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Effects of Increased Vitamin Premix Inclusion Rate on Growth Performance of Finishing Pigs

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Abstract

A total of 1,080 mixed sex pigs (337 × 1050, PIC; initially 63.1 ± 0.87 lb) were used in a 123-d growth trial to determine the effects of vitamin premix inclusion rate on growing-finishing pig growth performance and carcass characteristics. Pens of pigs were assigned to 1 of 2 treatments in a completely randomized design. There were 20 replicate pens/treatment and 27 pigs/pen. The experimental diets were corn-soybean meal-based and were fed in 4 phases from 63 to 110, 110 to 160, 160 to 220, and 220 to 293 lb. Pigs were fed 1 of 2 levels of a vitamin premix (control and double) that contained: 750,000 IU vitamin A acetate; 300,000 IU vitamin D; 8,000 mg vitamin E (dl-α-tocopheryl acetate); 600 mg vitamin K (menadione); 6 mg vitamin B_{12}; 9,000 mg niacin; 5,000 mg pantothenic acid; and 1,500 mg riboflavin per lb. The inclusion rate per phase was 3, 2.5, 2, and 1.5 lb/ton, respectively, for the control, or the same premix added at double rate in each phase for the high vitamin fortification. Overall (d 0 to 123), there was no evidence for difference ($P > 0.10$) in ADG, ADFI, and F/G. Also, no statistical difference was observed ($P > 0.10$) for final BW, HCW, or any carcass characteristic. In conclusion, doubling the inclusion rate of a common vitamin premix did not influence growth and carcass traits in growing-finishing pigs.

Keywords

growth performance, finishing pigs, vitamins

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Summary
A total of 1,080 mixed sex pigs (337 × 1050, PIC; initially 63.1 ± 0.87 lb) were used in a 123-d growth trial to determine the effects of vitamin premix inclusion rate on growing-finishing pig growth performance and carcass characteristics. Pens of pigs were assigned to 1 of 2 treatments in a completely randomized design. There were 20 replicate pens/treatment and 27 pigs/pen. The experimental diets were corn-soybean meal-based and were fed in 4 phases from 63 to 110, 110 to 160, 160 to 220, and 220 to 293 lb. Pigs were fed 1 of 2 levels of a vitamin premix (control and double) that contained: 750,000 IU vitamin A acetate; 300,000 IU vitamin D; 8,000 mg vitamin E (dl-α-tocopheryl acetate); 600 mg vitamin K (menadione); 6 mg vitamin B_{12}; 9,000 mg niacin; 5,000 mg pantothenic acid; and 1,500 mg riboflavin per lb. The inclusion rate per phase was 3, 2.5, 2, and 1.5 lb/ton, respectively, for the control, or the same premix added at double rate in each phase for the high vitamin fortification. Overall (d 0 to 123), there was no evidence for difference ($P > 0.10$) in ADG, ADFI, and F/G. Also, no statistical difference was observed ($P > 0.10$) for final BW, HCW, or any carcass characteristic. In conclusion, doubling the inclusion rate of a common vitamin premix did not influence growth and carcass traits in growing-finishing pigs.

Introduction
Vitamins are required primarily as coenzymes in nutrient metabolism for physiological functions such as maintenance, growth, development, and reproduction. Some vitamins are synthesized by the pig or are present in feed ingredients commonly used in swine diets to meet requirements. However, several vitamins need to be added to swine diets in the form of a vitamin premix to avoid deficiency and obtain optimal performance. The quantity of added vitamins may be substantially higher than the requirement because vitamins can lose potency during storage and feed processing (NRC[2]). A survey by Flohr et al.[3] showed that many swine nutritionists in the US fed vitamins at 2 to 5

[1] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.
[2] National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298.
[3] Flohr, J. R., J. M. DeRouchey, J. C. Woodworth, M. D. Tokach, R. D. Goodband, and S. S. Dritz. 2016. A survey of current feeding regimens for vitamins and trace minerals in the US swine industry. Journal of Swine Health and Production. 24:290–303.

times the NRC requirement estimates to growing-finishing pigs. In addition, a similar survey[4] showed that the Brazilian industry is feeding 3 to 6.5 times NRC requirement estimates. As a result of a shortage in the vitamins supply chain in 2017 and an increase of vitamin prices, some nutritionists decreased the vitamin levels of premixes to reduce cost. However, many did not return to the original inclusion levels once availability increased and costs were reduced. Therefore, the objective of this study was to determine the effect of increased inclusion of a vitamin premix on grow-finish pig growth performance, and carcass characteristics.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research-finishing site in southwest Minnesota. The barn was naturally ventilated and double-curtain-sided with totally slatted floors. Each pen was equipped with a 5-hole stainless steel dry self-feeder and a bowl waterer for *ad libitum* access to feed and water.

