



New animal traits for innovative livestock management strategies

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Final meeting FaG Rennes
22-23 January 2020



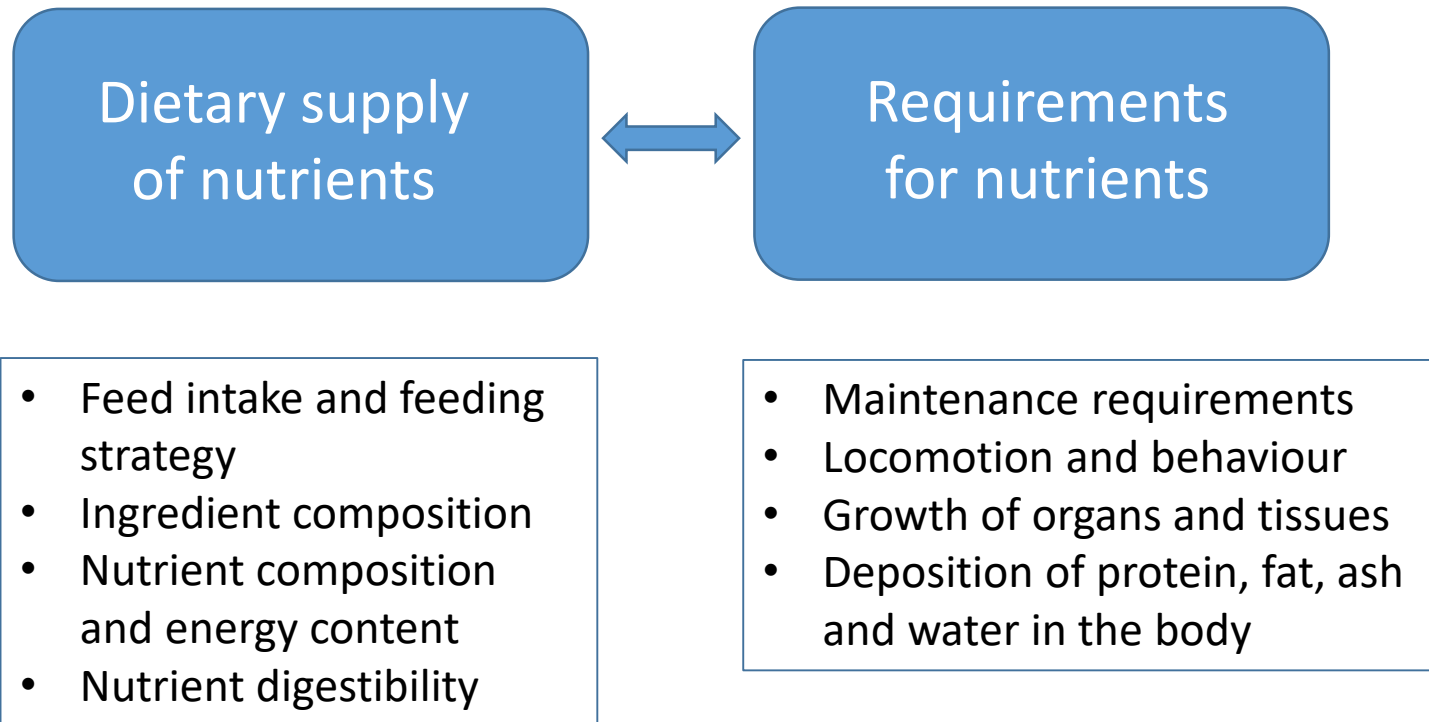


New traits related to feed efficiency

- ▶ Feed-a-Gene aimed is to explore and identify new animal traits directly or indirectly related to individual variation in the animal's response to feed and overall feed efficiency under different environmental conditions
- ▶ Traits to be used for new breeding and feeding strategies



