

# The 31<sup>st</sup> European Congress of AI VETS

The local organizing committee is pleased to welcome you to the 31<sup>st</sup> European congress of AI VETS in France. The event takes place at the Futuroscope Convention Center, near Poitiers from October 20 to 22, 2021.

This annual conference is a place for meetings and exchanges for those involved in animal insemination. For this new edition several topics will be on the agenda, such as animal health law, regulation of international trade of germinal products, environmental impacts of AI and semen production, management of young animals, new approaches to fertility prediction... and many more other varied topics that we invite you to discover all along the congress.



**AI VETS**  
2021

31<sup>st</sup>

**ifip**

Institut du porc



## VENUE

**Futuroscope** is a unique site devoted to companies that combines venues for meeting, accommodation and recreational sites based on an Image-focused amusement park.

Futuroscope Park offers stunning shows that use the most innovative projection techniques (360°, 3D and relief, giant screens, simulators, etc.). Spectators are immersed in a world of extreme sensations.

Direct site access 80 minutes away from Paris The Futuroscope site, near Poitiers, has its own TGV railway station (on the Paris/Bordeaux/Toulouse line). There are links to Brussels and the TGV station at Roissy-CDG Airport for international connections. Links to European destinations from the Poitiers-Biard Airport, including a direct fly between London and Poitiers. It's all there!

On-site you have all the facilities required for your event to be a success: over 15,000 m<sup>2</sup> of meeting spaces, 7 theme-based hotels dedicated to business customers for seminars involving 10 to 150 people, and a Conference Centre able to adapt to your event, with 3 amphitheatres seating 150, 300 and 1,150 people (can be adjusted for 500 or 800 people) and featuring the latest communication and co-ordination equipment for videoconferences, video transmissions, etc.



## ACCESS

Futuroscope is situated 8 km from the town of Poitiers.

### **By plane**

The airport of Poitiers-Biard is 10 km from Futuroscope and has daily national connections with CLERMONT-FERRAND, LYON, TOULOUSE, DIJON, MARSEILLE, METZ/NANCY, MULHOUSE, NICE, STRASBOURG, TOULOUSE

There are also international links with LONDON (direct) and connections with AMSTERDAM, BRUXELLES, GENEVE, MILAN, TURIN

### **By train**

Direct TGV Station on Futuroscope area or Poitiers railway station from 8 km to Futuroscope. Poitiers is at 90 minutes from Paris by TGV (high speed train) departure to Montparnasse station (Paris centre) or the new TGV station of Charles de Gaulle airport (4 links per day).

### **By road**

By motorway n°10, exit n°28-direct to the park  
320 km from Paris and 250 km from Bordeaux.

### **By bus**

Vitalis buses, lines 1E and 21 (Monday to Saturday) and line E (Sunday) serve Poitiers station and the Futuroscope site (TGV station, park entrance and hotels). [Consult the schedules on vitalis-poitiers.fr](http://vitalis-poitiers.fr)

**DAY 1**  
**OCTOBER 2021 THE 20<sup>th</sup>**

**8:15 - 10:00** : Repvet Meeting

**10:00 - 10:15**: Coffee break

**10:15 - 12:30**: Qualivet

Presentation of objectives and deliverables of each Qualivet subgroups

**12:30 - 13:45**: Lunch

**13:45 - 14:10**: Welcome speech

**PLENARY SESSION 1**

**14:10 - 14:55**: Plenary n°1

Animal health law

Ewa Camara - European commission

**14:55 - 15:40**: Plenary n°2

Environmental assessment of pig production : what lessons from LCA ?

Sandrine Espagnol - IFIP / France

**15:40 - 16:25**: Plenary n°3

OIE recommendations regarding germinal products production and exchanges

Etienne Bonbon - OIE / France

**16:25 - 16:40** : Coffee break

**CATTLE PARALLEL SESSION 1**  
**ENVIRONMENTAL IMPACT**

**16:40 - 17:40**: Cattle // n°1

Global warming : consequences for sperm quality and fertility of bulls

Ann van Soom - Univ. Ghent / Belgium

# PROGRAM

**PIG PARALLEL SESSION 1**

**16:40 - 17:10**: Pig // n°1

Sperm production and boar taint risk

Armelle Prunier - INRAE / France

**17:10 - 17:40**: Pig // n°2

Ultrasound for testicular evaluation

Michael Kleve Feld - PIC / France

**PLENARY**

**17:40 - 18:00**: Repvet/qualivet report

**19:30**: Gala dinner

**DAY 2**  
**OCTOBER 2021 THE 21<sup>st</sup>**

**PLENARY SESSION 2**

**8:15 - 8:45**: Plenary n°4

The future of livestock – an animal health company's outlook

Christian Wunderlich - Zoetis / Germany

**8:45 - 9:15**: Plenary n°5

What has been learned about toxics in plastics and new researches

Raquel Ausejo - Magapor / Spain

**9:15 - 9:45**: Plenary n°6

The genetics of male infertility in humans

François Vialard - UVSQ / France

**9:45 - 10:30**: Sponsors session

**10:30 - 11:00**: Coffee break

**CATTLE PARALLEL SESSION 2**  
**FERTILITY PREDICTION : NEW TOOLS/ APPROACHES TO PREDICT THE MALE FERTILITY?**

**11:00 - 11:30**: Cattle // n°2

Genome-wide association on male fertility traits

Chris Hoze - Allice / France

**11:30 - 12:00**: Cattle // n°3

Protein markers of bull fertility in seminal plasma

Patrice Humblot - Univ. Upsala / Sweden

**12:00 - 12:30**: Cattle // n°4

Omics in sperm fertility - challenges and perspectives ?

Chrystelle Le Danvic - Allice / France

**PIG PARALLEL SESSION 2**

**11:00 - 11:30**: Pig // n°3

Introduction to bacteria present in sperm

Wajdi Ben Hania - LNCR / France

**11:30 - 12:00**: Pig // n°4

High throughput sequencing of sperm bacteria

Duc Pham - Genes Diffusion / France

**12:00 - 12:30**: Pig // n°5

Hygiene & bacteria in extended semen

Martin Schulze - IFN / Germany

**12:30 - 13:30**: Lunch

**CATTLE PARALLEL SESSION 3**  
**MANAGEMENT OF YOUNG ANIMALS**

**13:30 - 14:00**: Cattle // n°5

Semen production from prepubertal bulls at Viking Genetics

Kasia Kupisiewicz - Viking Genetics / Denmark

**14:00 - 14:30**: Cattle // n°6

'Well begun is half done' – Impact of early life nutrition on the sexual development of the bull

David Kenny - Teagasc / Ireland

**14:30 - 15:00**: Cattle // n°7

Long-term impact of early life nutrition on DNA methylation patterns in bull sperm

Hélène Kiefer - INRAE / France

**PIG PARALLEL SESSION 3**

**13:30 - 14:00**: Pig // n°6

Biosecurity applied on AI studs in France

Mireille Mausservey - Groupe Cristal / France

**14:00 - 15:00**: Pig // n°7

Introducing PCAI as a game changer : practical and economical consequences

Hans Jubbega - Agrisyst / The Netherlands

**15:00 - 16:00**: Sponsors session

**16:00**: Futuroscop visit and free time

**DAY 3**  
**OCTOBER 2021 THE 22<sup>nd</sup>**

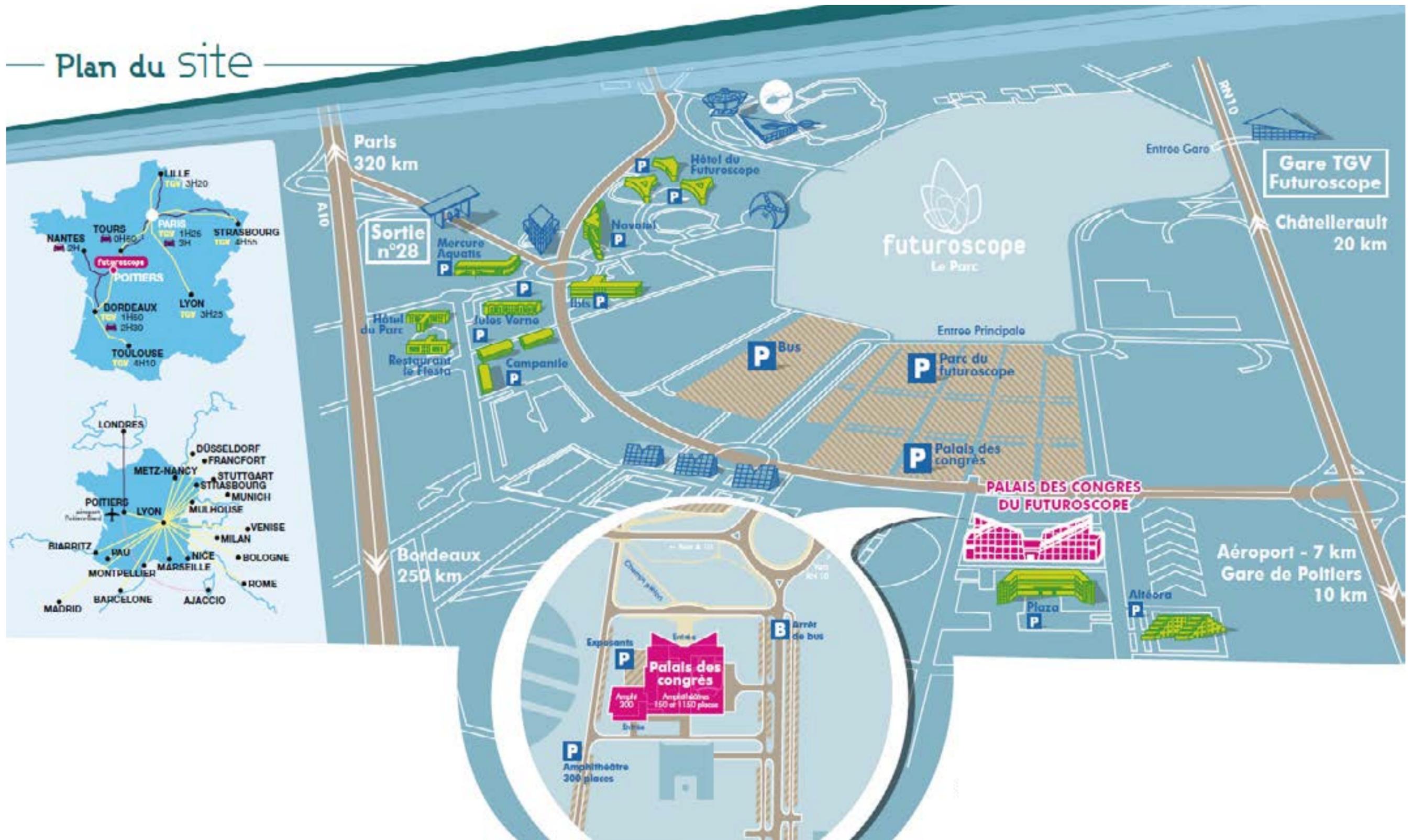
**9:00**: Departure from Plaza Hotel to visits

**9:30-13:00**: Capgenes + scientists from Allice & INRAe

**9:30-13:00**: Porcine commercial farm + scientists from INRAe

**13:00**: Departure to Poitiers train station

# Plan du site





### **Working to make farmers competitive**

Alice, a professional farming organisation, has the benefit of more than 70 years' expertise and its **members** figure among the **world leaders** in the animal selection and reproduction sector. It represents and defends all the networks for artificial insemination of cattle, goats and sheep nationally, in Europe, and internationally.

