TOWARDS IMPROVEMENT OF **RUMI**NANT BREEDING THROUGH **GEN**OMIC AND EPIGENOMIC APPROACHES

# Newsletter - Issue 1

## October 2022

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## Editorial by Eric Pailhoux, project coordinator, INRAE

Dear RUMIGEN Partners,

It is with great pleasure that I inaugurate this first newsletter of our RUMIGEN project. One of the main objectives of RUMIGEN is to improve the genomic selection schemes of dairy cows in order to achieve a better adaptation of these animals to the climatic challenges that await us. During this summer 2022, different experimental schemes were scheduled in France (on an experimental farm of our partner IDELE) and in Spain (on a commercial farm having agreements with our partner INIA) to evaluate the behavior of animals facing heat waves, obviously without predicting the weather conditions beforehand but hoping for at least one particularly hot episode. This summer's climate has been particularly unusual in Europe with several successive heat waves that have led to numerous fires, a shortage of water in many regions and consequently a decrease in plant resources. Our RUMIGEN project takes on its full meaning in this context that we all hope will remain exceptional but which, according to the IPCC experts, could happen again much more frequently than in the past. In any case, the experimental devices of RUMIGEN were challenged beyond our expectations and it will be very interesting to observe the results of these herds, both at the genetic and epigenetic

levels, in the coming months. The 2nd RUMIGEN annual meeting will take place in Spain in spring 2023 and will be the opportunity to share and discuss this work and many others that are in progress.

Regarding the past 1st year of the project, one of the main events that can be highlighted is the 1st face-to-face meeting that was held in INRAE's center of Jouy-en-Josas, France, from April 20 to 22, 2022. It is important to remember that RUMIGEN project was built during the Covid pandemic crisis. Thus, during the drafting and launching phases of the project, interactions were only possible virtually. What a thrill it has been to finally get together and interact live! It seems to me that most of us were even frustrated by the very busy agenda that only allowed for informal interaction time to get to know each other better and to consolidate the consortium. The next meeting in Spain will have to take into account these needs. Until then, our 1st project reporting will have to be completed as the first 18 months' period will end the 30th of November 2022. I count on all of you to carry out this first reporting in the best conditions and to respect the deadlines. I hope that this reporting will be an occasion to evaluate what the project will concretely bring to the breeding sectors, according to the objectives previously fixed and, if necessary, which inflexions should be given to the project to take into account the first results obtained and/or the first difficulties met.

In conclusion, I hope that you all have had a good summer vacation and that you are all motivated to continue RUMIGEN's work and to achieve the ambitious objectives we have set ourselves. I wish you all a good return to work and the best for our collaborations through RUMIGEN.

## News

### *Kick off meeting*

RUMIGEN project has started!


This Horizon 2020 project launched on 1st June 2021 and will run until May 2026. The project gathers 18 different partners across 9 countries with 13 academic and 5 commercial partners with two pan-European organisations representing the animal breeding sector and animal production researchers.

*"The main objective of RUMIGEN is to improve genetic tools in bovine breeds through addition of new traits such as heat tolerance, and epigenetic information".* Eric Pailhoux, project coordinator, INRAE.

### *1st Annual Meeting, 20th-22th April 2022, Jouy-en-Josas*

The 1st RUMIGEN Annual Meeting took place between the 20th and the 22nd of April 2022 at Jouy-en-Josas, a small town located 20 km South of Paris in the Bièvre valley, inside the INRAE research centre. This three-day meeting, the 1st RUMIGEN meeting in presential, attracted 56 participants, including Colombe Warin, the EC project officer who gave a speech on EC expectations, covering nearly all the partners of