Feeding and nutrient efficiency





New animal traits for innovative feeding and breeding strategies

behaviour and welfare



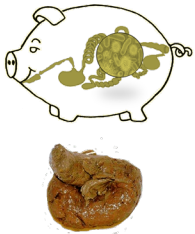
image analysis
serotonin, cortisol

individual feed intake



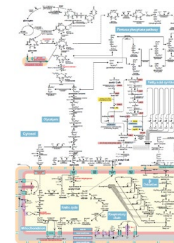
feed intake patterns
feeding behavior

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)



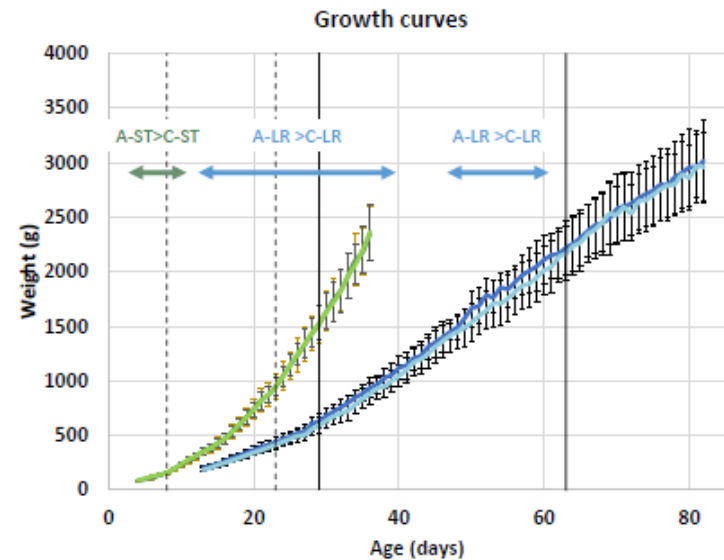
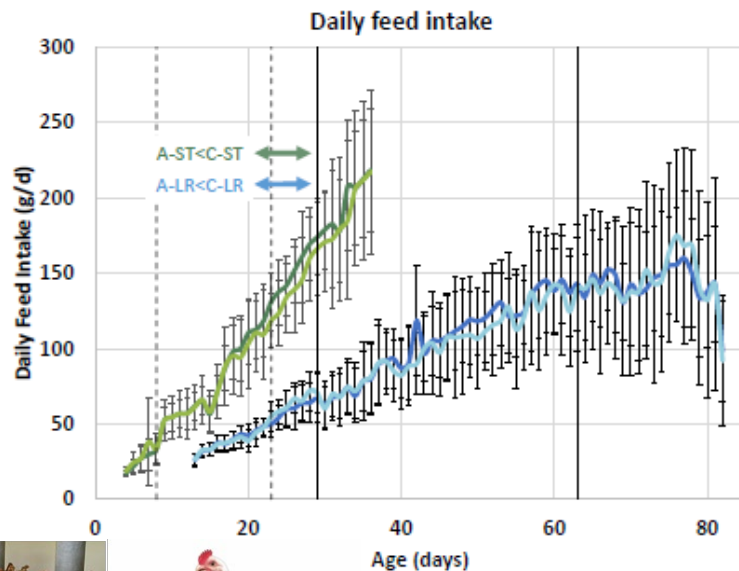


Individual feed intake in broilers



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-GRATEAU Sandrine



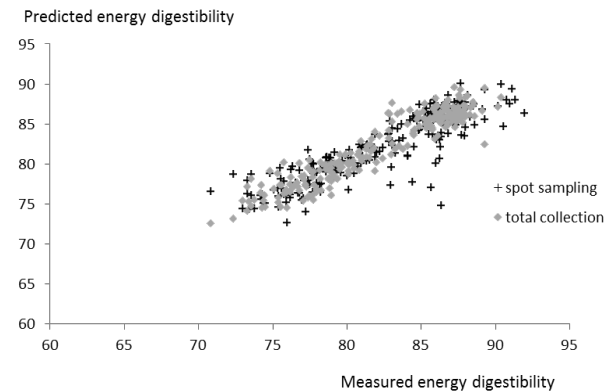
Berger et al. (2019)