Over and above the values borne by its **cooperative DNA (solidarity, equality and transparency)**, there are 5 distinguishing values that drive Alice's actions: mutualism, innovation, competitiveness, proximity and commitment to sustainable breeding.

Its actions and expertise enable Alice to contribute to **improvement in the competitiveness** of the selection and reproduction sector to the advantage of all breeders. It provides individual assistance to its members who support farmers in managing their reproduction tools and improving the genetics of their herds, thus helping them to gain market shares worldwide.

### **Our cooperative model**

enables us to carry out our task in a different way by sharing our skills in order to reinforce breeding companies and develop innovative, sustainable solutions to meet the challenge of agriculture and nutrition. In this context of cooperative competition Alice has a very special responsibility to help its members meet the growing corporate social expectations in terms of product quality, farmers' quality of life, and respect for the environment and animal welfare.

Alice - MNE  
149, rue de Bercy  
75595 Paris cedex 12  
communication@alice.fr



### **IFIP-institut du porc, the French Pig and Pork Research Institute**

Ifip is the national applied research institute serving the French pork industry. It was created in 1961 to support its development. Ifip's mission is to provide public and private actors of the pig industry, knowledge, results, analyzes, innovations that enable them to face the economic, environmental, social and societal challenges.

The IFIP-Institut du Porc provides technical and economic references, expertise and support to public authorities, professional organisations and companies (pig producer groups, meat industries, pig breeding organisations, animal feeding companies, etc.).

IFIP produces technical and economic standards for the benefit of French farmers, their advisory providers and more generally economic operators involved in the national pig chain. 90 full-time equivalent (including 65 ag.engineers, DVM or PhD) based in Brittany, offer a wide range of expertise covering the whole pig chain.

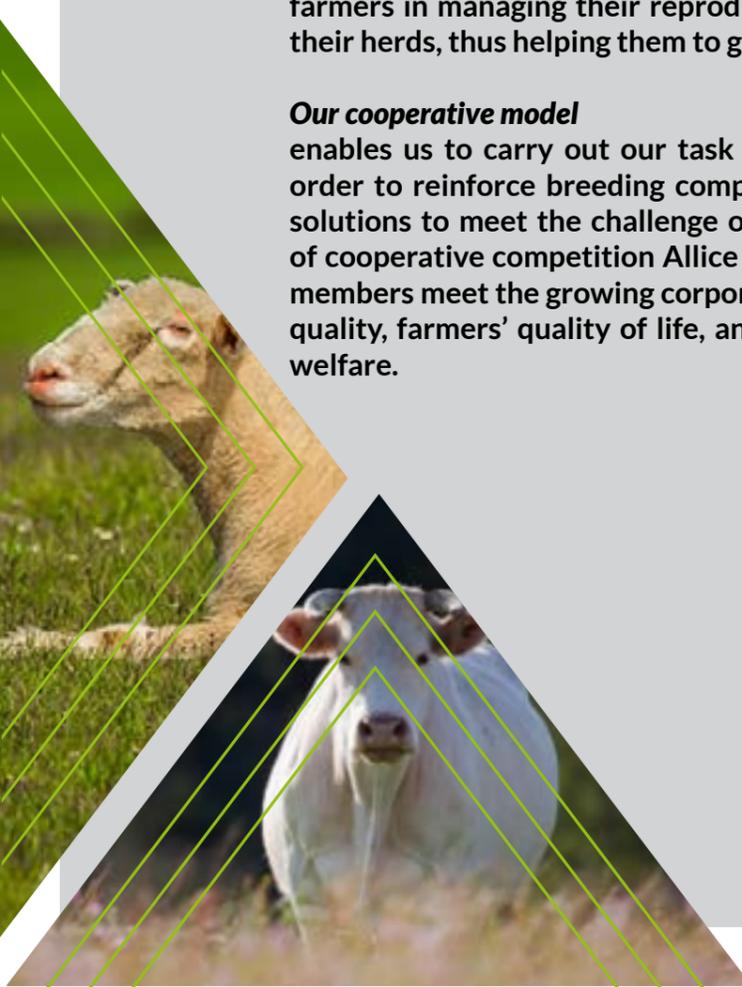
Skills and activities are organized around 4 technical areas and teams : Breeding techniques, Economics and sociology, Meat quality, Genetics. IFIP expertise, especially through its departments, Farming Techniques and Carcass & Meat Processing, is fully concerned by the fields targeted in the EU PiG project: animal health and related practices (e.g. the use of antimicrobials), animal welfare (castration, mutilations, farming methods...), precision farming (monitoring, warning emission, modelling & automated disposal driving...), meat quality screening (technological, organoleptic, microbial...).

For research or demonstration, Ifip avails on specific equipments: a 200 sow farm for testing, a laboratory for microbiological studies, a RX scan to assess tissue composition on live animal or carcasses.

The IFIP ensures a permanent support to the regional engineering teams, including producer groups and Chambers of Agriculture. More than 900 technicians participate annually to IFIPs trainings. Beyond R/D activities, IFIP also brings an expert advice to various pig chain actors and Public authorities. This wide range of activities draws on a dense network of partners, from academic research to field operators.

In collaboration with INRAe, IFIP organize an annual conference, the Days of Swine Research, which presents the latest results of its work and the results of research in French-speaking countries (Canada, Belgium, Switzerland in particular). Journals and technical brochures complement the device dissemination of information to the industry.

[www.ifip.asso.fr](http://www.ifip.asso.fr)





Founded in 2008, CAPGENES is the National association of goat breeders. It gathers all goat stakeholders involved in the promotion and breeding of French caprine breeds. CAPGENES is the French center for semen production in goat. CAPGENES is responsible for the national breeding scheme of the Alpine and Saanen dairy breeds and supervises other French breeds (13) under the control of the Ministry of Agriculture, Food and Forest.

CAPGENES therefore defines the breeding objectives with stakeholders, develops the breeding schemes and is the national support for genetic improvement of caprine breeds.

CAPGENES is involved in the national research and development programs such as 'RUSTIC' dedicated to genomics longevity and dairy persistence

CAPGENES has services permitting to identify a network of farmers (n = 1500), an equipment, enabling to produce and preserve 250,000 doses of frozen semen per year, and a technical team to provide guidance and technical actions necessary to conduct a scheme of selection. The infrastructures include a laboratory for cryopreservation and for buildings for quarantine and photoperiodic treatment of AI bucks. The buildings can hold up to 400 bucks.

During the third-day visit, we propose you three different workshops:

- Buck sperm collection with photoperiodic treatments
- Process semen production in buck and semen quality control after post thawing with CEROS
- Our researchs in reproduction control and breeding goals evolution



Local pig farmer and research team explore new strategies for swine production

#### *An evolving sustainable pig farm*

We will meet Yves, Juliette and Eric Debien on their pig farm « La Baie des Champs » and discover how they successfully tackle many challenges. Autonomy, sustainability, welfare and health, meat quality, circular economy, positive communication : this farm ticks all the boxes ! Pigs are produced in accordance with quality specifications «IGP Sud-Ouest » and « Sustainable agriculture ». They are fed from cereals and oleo-protein crops cultivated and transformed on-site. Slurry and composted green waste contribute to fertilization and the farm methaniser covers a large part of the electricity and heating needs. Welfare and health are at the heart of concern with banned castration and restricted antibiotic use. And last not least, direct on-farm sale of pork products meets the increasing demand for local quality goods and contributes to positive communication.

#### *INRAe innovative research*

Researchers from INRAe will come to the farm to tell more about GENESI Unit and innovative research on contrasted pig farming systems. You will discover PORGANIC the 1st French experimental farm dedicated to studies on organic indoor pig production issues. The virtual visit, will show pictures from the farrow-to-finish herd and its new facilities. In accordance with organic production specifications, the 48 sows have outdoor access at all the stages and can farrow in free-farrowing pens. PORGANIC benefits of specific tools : experimental boar stud for semen production, video monitoring, sensors ... Current research programs cover a variety of topics : reproduction physiology, genetic, piglet survival, alternative to protein sources and treatments, health and welfare. Researchers will present the main on-going projects : PPILOW, POWER, FARINELLI ...



## The European Forum of Farm Animal Breeders

### Our work

The European Forum of Farm Animal Breeders is the association that represents the animal breeding and reproduction organisations and companies in Europe. Members of EFFAB are involved in the genetic improvement of different farm animal species and represent a wide diversity of farming systems. Ruminants, pigs, poultry, aquaculture and insects, are the main species covered by EFFAB members. Together with our members, **EFFAB promotes sustainable, responsible, and balanced animal breeding.** Visit EFFAB's website here.

### RepVet and Qualivet groups



The RepVet, the reproduction veterinarians group is since the 1 January of 2017 a Working Group of EFFAB. The WG RepVet is giving solicited/active and unsolicited/pro-active advices to the EU Commission (DG SANTE) regarding the European legislative framework - as well as technical advices - related to the (biosecurity of) artificial reproduction of ruminants and pigs, based on scientific knowledge and practical expertise.



The QualiVets working group is open for people involved in bull and boar semen production. Members of this working group meet annually before the AIVETS meeting. The focus of this WG is on all relevant subjects concerning AI station management, semen collection, evaluation of semen quality, semen dilution, semen storage and semen transportation.

### The code of good practice



Code EFABAR is the code of good practice on Animal Breeding and Reproduction. By committing to Code EFABAR, companies show commitments towards sustainability, responsible and balanced breeding. Code EFABAR explains how animal breeders work and which are the main elements of their breeding programs.

### How we create impact for the sector

EFFAB plays a supportive role in ensuring that Europe provides the perfect environment for animal breeding and reproduction companies



European policy and legislation involvement; promoting science-based policy



Platform to connect and exchange



Engaging dialogue with other stakeholders



If you have any questions or want to engage in dialogue, contact us at: [ana.granados@effab.info](mailto:ana.granados@effab.info)



# Plenary n°1

## ANIMAL HEALTH LAW - EWA CAMARA

The presentation provides for an overview of requirements for registration and approval of germinal product establishments, registers and record keeping obligations, traceability of germinal products in the Union, as well as animal health requirements for movements between the Member States and entry into the Union of germinal products in the framework of Regulation (EU) 2016/429 of the Council and the European Parliament (the Animal Health Law) and Commission Delegated Regulations (EU) 2020/686 and 2020/692 supplementing the Animal Health Law.

The presentation clarifies types of germinal product establishments and requirements for their approval, as well as information on registers kept by the competent authorities and record keeping obligation for the operators of approved germinal product establishments. Operators producing, processing or storing germinal products shall mark germinal products in such a way that they can be clearly traced to the donor animals, the date of collection and the germinal product establishments where they were collected, produced, processed and stored. Commission Implementing Regulation (EU) 2020/999 provides detailed rules for marking of germinal products.

The presentation also contains information on the list of animal diseases relevant for the movement and entry into the Union of germinal products in accordance with Article 5(1) of Animal Health Law and it explains

requirements for establishment of origin of donor animals and testing regimes.

