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# GEroNIMO and RUMIGEN Joint Final Event

**Breeding the Future  
Genomics, Epigenomics & Societal  
Acceptability for Sustainability in Livestock**

## Strategies to maintain and improve local and small breeds

*15<sup>th</sup> April 2026, Belgium*

**Marie-Jose MERCAT**  
*IFIP-Institut du Porc*



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## Pig and chicken local breeds in Europe

- Europe hosts a large diversity of local breeds, generally raised in extensive outdoor systems in small farms



Krškopolje pig



Gascon pig, photo credit of consortium noir de Bigorre



Turopolje pig



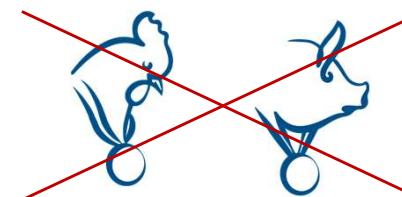
Photo credit: Association for the Preservation and Promotion of the Noire de Challans chicken

- Local breeds are associated with strong cultural value and high-quality products



## Pig and chicken local breeds in Europe

- Genetic diversity preservation is the main driver of the stakeholders
- Secondary drivers:
  - Economic valorisation for pigs
  - Leisure or hobby farming for chickens
- Current practices:
  - Almost no selection program - Choice of breeding animals mostly based on:
    - External traits (breed standard)
    - In pigs: inbreeding management



## Objective

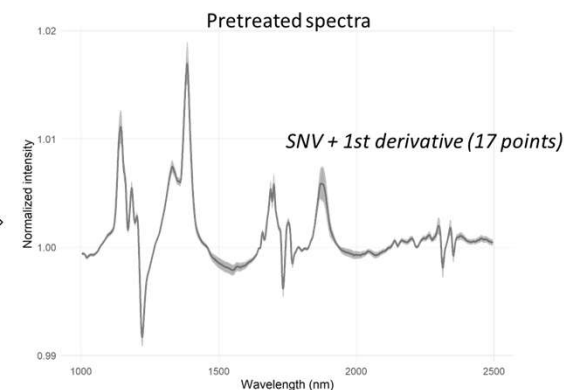
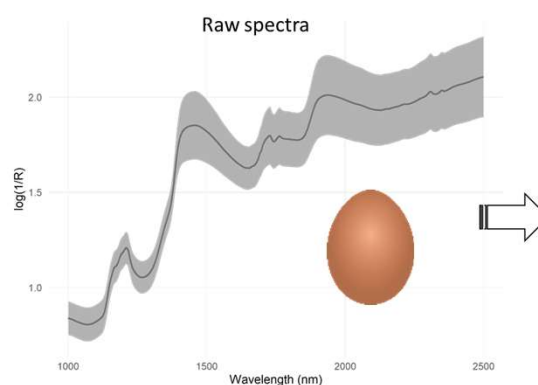
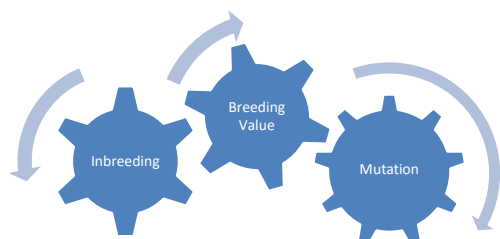
- Propose new strategies to improve the management and selection of local breeds

- Based on:

- Innovative **phenotyping** tools based on Near Infra Red Spectroscopy (NIRS)

- **Genotyping** approaches

- State-of-the-art **optimisation** methods



Prediction of :

- ✓ PUFAresidualsTotalFA
- ✓ MUFAresidualsTotalFA
- ✓ MUFAresidualsTotalFA

reagents required  
reagents required

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## Affordable large-scale phenotyping

- Development of NIRS-based tools

- Chickens: egg yolk lipid composition: PolyUnsaturated / MonoUnsaturated / Saturated Faty Acids (%PUFA / %MUFA / %SFA)
  - Nutritional value and health
- Pigs: IntraMuscular Fat (IMF)
  - Key determinant of meat quality

NIRS compared to  
chemical analyses:

