New animal traits for innovative feeding and breeding strategies

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Wageningen Livestock Research

Feed-a-Gene seminar 12 December 2019

Feed-a-Gene

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Introduction

- EU Feed a Gene
- New traits related to feed efficiency
- Some results
- Future application of the traits

EU funded Research project

2015 2020

€10 M Budget

Feed-a-Gene

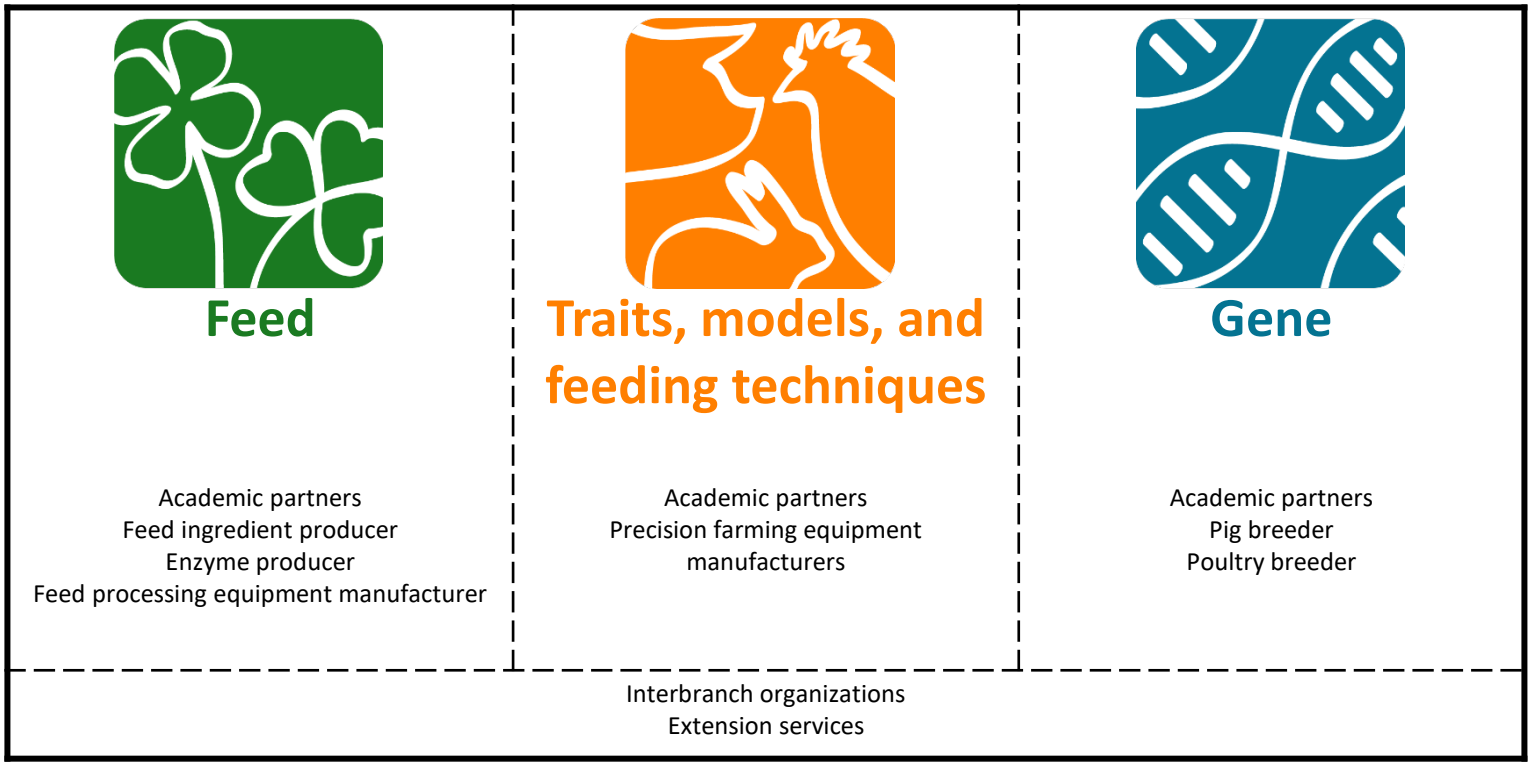
Adapting the **feed**, the **animal** and the **feeding techniques** to improve the efficiency and sustainability of monogastric livestock production systems

(www.feed-a-gene.eu)

23 Partners EU + China

15 Industry

8 Academic


Feed
Academic partners
Feed ingredient producer
Enzyme producer
Feed processing equipment manufacturer
Traits, models, and feeding techniques
Academic partners
Precision farming equipment manufacturers
Gene
Academic partners
Pig breeder
Poultry breeder
Interbranch organizations
Extension services

