicators of sustainable development.
 - To analyze the territorial consequences of global changes.

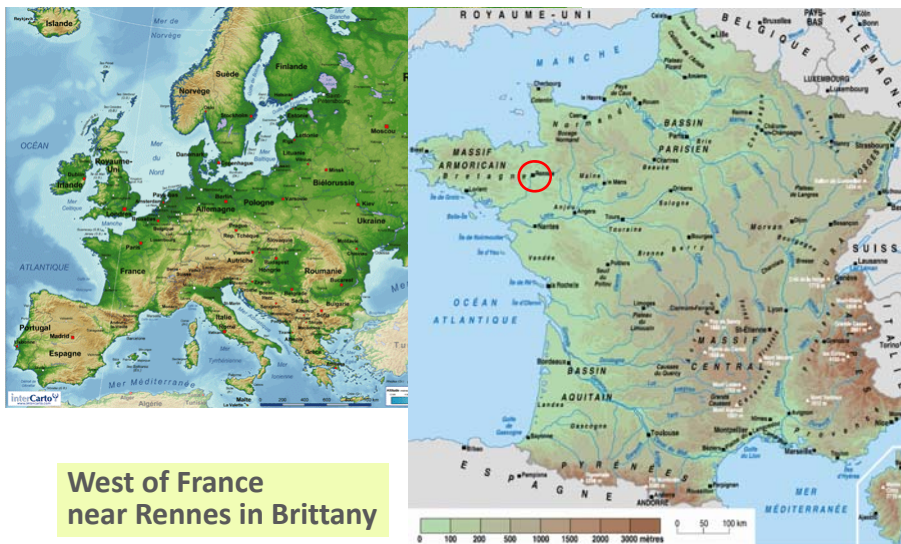
UMR1348 PEGASE
Physiology, Environment and Genetics for
the Animal and Livestock Systems

Manager : J. Van Milgen. jaap.vanmilgen@rennes.inra.fr



PEGASE Unit

Where are we ?



We are in Brittany

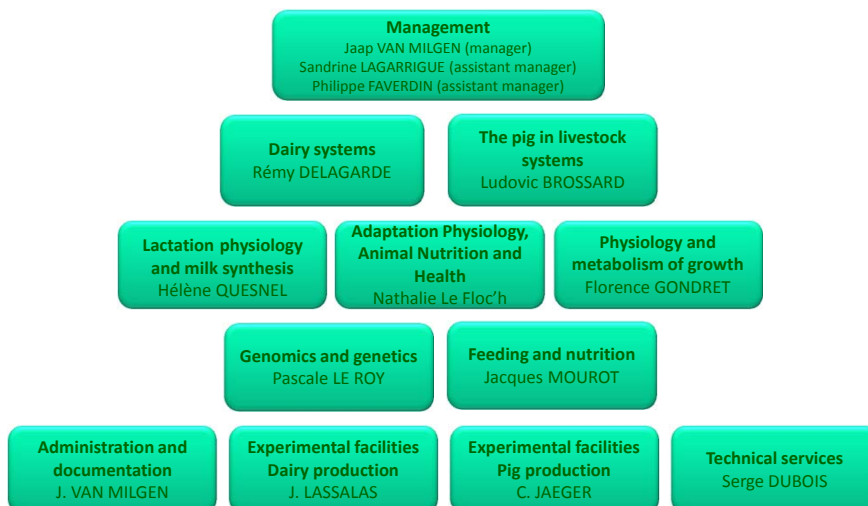


PEGASE Research unit

- Scientific project :
 - To acquire a better knowledge of animals plasticity
 - To make a real contribution to the design of innovating and sustainable breeding systems