It explains that consignments of germinal products can only be moved to another Member State if they are dispatched from a germinal product establishment approved by the competent authority. In addition, it guides on certification and notification requirements necessary for the movement and entry into the Union of germinal products. Model official certificates are laid down in Commission Implementing Regulation (EU) 2021/403.

The presentation provides as well for the requirements for transport of germinal products and for their collection, production, processing and storage, including on addition of antibiotics in semen diluents.

Finally, new provisions are presented, in particular rules on movement to other Member States of germinal products intended for scientific purposes and those stored in gene banks, as well as of germinal products of dogs, cats, cervids and camelids.

The presentation gives a complete picture on new animal health requirements for movements between the Member States and entry into the Union of germinal products applicable from 21 April 2021. It also provides information what has been changed comparing to the previously applicable Union legislation in this area.

# Plenary n°2

## OIE RECOMMENDATIONS REGARDING GERMINAL PRODUCTS PRODUCTION AND EXCHANGES - ETIENNE BONBON

With the expansion and intensification of international trade in animals and animal products in the last decades, the risk of the spread of transboundary animal diseases has increased. Germinal products, although less than live animals, bear specific risks of disease transmission. Veterinary Authorities may take legitimate measures at import to protect their territories' animal populations. These measures have often led to overly stringent restrictions or even wide embargos that may have a counterproductive effect. In order to avoid unjustified barriers to trade, the World Trade Organization's Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) recognises the OIE Standards as the international reference to be followed for animal health measures. OIE Standards provide for scientifically based recommendations for risk mitigation measures before and during international movements, depending on the disease and the commodity.

Regarding germinal products of terrestrial animals, the OIE Terrestrial Animal Health Code (Terrestrial Code) include 'horizontal' conditions for the safe production of semen and embryos from the major production species, as well as 'vertical' conditions for the safe trade of those products depending on the disease and the exporting country's health status. Veterinary Authorities are invited to use the Terrestrial Code (as well as the Terrestrial Manual for the diagnostic techniques) to implement sound and effective risk mitigation measures at import.

However, Member Countries and other users of the Code complained about difficulties in implementing the recommendations relating to germinal products, notably semen. The Terrestrial Animal Health Commission (Code Commission) acknowledged these difficulties

were linked to possible inconsistencies and lack of clarity in the relevant Terrestrial Code chapters. It requested in 2019 that an expert ad hoc Group be convened to revise Chapters 4.6 and 4.7, respectively on 'General hygiene in semen collection and processing centres' and 'Collection and processing of bovine, small ruminant and porcine semen', as well as provisions in relevant disease-specific chapters of the Terrestrial Code and the Terrestrial Manual, in order to ensure that those texts reflect the latest scientific evidence and best practices regarding risk mitigation measures in the collection and processing of semen of animals. The ad hoc Group was also requested to consider the inclusion of provisions to address equine semen in these chapters.

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The ad hoc Group met twice between November 2020 and July 2021. It first worked on Chapter 4.6. This complex task will continue by engaging a leading expert who will work closely with the OIE Secretariat and a representative of the Code Commission to review the draft text, based on the outputs of the ad hoc Group, the advice of the Code Commission, and the recommendations of species-specific experts. The adoption of new chapters is foreseen in 2023. Until then, Terrestrial Code users are encouraged to continue developing import conditions reflecting risk-based mitigation measures and widely applied up-to-date science, and exchanging latest data and knowledge for a common understanding of both the biosecurity in production and the sanitary measure in trade, of animal germinal products.

# Plenary n°3

## ENVIRONMENTAL ASSESSMENT OF PIG PRODUCTION : WHAT LESSONS FROM LCA? - SANDRINE ESPAGNOL

Environmental assessment of animal production can be performed by Life Cycle Assessment. For the agricultural stage, the perimeter includes the production of inputs like feeds, the construction of buildings, the animal farming and the manure management. The results are expressed per kilo of liveweight at farm gate. The environmental impacts most often considered are climate change, acidification, eutrophication, nonrenewable energy consumption and land occupation.

In pig production, the results indicate two main stages responsible of the impacts: production of feedstuffs mainly due to emissions occurring at field for crops, and transformation of manure in buildings and during external storage due to gaseous emissions. Several criteria have been identified as decisive: the part of Brazilian soybean meal in feed, the protein content of feed, the technical performances of pigs (number of pigs produced per sow per year, feed conversion ratio) and the type of manure (solid manure vs slurry) depending on the configuration of the buildings. Innovative strategies have been explored, firstly to reduce the environmental impacts of feeds thanks to the used of ecological feedstuffs, and secondly to decrease impacts from manure with alternative managements like frequent removal from buildings or treatments. Genetic is another lever at the heart of the system because it defines technical performances like productivity gain or residual feed intake (RFI). More productivity leads to less mobilization of resources (energy, area, water) and less emissions (ammonia, greenhouse gases) to produce the same quantity of animal product (milk, meat). An improvement of the feed

intake corresponds to the use of less feed for the same amount of animal product.

Recent works assessed the incidences of genetic aspects in cattle and pig productions. The activities of genetic selection (production of semen for artificial insemination or management of bulls for life-cover) have been integrated in the perimeter referring to LCA of milk or beef. The results indicate a very small contribution (<1%) of the activity itself for most of environmental impacts, except for energy consumption with 4%. However, the improvement due to genetic proved to reduce significantly environmental impact of milk and beef up to 11%.

In pig production, the comparison between two genetic lines RFI- and RFI+ show, a feed conversion ratio (FCR) improved by respectively 12% and 8% in ad libitum and restricted strategies, nitrogen excretions reduced by 23% and 8%, and VS excretions decreased by 14% and 1%. The improvement is higher in ad libitum strategies compared to restricted ones because the potential of RFI- animals is more expressed in those strategies. The environmental impacts of RFI- genetic line are not all reduced at the same level, compared to the impacts of RFI+ genetic line. The higher reductions are obtained for the acidification and eutrophication, by respectively 10% and 7% for restricted strategy and by 16% and 11% for ad libitum strategy. The explanation is that those impacts are closely linked to nitrogen excretions of animals. However, all the impacts are reduced, and this underlines the fact that the improvement in genetic concerning the feed intake is an added lever to reduce the environmental impacts of animal products.



# Cattle session n°1

## GLOBAL WARMING : CONSEQUENCES FOR SPERM QUALITY AND FERTILITY ON BULLS - ANN VAN SOOM

Rising temperatures caused by climate change have adverse effects on cattle physiology, welfare, health and reproduction. Heat stress in cows impacts the oocyte and embryo directly through heat shock on cellular function. Fewer data are available on the impact of high temperatures on male fertility. Temperature-Humidity Index (THI) is a measure for assessing the risk of heat stress combining the effects of temperature and humidity. The aim of this study was to determine the relationship between THI and fresh and frozen-thawed sperm quality of Holstein bulls kept in temperate climates. Bull sperm data of 29,170 ejaculates from 933 bulls collected at three Dutch AI centers between 2015 and 2018 were evaluated. The assessed variables included total sperm motility and morphology of fresh semen, and total sperm motility, morphology, and progressive motility of frozen semen 0 and 3 h after thawing. In addition, 56-day non-return rates (NRR56%) were analyzed. The assessed effects were season and THI on the day of semen collection and during spermatogenesis (30 days before collection), bull, age of bull, year, and location. Bulls were divided into two categories according to their

age: young (< 36 months) and older. Overall sperm quality of young bulls improved as age increased. No effect of THI on fresh sperm variables was observed in both young and older bulls. However, high THI at spermatogenesis negatively affected the cryotolerance of sperm cells. Sperm cells from young and old bulls showed a pronounced decrease (14 to 18%) of the assessed variables 3 h after thawing after the increase of THI during spermatogenesis in autumn. Remarkably, older bulls were more sensitive to THI at spermatogenesis compared to semen collection, showing up to 3.8 times higher negative effect on frozen sperm quality. However, an elevated THI at semen collection produced a tendency towards decreased NRR56% as the age of the bull increased. Although this decrease was up to 4%, rising temperatures may still cause important economic losses in the future. For the first time, the present study confirmed that climate compromises not only sperm quality, but also dairy bull fertility.

# Pig session n°1

## SPERM PRODUCTION AND BOAR TAIN RISK - ARMELLE PRUNIER

Androstenone and skatole are the two main components causing an unpleasant flavor of pork meat from male pigs (so-called boar taint). Androstenone is increasingly produced by the testes during the pubertal development and accumulates in fat. Skatole is produced by intestinal microorganisms and also accumulates in fat tissue. Due to testicular steroids, skatole is more present in males than in females. Numerous studies have demonstrated a high heritability for androstenone (0.5 to 0.7), a moderate one for skatole (0.24 to 0.5) and a low to moderate genetic correlation between both (0.12 to 0.48). Therefore, genetic selection against fat androstenone should be effective in reducing boar taint. However, high phenotypic and genetic correlations were also demonstrated between fat androstenone on one hand and plasma testosterone and FSH and even, more pronounced, plasma oestradiol on the other hand. These hormones playing a major role in the control of the reproduction function in males, it is of particular importance to examine potential relationships between fat androstenone, plasma oestradiol and testosterone and performance of reproductive traits in male pigs. Regarding paternal reproduction performance, small negative effects between androstenone and semen quality and quantity were detected. Positive genetic correlation between fat androstenone and testicular size was also measured. Divergent selection for fat androstenone induced a higher testosterone plasma level in males from the third generation. Considering three Pietrain varieties, boars with high sperm production had a lower proportion

of offspring without risk of odor compared to boars with lower sperm production. However, fat androstenone level seemed to be independent from main parameters of the ejaculate (volume, concentration, and total semen) in LargeWhite boars. In Danish Landrace boars, genetic correlations between fat skatole and androstenone and different semen quality traits were even negative and varied slightly with age tending to be more favorable in older boars. In the same population of boars, the genetic correlations between litter size traits (measured on sows related to boars) and boar taint compounds were low and not significantly different from 0. More recently, using boars from different genotypes (Landrace, Duroc and Pietrain) and a multivariate approach, androstenone levels in fat appeared to be fairly independent of the sperm production characteristics of the pubescent boar. In addition, sperm production did not appear to be related to pubertal development either, as assessed by hormone assays or by genital weight. Results from commercial AI centers, also suggest that the sexual precocity of boars, as assessed by blood tests, does not influence the career of boars. This is true even for boars with very low hormone concentrations at stages well before the collection period. In other words, a lower or delayed pubertal development does not seem to affect markedly the sperm production and thus the reproductive ability of the boar. In conclusion, fat androstenone seems to be linked to plasma sex steroids in boars but without clear detrimental influence on their reproductive abilities.



# Pig session n°2

## ULTRASOUND FOR TESTICULAR EVALUATION - MICHAEL KLEVE-FELD

New ways of predicting sperm quality and output performance in young artificial insemination (AI) boars are important for breeding companies to ensure that the pubertal boars delivered to the Gene Transfer Centers (GTCs) have a high chance of meeting minimum quality standards to be used for insemination and therewith genetic dissemination.

In a joint research project with the IFN Schönow boars in a boar multiplication nucleus farm were evaluated using testicular sonography during puberty on day  $100 \pm 5$  (on-test,  $n=1.650$ ) and  $170 \pm 5$  (off-test,  $n=925$ ). Two to three vertical and one horizontal image were taken from each boars' testicle in addition to a width measurement to aid the testicular volume calculation. A software supported Grey Scale Analysis (GSA) was performed on all images describing the testicular tissue texture through various pixel characteristics. Further details about the data capturing can be found in the respective peer reviewed paper [Schulze et al. 2020].