The Feed-a-Gene consortium

Research

1. INRA
2. WUR
3. UNew
4. UdL
5. IRTA
6. KU
7. AU
8. CAU

Industry

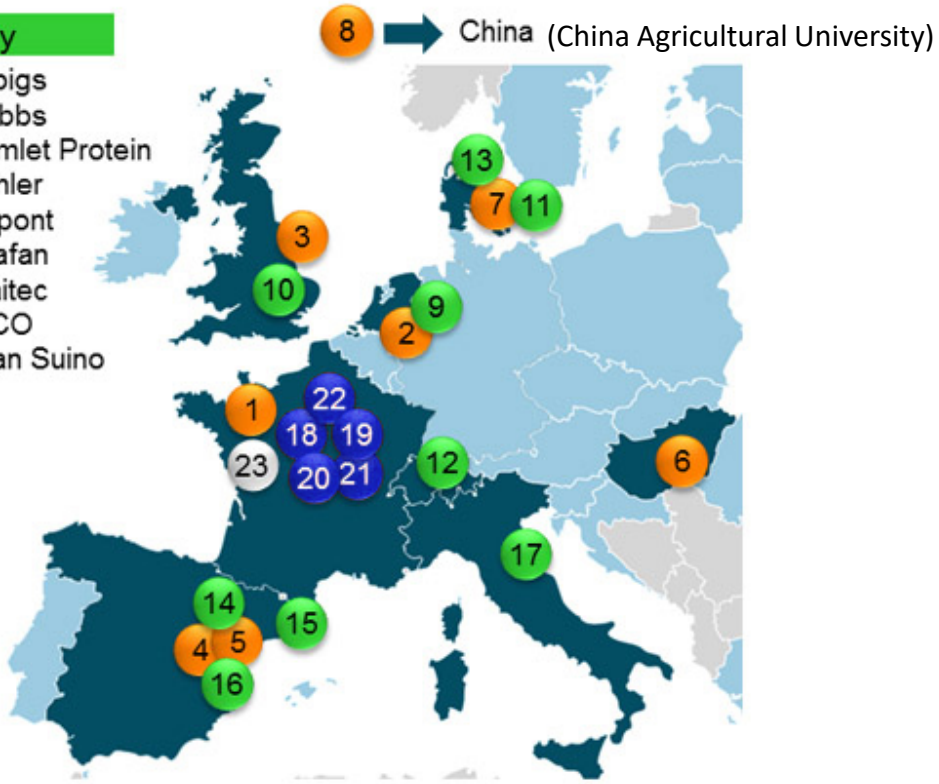
9. Topigs
10. Cobbs
11. Hamlet Protein
12. Bühler
13. Dupont
14. Exafan
15. Claitec
16. INCO
17. Gran Suino

Extension

18. ACTA
19. IFIP
20. ITAVI
21. Terres Inovia
22. AFZ

Management

23. IT



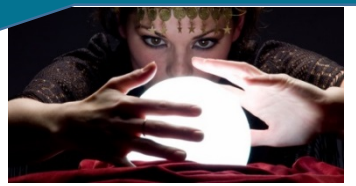
Objectives of the Feed-a-Gene project

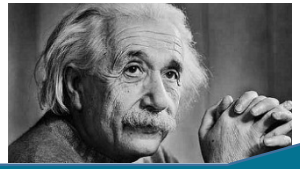
- Feed:
  - Develop new local feed resources that are not/less in competition with food
  - Improve the nutritional value of feed resources
- Gene:
  - Use of novel traits indicative for feed efficiency and robustness that can be used as selection criteria
  - “Do better with feeds that may be worse”
- Traits, models, and feeding techniques:
  - Appreciate variation among animals
  - Develop precision feeding techniques
  - Evaluate the overall sustainability

It is all about variation

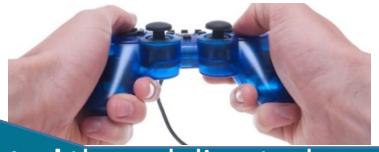
Observe variation in feeds, animals, and the environment

Predict using data-driven models and quantify interactions and variation





Understand the underlying mechanisms of variation



Control through livestock management (e.g., feeding, breeding)

Feed efficiency

Geno-type | Sex | Age | Health | Climate | Manage-ment

Dietary supply of nutrients ⟷ **Requirements for nutrients**

- Ingredient composition
- Nutrient composition and energy content
- Nutrient digestibility
- Feed intake and feeding strategy

- Maintenance requirements
- Locomotion and behaviour
- Growth of organs and tissues
- Deposition of protein, fat, ash and water in the body

New animal traits for innovative feeding and breeding strategies

behaviour and welfare

image analysis
serotonin, cortisol

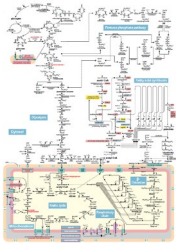
individual feed intake

feed intake patterns
feeding behavior

digestive efficiency

digestibility markers
gut health
microbiota

metabolic efficiency



metabolomics

Individual feed intake in broilers and rabbits

Development of feed station

October-November 2016: 1st test of feed station

5 weeks
Cobb birds
Standard diet (corn+soy)