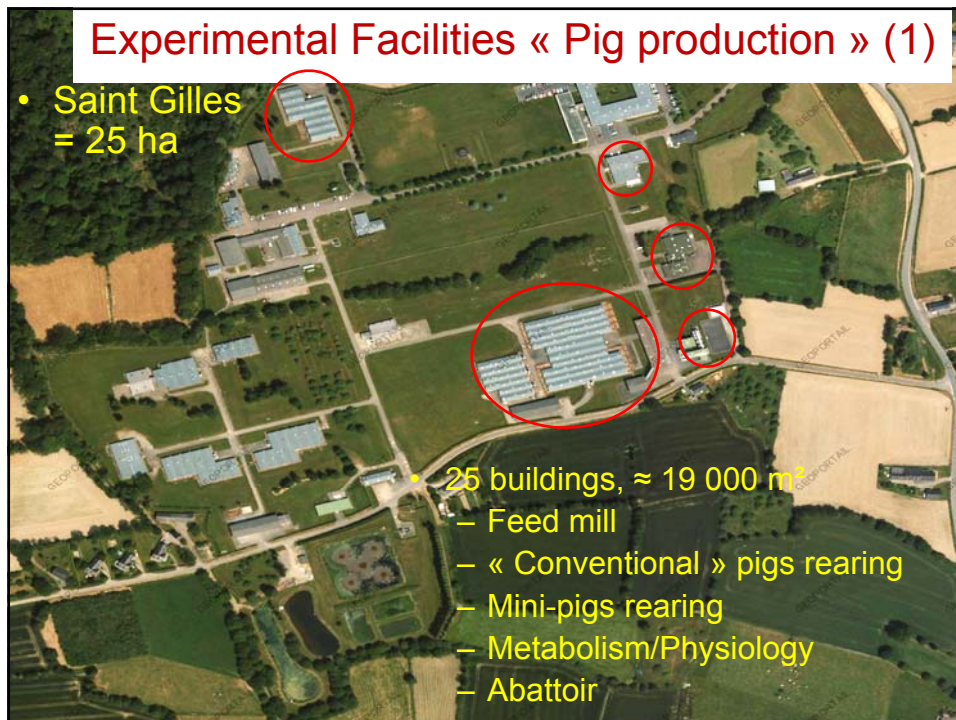


Organization chart of PEGASE unit



56 researchers (+ 22 PhD), 93 support staff

Experimental facilities



Experimental Facilities « Pig production » (2)

Feed mill (for pigs, poultry and ruminants)

- Production: kgs or tons
- Mixing from 0.1% to 50%
- Authorization medicinal pre-mixing

« Conventional » pig rearing

- 7 batches farrowing system
- Sows auto-renewal (LW et LW×Ld)
- Artificial insemination
- Individual identification at birth

Abattoir:

- Slaughter of different animals (age, weight)
- Sampling of tissue or complete dissection or grinding of the whole animal

Experimental Facilities « Pig production » (3)

Mini-pigs rearing :

- 1 building of 1300 m²
- Reproductive animals : 15 ♂ et 60 ♀, 3 breeds
- Growth: 432 animals in 6 rooms



Physiology

- 1 growth room with air-conditioning + maternity rooms
- 2 big and 1 small respiratory rooms
- Accommodations for nutritional balances
- Equipment to measure and perform sampling on operated animals



Experimental facilities dairy production (1)



Dairy cows herd

Herd of 150 dairy cows Prim'Holstein: zootechnic experiments at trough and at grazing

- Calving in autumn-winter
- Milk: 8 400 kg – Fat content: 3.85% - Protein content: 3.15%



- Automated delivery of feed
- Individual controls of trough food intake



- Individual measures of milk production and composition
- Facilities to isolate milk from sample groups
- Automated weighing of dairy cows at each milking

Experimental facilities dairy production (2)



Dairy cows physiology studies



A herd of 25 dairy cows prepared for nutrition and lactation physiology experiments

- 4 experimental independent air- and temperature-conditioned rooms
- Individual stalls equipped with:
 - Automated food delivery
 - Automated recording of feeding behaviour (ingestion, drinks), standing-up and lying-down and physiological parameters thanks to shared measure station
 - Measure of digestive balances
- Measures of feeding behaviour, ingestion and digestion at grazing
- Technique of mammary gland balances (probe flow)



Experimental facilities dairy production (3)

