Piglet birth weight and uniformity

Importance of the pre-mating period

Anne Wientjes
Technical results, the Netherlands

![Graph showing the number of piglets born and born alive from 2000 to 2015. The graph indicates an increase in both categories over time.]
Technical results, the Netherlands

![Graph showing trends in total born, born alive, and mortality percentage from 2000 to 2015.](image-url)
Birth weight and uniformity negatively related with litter size

Milligan et al., 2002; Quesnel et al. 2008; Wientjes et al. 2012
How to improve piglet uniformity?

Part of uniformity at birth already determined in pre-mating period?
Sow body condition loss during lactation

WEI ↑

Pregnancy rate ↓  
litter size ↓

Piglet birth weight?  
Piglet uniformity?

OR ↓

Embryo survival/quality ↓

Developmental variation in follicle pool?

Insufficient restoration of follicle development
Sow body condition loss during lactation

- \( n = 772 \) Topigs20 sows with WPI \( \leq 7d \)
- Corrected for litter size
- \( ab \ P < 0.05 \)

Wientjes et al. (submitted)
## Prolonged weaning-to-pregnancy interval

<table>
<thead>
<tr>
<th></th>
<th>WPI ≤7d</th>
<th>WPI 8-21d</th>
<th>WPI &gt;21d(^1)</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1,584</td>
<td>72</td>
<td>182</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total number born, n</strong></td>
<td><strong>13.7(^a)</strong></td>
<td><strong>14.9(^b)</strong></td>
<td><strong>14.4(^b)</strong></td>
<td>0.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Mean birth weight(^2), g</td>
<td>1,428</td>
<td>1,438</td>
<td>1,431</td>
<td>17</td>
<td>0.83</td>
</tr>
<tr>
<td>Birth weight SD(^2), g</td>
<td>310(^b)</td>
<td>291(^{ab})</td>
<td>287(^a)</td>
<td>7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Birth weight CV(^2), %</td>
<td>22.2(^b)</td>
<td>20.8(^{ab})</td>
<td>20.5(^a)</td>
<td>0.5</td>
<td>&lt;0.01</td>
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</table>

\(^1\) including repeat breeders  
\(^2\) corrected for litter size  

Wientjes et al. (submitted)
Yes,

- Pre-mating period is important
  - Piglet uniformity is compromised by severe sow body condition losses during lactation
  - Piglet uniformity is improved in sows with a prolonged WPI
    - (insufficient) follicle restoration?

  How to improve piglet uniformity?
## Pre-mating insulin-stimulating diets

- **Dextrose (150g/d) during WII:**

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<td>Total born piglets, n</td>
<td>13.96</td>
<td>13.44</td>
<td>0.38</td>
<td>0.35</td>
</tr>
<tr>
<td>Mean birth weight, kg</td>
<td>1.59</td>
<td>1.61</td>
<td>0.05</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>CV birth weight, %</strong></td>
<td>21.2</td>
<td>17.5</td>
<td>1.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Mortality until weaning, %</td>
<td>7.4</td>
<td>6.9</td>
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Van den Brand et al., 2006; 2009
## Pre-mating insulin-stimulating diets

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- **Dextrose+lactose (both 150g/d) during lactation and WII:**

<table>
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<th>DEX+LAC</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total born piglets, n</td>
<td>14.25</td>
<td>14.40</td>
<td>0.52</td>
<td>0.84</td>
</tr>
<tr>
<td>Mean birth weight, kg</td>
<td>1.47</td>
<td>1.55</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>CV birth weight, %</td>
<td>23.7</td>
<td>20.5</td>
<td>1.0</td>
<td>0.04</td>
</tr>
<tr>
<td>Mortality until weaning, %</td>
<td>13.4</td>
<td>12.1</td>
<td></td>
<td>0.44</td>
</tr>
</tbody>
</table>

Van den Brand et al., 2006; 2009
Insulin-stimulating diets

Time relative to feeding, min

- [insulin], uU/ml

- CON (n=27)
- D (n=20)
- DL (n=25)
- SL (n=23)

Wientjes et al. 2012
Possible mechanism involved (1)

Pre-mating diet

Insulin ↑
IGF-1 ↑

BRAIN

FSH ↑
LH ↑

OVARY

Follicle / oocyte dev. ↑
Follicle / oocyte uniformity ↑
Possible mechanism involved (2)

- Follicle / oocyte dev. ↑
- Follicle / oocyte uniformity ↑

CL development ↑

- P4 ↑

Embryo dev. ↑

- Embryo uniformity ↑

Birth weight uniformity ↑
Unravelling the mechanism

- 32 multiparous Topigs20 sows
- Effects of nutritionally increased insulin and/or IGF-1 levels during WII on:
  - Reproductive hormones → LH and P4
  - (uniformity in) pre-ovulatory follicle development
  - Luteal development
  - (uniformity in) embryo development at d10
Insulin/IGF-1 levels during WII related to:

- **Follicle diameter**
  - basal insulin with follicle diameter at ovulation: +

- **LH**
  - insulin AUC/mean insulin/IGF-1 with basal LH level: +

- **Progesterone**
  - insulin AUC/mean insulin with mean and maximal P4: +

- **Embryo development**
  - insulin AUC/mean insulin with embryo diameter: +
Relation between mean insulin and P4 at d10

\[ \beta = 0.27 \, \text{ng/ml} / (\mu U/ml) \]

\[ p = 0.05 \]
Yes,

- Pre-mating insulin $\uparrow$
  - Follicle development $\uparrow$
    - CL development $\uparrow$
      - P4 $\uparrow$
    - Embryo development $\uparrow$
      - Embryo/fetal uniformity?
  - Birth weight uniformity?
Effects of sow metabolic state

- **Conventional sows:**
  - Catabolic state during 3-4wk lactation
    - Suppresses insulin and follicle development

- **Organic sows:**
  - 6wk lactation $\rightarrow$ 4±2 kg (1.6%) body weight loss
  - Switch to anabolic state during last wks?
    - Follicle development less suppressed?
      - (larger litters)
## Effect of pre-mating insulin-stimulating diets

<table>
<thead>
<tr>
<th></th>
<th>CON N = 34</th>
<th>WII N = 42</th>
<th>LAC+WII N = 39</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total born piglets, n</td>
<td>17.0</td>
<td>17.2</td>
<td>17.8</td>
<td>0.5</td>
<td>0.53</td>
</tr>
<tr>
<td>Mean birth weight, kg</td>
<td>1.28</td>
<td>1.29</td>
<td>1.23</td>
<td>0.03</td>
<td>0.48</td>
</tr>
<tr>
<td>CV birth weight, %</td>
<td>23.4</td>
<td>22.6</td>
<td>23.3</td>
<td>1.0</td>
<td>0.79</td>
</tr>
<tr>
<td>Mortality d0-3, %</td>
<td>15.8</td>
<td>16.0</td>
<td>16.5</td>
<td>1.6</td>
<td>0.96</td>
</tr>
<tr>
<td>Mortality d0-weaning, %</td>
<td>27.7</td>
<td>27.2</td>
<td>23.1</td>
<td>2.5</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Wientjes et al. (2012)
Take home message

- Pre-mating period is important for piglet birth weight and uniformity:
  - Compromised by severe sow body condition losses during lactation
  - Improved in sows with a prolonged WPI
    \[(\text{insufficient}) \text{ follicle restoration?}\]
  - Insulin-stimulating diets during the pre-mating period may be beneficial for follicle development and subsequent piglet birth weight and uniformity
    \*[But only so in sows with a compromised follicle development at weaning?]
Thanks for your attention!

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