To automate this process and identify relevant regions for analysis within the testis, a convolutional neuronal network was trained to perform semantic segmentation. The GSA data from the ultrasound analysis in combination with the spermatologic data delivered by 3 GTCs (who purchased the boars) was used to program a supervised learning algorithm to

predict whether a boar will produce ejaculates with satisfactory semen quality.

The prediction model developed based on the trial data is capable of predicting a boars' later semen quality status with ~94% accuracy (95% sensitivity, 91% specificity) so that 95% boars with poor semen quality can be identified correctly.

### Summary

Ultrasound Technology enables the early identification and negative selection of AI boars with expected poor semen quality. The approach uses testicular ultrasound images to automatically analyze relevant organ sections by convolutional neuronal network and semantic segmentation approaches and describe the functional tissue characteristics via Grey Scale Parameters. This information feeds a classification algorithm to predict a boars' capability of producing good semen quality later in life. The technology offers advantages throughout the value chain by:

- Enhancing the breeding company's ability to enable genetic dissemination
- Raising the GTCs overall semen production efficiency per purchased boar
- Delivering higher quality semen to sow farmers with respective fertility implications

# Plenary n°4

## THE FUTURE OF LIVESTOCK - AN ANIMAL HEALTH COMPANY'S OUTLOOK - CHRISTIAN WUNDERLICH

During changing and challenging times, the reliability of food chain supply becomes more important and the vulnerability more visible than usual, as currently seen. However especially the growing demand for food from a worldwide growing society, the high-quality level of food produced in the European Union and good veterinary care are making the livestock industry a pillar for the future.

Especially if – as a single vet, a profession or even a company – we are taking into account that the livestock sector is one of the most innovative and transforming sectors during recent years. Constantly changing requirements, the need to endure cyclic low-price phases and even new challenges in front of us on a more European level did not stop livestock farmers to have one thing in mind – their individual animals they care for.

In the upcoming years, a more wholistic approach from supporting and supplying industries of the livestock sector will become necessary. While improving in the breeding sector constantly – whether by using genomic testing, efforts in breeding programs and others – quick wins were not observed in general. Furthermore, the animal health indicators – which are objectively hard to measure – did not change either. It seems like there are other factors impacting the development and the more general outcome of the livestock industry. One important factor in this context is the people taking decisions on farms and implementing or actually not implementing what has been shared with them in their operations.

With that in mind, future focus areas – to

successfully improve animal health and maybe more importantly animal welfare – must include a more holistic approach of implementations and support to livestock farmers. By supporting veterinarians in their role as animal health and welfare advisors in their daily work, supporting their customers – the farmers – together with innovative solutions and trainings to make the change happen, Zoetis will support both in the future.

From a European point of view, new regulation and political initiatives like the Farm to Fork Strategy will have an impact in the next years and accelerate the need for change, focusing on the area of prediction, prevention, and detection – to increase animal welfare and animal health. Also sharing the efforts taken, being open to the consumer of farm produced food and ensure visibility through the food chain will help to have the social license to operate.

In this context sustainability becomes critically important – solutions to measure the current footprint, show potential improvements and new ways of reducing carbon dioxide for example, will be a topic to be considered as well. Especially processors and retailers are pledging to become carbon neutral and will pass these requirements down the value chain to the farmer.

To conclude, the future of livestock in general can be seen as positive, however in the short term some changes need to be made – hand in hand by farmers, veterinarians and the whole value chain – to build a stable foundation for the next decades.

# Plenary n°5

## WHAT HAS BEEN LEARNED ABOUT TOXICS IN PLASTICS AND NEW RESEARCHES - RAQUEL AUSEJO

In intensive pig production systems, all fecundation is done by artificial insemination. For this purpose, the use of generally plastic containers is necessary because boar semen is collected, diluted and finally packaged until final use. Sperm quality is always checked during processing, and routine parameters are measured before insemination. Sperm is accepted for breeding use only if these parameters achieve the required thresholds. Some reproductive failures in which the seminal sample had all the commonly studied parameters correct have been found. These samples had a correct state of acrosomes, plasma membranes, mitochondrial activity,... (evaluated by flow cytometry), but later these samples generate returns to heat, abortions and even smaller litter size.

The toxic effect of plastic materials in food and on human health due to ingestion has been extensively studied. But lately the harmful effects of plastic materials used in the conservation of seminal samples are being analyzed more in depth. This effect becomes a problem of reprotoxicity since it goes unnoticed in all the controls carried out in the seminal doses.

The composition of the plastic materials used for seminal preservation can produce migrations of certain compounds that affect the reproductive capacity of the sperm. Later research has demonstrated that not only multilayer containers present these type of toxics, but all plastic materials in general (heat- sealed tubes included), so it is essential that good internal quality control of plastic containers (regardless if they are multilayer

or monolayer) is able to detect the minimum change in composition or functioning. Another component commonly added to seminal dose containers is inks. Inks are made of different components that can migrate and cause this damage to reproduction. Toxicity will depend on the proportion of the component to migrate, the speed of migration and its capacity for synergy, enhancing its toxic effect together with other components. Detecting any compound or pathogen involves knowing its existence, action mechanism and the effects it produces. Once identified, there should exist the necessary diagnosis methods. It should be pointed out that any compound in enough quantity has toxic effects, having to evaluate the effect of any substances on biological functions considering dosage and the combined effect of the substances.

- Nerín et al, Compounds from multilayer plastic bags cause reproductive failures in artificial insemination. *Scientific Reports* 2014; 4 : 4913
- Ausejo et al, Update of toxic compounds from plastic packaging used in artificial insemination that cause reproductive failure. *IPVS 2016*
- Rehfeld et al, Bisphenol A Diglycidyl Ether (BADGE) and Progesterone Do Not Induce Ca<sup>2+</sup> Signals in Boar Sperm Cells. *Frontiers in Physiology* 2020, 11:785
- Nerín et al, Influence of nonylphenol from multilayer plastic films on artificial insemination



# Plenary n°6

## THE GENETICS OF MALE INFERTILITY IN HUMANS - FRANÇOIS VIALARD

At the opposite to animal breeding, with the objective to select the best animal for reproduction, the medical strategy is to help infertile patients to parenthood. If environmental problem is a major cause to explain increase frequency of infertile patients, genetic seems also to impact dramatically the human reproduction, and especially the spermatogenesis. Since the emergence of karyotype, cytogenetic analysis is the first line analysis to evaluate male infertility, and Klinefelter syndrome is the most frequent abnormality, identified in 10% of patient with a total spermatogenesis failure. But, with the emergence of new molecular genetics technology, the list of gene defects is

continuously increase, and the etiology of many spermatogenesis defects have been explained. If, in general, genetic variants need to be validated on mouse model, and considering a large genome homology between human and other mammals species, human gene defects could help to identify new gene variants to improve animal selection in the future.

# Cattle session n°2

## GENOME-WIDE ASSOCIATION ON MALE FERTILITY TRAITS - CHRIS HOZÉ

With the development of genomic selection and the cessation of progeny testing, bulls are no longer tested for fertility before being used on a large scale. Calves are purchased at a very young age based on their genomic evaluation for female traits without any knowledge on their own fertility.

The objective of this study was to provide early indicators of bull fertility. Two complementary approaches were used, one seeking to set up a genomic evaluation of male fertility, the second looking for genomic region (QTLs) associated with this trait.

The effect of the service bull estimated in the female fertility (conception rate) genetic evaluation model, i.e. the effect of the bull after correction of all the effects (environmental and cow's genetics) affecting the result of each artificial insemination, was used as a proxy phenotype for male fertility. QTL detection was performed in the three major dairy breeds, i.e. populations of 2390, 1117 and 4886 Montbéliarde, Normande and Holstein bulls, respectively. The animals were genotyped with bovine chips for 53,869 SNP markers

and genotypes were then imputed to whole genome sequence (WGS) with Minimac4 using RUN8 data of the "1000 bull genomes" project. WGS data were then filtered for imputation quality ( $R^2 > 0.1$ ) and allelic frequency ( $MAF > 0.001$ ) leading to a set of 15,884,722 variants. Association analyses were run using GCTA software.

In Montbéliarde breed, 17 genomic regions were detected with the two major ones associated with genetic defects inducing abortions. In Normande breed, 7 regions were detected but no candidate gene could be identified. In Holstein breed, 12 regions were identified, 6 of them including genes known to have an effect on male fertility.

The results obtained in this study, in particular in Holstein, seem promising to highlight regions involved in bull fertility and thus produce indicators to select the future sires. Further work is required to quantify the impact of identified QTL on male fertility and to test for non-additive genetic effects.



## Cattle session n°3

### PROTEIN MARKERS OF BULL FERTILITY IN SEMINAL PLASMA - PATRICE HUMBLOT

Bull fertility is an important trait in breeding but the high number of inseminations needed to obtain reliable measures from Non-Return Rates to oestrus creates difficulties in assessing fertility accurately. The molecular knowledge of seminal plasma properties provide ways to study its relationships with semen quality and fertility. In this study, we used liquid chromatography mass spectrometry (LC-MS/MS) to analyze the protein content from the seminal plasma of 20 bulls with Non-Return Rates between 35 and 60%. Seminal plasma samples from these same bulls were collected across three seasons. Overall, 23990 peptides and 1343 proteins were identified and proteins with consistent correlation to fertility across multiple seasons found. From these, nine protein groups had a significant Pearson correlation

( $p < 0.1$ ) with fertility across all three seasons and 34 protein groups had a similar correlation across at least two seasons. These proteins showing a high and consistent correlation across seasons included Osteopontin, a lipase (LIPA) and N-acetylglucosamine-1-phosphotransferase subunit gamma. Three proteins were combined in a multiple linear regression to predict fertility ( $r = 0.81$ ). These sets of proteins represent potential markers, which may be used by the breeding industry to phenotype bull fertility and also characterize semen at a young age.

## Cattle session n°4

### OMICS IN SPERM FERTILITY - CHALLENGES AND PERSPECTIVES? - CHRYSTELLE LE DANVIC

During the twenty past years, numerous studies highlighted the link between sperm cells functionalities and fertility. Nevertheless, the underlined phenotypes do not allow a strong prediction of male fertility (40%; Sellem et al., 2015). The emergence of the 'Omics' analyses has provided new opportunities to the search for accurate predictors of male/ejaculate fertility. 'Omics' technologies allow to interrogate the genome, the epigenome, the transcriptome, the proteome, ... multiplying the possibilities of relevant fertility biomarkers discovery, and above all, highlighting the need to combine as much molecular information as possible to arrive at a reliable prediction.

