Effects of maternal selenium supply during late gestation on colostrum quality and passive transfer of immunity in neonatal lambs

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Introduction

• Colostrum production in ewes
  - Major source of neonatal immunity and energy
  - A key for lamb mortality control

• Numerous factors of variation of colostrum production
  - Udder health
  - Age
  - Litter size
  - Genetic
  - Nutrition (energy and proteins supply, minerals)
  - ...
Introduction

• Supra-nutritional Se supply in late gestation (80 µg/kg BW)
  - Control: adequate supply (~ 10 µg/kg BW) in non deficient ewes
  - No effect or increase of colostrum yield (Swanson et al., 2008; Meyer et al., 2011)
  - No effect on IgG1 concentration (Swanson et al., 2008; Rock 2001)
  - Effect on passive transfer of immunity: conflicting reports (Hammer et al., 2011; Boland et al 2005; Lacetera et al. 1996, 1999, Rock 2001)

• Se adequate supply in deficient ewes in late gestation
  - Colostrum yield: ?
  - IgG1 concentration: ?
  - Effect on passive immunity transfer: ?
Aims

- To investigate effects of Selenium supply during late gestation on moderately deficient ewes
  - on colostrum quality
  - on passive transfer of immunity in neonatal lambs
  - on lambs performances
Material and methods

- 80 Vendéen ewes, allocated in two groups
  - Same age \((3.3 \pm 0.28\) years\)
  - Same litter size \((1.77 \pm 0.08)\)
  - Same body score condition
    - allocation \((3.5 \pm 0.1)\); lambing \((3.0 \pm 0.1)\)

- Daily regimen during the last five weeks of gestation
  - Both groups: grass + triticale \((5\ w, 200g/d)\) + rape oil cake \((2\ w, 100\ g/d)\)
  - Se group: mineral preparation: \(40\ g/d\)
    - Sodium selinite \((28\ mk/kg)\) + selenium yeast* \((6\ mg/kg)\)
    - Se daily total intake: \(15\ \mu g/kg\ BW = 0.5\ ppm\ DM\)
  - Control group: same preparation without Se
    - Se daily total intake: \(1.5\ \mu g/kg\ BW = 0.06\ ppm\ DM = low\ level\)

*Saccharomyces cerevisiae, Sel-plex®*
Material and methods

- Selenium status assessment

Group allocation
20 ewes / group
Plasma Se
GPx

Lambing
Same 20 ewes / group
Plasma Se
GPx

40 days
...

24 h of age
20 lambs / group
Plasma Se

20 days of age
35 lambs / group
Plasma Se
GPx

GPx: erythrocyte glutathione peroxidase activity
Material and methods

• Assessment of colostrum quality
  - 25 ewes / group
  - Colostrum milking at lambing (before any sucking)
  - IgG1 concentration : SRID (IDRing Sheep IgG, IDBiotech)
  - Butterfat concentration : Gerber method

• Assessment of passive transfert of immunity
  - 30 lambs / group
  - 24 hours of age
  - IgG1 concentration : SRID (IDRing Sheep IgG, IDBiotech)
Material and methods

• Other records
  - Lambing ease
  - Udder health
  - Lamb weight
    • At birth
    • At weaning
    • At slaughtering
  - Lamb diseases and deaths (necropsy)
Results: Se status in ewes

- Se status in ewes at group allocation and lambing

<table>
<thead>
<tr>
<th>Time point</th>
<th>Variable</th>
<th>Control group (n=20)</th>
<th>Se Group (n=20)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>At group allocation</td>
<td>Se (μg/l)</td>
<td>27.2 ± 1.3</td>
<td>25.2 ± 1.5</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>GPX (UI/ml)</td>
<td>60.2 ± 3.2</td>
<td>63.1 ± 3.5</td>
<td>0.52</td>
</tr>
<tr>
<td>At lambing</td>
<td>Se (μg/l)</td>
<td>79.6 ± 5.4</td>
<td>169.6 ± 5.8</td>
<td>&lt;10⁻⁴</td>
</tr>
<tr>
<td></td>
<td>GPX (UI/ml)</td>
<td>71.7 ± 4.0</td>
<td>421.9 ± 28.1</td>
<td>&lt;10⁻⁴</td>
</tr>
</tbody>
</table>