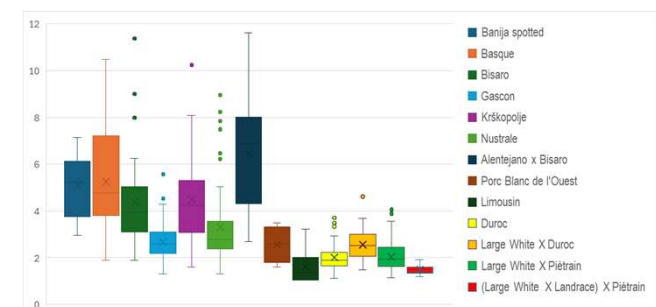
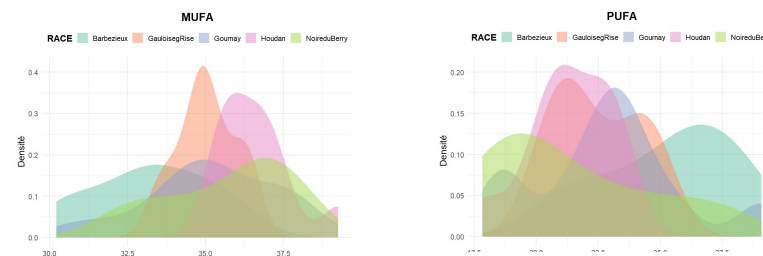
No chemicals  
Cost-effective  
Faster

- Results: robust calibrations

- IMF: 4 devices calibrated with high predictive ability using shared samples
- %PUFA and %MUFA: prediction accuracy sufficient for practical use

- Trait variability within and across local breeds and populations under selection

- Traits rarely explored in genetic analyses, especially in local breeds



## Genetic determinism and selection potential

- **First estimation of genetic parameters** → medium to high heritabilities
  - Chickens (commercial line): %PUFA, %MUFA →  $h^2 \approx 0.5 \pm 0.19$  –  $0.58 \pm 0.17$
  - Pigs: intramuscular fat (IMF)
    - Krškopolje pigs:  $h^2 \approx 0.44 \pm 0.10$
    - Gascon:  $h^2 \approx 0.73 \pm 0.19$
- **Genetic correlations** estimated between IMF and other traits (backfat, muscle depth, pH, etc.)

→ Genetic progress on these traits is possible in local breeds

*More detailed results will be presented tomorrow to the GEroNIMO consortium*

	IMG	pH	BFT	MT
IMF			Genetic correlations	
pH	Phenotypic correlations			
BFT				
MT				

## Improved management of genetic diversity in chickens

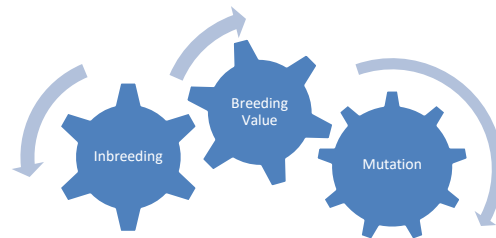
- **Genealogy** usually only **partially known**
- **Objective:** Establish a **proof of concept** for in situ genetic management using **molecular markers**
- **How?**
  - Developing a **96 SNP marker panel**
  - Assessing **genetic diversity**
  - Optimising **mating plans** (simulated annealing)
  - Reconstructing pedigree a posteriori using **parentage assignment**
  - Implementing **new practices**
    - Structured mating groups (**parquets**)
    - **Sampling** for genotyping





over 4 generations

## Designing breeding strategies in pigs

- **Case studies:** Krškopolje pigs (Slovenia), Gascon (France) + Turopolje (Croatia)
- **Objectives**
  - Preserve genetic diversity
  - Improve meat quality (IMF) through selection
  - Improve welfare through reduction of the RYR1 deleterious allele
- Need to **identify the best compromise** between these objectives
  - Adapted Optimal Contribution Selection (**aOCS**, R package)
    - Extended to include management of deleterious alleles
    - Applied to: Turopolje, Krškopolje, Gascon pigs



## Searching for the best compromise

- Main case studies confirm that it is possible to improve IMF, control inbreeding or reduce the RYR1 mutation frequency  
**But it requires careful prioritisation and stepwise implementation**
  - Krškopolje pigs → Suggestion: priority on RYR1 mutation reduction
  - Gascon → Suggestion: stronger emphasis on IMF, progressive strategy on RYR1 mutation based on boar genotyping
- In all cases: inbreeding management remains essential 
- On Turopolje pigs: Studied genetic diversity and OCS approach
  - Shallow pedigree depth → limits the accuracy of inbreeding estimates
  - Small effective population size → represents a risk of genetic erosion
  - Genomic data are needed to improve inbreeding management