As part of our SeQuaMol and Spermat'Omics projects, we have undertaken the phenotyping of bull semen through various 'Omics' analysis (from epigenetic to glycomic analysis). The results described here will focus on three of the studied molecular phenotypes: proteins, glycans and lipids. Frozen/thawed, animal insemination semen from Montbéliard ( $n=100$ ) and Holstein ( $n=46$ ) bulls with contrasting fertility (fertile vs sub-fertile) were studied for their proteins, lipids and N-glycans composition. Whatever the phenotype, the obtained results highlighted a heterogeneity between the bulls' profiles regardless of the fertility group or of the breed. Despite this heterogeneity, fertile and sub-fertile groups could be discriminated. Interestingly, most proteins that stand out as discriminating between the fertility groups are not the same between breeds. Nevertheless, some common biological pathways seem to be involved in the fertility discrimination as

protein degradation or metabolic pathways. A first structural characterization of the sperm glycocalyx was obtained from our glycome analysis. The two studied breeds globally shared the same N-glycans. Differences between fertility groups seems to be marked by longer polysaccharides and an increased in fucosylated N-glycans in the sub-fertile group. If some tiny variations could be observed in sperm phospholipid content between the breeds, sub-fertile and fertile bull seem to be discriminated by the presence of more unsaturated fatty acids with longer chains.

If some leads emerge from this work, many challenges remain to be addressed. The final objective is to develop fertility prediction tools based on a combination of biomarkers that could be used as routine quality control by the breeding industry. Integration of all the identified potential biomarkers (genetics, epigenetics, proteomics, glycomics, ...) is one major point. The multi-omics statistical analysis would be our next move (LabCom SeQuaMol, French ANR and French breeding companies program). The validation of all the identified biomarkers is another major key. Work is on-going on the development or appropriation of existing easy, rapid, reliable, and low-cost technologies to facilitate the molecular phenotyping in order to increase the phenotyped population.

#### Acknowledgements

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# Pig session n°3

## INTRODUCTION TO BACTERIA PRESENT IN SPERM - WAJDI BEN HANIA

Artificial insemination is widely used to advance genetic progress and pork productivity. Since the swine semen is still conserved at 17°C for several days, many bacteria are isolated and/or detected independently from the breed, age or even country. We propose to classify these bacteria on 3 main groups (true pathogen, probiotic, commensal bacteria). The presence of true pathogen in semen is prohibited because of sanitary repercussion. Meanwhile, the presence of the commensal bacteria can be tolerated at low concentration. Only probiotic bacteria could be of interest since they can inhibit pathogen bacteria and can play a beneficial role on female genital tract. It was proven that bacteria could have negative impact on sperm, that's why the antibiotics are used systematically to protect spermatozoa.

Some of semen bacteria could have naturally or acquire antibiotic resistance mechanism that protect them from different antibiotic used in extenders. Thus, these bacteria will thrive to spread antibiotic resistance gene in the environment. This phenomenon is considered as a serious health threat from the one health perspective.

# Pig session n°4

## HIGH THROUGHPUT SEQUENCING OF SPERM BACTERIA - DUC PHAM

Artificial insemination is worldwide used in the swine industry. Unlike other animal productions, pig semen is commonly used diluted, in liquid stored at relatively controlled temperature (between 14°C and 18°C). This method requires a rather rapid use of the semen (mainly less than 5 days). A main challenge for the artificial insemination industry is to maintain semen quality that satisfies the fertilization objectives while preserving bacteriological safety. A relatively large number of studies have identified bacteria recovered from boar semen attributed to fecal, preputial, cutaneous microorganisms, or other environmental bacteria from semen analysis and semen dose packaging areas for artificial insemination. From automated semen collection technologies to the use of antibiotics incorporated at the time of semen dilution, many procedures have made it possible to bacteriologically secure the product. Some of the bacteria found in semen have been associated with deterioration of expected fertility performance : Enterobacteriaceae with significant decrease in sperm motility, E. coli with decreases in litter size, P. aeruginosa alters sperm capacitation in vitro. In addition to the objective of quality and safety, the reduction of the antibiotic load in marketed semen is an objective of the pig semen industry. Basic culture methods do not allow the complexity of a microbiota to be revealed for practical reasons : response time and/or cost-effectiveness.

For more than ten years, with the arrival of high-throughput DNA sequencers, microbiota investigation approaches have considerably evolved, initially reserved for research in human health or studies of microbial ecosystems in ecology, today these methods are beginning to be used in an industrial context to qualify products in bacteriological terms. A previous study of the human seminal microbiota was performed using 16S high throughput sequencing and microbial signature has been associated with semen quality.

In this study, we offer a preliminary approach integrating the high-throughput metagenomics sequencing tool into the study of porcine bacteriospermia. We will attempt to characterize the porcine seminal microbiota before and after dilution (at the beginning and at the end of the process) of different semen production artificial insemination center: boar studs (AI) (5 French AI studs and 1 AI stud in the United States of America). This pilot study will demonstrate the potential application of seminal microbiota analysis in the context of industrial boar semen production. It consists in an experimental design and methodology to assess the use of this innovative approach. The interpretation of the results allows us to perceive which variables would be preferentially associated with the composition of the seminal microbiota.

Thus we saw that 16S metagenomics defined a specific profile's stud in terms of location, flooring. It shows that the process has an impact on the diversity of the porcine seminal microbiota and so that 16S metagenomics could be a tool to ensure the conformity of a semen production process as well as a perspective to adjust dilutions conditions of the semen.

Despite the limitations of this method, not a quantitative method and often difficult to access to the taxonomic level of the bacteria species, establishing reference samples with the 16S metagenomic could help to monitor an AI's stud. Thus by regularly carrying out an image of the stud, we believe we can follow the bacteriological quality of the semen produced by anticipating the production process.

Finally 16S amplicon sequencing - a culture free method - allows us to an access to a global profile of the bacterial microbiota of the porcine semen produced. The idea will be then to associate certain profiles with profiles producing a semen with good fertility.

# Pig session n°5

## HYGIENE AND BACTERIA IN EXTENDED SEMEN: AN EIGHT-YEAR RETROSPECTIVE STUDY OF 28 EUROPEAN BOAR STUDS - MARTIN SCHULZE

Antibiotic agents such as gentamicin represent essential components of semen extenders in order to reduce bacterial contamination. But antibiotic resistance increases and AI centers start utilizing antibiotic agents which are more potent. Therefore, a shift to preventing bacterial contamination has to take place. In this study, we could demonstrate that hygiene is a tool capable of reducing bacterial load. In order to analyze 1,434 extended semen samples and nine specially established hygienic critical control points (HCCPs, n = 828), 92 quality control audits have been carried out in a time period from 2012 until 2019 in 28 European AI centers (size 80 to 500 boars). AI centers were visited every two years and were located throughout Germany (n=23), Austria (n=3) and Switzerland (n=2). Twenty-three AI centers were visited during the first audit (332 ejaculates + 207 HCCPs), 27 within the second audit (413 ejaculates + 243 HCCPs), 19 during the scope of the third audit (310 ejaculates + 171 HCCPs) and 23 studs as part of the fourth audit (379 ejaculates + 207 HCCPs) in order to identify the sources of bacterial contamination. Between these four quality audits, individualized modifications of the workflow were implemented based on a standardized inspection protocol. Dip-Slides (Dip-Slide Plate Count/VRBD, Oxoid-Thermo Fischer) were used to obtain samples from HCCPs, including filling machine, ejaculate transfer (air tube/pass-through), extender, inner face of dilution tank lids, dyes, manual operating elements (keyboards, telephone set), laboratory surfaces, ultrapure water treatment plants and sinks/drains. All evaluated HCCPs were classified by a valuation code. The results show the process of introducing a basic hygienic standard in audit 1 (2012/2013) and 2 (2014/2015) and the resulting achievements by means of improved hygienic conditions in audit 3 (2016/2017) and 4 (2018/2019). In total, 79.4% of the semen samples were not

contaminated at all (0 CFU/mL), 9.8% were contaminated with bacteria of 1-99 CFU/mL, 6.6% showed a bacterial contamination of >100-499 CFU/mL, 1.3% of the samples had a bacterial contamination of >500-1,000 CFU/mL and 2.9% of >1,000 CFU/mL. The total bacterial count in extended semen averaged from 0 CFU/mL to 1,179 CFU/mL whereby a mean number of 359 CFU/mL has been detected in audit 1, 88 CFU/mL in audit 2, in data set 3 a total of 20 CFU/mL were identified and within the scope of data set 4 the amount of 55 CFU/mL was detected. Within the scope of audit 1, 19% of the semen samples were contaminated with bacteria (cutoff  $\geq 100$  colony-forming units/mL). Audit 2 showed a bacterial load of 13.6% whereas during audit 3 and 4 very low bacterial contamination rates were recorded (4.5 and 5.5%, respectively). In the same manner, analysis of hygiene at different CCPs during semen production showed a decrease in all average HCCP-scores (score 1-6) comparing audit 4 to 1. By regression analysis we could show a significant audit-dependent association of the bacterial contamination in semen samples and hygiene of HCCPs. Furthermore, analysis of the odds ratio (OR) reveals that the bacterial contamination of certain HCCPs poses an increased risk of receiving bacterially contaminated semen samples (filling machine: OR = 3.02, P = 0.06; extender: OR = 8.97, P < 0.001; inner face of dilution tank lids: OR = 3.14, P = 0.09). Around 60% of the variance of the bacterial contamination in semen samples could be explained by hygienic conditions at different control points and their interaction with audit period and AI center. Antimicrobial agents are essential to protect human and animal health but excessive or inappropriate use can lead to the emergence of resistant bacteria. As shown in our study, hygiene management can significantly reduce bacterial contamination and is therefore capable of preventing antibiotic resistance.

# Cattle session n°5

## SEMEN PRODUCTION FROM PREPUBERTAL BULLS AT VIKING GENETICS - KASIA KUPISIEWICZ

Genomic selection revolutionized modern cattle breeding, and a desire of shortened generation intervals urged for the use of semen from very young genomic bulls. In practice, semen production from such pubertal bulls is challenging due to lower semen quality and higher discard rates in production compared to older bulls.

Young bulls can be defined either by their semen quality and quantity or, more practically at AI centers, by their age. At Viking Genetics, term "young bulls" covers semen producing individuals up to 12 months. Overall discard rates (pre- and post-freezing) for young bulls are 26% compared to 13% for 12-15 months when semen production is at its highest or bulls older than 15 months where discarded doses account for 10% of total production. Semen of young bulls is mainly rejected due to their neat semen quality, however ejaculates with satisfactory neat semen quality can also fail freezing. Thus, semen production from young bulls is less effective with high discard rates and low number of doses per ejaculate (average of 120 approved doses at 9 months in 2020 across breeds). Also, fertility of first ejaculates obtained from young bulls may yield lower field fertility than subsequently produced AI doses but those results are uncertain due to low number of inseminations performed with first ejaculates.

Production sites are daily challenged trying to balance the advantages of genetic gain and problematic semen production and insemination success. Therefore, production personnel faces following questions: i) how to obtain good quality semen from even younger animals; ii) how to predict bull's maturation status; iii) is it possible to predict semen quality prior production start?

Several studies addressed the importance of nutrition specially at early age (reviewed by Kenny DA and Byrne CJ). Our own results showed that bull calves with low weight gain in quarantine are less likely to start successful production compared with calves with average or high weight gain. Therefore, weight and daily gain of bulls are closely monitored not only as indicators of bulls' health and welfare but also as putative markers of production outcome.

Another aspect of semen production is bull's ability to produce freezable semen, which is unknown when selecting genomic bulls. In latest study, Viking Genetics evaluated the heritability of semen quality traits and their correlations with field fertility. Generally, semen quality traits showed moderate heritability and moderate to high correlation with field fertility. These results indicate that there is a potential for cautious prediction of semen quality based on genetics tests. Due to moderate heritability of semen quality traits, the prediction cannot be very accurate but could be an aid for setting production goals.