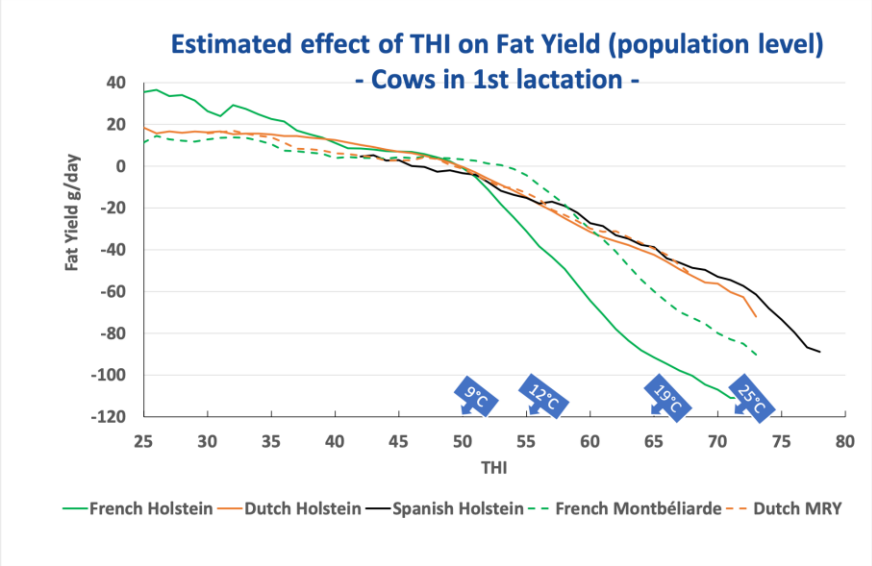
this project. Each of the 9 WPs ongoing work, achievements and action plan were presented by WP leaders helped by task leaders. Four dedicated workshops completed this program as well as a Stakeholder remote meeting with the ExCom members. This was a casual but intensive meeting. It allowed to highlight the 1st year achievements, to discuss some of the difficulties that have been observed and the proposed new action plans, to reinforce the collaborative networks between partners, not forgetting of course, to leave times for enjoying the beautiful spring weather and nice relaxation times, including the social dinner organized in the nearby royal city of Versailles. Building on the success of this meeting, partners look forward to the 2nd RUMIGEN Annual meeting that should take place near Madrid in June 2023.

## *First genome-edited Alpine goats: born to resist!*

One of the objectives of the RUMIGEN WP5 activity 3 is to compare the relative efficiency of introducing a favourable allele from a Norwegian goat breed into the Alpine breed by gene introgression or genome editing, while preserving the specific traits of these animals. The chosen allele confers to the homozygous carrier goats a resistance to scrapie, a fatal pathology that affects small ruminants. In addition, this study also aims to study some other phenotypes observed in the Norwegian breed in animals carrying this allele, and to ascertain whether they are due to the allele itself or to the genetic context. A key step in this project is the editing of the genome of Alpine animals to reproduce an allele identical to that present in the Norwegian breed. This work, performed using the CrispR/Cas9 technique, has been set up with the collaboration of ELIANCE (ex ALLICE), INRAE and NMBU teams. We are happy to announce that it has allowed the birth of three genome-edited kids, in excellent health (see a picture of two of them with their mother), in April 2022, that will allow us to continue our investigations.

## *Impact of heat stress periods on dairy cows*

One of the main objectives of RUMIGEN is to provide breeding tools to face selection under the harsh environmental conditions generated by climate change. For this purpose, France (Idele, INRAE), Spain (INIA-CSIC, IRIAF) and the Netherlands (WUR) collaborate to define new traits related to heat tolerance. The partners study the tradeoffs between production, reproduction and health during heat stress periods.




The studies are based on performances collected in commercial farms and routinely used in the genetic evaluations, and on weather data from the closest meteorological stations to each farm. In order to measure the impact of heat stress in each country, the performances of dairy cows were associated with a Temperature – Humidity Index (THI) based on average daily temperature and the relative humidity measured in the closest station.

Dairy cows from the Holstein breed and two local breeds (Montbéliarde and MRY) were considered. At the population level, the first results on production and on udder health (measured by milk Somatic Cell Scores or SCS) showed that increasing THI, mostly due to increasing temperatures, had a negative impact on all studied traits and all breeds. For example, we estimated a decrease of 11% of the daily Fat Yield production of 1$^{st}$ parity French Holstein cows between a daily average temperature of 9ºC and of 22 ºC during the summer. The estimated impact differed from one trait to the other and it was more prominent for production than for SCS.

