

The role of hygiene in the expression of production diseases in pigs

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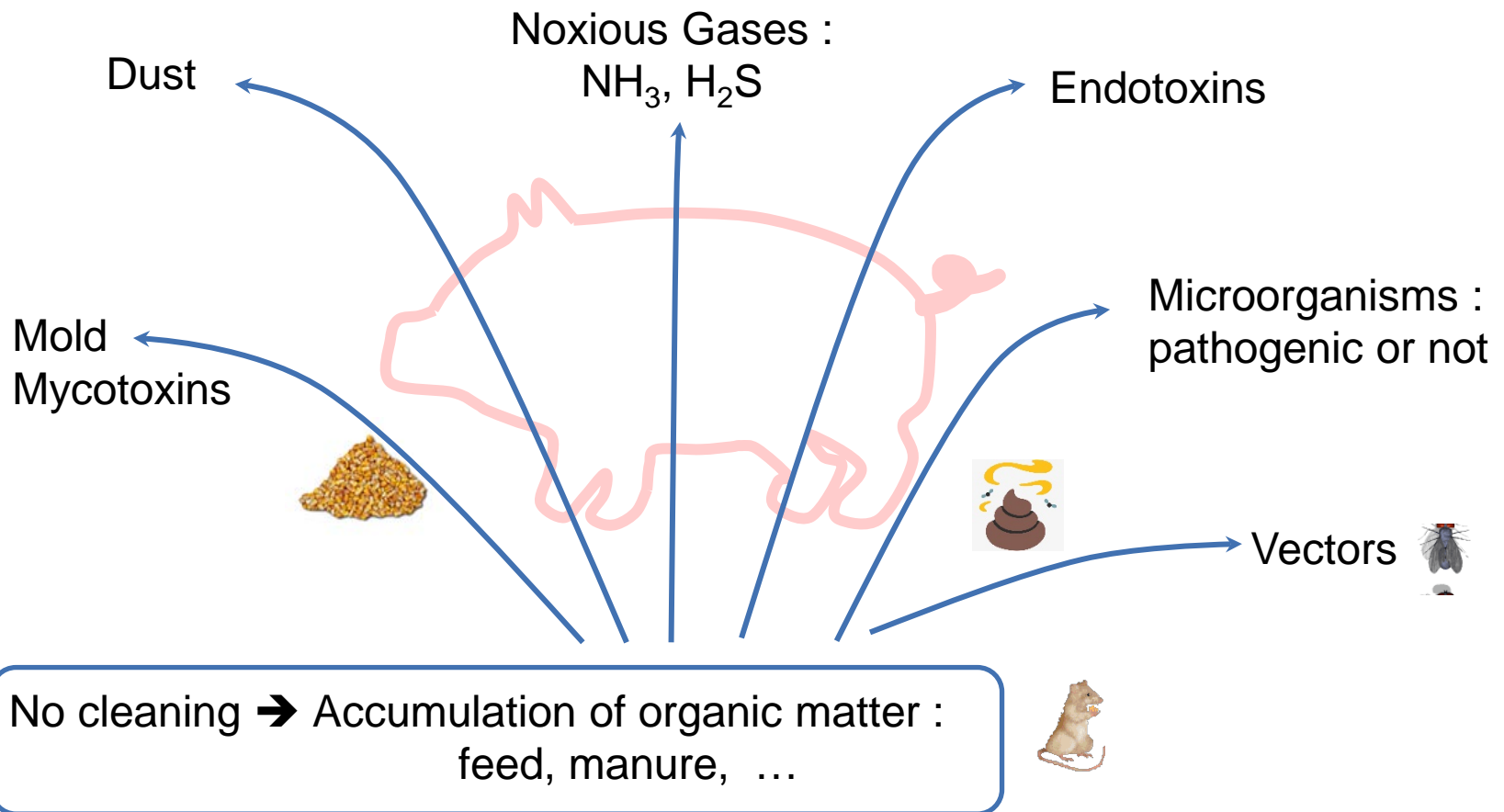


