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Evaluation of Different Vitamin Concentrations on Grow-Finish Pig Growth and Carcass Characteristics

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Cover Page Footnote

Appreciation is expressed to New Horizon Farms (Pipestone, MN) for providing research facilities.

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Evaluation of Different Vitamin Concentrations on Grow-Finish Pig Growth and Carcass Characteristics¹

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Summary

Vitamins are generally added to swine diets in concentrations well above their requirement estimates to provide a generous margin of safety. However, with the increase in vitamin prices in 2017, there was a need to re-evaluate suggested vitamin additions. Therefore, the objective of this study was to compare two premixes with different vitamin concentrations on growth performance and carcass characteristics of grow-finish pigs reared in a commercial environment. A total of 1,188 pigs (PIC 359 × 1050; initially 35.5 lb) were used in a randomized complete block design with 27 pigs per pen and 22 pens per treatment. The experimental diets were corn-soybean meal-DDGS-based and were fed in 5 phases from approximately 35 to 60, 60 to 110, 110 to 165, 165 to 220, and 220 to 280 lb. There were two dietary treatments based on different vitamin concentrations. The first was the Kansas State University recommended vitamin premix up to December 2017. It contained 1,600,000 IU vitamin A; 400,000 IU vitamin D, 8,000 mg vitamin E; 800 mg vitamin K; 7 mg vitamin B₁₂; 15,000 mg niacin; 5,000 mg pantothenic acid; and 1,500 mg riboflavin. The second was the K-State recommended vitamin premix since January 2018. It contained: 750,000 IU vitamin A; 300,000 IU vitamin D; 8,000 mg vitamin E; 600 mg vitamin K; 6 mg vitamin B₁₂; 9,000 mg niacin; 5,000 mg pantothenic acid; and 1,500 mg riboflavin. Overall (d 0 to 138), there was no evidence for differences in average daily gain (ADG), average daily feed intake (ADFI), or feed efficiency (F/G). Also, no evidence for differences was observed for final weight, hot carcass weight or any other carcass characteristic. In conclusion, the new K-State 2018 recommended vitamin premix concentrations provided similar growth performance as the 2017 recommendations, while not influencing carcass traits in grow-finish pigs.

Introduction

Added vitamins in swine diets are essential for optimal growth performance. Vitamins serve as co-factors in many different metabolic processes, such as bone mineralization, enzymatic activities, and tissue maintenance. It is a common practice to provide added

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dietary vitamins greater than the daily requirement estimate as a safety factor and to account for potential losses from feed manufacturing errors and prolonged premix storage. Many vitamins have been inexpensive, and thus high margins of safety have been used. However, due to changes in world vitamin supply in 2017, particularly with vitamin A and others, premix prices increased substantially, thus raising the question about whether current margins were necessary.

Therefore, the objective of this study was to compare two different vitamin premixes with a high or low margin of safety on growth performance and carcass characteristics for grow-finish pigs raised under commercial conditions.

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 facility in southwestern Minnesota. The barn was naturally ventilated and double curtain-sided. Each pen was equipped with a 4-hole stainless steel dry self-feeder and a cup waterer for *ad libitum* access to feed and water. Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro, Feedlogic Corp., Wilmar, MN).

A total of 1,188 pigs (PIC 337 × 1050, initially 35 lb) were used in a 138-d growth trial with 27 pigs per pen and 22 pens per treatment. Pigs were allotted to treatments based on initial body weight (BW) in a randomized complete block design.

The experiment included two dietary treatments. The first treatment contained the K-State recommended vitamin premix up to December 2017. The second treatment contained the new K-State recommended vitamin premix as of January 2018. The January 2018 premix contained lower levels of vitamins A, D, K, niacin, and B₁₂ than the December 2017 recommendations (Table 1).

The experimental diets were based on corn, distillers dried grains with solubles (DDGS), and soybean meal. Diets were fed in 5 different phases from 35 to 60, 60 to 110, 110 to 165, 165 to 220, and 220 to 280 lb (Table 2). Pens of pigs were weighed, and feed disappearance measured on d 0, 17, 31, 52, 67, 81, 97, 110, 123, and 138 to determine ADG, ADFI, and F/G. On d 110, the 2 heaviest pigs in each pen were weighed and marketed according to the farm marketing strategy. On d 138, final pen weights were recorded and pigs were tattooed with a pen identification number and transported to a USDA-inspected packing plant (JBS Swift and Co., Worthington, MN) for processing and carcass data collection. Carcass measurements included hot carcass weight (HCW), backfat, loin depth, 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.

Data were analyzed using a linear mixed model with treatment as fixed effect, block as random effect, and pen as the experimental unit. Hot carcass weight was used as a covariate for analyses of backfat, loin depth, and lean percentage. Statistical models were fitted using the GLIMMIX procedure of SAS version 9.4 (SAS Institute Inc., Cary, NC). Results were considered significant at $P \leq 0.05$.

Results and Discussion

For overall growth performance, there was no evidence for differences ($P > 0.05$) in ADG, ADFI, or F/G (Table 3). During phase 3 (110 to 165 lb) pigs experienced a *Haemophilus parasuis* outbreak. During that time, ADFI and ADG decreased and mortality increased, but no differences among treatments were observed. There was a tendency ($P \leq 0.10$) for increased final body weight and HCW for pigs fed the December 2017 premix levels; however, this advantage was caused by a numeric increase in removal of lightweight pigs from that treatment and not by an increase in growth rate. Total pen gain and total feed intake also showed no evidence for differences between treatments. For carcass characteristics, no evidence for differences ($P > 0.05$) was observed for carcass yield, backfat thickness, loin depth, or percentage lean. Mortality and percentage of pigs removed from the study due to poor growth were not different between the two treatments.