Animals and diets

A total of 1,080 pigs (337 × 1050, PIC; initially 63.1 ± 0.87 lb) were used in a 123-d growth trial. Pigs were housed in mixed gender pens with 27 pigs per pen and 20 pens per treatment. Daily feed additions to each pen were accomplished using a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN) able to record feed deliveries for individual pens. Pens of pigs were assigned to 1 of 2 dietary treatments in a completely randomized design and consisted of corn-soybean meal-based diets with the current KSU Vitamin Premix (Table 1) included at 3, 2.5, 2, and 1.5 lb per ton for phase 1, 2, 3, and 4, respectively, or the same premix added at double the rate in each phase. Experimental diets were fed in meal form (Table 2) with phase 1 fed from 63 to 110 lb, phase 2 from 110 to 160 lb, phase 3 from 160 to 220 lb, and phase 4 from 220 to 293 lb.

Pigs were weighed approximately every 14 days to determine ADG, ADFI, and F/G. On d 109, the 3 heaviest pigs in each pen were selected and marketed, but not included in the final pen carcass data. On the last day of the trial, final pen weights were obtained, and the remaining pigs were tattooed with a pen identification number and transported to a U.S. Department of Agriculture-inspected packing plant (JBS Swift, Worthington, MN) for carcass data collection. Carcass measurements included HCW, loin depth, backfat, and percentage lean. Percentage lean was calculated from a plant proprietary equation. Carcass yield was calculated by dividing the pen average HCW by the pen average final live weight obtained at the farm.

Statistical analysis

Data were analyzed as a completely randomized design using R Studio (Version 3.5.2, R Core Team, Vienna, Austria) with pen serving as the experimental unit and treatment as a fixed effect. Hot carcass weight was used as a covariate for analysis of backfat, loin depth, and lean percentage. Results were considered significant at $P \leq 0.05$, and marginally significant at $P \leq 0.10$.

[4] Dalto, D. B and Da Silva, C. A, 2020. A survey of current levels of trace minerals and vitamins used in commercial diets by the Brazilian pork industry-a comparative study. Translational Animal Science. doi: 10.1093/tas/txaa195.

Results and Discussion

From d 0 to 67, there was no evidence of differences ($P \geq 0.10$) in ADG, ADFI, or F/G between the treatments (Table 3). However, from d 67 to 123, there was a marginal response ($P = 0.092$) in F/G with pigs fed the current vitamin inclusion rate having better F/G, but no evidence of differences ($P \geq 0.10$) in ADG and ADFI was observed. For overall growth performance (d 0 to 123), there was no evidence of differences ($P > 0.10$) in ADG, ADFI, and F/G between the treatments.

When evaluating carcass characteristics, no evidence of differences ($P \geq 0.10$) was observed in HCW, carcass yield, backfat thickness, loin depth, and percent lean. Mortality and pigs removed from the study due to poor growth were not different ($P \geq 0.10$) between the two treatments.

In conclusion, this study provides evidence that feeding twice the normal inclusion rate of a vitamin premix had no impact on overall growth performance, mortality, or carcass characteristics for growing-finishing pigs.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Premix used in the experimental diets, guaranteed potency per pound of premix

Vitamin	Units	KSU vitamin premix
Vitamin A	IU	750,000
Vitamin D	IU	300,000
Vitamin E	mg	8000
Vitamin K	mg	600
Vitamin B_{12}	mg	6
Niacin	mg	9,000
Pantothenic acid	mg	5,000
Riboflavin	mg	1,500

Table 2. Composition of experimental diets (as-fed basis)[1]

