Feed-a-Gene

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

New tool for phenotypic selection: predicting digestive ability of growing pigs from Near-Infra Red Spectra of feces

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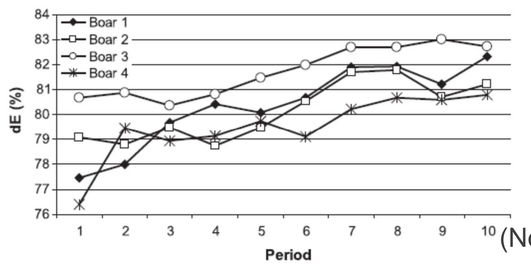
INTRODUCTION

- Preliminary results on genetic variability for digestive efficiency
  - 20 pigs from 4 boars:



(Noblet *et al.*, 2013)

- Classical methodology to evaluate digestive utilization of nutrients is time-consuming, laborious and raises ethical issues
  - Prolonged individual housing in a digestibility cage
  - Total collection of feces
  - Numerous lab analyses

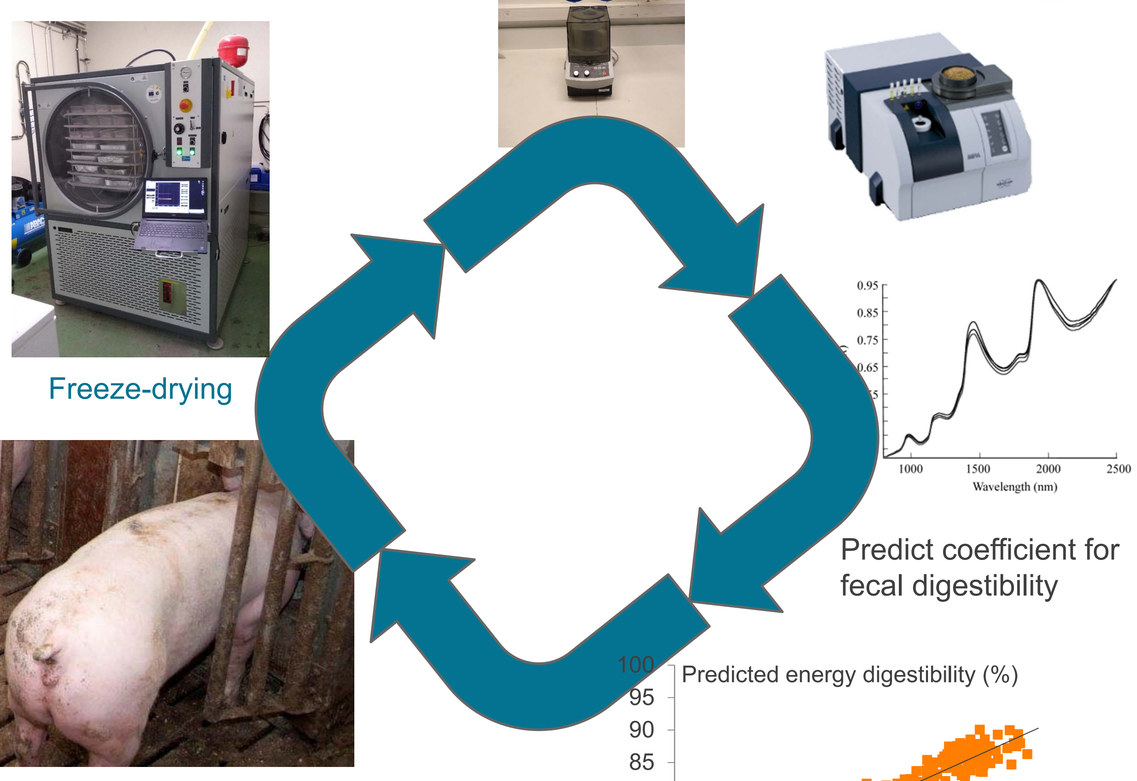
- Alternatives:
  - To avoid total collection of feces: spot sampling of feces
    - Identified or non-identified indigestible marker to estimate total weight of feces
  - To avoid lab analyses: Near Infra Red Spectroscopy NIRS

OBJECTIVES

- To develop a rapid, non invasive method to predict digestive ability of a large number of animals
- To use digestive ability as a component of feed efficiency to select pigs for

METHOD: Predicting digestibility coefficient in growing pigs

(Labussière *et al.*, 2019)



Accuracy of NIRS calibration equations to predict digestibility coefficients (DC) of energy and nutrients in the feces of growing pigs (INRAE trials)

