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Effects of increasing pantothenic acid on growth performance of segregated early-weaned pigs

Abstract
We conducted a 28-d experiment to evaluate effects of increasing dietary pantothenic acid on growth performance of segregated early-weaned pigs. Pigs (initially 8.8 ± 2.21b and 11 ± 2 d of age) were fed a control diet (no added pantothenic acid) or the control diet with 30, 60, and 120 ppm of added pantothenic acid. Increasing pantothenic acid increased ADG and ADFI linearly from d0 to 14 after weaning. However, from d 14 to 28 after weaning, pigs fed 60 mg/kg of added pantothenic acid tended to have the greatest ADG and ADFI. For the cumulative period (d 0 to 28 after weaning), ADO and ADFI increased linearly with increasing added pantothenic acid. The linear improvements in weanling pig growth performance observed with increasing pantothenic acid indicated that current NRC (1998) requirement estimates may be too low. Because of the wide range of pantothenic acid concentrations used in our study, additional research is warranted to define a more precise requirement estimate.; Swine Day, Manhattan, KS, November 19, 1998

Keywords
Swine day, 1998; Kansas Agricultural Experiment Station contribution; no. 99-120-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 819; Swine; Starter pigs; Pantothenic acid; Performance

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EFFECTS OF INCREASING PANTOTHENIC ACID ON GROWTH PERFORMANCE OF SEGREGATED EARLY-WEANED PIGS


Summary

We conducted a 28-d experiment to evaluate effects of increasing dietary pantothenic acid on growth performance of segregated early-weaned pigs. Pigs (initially 8.8 ± 2.2 lb and 11 ± 2 d of age) were fed a control diet (no added pantothenic acid) or the control diet with 30, 60, and 120 ppm of added pantothenic acid. Increasing pantothenic acid increased ADG and ADFI linearly from d 0 to 14 after weaning. However, from d 14 to 28 after weaning, pigs fed 60 mg/kg of added pantothenic acid tended to have the greatest ADG and ADFI. For the cumulative period (d 0 to 28 after weaning), ADG and ADFI increased linearly with increasing added pantothenic acid. The linear improvements in weanling pig growth performance observed with increasing pantothenic acid indicated that current NRC (1998) requirement estimates may be too low. Because of the wide range of pantothenic acid concentrations used in our study, additional research is warranted to define a more precise requirement estimate.

(Key Words: Starter Pigs, Pantothenic Acid, Performance.)

Introduction

Recent research has demonstrated that segregated early weaning (10 to 17 days of age) results in minimizing the transmission of disease from the sow to the pig. Pigs raised in these high-health environments have been shown to have increased growth rate compared to those conventionally weaned. Part of the improved growth performance has been linked to decreased immune system activation. Studies have found that these pigs may require increased dietary nutrient fortification to support the increased protein deposition. Recently, Iowa State University demonstrated that high-health pigs had a greater requirement for B-complex vitamins (approximately 4 times NRC, 1988 estimates) compared to pigs with chronic immune system activation. However, these pigs were fed a B-vitamin deficient diet for 1 week before experimental diets were fed, possibly confounding the response to vitamin supplementation. Therefore, the objective of this experiment was to evaluate the effects of increasing concentrations of one B-vitamin, pantothenic acid, on growth performance of pigs when fed from d 0 to 28 after weaning in an age-segregated production system.

Procedures

A total of 275 weanling pigs (initially 8.8 ± 2.2 lb and 11 ± 2 d of age) was used in a 28-d growth trial. Pigs were blocked by weight and allotted randomly to one of four dietary treatments. There were seven or eight

1The authors thank Daiichi Pharmaceutical Corp., Tokyo, Japan for providing the vitamin premix and pantothenic acid and partial financial support. We also thank Adam McNess and Eichman Brothers, St. George, KS for the use of facilities and animals.

2Northeast Area Extension Office, Manhattan, KS.

3Food Animal Health and Management Center.
pigs per pen and nine replications per treat-
ment. Pigs were fed a control diet (no added
pantothenic acid) or diets containing 30, 60,
or 120 ppm of added pantothenic acid re-
placing corn starch in the control diet. All pigs
were fed a pelleted corn-soybean meal diet
containing 25% dried whey, 6.7% spray-
dried animal plasma, 6.0% select menhaden
fish meal, and 5.0% lactose from d 0 to 14
after weaning (Table 1). This diet was for-
mulated to contain 1.7% total lysine, .9% Ca,
and .8% P. From d 14 to 28, all pigs were
fed a corn-soybean meal diet containing 15%
dried whey, 2.0% spray-dried blood meal,
2.0% select menhaden fish meal, and 1.0%
spray-dried animal plasma. This diet was in
a meal form and formulated to contain 1.4%
lysine, .85% Ca, and .75% P. Pigs remained
on their respective pantothenic acid levels
throughout the 28-d experiment.