INRA and IRTA

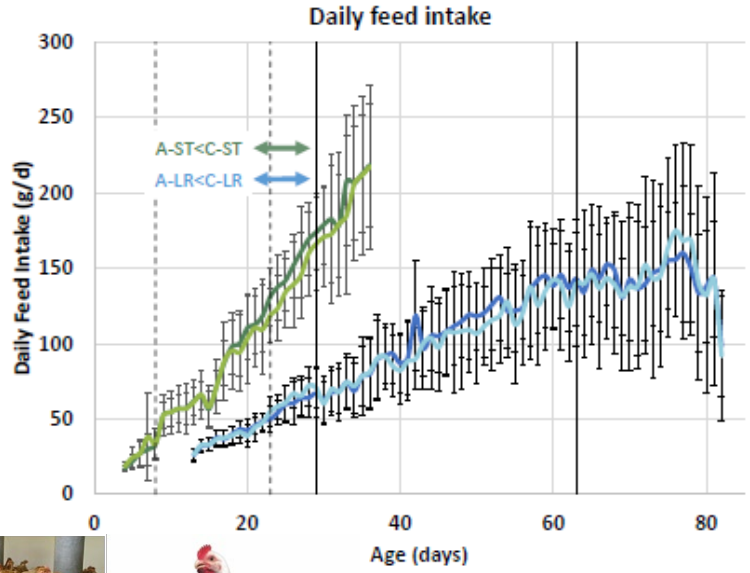
ESPG
XI. European Symposium on Poultry Genetics 2019

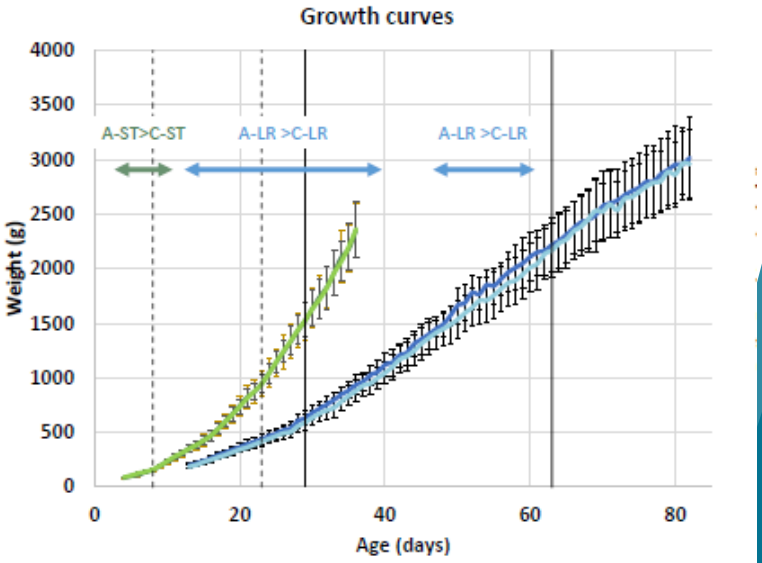
Individual feed intake in broilers

INRA SCIENCE & IMPACT

Using high throughput phenotyping of body weight and feed intake to improve adaptation of chickens to sustainable diets

BERGER Quentin, GUETTIER Elodie, URVOIX Séverine, LE BIHAN-DUVAL Elisabeth, MIGNON-GRASTEAU Sandrine

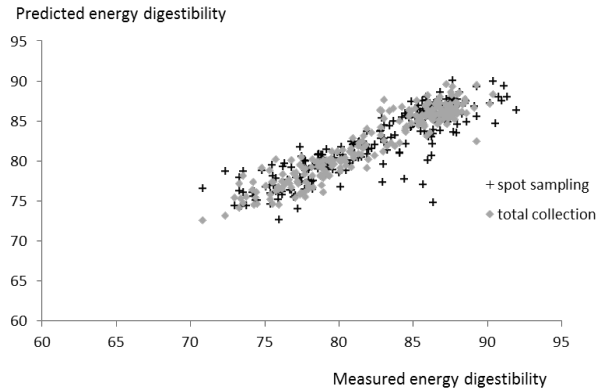




Berger et al. (2019)

NIRS determination in faeces for the rapid evaluation of variation in nutrient digestibility between pigs