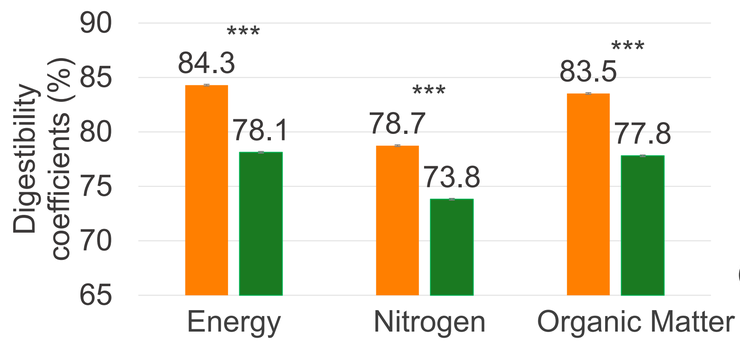
		Calibration dataset			Validation dataset							
DC	Range (%)	n	SD	R^2	n	SD	R^2	RPD	r	Bias	Intercept[1]	Slope[1]
Dry matter	72.1-90.4	749	1.61	83.5	82	1.71	85.7	2.67	0.93	0.2	12.3	0.85
Organic matter	73.9-91.8	749	1.63	82.5	82	1.47	89.3	3.05	0.94	0.1	9.2	0.89
Energy	70.9-90.4	749	1.84	79.2	82	1.73	87.0	2.78	0.94	0.1	15.8	0.81
N	67.4-90.9	749	2.32	79.1	82	1.82	89.6	3.11	0.95	0.1	14.5	0.82
Crude fibre	24.0-73.7	497	6.75	61.4	82	6.64	66.4	1.74	0.82	0.8	18.8	0.59

RPD, ratio between standard deviation of laboratory results and standard deviation of prediction.
[1]Intercept and slope of the regression line between predicted and measured DC.

IMPLEMENTATION: selecting pigs for their digestive ability

RESULTS

- 1242 growing pigs fed a conventional diet or a diet with a high level of dietary fiber (mixture of wheat bran, soybean hulls and sugar beet pulp; 8.4 % of crude fiber)



(Déru *et al.*, 2019)

➢ Pigs fed a dietary fiber diet had lower digestibility coefficients (DC) than pigs fed a conventional diet

- Study of genetic variability of digestive efficiency in the two diets:

	heritability conventional diet	heritability dietary fiber diet	Genetic correlations between diets
DC of energy	0.38 ± 0.12	0.54 ± 0.15	0.76 ± 0.15
DC of organic matter	0.40 ± 0.12	0.54 ± 0.15	0.79 ± 0.15
DC of nitrogen	0.41 ± 0.12	0.56 ± 0.15	0.86 ± 0.16

(Déru *et al.*, 2019)

➢ There is a genetic variability of digestive efficiency, even in the conventional diet!

➢ DC measured in the two diets are similar traits

- Genetic correlations between DC and main production traits for both diets combined:

	Average Daily Gain (ADG)	Daily Feed Intake (DFI)	Feed Conversion Ratio (FCR)
DC of energy	-0.53 ± 0.13	-0.75 ± 0.10	-0.39 ± 0.14
DC of organic matter	-0.42 ± 0.13	-0.66 ± 0.10	-0.43 ± 0.13
DC of nitrogen	-0.52 ± 0.13	-0.74 ± 0.10	-0.50 ± 0.15

(Déru *et al.*, 2019)

➢ Favorable genetic correlations of DC with DFI and FCR, but unfavorable with ADG

FIRST CONCLUSIONS ABOUT THESE RESULTS

- It is interesting to select pigs for their digestive ability for many reasons :
  - To have pigs that better digest diet with a high level of dietary fiber
  - Cheaper method and can be done in a large number of animals
  - Heritable trait
  - Favorable genetic correlations with some production traits

TAKE HOME MESSAGES

- NIRS satisfactorily predict digestibility coefficient of nutrients and energy in growing pigs
- Digestive ability has a moderate to high heritability = new candidate for selection

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Feed-a-Gene

Feed-a-Gene is a European H2020 project involving 23 partners which aims to adapt feeds, animals and feeding techniques to improve the efficiency and sustainability of pig, poultry and rabbit production systems. It is coordinated by INRA (France), started in March 2015 and will last 5 years. The project aims to reduce the environmental impact of monogastric livestock production by improving and diversifying animal diets and feed technologies and by integrating new selection criteria for these animals. The Feed-a-gene project further aims to develop new management systems for precision feeding and precision farming and to evaluate the overall sustainability of the different management solutions proposed in the project.

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