In conclusion, new 2018 K-State vitamin premix recommendations and dietary levels for grow-finish pigs did not influence growth and carcass traits compared with the 2017 recommendations. The decrease in the historical margin of safety for vitamins to levels in the 2018 premix allows nutritionists and producers to reduce feed cost.

Table 1. Description of premixes used in experimental diets, guaranteed potency per pound of premix

Vitamin	Units/lb	December 2017 ¹	January 2018 ²
Vitamin A	IU	1,600,00	750,000
Vitamin D	IU	400,000	300,000
Vitamin E	mg	8,000	8,000
Vitamin K	mg	800	600
Vitamin B ₁₂	mg	7	6
Niacin	mg	15,000	9,000
Pantothenic acid	mg	5,000	5,000
Riboflavin	mg	1,500	1,500

¹Values represent Kansas State University recommended vitamin concentrations up to December 2017.

²Values represent Kansas State University recommended vitamin concentrations since January 2018.

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

		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Item	Weight range, lb:	30 to 60	60 to 110	110 to 165	165 to 220	220 to 280
Ingredients, %						
Corn		51.46	56.88	64.56	69.33	83.29
Soybean meal, 47% crude protein		28.73	19.12	11.74	7.23	13.62
DDGS ²		15.00	20.00	20.00	20.00	---
Beef tallow		1.00	1.00	1.00	1.00	1.00
Monocalcium phosphate		0.85	0.40	0.25	0.10	0.35
Limestone		1.33	1.29	1.23	1.18	0.89
Sodium chloride		0.58	0.35	0.35	0.35	0.35
L-Lysine-HCL		0.40	0.48	0.48	0.48	0.25
DL-Methionine		0.10	0.05	0.01	---	0.01
L-Threonine		0.10	0.10	0.10	0.09	0.08
L-Tryptophan		0.04	0.03	0.04	0.04	0.02
Trace mineral premix		0.15	0.15	0.13	0.10	0.08
Phytase ³		0.02	0.01	0.01	0.01	0.01
Vitamin premix		0.25	0.15	0.13	0.10	0.08
Total		100	100	100	100	100
Calculated analysis						
Standardized ileal digestible (SID) amino acids amino acids, %						
Lysine, %		1.24	1.08	0.90	0.79	0.71
Isoleucine:lysine		63	61	59	58	63
Methionine:lysine		34	32	30	30	30
Methionine and cystine:lysine		58	57	57	59	59
Threonine:lysine		62	62	63	62	66
Tryptophan:lysine		21	18.8	18.5	18.6	19.2
Valine:lysine		71	70	71	72	74
Total lysine, %		1.41	1.24	1.04	0.92	0.81
Net energy, kcal/lb		1,100	1,128	1,151	1,166	1,175
SID Lysine:NE, g/Mcal		5.12	4.34	3.55	3.07	2.74
Crude protein, %		22.7	20.0	17.1	15.3	13.7
Calcium, %		0.76	0.64	0.56	0.50	0.45
STTD P, ⁴ %		0.48	0.38	0.33	0.29	0.26

¹Diets were fed *ad libitum* in meal form from 35.5 to 278.2 lb BW.²DDGS = distillers dried grains with solubles.³Optriphos 2000 (Huvepharma, Sofia, Bulgaria) provided an estimated release of 0.09% digestible P for phase 1 and 0.07% for phases 2, 3, 4, and 5.⁴STTD P = standardized total tract digestible phosphorus.

NE = net energy.

Table 3. Effect of different vitamin concentrations on growth performance and carcass characteristics of grow-finish pigs¹

Item	December 2017 ²	January 2018 ³	SEM	Probability, P <
Body weight, lb				
Day 0	35.4	35.5	0.38	0.532
Day 138	275.1	272.2	1.31	0.100
Overall (0 to 138) ⁴				
ADG, lb	1.73	1.73	0.01	0.732
ADFI, lb	4.27	4.23	0.03	0.309
F/G	2.47	2.45	0.01	0.393
Total pen gain, lb ⁵	6,040	6,067	52.71	0.693
Total pen intake, lb ⁵	14,900	14,888	159.48	0.951
Carcass characteristics				
HCW, lb	205.8	203.9	0.86	0.090
Carcass yield, %	74.8	74.9	0.26	0.825
Backfat, in. ⁶	0.62	0.61	0.09	0.685
Loin depth, in. ⁶	2.58	2.59	0.01	0.714
Lean, %	57.2	57.3	0.13	0.593
Removals %	13.3	11.6	1.39	0.541
Mortality %	3.7	3.6	0.87	0.880

¹A total of 1,188 pigs (PIC 337 × 1050) were used with 27 pigs per pen and 22 pens per treatment.

²Provided per lb of premix: 1,600,000 IU vitamin A acetate; 400,000 IU vitamin D; vitamin E (8000 mg dl- α -tocopheryl acetate); 800 mg vitamin K (menadione); 7 mg vitamin B₁₂; 1,500 mg niacin; 5000 mg pantothenic acid; and 1,500 mg riboflavin.

³Provided per lb of premix: 750,000 IU vitamin A acetate, 300,000 IU D, vitamin E (8000 mg dl- α -tocopheryl acetate), 600 mg vitamin K (menadione), 6 mg vitamin B₁₂, 9,000 mg niacin, 5,000 mg pantothenic acid, and 1,500 mg riboflavin.

⁴ADG = average daily gain. ADFI = average daily feed intake. F/G = feed efficiency. HCW = hot carcass weight.

⁵Total gain and total feed intake were calculated on a pen basis.

⁶Adjusted for HCW as a covariate.