*Adjusted on dam’s age, BCS and litter size

Strong effect on ewes Se status
## Results: Se status in lambs

- **Se status in lambs at 24 hours (n=20) and 20 days of age (n=35)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Variable</th>
<th>Control group</th>
<th>Se group</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>Se (μg/l)</td>
<td>27.8 ± 1.3</td>
<td>70.6 ± 3.9</td>
<td>&lt;10⁻⁴</td>
</tr>
<tr>
<td>20 days</td>
<td>Se (μg/l)</td>
<td>62.7 ± 1.9</td>
<td>80.7 ± 1.7</td>
<td>&lt;10⁻⁴</td>
</tr>
<tr>
<td></td>
<td>GPX (UI/ml)</td>
<td>317.9 ± 19.9</td>
<td>791.7 ± 28.6</td>
<td>&lt;10⁻⁴</td>
</tr>
</tbody>
</table>

*Adjusted on dam’s age and BCS, litter size, lamb sex, birth weight

⇒ **Strong effect on lamb Se status**
Results: colostrum quality

- Colostrum IgG1 and Butterfat concentrations at lambing

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n=24)</th>
<th>Se group (n=25)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG1 (g/l)</td>
<td>91.4 ± 6.0</td>
<td>92.5 ± 7.6</td>
<td>0.80</td>
</tr>
<tr>
<td>% &lt; 50 g/l IgG1</td>
<td>4.2</td>
<td>16.0</td>
<td>0.35</td>
</tr>
<tr>
<td>BT (g/l)</td>
<td>87.3 ± 7.2</td>
<td>79.8 ± 6.5</td>
<td>0.94</td>
</tr>
</tbody>
</table>

*Adjusted on dam's age, BCS and litter size

⇒ No effect of Se supply on colostrum IgG1 and Butterfat concentrations
Results: PTI in lambs

- Plasma IgG1 concentration in lambs at 24 h of age

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n=35)</th>
<th>Se group (n=35)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG1 (g/l)</td>
<td>25.8 ± 1.7</td>
<td>26.8 ± 1.2</td>
<td>0.67</td>
</tr>
<tr>
<td>% &lt; 10 g/l IgG1</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>% &lt; 15 g/l IgG1</td>
<td>3.4</td>
<td>3.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Adjusted on dam’s age and BCS, litter size, sex, birth weight

No effect of Se supply on lambs plasma IgG1 concentrations
Results: lambs performances

• Lambs weight
  - Birth weight: no effect (p=0.61*)
  - Daily weight gain
    • Between birth and 30 days: Se group / control group: -19.2 g (p=0.054*)
    • Between birth and weaning at 70 days: no effect (p=0.39*)
    • Between birth and slaughtering at 150 days: no effect (p=0.29*)

• Mortality records

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Se group</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortion and stillbirth (%)</td>
<td>2.9</td>
<td>7.6</td>
<td>0.26</td>
</tr>
<tr>
<td>Death birth to weaning (%)</td>
<td>3.7</td>
<td>3.5</td>
<td>0.95</td>
</tr>
<tr>
<td>Death after weaning (%)</td>
<td>5.6</td>
<td>5.3</td>
<td>0.94</td>
</tr>
</tbody>
</table>

*Adjusted on dam’s age and BCS, litter size, lamb sex and birth weight
Discussion / conclusion

• **Effect of Se supply during last gestation**
  - No effect
    • On colostrum IgG1 / BT concentration
    • On passive transfer of immunity
    • On lambs’ performances

• **Material and methods : limits**
  - Moderate Se deficiency
    • Effect in highly deficient ewes ?
  - No evaluation of colostrum yield
Discussion / conclusion

- Effect of Se supply during last gestation
  - Highly efficient
    - To restore Se status in dams
    - To provide lambs with satisfactory Se status at birth
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- Christele Piau
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