Careful utilization of all available data is essential for successful semen production from very young bulls. Combining genomic information for prediction of semen quality with tailored feeding for optimal weight gain, plus observation of bull's physiology (scrotal development) in relation to housing conditions and management decisions are fundamental for modern cattle breeding where availability of young bull doses is of a highest demand. Gathering reliable data, mapping their relationships, and understanding the mechanisms linking reproductive biology, genetics and management can with time help to turn average bulls into top semen producers even at young age.



## Cattle session n°6

**'WELL BEGUN IS HALF DONE' - IMPACT OF EARLY LIFE NUTRITION ON THE SEXUAL DEVELOPMENT OF THE BULL - DAVID KENNY**

Progress in genomic selection processes has accentuated interest in procuring saleable semen from young genetically elite bulls as early in life as possible. However, the timing of availability of semen for commercial use will be determined by the age at which these young animals reach puberty and subsequent sexual maturity. Recent evidence indicates that the timing of sexual precocity in the bull, which is dictated by an early gonadotropin rise (8–20 wk of age), is determined by prevailing metabolic status during calf-hood and is not compensable even where prior undernutrition is followed by unrestricted access to nutrient dense feed. Despite this, the precise neuronal mechanisms regulating these developmental processes remain to be fully elucidated. The advent of next generation sequencing technologies has, however, revolutionised our capability to describe the complex molecular regulation underlying key biological traits in cattle including earlier sexual development in the bull. Recently, increased efforts have focused on the complementary application of multi-omics based analytical approaches, in order to more comprehensively decipher the underlying biology of particular traits. Moreover, through integrating various levels of genomic data it is also possible to more clearly understand the functional role of specific genetic variants by determining the interactions between genes through co-expression analyses. Thus, the use of multi-omics based approaches and their

subsequent mathematical integration allows for more precise evaluation of biological traits as well as for discovery of more reliable biomarkers for complex, multidimensional traits. Our group have employed such interactive molecular analyses to examine the effect of nutritional status on the regulation of sexual development in prepubertal bull calves. For example, results from this integrative analysis of transcriptome and proteome data in tissues of the hypothalamic-pituitary-testicular signalling axis reveal a potential regulatory role for a specific miRNA (miR-2419) in influencing proteomic expression within each of the component HPT tissues of young bull calves. Specifically, processes including insulin and GnRH signalling within the hypothalamus, hormone processing in the anterior pituitary and cholesterol biosynthesis within the testes were all affected by prevailing dietary management at the protein level, with evidence for the effect to be mediated by miR-2419 expression. Knowledge derived from such analyses can be harnessed to identify accurate genomic targets, contributing to robust biomarker discovery within the context of genomically assisted breeding programs as well as facilitating the development of strategic nutritional regimens to optimize sexual maturation and subsequent semen availability from genetically elite young bulls, ultimately shortening the generation interval.



## Cattle session n°7

**LONG-TERM IMPACT OF EARLY LIFE NUTRITION ON DNA METHYLATION PATTERNS IN BULL SPERM - HÉLÈNE KIEFER**

DNA methylation is an epigenetic mark that covalently modifies CpG sites in genomic DNA. The DNA methylation landscape of male germ cells is massively remodeled during the differentiation of male germ cells, and these genome-wide changes are highly sensitive to environmental factors. While bull semen is widely used in artificial insemination, the literature describing DNA methylation in bovine male germ cells and spermatozoa is still scarce. One of the goals of the SeQuaMol team is to bring knowledge to this field in order to improve semen quality control procedures and bull fertility.

I will first present results we obtained on the characterization of the bull sperm methylome relative to somatic cells using a genome-wide, base-level resolution technology. A large share of differentially methylated CpGs (DMCs) was less methylated in sperm than in somatic cells. Consistent with previous studies in other species, these hypomethylated DMCs were enriched for genes relevant to the germline differentiation program and sperm functions. The most remarkable observation was a dramatic enrichment for repeats and particularly for satellites, which may partly

account for the lower global methylation we observed in bull sperm when compared to sperm from other species. Using the same technology, we interrogated the sperm DNA methylome of >300 bulls, and observed inter-individual variations as a function of age, breed, nutrition during early life and fertility, suggesting that physiological, genetic and environmental factors all contribute to shape the sperm methylome.

Altogether, these results call for a systematic quality control of the sperm epigenome which is transferred to the embryo alongside the paternal genetic heritage. I will discuss the opportunities offered by inter-individual variations in the sperm methylome to predict fertility, but also to diagnose programming events that occurred during the bulls' history and may have further consequences on offspring phenotype.

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# Pig session n°6

**BIOSECURITY APPLIED ON AI STUDS IN FRANCE - MIREILLE MAUSSERVEY**

When ASF appeared close to the French border in 2018, health security became a major concern for ALL pig farms. What was only field vets advice became a legal obligation for all site with pigs.

For AI studs, this new regulation was an opportunity to review the health protocols already implemented a long time ago.

The concentration of pig production in France and the necessarily short delay between collection and use of the semen place the AI studs in the middle of high pig density areas or

close. Since the beginning of Porcine Artificial Insemination, more than 30 years ago, the main organisations have been aware of the importance of the health protection of these studs: they are pioneers of Biosecurity.

We will see here, on a specific example, how the new regulation brings only minor changes to what already exists.

# Pig session n°7

**INTRODUCING PCAI AS A GAME CHANGER: PRATICAL AND ECONOMICAL CONSEQUENCES - HANS JUBBEGA**

We were convinced our future customer and pig producer will have a demand for accurate data and actual information presented in easy to understand reports. We started to develop our own management software “PigExpert ” and “BoarExpert” and built tailor made reports on all kinds of data sources. Meanwhile we supported our customers with consultancy, where I was responsible for boar stud management.

Today in 2021 AgriSyst is recording over 1 million sows in their database. We offer a complete ERP system developed for boar stud

management “BoarExpert” to Track & Trace of animals by RFID technology and handhelds from birth to slaughter.

With daughter companies in Germany, Belgium and future in Spain as well as a wide international dealer network we serve our customers and have the aspiration to become the national and international market leader in swine management software. We are working every day to serve our customers.

# Ewa Camara

I have graduated from Warsaw University of Life Science and obtained my diploma as Doctor of Veterinary Medicine (DVM) in 2003.

After graduation, I worked at General Veterinary Inspectorate in Warsaw as a specialist in Animal Health and Welfare Office.

Since 2013 I have been working as a legislative veterinary officer in Unit G2 – Animal Health of DG SANTE of the European Commission. Main areas of my responsibility are as follows:

- an animal health policy related to germinal products by managing, drafting and implementing the Union legislation, including Animal Health Law and delegated and implementing acts thereto;
- drafting of EU model certificates for movement within the Union and for entry into the Union of germinal products to allow the safe trade of germinal products for the EU Member States and third countries;
- an animal breeding policy related to breeding animals and germinal products thereof by managing, drafting and implementing the Union legislation, including Animal Breeding Regulation and delegated and implementing acts thereto.



European Commission  
Directorate-General for Health and Food  
Safety  
(DG SANTE)  
Unit G2: Animal Health  
F101 03/90  
B-1049 Brussels/Belgium  
+32 229-87701  
ewa.camara@ec.europa.eu

# Etienne Bonbon



Etienne Bonbon has been Senior Veterinary Advisor to the FAO Animal Health Service, Emergency Management Centre for Animal Health, since May 2017. He received his diploma in Veterinary Medicine in 1987, DVM in 1989, and Master's degree in human and animal epidemiology in 1991. Primarily a private practitioner in rural areas, he has been a Veterinary Public Health Inspector in the French Ministry of Agriculture since 1991. From 1992 to 2017, he was successively: Deputy Director of Veterinary Services in continental France and Martinica; Head of the Export Unit at General Directorate for Food in Paris; Regional Veterinary Attaché for the Near and Middle East in Beirut, and then for Northern Asia in Beijing; Seconded to the European Commission in DG Santé in Brussels; Head of the Communication Unit of the OIE and Advisor to the Director General of the OIE in Paris; and Seconded to the European Union Delegation to the OECD, UNESCO and OIE in Paris. He has been President of the OIE Terrestrial Animal Health Standards Commission since 2015, after having been Vice-President since 2009, and was reelected in May 2021 for a three-year term.



Dr Etienne Bonbon  
Senior veterinary advisor  
Animal Health Service  
Food and Agriculture Organisation of the  
United Nations  
Viale delle Terme di Caracalla, 00154  
Roma - Italia  
+39 0657052447  
etienne.bonbon@fao / e.bonbon@oie.int

# Sandrine Espagnol

“Sandrine ESPAGNOL - Environmental Engineer: IFIP Institute (F) Sandrine is a senior engineer in charge of the environmental assessment of pig husbandry systems. She deals with modelling the environmental fluxes, assessing by LCA current and innovative livestock systems, building tools for farmers to allow them to follow their environmental performances. She also works on gaseous emissions during the external storage of pig manures and the spreading. She leads a national French network gathering research partners involved in the environmental assessment of livestock farming. Sandrine has contributed to several EU projects (e.g. CANTOGETHER, FEEDAGENE, upcoming project PATHWAYS).”



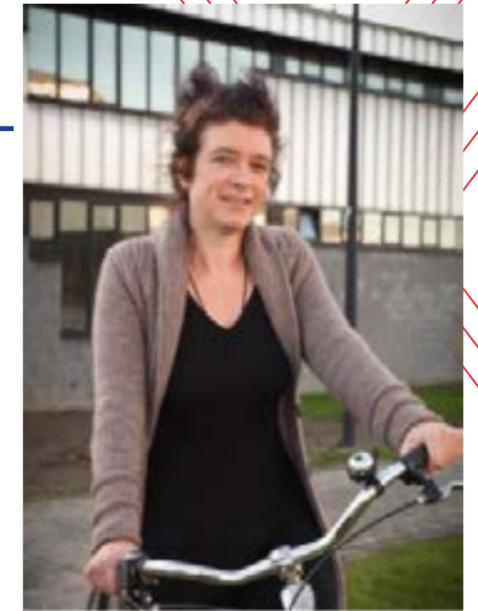
# Ann Van Soom

Ann Van Soom graduated in 1988 as DVM at the faculty of Veterinary Medicine, Ghent University, Belgium, and obtained a PhD on the development of bovine embryos in 1996. She has been employed at Ghent university since 1990.

At present, she holds a position as full professor at the department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, and is also Head of Department. She has been teaching assisted reproduction in domestic species, small animal reproduction and obstetrics to the veterinary students for more than 20 years now.