Introduction

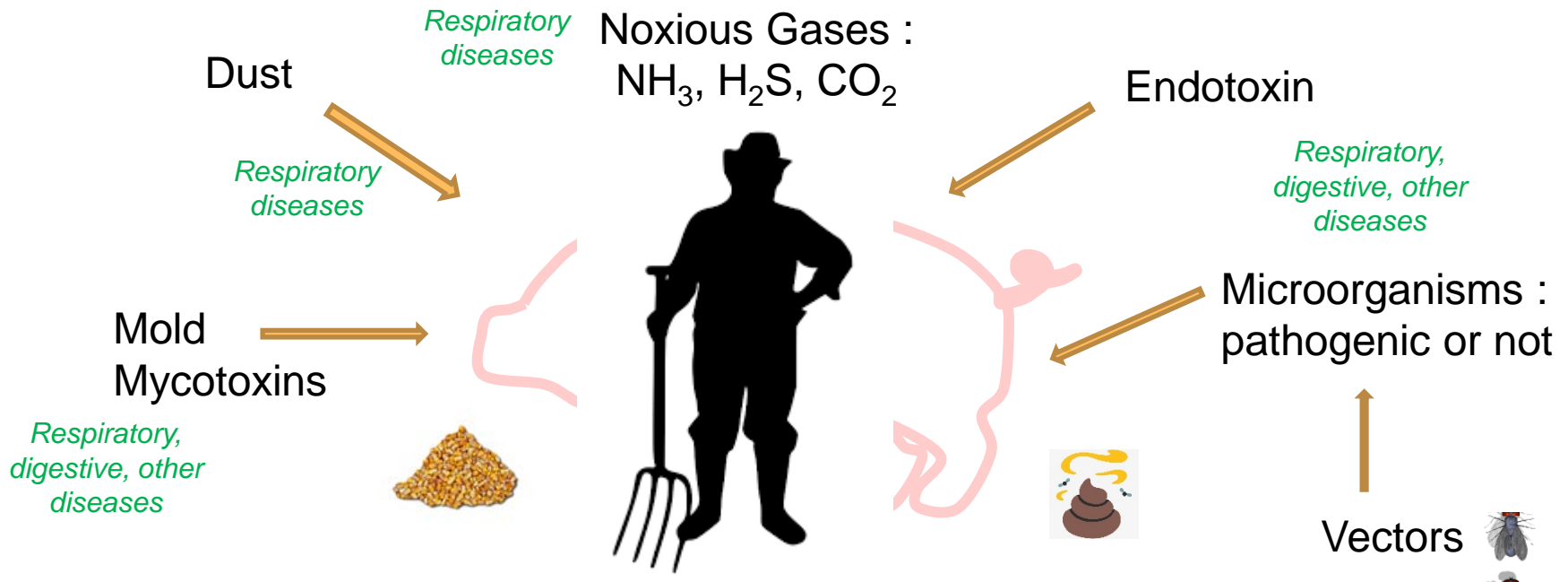
- Biosecurity is defined as the implementation of measures that reduce the risk of “disease agents” being introduced and/or spread
- For pig production, cleaning and disinfection (internal biosecurity) of pens are assumed to be routinely implemented
- PROHEALTH : implementation of cleaning and disinfection is variable between and across countries* and a margin of progress is still possible

* WP1 : Chantziaras et al, 2018 PROHEALTH survey on 4 European countries
Biocheck-Ugent™ biosecurity scoring system

What happens when pens are not cleaned and disinfected



What happens when pens are not cleaned and disinfected



No cleaning → Accumulation of organic matter :
feed, manure, ...



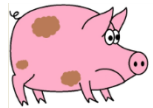
Limit values suggested for human and pigs

Pollutant	Human health	Swine health
Ammonia (ppm)	7.0	11.0
Carbon dioxide (ppm)	1,540	1,540
Total dust (mg/m ³)	2.4	3.7
Respirable dust (mg/m ³)	0.23	0.23
Endotoxin (g/m ³)	0.08	0.15
Total bacteria (cfu/m ³) ^a	4.3 x 10 ³	4.3 x 10 ³
■ H ₂ S : mid term exposition (<1 year)	0.02 ppm	Source ATSDR

Murphy et al., 2011

Poor hygiene of housing conditions during the growing phase : an experimental proof

- 2 hygiene of housing conditions
 - **Dirty room** : no biosecurity precautions, no cleaning and disinfection after previous occupation by non-experimental pigs, no manure evacuation, decreased aeration rate, pigs were mixed with non-experimental pigs
 - **Clean room** : cleaning and disinfection, clean cloth and boots, optimal aeration rate, no mixing with non-experimental pigs
- Dirty housing conditions : immune stimulation, inflammation, low growth rate, changes in fecal microbiota, in digestion and metabolism *Le Floc'h et al, 2014*

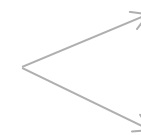


Experimental design

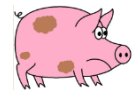
- 160 **growing – finishing** pigs (50% females 50% males)
- 4 Experimental groups (40 pigs per groups)