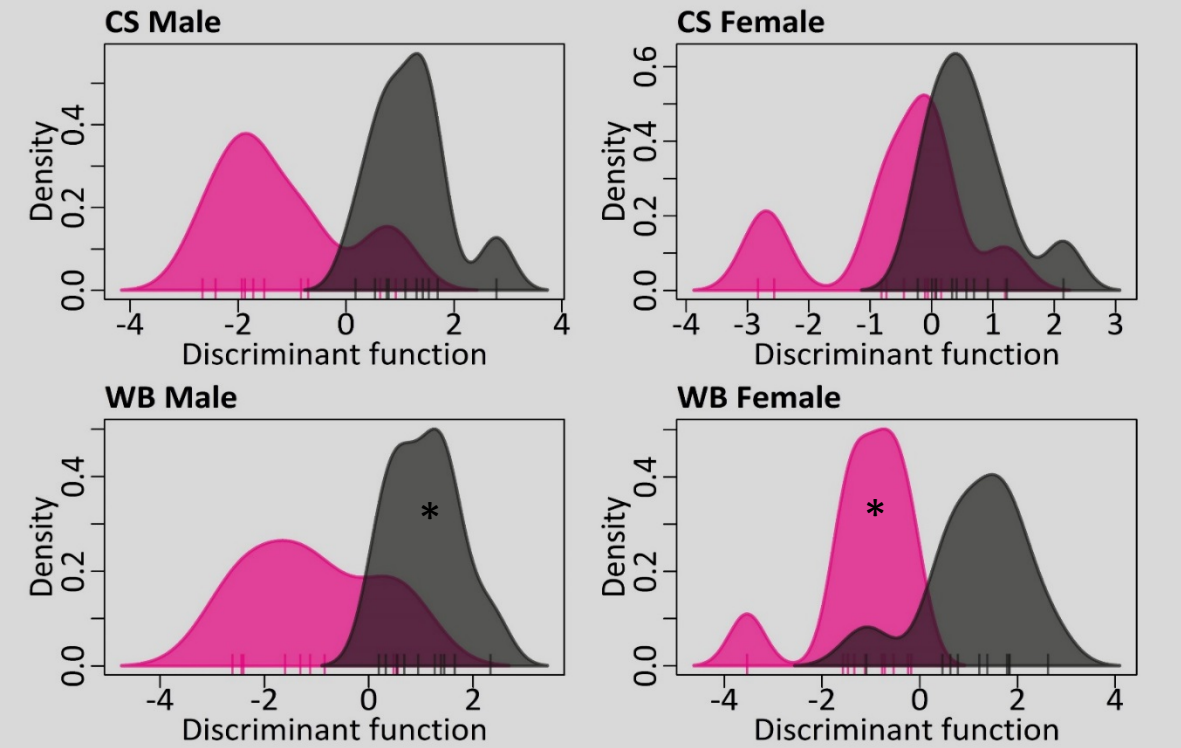
- Goal: to predict digestibility of nutrients from faecal NIRS
- Calibration of the equations based on 246 faeces samples (FaG) and 500 samples (INRA trials)
  - Equations are good
    for digestibility of DM, OM, N and energy
    but poor for digestibility of fibre



- Ability of the method to rank pigs for their digestive ability
- Heritability of DC of DM 0.4-0.6 and diet dependent

Labussiere et al. (2019)

Faecal microbiota as a trait to differentiate



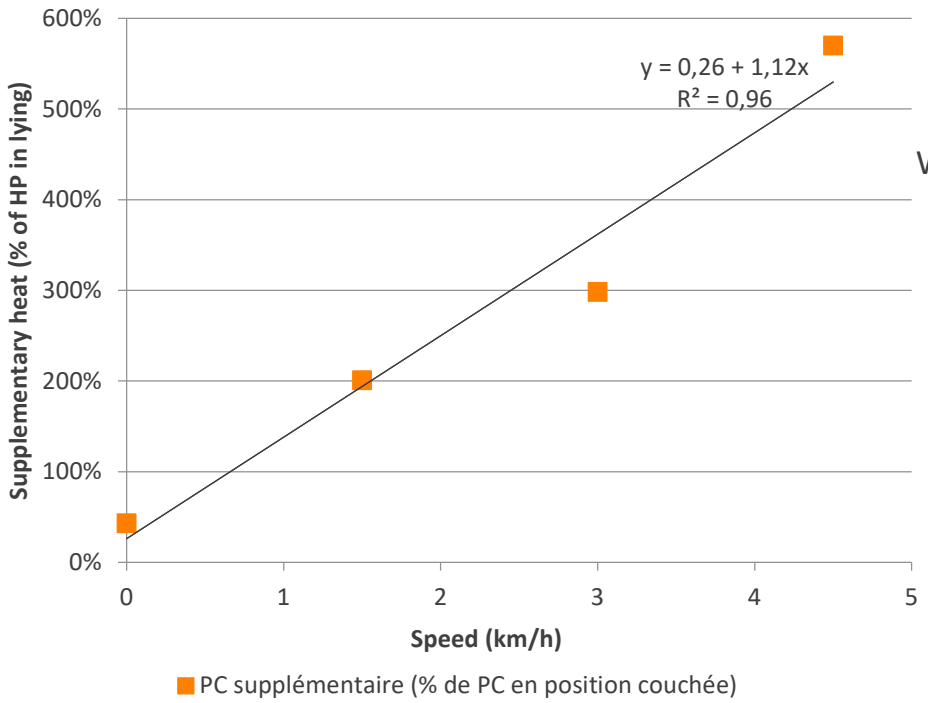
Feed efficiency: * = $P < 0.05$

Pink = high feed efficient pigs, **Black** = low feed efficient pigs

Verschuren *et al*. (2018)