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

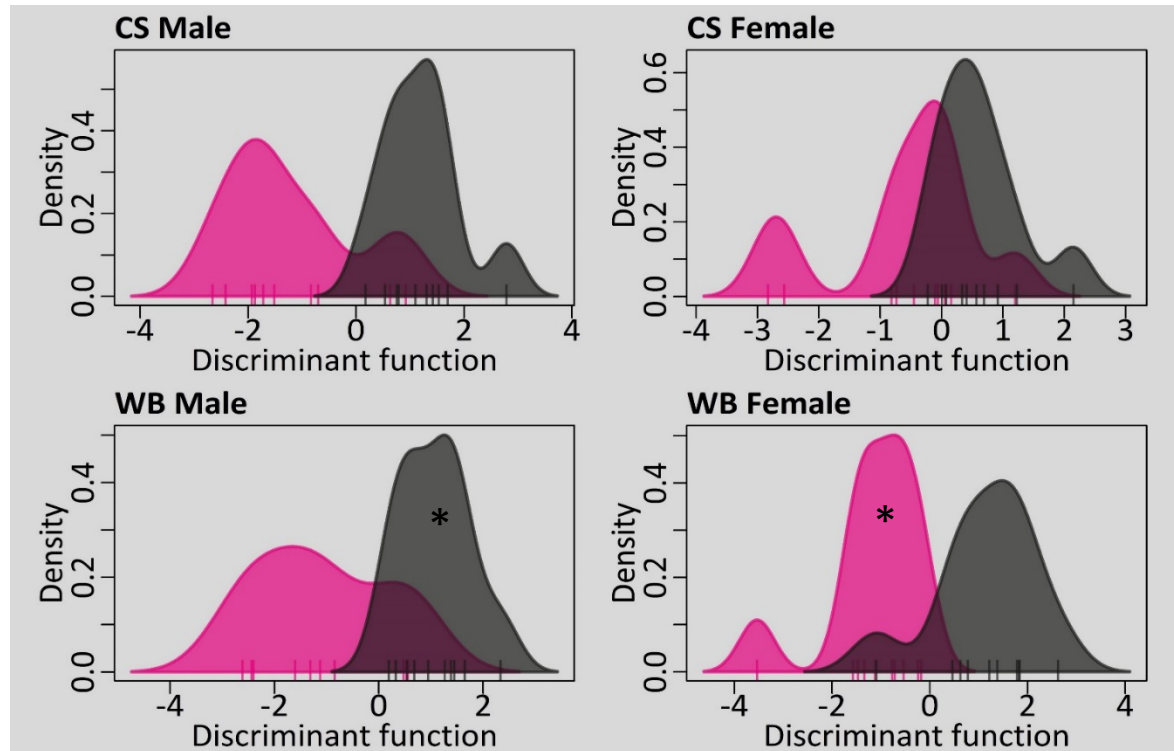


- ▶ Ability of the method to rank pigs for their digestive ability
- ▶ Heritability of DC of DM 0.4-0.6 and diet dependent

Labussiere et al. (2019)