*2 lines of LW pigs
selected for Residual
Feed Intake*

LRFI



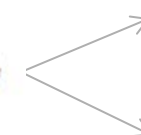
Dirty



Clean



HRFI



Dirty

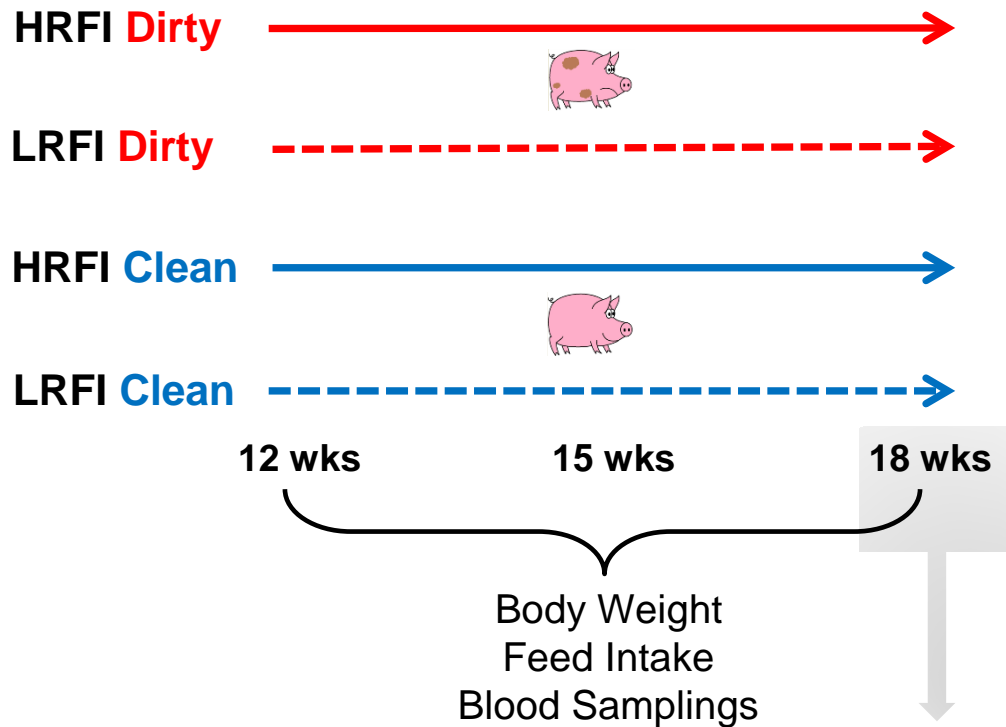


Clean



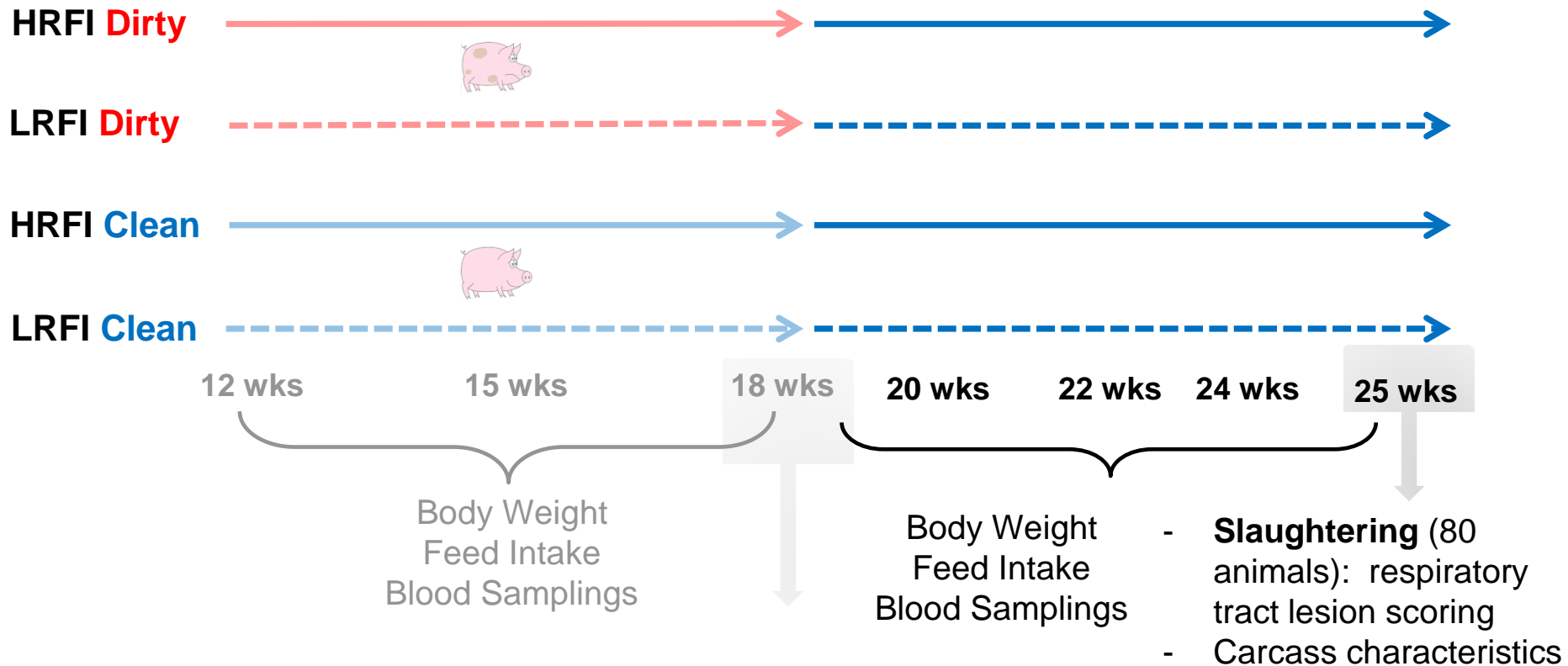
- Feed and water ad libitum
- Individual pen
- **13 Weeks (W)**, 2 periods:
 - **Period 1 : 6 weeks of challenge (12-18 wks of age)**
 - **Period 2 : 7 weeks of recovery (18-25 wks of age)**

