Withdrawal may affect bone strength

The National Research Council's (NRC) 1998 swine nutrient recommendations provide suggested calcium and phosphorus requirements for growing-finishing pigs. In recent years, NRC also suggests increasing calcium and phosphorus levels approximately 0.10% over the growth requirements, to increase bone mineralization and bone strength for pigs kept for breeding purposes.

Swine producers have expressed considerable interest in reducing the dietary phosphorus in the late finishing diet to reduce phosphorus excretion and feed costs. Recent research has shown that two-thirds of the inorganic phosphorus in swine diets could be removed from the late finishing diet and maintain growth performance by using calcium as a substitute. During this period of reduced dietary phosphorus intake, the pig will draw upon its mineral reserves present in the bone and other tissues to support metabolic requirements. However, would reducing dietary calcium and phosphorus levels decrease bone strength and alter bone metabolism sufficiently, thereby increasing the incidence of bone fractures during slaughter?

Swine researchers D.T. Shaw, D.W. Roeboom, G.M. Hill, M.W. Orth, D.S. Rosenstein and J.E. Link at Michigan State University conducted a study to determine the effects of supplemental withdrawal (omission of the vitamins and trace minerals and two-thirds of the inorganic phosphorus and calcium) of the withdrawal diet on bone metabolism, bone strength and incidence of bone fractures occurring at slaughter. In addition, the researchers evaluated the influence of dietary wheat middlings at various levels on calcium metabolism in nutritional studies.

The study used 64 crossbred barrows — with an average bodyweight of 8.5 kg — that were allotted to a 2 x 2 factorial arrangement of treatments replicated twice over time. Treatments included:

1. (Normal) supplemental levels of vitamin-trace mineral and inorganic phosphorus during the 28 days before slaughter.
2. (Without) supplemental levels of vitamins, trace minerals and two-thirds of the inorganic phosphorus and calcium during the 28 days before slaughter.

The results of this study indicate that bone resorption exceeded bone formation. The increased bone resorption caused by the supplemental withdrawal is reflected by the change in serum pyridinoline from days 0 to 14 and on day 27 of the withdrawal period. Supplemental withdrawal of vitamin trace minerals and two-thirds of the inorganic phosphorus in the late finishing diet, but not with wheat middling inclusion, had a greater effect on the change in serum pyridinoline concentration from days 0 to 14 and on day 27 of the withdrawal period.

The results of this study indicate that removing two-thirds of the inorganic phosphorus, vitamins and trace minerals for 28 days pre-slaughter increases bone turnover and decreases bone quality. Another item not studied, and where more research is needed, is the effects of withdrawal on meat quality.

Reference

The Bottom Line
This study showed that serum osteocalcin and pyridinoline assays are valid predictors of bone metabolism in nutritional studies. More research is needed to determine whether withdrawal increases the incidence of bone fractures in market animals.

In 60 seconds
Organic disinfectant: DuPont Animal Health Solutions announced that its Virkon S livestock and veterinary disinfectant was accepted for use in organic farming in the U.K. The U.K. Advisory Committee on Organic Standards recommended the Department for Environment, Food & Rural Affairs that the combination of materials used in Virkon S is suitable for use as they are analogous to those allowed in Annex II E of the Compendium of U.K. Organic Standards.

Waste hotline: A new hotline provides assistance to farmers looking for more information on the Environmental Quality Incentives Program (EQIP). The hotline is a service provided by Engineered Storage Products Co. Farmers can call the hotline at (866) 376-EQIP (3747) or visit www.slurrystore.com and click on the EQIP Hotline link. It specializes in the EQIP funding areas of waste storage (EQIP code 313) and manure transfer (code 634).

Bottom Line of Nutrition: Swine

1. Calculated nutrient levels of diets fed during each phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Nursery Phase 1</th>
<th>Nursery Phase 2</th>
<th>Grower Phase 3</th>
<th>Early Finisher Phase 4</th>
<th>Late Finisher Phase 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whelpings</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wheat middlings kg</td>
<td>2.330</td>
<td>3.080</td>
<td>3.730</td>
<td>3.372</td>
<td>3.372</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.98</td>
<td>1.07</td>
<td>0.99</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.64</td>
<td>0.64</td>
<td>0.66</td>
<td>0.64</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Available phosphorus, %
- Whelpings: 0.32, 0.29, 0.32, 0.29, 0.23, 0.23
- Nursery: 0.32, 0.29, 0.32, 0.29, 0.23, 0.23
- Grower: 0.45, 0.44, 0.37, 0.33

Total phosphorus, %
- Whelpings: 0.49, 0.66, 0.60, 0.60, 0.60, 0.58
- Nursery: 0.49, 0.66, 0.60, 0.60, 0.60, 0.58
- Grower: 0.47, 0.45, 0.44, 0.43

Serum osteocalcin — a reflection of osteoblast activity and bone turnover.
Pyridinoline concentrations — a measurement that reduces the variability in estimating collagen degradation.
Radiographs — at slaughter, after evisceration and before splitting the spine, a ventrodorsal projection of the lumbar vertebrae of each carcass was recorded on a portable radiograph machine of the right and left femurs and femoral heads. This was done to identify bone fractures.
Computed tomography — a measurement of the bone mineral density of the third metacarpal of the right foot.
Bone characteristics — the third metacarpal of the right foot was subjected to peak force and ultimate shear stress. These same bones were then extracted with ethyl ether for 72 hours and ashed to calculate ash as a percentage of dry-fat free weight.

• Other nutrients were also decreased.
• In this study, the supplemental withdrawal of vitamins, trace minerals and two-thirds of the inorganic phosphorus in the late finisher diet, but not with wheat middling inclusion, had a greater effect on the change in serum pyridinoline concentration from days 0 to 14 and on day 27 of the withdrawal period.

Calcium, % 0.72, 0.72, 0.60, 0.60, 0.60, 0.58
Phosphorus, % 0.60, 0.65, 0.60, 0.60, 0.60, 0.60
Available phosphorus, % 0.49, 0.54, 0.58, 0.58, 0.82