Pigs were housed in an environmentally
controlled nursery in 5 × 5 ft pens. All pens
contained one self-feeder and two nipple
waterers to provide ad libitum access to feed
and water. Average daily gain, ADFI, and
feed:gain ratio (F/G) were determined by
weighing pigs and measuring feed disappear-
ances on d 7, 14, 21, and 28 after weaning.

Samples of each diet were collected and
analyzed for pantothenic acid concentration.
Given the wide range in permitted analytical
variation in vitamin analysis, analyzed values
were within acceptable expectations (Table
1).

Results and Discussion

From d 0 to 7 after weaning, increasing
pantothenic acid had no effect on pig growth
performance (Table 2). However, from d 7
to 14 after weaning, ADG and ADFI tended
to increase (linear, P = .09 and .03 respec-
tively) with increasing pantothenic acid, but
feed efficiency was not affected. For the
entire period (d 0 to 14 after weaning), ADG
(linear, P = .01) and ADFI (linear, P = .04)
increased with increasing pantothenic acid,
but feed efficiency was not affected. Al-
though the response to increasing
pantothenic acid was linear, little or no
improvement in ADG or ADFI occurred for
pigs fed 30 or 60 ppm, but a large increase
occurred for those fed 120 ppm.

From d 14 to 28 after weaning, ADG and
ADFI tended to improve with increasing
pantothenic acid (quadratic, P<.10 and linear,
P<.08, respectively). Unlike the response
from d 0 to 14 after weaning, pigs fed 60
ppm of added pantothenic acid had the great-
est ADG and ADFI.

For the entire experimental period (d 0 to
28 after weaning), ADG and ADFI increased
(linear, P<.02) with increasing pantothenic
acid. Although a quadratic response was not
observed, the greatest increases in ADG and
ADFI were observed as pantothenic acid
increased from 30 to 60 ppm. Feed effi-
ciency was unaffected by increasing
pantothenic acid.

The results of this experiment suggest
that increasing pantothenic acid improved
growth performance of pigs weaned at 11 d
of age and averaging 8.8 lb. These data
suggest that current NRC (1998) estimates
(12 ppm) for pantothenic acid requirements
are too low for maximum pig performance.
The linear response to increasing pantothenic
acid observed from d 0 to 14 followed by the
quadratic response observed from d 14 to 28
suggests that the pantothenic acid require-
ment may decrease as the pig becomes older
and feed intake increases. Because of the
wide range of pantothenic acid concen-
trations used in our study, additional research is
warranted to define a more precise require-
ment estimate.
### Table 1. Compositions of Experimental Diets

<table>
<thead>
<tr>
<th>Ingredients, %</th>
<th>Day 0 to 14&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Day 14 to 28&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>34.55</td>
<td>49.77</td>
</tr>
<tr>
<td>Dried whey</td>
<td>25.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>12.39</td>
<td>22.89</td>
</tr>
<tr>
<td>Spray-dried animal plasma</td>
<td>6.70</td>
<td>1.00</td>
</tr>
<tr>
<td>Select menhaden fish meal</td>
<td>6.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Lactose</td>
<td>5.00</td>
<td>---</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>6.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Spray-dried blood meal</td>
<td>1.75</td>
<td>2.00</td>
</tr>
<tr>
<td>Antibiotic&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
<td>0.76</td>
<td>1.30</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.48</td>
<td>0.79</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>0.38</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin premix&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Salt</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>L-Lysine HCl</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Trace mineral premix</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>DL-methionine</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Corn starch&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

**Total** 100.00 100.00

<sup>a</sup>Diets were formulated to contain 1.7% lysine, .48% methionine, .9% Ca, and .8% P.

<sup>b</sup>Diets were formulated to contain 1.4% lysine, .39% methionine, .85% Ca, and .75% P.

<sup>c</sup>Provided 50 g/ton carbadox.