Faecal microbiota composition as a trait to differentiate low and high FE pigs



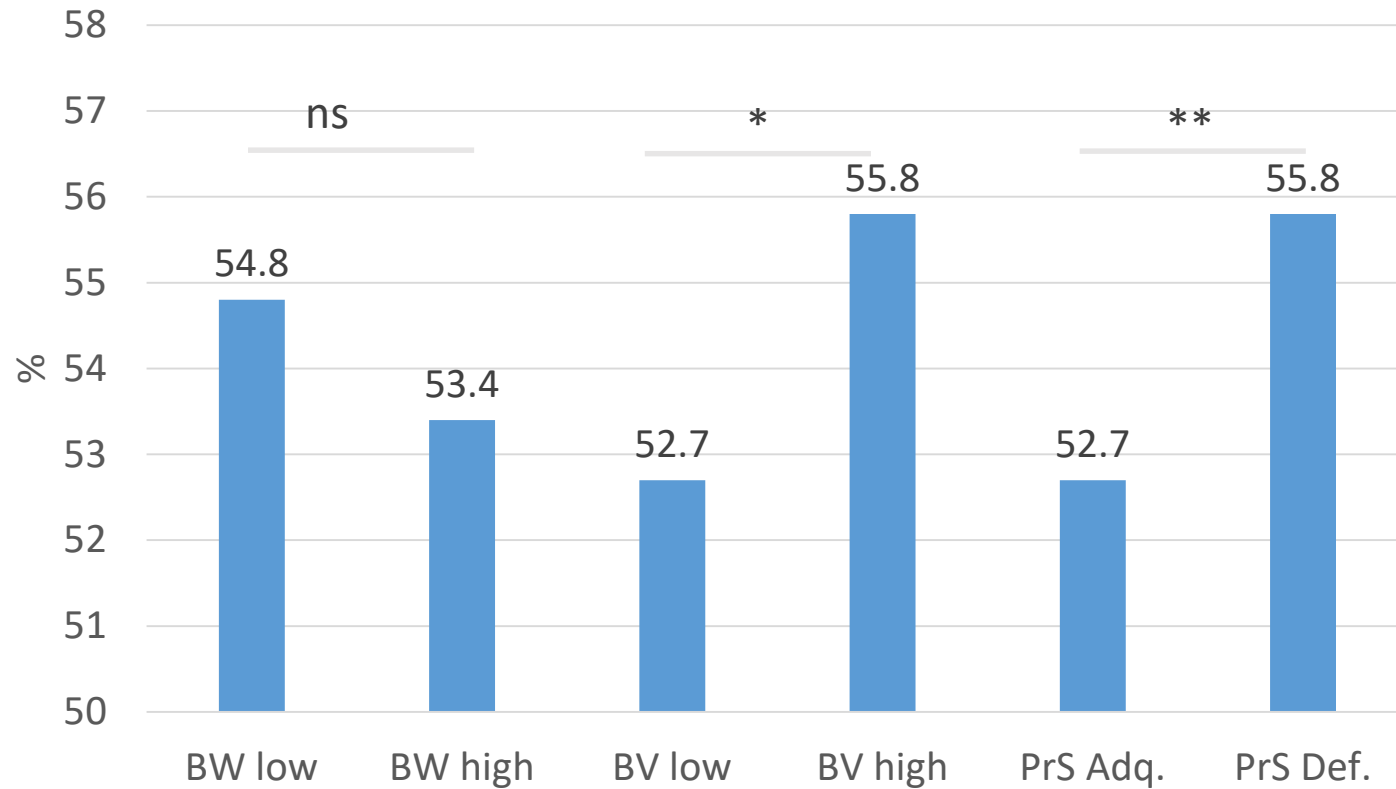
Feed efficiency: * = $P < 0.05$

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

Verschuren *et al.* (2018)



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



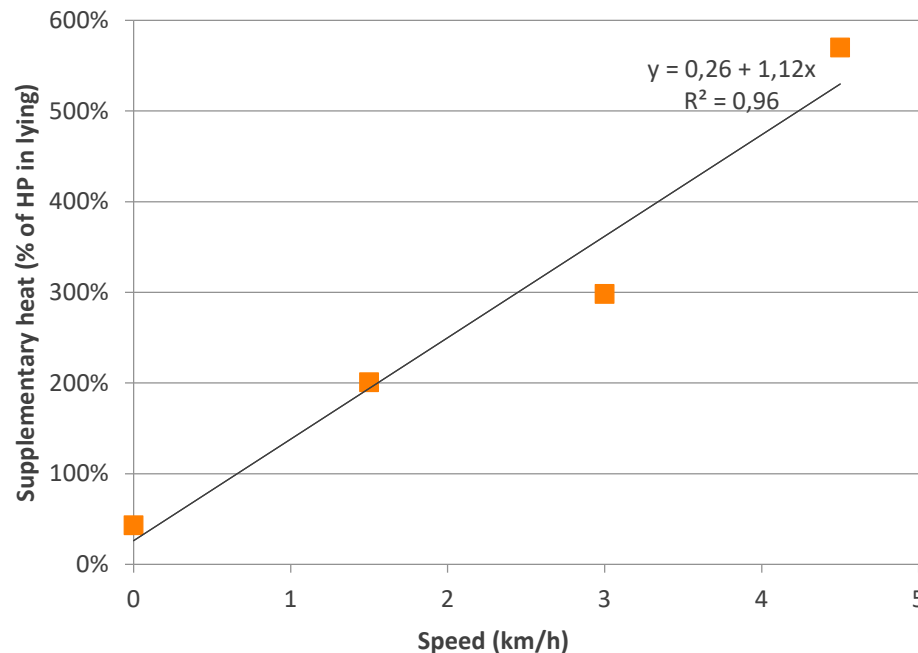
Jansman et al. (2019)