High Level of Sow Physical Activity on Heat Production

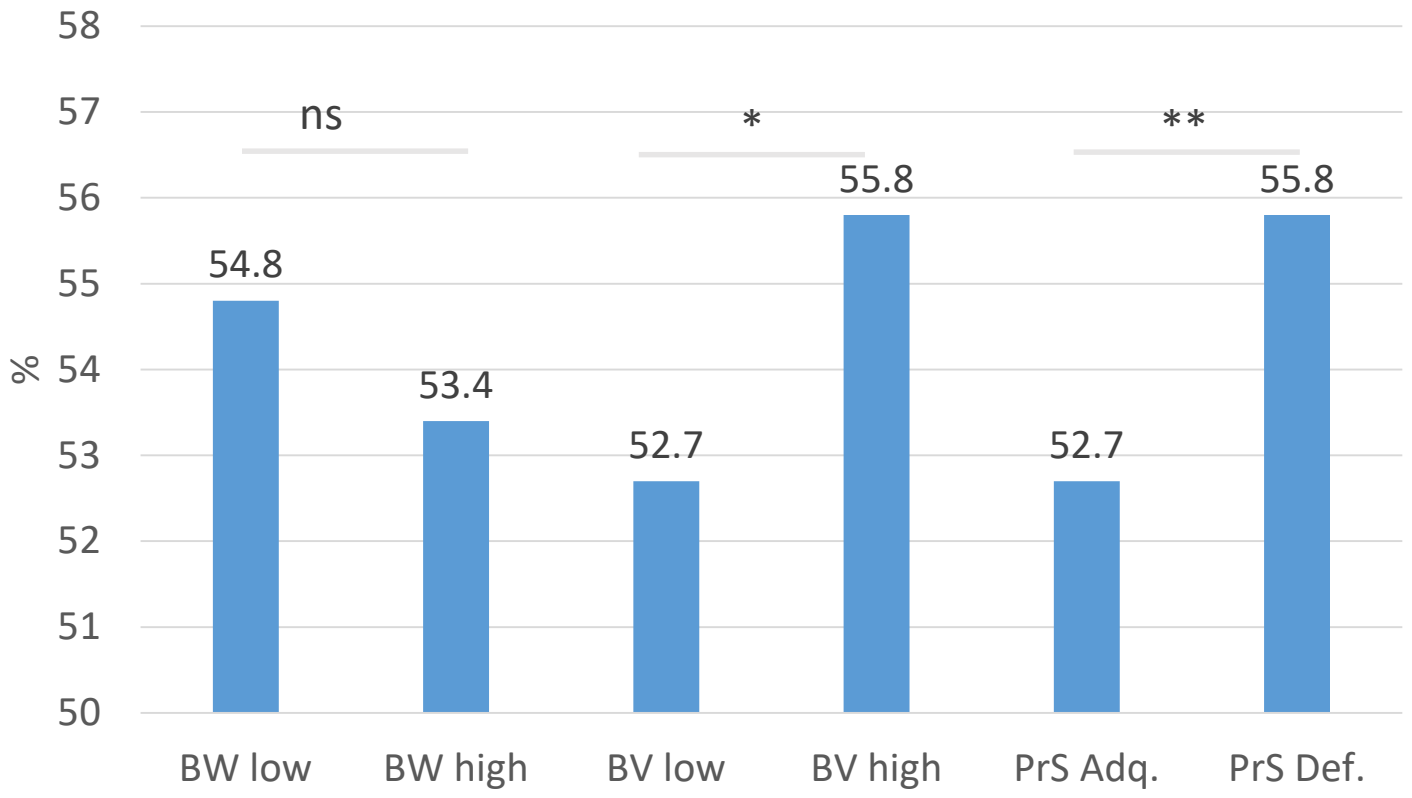
12 sows trained to walk/run in a treadmill at 1.5, 3 and 4.5 km/h



Walking at 1.5 km/h = +200% HP relative to lying

Labussiere et al. (2019)

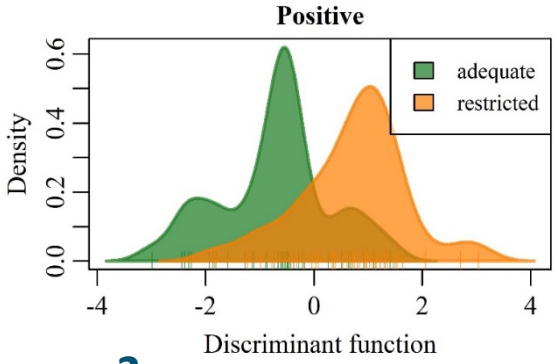
Birth weight and breeding value for PD and N-efficiency (% of N-intake) in growing pigs



Jansman et al. (2019)

Biomarkers for N-efficiency in pigs in blood

- Diet



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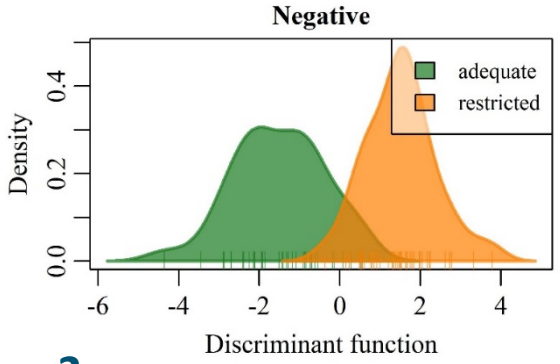