Goats herd

A herd of 150 Alpine dairy goats for physiology studies

- Management in building during the whole year
- Farrowing February - 280 d of lactation
- Milk: 700 kg – Fat content: 3.76% - Protein content: 3.18%

- Control of milk production
- Measure of mammary gland and milking traits



Research teams

Dairy systems
Rémy DELAGARDE

The pig in livestock systems
Ludovic BROSSARD

Lactation physiology and milk synthesis
Hélène QUESNEL

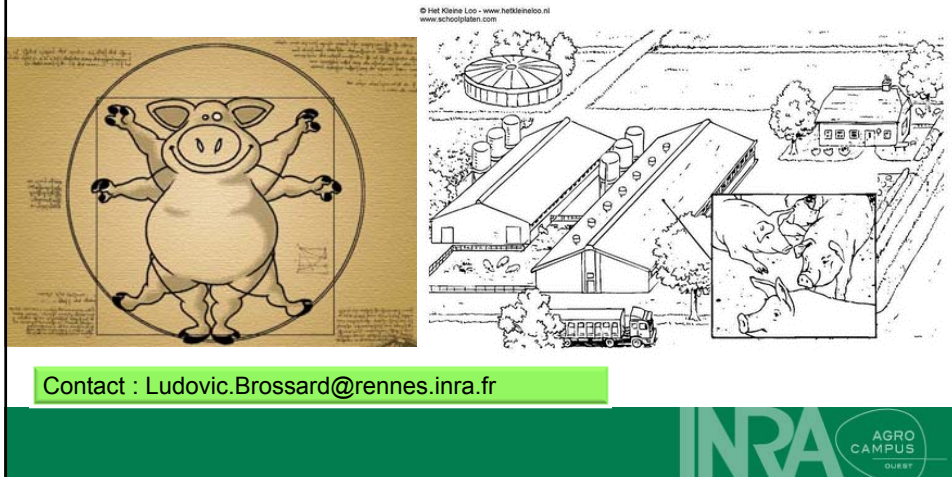
Adaptation Physiology, Animal Nutrition and Health
Nathalie Le Floc'h

Physiology and metabolism of growth
Florence GONDRET

Genomics and genetics
Pascale LE ROY

Feeding and nutrition
Jacques MOUROT

The pig in livestock systems team



The pig in livestock systems

Social and economic context

Sustainability of farming systems in question:

- Economic sustainability of farms facing high and volatile feed prices, volatile pork price, international competition
- Environmental impact to reduce on soil and water
- Social acceptance to maintain or improve

The pig in livestock systems

Objectives

To contribute to the development of innovative livestock systems taking into account :

- the different dimensions of sustainability : animal welfare, performance, impact on environment, economy
- the knowledge about welfare and pig behaviour

The pig in livestock systems



Marie-Christine
Meunier-Salaün



Céline
Tallet

Research topics

Obtain data for a better understanding of **animal behaviour** in relation to the environment of the animal:

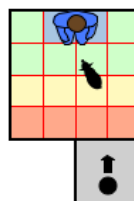
- Human-Animal relationships and their impact on animal welfare



- Feeding behaviour



- Emotional and cognitive capacities



The pig in livestock systems

Research topics



Multicriteria analysis and optimisation of livestock systems:

- Control mechanisms for precision livestock production systems
- Evaluation of environmental impact
- Methods of system optimisation with respect to indicators of performance, environment and economics to propose and/or to develop further livestock production systems



The pig in livestock systems

People and facilities

- A team of 5 engineer/researcher and 2 technicians
- Skills and knowledge in behaviour, nutrition, environment, farming systems, modelling
- Experimental facilities (experimental farm, video laboratory and equipment)