She is a diplomat of the European College of Animal Reproduction (ECAR) since 1999, and has been a member of the EVSSAR and the IETS for many years. She has been elected as a governor for IETS in 2007 and in 2013. She was member and Chair of the HASAC (Health and Safety Advisory Committee) Research subcommittee of IETS for about ten years. She was chair of the COST Action Epiconcept FA1201 from 2012-2016, and was a member of the EU-ITN network RepBiotech, and is now involved in EU-ITN network EUrova. She is also serving in national and international advisory committees on sanitary risks involved with assisted reproduction in domestic species, and has been authoring a chapter in the 4th edition of the IETS Manual dealing with these problems. She is supervising a group of about 10 PhD students and three postdocs working together on embryonic development and semen quality in different model species, like horses, cattle, cats, dogs and pigs. The main goals of the research performed at the Reproductive Biology Unit is to determine the causes of epigenetic changes and inferior quality of in vitro produced embryos by focusing on the suboptimal culture conditions in vitro and, on the other hand, the embryo-maternal interaction in vivo. We aim to define

key molecules and messengers, like extracellular vesicles, involved in oocyte maturation and in the embryo-maternal dialogue as well as in the communication between oocytes/embryos during group culture in vitro. Molecular biology, including whole genome sequencing, and



protein analysis has been used as a tool to evaluate gene expression, chromosomal instability and secretions of embryos, and to investigate interactions with the maternal tract and during in vitro culture, and to gain insight in underlying mechanisms and pathways. Prof. Van Soom has published more than 350 papers with an h-index of 46

She has up to now (May 2021) supervised a total of 37 PhD students as main supervisor or cosupervisor. She has served in the examination committee of 20 international PhD students and more than 30 national PhD students.

Her clinical activities are related to small animal reproduction, with an emphasis on semen collection, (research on) gamete cryopreservation and artificial insemination in cats and dogs. She is also visiting catteries and dog breeding facilities which are experiencing breeding problems. She is offering advice for applying new methods of contraception and oestrus induction in dogs and cats to practicing veterinarians, as well as giving advice in small animal obstetrics. Finally, she has been breeding English springer spaniels and Somali cats as a hobby.

Ann Alice Jozef Maria  
Professor in Animal Reproduction  
Salisburylaan 133  
9820 Merelbeke  
Belgium  
++ 32 9 264 75 50  
ann.vansoom@UGent.be

# Armelle Prunier

Armelle Prunier studied at AgroParistech (16 rue Claude Bernard, 75231 Paris, France) and got a PhD in Biology, speciality: Reproduction, at the University of Paris VI (France) in 1984. She worked in the PEGASE research unit between 1981 and June 2021. She started her research as a physiologist and developed skills in the field of animal science and applied ethology along her career. Between 1981 and 2002, Armelle has worked essentially on the control of pig reproduction with two main facets: understanding the physiological mechanisms and developing applied experiments to optimize reproductive performance by a better control of feeding, housing and management. During a transition period starting in 1999, her focus was mainly on piglet mortality: elucidation of causes and ways to reduce it. Between 2002 and 2021, Armelle Prunier worked essentially on the assessment and improvement of pig welfare. She integrated physiological, behavioural and sanitary measurements to assess husbandry practices, housing and management techniques. In particular, she developed studies to evaluate pain associated to castration, tooth resection and tail docking and, to develop methods to suppress or relieve pain associated to these husbandry techniques. More recently, she was involved in projects aiming at improving health and welfare of organic pigs, entire male pigs and undocked pigs. In addition to her research work, she was involved in numerous expertise groups (EFSA, Anses ethical committees). She has published more than 100 refereed papers and book chapters. These papers concern two main fields: control of pig reproduction and welfare of pigs. From the 1st June 2021, Armelle Prunier is retired but was assigned a mission by INRAE to support on-going research projects on animal welfare and solutions to stop surgical castration in pigs.

## *Selection of recent papers and book chapters*

Prunier, A., Brillouët, A., Merlot, E., Meunier-Salaün, M.C., Tallet, C., 2013. Influence of housing and season on pubertal development, boar taint compounds and skin lesions of male pigs. *Animal* 7, 2035-2043.

Tallet, C., Brilloüet, A., Meunier-Salaün, M.-C.,



Paulmier, V., Guérin, C., Prunier, A., 2013. Effects of neonatal castration on social behaviour, human-animal relationship and feeding activity in finishing pigs reared in a conventional or an enriched housing. *Applied Animal Behaviour Science* 145, 70-83.

Leclercq, C., Prunier, A., Thomas, F., Merlot, E., 2014. Neonatal surgical castration of male pigs reduces thymic growth but has moderate consequences on thymocytes. *Journal of Animal science* 92, 2415-2421.

Prunier, A., Dippel, S., Bochicchio, D., Edwards, S., Leeb, C., Lindgren, K., Sundrum, A., Dietze, K., Bonde, M., 2014. Characteristics of organic pig farms in selected European countries and their possible influence on litter size and piglet mortality. *Organic Agriculture* 4, 163-173.

Parois, S.P., Prunier, A., Mercat, M.J., Merlot, E., Larzul, C., 2015. Genetic relationships between measures of sexual development, boar taint, health, and aggressiveness in pigs. *Journal of Animal Science* 93, 3749-3758.

Robic, A., Fève, K., Riquet, J., Prunier, A., 2016. Transcript levels of genes implicated in steroidogenesis in the testes and fat tissue in relation to androstenone accumulation in fat of pubertal pigs. *Domestic Animal Endocrinology* 57, 1-9.

# Michael Kleve Feld

Dr. Michael Kleve-Feld graduated in veterinary medicine at the Free University of Berlin and earned his doctoral degree at the Unit of Reproductive Medicine at the University of Veterinary Medicine Hannover. After five years with the largest AI stud company in Europe he joined PIC where he serves as the Global Lead of Technical Boar Stud Operations. Michael is also an MBA candidate of Durham Business School.



# Christian Wunderlich



Dr.med.vet. Christian Wunderlich, specialized in cattle (Fachtierarzt für Rinder), studied Veterinary Medicine in Hanover, worked in private practice, did his doctor degree in the Department of Pharmacology, Toxicology and Pharmacy of TiHo Hannover, gained experience in the Clinic for Cattle at TiHo Hannover and joined Zoetis in 2016. At Zoetis his team and he are responsible for the companies dairy on farm business and the herd health management approaches mainly in Germany.

# Raquel Ausejo

Raquel Ausejo Marcos has a degree in veterinary medicine from the University of Zaragoza. After finishing her studies in France, she attended the master's degree in health and swine production conducted by the University of Zaragoza, Lérida, Barcelona and Madrid, winning the award for «Best Masters project».

After starting her career as a veterinarian in the pig sector, in 2010 she joined Magapor SL, initially as technical service, to become director of the Biotechnology R&D and the veterinary services of the company in August 2014.

She has taken part in several research projects aimed at improving productivity and modernization of the pig sector. She has written numerous informative texts, she is co-author of articles in journals of recognized impact, and she participates as a speaker at conferences and technical meetings internationally.



# François Vialard

Pharmacist and Geneticist, the Professor François Vialard is the head of the Department of Genetic in the Poissy-St Germain hospital. He is also in charge of the Histology and Embryology teaching program in the medical university of Saint Quentin en Yvelines. François Vialard has expertise in reproduction and genetics and signed a large number of papers on this topic. Currently, his researches are focusing in 3 majors topics:

- 1- genetic of azoospermia and he tries to implement a strategy, in France, to take in charge the patients, collaborating with a large number of specialists on spermiology, anatopathology and research.
- 2- Time lapse system to evaluate embryo development during in vitro fertilization
- 3- Therapy in Down syndrome to reduce the 3rd chromosome 21 impact on brain.

He is also a member of the executive committee for the French research group on reproduction (<https://www6.inrae.fr/gdr-repro/>), president of the French Cytogenetics society ([www.eaclf.org](http://www.eaclf.org)) and general secretary of the French society of reproductive medicine (<https://s-m-r.org/>).



# Chris Hoze

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Dr. Chris Hoze joined Allice's genetic team 10 years ago. After a PhD dedicated to marker imputation and multi-breed genomic selection, she developed projects and expertise in bovine genomic selection and GWAS, including the use SNP chip and sequence data. She is now cooperating with a male fertility team to improve the prediction of male fertility using SNP information.

# Patrice Humblot

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Patrice Humblot has been working as project manager and then head of the R&D Department of the French union of breeding companies (UNCEIA) for 30 years. He has got his PhD in reproductive physiology from the University of Tours in 1999. Since 2010, he holds a Professor position in the Swedish University of Agricultural Sciences (SLU) in Uppsala.

In UNCEIA R&D Dpt, he has been working on female and male fertility and later on with reproductive technologies with the goal to improve AI's efficiency and selection for fertility through better phenotyping for this trait. Together with genomic studies on reproductive physiology, he has initiated and developed embryo typing in view of genomic selection. Since he arrived in SLU, he focused on endometrial physiology and interactions of sperm with the female genital tract. He has a particular interest in the study of molecular mechanisms leading to establishment of pregnancy and in understanding the negative impacts of pro-inflammatory reactions and environmental factors on fertility. Privately, Patrice especially loves sailing with friends close or far-away from Swedish home.



# Chrystelle Le Danvic

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C. Le Danvic - ALLICE

Research Engineer at ALLICE R&D department for 12 years.

After a PhD and few years dedicated to the identification and characterization of pheromones implicated in reproductive process in cattle and small ruminants (estrus detection, induction and synchronization of ovulation, male libido, ...), I'm involved in programs connected to male production and fertility with a focus on the identification of fertility biomarkers on sperm cells for 5 years. My work is principally focus on the use of mass spectrometry technologies to decipher sperm cells functionality and to identify new (combination) biomarkers from proteins to glycans.



# Wajdi Ben Hania

Wajdi Ben Hania has been working as R&D manager at LNCR since 2018. He holds a PhD in microbiology from Aix-Marseille University. His previous research focused on the exploration of aerobic and anaerobic microorganisms involved in the sulfur and carbon cycles, with a particular emphasis on these inhabiting extreme environments (e.g. terrestrial thermal springs, oil reservoirs, hypersaline lakes) and microbiota (eg. human, animals). Multiple peer reviewed scientific manuscripts and book chapters have been accepted and published internationally along with registered patents. At LNCR, he has been actively working on the sperm microbiota and the interaction between the microbes and their environment. He is currently exploring new approaches to detect Microorganisms and multi-resistant bacteria “superbug”.



In his spare time, he practices sport and like relaxing in front of a good movie or with a best seller book...

# Duc Pham



Duc PHAM - Technical director of Genes Diffusion

After studying cellular and molecular biology, Duc started his career in a boar stud of 150 boars for managing the production. After 10 years, he joined Genes Diffusion for opening a new boar stud of 350 boars. Optimization of the A.I center, direct relation with farmers, Genetics management was his job during ten more years...

Duc is now Technical director of Genes Diffusion, responsible of the production of 2 500 boars in France, technical and quality monitoring of 8 labs. Finally, he developed the Advadiag for an annual internal audit on the 16 boar studs of Genes Diffusion. He is also part of the Genepro team as a technical support.

# Martin Schulze

Dr. Martin Schulze studied at the FU Berlin (Germany), qualified as a veterinarian in 2007 and graduated as doctor of veterinary medicine in 2010. Currently, Dr. Schulze is the scientific head of the Institute for Reproduction of Farm Animals Schönnow. His main research areas include boar fertility and semen quality assessment. Dr. Schulze is responsible for a spermatological reference laboratory and executes continuous international quality audits in boar studs.



# Kasia Kupisiewicz



Kasia Kupisiewicz has been working as project manager in R&D Department at Viking Genetics since 2013. She holds a PhD in molecular biology from the University of Southern Denmark and is experienced in project management and quality assurance from previous positions as university associate and from private sector. At Viking Genetics, Kasia works at the interface between breeding, barn and lab, aiming at optimization and higher quality of semen production, especially from very young bulls. Her professional interests include male fertility and reproductive biology, and understanding environmental impact on semen production and quality. She is data-driven and uses various registrations to make correlations and draw conclusions. Privately, Kasia loves long-distance hiking in Scandinavian nature, and, when not on the road, she relaxes with a good book.