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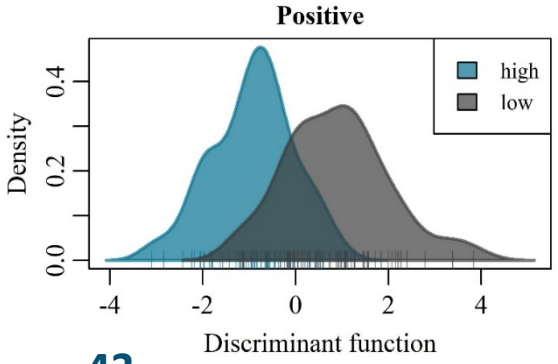
- Birth weight



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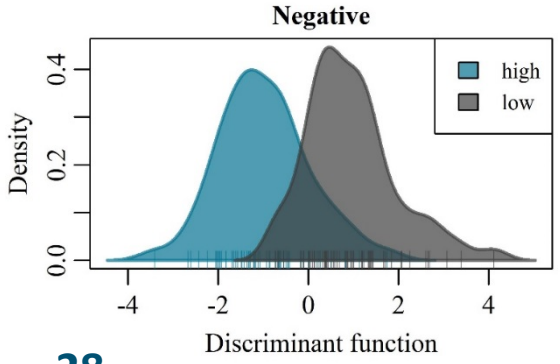

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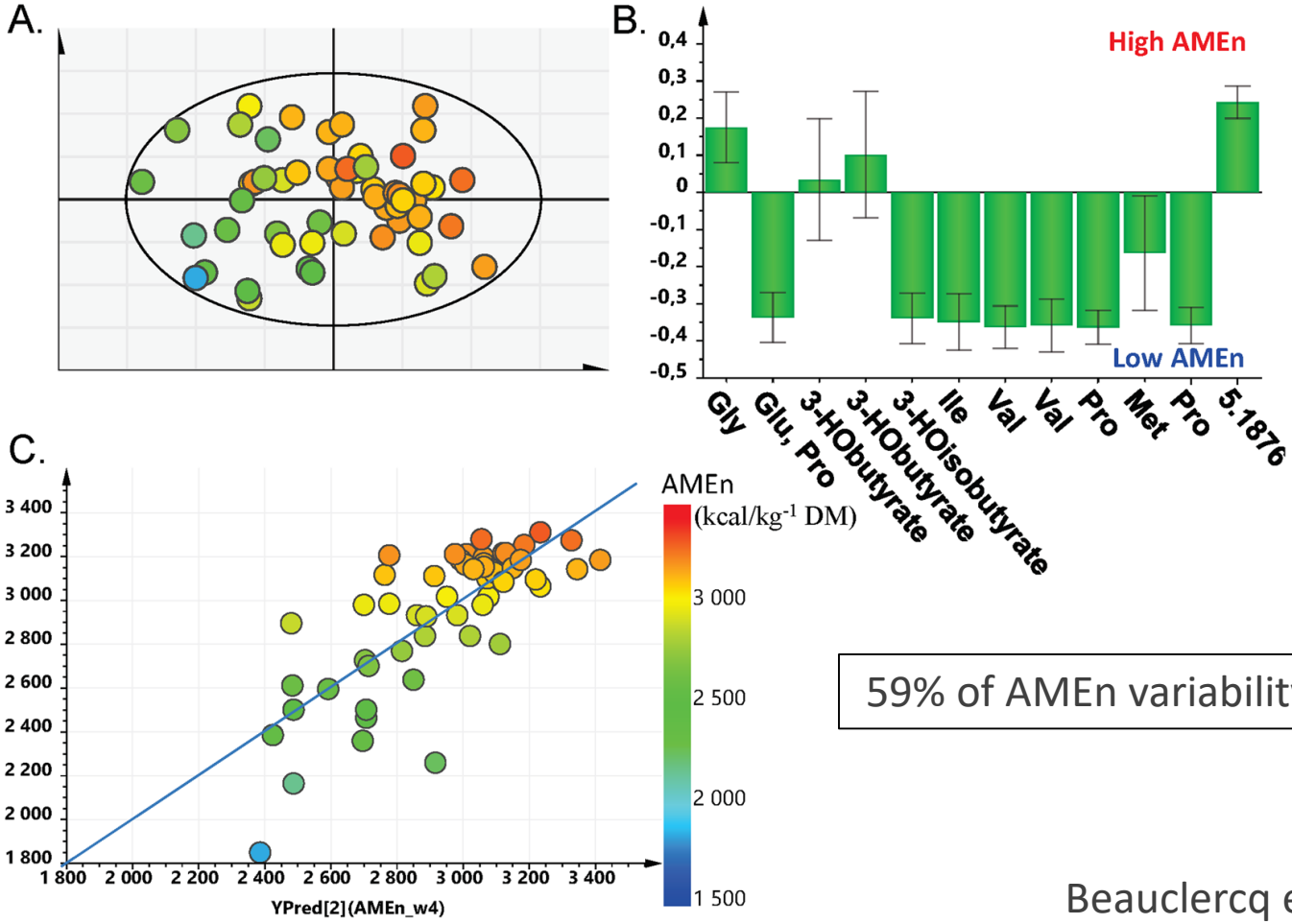
Verschuren et al. (2018)