Research team

Physiology and Metabolisms of Growth

Contact : florence.gondret@rennes.inra.fr

Our main topics and expected outcomes

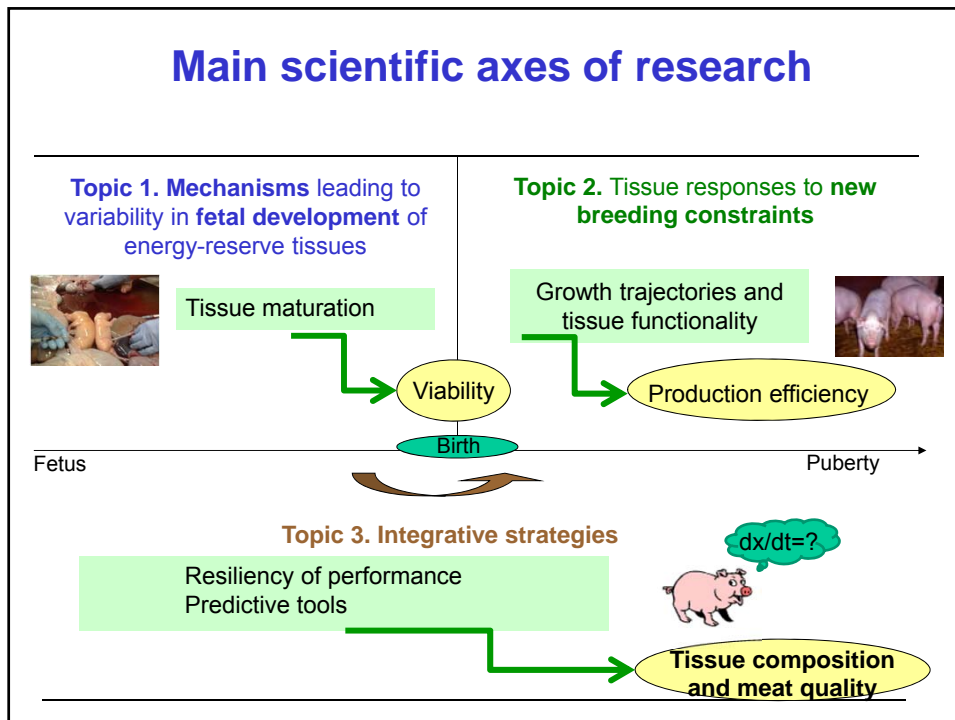


Identifying the mechanisms associated with the plasticity of tissue properties and their consequences on energy reserves in developing pigs

To manage adaptation of animals in livestock systems

- * To add understanding on **tissue adaptation** that triggers **neonatal viability** and the **efficiency of pig production**
- * To propose **new breeding strategies** to control lean and adipose tissue growth and **meat quality**
- * To establish **prediction tools** for pork quality

Main scientific axes of research



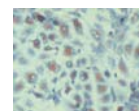
The scientific staff

7 permanent researchers with complementary skills

Florence Gondret
Maryline Kouba
Bénédicte Lebre
Louis Lefaucheur
Isabelle Louveau
Marie-Christine Père
Marie-Hélène Perruchot

Our main skills:

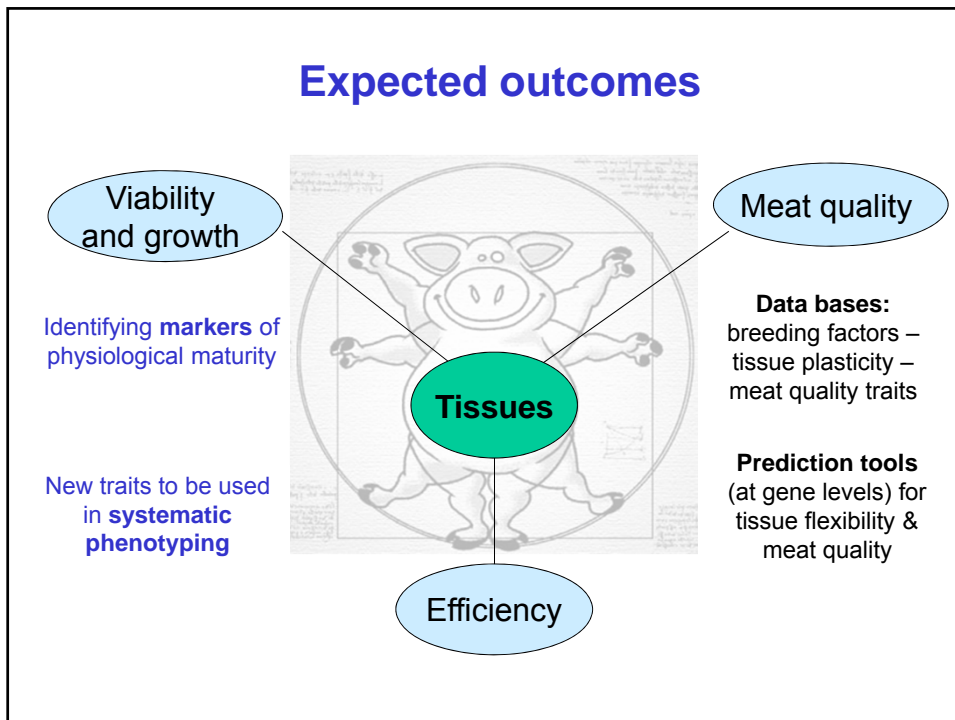
Stem cells and primary cell culture
Maternal and fetal surgeries
Tissue characterization
Experiments on living animals



