Animal based indicators: tools to study production diseases in pigs

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session 38 "Sustainable control of production diseases in pigs and poultry
What are production diseases?

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

Environment

- Environnemental 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

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
✓ 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

Experimental approaches (4 trials)
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

![Graph showing effect size for various traits](image-url)
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

<table>
<thead>
<tr>
<th>Genetic factor (P&lt;0.001)</th>
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<tbody>
<tr>
<td>High efficiency (LRFI)</td>
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<tr>
<td>28</td>
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<tr>
<th>Dietary sequence (P&lt;0.05)</th>
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<tr>
<td>Conventional</td>
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<td>30</td>
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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

**Haptoglobin, g/L**

- **W12**
- **W15**
- **W18**

**Respiratory lesions**

| Pneumonia prevalence  | Dirty n=19/40 > Clean n = 3/40 | Average score  | HRFI (11.2) > LRFI (6.8) |

ADG W12-18, g/day

- **LRFI Dirty**
- **HRFI Dirty**
- **LRFI Clean**
- **HRFI Clean**

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)

<table>
<thead>
<tr>
<th></th>
<th>LRFI Spont</th>
<th>LRFI Inc</th>
<th>HRFI Spont</th>
<th>HRFI Inc</th>
<th>Line</th>
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<tbody>
<tr>
<td><strong>Lameness scores</strong></td>
<td>(% of pigs in each category with score &gt;2)</td>
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<tr>
<td><strong>Osteochondrosis scores</strong></td>
<td>(0 - 5)</td>
<td>(surface evaluation, proximal condyles, [0,5])</td>
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<tr>
<td>Humerus</td>
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<td>Femur</td>
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<tr>
<td><strong>Seric biomarkers of cartilage degradation (C2C) or synthesis (CPII)</strong></td>
<td>(ng/ml)</td>
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<td>C2C</td>
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<td>CPII</td>
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*Stavrakakis, 2014*
The question of early detection of traits related to lameness to test a genetic factor and an imposed physical activity

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<tr>
<td>(% of pigs in each</td>
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<td>9</td>
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<td>category with score</td>
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<tr>
<td>Humerus</td>
<td>2.50</td>
<td>2.20</td>
<td>1.57</td>
<td>1.36</td>
<td>***</td>
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<tr>
<td>Femur</td>
<td>1.78</td>
<td>1.67</td>
<td>1.18</td>
<td>1.13</td>
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<td><strong>Seric biomarkers</strong></td>
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<td>of cartilage</td>
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<td>degradation (C2C)</td>
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<td>C2C</td>
<td>537</td>
<td>577</td>
<td>477</td>
<td>501</td>
<td>***</td>
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<tr>
<td>CPII</td>
<td>2595</td>
<td>2442</td>
<td>2024</td>
<td>2321</td>
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➢ 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

<table>
<thead>
<tr>
<th>Classification of osteochondrosis lesions</th>
<th>Normal (0)</th>
<th>Serious (2, 3, 4)</th>
<th>$\chi^2$ test</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
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<tr>
<td>Distal femur</td>
<td></td>
<td></td>
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<tr>
<td>HF</td>
<td>15</td>
<td>25.4</td>
<td>20</td>
</tr>
<tr>
<td>HP</td>
<td>11</td>
<td>21.2</td>
<td>18</td>
</tr>
<tr>
<td>Gilts</td>
<td>14</td>
<td>25.5</td>
<td>12</td>
</tr>
<tr>
<td>Boars</td>
<td>12</td>
<td>21.4</td>
<td>26</td>
</tr>
</tbody>
</table>

➢ 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


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.