Finding biomarkers in serum for AMEn in broilers



59% of AMEn variability explained

Beauclercq et al. (2018)

Predictive biomarkers

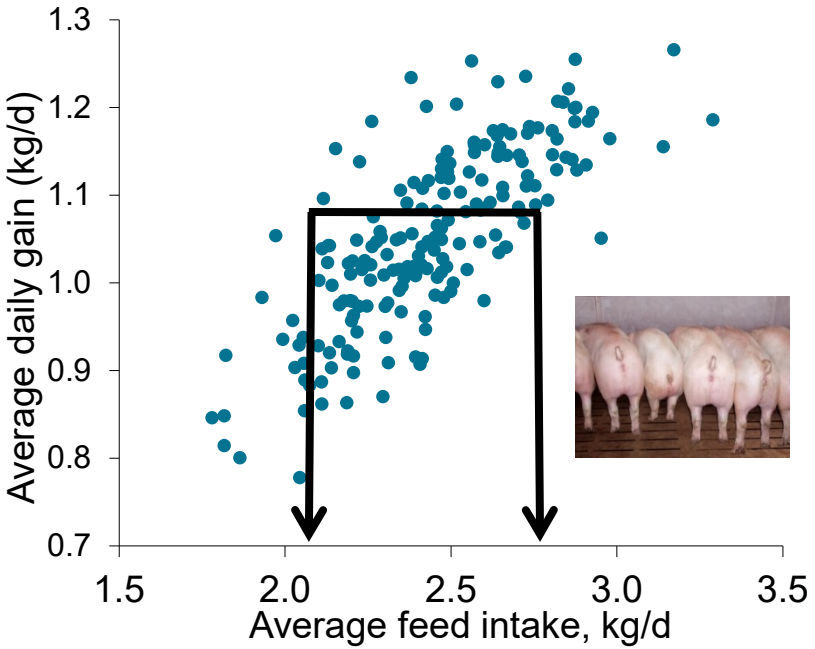
Molecular indicators of feed efficiency in pigs as proposed by a meta-analysis of transcriptomics data in tissues and fluids

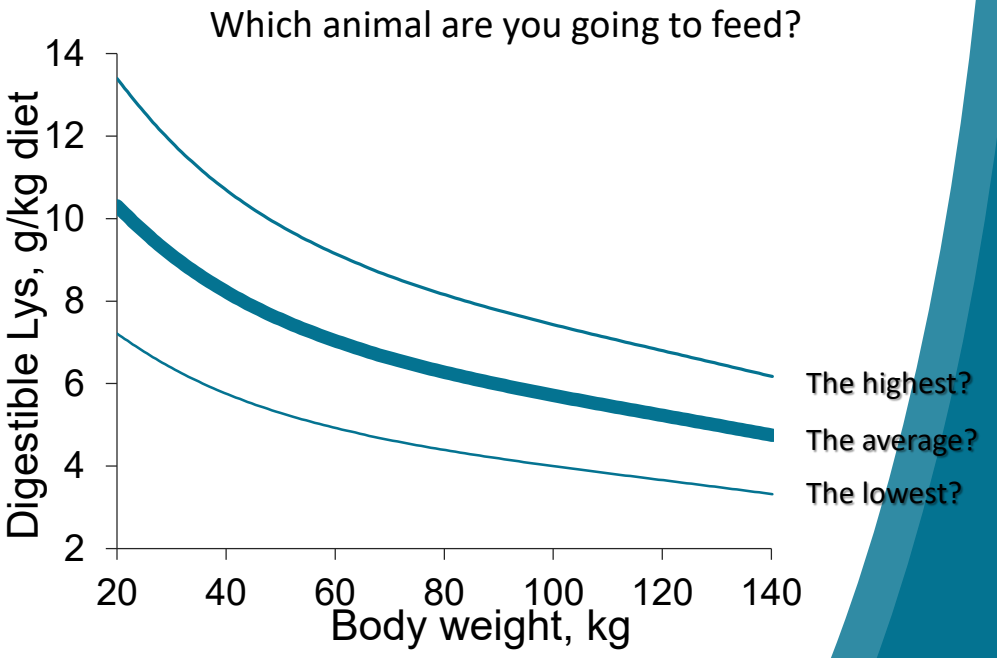
- Microarrays data were obtained from longissimus muscles or blood of two lines divergently selected for residual feed intake (RFI).
- Identification of ~50 biomarkers by feed efficiency traits (RFI, F:G, energy-corrected F:G) with machine learning methods - validation of a subset of them by qPCR on the same (muscle) or other (blood) samples

Conclusion: It was possible to identify a few genes expressed in muscle or blood that might be reliable predictors of feed efficiency.

