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# Vitamin $B_{12}$ Requirement for Weanling Pigs

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### Summary and Implications

*An experiment was conducted to further define the vitamin $B_{12}$ requirement of the 11- to 44-lb pig. Pigs (initial weight 11.20 lb) were fed one of six diets for a total of 35 days: 1) Negative control, common nursery diet with no added vitamin $B_{12}$; 2) 1X, common nursery diet with the addition of 100% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (7.94 µg/lb of diet), 3) 2X, common nursery diet with the addition of 200% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (15.87 µg/lb of diet), 4) 4X, common nursery diet with the addition of 400% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (31.75 µg/lb of diet), 5) 8X, common nursery diet with the addition of 800% the 1998 NRC-requirement for the 11- to 22-lb for vitamin $B_{12}$ (63.49 µg/lb of diet), and 6) 16X, common nursery diet with the addition of 1600% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (126.98 µg/lb of diet). Pig weights and feed disappearances were measured weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (ADG/ADFI). Pigs were visually scored to assess any visual signs of vitamin $B_{12}$ deficiencies on d 14, 21, 28, and 35. During Phase I, there was no growth or feed intake response to supplemental vitamin $B_{12}$. During Phase II and the overall experimental period, there were no feed intake responses. During Phase II, there were quadratic responses of ADG ($P < 0.009$) and feed efficiency responses ($P < 0.02$) to supplemental vitamin $B_{12}$. Overall (Phase I +II), there was a tendency for a linear growth response ($P < 0.1$) and there was a quadratic feed efficiency response ($P < 0.02$). There were no differences among groups based on visual assessment of vitamin $B_{12}$ deficiencies. Based on these results the vitamin $B_{12}$ requirement of the 11- to 22-lb pig is similar to that recommended by the 1998 NRC (7.94 µg/lb). However, the 22- to 44-lb pigs responded to vitamin $B_{12}$ concentrations between 4 and 8 times that currently recommended by the 1998 NRC (6.8 µg/lb of diet). These data suggest that many pork producers are feeding vitamin $B_{12}$ at concentrations well below those observed to maximize growth and feed efficiency. The data from this experiment should be used in the reassessment of the vitamin $B_{12}$ requirement for weanling pigs.*

### Introduction

Our group previously reported that pigs fed four times the 1998 NRC requirement for vitamin $B_{12}$ had greater ADG during phase II (d 15 to 35 post-weaning) and a greater ADG and improved feed efficiency during the overall (d 0 to 35 post-weaning) experimental period as compared to pigs not fed supplemental vitamin $B_{12}$. In another study, we reported that pigs fed supplemental vitamin $B_{12}$ had greater ADG and improved feed efficiencies during phase II and the overall experimental period. Based on these findings there was interest in reassessing the current vitamin $B_{12}$ requirement in weanling pigs (11- to 44-lb).

The objective of this study was to determine the vitamin $B_{12}$ requirement of 11- to 22-lb pigs and 22- to 44-lb pigs. Our hypothesis was that the vitamin $B_{12}$ requirement of the 11- to 22-lb pigs will be near that currently recommended by the 1998 NRC (7.94 µg/lb of diet) and that the vitamin $B_{12}$ requirement of the 22- to 44-lb pigs will be greater than that currently suggested by the 1998 NRC (6.8 mg/lb).

### Materials and Methods

*Experimental Design*

One hundred forty-four crossbred pigs [Danbred × (Danbred × Nebraska White Line)] were allotted based on initial weight and litter of origin, to one of six treatments using a completely randomized design. Treatments were arranged as a regression surface design. There were six replications per treatment and four pigs per pen. Pigs were weaned at 14 to 17 d of age with an average initial weight of 11.2 lb. Average final weight was 45.8 lb. The duration of the trial was 35 d and it was divided into two phases, (phase I was from d 0 to 14 and phase II was from d 15 to 35).

