

# Animal based indicators: tools to study production diseases in pigs

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# What are production diseases ?

Diseases that induce losses of performance,  
increase mortality and morbidity,  
...originated from complex interactions



## Environment



- Environmental conditions
- Management and practices
- Nutrition

**Expression of disease : severity,  
duration, prevalence**

## Pathogens



## Animal



- Genetic
- Age
- Early life experience

...adversely impact farm economy

## Respiratory diseases

6.8€ [2 – 19 €]

per fattening pig produced by an affected herd

## Mastitis, Metritis and Agalactia

up to 95 € per affected sow

*Meta-analyses of 130 published studies (1995-2015)*

*Niemi et al (2016)*

...decrease animal welfare and  
reduce consumer acceptability

## Aim of this study

**To identify animal-based traits characterizing the physiological and health status of pigs and usable as potential indicators of diseases**

## Why animal-based indicators are so important?

For farmers, veterinarians and researchers

- ✓ to early diagnose pigs affected by production diseases: precision farming and medicine
- ✓ as tools to better understand the impact of factors and evaluate preventive and corrective strategies

# Research strategy



**Systematic review of the literature and meta-analyses**



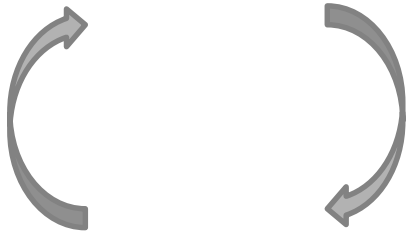
**Experimental approaches  
(4 trials)**

- Post weaning diarrhoeas
- Leg disorders and osteochondrosis in growing pigs
- Inflammatory and respiratory diseases in growing pigs

# Research strategy



**Systematic review of the literature and meta-analyses**



**Experimental approaches  
(4 trials)**

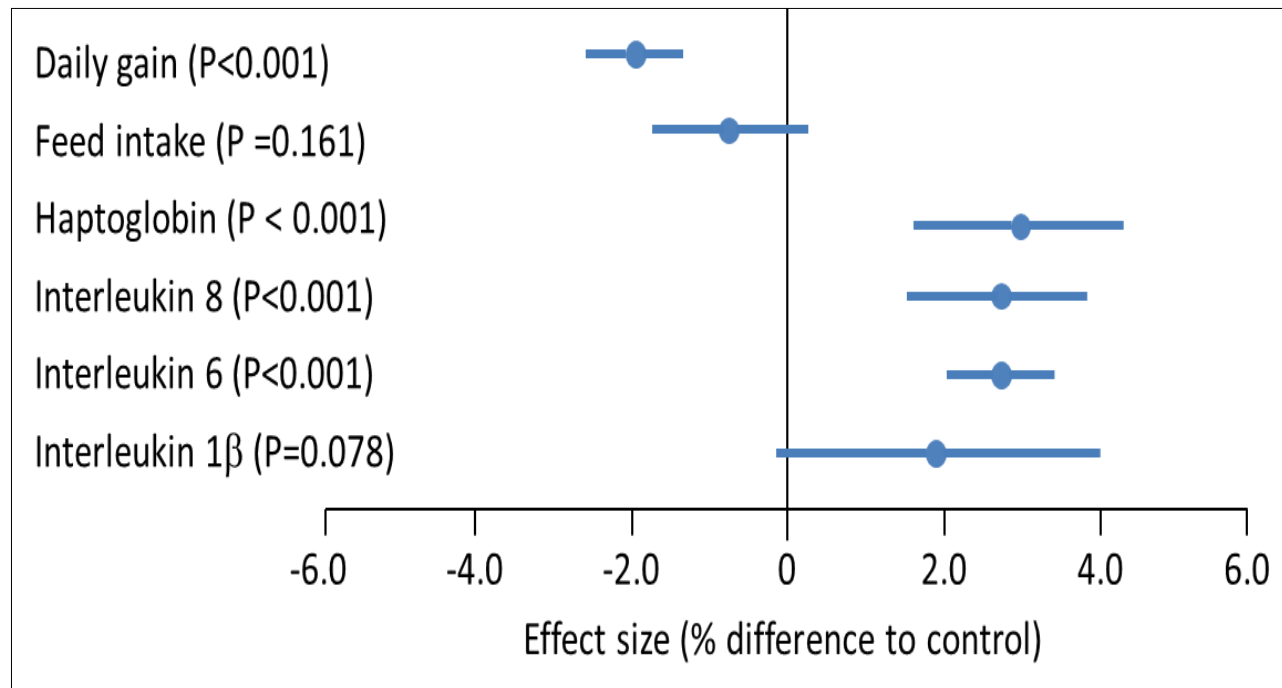
- ✓ to identify and classify measured traits
- ✓ to quantify the impact of diseases on these traits
- ✓ to propose traits as candidates for indicators
- ✓ to identify gaps