Period 1 : hygiene Challenge



- **Slaughtering 1** (80 animals): respiratory tract lesion scoring
- **Transfer** (80 animals) to “clean” conditions

Period 2 : recovery



Herd sanitary status and Treatments

■ Herd status

Actinobacillus pleuropneumoniae 1 et 2 BVT	negatif
Actinobacillus pleuropneumoniae 3,6,8	negatif
Bordetella bronchiseptica	positif
Lawsonia intracellularis	positif
Pasteurella multocida	negatif
PCV2	positif
PPRS	negatif
Mycoplasma hyopneumoniae	positif
Respiratory coronavirus	positif
Digestif coronavirus	négatif

- Treatments and vaccination : coccidiosis (PW), *Haemophilus parasuis* (50 and 70 d), *Mycoplasma hyopneumoniae* (PW)
- Mortality and morbidity during the trial : 3 deads (2 « Clean », 1 « Dirty », cough, diarrhea, dermatitis

Results: Characterization of the environment

Temperatures (°C) WP4

Dirty: 20.7 (13.8-26.4)

Clean: 21 (13.3-26)

CO₂(ppm) WP4+ Dräger device

Dirty: 1058 (224-2277)

Clean: 1186 (354-2313)

< 1500 ppm

NH₃(ppm) Dräger device

Dirty: 7.25(4-25) n=30 (6 values below 5 ppm)

Clean: 3 (2.5-5) n=24 (12 values below 5 ppm)

< 11 ppm

Relative humidity (%)

Dirty: 74.5 (39.9-92.7)

Clean: 54.45 (29.7-84.4)

Total dust (µg/m³)

Dirty :21(6-86)

Clean: 47(7-174)