<sup>d</sup>Premix provided the following vitamins per pound of complete feed: vitamin A, 5000 IU; vitamin D₃, 750 IU; vitamin E, 20 IU; vitamin K, 2 mg; vitamin B₁₂, .02 mg; riboflavin, 4.5 mg; niacin, 25 mg; biotin, .10 mg; pyridoxine, 1.5 mg; and pantothenic acid, 0 mg.

<sup>e</sup>Pantothenic acid premix (d-Cal Pan) replaced corn starch to provide the three additional experimental treatments within each phase. Analyzed pantothenic acid concentrations fed 21.4, 49.7, 87.1, and 146.0 from d 0 to 14 after weaning and 12.6, 48.4, 96.8, and 127.0 ppm from d 14 to 28 after weaning for the control, 30, 60, and 120 ppm of added pantothenic acid diets, respectively.
Table 2. Effects of Increasing Pantothenic Acid on Weaning Pig Growth Performance*

<table>
<thead>
<tr>
<th>Item</th>
<th>Added Pantothenic Acid, ppm</th>
<th>SEM</th>
<th>Linear</th>
<th>Quadratic</th>
<th>Cubic</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>30</td>
<td>60</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Day 0 to 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.25</td>
<td>.25</td>
<td>.26</td>
<td>.30</td>
<td>.022</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>.33</td>
<td>.33</td>
<td>.33</td>
<td>.35</td>
<td>.016</td>
</tr>
<tr>
<td>F/G</td>
<td>1.39</td>
<td>1.29</td>
<td>1.37</td>
<td>1.22</td>
<td>.092</td>
</tr>
<tr>
<td>Day 7 to 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.64</td>
<td>.61</td>
<td>.64</td>
<td>.68</td>
<td>.022</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>.66</td>
<td>.63</td>
<td>.67</td>
<td>.72</td>
<td>.021</td>
</tr>
<tr>
<td>F/G</td>
<td>1.04</td>
<td>1.05</td>
<td>1.07</td>
<td>1.06</td>
<td>.032</td>
</tr>
<tr>
<td>Day 0 to 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.44</td>
<td>.43</td>
<td>.45</td>
<td>.49</td>
<td>.014</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>.50</td>
<td>.48</td>
<td>.50</td>
<td>.53</td>
<td>.015</td>
</tr>
<tr>
<td>F/G</td>
<td>1.12</td>
<td>1.12</td>
<td>1.12</td>
<td>1.10</td>
<td>.024</td>
</tr>
<tr>
<td>Day 14 to 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.56</td>
<td>.60</td>
<td>.65</td>
<td>.62</td>
<td>.022</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>.91</td>
<td>.91</td>
<td>.95</td>
<td>.94</td>
<td>.020</td>
</tr>
<tr>
<td>F/G</td>
<td>1.68</td>
<td>1.53</td>
<td>1.47</td>
<td>1.54</td>
<td>.050</td>
</tr>
<tr>
<td>Day 21 to 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>1.03</td>
<td>1.07</td>
<td>1.09</td>
<td>1.09</td>
<td>.030</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>1.39</td>
<td>1.37</td>
<td>1.45</td>
<td>1.43</td>
<td>.025</td>
</tr>
<tr>
<td>F/G</td>
<td>1.38</td>
<td>1.30</td>
<td>1.34</td>
<td>1.33</td>
<td>.027</td>
</tr>
<tr>
<td>Day 14 to 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.80</td>
<td>.84</td>
<td>.87</td>
<td>.85</td>
<td>.022</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>1.15</td>
<td>1.14</td>
<td>1.20</td>
<td>1.19</td>
<td>.019</td>
</tr>
<tr>
<td>F/G</td>
<td>1.48</td>
<td>1.38</td>
<td>1.39</td>
<td>1.41</td>
<td>.025</td>
</tr>
<tr>
<td>Day 0 to 28</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>ADG, lb</td>
<td>.62</td>
<td>.63</td>
<td>.66</td>
<td>.67</td>
<td>.015</td>
</tr>
<tr>
<td>ADFI, lb</td>
<td>.82</td>
<td>.81</td>
<td>.85</td>
<td>.86</td>
<td>.014</td>
</tr>
<tr>
<td>F/G</td>
<td>1.35</td>
<td>1.29</td>
<td>1.29</td>
<td>1.30</td>
<td>.020</td>
</tr>
</tbody>
</table>

*A total of 275 weanling pigs (initially 8.8 lb ± 2.2 and 11 ± 2 d of age) with seven or eight pigs per pen and nine replications per treatment.