# David Kenny

Professor David Kenny is a Principal Research Scientist in Ruminant Nutritional Physiology with Teagasc, the Irish agriculture and food research and development authority, and also holds an adjunct professorship at University College Dublin. He has over twenty years of research experience in the biological control of a range of economically important traits to ruminant livestock production systems, including growth and reproductive efficiency of both male and female cattle. His work is based on in-depth study and the application of state-of-the-art physiological and molecular approaches to these complex, multidimensional traits. He has led a number of large multi-partner research projects and has supervised the studies of 18 Ph.D. and nine M.Sc. students to completion, as principal supervisor. His research has resulted in the publication of in excess of 165 full length internationally peer reviewed scientific manuscripts and book chapters to-date, as well as many industry targeted technical reports. He was awarded the prestigious Hammond award by the British Society of Animal Science in 2018 in recognition of outstanding contribution to an improved understanding of how nutrition affects the complex underlying biology regulating economically important traits in cattle, including feed efficiency, rumen methane emissions and male and female reproduction. In his spare time he runs a small pedigree Charolais cattle herd and sheep flock in County Mayo, in the west of Ireland.



# Hélène Kiefer

Hélène Kiefer obtained a permanent researcher position in 2010 at INRAE of Jouy-en-Josas. She joined a team working on livestock epigenetics (leader: Hélène Jammes), and developed several tools to study DNA methylation at a genome-wide scale in cattle: a Roche-NimbleGen microarray, and more recently RRBS. She collaborates with bioinformaticians and statisticians to develop pipelines for DNA methylation analyses. Her research interest is to understand how epigenetic modifications vary under the influence of both environmental and genetic factors and contribute to phenotype variability in cattle. She is particularly interested in bull sperm epigenome and its potential role as a mediator of intergenerational inheritance effects.



# Mireille Mausservey

I'm a field vet, lost among clever scientists. My world is Pig production for about 30 years (since 1991).

Working for a coop, a breeding company and, finally, for a vet practice my main activity was always to support pig farmers with a global approach of health and productivity.

During all this time, I had the opportunity to run the breeding program of a coop, to organise the health management for a breeding company and to support one of the main french stud regarding health.

So Farm protection and biosecurity are my day to day concern and expertise.



# Hans Jubbega

With over 40 years of experience in pig production, boar stud management and data analyses, I am one of the founders of the company AgriSyst with products as PigExpert, BoarExpert and AgriSyst reporting. Together with my business partners; Msc Marc Cox, Mba Twan van Dijk, Eric Verhorstert and our team of employees we are AgriSyst.

Within AgriSyst I am responsible for boar stud consultancy. Where I oversee and coordinate the operational aspects of the on-going process at boar studs to ensure the clients goal of time, cost and quality performance. As the primary level liaison with customers and their employees we monitor against production progress and activity compliance with pre set targets.

I have developed a unique audit with over 700 questions to oversee the complete boar stud production facilities at all levels. The result of the audit is a transparent picture of the actual situation including a SWOT.

- 1985-1995

Takeover of the home business with sows and chickens. As a pilot company for a feed company responsible as a practice company for developing new feed strategies. Because no expansion was possible at the existing location it was not future-proof, it was decided to sell.

- 1995-2000

Responsible for one of the largest pig producers in the Netherlands to set up a boar stud. Starting with nothing we succeeded in a dominated market, survived Swine fever with a keen business strategy and made the company grow into the largest privately owned AI-Centre, learned all facets of semen production and worked on all levels. Because of new EU regulations I became involved in the development of a management program for boar studs to guarantee T&T.

- 2000-2006

In 2000 I became a shareholder of Farmsoftware.



We introduced the new Windows software in more than 40 countries. This software was one of the first solutions with a relational database that could handle an uncountable number of animals. With Farm we were the first company introducing RFID technology as identification for pigs. We were honoured with the prize for best innovative product in Belgium the "Golden Hoof " In 2006 Farm was taken over to allow further future developments.

Short after this take over I left the company because of disagreement on the possible strategy.

- 2008-

During my international work, a large network has developed with interesting people. Due to market demand I started working with Marc Cox and John Williams †, together we launched AgriSyst.

# SPONSOR GOLD



Having celebrated its 50th anniversary, Minitube today sets worldwide standards in reproductive technology. With a full range of assisted reproduction products, Minitube provides a global service to customers in agriculture, sports, pet breeding, veterinary and human medicine and in diverse research fields. Headquartered in Germany, Minitube serves customers worldwide with local support through highly qualified subsidiaries and distributors.

As an industry leader, Minitube understands the importance of providing products that do not compromise quality or safety, even if this results in higher production costs. For this reason, all proprietary products are manufactured in our own state-of-the-art, ISO-certified facilities.

A world-class team of scientists, researchers and technicians at Minitube is engaged in basic and applied research, product development, quality assurance, contract services and customer training. New, innovative products and technologies are regularly developed in line with customer needs.

One example is the MultiCoder, the first and only system for semi-automatic direct print on lab items. With quick and easy machine-readable labeling of lab items, lab processes are greatly professionalized.

Minitube's brand-new boar stud management software, Prism10, connects all processes from semen collection to reporting production statistics. All steps of production and management are perfectly integrated. Prism10 stands out through its dynamic, intuitive user interface and flexible architecture.

For an overview of our entire product range, please visit the Minitube website: [www.minitube.com](http://www.minitube.com). Or contact us by phone or e-mail to book your exclusive tour through our virtual showrooms. Take advantage of this convenient way to gain in-depth information on the most important Minitube products for assisted animal reproduction.

Hauptstr. 41  
84184 Tiefenbach  
Germany  
Phone:  
+49 (0) 8709 9229 0  
E-mail:  
[minitube@minitube.de](mailto:minitube@minitube.de)

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The idea behind the SpermVital technology is to extend the life of spermatozoa after insemination. To achieve this, sperm cells are immobilized in a natural substance before cryopreservation. This immobilization preserves energy and enables a controlled release of sperm cells in the uterus after insemination over an extended period of time. This makes timing of insemination less critical with regards to ovulation in the female, and increases the odds of fertilization success.

### Advantages:

- Timing of insemination will be less critical.
- Conception rate will be higher than or at least equal to conventional semen.
- Inseminations per heat can be reduced.
- Inseminations on weekends and public holidays can be reduced or avoided altogether.
- Conventional insemination equipment and technique is used.

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In 1963, Robert Cassou founded IMV Technologies and set the standard for semen storage and insemination with the revolutionary «French Straw». Since then, we've approached every new solution with the same innovative spirit as he did. Today, we are still leaders in applied and disruptive technologies. We not only make things; we also improve things that already exist.

#### **RESEARCH IS IN OUR DNA.**

Our process of innovation is based on scientific principles, as well as on years of experience. While some innovation answers existing concerns, the bulk of our work is true creation. Our dedicated R&D teams include veterinarians, theriogenologists, biologists, chemists, cryobiologists, plastic specialists, engineers and designers - each working to create the next breakthrough.

#### **CREATING LIFE'S SOLUTIONS.**

Our innovation is inspired by customer needs, and we believe that research and development are invaluable investments. With this commitment, we've registered almost 300 patents across the world.

#### **ADVANCEMENT IN ALL FORMS.**

Our expertise covers a wide range of subjects. We work on the development and improvement of equipment used to collect, analyze, preserve, store, freeze or package cells. We also are dedicated to advanced data processing software that helps our partners make decisions every day. In many cases, we develop the machines we need to create our products or the processes needed to obtain, treat or control our inputs. We constantly strive to improve functionality and expand what's truly possible.

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61300 L'Aigle FRANCE  
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GENEPRO, Inc is a global reproductive technology company specializing in engineering, manufacturing, sales, and service of the most innovative livestock reproductive supplies. The core of our customer-driven focus centers on the tenants of Quality, Innovation and Performance. Our commitment is to help our customers succeed while providing unparalleled customer support.

We are highly specialized in fresh semen preservation and turnkey production equipment. The GENEPRO team, in collaboration with our parent company Genes Diffusion, world renowned for their innovation and technological advancements, produce highly acclaimed swine products. Through this partnership, GENEPRO, Inc and Genes Diffusion provide our customers not only the right products, but the expertise to master their implementation. In addition to our products, GenePro, thanks to Genes Diffusion experience, is active in boar stud management, consultation, and quality assurance/quality control services.

We promise to bring you the greatest quality, innovation, and performance the industry has to offer. GENEPRO, Inc has developed and implemented a Quality Management System that meets the requirements of the international standard ISO 9001:2015.

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Phone: (608) 270-1230 / (608) 270-1240  
E-mail :sales@genepro-inc.com  
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LABORATOIRE NATIONAL DE  
CONTRÔLE DES REPRODUCTEURS

The LNCR (French National Laboratory for Health control of breeding animals) is a Laboratory for Veterinary Analyses located in Maisons-Alfort and dedicated to sanitary control for breeding stock. The LNCR is specialised in diagnostic tests for regulated and non-regulated diseases on ruminants and pigs, their germinal products and in extenders validation.

The main missions of LNCR consist of:

- Anticipate and manage health risks for breeding stock in Ruminants and Swine, for live animals, semen, or embryos,
- Assist AI professionals in achieving access to international markets,
- Develop control actions as well as studies and research programs in close collaboration with the Ministry of Agriculture and OIE

Many analyses for diseases diagnostic can be performed in the 6 technical units of the lab. Analyses on semen are part of the specificity of the LNCR in his area of activity.

The international reputation of the LNCR is reflected by his participation in several international scientific groups and provision of services for breeding exporters and companies abroad.

LNCR is recognised as OIE Collaborative Centre for reproduction diseases.

LNCR is accredited by the French Accreditation Committee to guaranty quality of results (COFRAC Accreditation n°1 -1399 See on [www.cofrac.fr](http://www.cofrac.fr))

13 rue Jouët  
94700 Maisons-Alfort  
Phone :01 43 53 51 00 / 01 43 53 51 01  
E-mail : [contact@lncr.org](mailto:contact@lncr.org)

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With over 30 years of experience, at Magapor we are specialists in swine reproduction thanks to our exclusive dedication to the design, manufacture and distribution of the technology necessary for artificial insemination in the swine sector.

This specialization is what differentiates us from our competitors. We are exclusively dedicated to the swine sector, which allows us to research more exhaustively and be ahead of the rest.

In addition, we have a great technical service available to our customers in order to provide unique and innovative solutions that allow them to improve their reproductive results.

Another of Magapor's fundamental strengths is its clear commitment to R+D+I, continuously improving our products and processes, which allows us to offer exclusive and innovative products. Thanks to our research work, we also look for new solutions to present and future problems that our customers may need.

At Magapor we are committed to our customers by helping them throughout the process and, therefore, we are proud to be their trustworthy technological partner.

PCTA Valdeferrin-AulaDei,  
Calle 5  
50600 Ejea de los Caballeros  
(Zaragoza)  
Phone : (+34) 976 662 914  
E-mail : [lop@magapor.com](mailto:lop@magapor.com)



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