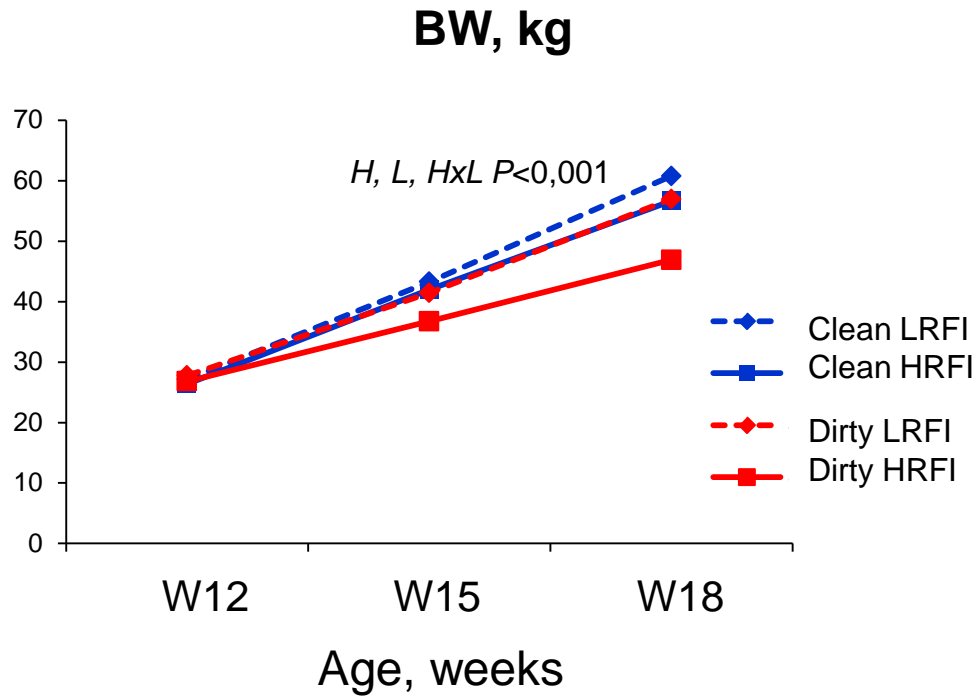
< 3,7 mg/m³

☹ 1 measure H₂S Dräger device

Dirty 0.275 ppm

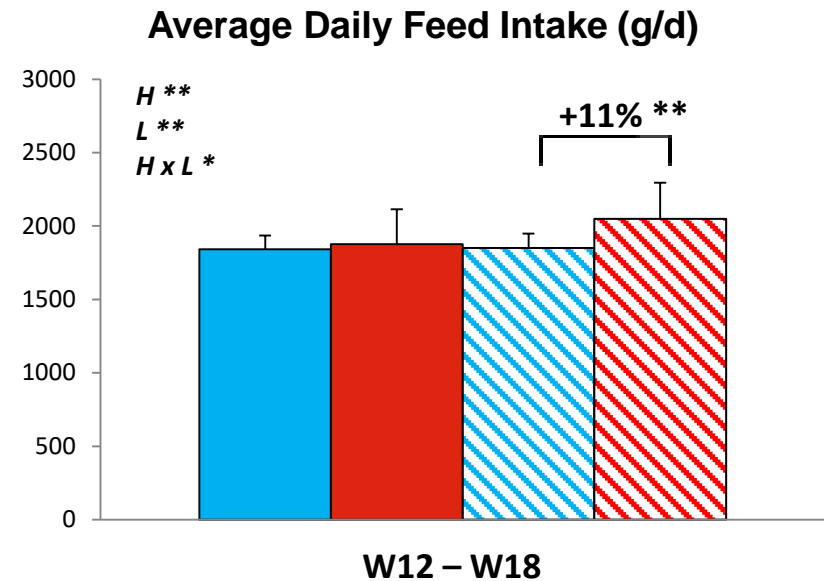
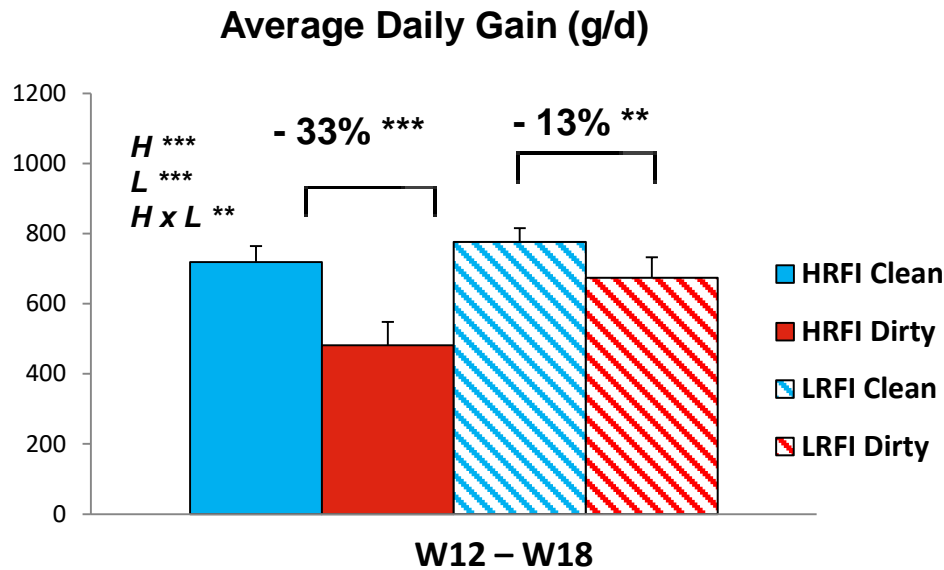
Clean 0 ppm

Results : Period 1 - Performance



After 6 weeks in a dirty pens, « Dirty » pigs were lighter than « Clean » pigs
 Δ BW : 3.8-9.7kg regarding the line

Results : Period 1 - Performance



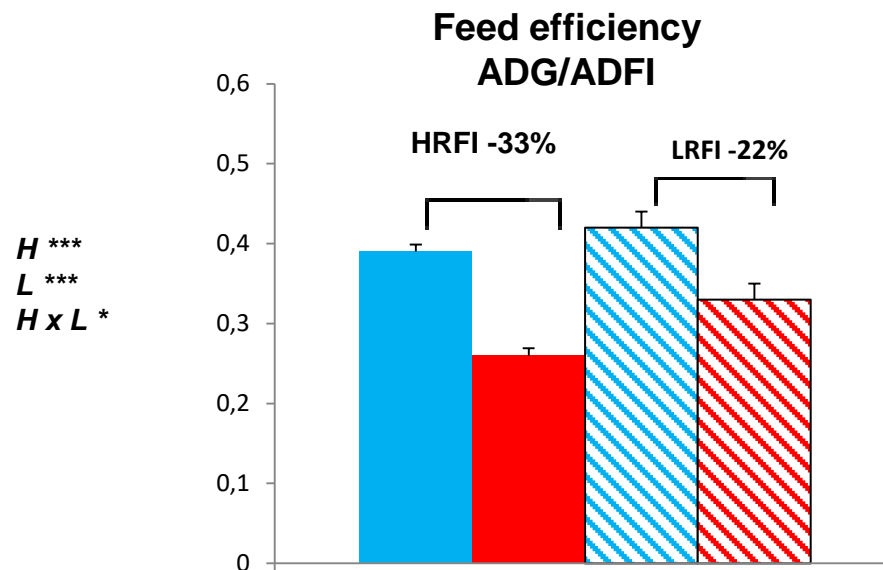
H : effect of Hygiene

L : effect of genetic Line

L x H : interaction Hygiene x Line

After 6 weeks in a dirty pens, « Dirty » pigs grew less than « Clean » pigs but did not eat less

Results : Period 1 - Performance

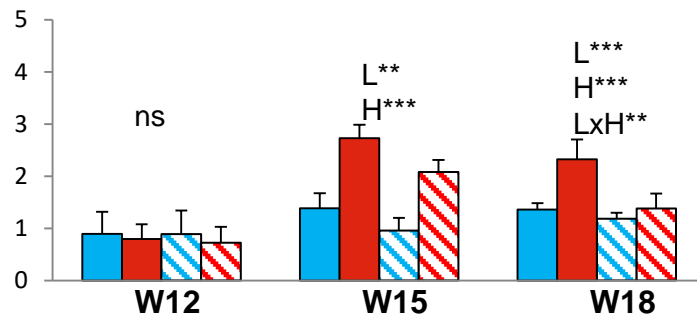


After 6 weeks in a dirty pens, « Dirty » pigs had a lower feed efficiency than « Clean » pigs