The six diets included (Table 1): 1) *Negative control*, common nursery diet with no added vitamin $B_{12}$; 2) *1X*, common nursery diet with the addition of 100% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (7.94 µg/lb of diet), 3) *2X*, common nursery diet with the addition of 200% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (15.87 µg/lb of diet), 4) *4X*, common nursery diet with the addition of 400% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (31.75 µg/lb of diet), 5) *8X*, common nursery diet with the addition of 800% the 1998 NRC-requirement for the 11- to 22-lb for vitamin $B_{12}$ (63.49 µg/lb of diet), and 6) *16X*, common nursery diet with the addition of 1600% the 1998 NRC-requirement for the 11- to 22-lb pig for vitamin $B_{12}$ (126.98 µg/lb of diet). All Phase-I diets were formulated to contain 22% CP, 1.60% total lysine, 0.90% Ca, and 0.80% P. Phase-II diets were

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similar to diets used in phase I, except diets were formulated to contain 21% CP, 1.40% total lysine, 0.85% Ca, and 0.74% P.

*Live Animal Care and Measurements*

Pigs and feeders were weighed every 7 d to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (ADG/ADFI). Two individuals visually examined the pigs on d 14, 21, 28, and 35 and evaluated the pigs on a scale of 1 to 5 (1 having extensive deficiency signs and 5 showing no signs of deficiency). Visual assessment was based on physical appearances, such as skin and hair coat characteristics.

Pigs were housed in pens (6.3 x 3.4 ft) that had plastic-coated wire flooring, one nipple waterer, and one four-hole stainless steel feeder. Pigs had ad libitum access to feed and water throughout the experiment. Heat lamps and comfort boards were provided during Phase I. The relative humidity (ranging between 38% and 70%) and room temperature (maintained at 78°F) were monitored continuously using temperature and humidity recorders.

## Results and Discussion

The response of ADG, ADFI, and ADG/ADFI to dietary treatments are shown in Figures 1 a, b, and c, respectively. During Phase I, there were no growth or feed intake responses to supplemental vitamin $B_{12}$. During Phase II, ADG responded quadratically to vitamin $B_{12}$ supplementation ($P<0.007$) with pigs fed 8 times the NRC recommendation having the greatest ADG (1.34 lb). In addition, feed efficiency responded quadratically ($P < 0.02$) to vitamin $B_{12}$ supplementation with pigs fed the 4X diet exhibiting the greatest feed efficiency (0.721 lb/lb). For the overall experimental period, there was a tendency for a linear and quadratic growth response ($P < 0.07$ and $P < 0.09$, respectively) of ADG to vitamin $B_{12}$ supplementation with pigs fed the 8X diet having the greatest ADG (1.05 lb). Feed efficiency responded quadratically during the