At the individual level, the first results suggested weak Genetic x THI interactions for production and for SCS levels. They suggest that the ranking of animals based on their genetic ability on production traits was almost the same in thermoneutral conditions as during heat stress. However, the highest productive cows were more impacted by heat stress than the average or least productive cows, which warns about a likely deterioration of adaptation to high temperatures as milk production increases, unless the potential for adaptation to heat is included somehow in the selection schemes. For SCS, the results show that heat stress amplifies the susceptibility to mastitis.

The studies are now ongoing for fertility traits in order to achieve a global view about the major traits included in breeding goals in dairy cattle. Moreover, Denmark (Aarhus University) will study heat tolerance traits under further harsher environmental conditions, as met in India.

## *RUMIGEN Workshop in Copenhagen*

On the 1st – 2nd of September the Danish Board of Technology and Wageningen University held a joint workshop in Copenhagen, which brought together 18 stakeholders and RUMIGEN partners, representing farmers, breeders, consumers, animal welfare advocates, researchers, and ethicists, in order to develop and assess the Room of Acceptance ex-ante that has been developed in WP2.

The workshop was arranged as a “dinner and a day” event, where an evening event introduced the participants to the concept of a Room of Acceptance and the history of GMO, followed by a dinner with opportunity to discuss the topics that had been raised. The next day the workshop began in earnest, with a detailed introduction to the dimensions contained within the Room of Acceptance and a plenary discussion of the identified issues and their clustering. This was followed by a more active session where participants had the opportunity to add to and edit the prepared dimensions and the issues contained in them. Following this, participants were broken into working groups where they more thoroughly worked with the newly refined dimensions. In these sessions, participants were asked to prioritize the important issues and provide best- and worst-case scenarios as well as a “boundary statement”. These exercises where intended to define which issues are the most important for the RUMIGEN project to consider, and what states-of-affairs would be acceptable to the public. The workshop helped the RUMIGEN project to further develop and assess the ‘Room of Acceptance’ for the technologies being developed in the project, with the intention of ensuring that the outcomes of RUMIGEN are both impactful and socially acceptable. This workshop was an important step in assessing the approach and findings in the Room of Acceptance. Work on the social acceptability of genetic technologies in husbandry will continue throughout the duration of the RUMIGEN project and will also involve citizen engagement in several countries across the EU. Many topics were covered during the workshop, but a few highlights include discussions about the need for a balance between increases in production efficiency and animal health & welfare, as well as ways to ensure that the introduction of genetic technologies in husbandry does not limit the options and free choice for different actors in the value chain as well as consumers. Participants also highlighted that there should be limits to genetic technologies’ impact on the integrity and wellbeing of animals. Lastly, the wider context that RUMIGEN exists in was also discussed, and it was noted how the technologies being worked on in the RUMIGEN project can contribute to food security in the future, while keeping in mind that relative disadvantages across actors are not increased. The outcomes of the workshop are intended to feed into the final stages of the Room of Acceptance ex-ante, and by extension the development of scenarios. By leveraging the expertise of the stakeholders, RUMIGEN will be able to develop a more robust Room of Acceptance and formulate more applicable scenarios for further study during the upcoming citizen engagement. Together with other initiatives in the RUMIGEN project, this work will ensure that the outcomes of the project are practically relevant and have a higher likelihood of uptake. Work now continues to finalize the Room of Acceptance ex-ante and to develop the scenarios on future breeding.

## *RUMIGEN at the 11th ATF meeting*

On the 18 of November 2021, the Animal Task Force (ATF) and the European Feed Manufacturer's Federation (FEFAC) hosted the 11th ATF Seminar. The topic of the day was "Going Beyond Feed vs Food". In the morning, an overview of policies, visions and current initiatives was given by representatives of different stakeholder groups such as DG Agri and IFIP. In the afternoon, a stakeholder event was organised where Ana Granados Chapatte (Director of EFFAB) presented RUMIGEN as part of an overview of the current Horizon 2020 projects that will contribute to the Feed vs Food competition. All presentations can be found on the ATF website.

## *RUMIGEN at the EFFAB/FABRE TP AM in Évora, Portugal*

On May 3 and 4, EFFAB/FABRE TP hosted their Annual General Meeting in Évora, Portugal. During the AM. On the 4 of May, EuroFAANG hosted a networking lunch where RUMIGEN was presented.

