OXIDATIVE STRESS AS BIOMARKER OF PIGLET HEALTH AT WEANING

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引言 Introduction

- 减少抗生素的使用 Reduction of the use of antibiotics
- 动物福利 Animal welfare
- 收益率 Profitability

断奶猪生产 Weaning in pig production

 Identification of biomarkers of the robustness of piglets at weaning

重点关注氧化状态 Focus on oxidative status
Mechanism of Oxidative Stress

- Free Radicals
- Inflammation
- Stress
- Infection

- Antioxidant molecules
- Pro-oxidant molecules

- SOD, CAT, GPX
- Vit E, Vit C, Se

- Endogenous responses
- Feed

- Lipids, Proteins, ADN

- Oxygen $O_2$, Nitrogen $N_2$
断奶可导致腹泻和生长率降低是抗生素使用的原因
Weaning can lead to diarrhea and reduced growth justifying why antibiotics are used (Madec et al. 1998)

断奶是氧化应激源，饲料中添加抗氧化剂有可能使氧化应激衰减
Weaning is source of oxidative stress (Pig, Robert, 2009, Sauerwein, 2005, Zhu, 2012; Pastorelli, 2012, Corino, 2007) and attenuation of oxidative stress is possible with antioxidant in feed (Pastorelli et al., 2012, Gerasopoulos et al. 2015)

农场动物氧化应激与疾病有关，Oxidative stress is associated with diseases in farm animals (Lykkesfeldt and Svendsen, 2007)

在断奶情况下，氧化应激是否可以被用作仔猪健康的生物标记？
In the context of weaning, can oxidative stress be used as biomarker of health of piglets?
### Material and Methods

- 4 batches of 16 animals
  - Weaning at 21 or 28 days of age
  - Deteriorated or Optimal Conditions

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Optimal (OC)</th>
<th>Deteriorated (DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>密度 Density</td>
<td>4 piglets/pen</td>
<td>8 piglets/pen</td>
</tr>
<tr>
<td>动物混群 Animals mixing</td>
<td>2 litters/pen</td>
<td>8 litters/pen</td>
</tr>
<tr>
<td>室内清洁度 Room cleanliness</td>
<td>Cleaned + disinfected</td>
<td>Non Cleaned + non disinfected</td>
</tr>
<tr>
<td>猪转移期温度 Temperature during animals transfer</td>
<td>Directly at 28°C</td>
<td>in 20°C waiting 4h</td>
</tr>
<tr>
<td>1/2饲料过渡1/2日龄 1/2Transition feed 1st Age/2nd age</td>
<td>On 3 days</td>
<td>Direct</td>
</tr>
</tbody>
</table>

- Non antibiotic treatment
- Blood samplings and weighing weekly from 12 to 61 days of age
恶略条件下断奶期生长率严重降低

More severe reduction of growth rate in deteriorated conditions around weaning

平均日增重

Average Daily Weight Gain

时间Time
条件Cond
时间*条件 Time*Cond
断奶日龄 Age at weaning

至断奶天数

No effect of age at weaning

断奶日龄无差异

Days to weaning

Optimal conditions
Deteriorated conditions

bcde
bc
de
cde
b
c
a

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断奶后期恶劣条件下较高的氧化应激指数

Higher oxidative stress index in deteriorated conditions after weaning

根据农场条件断奶期氧化应激指数（氢过氧化物/骨碱性磷脂酶）

Oxidative Stress Index (dROM/BAP) around weaning and according to farming conditions

- 时间Time: p<0.001
- 条件Cond: p=0.160
- 时间*条件Time*Cond: p=0.002
- 断奶期Age at weaning: p=0.950

断奶日龄无差异 No effect of age at weaning

至断奶天数 Days to weaning
Increased dROM for piglets in deteriorated conditions after weaning

Hydroperoxides (dROM) around weaning and according to farming conditions

- Time: p = 0.001
- Condition: p = 0.339
- Time * Condition: p = 0.053

Age at weaning:
- p = 0.340

No effects of age at weaning
Decreased plasma antioxidant capacity for piglets in deteriorated conditions

Plasma antioxidant capacity around weaning and according to farming conditions

- Time: p < 0.001
- Condition: p = 0.192
- Time x Condition
  - p = 0.012

Age at weaning:
  - p = 0.0907

Days to weaning:
- 28 days old
- Whatever time
- Lower BAP for piglets weaned at 28 days of age

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More piglets with diarrhea in deteriorated conditions

More severe slowing down of growth for piglets with diarrhea
仔猪较高的氧化应激指数呈现腹泻

Higher oxydative stress index for piglets exhibiting diarrhea

仔猪呈现
Piglets presenting:

氧化应激指数
Oxidative Stress Index

- 0 day with diarrhea the week before blood collection
- >=1 day with diarrhea the week before blood collection

umol/L

Days to weaning

至断奶天数

-9
-2
5
12
19

0.0
0.1
0.2
0.3
0.4
0.5

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Lower BAP but same dROM for piglets exhibiting diarrhea

**Hydroperoxides (dROM)**

- Green bars: 0 day with diarrhea
- Red bars: ≥1 day with diarrhea

**Biological Antioxidant Potential**

- Green bars: 0 day with diarrhea
- Red bars: ≥1 day with diarrhea

- **p=0.06**
- **NS**
- ****
- *****
- **NS**

Days to weaning: -9, -2, 5, 12, 19

CARRU: 0, 200, 400, 600, 800, 1000, 1200

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结论

我们的研究 In our study:

- 恶劣条件下断奶后期腹泻增加
  More diarrhea after weaning in deteriorated conditions
- 只有在最佳条件下断奶期无氧化应激
  No oxidative stress due to weaning only (optimal conditions)
- 恶劣条件下仔猪氧化应激和腹泻
  Oxidative stress in deteriorated conditions and for piglets with diarrhea
- 有可能可以使用氧化应激作为断奶仔猪健康的生物标志物
  There is an opportunity to use oxidative stress as biomarker of piglet’s health at weaning
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