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Summary and Implications

An experiment was conducted to assess the responsiveness of weanling pigs to an antibiotic-like compound (Mecadox®) and vitamin B_{12}. Pigs (initial weight 11.3 lb) were fed one of four diets for a total of 35 days: 1) Negative control, common nursery diet with no added Mecadox® or vitamin B_{12}; 2) Mecadox®, common nursery diet with 50 g/ton added Mecadox®; 3) B_{12}, common nursery diet with 36.28 µg/lb added vitamin B_{12}; and 4) Positive control, common nursery diet with 50 g/ton added Mecadox® and 36.28 µg/lb added vitamin B_{12}. Pig weights and feed disappearance 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 potential vitamin B_{12} deficiencies on d 14, 21, 28, and 35. No Mecadox® × vitamin B_{12} interactions were observed. During Phase I, pigs fed Mecadox® had greater ($P < 0.02$) ADG and a greater ADFI ($P < 0.003$) compared to pigs not fed Mecadox®. During Phase II and overall, pigs fed vitamin B_{12} had a greater ADG ($P < 0.003$), ADFI ($P < 0.04$), and improved feed efficiency ($P < 0.02$ and $P < 0.03$, respectively) compared to pigs not fed diets containing supplemental vitamin B_{12}. During Phase II, pigs fed Mecadox® had a greater ADFI ($P < 0.02$) compared to pigs not fed Mecadox®. For the overall experimental period, pigs fed Mecadox® had a greater ($P < 0.02$) ADG and ADFI ($P < 0.004$) versus pigs which were not fed Mecadox®. During Phase II and the overall experimental period, pigs fed Mecadox® had lower feed efficiencies ($P < 0.02$ and $P < 0.04$, respectively) than those not fed diets containing supplemental Mecadox®. There were no differences among groups for visual assessment of B-vitamin deficiencies. Vitamin B_{12} may be a partial alternative to Mecadox® for 22- to 44-lb pigs. The vitamin B_{12} requirement of the 22- to 44-lb pig may be greater than the current NRC requirement recommendation.

Introduction

B-vitamins have received little attention by swine nutritionists since the 1950s and 1960s. During the past 40 to 50 years, pigs with higher protein accretion rates have been developed, and that may increase their B-vitamin requirements. Vitamins are important for normal body growth and maintenance and support the bodies immune system. Vitamins are important to consider when formulating diets, especially the water-soluble vitamins, because the body cannot synthesize these vitamins and there is little storage in the body. In addition, vitamin requirements are

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

	Phase I				Phase II			
Ingredient, %	NC[a]	Mecadox®	Vitamin B_{12}	PC[a]	NC[a]	Mecadox®	Vitamin B_{12}	PC[a]
Corn	31.81	31.81	31.81	31.81	41.93	41.93	41.93	41.93
Soybean meal, 46.5% CP	12.16	12.16	12.16	12.16	28.24	28.24	28.24	28.24
Soy protein concentrate	6.25	6.25	6.25	6.25				
Whey	30.00	30.00	30.00	30.00	20.00	20.00	20.00	20.00
Blood cells					2.00	2.00	2.00	2.00
Animal plasma	8.00	8.00	8.00	8.00				
Lactose	4.00	4.00	4.00	4.00				
Corn oil	5.00	5.00	5.00	5.00	3.00	3.00	3.00	3.00
Limestone	0.65	0.65	0.65	0.65	0.50	0.50	0.50	0.50
Dicalcium phosphate	1.28	1.28	1.28	1.28	1.50	1.50	1.50	1.50
Salt	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
Trace mineral[c]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-Lysine•HCl	0.05	0.05	0.05	0.05	0.12	0.12	0.12	0.12
DL-Methionine	0.11	0.11	0.11	0.11	0.03	0.03	0.03	0.03
Mecadox®, 50 g/ton		1.00	1.00			1.00		1.00
Vitamin B_{12}, µg/lb			36.28	36.28			36.28	36.28

[a]NC = Negative control and PC = Positive control.
[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.