# Systematic review of the literature and meta-analysis



- Extraction of data from 67 publications selected from 2339 records
- **Diversity of traits**: 524 unique traits used to characterize production disease recorded in variety of sample materials (blood, muscle, bone) or at the level of whole animal
- **Gaps** for some diseases (locomotory system), some traits (behaviour)

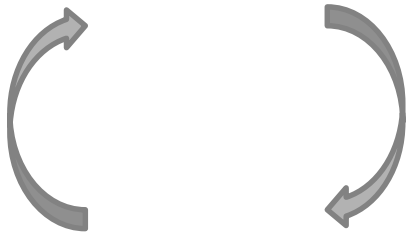
➤ **Traits relative to animal performance or immunological response of pigs are the most present and can be considered as good candidates for indicators**



# Research strategy



Systematic review of the literature and meta-analyses



**Experimental approaches  
(4 trials)**

- ✓ to quantify the impact of diseases on identify traits
- ✓ to quantify the effect of factors or corrective practices on diseases and on traits
- ✓ to fill gaps

# Use of traits relative to performance to test a protective dietary sequence and a genetic factor on post-weaning diarrhoea

- 132 pigs from 2 lines of pigs divergently selected for feed efficiency, weaned at 28 days (d0)
- 2 dietary sequences : conventional vs protective (3 successive diets, less protein, more AA, high digestibility)

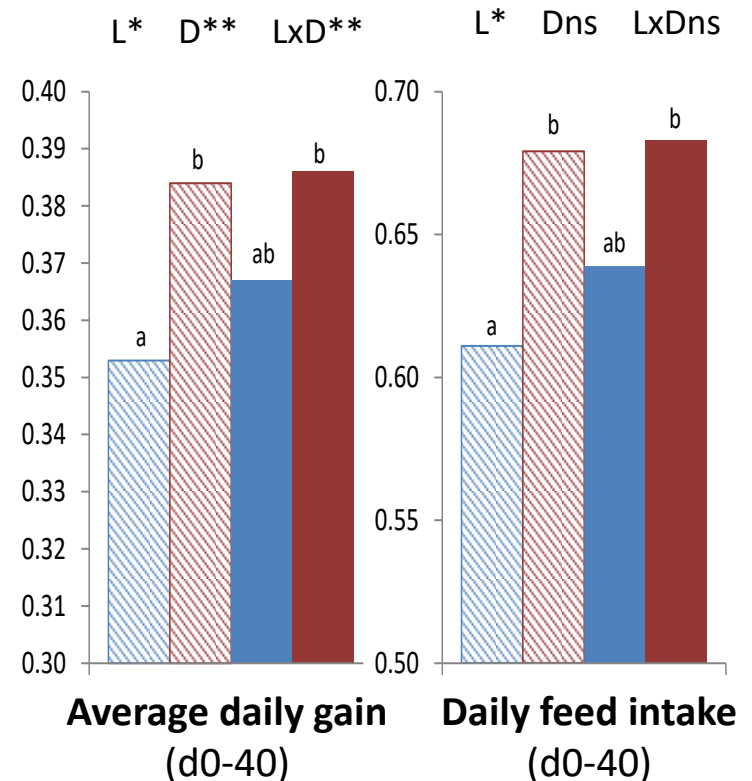
**Nb of pigs having diarrhoea** during the 1st wk after the weaning

Genetic factor (P<0.001)

High efficiency (LRFI)	Low efficiency (HRFI)
28	18

Dietary sequence (P<0.05)

