Effects of perinatal environment on later life resilience in farm animals

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Chair group Adaptation Physiology

CAWA
Centre of Animal Welfare and Adaptation
Coronary heart disease and type 2 diabetes may originate from
low birth weight and fetal undernutrition.
Farm animal issues that may be have a perinatal origin

- Feather pecking in laying hens
- Ascites in broilers
- Weaning and tail biting in piglets
- Performance and health in broilers
Examples of perinatal conditions on later resilience

- Prenatally
  - Stress in the mother hen
  - Incubation temperature in chickens
  - Flavour learning in pigs

- Early postnatal
  - Early feeding in chickens
  - Social learning: Mom knows best
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Effects of Parent stock stress on offspring:
A comparison at group level

PhD Elske de Haas, 2014
Effects of stress in the parents

Higher basal cort: lower egg weight
(De Haas et al., Poultry Science 2013)

Lower egg weight: smaller, less competitive chicks
(Hendriksen et al, 2013)
Effects of stress in the parents

- **White** parent stock with:
  - High feather damage
  - High basal corticosterone
  - High blood serotonin

- Offspring with:
  - High severe FP wk 1
  - High number of vocalisations isolation test

(De Haas et al., Plos One, 2014)
Number of distress peeps in social isolation at 1 week of age offspring

Number of severe feather pecks / 20 minutes at 1 week of age offspring

Basal plasma corticosterone parents (ng/mmol)
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High temperature during late incubation

<table>
<thead>
<tr>
<th></th>
<th>37.8°C</th>
<th>38.9°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>YFBM (g)</td>
<td>36.9\textsuperscript{a}</td>
<td>33.9\textsuperscript{b}</td>
</tr>
<tr>
<td>Heart (%, YFBM)</td>
<td>0.38\textsuperscript{a}</td>
<td>0.28\textsuperscript{b}</td>
</tr>
<tr>
<td>Total mortality (%)</td>
<td>8.4\textsuperscript{a}</td>
<td>12.5\textsuperscript{b}</td>
</tr>
<tr>
<td>Ascites related mortality (%)</td>
<td>2.8\textsuperscript{a}</td>
<td>6.6\textsuperscript{b}</td>
</tr>
</tbody>
</table>

(37.8 vs 38.9 °C from days 7-19 of incubation)
High temperature during late incubation I

Incubation temperature ❯

Heat production ❯

Glucose requirements ❯

(37.8 vs 38.9 °C from days 7-19 of incubation)

Molenaar et al., 2013, PloS One
High temperature during incubation

Incubation temperature ▼
Metabolic rate ▼
Glucose needs ▼
Glycogen reserves ▲
Protein ret. efficiency ▲
Urid acid levels ▲
Heart size ▼
Mortality due to ascites ▲
From science to innovation:

- Control incubator temperature settings based on Egg shell temperature and not machine temperature
- Better ventilation systems that prevent hot spots in incubator
- From multi stage to single stage incubator systems
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Problems associated with weaning of pigs

- Health and performance
  - Low nutriënt intake
  - Poor growth rate or even weight loss
  - Impaired intestinal functioning, diarrhoea
  - Use of antibiotics

- Welfare
  - Stress responses
  - Maladaptive behaviours
Feed intake before and after weaning

27 days lactation, creep feed from 7 days, feed intake after weaning first 7 days (g/piglet)

Kuller et al., 2004, JAS
Weaning

- Weaning: abrupt event
- At 3-4 weeks
- Little experience with solid food

- Weaning: gradual process
- Ends at 8-20 weeks
- Food exploration starts early!
Prenatal flavour learning to reduce weaning problems in piglets

flavours maternal diet via amniotic fluid, milk
-> exposure piglets *in utero*

flavour recognition
-> preference flavour ↑

food neophobia ↓

feed intake at weaning ↑

Growth ↑, diarrhoea ↓, damaging behaviours ↓

PhD Marije Oostindjer
Prenatal flavour learning...

Can it be used as a tool to improve piglet performance, health and welfare at weaning?

→ Flavour preference
→ Reduction of stress
Piglets prenatally exposed to flavour sow’s feed
→ lower cortisol response and less vocalisations
→ higher feed intake and higher growth
→ less diarrhoea and less damaging behaviours

... if flavour was present in postweaning environment

Bolhuis et al. 2009 VFI in Pigs;
From science to innovation

- Provide similar flavoured feed for sows and piglets
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Early feeding
Hatching window

- **Incubation time (h)**
  - Early
  - Midterm
  - Late

- **% chicks hatched**
  - 0%
  - 25%
  - 50%
  - 75%
  - 100%

Graph showing the hatching window with three distinct phases:
- **Early** at 440-460h
- **Midterm** at 480h
- **Late** at 500-520h
Early feeding and body weight

Gonzales et al., 2003
Early feeding after hatch

Growth performance ↑

Immune response later life ↑

Long term effects microbiota composition

PhD Irene Walstra, Lotte van de Ven
Antibiotic treatment and HuSA effects

Challenge with HuSA (T cell dependent) on d 105

**P = 0.08**

Simon et al. 2015, in prep.
From science to innovation

Patio, Vencomatic

HatchCare, Hatchtech

X-track, Vencomatic
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Learning how to eat like a pig

Do piglets learn for mom what & where to eat
More interactions with the sow

- In the presence of the sow
  - Reduced food neophobia
    - faster to touch the food (19 vs. 111 s)
    - consumed more food items (6.3 vs. 4.6)

- Loose-housed sow
  - Higher pre-weaning growth
  - Less damaging behaviours & more play behaviour after weaning

Social learning: processes and cues

- Observing sow and participating with sow both effective
  - Higher feed intake than controls, start to eat sooner
  - Preference for sow’s feed and feeder
  - Observing sow more effective than own exposure to food!

Conclusions on processes and cues in social learning

- Piglets should be able to participate in or at least to observe the sow eating
- Piglets prefer a similar flavoured sow feed
- Piglets prefer to eat at the same feeder as the sow
Prenatal flavour learning

Observation

Participation

Location of feeder

Enrichment

Prenatal flavour learning
From Science to innovation
Science to innovation (lactation group housing)
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Take home messages

- The perinatal environment has substantial effects on later life health, welfare, and performance.
- In housing and management of animals in early stages of life, effects on later resilience need to be considered.
- To optimize lifetime performance, a whole chain approach is needed.
Thank you