Effects of maternal nutrition on immune competence and microbiota composition of piglets

A. de Greeff, S.A. Vastenhouw, P. Bikker, A. Bossers, F.M. de Bree, D. Schokker, P.J. Roubos, P. Ramaekers, M.A. Smits, J.M.J. Rebel

✉️ annemarie.rebel@wur.nl
Introduction

- Programming intestinal immune system via maternal intervention
  - Transmission of mucosal immune memory
  - Chickens: Rebel et al. (2006); Comp. Biochem. Physiol. 145:502-508

- Microbial colonisation initiates maturation and programming of intestinal immune system

- Program intestinal immune system piglets via maternal intervention on microbial colonisation e.g. via:
  - Transmission via vaginal flora
  - Transmission via faeces
  - Transmission via colostrum and milk
Experimental set-up

**AIM:**

Study the effect of in feed amoxicillin treatment in sows on microbial composition and intestinal development of piglets

- Sows divided over 2 treatments:
  - Regular lactation feed \( n = 16 \)
  - Lactation feed with amoxicillin for 1 week \( n = 15 \)

- Effects of treatment on sows and offspring determined
Zootechnical parameters:
Sow lactation feed intake + weight

- No significant differences in feed intake nor in body weight due to amoxicillin addition
- No significant differences in reproduction due to amoxicillin treatment
RA2

mag dit of kan dit er beter
Rebel, Annemarie, 12/08/2014
Zootechnical parameters:

Piglet weight

No significant difference in growth of piglet.
Microbiota composition

Transmission route sow - piglets

- Microbiota composition
  - Faeces sows around farrowing (ZD-7, ZD1, ZD7)
  - Vagina sows after farrowing (ZD0)
  - Ingesta proximal jejunum piglets (D1, D7, DW, DW4, DW28)

- Microbiota composition piglets day 1 overlaps microbiota sow vagina

- No significant differences between treatment groups
Microbiota composition
Effect of amoxicillin treatment
Specific changes in microbiota piglets
Intestinal microbiota

Conclusions

- Significant differences between treatment groups at level of specific microbiota in sow and piglets
- Microbiota composition piglets day 1 overlaps microbiota sow vagina
Intestinal gene expression offspring
Can maternal feed interventions affect immune competence?

- Transcriptional analysis of proximal jejunum offspring
- Principle component analysis (PCA) demonstrates differences between control and amoxicillin piglets
- PCA shows development as function of time in both groups
Intestinal gene expression offspring
Statistics of regulated probes and genes in offspring

Table 1. Descriptive statistics of regulated probes/genes between treatments on day 1, 7, W, W+4, and W+28.

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Day</th>
<th>Regulated Probes</th>
<th>Regulated Annotated Genes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin vs control</td>
<td>1</td>
<td>159</td>
<td>52</td>
</tr>
<tr>
<td>Amoxicillin vs control</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amoxicillin vs control</td>
<td>28</td>
<td>194</td>
<td>95</td>
</tr>
<tr>
<td>Amoxicillin vs control</td>
<td>32</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Amoxicillin vs control</td>
<td>56</td>
<td>154</td>
<td>67</td>
</tr>
</tbody>
</table>

1 logFC > |1.5| and adjusted p-value < 0.05

- Most pronounced changes at weaning
- Only part of regulated probes has been annotated (30 – 50%)
- Limited regulation at day 7
Intestinal gene expression offspring day 1

- Up regulated genes
- Down regulated genes
Parameters intestine piglets

Villus length jejunum

Crypt depth jejunum

VCR jejunum

PASS jejunum
Intestinal development offspring

Conclusions

- Transcriptional differences in offspring due to maternal feed intervention
- Transcriptional differences translates in intestinal cellular parameters
- Treatment of sows with amoxicillin leads to a difference in immune processes at day 1 with decreased number of goblet cells
- Treatment of sows with amoxicillin leads to difference apoptosis processes at weaning with an increase in crypt depth
Conclusion

- Treatment sows with amoxicillin no effect on performance piglets until day 42.
- Treatment of sows with amoxicillin has effect on microbiota and gene expression of piglets as measured
  - Either due to changes in microbiota composition of sows via vaginal microbiota or oral-fecal transmission.
- Possibility to modulate the intestinal development as well as microbiota of piglets by maternal feed intervention
- Follow up: determine correlation microbiota with gene expression
Credits

Central Veterinary Institute
- Mari Smits
- Astrid de Greeff
- Stéphanie Vastenhouw
- Alex Bossers
- Freddy de Bree
- Frank Harders
- Ralph Kok

Nutreco
- Petra Roubos
- Peter Ramaekers (Swine Research Center)

Wageningen Livestock Research
- Dirkjan Schokker
- Paul Bikker
- Carola vd Peet

Financial support