Results : Period 1 – Blood indicators

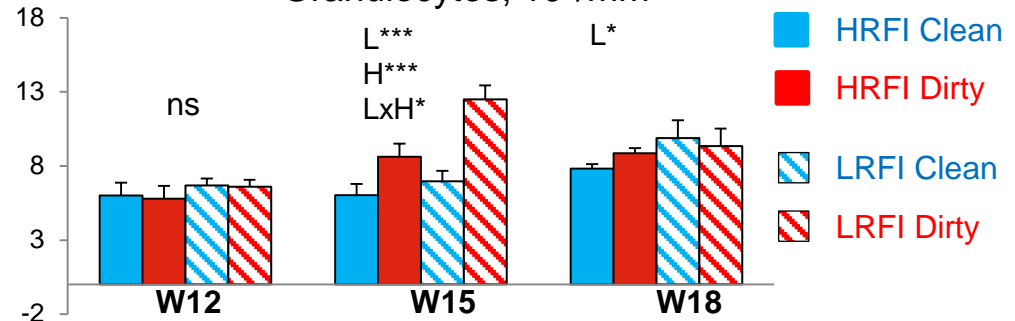
Systemic inflammation

Haptoglobin, g/L



Systemic infection

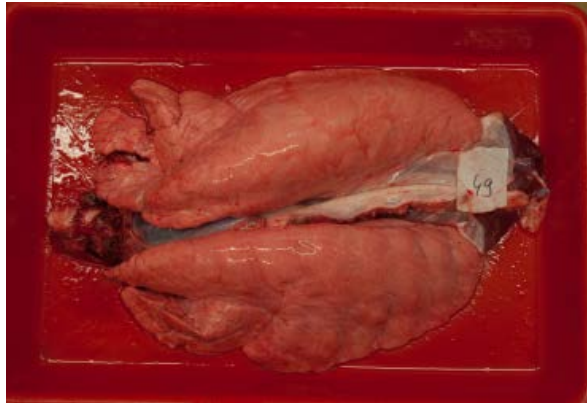
Granulocytes, $10^6/\text{mm}^3$



Poor hygiene induced a systemic inflammatory response
Not shown : ↗ oxidative stress measured in plasma and fat

Poor hygiene induced an immune response
Not shown : ↗ Total plasma immunoglobulins

Period 1 – Respiratory tract

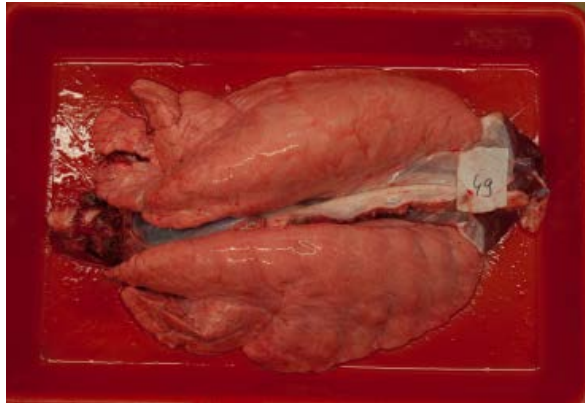


Healthy lung : Lung lesion (1/28)



Pneumonia : when lung lesions scoring > 6

Period 1 – Respiratory tract



Healthy lung : Lung lesion (1/28)