## What GEroNIMO delivered

- A set of operational tools for local breeds
  - Parentage assignment tool (Noire de Challans)
  - New management practices in chicken local breeds
  - Enhanced OCS package including deleterious alleles
  - NIRS phenotyping tools (IMF, egg lipid composition)

**New tools for:**

- ↗ genetic diversity preservation
- ↗ welfare
- ↗ meat quality

→ These tools are usable in practice to characterise phenotypic and genetic variability and manage the local breeds

- First genetic parameters were estimated in Krškopolje and Gascon pigs

→ Selection potential in these breeds

	IMG	pH	BFT	MT
IMF			Genetic correlations	
pH				
BFT	Phenotypic correlations			
MT				

## Perspectives and implementation

- In chickens
  - Noire de Challans: additional generations produced within another project (RESIGEN)
  - This experience could be leveraged for implementation in other local breeds
- Some analyses are still in progress, for example:
  - In the Gascon breed:
    - Simulation of breeding schemes
    - Estimation of genetic gains under realistic phenotyping and genotyping scenarios
  - Epigenetic analyses are to be completed (poultry and pigs)
- **The next step is to support breed organisations in decision-making by**
  - Evaluating the relevance and feasibility of implementing GEroNIMO tools
    - In conservation programmes (chickens)
    - In selection programmes (pigs)
  - Introductory genetics training sessions were organised, complemented by accessible presentations of the results





## GEroNIMO and RUMIGEN Joint Final Event

### With contributions from

- IFIP: Gwladys Flého, Herveline Lenoir, Sébastien Taussat, Antoine Vautier
- INRAE: Sophie Dare, Philippe Ganier, Bénédicte Lebret
- Institut Agro Rennes Angers: Sandrine Lagarrigue
- KIS: Marjeta Čandek Potokar, Klavdija Poklukar Žnidaršič, Martin Škrlep
- SYSAAF: Maëna Le Corvec, Romuald Rouger
- UNIZG: Danijel Karolyi, Dubravko Škorput
- Univ ÉVORA: Andreia Amaral & CIMO: Luís Dias, Alfredo Teixeira
- Univ Hohenheim: Jörn Bennewitz, Robin Wellmann

...

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[www.geronimo-h2020.eu](http://www.geronimo-h2020.eu)

@GeronimoH2020



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# THANK YOU

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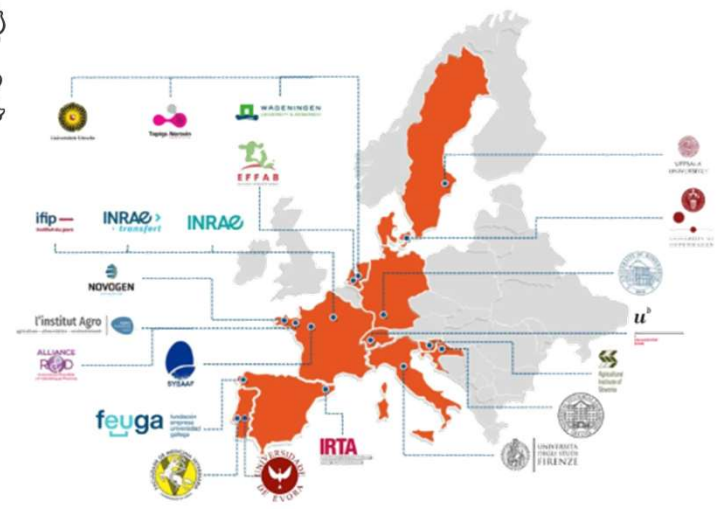
TOWARDS IMPROVEMENT OF RUMINANT BREEDING THROUGH GENOMIC AND EPIGENOMIC APPROACHES

## GERONIMO

GENOME AND EPIGENOME ENABLED BREEDING IN MONOGASTRICS



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## Diapositive 13

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**NJ(1)** I would propose to have a final slide which includes:

- \* Thanks you!
- \* the logos of all partners,
- \* project website address
- \* perhaps some other information (space for contact email, social media address(es) etc.).
- \* funding acknowledgement

Niemi Jarkko (LUKE); 2023-12-27T19:48:38.446

