Standardized total tract digestibility of calcium in growing pigs

Caroline González Vega
OUTLINE

• Background
• Endogenous losses of Ca
• Site of absorption of Ca
• Factors that affect digestibility of Ca
Ca:P ratio

- Absorption and retention of Ca and P are influenced by Ca:P ratio

\[
\text{Total Ca: total P} \quad \text{between 1:1 and 1.25:1} \\
\text{Total Ca: STTD of P} \quad \text{between 2:1 and 3:1}
\]

No STTD of Ca

Crenshaw, 2001; NRC, 2012.
Apparent total tract digestibility (ATTD)

Endogenous losses

Standardized total tract digestibility (STTD)
True total tract digestibility (TTTD)
OUTLINE

- Background
- **Endogenous losses of Ca**
- Site of absorption of Ca
- Factors that affect digestibility of Ca
Regression method

\[ y = -0.16 + 0.46x \]
\[ R^2 = 0.85 \]

\[ y = -0.19 + 0.70x \]
\[ R^2 = 0.92 \]

Apparent total tract digested Ca (g/kg DMI)

Total ECaL

Dietary Ca intake (g/kg DM)
OUTLINE

- Background
- Endogenous losses of Ca
- **Site of absorption of Ca**
- Factors that affect digestibility of Ca
Standardized digestibility of Ca, %

Ca source × site of absorption: $P < 0.01$

<table>
<thead>
<tr>
<th>Source</th>
<th>Duodenal</th>
<th>Ileal</th>
<th>Total tract</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaCO3</td>
<td>57.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>51.3&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>59.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vistacal</td>
<td>30.8&lt;sup&gt;d&lt;/sup&gt;</td>
<td>41.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>49.2&lt;sup&gt;bc&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
OUTLINE

- Background
- Endogenous losses of Ca
- Site of absorption of Ca
- Factors that affect digestibility of Ca
Factors:

- Ca level
- Phytase
- Fiber
- Fat

Digestibility of Ca
Factors:

- Ca level
- Phytase
- Fiber
- Fat

Digestibility of Ca
ATTD of Ca, %

Ca level: $P < 0.05$

Ca level, %

<table>
<thead>
<tr>
<th>Ca level</th>
<th>ATTD of Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.08</td>
<td>33.7</td>
</tr>
<tr>
<td>0.16</td>
<td>34.7</td>
</tr>
<tr>
<td>0.24</td>
<td>40.0</td>
</tr>
<tr>
<td>0.32</td>
<td>43.0</td>
</tr>
</tbody>
</table>
TTTD of Ca, %

Ca level: $P = 0.86$

Ca level, %

- 0.08: 53.95
- 0.16: 44.65
- 0.24: 46.28
- 0.32: 47.93
Factors:

- Ca level
- Phytase
- Fiber
- Fat

Digestibility of Ca
Canola meal

**TTTD of Ca. %**
- No phytase: 48.2
- With phytase: 68.76

**ATTD of P. %**
- No phytase: 59.9
- With phytase: 76.6

*P < 0.01*
STTD of Ca (%) in Ca supplements

- **Without phytase**
  - MCP: 86.5
  - DCP: 78.0
  - CaCO3: 61.2

- **With phytase**
  - MCP: 87.0
  - DCP: 79.1
  - CaCO3: 73.8

**P < 0.05**

Other supplements:
- L. calcareum Ca: 65.6
- Sugar beet coproduct: 67.1
Fish meal-corn-corn germ

**STTD of Ca, %**
- No phytase: 76.21
- With phytase: 86.88

**ATTD of P, %**
- No phytase: 72.46
- With phytase: 83.31

*P < 0.001*

Note: Lower case letters indicate significant difference between means.
Fish meal-cornstarch

No phytase       With phytase

<table>
<thead>
<tr>
<th>STTD of Ca, %</th>
<th>53.87</th>
<th>60.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTD of P, %</td>
<td>63.97</td>
<td>67.26</td>
</tr>
</tbody>
</table>

$P = 0.30$  
$P = 0.43$
STTD of Ca, %

No phytase vs. With phytase

Corn: Phytate + Fiber
Corn germ: Phytate + Fiber + Fat

FM-cornstarch

FM-corn-corn germ

53.87
60.07
76.21
86.88

P < 0.001
Factors:

- Ca level
- Phytase
- Fiber
- Fat

Digestibility of Ca
Fiber

- **FM-cornstarch**
  - STTD of Ca%: 45.64
  - ATTD of P%: 54.66
  - *P* < 0.001

- **FM-cornstarch + fiber**
  - STTD of Ca%: 62.23
  - ATTD of P%: 65.18
  - *P* < 0.001
Factors:

- Ca level
- Phytase
- Fiber
- Fat

Digestibility of Ca
Fat

STTD of Ca%  ATTD of P%

FM-corn  FM-corn + fat

88.99  88.14  76.29  76.7

P = 0.75  P = 0.85
STTD of Ca, %

- FM: 45.67%
- FM + Fiber: 62.23%
- FM + Corn: 88.99%
- FM + Corn + Fat: 88.14%
Conclusions

• **Endogenous Ca** is lost from the GIT

• **STTD or TTTD of Ca** are more accurate to formulate mixed diets
Conclusions

- STTD of Ca varies among Ca sources
- Phytase increased STTD of Ca in diets containing phytate
  - Different effect of phytase on STTD of Ca in Ca supplements
Conclusions

• **Fiber** increased the STTD of Ca

• **Fat** did not affect the STTD of Ca

• Semisynthetic *(cornstarch)* diets reduced the STTD of Ca and ATTD of P in fish meal
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Thank You

ABVista
Feed Ingredients

Hans H. Stein
Monogastric Nutrition Group

http://nutrition.ansci.illinois.edu

www.uiuc.edu