Pneumonia : when lung lesions scoring > 6

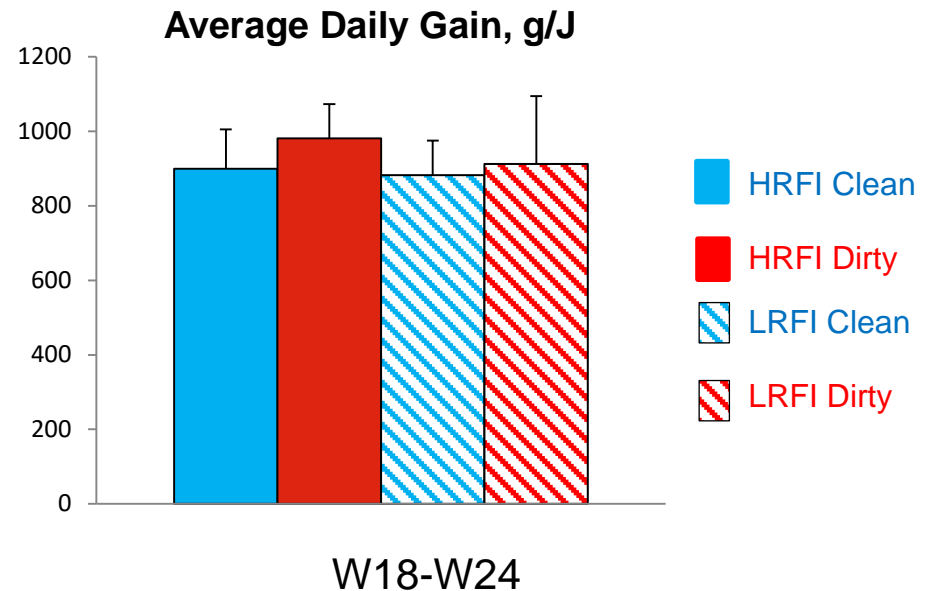
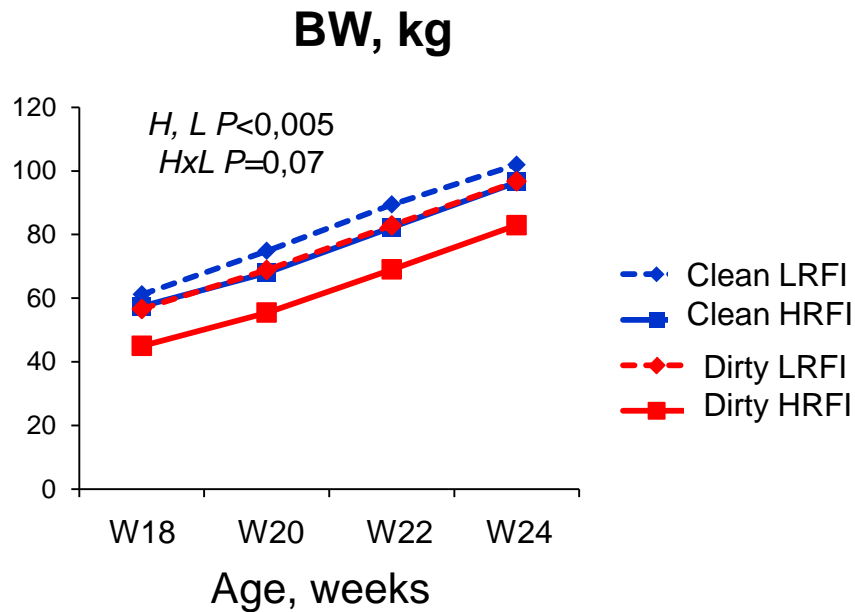
Hygiene	Clean		Dirty		<i>p-value*</i>	
Line	HRFI	LRFI	HRFI	LRFI	H	L
n	19	19	19	18		
Pleurisy count	0	0	3	0	0.12	0.24
Pericarditis count	0	0	2	0	0.24	0.50
Pneumonia count	3	0	9	10	<.0001	0.61