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

■ PC supplémentaire (% de PC en position couchée)

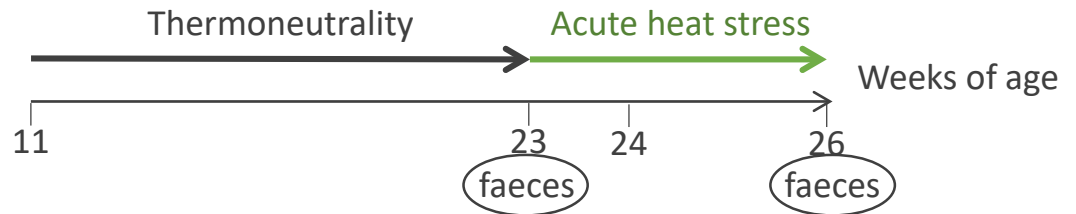
Labussiere et al. (2019)



Microbiota and Heat Stress (INRA)

Protocol

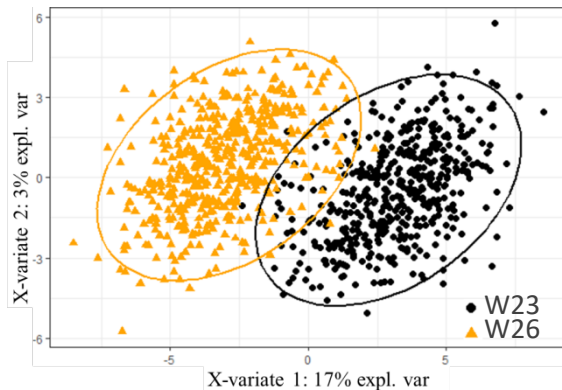
N = 558



Objectives

- Microbiota composition differs before and after HS?
- Predict performances from microbiota before HS?

Results



Great discrimination
before and after HS
using microbiota information
(7% error-rate)

At W23 : each sample classified into an enterotype based on microbiota composition

Enterotype 1 vs 2:

↘ *Lactobacillus*

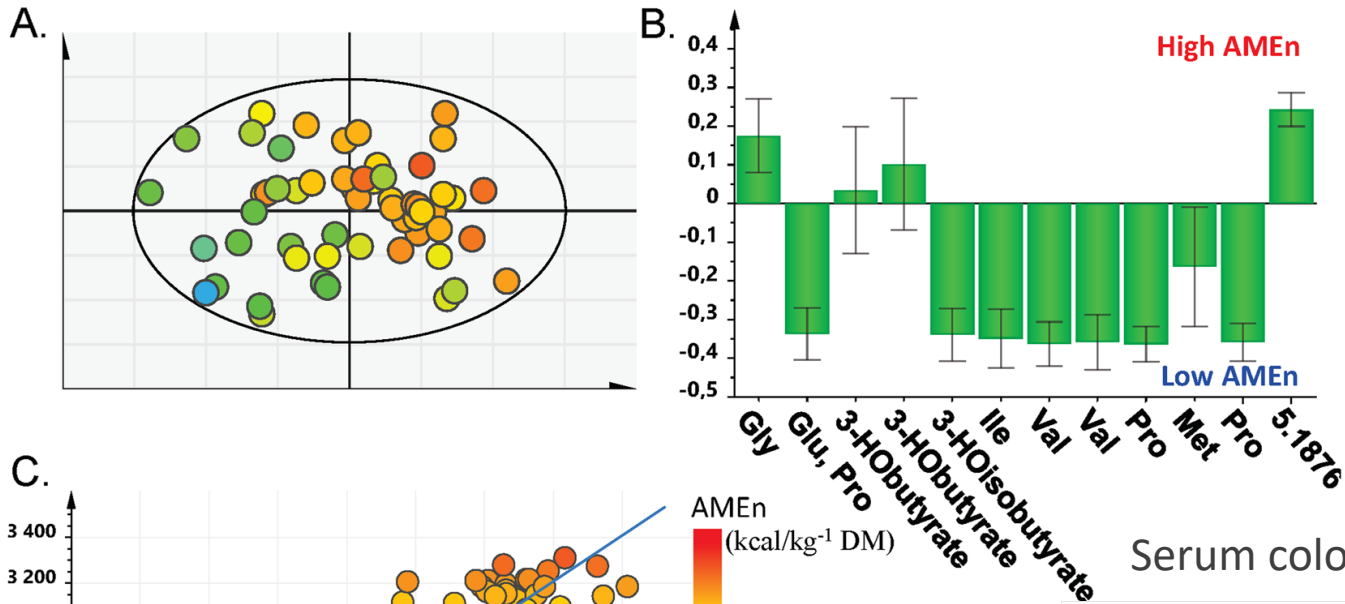
↗ *Turicibacter, Sarcina, Clostridium*

	E 1	E 2	RSD ²
Short-term response (from 23 to 24 wk)			
ADG, g/d	590	600	390
Change in Skin Temperature, °C	2.20	2.11	0.98
Change in Rectal Temperature, °C	0.25 ^a	0.34 ^b	0.45
Long-term response (from 23 to 26 wk)			
ADG, g/d	579	589	157
Change in ST, °C	1.86	1.87	0.87
Change in RT, °C	0.09 ^a	0.14 ^b	0.43



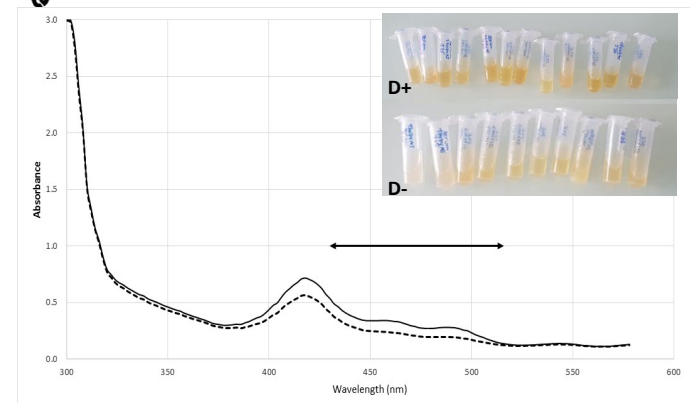


Finding biomarkers in serum for AMEn in broilers



59% of AMEn variability explained

Serum colour as a biomarker of DE



Beauclercq et al. (2018)

11/02/2020



Predictive biomarkers in muscle tissue and blood

Table 2 Number of probes and encoded genes identified as VIP for feed efficiency traits

	Nb annotated probes	Nb unique genes	R ²	RMSE
RFI-BV	384	222	0.63	42.9
	280	161	0.64	39.6
	50	27	0.65	39.3
FCR	421	267	0.61	0.23
	88	52	0.70	0.22
	50	33	0.67	0.22
FCRe	318	218	0.49	2.2
	50	29	0.52	2.0
	7	6	0.52	2.0

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-based F:G) with machine learning methods - validation of a subset of them by qPCR on the same (muscle) or other (blood) samples