## *GenTORE final Stakeholder event & Rumigen presentation*

After five years, the GenTORE project is drawn to a close. GenTORE developed innovative genome-enabled selection and management tools that optimise cattle resilience and efficiency (R&E). The results of the endeavour were presented at the final stakeholder event preceding WCGALP 2022. Didier Boichard from INRAE had the opportunity to present RUMIGEN project.

## *Joint Dissemination Clustering: EuroFAANG*

EuroFAANG was initially kicked off by three H2020 projects, AQUA-FAANG, BovReg and GENE-SWitCH, with the aim of forming a closer relationship to coordinate their objectives within Europe in association with the international FAANG initiative. Later on, three more H2020 projects, RUMIGEN, HoloRuminant and GEroNIMO, joined the initiative. Within its activities, EuroFAANG has created a Communication and Dissemination working group, in which RUMIGEN is actively involved.

### *RUMIGEN Brochure online with translations available in 8 languages*

RUMIGEN continuously creates promotional material, in particular the project brochure, which is now translated into eight languages, English, Spanish, French, Dutch, Swedish, Danish, Italian and Norwegian.

## Publications

The study aims to estimate the effect of temperature-humidity index and the magnitude of genotype-by-THI interactions on milk production traits and on somatic cell score in Montbéliarde cows.

Vinet, A.; Vallée, R.; Bertuzzi, P.; Mattalia, S.; Boichard, D.; Bertrand, C.; Cuyabano, B.C.D. Genotype by temperature-humidity index interactions on milk production.

## Meet the consortium

### *Eric Pailhoux (INRAE, project coordinator)*

I am a senior scientist (Director of Research) in Reproductive and Developmental Animal Biology at INRAE, the National Research Institute for Agriculture, Alimentation and Environment in France. My research focusses are mainly on sex determination and gonad differentiation in mammals with a particular attention to farm mammals (ruminants, pigs and rabbits). During the last decade, I have used the new technology of genome editing to decipher and demonstrate the role of sex-determining genes and their different functions between mouse and farm mammals. I have published over 80 papers and I am a member of the editorial board of the journal "Sexual Development". I started to build the RUMIGEN project in January 2019 with three other scientists (Drs D. Boichard, J-L Vilotte & L Schibler) located at the same INRAE centre of Jouy en Josas near Paris. At the same time, I accepted to be the coordinator of RUMIGEN, contributed to the writing of the proposal and now part of my job is to ensure that the project runs smoothly. Anne Jarousse from INRAE-Transfert nicely assists me on this task. In addition to this coordination, I am involved with different colleagues of my BREED unit (Biology of Reproduction, Environment, Epigenetic and Development) and of ALLICE society in different parts of the RUMIGEN project, mainly focused on epigenetic and potential new breeding technics.

*Credit: Béatrice Mandon-Pépin*

### *Anne Jarousse (IT, project manager)*

I am Anne Jarousse, an agricultural sciences engineer. After several research positions at INRAE & VetAgro-Sup and a support position to farmers (Chamber of agriculture), I joined the European Department of INRAE Transfert (IT) in 2021. Based in Clermont-Ferrand in France, I'm the Project Manager of RUMIGEN. With the help of a Consultant and an Administrator of IT (Project Management Team), my role is to ensure the day-to-day management and to help the coordinator and the consortium with the management of operational, technical and financial tasks of the project.

## *Rasmus Bjerregaard Mikkelsen (project manager, Danish Board of Technology)*

Hi, my name is Rasmus, and I am a project manager at the Danish Board of Technology. I hold an MA in Bioethics, and I will soon defend my PhD in Empirical Ethics at the University of Copenhagen. My research has focused on how we can use empirical information, including stakeholder and citizen views, to shape practical guidance and decisions about the development and implementation of new technologies in society, like genetic technologies in food production. At the Danish Board of Technology, I work with stakeholder and citizen engagement on the RUMIGEN project to assess the social acceptability of the new breeding technologies that RUMIGEN is working towards. We do this both through stakeholder forums and citizen consultations within the EU.

## Upcoming events

- ATF-FEFAC-H2020 projects Stakeholder event - Brussels 18 November 2022

**Coordinator: Eric Pailhoux (INRAE)**

Please send all your inquiries to: **rumigenH2020@gmail.com**

For more information visit our website:

# www.rumigen.eu

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