Our main tools:


For gene expression → functional proteins → phenotypes

- **profiles:** transcriptomics, proteomics and metabolomics
- **key targets:** real-time qPCR, western-blotting, biochemistry, radioimmunology, (immuno)histochemistry, biochemistry of meat quality
- **models:** predictive equations for meat quality, modeling gene relationships for high throughput put analyzing





Team

Physiology of adaptation, Animal Nutrition and Health



Contact : Nathalie.Lefloch@rennes.inra.fr

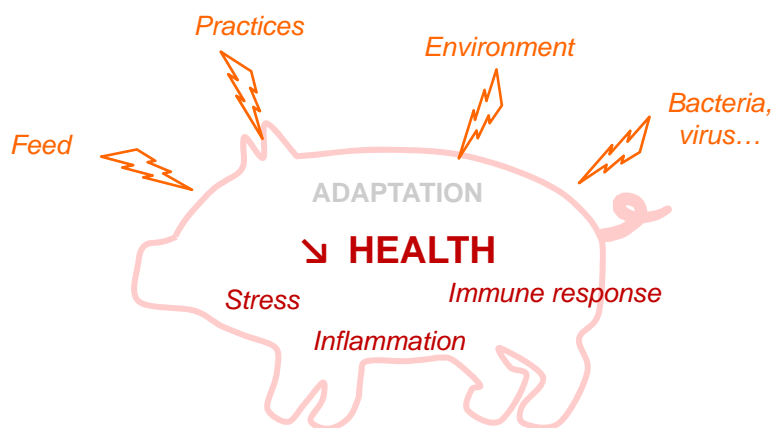
The context of our research

- Necessity to improve the animals' ability to **adapt** to changing farm conditions while preserving **animal health and welfare**
- Competition between **immune and defense functions/ productive functions** for nutrient utilization

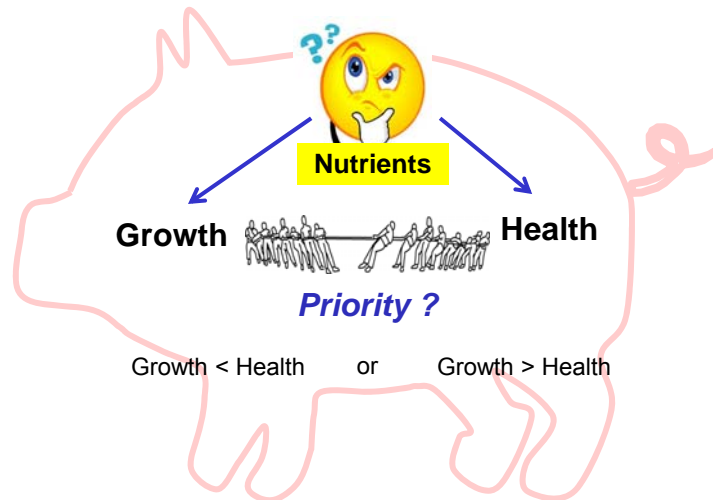
Our Objectives

- To study and quantify **nutrient partitioning** between productive (growth) and non productive (defense, immune) functions
- To identify the **mecanismos** responsible for nutrient repartitioning and to understand the **physiological basis** of animal response to farm management

The links between health and nutrition



Nutrient partitioning between health and growth : what are the consequences ?