Higher in dirty conditions

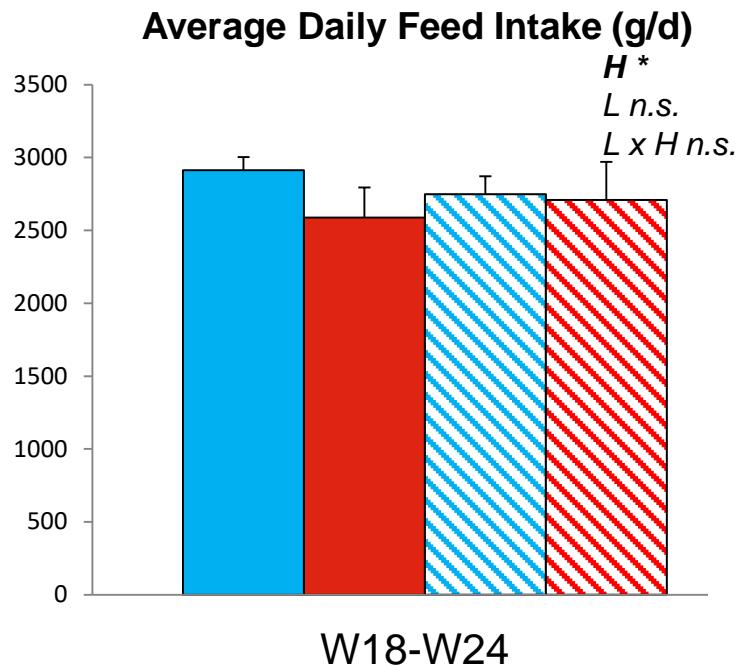
* Fisher's exact test

Results: Period 2 - Performance

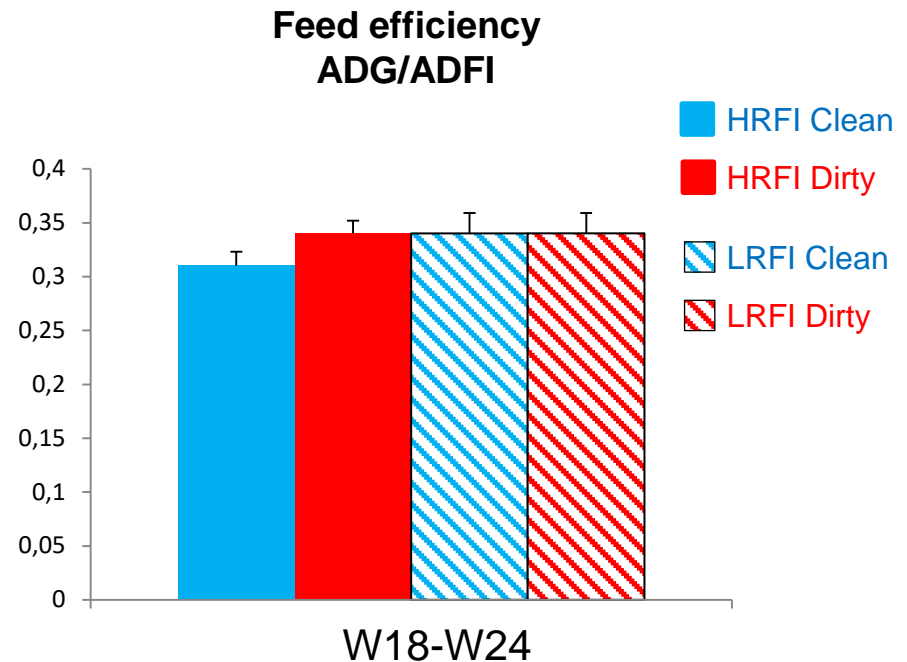


After 6 weeks back in clean conditions, despite no more difference in ADG,
 « Dirty » pigs were still lighter than « Clean » pigs
 Δ BW : 5.8-13.4kg regarding the line

Results: Period 2 - Performance



Lighter pigs (former « dirty » pigs) ate less because they were lighter



No more difference between groups

Results: Period 2 - Health

- No more difference on blood indicators
- Respiratory tract :

Hygiene	Clean		Dirty		<i>p-value*</i>	
	HRFI	LRFI	HRFI	LRFI	H	L
Line	n	20	19	20	21	
Pleurisy count	0	1	6	3	0.02	0.5
Pericarditis count	0	1	8	3	0.002	0.21
Pneumonia count	7	7	9	7	0.64	0.64

Dirty pigs > Clean pigs

No difference for pneumonia

Carcass characteristics and meat quality

- Period 1 : no difference (backfat and muscle depths, proportions of wholesale cuts) between pigs from Dirty or Clean except carcass weight
- Period 2 (Market slaughter age) : “Dirty” pigs had lower muscle glycogen concentration but no difference on pH 24h or other meat quality traits of LM such as drip loss or colour
- No major effect on meat quality

Conclusions

- Pigs housed in uncleaned environment had **20% lower growth rate**
 - Poor hygiene induced a **systemic inflammatory response** in pigs and respiratory diseases, such as **pneumonia** (short term)
 - **These negative effects on health and performance persist even if corrective solution have been implemented later**
-
- **Ensuring a good hygiene standard improves pig health in the growing-finishing phase and increases pigs' weight at slaughter**

Good hygiene : How much does it cost ?

Table 1. Change in production factors resulting from improved housing cleanliness.

¹ Information in this table is based on Chatelet et al. (2018) and authors' calculations.

² Authors' calculations. This represents a range of effects calculated for different market conditions.

Parameter ¹	Change
Mean body weight on the 85 th day of fattening (kg)	11 kg (13%)
Feed conversion ratio until day 85 (kg feed/kg gain)	-9.7%
Pleurisy (% slaughtered pigs)	-16 %
Financial return (€ per pig) ²	€18.90 - €21.59
Amount of meat produced (kg/pig space/year)	+38 kg (22%)

Niemi et al 2018 (PROHEALTH Deliverable 7.5)

To learn more

- Chatelet, A., Gondret, F., Merlot, E., Gilbert, H., Friggens, N.C., Le Floch'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*.
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- Chatelet, A., Gondret, F., Merlot, E., Gilbert, H., Le Floch'h, N (2017). Les performances, la santé, et les réponses immunitaires et métaboliques des porcs à un challenge sanitaire différent selon leur potentiel génétique d'efficacité alimentaire. 49. Journées de la Recherche Porcine In : 49èmes Journées de la Recherche Porcine. Paris (FRA) : IFIP - Institut du Porc (Journées de la Recherche Porcine en France), 2017.
- Kubasova T, Davidova-Gerzova L, Babak V, Cejkova D, Montagne L, Le-Floch'h N, Rychlik I (2018) Effects of host genetics and environmental conditions on fecal microbiota composition of pigs, *Plos One*,
<https://doi.org/10.1371/journal.pone.0201901>
- Rémond R, Gondret F, Le Floch'h N (2019) Identification de variables sanguines impliquées dans la variabilité de la vitesse de croissance des porcs selon leur statut inflammatoire et métabolique, *Journées de la Recherche Porcine*, In press
- Sierzant, K., Merlot, E., Tacher, S., Le Floch'h, N., Gondret, F. (2016). Antioxidant capacities of pigs were altered in a tissue-specific manner by poor hygiene conditions. 16. International Conference on Production Diseases in Farm Animals (ICPD) (2016-06-21-2016-06-23) Wageningen (NLD). In 16th International Conference on Production Diseases in Farm Animals. Book of abstracts. Wageningen (NLD) : Wageningen Academics Publishers 2016. Paper in progress
- Niemi J, Le Floch N, Jones P (2017) Does good biosecurity in pig fattening pay? - a case study, XV EAAE Congress "Towards Sustainable Agri-Food Systems: Balancing between Markets and Society"



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