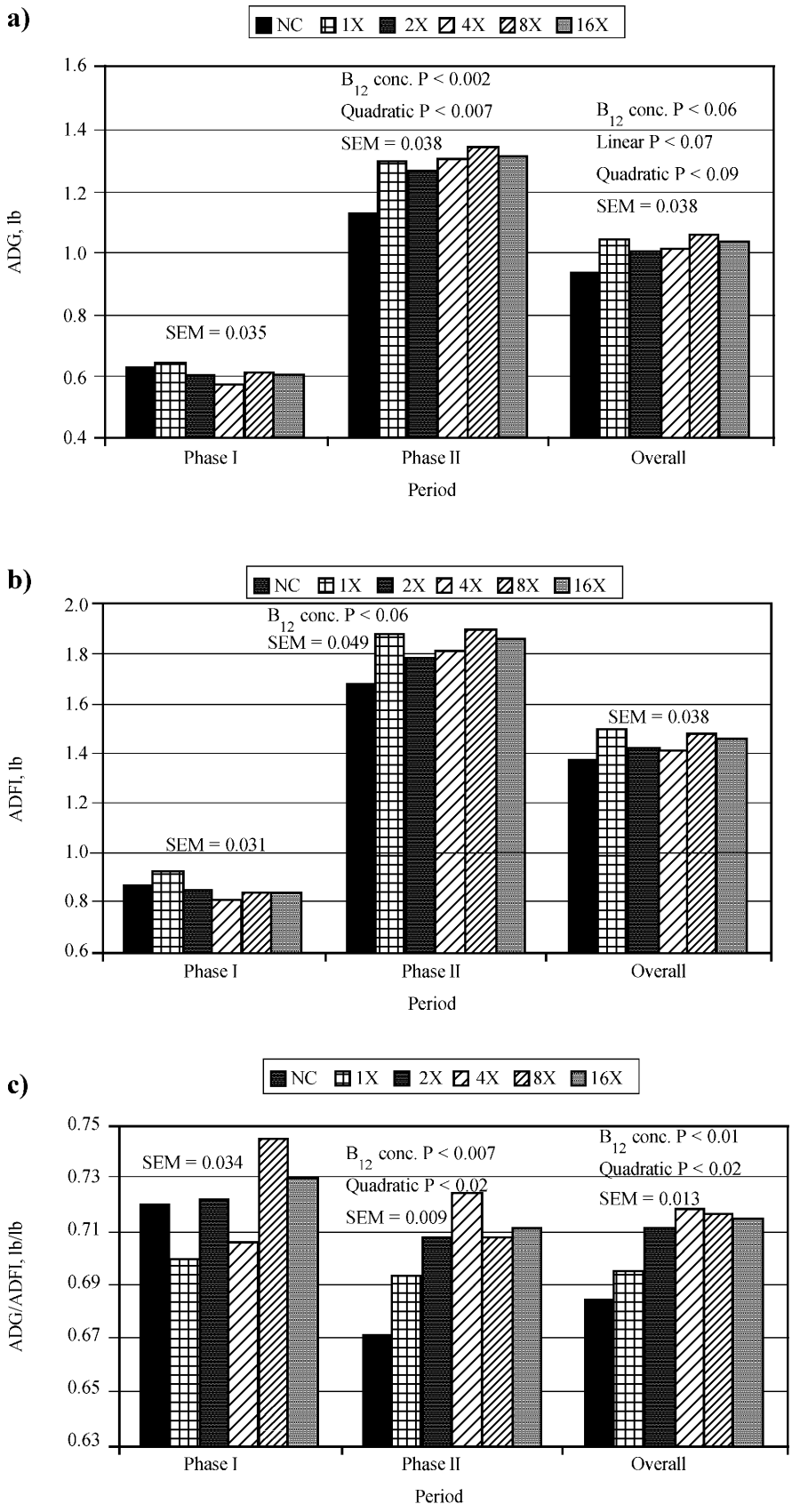


**Figure 1. The response of a) average daily gain (ADG), b) average daily feed intake (ADFI), and c) ADG/ADFI in weanling pigs to 44 lb. SEM = standard error of the mean. NC = Negative control, 1X = 100%, 2X = 200%, 4X = 400%, 8X - 800%, and 16X = 1,600% the 1998 NRC requirment recommendation for the 11- to 22-lb pig.**

**Table 1. Composition of experimental diets, as-fed basis.**

| | Phase I[a] | | | | | | Phase II[a] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ingredient | NC | 1X | 2X | 4X | 8X | 16X | NC | 1X | 2X | 4X | 8X | 16X |
| Corn | 30.19 | 30.19 | 30.19 | 30.19 | 30.19 | 30.19 | 45.13 | 45.13 | 45.13 | 45.13 | 45.13 | 45.13 |
| Soybean meal, 46.5% CP | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 30.62 | 30.62 | 30.62 | 30.62 | 30.62 | 30.62 |
| Soy protein concentrate | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | | | | | | |
| Whey | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| Blood cells | | | | | | | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Animal plasma | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | | | | | | |
| Lactose | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | | | | | | |
| Corn oil | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Limestone | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| Dicalcium phosphate | 1.30 | 1.30 | 1.30 | 1.30 | 1.30 | 1.30 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Vitamin mix[b] | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Trace mineral[c] | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| L-Lysine•HCl | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| DL-Methionine | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| ZnO | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Mecadox®, 50 g/ton | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Vitamin $B_{12}$, µg/lb | | 7.94 | 15.87 | 31.75 | 63.49 | 126.98 | | 7.94 | 15.87 | 31.75 | 63.49 | 126.98 |