Our group

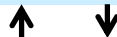
Lucile Montagne



Nathalie Le Floc'h



Nutrient Utilization /Metabolic fluxes



Cytokines
Hormones
ROS



Marie Damon



Elodie Merlot



Armelle Prunier



Feeding and Nutrition team



Contact : Jacques.Mourot@rennes.inra.fr



Context

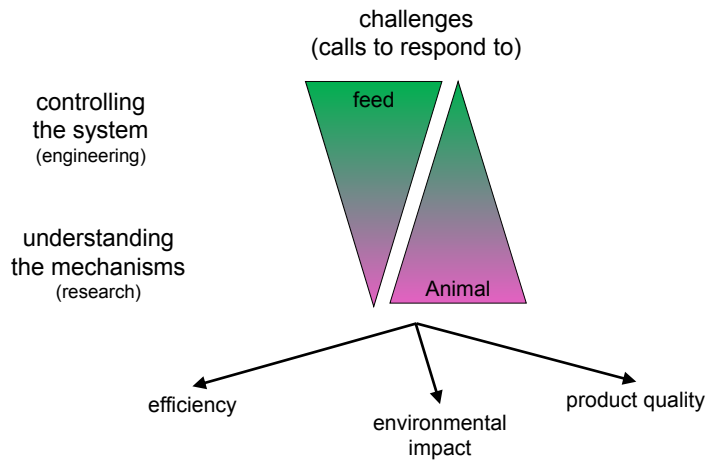
- More rare and more diversified resources (feed-food-fioul, co-products)
- Competition between Man and Animal
- Climate changes (increase of temperatures in South of Europe, heat wave...)

**How does the animal adapt / how to adapt the animal ?
Relationship with genetics**

Consequences on product quality



Objectives



The main objective of the research is to understand and quantify the metabolic responses of an animal in response to challenges of physiological, food or climate origin while taking care of optimizing resource food utilization for their transformation into animal products.

Research topics

Characterisation of feeds

- « New » more complex feedstuffs
- Impact of feed technologies
- Digestive utilization
- Alternative methods

Studying the response

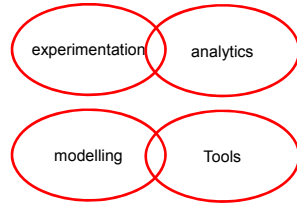
- Energy and protein metabolism
- Nutritional dynamics
- Role of the animal
- Relation with the environment of the animal (e.g. thermoregulation)
- Effect of feeds and feeding on product quality

Modelling and engineering

- Meta-analysis, simulation modelling and development of tools
- Evapig: prediction of nutritional values for feedstuffs
- InraPorc: a dynamic, nutritional model and tool for growing pigs and sows
- Precision feeding

Strategy and means

2 complementary approaches



- 3 respiration chambers



Serge
Dubois

- 1 technical platform
of mass spectrometry



Jean-Noël
Thibault

- Collaboration intra- and extra-unit
- ANR (3) and FUI (1) programs
- Partnership with industry



Genetics and Genomics team research project



Contact : Pascale.Leroy@rennes.inra.fr



Background and issues

- Use of molecular information for genetic improvement of livestock
- Application, in poultry, to the traits related to the mobilization of lipid reserves for growth, body composition or spawning
- The GG team is part of the INRA Avian Genetics Network



GG activities

- Development of methods and tools
(statistics, computing, molecular biology, genomics ...)
- Application to lipid metabolism in poultry
(chicken, duck)
- Collaborations for other species (pig, trout, mouse) and other functions (health, product quality)