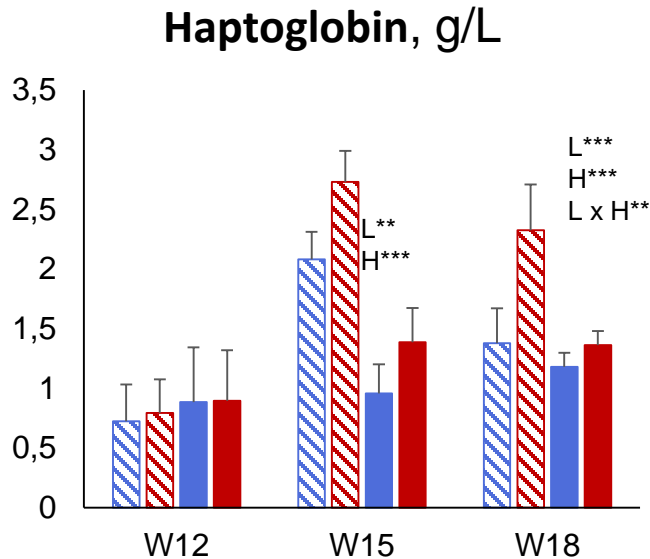
Conventional	Protective
30	16



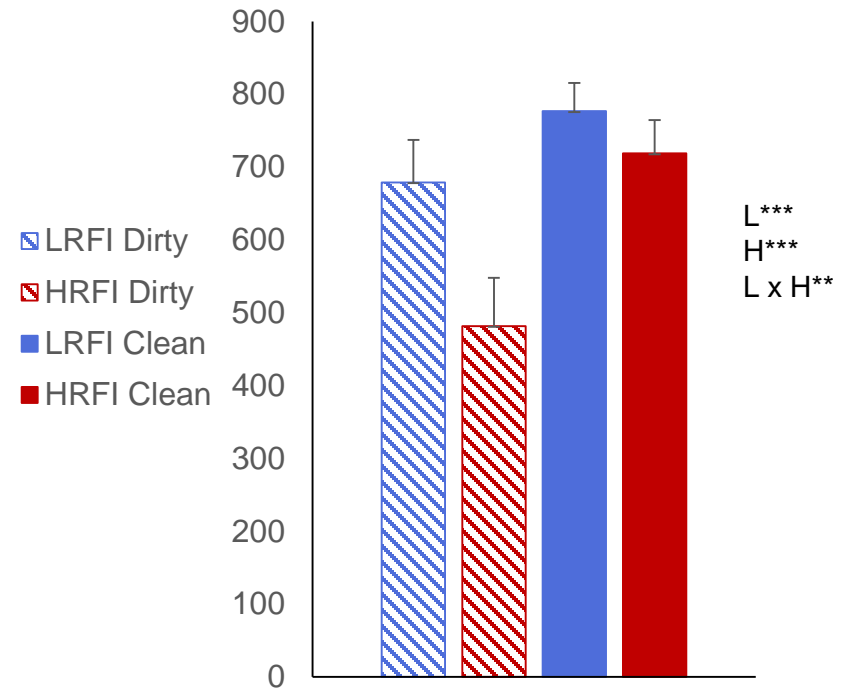


# Use of performance and immune related traits to test a genetic factor and hygiene condition

- 160 growing pigs (12-18 wk of age) from 2 lines of pigs divergently selected for feed efficiency
- 2 hygiene of housing conditions : clean vs dirty rooms



### ADG W12-18, g/day



## Respiratory lesions

pneumonia prevalence **Dirty n=19/40 > Clean n = 3/40**

average score **HRFI (11.2) > LRFI (6.8)**

*Chatelet et al, 2018*

# The question of early detection of traits related to lameness to test a genetic factor and an imposed physical activity

- 160 growing pigs (10 wk of age at the start) from 2 lines of pigs divergently selected for feed efficiency
- 2 levels of physical activity : spontaneous or increased (forced increased way to access to the feed)

	LRFI Spont	LRFI Inc	HRFI Spont	HRFI Inc	Line
<b>Lameness scores</b> (% of pigs in each category with score >2)					
<b>Osteochondrosis scores</b> (0 - 5) (surface evaluation, proximal condyles, [0,5])					
Humerus					
Femur					
<b>Seric biomarkers of cartilage degradation (C2C) or synthesis (CPII) (ng/ml)</b>					
C2C					
CPII					



*Stavarakakis, 2014*



*van Grevenhof et al. (2011)*

# The question of early detection of traits related to lameness to test a genetic factor and an imposed physical activity

- 160 growing pigs (10 wk of age at the start) from 2 lines of pigs divergently selected for feed efficiency
- 2 levels of physical activity : spontaneous or increased