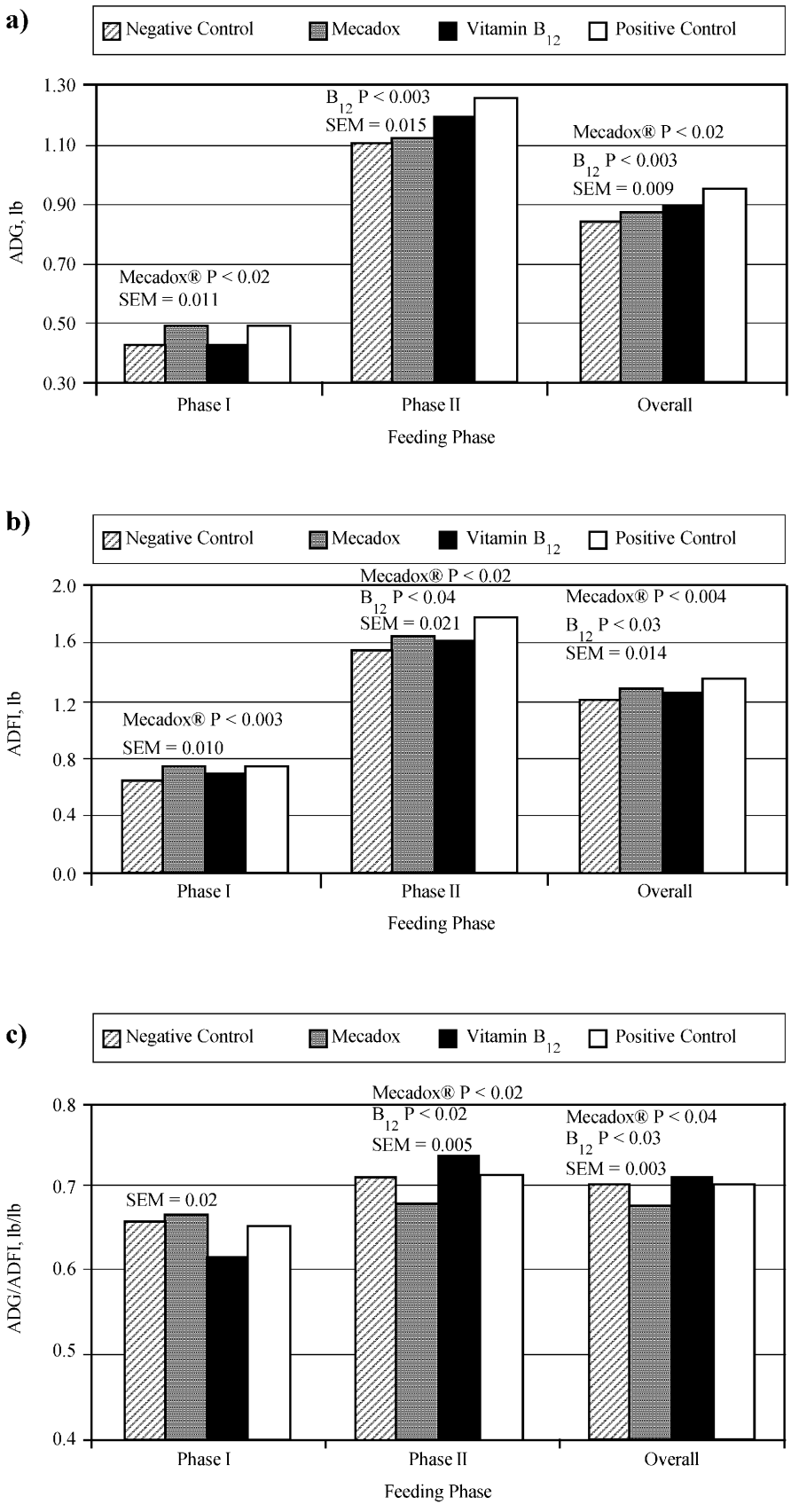

Figure 1. The response of a) average daily gain (ADG), b) average daily feed intake (ADFI), and c) ADG/ADFI in weanling pigs. SEM = standard error of the mean.

affected by many factors, including herd health status, age, and previous nutrition. In a recent survey published by BASF of 27 companies that produce swine feeds or raise pigs, the average addition of vitamin B_{12} to starter diets (weaning to 44 lb body weight) was 18.62 µg/lb of feed. Companies representing the highest 25% of vitamin B_{12} concentrations reported were adding an average of 28.63 µg/lb of feed and the lowest 25% were adding an average of 12.10 µg/lb of feed. These findings indicate that the industry is adding vitamin B_{12} at concentrations well above current 1998 NRC recommendations.

With the possibility of a ban on antibiotics, it is important to look at how the removal of antibiotics may affect the requirements of other nutrients. Because vitamin B_{12} is involved in immune function, its status could be affected by the removal of antibiotics. Therefore, vitamin B_{12} may serve as a partial alternative to feeding antibiotics for disease prevention and growth promotion.

The objective of this study was to investigate factors affecting the vitamin B_{12} requirement of weanling pigs, specifically antibiotics (Mecadox®). Our hypothesis was that pigs fed diets containing supplemental Mecadox® or vitamin B_{12} would have greater average daily gain and improved feed efficiency compared to pigs fed a negative control diet.

Materials and Methods

Experimental Design

Ninety-six crossbred pigs [Danbred × (Danbred × Nebraska White Line)] were allotted based on initial weight and litter of origin, to one of four treatments using a randomized complete block design. Treatments were arranged as a 2 × 2 factorial. There were four replications per treatment and six pigs per pen. Pigs were weaned at 14 to 16 d post-farrowing with an average initial weight of 11.3 lb. Average final weight was 42.4 lb. The duration of the trial was 35 days, which was divided

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into two phases (Phase I was from days 0 to 14 and Phase II was from days 15 to 35).

The four diets included (see Table 1): 1) *Negative control*, common nursery diet with no added Mecadox® or vitamin B_{12}; 2) *Mecadox®*, common nursery diet with 50 g/ton added Mecadox®; 3) *B_{12}*, common nursery diet with 36.28 µg/lb added vitamin B_{12}; and 4) *Positive control*, common nursery diet with 50 g/ton added Mecadox® and 36.28 µg/lb added vitamin B_{12}. None of the diets contained ZnO. All Phase-I diets were formulated to contain 22% CP, 1.5% total lysine, 0.9% Ca, and 0.78% P. Phase-II diets were similar to diets used in phase I, except diets were formulated to contain 21% CP, 1.4% total lysine, 0.86% Ca, and 0.74% P.