Syslait team

Contact : Remy.Delagarde@rennes.inra.fr

SYSLAIT : Dairy systems
(Leader : R. Delagarde)



Rémy Delagarde

General context:

- Great variability in dairy systems (feeding, reproduction, milking)
- Fluctuation of constraints

General objective:

- Predict reactivity of dairy systems to different keys factors in dairy cows rearing, to be efficient
- Multi-criteria approach: production, environment, (work, economy)



Favoured approach level:

Herd × production cycle

(infra knowledge = entire animal) ⇒ experimentation

(supra consequences = farm, area) ⇒ modeling

Competences

Zootechnics : Feeding, lactation, reproduction, digestion, feeding behaviour

Modeling, systemic approach, programming:

- Ingestion, lactation, reproduction
- Computer driven systems (grazing, herd, production system)
- Tools to help to decide (Pâtur'In, Herb'Evol, Herb'Avenir, INRAtion, INRA tables)



Axis 1: Management and efficiency of dairy herds

Axis 2: Management and grazing efficiency

Axis 3: Environnemental evaluation of dairy systems



Lactation team

Contact : Helene.Quesnel@rennes.inra.fr



LACTATION : lactation physiology and milk and colostrum synthesis

(leader : *Hélène Quesnel*)



Objective: to identify and promote rearing systems to control, from production volume, composition and milk properties that preserve the animal's milking potential.

Strategy : To understand the mechanism of the dynamics of the secretion tissue of the mammary gland and the regulation of the synthesis of milk components.

→ 2 different projects :



Lactation : Milk and colostrum synthesis

LACTATION : Milk synthesis and quality of milk and colostrum

The objective is to succeed in controlling and predicting milk and colostrum composition:

- properties - milk : to improve nutritional properties, cheese and butter
- colostrum: to decrease mortality in the young



Lactation : Milk and colostrum synthesis

Control of mammary gland metabolism



Control of nutritional and technological quality of milk

Quality of colostrum and milk (immune properties)



Approach to animal, organ, and model

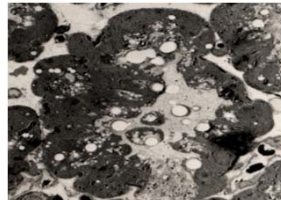
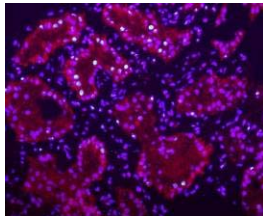


Lactation: Physiological factors of production potential

LACTATION : Physiological factors of production potential of mammary glands and milking aptitude

The objective is to understand the key factors of:

- dynamics of secretory tissue (on young females and during lactation)
- control of milk secretion and ejection in order to pilot milking systems and to improve dairy females aptitudes



Lactation: Physiological factors of production potential

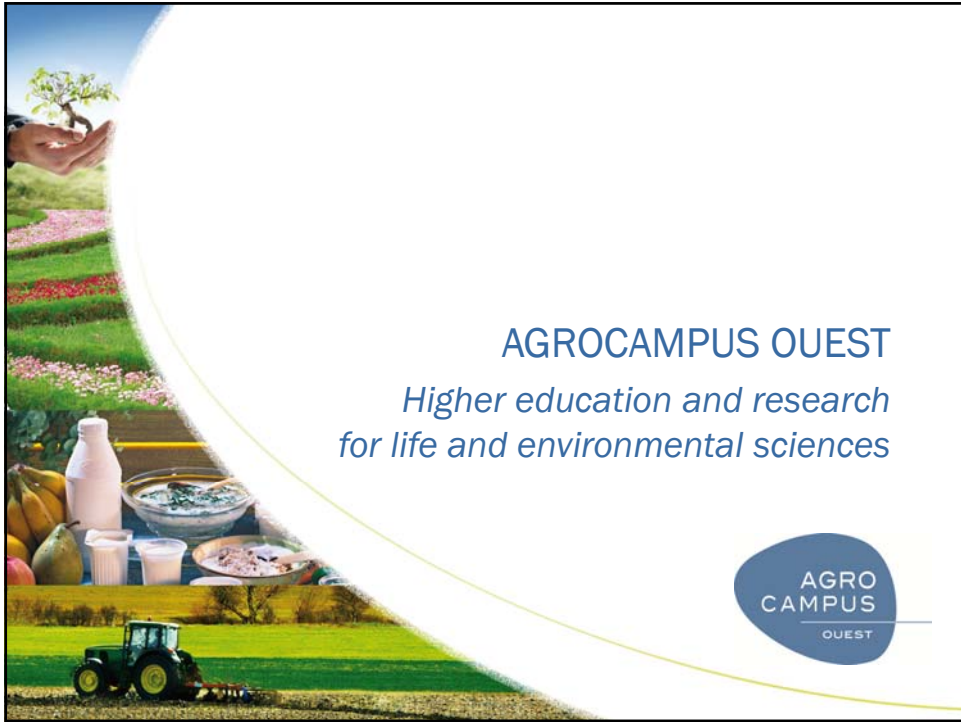
Dynamics of secretory tissue and potential production of mammary gland