Item	Phase 1	Phase 2	Phase 3	Phase 4
Ingredients, %				
Corn	71.55	78.15	81.89	85.34
Soybean meal, 46.5% CP	24.25	18.15	14.70	11.65
Fat	0.50	0.50	0.50	0.50
Calcium carbonate	1.00	0.90	0.85	0.80
Monocalcium P, 21% P	0.85	0.65	0.50	0.25
Sodium chloride	0.50	0.50	0.50	0.50
L-Lys-HCl	0.44	0.40	0.38	0.36
DL-Met	0.13	0.08	0.07	0.05
L-Trp	0.03	0.03	0.03	0.03
Threo pro[2]	0.19	0.16	0.16	0.16
L-Val	0.10	0.07	0.05	0.03
KSU vitamin premix[3]	0.15	0.125	0.10	0.075
KSU trace mineral premix	0.15	0.15	0.15	0.15
Optiphos plus[4]	0.02	0.02	0.02	0.02
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Standardized ileal digestible (SID) amino acids, %				
Lys	1.12	0.94	0.84	0.75
Ile:Lys	56	56	56	56
Leu:Lys	122	131	137	145
Met:Lys	33	32	33	33
Met and Cys:Lys	56	56	58	60
Thr:Lys	62	62	64	66
Trp:Lys	18.7	18.7	18.7	18.7
Val:Lys	70	70	70	70
His:Lys	38	39	40	41
Total Lys, %	1.25	1.05	0.94	0.84
NE, kcal/lb	1,191	1,195	1,198	1,201
SID Lys:NE, g/Mcal	4.27	3.57	3.18	2.83
CP, %	18.2	15.7	14.3	13.1
Ca, %	0.71	0.61	0.55	0.46
P, %	0.54	0.47	0.43	0.36
STTD P, %	0.42	0.37	0.33	0.28

[1]Phases 1, 2, 3, and 4 were fed from 63 to 110 lb, 110 to 160 lb, 160 to 220 lb, and 220 to 293 lb, respectively.
[2]Threo Pro; CJ America-Bio, Downers Grove, IL.
[3]KSU vitamin premix inclusion used in the control treatment with the levels doubled to form the high vitamin fortification treatment. The vitamin premix was added at the expense of corn to form the treatments.
[4]Optiphos (Huevepharma, Sofia, Bulgaria) provided an estimated release of 0.10% STTD P for all the diets.

Table 3. Effects of vitamin premix inclusion rate on growth performance and carcass characteristics of finishing pigs[1]

Item	Control[2]	Double	SEM	P =
BW, lb				
d 0	63.2	63.1	0.87	0.947
d 123	293.2	293.1	1.69	0.957
d 0-67				
ADG, lb	1.72	1.71	0.017	0.949
ADFI, lb	2.41	2.42	0.017	0.788
F/G	2.67	2.67	0.018	0.893
d 67-123				
ADG, lb	2.09	2.05	0.022	0.255
ADFI, lb	2.41	2.42	0.017	0.788
F/G	3.02	3.08	0.026	0.092
Overall (d 0 to 123)				
ADG, lb	1.88	1.86	0.008	0.238
ADFI, lb	5.32	5.33	0.038	0.788
F/G	2.84	2.87	0.014	0.152
Carcass characteristics[3]				
HCW, lb	220.2	219.6	1.21	0.712
Carcass yield, %	75.0	75.0	0.30	0.879
Backfat, in.	0.66	0.64	0.009	0.288
Loin depth, in.	2.80	2.79	0.014	0.782
Lean, %	57.2	57.4	0.10	0.370
Removals				
Removals, %	9.4	8.9	1.29	0.792
Mortality, %	3.3	3.0	0.79	0.744
Total removals, %	12.7	11.9	1.47	0.686

[1]A total of 1,080 pigs were used in a 123-d study with 27 pigs per pen and 20 replicates per treatment.
[2]Provided per lb of premix: 750,000 IU vitamin A acetate; 300,000 IU D, 8,000 mg vitamin E (dl-α-tocopheryl acetate), 600 mg vitamin K (menadione), 6 mg vitamin B_{12}, 9,000 mg niacin, 5,000 mg pantothenic acid, and 1,500 mg riboflavin. The inclusion level by phase for control was 3, 2.5, 2, and 1.5 lb per ton from 63 to 110, 110 to 160, 160 to 220, and 220 to 293 lb, respectively, with double those levels for the high treatment.
[3] HCW was used as a covariate for analysis of backfat, loin depth, and percentage lean.