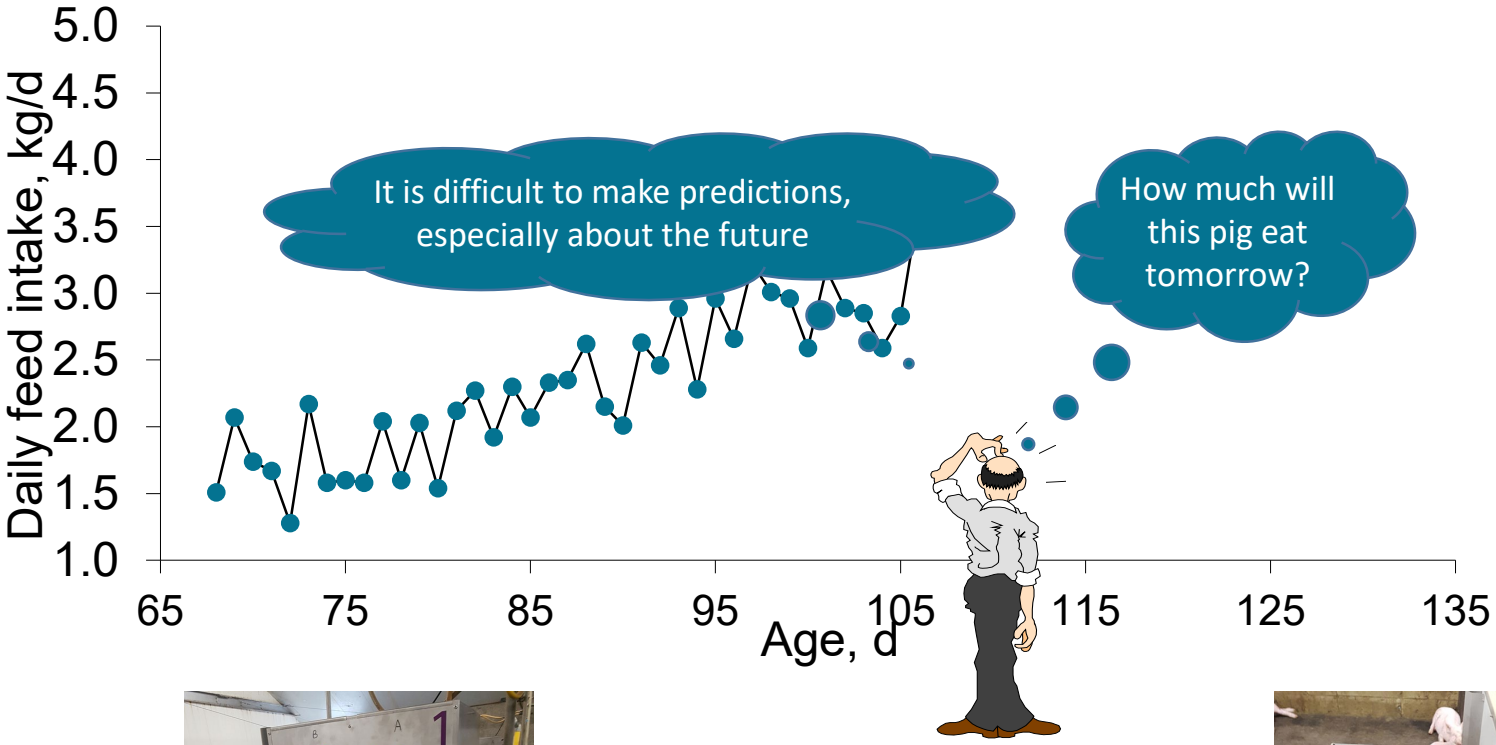
Perspective: The usefulness of genes as biomarkers for feed efficiency for other pig populations will be validated.

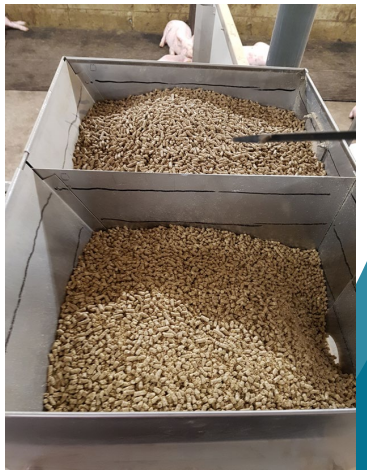
Managing variation among individuals through precision livestock feeding





Precision livestock feeding is about observing, predicting, and control





Conclusions

- Further understanding of responses of animals to feed and nutrient intake requires simultaneous measurement of data and information on the genotype, phenotype and the environment using novel, state of the art tools.
- New traits have been identified related to feed and nutrient efficiency in pigs, poultry and rabbits which can be used in new precision feeding concepts and future breeding programmes.
- Validation of the use of the traits and biomarkers requires further attention.

Thank you for your attention!