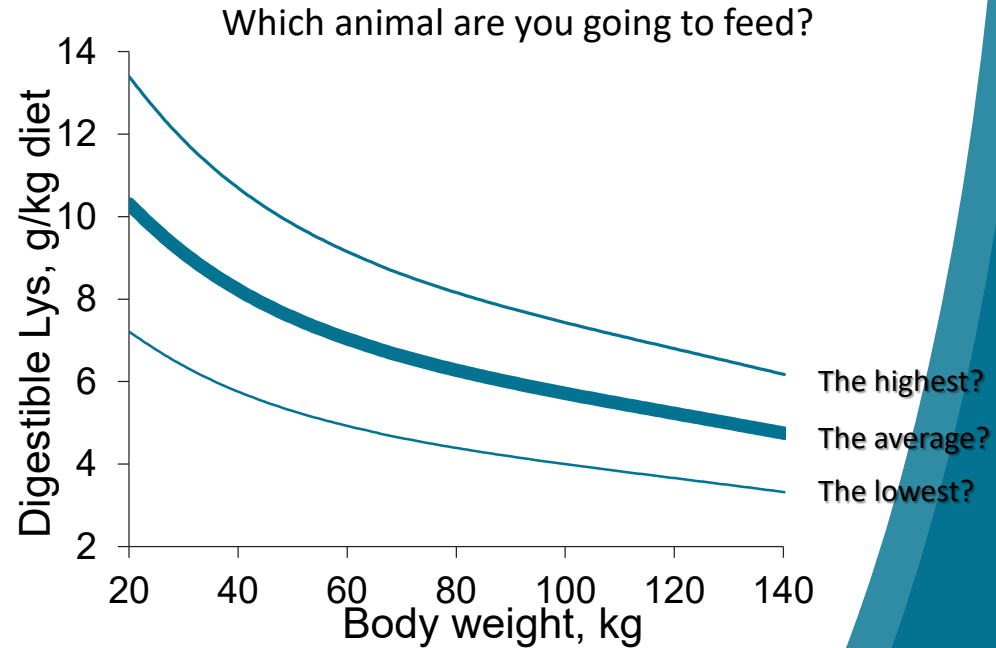
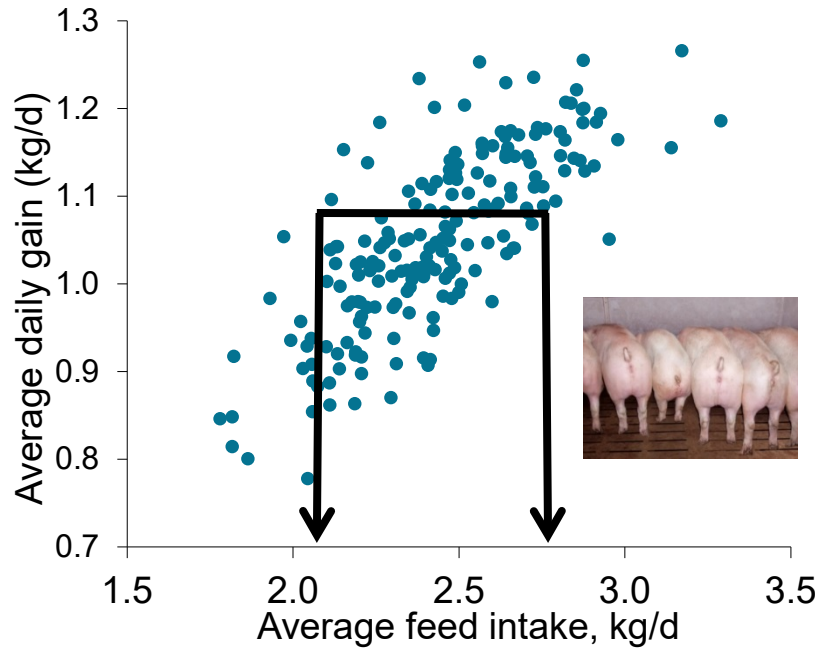
Conclusion: It was possible to identify few genes expressed in muscle or blood that might be reliable predictors of feed efficiency.

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

Gondret et al. (2019)



Managing variation among individuals through precision livestock feeding





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 and to all partners involved in FaG!