Mammary gland development before puberty

Lactogenesis (sow)

Lactation persistence

Phenotyping aptitudes of mammary glands to milk storage



AGROCAMPUS OUEST

*Higher education and research
for life and environmental sciences*



A world-class « Grande Ecole »

AGROCAMPUS OUEST is a higher education and research public Institute of the French Ministry of Food, Agriculture and Fisheries

Multidisciplinary education from Master's degrees to PhD courses & degrees

The higher education system in France includes universities and other elite institutions called the "Grandes Ecoles". These are the most prestigious and highly rated trajectory for higher education in Engineering and Management. The majority of chief executives in major French companies and top managers in the French Administration are graduates from the "Grandes Ecoles".



AGROCAMPUS OUEST



AGROCAMPUS OUEST in figures

1880 students (graduate & postgraduate degrees) including
130 PhD students
15% international students
A network of 13,000 alumni all over the world
80 academic partners worldwide
150 full-time faculty members including 135 research-
lecturers dispersed among:
18 research units featuring more than 500 scientists
11 academic departments
250 administrative and support staff
500 part-time lecturers
(professionals from industry and researchers)
3 locations: Angers, Rennes, Beg-Meil



A threefold vocation

Education
Research
Knowledge valorisation

Through a distinctive tradition of core-discipline
excellence, interdisciplinary collaborations and
productive partnerships, AGROCAMPUS OUEST

- teaches students to think critically, objectively
and creatively and to be lifelong learners, engaged
leaders and productive worldwide citizens;
- pursues research to advance knowledge and
address regional, national and global challenges;
- serves the society improvements through the
generation, broad dissemination and application
of knowledge.



Master of Animal Science

SAED (Sciences de l'Animal pour l'Elevage de Demain)

3 partners



- ❑ Deep links with research (INRA UMR PEGASE) and with professionals (proximity)
- ❑ Continuum between different levels : from the animal cell to livestock farms integrated in food chains and in territories
- ❑ Multi-disciplinary approach : physiology, animal production, statistics, environmental sciences, ethic, law...
- ❑ Definition of individual courses with each student (tutorial and choice of options)
- ❑ M2: few lectures, problem-based learning
- ❑ 2 training periods (M1: 6-8 wk and M2: 6 months)
- ❑ 20-30 students par year



More information and contacts

<http://www.agrocampus-ouest.fr>

<http://www.agrocampus-ouest.fr/infogludeLiveLive/fr/formation/masters/saed>

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Animal sciences department

Catherine Disenhaus	dairy cow, reproduction, dairy LFS
Jocelyne Flament	dairy cow, lactation, metabolism
Justine Faure	meat production, pig
Maryline Kouba	poultry, meat quality
Yannick Le Cozler	growth, calves, LFS
Vanessa Lollivier	physiology, lactation, welfare
Lucile Montagne	nutrition, feeding, nutrition&health, pig

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Thank you for your attention