	LRFI Spont	LRFI Inc	HRFI Spont	HRFI Inc	Line
<b>Lameness scores</b> (% of pigs in each category with score >2)					
	7	9	6	5	ns
<b>Osteochondrosis scores</b> (0 - 5) (surface evaluation, proximal condyles, [0,5])					
Humerus	2.50	2.20	1.57	1.36	***
Femur	1.78	1.67	1.18	1.13	***
<b>Seric biomarkers</b> of cartilage degradation (C2C) or synthesis (CPII) (ng/ml)					
C2C	537	577	477	501	***
CPII	2595	2442	2024	2321	*

- 90% of pigs had OC >1
- OC scores greater in pigs of the high efficient line

- No relation between OC scores and biomarkers

# The question of early detection of traits related to lameness to test breeding line or gender effects



- 135 Finish Landrace growing pigs
- Average breeding index values of the parents: High maternal fertility line (HF) or High performance line (HP)

**Lameness scores:** no difference between the breeding lines or sexes

## Classification of osteochondrosis lesions

	Normal (0)		Serious (2, 3, 4)		$\chi^2$ test
	n	%	n	%	P
Distal femur					
HF	15	25.4	20	33.9	ns
HP	11	21.2	18	34.6	ns
Gilts	14	25.5	12	21.8	ns
Boars	12	21.4	26	46.4	*

- **OC is common in finish Landrace pigs**
- **No effect on the selection for performance or maternal fertility**
- **OC lesions more severe and frequent in boars than in gilts**

## Conclusions

- Both approaches (literature review and experiments) confirm that performance and haptoglobin are relevant as indicators of production diseases in our experimental conditions
- An indicator is rarely universal: should be tested and validated
- Indicators for low prevalence diseases (leg disorders) are still missing
- Global and systematic approaches are still difficult because of the availability and diversity of data

# Acknowledgements



- This study has been performed in the WP3  
« Associations between genotype and health”
- Associate publications

Loisel F., Stravakakis S., Sakkas P., Kyriazakis I., Stewart G., Le Floc'h N., Montagne L. 2016. Identification of animal-based traits as indicators of production diseases in pigs. 16th International Conference on Production Diseases in Farm Animals (ICPD), June 2016, Wageningen, Netherlands.

Stravakakis S., Loisel F., Sakkas P., Le Floc'h N., Kyriazakis I., Stewart G., Montagne L. 2017. A systematic literature review and meta-analysis of animal-based traits as indicators of production diseases in pigs, *Animal*, submitted

Gilbert H., Ruesche J., Muller N., Billon Y., Robert F., Montagne L. 2018. Responses to weaning in two pig lines divergently selected for residual feed intake depending on diet. *Journal of Animal Sciences*, submitted

Gilbert H., Ruesche J., Muller N., Billon Y., Robert F., Roger L., Montagne L. 2016. Responses to weaning in two pig lines divergently selected on residual feed intake fed conventional or securing diets. 67th Annual Meeting of the European Federation of Animal Science (EAAP), 29 August -2 September 2016, Belfast, p 428

Chatelet, A., Gondret, F., Merlot, E., Gilbert, H., Friggens, N.C., Le Floc'h, N. (2018). Impact of hygiene of housing conditions on performance and health of two pig 2 genetic lines divergent for residual feed intake. *Animal*. doi 10.1017/S1751731117001379.

Niemi J., Jones P., Tranter R., Heinola K., Cost of production diseases to pig farms. 24th International Pig Veterinary Society Congress, Dublin, Ireland, June 2016

Boudon A, Karhapää M, Siljander-Rasi H, Le Floc'h-Burban N., Cantaloube E, et al.. 2016, Effect of genetic selection and physical activity on lameness and osteochondrosis prevalence in pigs. 16 th International Conference on Production Diseases in Farm Animals (ICPD), June 2016, Wageningen, Netherlands.

Meunier-Salaün, Marie-Christine , Karhapää, Maija, Siljander-Rasi, Hilikka, Cantaloube, Emma, Archimbaud, Lucile, Brossard, Ludovic, Le Floc'h, Nathalie, Boudon, Anne. 2018, Effects of divergent lines on feed efficiency and physical activity on lameness and osteochondrosis in growing pigs. ISAE, July 2018, Prince Edward Island, Canada