[a]NC = Negative control, 1X = 100%, 2X = 200%, 4X = 400%, 8X = 800%, 16X = 1,600% the 1998 NRC requirement for the 11- to 22-lb pig.
[b]Supplied per kilogram of diet: retinyl acetate, 5,500 IU; cholecalciferol, 550 IU; alpha-tocopherol acetate, 30 IU; menadione sodium bisulfite, 4.4 mg; riboflavin, 11 mg; d-pantothenic acid, 22.05 mg; niacin, 30 mg.
[c]Supplied per kilogram of diet: Zn (as ZnO), 125 mg; Fe (as $FeSO_4 \cdot H_2O$), 125 mg; Mn (as MnO), 15 mg; Cu (as $CuSO_4 \cdot 5 H_2O$), 10 mg; I (as $Ca(IO_3) \cdot H_2O$), 0.25 mg; Se (as $Na_2SeO_3$), 0.3 mg.

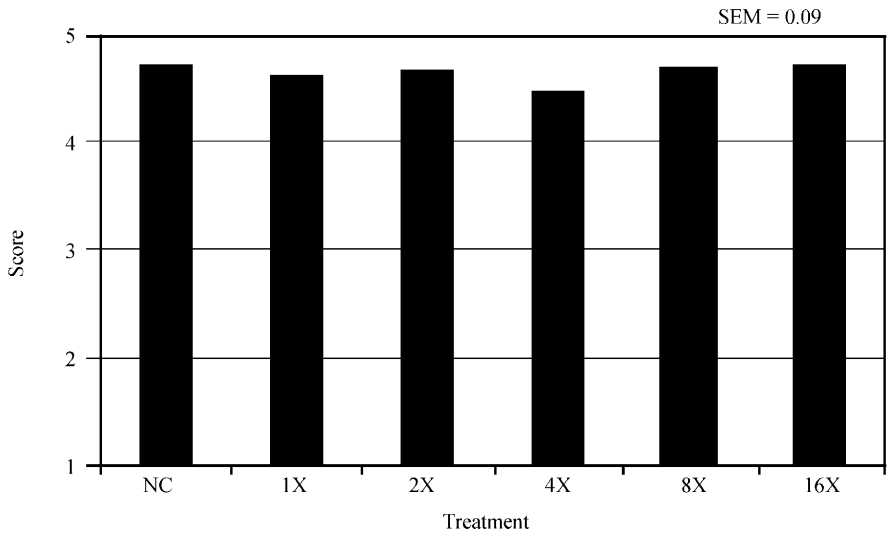


**Figure 2. Visual assessment of deficiency signs. Data based on a scale of 1 to 5, with 1 having extensive deficiency signs and 5 having no deficiency signs. SEM = standard error of the mean.**

overall experimental period ($P < 0.02$). Pigs supplemented with 4 times the NRC recommendation had the greatest feed efficiency (0.718 lb/lb). There was a significant main effect ($P < 0.06$) of feed intake due to vitamin $B_{12}$ supplementation during Phase II.

The growth and feed efficiency data for the 4X and 8X supplemental groups were similar during Phase II and overall. Pigs fed supplemental vitamin $B_{12}$ consistently had improved growth characteristics compared to the negative control group during Phase II. This suggests that the vitamin $B_{12}$ requirement for the 22-to-44 lb pig may be well above concentrations currently recommended by the 1998 NRC.

Visual scores for B-vitamin assessment for each group are shown in Figure 2. There were no differences among groups based on visual assessment of vitamin $B_{12}$ deficiencies.

## Conclusion

The vitamin $B_{12}$ requirement of the 11- to 22-lb pig appears to be similar to that recommended by the 1998 NRC (7.94 µg/lb). During phase II (22- to 44-lb), pigs responded to vitamin $B_{12}$ concentrations between 4- and 8-fold greater than those currently recommended by the 1998 NRC (6.8 µg/lb of diet). Those concentrations are similar to only about 25% of the vitamin $B_{12}$ levels used in the feed industry for weanling pigs (28.63 µg/lb of diet) according to a recent survey.

[1]Sara S. Blodgett is a graduate student, Philip S. Miller is an associate professor, and Robert L. Fischer is a research technologist and graduate student in the Department of Animal Science.