Live Animal Care and Measurements

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

Pigs were housed in pens (6.3 × 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 of the trial. The relative humidity (ranging between 50% and 60%) and room temperature (maintained at 78°F) were monitored continuously using a temperature and humidity recorder.

Results and Discussion

The response of ADG, ADFI, and ADG/ADFI to dietary treatments are shown in Figures 1 a, b, and c, respectively. No Mecadox® × vitamin B_{12} interactions were observed. During Phase I, pigs fed Mecadox® had a greater ($P < 0.02$) ADG (0.49 lb vs. 0.43 lb) and a 0.07 lb greater ADFI ($P < 0.003$) versus pigs not fed an antibiotic. During Phase II, pigs fed diets containing supplemental vitamin B_{12} had greater ($P < 0.003$) ADG (1.11 lb vs. 1.23 lb), 0.10 lb greater ADFI ($P < 0.04$), and improved ($P < 0.02$) feed efficiency (0.72 vs. 0.69) compared to pigs not fed diets containing supplemental vitamin B_{12}. During Phase II, pigs fed Mecadox® had greater ($P < 0.02$) ADFI (1.71 lb vs. 1.60 lb) compared to pigs not fed supplemental Mecadox®. During the overall experimental period, pigs fed supplemental vitamin B_{12} had a greater ($P < 0.003$) ADG (0.92 lb vs. 0.85 lb), greater ($P < 0.03$) ADFI (1.31 lb vs. 1.24 lb), and improved ($P < 0.03$) feed efficiency (0.70 vs. 0.68) versus pigs not fed supplemental vitamin B_{12}. Overall, pigs fed Mecadox® had a greater ($P < 0.02$) ADG (0.91 lb vs. 0.86 lb) and 0.10 lb greater ADFI ($P < 0.004$) versus pigs not fed supplemental Mecadox®. During Phase II and the overall experimental period, pigs fed supplemental Mecadox® had lower feed efficiencies ($P < 0.02$ and $P < 0.04$, respectively) compared to pigs not fed diets containing supplemental Mecadox®.

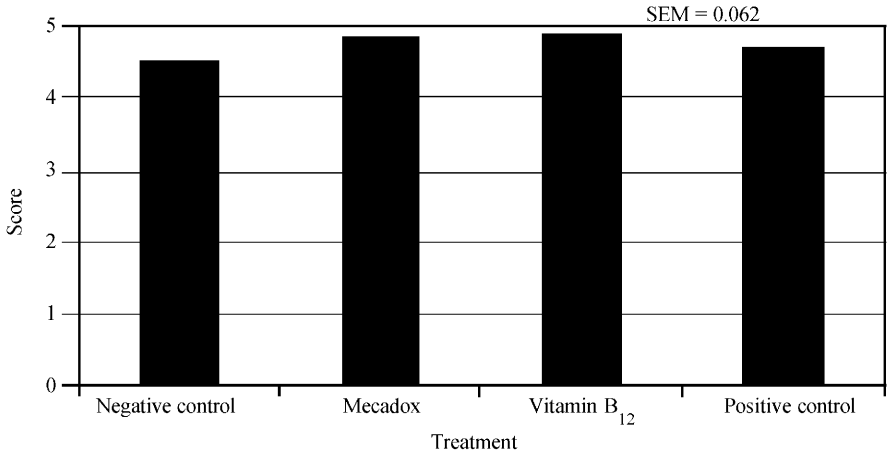

Figure 2. Visual assessment of deficiency signs. Data based on a scale of 1 to 5, with 1 having extensive deficiency signs and 5 having no deficiency signs. SEM = standard error of the mean.

Visual scores to assess B-vitamin status for each group are shown in Figure 2. No B-vitamin deficiencies were observed throughout the 5-week study and there were no differences among treatment groups.

The vitamin B_{12} concentration of the negative control and vitamin B_{12} supplemented diets were calculated to be 3.13 and 39.41 µg/lb of diet, respectively, and the NRC requirement for the 22- to 44-lb pig is 6.80 µg/lb of diet. Thus, as expected, supplemental vitamin B_{12} and antibiotics improved growth performance. All of the growth response due to vitamin B_{12} supplementation was observed in Phase II. A response to vitamin B_{12} during phase I may not have been observed because sows' milk has a high concentration of vitamin B_{12} and perhaps the pigs had sufficient stores of vitamin B_{12} at weaning to supply vitamin B_{12} for the first two weeks post-weaning.

Conclusion

The data suggest that vitamin B_{12} may be a partial alternative to Mecadox® for 22- to 44-lb pigs. The results from this study indicate that the vitamin B_{12} requirement of 22- to 44-lb pigs may be greater than the current NRC requirement recommendation. Further research is needed to more precisely define the vitamin B_{12} requirement of the 22- to 44-lb pig.

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